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ABB drives for water

Firmware manual
ACQ580 pump control program

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List of related manuals

Drive manuals and guides	**Code (English)**
ACQ580 pump control program firmware manual	3AXD50000035867
ACQ580-01 (0.75 to 250 kW, 1.0 to 350 hp) hardware manual	3AXD50000035866
ACQ580-01 quick installation and start-up guide for frames R0 to R5	3AXD50000035755
ACQ580-01 quick installation and start-up guide for frames R6 to R9	3AXD50000037301
ACX-AP-x assistant control panels user's manual	3AUA0000085685

Option manuals and guides	
CDPI-01 communication adapter module user's manual	3AXD50000009929
DPMP-01 mounting platform for control panels	3AUA0000100140
DPMP-02/03 mounting platform for control panels	3AUA0000136205
FDNA-01 DeviceNet™ adapter module user's manual	3AFE68573360
FENA-01/-11/-21 Ethernet adapter module user's manual	3AUA0000093568
FPBA-01 PROFIBUS DP adapter module user's manual	3AFE68573271
FSCA-01 RS-485 adapter module user's manual	3AUA0000109533
Flange mounting kit installation supplement	3AXD50000019100
Flange mounting kit quick installation guide for ACX580-01 frames R0 to R5	3AXD50000036610
Flange mounting kit quick installation guide for ACS880-01 and ACX580-01 frames R6 to R9	3AXD50000019099

Tool and maintenance manuals and guides	
Drive composer PC tool user's manual	3AUA0000094606
Converter module capacitor reforming instructions	3BFE64059629
NETA-21 remote monitoring tool user's manual	3AUA00000969391
NETA-21 remote monitoring tool installation and start-up guide	3AUA0000096881

You can find manuals and other product documents in PDF format on the Internet. See section *Document library on the Internet* on the inside of the back cover. For manuals not available in the Document library, contact your local ABB representative.

ACQ580-01 manuals

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3AXD50000035867 Rev C
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Introduction to the manual

Contents of this chapter

The chapter describes applicability, target audience and purpose of this manual. It also describes the contents of this manual and refers to a list of related manuals for more information.

Applicability

The manual applies to the ACQ580 pump control program (version 2.03.0.0).

To check the firmware version of the control program in use, see system information (select **Menu** - **System info - Drive**) or parameter *07.05 Firmware version* (see page *116*) on the control panel.

Safety instructions

Follow all safety instructions.

- Read the **complete safety instructions** in the *Hardware manual* of the drive before you install, commission, or use the drive.
- Read the **firmware function-specific warnings and notes** before changing parameter values. These warnings and notes are included in the parameter descriptions presented in chapter *Parameters* on page *99*.

Target audience

The reader is expected to know the fundamentals of electricity, wiring, electrical components and electrical schematic symbols.

The manual is written for readers worldwide. Both SI and imperial units are shown. Special US instructions for installations in the United States are given.

Purpose of the manual

This manual provides information needed for designing, commissioning, or operating the drive system.

Contents of this manual

The manual consists of the following chapters:

- *Introduction to the manual* (this chapter, page *7*) describes applicability, target audience, purpose and contents of this manual. At the end, it lists terms and abbreviations.
- *Start-up, control with I/O and ID run* (page *13*) describes how to start up the drive as well as how to start, change the direction of the motor rotation and adjust the motor speed through the I/O interface.
- *Control panel* (page *27*) contains instructions for removing and reinstalling the assistant control panel and briefly describes its display, keys and key shortcuts.
- *Default configuration* (page *33*) contains the connection diagram of the Water default configuration together with a connection diagram. The predefined default configuration will save the user time when configuring the drive.
- *Program features* (page *37*) describes program features with lists of related user settings, actual signals, and fault and warning messages.
- *Parameters* (page *99*) describes the parameters used to program the drive.
- *Additional parameter data* (page *301*) contains further information on the parameters.
- *Fieldbus control through the embedded fieldbus interface (EFB)* (page *363*) describes the communication to and from a fieldbus network using the drive embedded fieldbus interface with the Modbus RTU protocol.
- *Fieldbus control through a fieldbus adapter* (page *391*) describes the communication to and from a fieldbus network using an optional fieldbus adapter module
- *Fault tracing* (page *337*) lists the warning and fault messages with possible causes and remedies.
- *Control chain diagrams* (page *403*) describes the parameter structure within the drive.
- *Further information* (inside of the back cover, page *417*) describes how to make product and service inquiries, get information on product training, provide feedback on ABB Drives manuals and find documents on the Internet.

Related documents

See *List of related manuals* on page *2* (inside of the front cover).

Categorization by frame (size)

The ACQ580 is manufactured in several frames (frame sizes), which are denoted as RN, where N is an integer. Some information which only concern certain frames are marked with the symbol of the frame (RN).

The frame is marked on the type designation label attached to the drive, see chapter *Operation principle and hardware description*, section *Type designation label* in the *Hardware manual* of the drive.

Terms and abbreviations

Term/abbreviation	**Explanation**
ACX-AP-x	Assistant control panel, advanced operator keypad for communication with the drive. The dedicated assistant control panel for the ACQ580 is ACH-AP-H (Hand-Off-Auto panel). The ACQ580 offers limited support of ACS-AP-I and ACS-AP-W. You can use parameters and Primary settings menus with ACS-AP-I and parameters and I/O with ACS-AP-W.
AI	Analog input; interface for analog input signals
AO	Analog output; interface for analog output signals
Control board	Circuit board in which the control program runs.
CDPI-01	Communication adapter module
CCA-01	Configuration adapter
CHDI-01	Optional 115/230 V digital input extension module
CMOD-01	Optional multifunction extension module (external 24 V AC/DC and digital I/O extension)
CMOD-02	Optional multifunction extension module (external 24 V AC/DC and isolated PTC interface)
CRC	Cyclic redundancy check. The IPC checks the parameter group validity in terms of CRC.
DC link	DC circuit between rectifier and inverter
DC link capacitors	Energy storage which stabilizes the intermediate circuit DC voltage
DDCS	Distributed drives communication system.
DI	Digital input; interface for digital input signals
DO	Digital output; interface for digital output signals
DPMP-01	Mounting platform for ACX-AP control panel (flange mounting)
DPMP-02/03	Mounting platform for ACX-AP control panel (surface mounting)
Drive	Frequency converter for controlling AC motors
EFB	Embedded fieldbus
FBA	Fieldbus adapter
FCAN-01	Optional CANopen adapter module
FDNA-01	Optional DeviceNet adapter module
FENA-01/-11/-21	Optional Ethernet adapter module for EtherNet/IP, Modbus TCP and PROFINET IO protocols
FLON-01	LONWORKS® adapter module
FPBA-01	Optional PROFIBUS DP adapter module
Frame (size)	Refers to drive physical size, for example R0 and R1. The type designation label attached to the drive shows the frame of the drive, see chapter *Operation principle and hardware description,* section *Type designation label* in the *Hardware manual* of the drive.

Term/abbreviation	**Explanation**
FSCA-01	Optional RSA-485 adapter module
ID run	Motor identification run. During the identification run, the drive will identify the characteristics of the motor for optimum motor control.
IGBT	Insulated gate bipolar transistor
Intermediate circuit	See *DC link*.
Inverter	Converts direct current and voltage to alternating current and voltage.
I/O	Input/Output
IPC	Intelligent pump control
LONWORKS®	LONWORKS® (local operating network) is a networking platform specifically created to address the needs of control applications.
LSW	Least significant word
NETA-21	Remote monitoring tool
Network control	With fieldbus protocols based on the Common Industrial Protocol (CIP^{TM}), such as DeviceNet and Ethernet/IP, denotes the control of the drive using the Net Ctrl and Net Ref objects of the ODVA AC/DC Drive Profile. For more information, see www.odva.org, and the following manuals: • *FDNA-01 DeviceNet adapter module user's manual* (3AFE68573360 [English]), and • *FENA-01/-11/-21 Ethernet adapter module user's manual* (3AUA0000093568 [English]).
Parameter	User-adjustable operation instruction to the drive, or signal measured or calculated by the drive
PFC	Single pump control
PID/Loop controller	Proportional–integral–derivative controller. Drive speed control is based on PID algorithm.
PLC	Programmable logic controller
PROFIBUS, PROFIBUS DP, PROFINET IO	Registered trademarks of PI - PROFIBUS & PROFINET International
PTC	Positive temperature coefficient, thermistor whose resistance is dependent on temperature,
R0, R1, ...	*Frame (size)*
RO	Relay output; interface for a digital output signal. Implemented with a relay.
Rectifier	Converts alternating current and voltage to direct current and voltage.
SPFC	Soft pump control
STO	Safe torque off. See chapter *The Safe torque off function* in the *Hardware manual* of the drive.

Cybersecurity disclaimer

This product is designed to be connected to and to communicate information and data via a network interface. It is Customer's sole responsibility to provide and continuously ensure a secure connection between the product and Customer network or any other network (as the case may be). Customer shall establish and maintain any appropriate measures (such as but not limited to the installation of firewalls, application of authentication measures, encryption of data, installation of anti-virus programs, etc) to protect the product, the network, its system and the interface against any kind of security breaches, unauthorized access, interference, intrusion, leakage and/or theft of data or information. ABB and its affiliates are not liable for damages and/or losses related to such security breaches, any unauthorized access, interference, intrusion, leakage and/or theft of data or information.

See also section *User lock* on page *97*.

2

Start-up, control with I/O and ID run

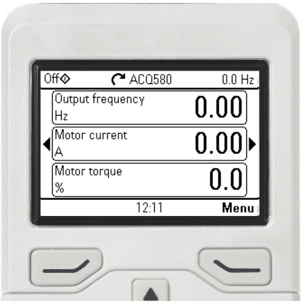
Contents of this chapter

The chapter describes how to:

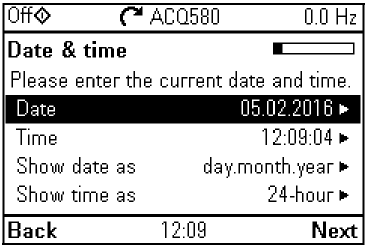
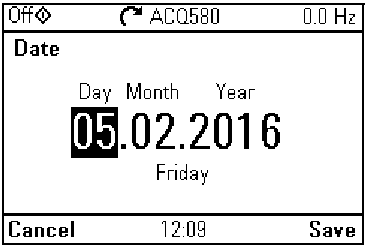
- perform the start-up
- start, stop, change the direction of the motor rotation and adjust the speed of the motor through the I/O interface
- perform an Identification run (ID run) for the drive.

How to start up the drive

How to start up the drive using First start assistant on the Hand-Off-Auto control panel

<table>
<tr><th colspan="3">Safety</th></tr>
<tr><td colspan="3">⚠ Do not start-up the drive unless you are a qualified electrician.
Read and obey the instructions in chapter *Safety instructions* at the beginning of the *Hardware manual* of the drive. Ignoring the instructions can cause physical injury or death, or damage to the equipment</td></tr>
<tr><td>☐</td><td colspan="2">Check the installation. See chapter *Installation checklist* in the *Hardware manual* of the drive.</td></tr>
<tr><td>☐</td><td colspan="2">⚠ Make sure there is no active start on (DI1 in factory settings, that is, Water default configuration). The drive will start up automatically at power-up if the external run command is on and the drive is in the external control mode.
Check that the starting of the motor does not cause any danger.
De-couple the driven machine if
• there is a risk of damage in case of an incorrect direction of rotation, or
• a **Normal** ID run is required during the drive start-up, when the load torque is higher than 20% or the machinery is not able to withstand the nominal torque transient during the ID run.</td></tr>
<tr><th colspan="3">Hints on using the assistant control panel</th></tr>
<tr><td></td><td>The two commands at the bottom of the display (**Options** and **Menu** in the figure on the right), show the functions of the two softkeys ⌣ and ⌣ located below the display. The commands assigned to the softkeys vary depending on the context.
Use keys ◄, ►, ▲ and ▼ to move the cursor and/or change values depending on the active view.
Key ? shows a context-sensitive help page.
For more information, see *ACS-AP-x assistant control panels user’s manual* (3AUA0000085685 [English]).</td><td>
</td></tr>
</table>

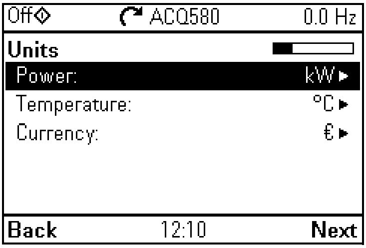
1 – First start assistant guided settings: Language, date and time, and motor nominal values

☐	Have the motor or pump name plate data at hand. Power up the drive.	
☐	The First start assistant guides you through the first start-up. The assistant begins automatically. Wait until the control panel enters the view shown on the right. Select the language you want to use by highlighting it (if not already highlighted) and pressing (**OK**). **Note:** After you have selected the language, it takes a few minutes to download the language file to the control panel.	 English Deutsch Suomi Français Italiano Svenska Español OK ▸
☐	Select **Start set-up** and press (**Next**).	 Off ◇ ACQ580 0.0 Hz **First start assistant** Set up drive now? Start set-up Exit & don't show at power-up Not now 12:09 **Next**
☐	Set the date and time as well as date and time display formats. • Go to the edit view of a selected row by pressing ▶. • Scroll the view with ▲ and ▼. Go to the next view by pressing (**Next**).	 Off ◇ ACQ580 0.0 Hz **Date & time** Please enter the current date and time. Date 05.02.2016 ▸ Time 12:09:04 ▸ Show date as day.month.year ▸ Show time as 24-hour ▸ **Back** 12:09 **Next**
☐	To change a value in an edit view: • Use ◀ and ▶ to move the cursor left and right. • Use ▲ and ▼ to change the value. • Press (**Save**) to accept the new setting, or press (**Cancel**) to go back to the previous view without making changes.	 Off ◇ ACQ580 0.0 Hz **Date** Day Month Year 05.02.2016 Friday **Cancel** 12:09 **Save**

☐ Change the units shown on the panel if needed.

- Go to the edit view of a selected row by pressing ▶.
- Scroll the view with ▲ and ▼.

Go to the next view by pressing ▭ (**Next**).


Off◇ ACQ580 0.0 Hz

Units

Power: kW ▸
Temperature: °C ▸
Currency: € ▸

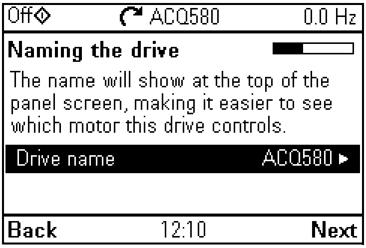
Back 12:10 **Next**

☐ To give the drive a name that will be shown at the top, press ▶.

If you do not want to change the default name (ACQ580), continue by pressing ▭ (**Next**).

For information on editing text, see *ACQ580 firmware manual* (3AXD50000035867 [English]).

Hint: Name the drive, for example, Pump 1.


Off◇ ACQ580 0.0 Hz

Naming the drive

The name will show at the top of the panel screen, making it easier to see which motor this drive controls.

Drive name ACQ580 ▸

Back 12:10 **Next**

Refer to the motor or pump nameplate for the following nominal value settings of the motor. Enter the values exactly as shown on the motor or pump nameplate.

Example of a nameplate of an induction (asynchronous) motor:

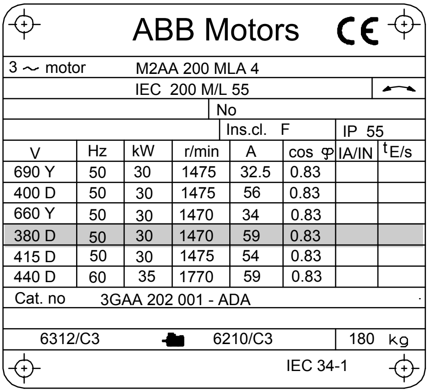


ABB Motors

3 ~ motor M2AA 200 MLA 4
IEC 200 M/L 55
No
Ins.cl. F IP 55

V	Hz	kW	r/min	A	cos φ	IA/IN	tE/s
690 Y	50	30	1475	32.5	0.83		
400 D	50	30	1475	56	0.83		
660 Y	50	30	1470	34	0.83		
380 D	50	30	1470	59	0.83		
415 D	50	30	1475	54	0.83		
440 D	60	35	1770	59	0.83		

Cat. no 3GAA 202 001 - ADA
6312/C3 6210/C3 180 kg
IEC 34-1

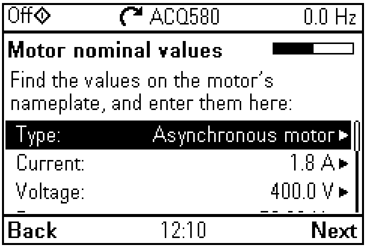
☐ Check that the motor data is correct. Values are predefined on the basis of the drive size but you should verify that they correspond to the motor.

Start with the motor type.Go to the edit view of a selected row by pressing ▶.

- Scroll the view with ▲ and ▼.

Motor nominal cosΦ and nominal torque are optional.

Press ▭ (**Next**) to continue.

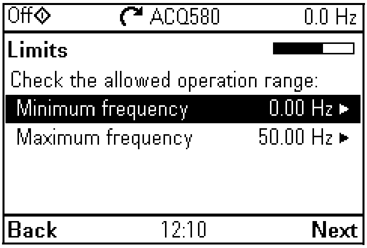
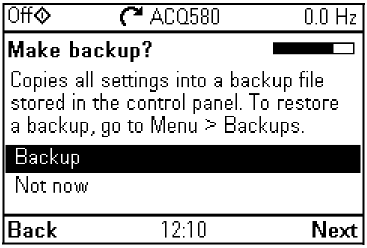
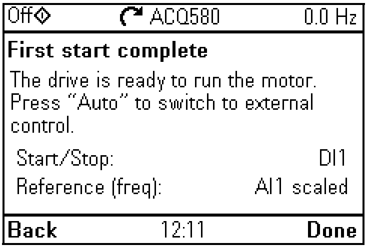
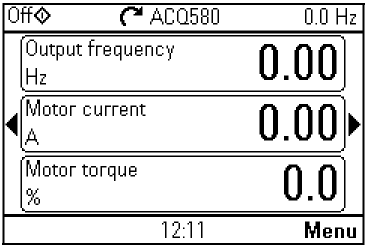

Off◇ ACQ580 0.0 Hz

Motor nominal values

Find the values on the motor's nameplate, and enter them here:

Type: Asynchronous motor ▸
Current: 1.8 A ▸
Voltage: 400.0 V ▸

Back 12:10 **Next**

☐	Adjust the limits according to your needs. • Go to the edit view of a selected row by pressing ▶. • Scroll the view with ▲ and ▼. Go to the next view by pressing (**Next**).	 Off ACQ580 0.0 Hz **Limits** Check the allowed operation range: Minimum frequency 0.00 Hz ▸ Maximum frequency 50.00 Hz ▸ **Back** 12:10 **Next**
☐	If you want to make a backup of the settings made so far, select **Backup** and press (**Next**). If you do not want to make a backup, select **Not now** and press (**Next**).	 Off ACQ580 0.0 Hz **Make backup?** Copies all settings into a backup file stored in the control panel. To restore a backup, go to Menu > Backups. Backup Not now **Back** 12:10 **Next**
☐	The first start is now complete and the drive is ready for use. Press (**Done**) to enter the Home view.	 Off ACQ580 0.0 Hz **First start complete** The drive is ready to run the motor. Press "Auto" to switch to external control. Start/Stop: DI1 Reference (freq): AI1 scaled **Back** 12:11 **Done**
☐	The Home view monitoring the values of the selected signals is shown on the panel.	 Off ACQ580 0.0 Hz Output frequency Hz 0.00 Motor current A 0.00 Motor torque % 0.0 12:11 **Menu**

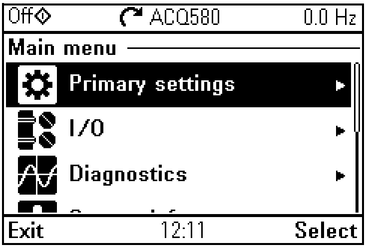
2 – Additional settings in the Primary settings menu

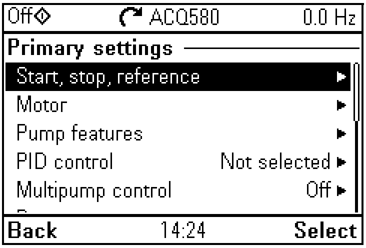
☐ Make any additional adjustments, for example, pump protections, starting from the **Main** menu – press ▭ (**Menu**) to enter the **Main** menu.

Select **Primary settings** and press ▭ (**Select**) (or ▶).

In the **Primary settings** menu, select **Pump protections** and press ▭ (**Select**) (or ▶).

To get more information on the **Primary settings** menu items, press ? to open the help page.





3 – Hand/Off/Auto operation

☐ The drive can be in remote control or local control, and in local control there are additionally two different modes.

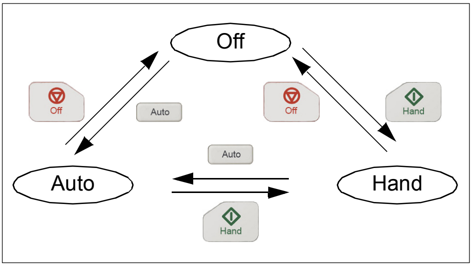
Remote control: Drive is controlled from the I/O or the fieldbus.

- Top row of the view shows Auto.

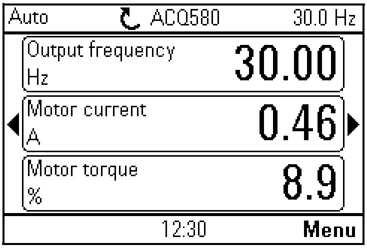
Local control: Drive is controlled from the control panel.

- Top row of the view shows Off, that is, the drive is in the Off mode. Drive is stopped.
- Top row of the view shows Hand, that is, the drive is in the Hand mode. Drive is running. The initial reference in the Hand mode is copied from the drive reference.
  Symbol ⬍ on the top row indicates that you can change the reference with ▲ and ▼.

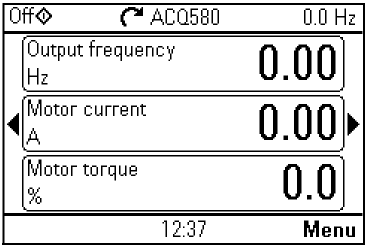
The following diagram shows the state transitions when you press the Hand, Off or Auto button:



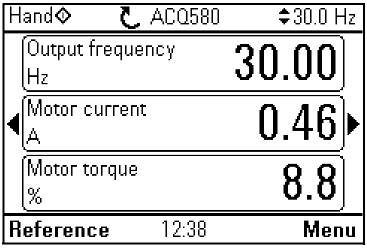
Note: When you restart the drive while fault 7081 Control panel loss is active, the mode changes from Hand or Off to Auto.



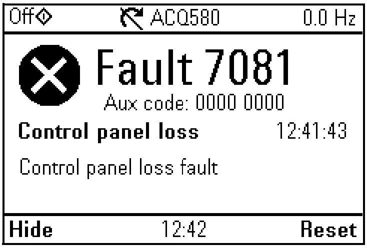
Auto ACQ580 30.0 Hz
Output frequency Hz 30.00
Motor current A 0.46
Motor torque % 8.9
12:30 **Menu**



Off ACQ580 0.0 Hz
Output frequency Hz 0.00
Motor current A 0.00
Motor torque % 0.0
12:37 **Menu**



Hand ACQ580 ⬍30.0 Hz
Output frequency Hz 30.00
Motor current A 0.46
Motor torque % 8.8
Reference 12:38 **Menu**

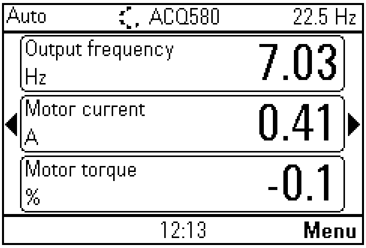
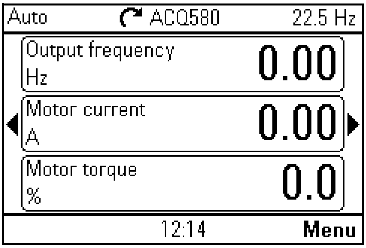


Off ACQ580 0.0 Hz
Fault 7081
Aux code: 0000 0000
Control panel loss 12:41:43
Control panel loss fault
Hide 12:42 **Reset**

How to control the drive through the I/O interface

The table below describes how to operate the drive through the digital and analog inputs when:

- the motor start-up is performed, and
- the default parameter settings of the Water default configurations are in use.

Preliminary settings	
If you need to change the direction of rotation, check that limits allow reverse direction: Check parameter group *30 Limits* and make sure that the minimum limit has a negative value and the maximum limit has a positive value. Default settings only allow forward direction.Note that efficient pump cleaning can require reverse speed.	
Make sure that the control connections are wired according to the connection diagram given for the Water default.	See section *Water default* on page *34*.
Make sure that the drive is in external control. To switch to external control, press key Auto.	In external control, the panel display shows text **Auto** at the top left.
Starting and controlling the speed of the motor	
Start by switching digital input DI1 on. The arrow starts rotating. It is dotted until the setpoint is reached. Regulate the drive output frequency (motor speed) by adjusting voltage of analog input AI1.	 Auto ACQ580 22.5 Hz Output frequency Hz 7.03 Motor current A 0.41 Motor torque % -0.1 12:13 Menu
Stopping the motor	
Switch digital input DI1 off. The arrow stops rotating.	 Auto ACQ580 22.5 Hz Output frequency Hz 0.00 Motor current A 0.00 Motor torque % 0.0 12:14 Menu

How to perform the ID run

The drive automatically estimates motor characteristics using *Standstill* ID run when the drive is started for the first time in vector control and after any motor parameter (group *99 Motor data*) is changed. This is valid when

- parameter *99.13 ID run requested* selection is *Standstill* and
- parameter *99.04 Motor control mode* selection is *Vector*.

In most applications there is no need to perform a separate ID run. The ID run should be selected manually if:

- vector control mode is used (parameter *99.04 Motor control mode* is set to *Vector*), and
- permanent magnet motor (PM) is used (parameter *99.03 Motor type* is set to *Permanent magnet motor*), or
- synchronous reluctance motor (SynRM) is used (parameter *99.03 Motor type* is set to *SynRM*), or
- drive operates near zero speed references, or
- operation at torque range above the motor nominal torque, over a wide speed range is needed.

Do the ID run with the ID run assistant by selecting **Menu - Primary settings - Motor - ID run** (see page *22*).

Note: If motor parameters (group *99 Motor data*) are changed after the ID run, it must be repeated.

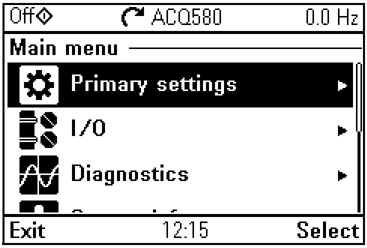
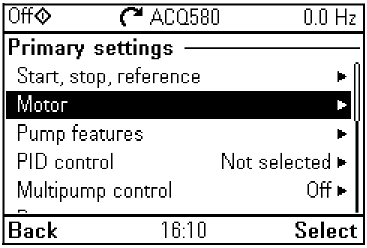
Note: If you have already parameterized your application using the scalar motor control mode (*99.04 Motor control mode* is set to *Scalar*) and you need to change motor control mode to *Vector*,

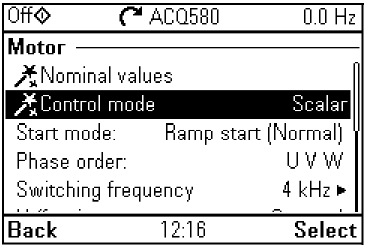
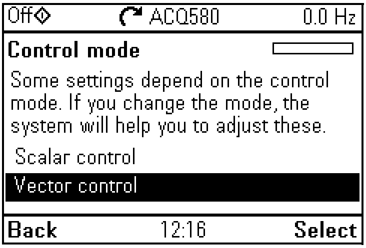
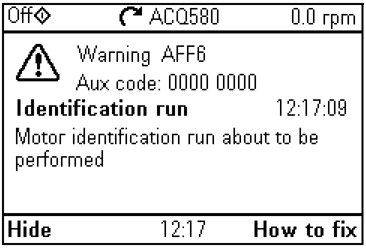
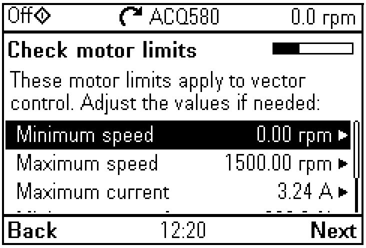
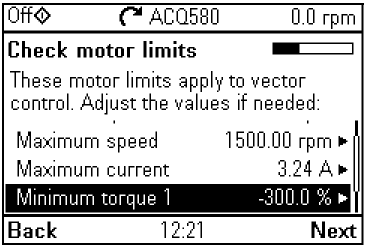
- change the control mode to vector with the **Control mode** assistant (go to **Menu - Primary settings - Motor - Control mode)** and follow the instructions. The ID run assistant then guides you through the ID run.

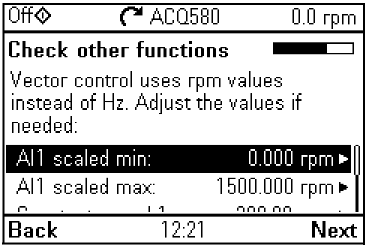
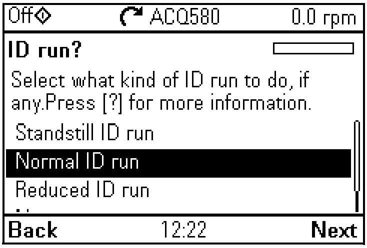
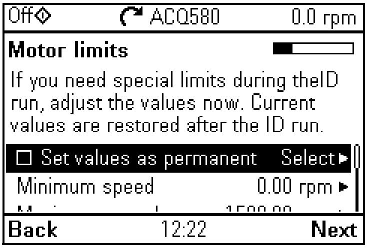
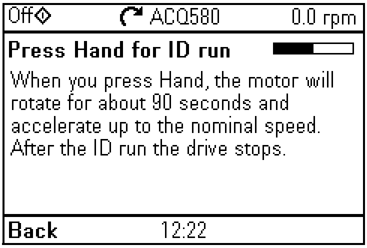
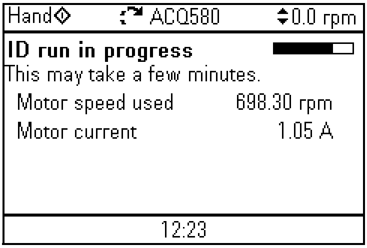
or

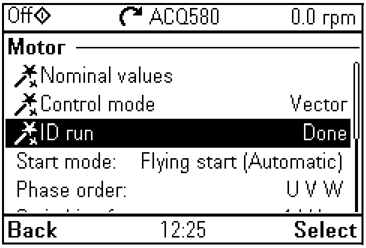
- set parameter *99.04 Motor control mode* to *Vector*, and
    - for I/O controlled drive, check parameters in groups *22 Speed reference selection*, *23 Speed reference ramp*, *12 Standard AI*, *30 Limits* and *46 Monitoring/scaling settings*.

ID run procedure with the ID Run assistant

<table>
<tr><th colspan="3">Pre-check</th></tr>
<tr><td colspan="3">WARNING! The motor will run at up to approximately 50…80% of the nominal speed during the ID run. The motor will rotate in the forward direction. Make sure that it is safe to run the motor before performing the ID run!</td></tr>
<tr><td>☐</td><td colspan="2">De-couple the motor from the pump.</td></tr>
<tr><td>☐</td><td colspan="2">Check that the values of the motor data parameters are equivalent to those on the motor nameplate.</td></tr>
<tr><td>☐</td><td colspan="2">Check that the STO circuit is closed.</td></tr>
<tr><td></td><td colspan="2">The assistant will ask if you want to use temporary motor limits. They must meet the following conditions:</td></tr>
<tr><td>☐</td><td colspan="2">Minimum speed ≤ 0 rpm</td></tr>
<tr><td>☐</td><td colspan="2">Maximum speed = motor rated speed (Normal ID run procedure needs the motor to be run at 100% speed.)</td></tr>
<tr><td>☐</td><td colspan="2">Maximum current > I_{HD}</td></tr>
<tr><td>☐</td><td colspan="2">Maximum torque > 50%</td></tr>
<tr><td>☐</td><td colspan="2">Make sure that the panel is in the Off mode control (text Off shown at the top left). Press the Off key ⊽ to switch to the Off mode.</td></tr>
<tr><th colspan="3">ID run</th></tr>
<tr><td>☐</td><td>Go to the Main menu by pressing ▭ (Menu) in the Home view.
Select Primary settings and press ▭ (Select) (or ▶).</td><td> </td></tr>
<tr><td>☐</td><td>Select Motor and press ▭ (Select) (or ▶).</td><td> </td></tr>
</table>

☐	If the control modes is scalar, select **Control mode** and press ⌨ (**Select**) (or ▶) and continue to the next step.	 Off◇ ACQ580 0.0 Hz **Motor** Nominal values Control mode Scalar Start mode: Ramp start (Normal) Phase order: U V W Switching frequency 4 kHz ▸ **Back** 12:16 **Select**
☐	Select **Vector control** and press ⌨ (**Select**) (or ▶).	 Off◇ ACQ580 0.0 Hz **Control mode** Some settings depend on the control mode. If you change the mode, the system will help you to adjust these. Scalar control Vector control **Back** 12:16 **Select**
☐	Warning message **Identification run** is shown for a moment.	 Off◇ ACQ580 0.0 rpm ⚠ Warning AFF6 Aux code: 0000 0000 **Identification run** 12:17:09 Motor identification run about to be performed **Hide** 12:17 **How to fix**
☐	Check the motor speed limits. The following must be true: - Minimum speed ≤ 0 rpm - Maximum speed = motor rated speed.	 Off◇ ACQ580 0.0 rpm **Check motor limits** These motor limits apply to vector control. Adjust the values if needed: Minimum speed 0.00 rpm ▸ Maximum speed 1500.00 rpm ▸ Maximum current 3.24 A ▸ **Back** 12:20 **Next**
☐	Check the motor current as well as torque limits. The following must be true: - Maximum current > I_{HD} - Maximum torque > 50%.	 Off◇ ACQ580 0.0 rpm **Check motor limits** These motor limits apply to vector control. Adjust the values if needed: Maximum speed 1500.00 rpm ▸ Maximum current 3.24 A ▸ Minimum torque 1 -300.0 % ▸ **Back** 12:21 **Next**

☐	Check that AI is scaled correctly for the control mode in use. In speed control mode, check that *12.20 AI1 scaled at AI1 max* = 1500 or 1800 rpm. In scalar control mode, check *12.20 AI1 scaled at AI1 max* = 50 or 60 Hz.	 Off◇ ACQ580 0.0 rpm **Check other functions** Vector control uses rpm values instead of Hz. Adjust the values if needed: AI1 scaled min: 0.000 rpm ▶ AI1 scaled max: 1500.000 rpm ▶ Back 12:21 Next
☐	Select the type of ID run you want to do and press ⌣ (**Select**) (or ▶).	 Off◇ ACQ580 0.0 rpm **ID run?** Select what kind of ID run to do, if any.Press [?] for more information. Standstill ID run Normal ID run Reduced ID run Back 12:22 Next
☐	Check the motor limits shown on the panel. If you need other limits during the ID run you can enter them here. The originals limits will be restored after the ID run, unless you select **Set values as permanent**.	 Off◇ ACQ580 0.0 rpm **Motor limits** If you need special limits during theID run, adjust the values now. Current values are restored after the ID run. ☐ Set values as permanent Select ▶ Minimum speed 0.00 rpm ▶ Back 12:22 Next
☐	Press the Hand key (◇) to start the ID run. In general, it is recommended not to press any control panel keys during the ID run. However, you can stop the ID run at any time by pressing the Off key (▽). During the ID run a progress view is shown. After the ID run is completed, text **ID run done** is shown. The LED stops blinking. If the ID run fails, fault *FF61 ID run* is shown. See chapter *Fault tracing* on page *337* for more information.	 Off◇ ACQ580 0.0 rpm **Press Hand for ID run** When you press Hand, the motor will rotate for about 90 seconds and accelerate up to the nominal speed. After the ID run the drive stops. Back 12:22  Hand◇ ACQ580 ⇕0.0 rpm **ID run in progress** This may take a few minutes. Motor speed used 698.30 rpm Motor current 1.05 A 12:23

☐	After the ID run is completed, text **Done** is shown on row **ID run**.	 Off◇ ACQ580 0.0 rpm **Motor** Nominal values Control mode Vector ID run Done Start mode: Flying start (Automatic) Phase order: U V W **Back** 12:25 **Select**

3

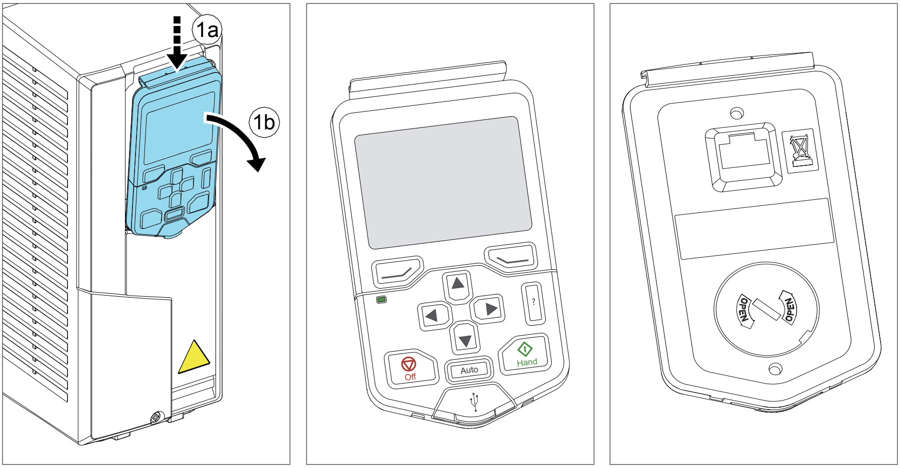
Control panel

Contents of this chapter

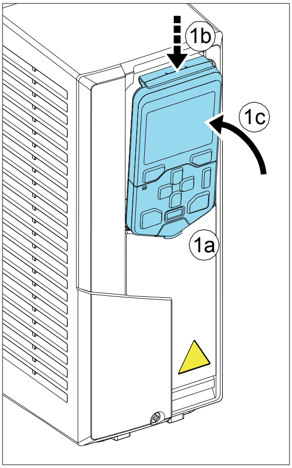
This chapter contains instructions for removing and reinstalling the assistant control panel and briefly describes its display, keys and key shortcuts. For more information, see *ACX-AP-x assistant control panels user’s manual* (3AUA0000085685 [English]).

Removing and reinstalling the control panel

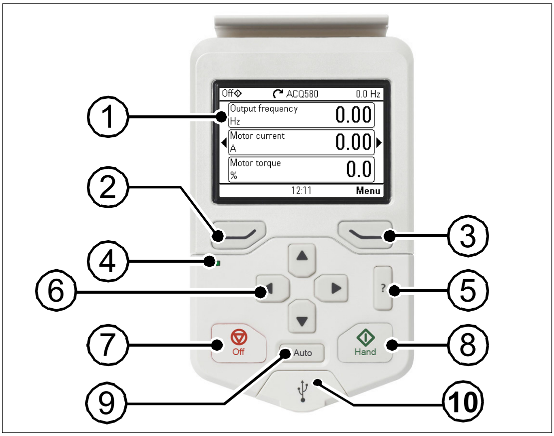
To remove the control panel, press the retaining clip at the top (1a) and pull it forward from the top edge (1b).



To reinstall the control panel, put the bottom of the container in position (1a), press the retaining clip at the top (1b) and push the control panel in at the top edge (1c).



Layout of the control panel

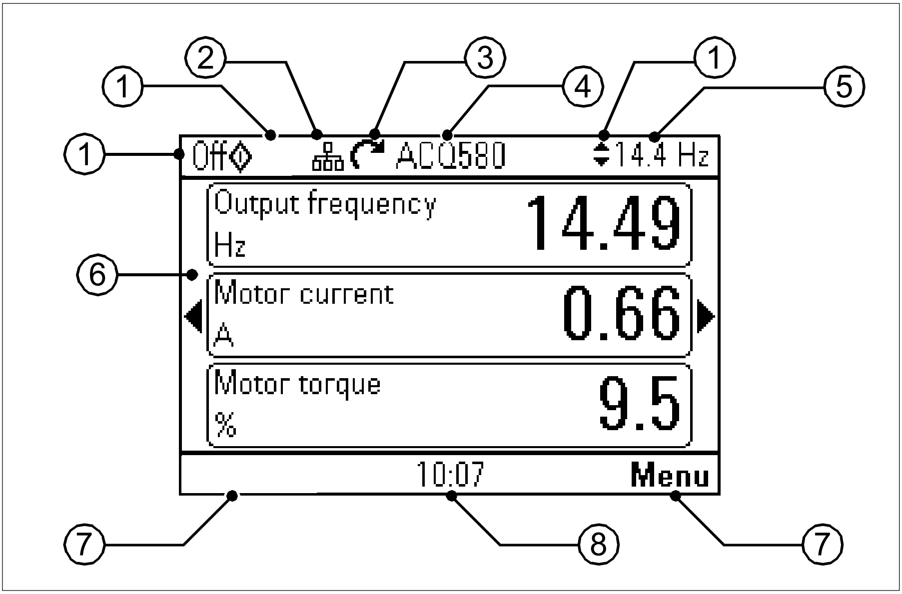


1	*Layout of the control panel display*
2	*Left softkey*
3	*Right softkey*
4	Status LED, see chapter *Maintenance and hardware diagnostics*, section *LEDs* in the *Hardware manual of the drive*.
5	*Help*

6	*The arrow keys*
7	Off (see *Hand, Off and Auto*)
8	Hand (see *Hand, Off and Auto*)
9	Auto (see *Hand, Off and Auto*)
10	USB connector

Layout of the control panel display

In most views, the following elements are shown on the display:



1. **Control location and related icons**: Indicates how the drive is controlled:
   - **No text**: The drive is in local control, but controlled from another device. The icons in the top pane indicate which actions are allowed:

Text/Icons	Starting from this control panel	Stopping from this control panel	Giving reference from this panel
	Not allowed	Not allowed	Not allowed

   - **Local**: The drive is in local control, and controlled from this control panel. The icons in the top panel indicate which actions are allowed:

Text/Icons	Starting from this control panel	Stopping from this control panel	Giving reference from this panel
Off ◇ ⬍	Allowed	Drive is stopped	Not allowed
Hand ◇ ⬍	Allowed	Allowed	Allowed

- **External**: The drive is in external control, ie, controlled through I/O or fieldbus. The icons in the top pane indicate which actions are allowed with the control panel:

Text/Icons	**Starting from this control panel**	**Stopping from this control panel**	**Giving reference from this panel**
Auto	Not allowed	Not allowed	Not allowed
Auto ◈	Allowed	Allowed	Not allowed
Auto ⬍	Not allowed	Allowed	Allowed
Auto ◈ ⬍	Allowed	Allowed	Allowed

2. **Panel bus:** Indicates that there are more than one drive connected to this panel. To switch to another drive, go to **Options - Select drive**.

3. **Status icon**: Indicates the status of the drive and the motor. The direction of the arrow indicates forward (clockwise) or reverse (counter-clockwise) rotation

Status icon	**Animation**	**Drive status**
↷	-	Stopped
↷̸	-	Stopped, start inhibited
↷↔↷̸	Blinking	Stopped, start command given but start inhibited. See **Menu - Diagnostics** on the control panel
↷̸↔⊗	Blinking	Faulted
↷↔	Blinking	Running, at reference, but the reference value is 0
↷↔↻	Rotating	Running, not at reference
↷↔↻	Rotating	Running, at reference

4. **Drive name**: If a name has been given, it is displayed in the top pane. By default, it is “ACQ580”. You can change the name on the control panel by selecting **Menu - Primary settings - Clock, region, display** (see page *62*).
5. **Reference value**: Speed, frequency, etc. is shown with its unit. For information on changing the reference value in the **Primary settings** menu (see page *51*).
6. **Content area**: The actual content of the view is displayed in this area. The content varies from view to view. The example view on page *29* is the main view of the control panel which is called the Home view.
7. **Softkey selections**: Displays the functions of the softkeys (▱ and ▱) in a given context.
8. **Clock**: The clock displays the current time. You can change the time and time format on the control panel by selecting **Menu - Primary settings - Clock, region, display** (see page *62*).

You can adjust the display contrast and back light functionality on the control panel by selecting **Menu - Primary settings - Clock, region, display** (see page *62*).

Keys

The keys of the control panel are described below.

Left softkey

The left softkey ( ) is usually used for exiting and canceling. Its function in a given situation is shown by the softkey selection in the bottom left corner of the display.

Holding down exits each view in turn until you are back in the Home view. This function does not work in special screens.

Right softkey

The right softkey ( ) is usually used for selecting, accepting and confirming. The function of the right softkey in a given situation is shown by the softkey selection in the bottom right corner of the display.

The arrow keys

The up and down arrow keys (▲ and ▼) are used to highlight selections in menus and selection lists, to scroll up and down on text pages, and to adjust values when, for example, setting the time, entering a passcode or changing a parameter value.

The left and right arrow keys (◄ and ►) are used to move the cursor left and right in parameter editing and to move forward and backward in assistants. In menus, ◄ and ► function the same way as and , respectively.

Help

The help key (?) opens a help page. The help page is context-sensitive, in other words, the content of the page is relevant to the menu or view in question.

Hand, Off and Auto

The ACQ580 can be in local or external control. The local control has two modes: Hand and Off. See also the diagram in section *Local control vs. external control* on page *37*.

Hand key (◇):

- In local control / Off mode: Starts the drive. The drive will switch to the Hand mode.
- In external control: Switches the drive to local control / Hand mode, keeping it running.

Off key (⊽):

- Stops the drive and switches to the Off mode.

Auto key (Auto):

- In local control: The drive will switch to external control.

Key shortcuts

The table below lists key shortcuts and combinations. Simultaneous key presses are indicated by the plus sign (+).

Shortcut	**Available in**	**Effect**
◿ + ◺ + ▲	any view	Save a screenshot. Up to fifteen images may be stored in the control panel memory. To transfer images to PC, connect the assistant control panel to PC with a USB cable and the panel will mount itself as an MTP (media transfer protocol) device. Pictures are stored in the screen shots folder. For more instructions, see *ACX-AP-x assistant control panels user's manual* (3AUA0000085685 [English]).
◿ + ▲, ◿ + ▼	any view	Adjust backlight brightness.
◺ + ▲, ◺ + ▼	any view	Adjust display contrast.
▲ or ▼	Home view	Adjust reference.
▲ + ▼	parameter edit views	Revert an editable parameter to its default value.
◀ + ▶	view showing a list of selections for a parameter	Show/hide selection index numbers.
◿ (keep down)	any view	Return to the Home view by pressing down the key until the Home view is shown.

4

Default configuration

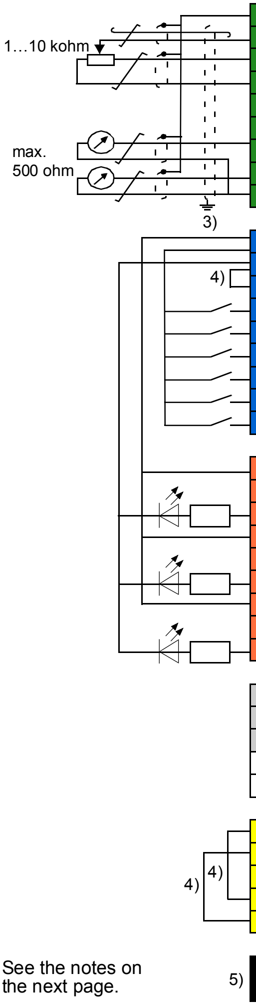
Contents of this chapter

This chapter describes the intended use, operation and default control connections of the application.

Water default

This is the default configuration of control connections for water and waste water applications.

Default control connections for the Water default



X1	Reference voltage and analog inputs and outputs	
1	SCR	Signal cable shield (screen)
2	AI1	**Output frequency/speed reference**: 0…10 V
3	AGND	Analog input circuit common
4	+10V	Reference voltage 10 V DC
5	AI2	**Actual feedback:** 0…10 V
6	AGND	Analog input circuit common
7	AO1	**Output frequency:** 0…10 V
8	AO2	**Motor current:** 0…20 mA
9	AGND	Analog output circuit common
X2 & X3	Aux. voltage output and programmable digital inputs	
10	+24V	Aux. voltage output +24 V DC, max. 250 mA
11	DGND	Aux. voltage output common
12	DCOM	Digital input common for all
13	DI1	**Stop (0) / Start (1)**
14	DI2	Not configured
15	DI3	**Constant frequency/speed selection**
16	DI4	Not configured
17	DI5	Not configured
18	DI6	Not configured
X6, X7, X8	Relay outputs	
19	RO1C	**Ready run** 250 V AC / 30 V DC 2 A
20	RO1A	
21	RO1B	
22	RO2C	**Running** 250 V AC / 30 V DC 2 A
23	RO2A	
24	RO2B	
25	RO3C	**Fault (-1)** 250 V AC / 30 V DC 2 A
26	RO3A	
27	RO3B	
X5	Embedded fieldbus	
29	B+	Embedded fieldbus, EFB (EIA-485)
30	A-	
31	DGND	
S4	TERM	Termination switch
S5	BIAS	Bias resistors switch
X4	Safe torque off	
34	OUT1	Safe torque off. Factory connection. Both circuits must be closed for the drive to start. See chapter *The Safe torque off function* in the *Hardware manual* of the drive
35	OUT2	
36	SGND	
37	IN1	
38	IN2	
X10	24 V AC/DC	
40	24 V AC/DC+ in	R6…R11 only: Ext. 24V AC/DC input to power up the control unit when the main supply is disconnected.
41	24 V AC/DC- in	

See the notes on the next page.

Terminal sizes:

R0…R5: 0.2…2.5 mm^2 (24…14 AWG): Terminals +24V, DGND, DCOM, B+, A-, DGND, Ext. 24V
0.14…1.5 mm^2 (26…16 AWG): Terminals DI, AI, AO, AGND, RO, STO

R6…R9: 0.14…2.5 mm^2 (all terminals)

Tightening torques: 0.5…0.6 N·m (0.4 lbf·ft)

Notes:

3) Ground the outer shield of the cable 360 degrees under the grounding clamp on the grounding shelf for the control cables.

4) Connected with jumpers at the factory.

5) Only frames R6…R11 have terminals 40 and 41 for external 24 V AC/DC input.

Input signals

- Analog frequency reference (AI1)
- Start/stop selection (DI1)
- Constant speed/frequency selection (DI3)

Output signals

- Analog output AO1: Output frequency
- Analog output AO2: Motor current
- Relay output 1: Ready run
- Relay output 2: Running
- Relay output 3: Fault (-1)

5

Program features

What this chapter contains

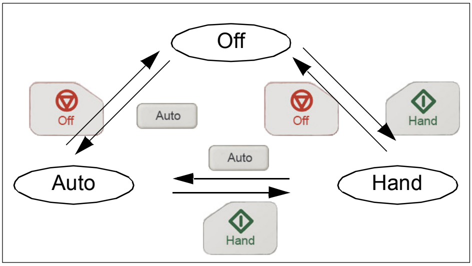
This chapter describes some of the more important functions within the control program, how to use them and how to program them to operate. It also explains the control locations and operating modes.

Local control vs. external control

The ACQ580 has two main control locations: external and local. In local control there are additionally two different modes: Off mode and Hand mode.

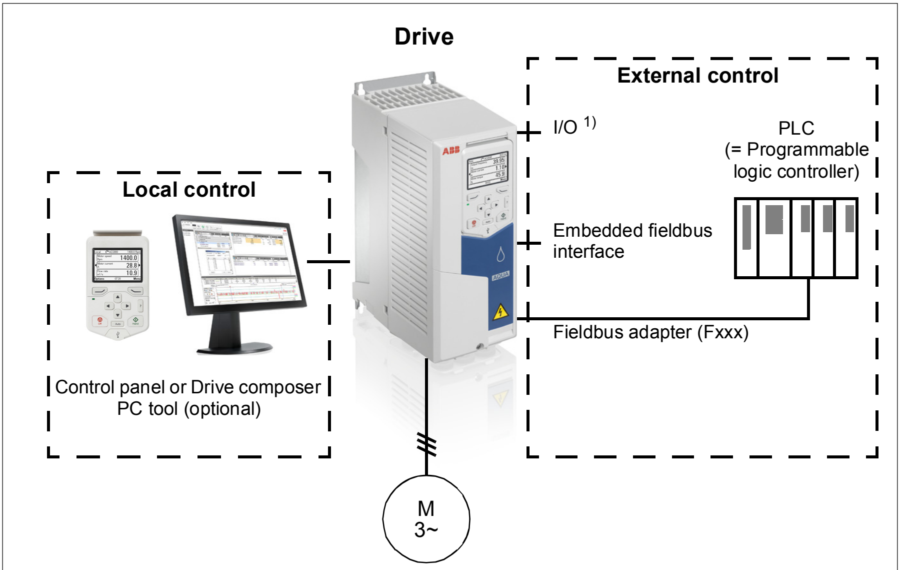
In the Off mode, the drive is stopped. In the Hand mode, the drive is running.The initial reference in the Hand mode is copied from the drive reference.

The following diagram shows the state transitions when you press the Hand, Off or Auto button:



The control location can also be selected in the PC tool.

Note: When you restart the drive while fault *7081 Control panel loss* is active, the mode changes from Hand or Off to Auto.



[1] Extra inputs/outputs can be added by installing an optional I/O extension module (CMOD-01, CMOD-02 or CHDI-01) in drive slot.

Local control

The control commands are given from the control panel keypad or from a PC equipped with Drive composer when the drive is in local control. Speed control mode is available in vector motor control mode; frequency mode is available when scalar motor control mode is used.

Local control is mainly used during commissioning and maintenance. The control panel always overrides the external control signal sources when used in local control. Changing the control location to local can be prevented by parameter *19.18 HAND/OFF disable source*.

The user can select by a parameter (*49.05 Communication loss action*) how the drive reacts to a control panel or PC tool communication break. (The parameter has no effect in external control.)

External control

When the drive is in external control, control commands are given through

- the I/O terminals (digital and analog inputs), or optional I/O extension modules
- the fieldbus interface (via the embedded fieldbus interface or an optional fieldbus adapter module).

Two external control locations, EXT1 and EXT2, are available. The user can select the sources of the start and stop commands separately for each location by setting parameters *20.01*…*20.09*. The operating mode can be selected separately for each location, which enables quick switching between different operating modes, for example speed and process PID control. Selection between EXT1 and EXT2 is done via any binary source such as a digital input or fieldbus control word (parameter *19.11 Ext1/Ext2 selection*). The source of reference is selectable for each operating mode separately.

Communication fail functionality

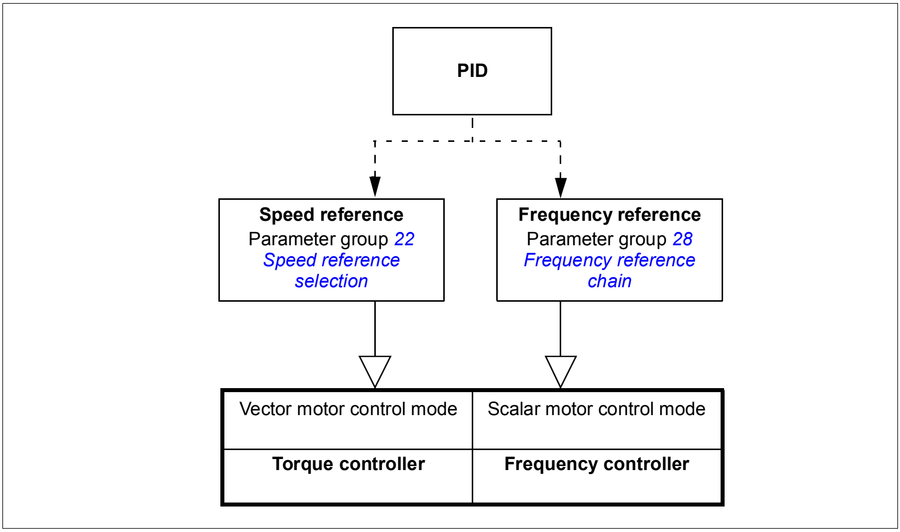
The communication fail functionality ensures continuous process without interruptions. If there is a communication loss, the drive automatically changes the control location from EXT1 to EXT2. This enables process to be controlled, for example, with the drive PID controller. When the original control location recovers, the drive automatically switches control back to the communication network (EXT1).

Settings

- Parameters *19.11 Ext1/Ext2 selection* (page *141*); *20.01*…*20.09* (page *142*).

Operating modes of the drive

The drive can operate in several operating modes with different types of reference. The mode is selectable for each control location (Local, EXT1 and EXT2) in parameter group *19 Operation mode*. An overview of the different reference types and control chains is shown below.



Speed control mode

The motor follows a speed reference given to the drive. This mode can be used with estimated speed used as feedback.

Speed control mode is available in both local and external control. It is supported in vector motor control only.

Speed control uses speed reference chain. Select speed reference with parameters in group *22 Speed reference selection* on page *154*.

Frequency control mode

The motor follows a frequency reference given to the drive. Frequency control is available in both local and external control. It is supported in scalar motor control only.

Frequency control uses frequency reference chain. Select frequency reference with parameters in group *28 Frequency reference chain* on page *167*.

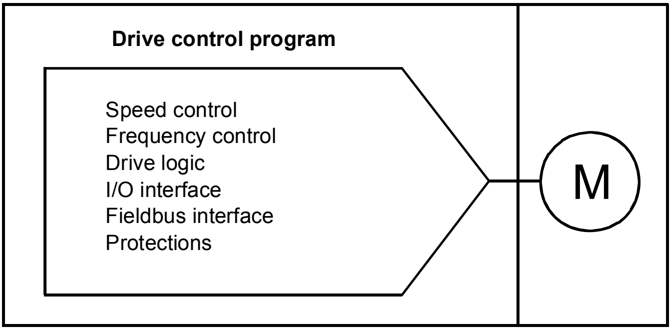
Special control modes

In addition to the above-mentioned control modes, the following special control modes are available:

- Process PID control. For more information, see section *Process PID control (PID/Loop controller)* (page *57*).
- Emergency stop modes OFF1 and OFF3: Drive stops along the defined deceleration ramp and drive modulation stops.
- Pre-magnetization: DC magnetization of the motor before start. For more information, see section *Pre-magnetization* (page *76*).
- DC hold: Locking the rotor at (near) zero speed in the middle of normal operation. For more information, see section *DC hold* (page *77*).
- Pre-heating (motor heating): Keeping the motor warm when the drive is stopped. For more information, see section *Pre-heating (Motor heating)* (page *78*).

Drive configuration and programming

The drive control program performs the main control functions, including speed and frequency control, drive logic (start/stop), I/O, feedback, communication and protection functions. Control program functions are configured and programmed with parameters.



Configuring via parameters

Parameters configure all of the standard drive operations and can be set via

- the control panel, as described in chapter *Control panel*
- the Drive composer PC tool, as described in *Drive composer user's manual* (3AUA0000094606 [English]), or
- the fieldbus interface, as described in chapters *Fieldbus control through the embedded fieldbus interface (EFB)* and *Fieldbus control through a fieldbus adapter*.

All parameter settings are stored automatically to the permanent memory of the drive. However, if an external +24 V DC or 24 V AC power supply is used for the drive control unit, it is highly recommended to force a save by using parameter *96.07 Parameter save manually* before powering down the control unit after any parameter changes have been made.

If necessary, the default parameter values can be restored by parameter *96.06 Parameter restore*.

Adaptive programming

Conventionally, the user can control the operation of the drive by parameters. However, the standard parameters have a fixed set of choices or a setting range. To further customize the operation of the drive, an adaptive program can be constructed out of a set of function blocks.

The Drive composer pro PC tool (version 1.10 or later, available separately) has an Adaptive programming feature with a graphical user interface for building the custom program. The function blocks include the usual arithmetic and logical functions, as well as for example, selection, comparison and timer blocks.

The physical inputs, drive status information, actual values, constants and parameters can be used as the input for the program. The output of the program can be used for example, as a start signal, external event or reference, or connected to the drive outputs. See the table below for a listing of the available inputs and outputs.

If you connect the output of the adaptive program to a selection parameter that is a pointer parameter, the selection parameter will be write-protected.

Example

If parameter *31.01 External event 1 source* is connected to an adaptive programming block output, the parameter value is shown as Adaptive program on a control panel or PC tool. The parameter is write-protected (= the selection cannot be changed).

The status of the adaptive program is shown by parameter *07.30 Adaptive program status*.The adaptive program can be disabled by *96.70 Disable adaptive program*.

For more information, see the *Adaptive programming application guide* (3AXD50000028574 [English].

Inputs available to the adaptive program	
Input	*Source*
I/O	
DI1	*10.02 DI delayed status*, bit 0
DI2	*10.02 DI delayed status*, bit 1
DI3	*10.02 DI delayed status*, bit 2
DI4	*10.02 DI delayed status*, bit 3
DI5	*10.02 DI delayed status*, bit 4
DI6	*10.02 DI delayed status*, bit 5
AI1	*12.11 AI1 actual value*
AI2	*12.21 AI2 actual value*
Actual signals	
Motor speed	*01.01 Motor speed used*
Output frequency	*01.06 Output frequency*
Motor current	*01.07 Motor current*
Motor torque	*01.10 Motor torque*
Motor shaft power	*01.17 Motor shaft power*
Status	
Enabled	*06.16 Drive status word 1*, bit 0
Inhibited	*06.16 Drive status word 1*, bit 1

Inputs available to the adaptive program	
Input	*Source*
Ready to start	*06.16 Drive status word 1*, bit 3
Tripped	*06.11 Main status word*, bit 3
At setpoint	*06.11 Main status word*, bit 8
Limiting	*06.16 Drive status word 1*, bit 7
Ext1 active	*06.16 Drive status word 1*, bit 10
Ext2 active	*06.16 Drive status word 1*, bit 11
Data storage	
Data storage 1 real32	*47.01 Data storage 1 real32*
Data storage 2 real32	*47.02 Data storage 2 real32*
Data storage 3 real32	*47.03 Data storage 3 real32*
Data storage 4 real32	*47.04 Data storage 4 real32*

Outputs available to the adaptive program	
Output	*Target*
I/O	
RO1	*10.24 RO1 source*
RO2	*10.27 RO2 source*
RO3	*10.30 RO3 source*
AO1	*13.12 AO1 source*
AO2	*13.22 AO2 source*
Start control	
Ext1/Ext2 selection	*19.11 Ext1/Ext2 selection*
Ext1 in1 cmd	*20.03 Ext1 in1 source*
Ext1 in2 cmd	*20.04 Ext2 in2 source*
Ext2 in1 cmd	*20.08 Ext2 in1 source*
Ext2 in2 cmd	*20.09 Ext2 in2 source*
Fault reset	*31.11 Fault reset selection*
Speed control	
Ext1 speed reference	*22.11 Ext1 speed ref1*
Speed proportional gain	*25.02 Speed proportional gain*
Speed integration time	*25.03 Speed integration time*
Acceleration time 1	*23.12 Acceleration time 1*
Deceleration time 1	*23.13 Deceleration time 1*
Frequency control	
Ext1 frequency reference	*28.11 Ext1 frequency ref1*
Events	
External event 1	*31.01 External event 1 source*
External event 2	*31.03 External event 2 source*
External event 3	*31.05 External event 3 source*
External event 4	*31.07 External event 4 source*
External event 5	*31.09 External event 5 source*
Data Storage	
Data storage 1 real32	*47.01 Data storage 1 real32*
Data storage 2 real32	*47.02 Data storage 2 real32*
Data storage 3 real32	*47.03 Data storage 3 real32*
Data storage 4 real32	*47.04 Data storage 4 real32*
Process PID	
Set 1 setpoint 1	*40.16 Set 1 setpoint 1 source*

Outputs available to the adaptive program	
Output	*Target*
Set 1 setpoint 2	*40.17 Set 1 setpoint 2 source*
Set 1 feedback 1	*40.08 Set 1 feedback 1 source*
Set 1 feedback 2	*40.09 Set 1 feedback 2 source*
Set 1 gain	*40.32 Set 1 gain*
Set 1 integration time	*40.33 Set 1 integration time*
Set 1 tracking mode	*40.49 Set 1 tracking mode*
Set 1 track reference	*40.50 Set 1 tracking ref selection*

Adaptive program fault and aux code formats

The format of the aux code:

Bits 24-31: State number	Bits 16-23: block number	Bits 0-15: error code

If the state number is zero but the block number has a value, the fault is related to a function block in the base program. If both state number and block number are zero, the fault is a generic fault that is not related to a specific block.

See fault *64A6 Adaptive program* on page *355*.

Sequence program

An adaptive program can contain base program and sequence program parts. Base program is run continuously when adaptive program is in running mode. The functionality of the base program is programmed using function blocks and system inputs and outputs.

Sequence program is a state machine. This means that only one state of the sequence program is run at a time. You can create a sequence program by adding states and programming the state programs using the same program elements as in the base program. You can program state transitions by adding state transition outputs to the state programs. The state transition rules are programmed using function blocks.

The number of the active state of the sequence program is shown by parameter *07.31 AP sequence state*.

Control interfaces

Programmable analog inputs

The control unit has two programmable analog inputs. Each of the inputs can be independently set as a voltage (0/2…10 V) or current (0/4…20 mA) input with parameters. Each input can be filtered, inverted and scaled.

Settings

Parameter group *12 Standard AI* (page *124*).

Programmable analog outputs

The control unit has two current (0…20 mA) analog outputs. Analog output 1 can be set as a voltage (0/2…10 V) or current (0/4…20 mA) output with a parameter. Analog output 2 always uses current. Each output can be filtered, inverted and scaled.

Settings

Parameter group *13 Standard AO* (page *128*).

Programmable digital inputs and outputs

The control unit has six digital inputs.

Digital input DI5 can be used as a frequency input.

Digital input DI6 can used as a thermistor input.

Six digital inputs can be added by using a CHDI-01 115/230 V digital input extension module and one digital output by using a CMOD-01 multifunction extension module.

Settings

Parameter groups *10 Standard DI, RO* (page *117*) and *11 Standard DIO, FI, FO* (page *122*).

Programmable frequency input and output

Digital input DI5 can be configured as a frequency input.

A frequency output can be implemented with a CMOD-01 multifunction extension module.

Settings

Parameter groups *10 Standard DI, RO* (page *117*) and *11 Standard DIO, FI, FO* (page *122*) and *15 I/O extension module* (page *133*).

Programmable relay outputs

The control unit has three relay outputs. The signal to be indicated by the outputs can be selected by parameters.

Two relay outputs can be added by using a CMOD-01 multifunction extension module or a CHDI-01 115/230 V digital input extension module.

Settings

Parameter group *10 Standard DI, RO* (page *117*) and *15 I/O extension module* (page *133*).

Programmable I/O extensions

Inputs and outputs can be added by using a CMOD-01 or CMOD-02 multifunction extension module or a CHDI-01 115/230 V digital input extension module. The module is mounted on option slot 2 of the control unit.

The table below shows the number of I/O on the control unit as well as optional CMOD-01, CMOD-02 and a CHDI-01 modules.

Location	**Digital inputs (DI)**	**Digital outputs (DO)**	**Digital I/Os (DIO)**	**Analog inputs (AI)**	**Analog outputs (AO)**	**Relay outputs (RO)**
Control unit	6	-	-	2	2	3
CMOD-01	-	1	-	-	-	2
CMOD-02	-	-	-	-	-	1 (non-configurable)
CHDI-01	6 (115/230 V)	-	-	-	-	2

The I/O extension module can be activated and configured using parameter group 15.

The CMOD-02 offers, in addition to the relay output (non-configurable), a +24VDC/AC input and a thermistor input.

Note: The configuration parameter group contains parameters that display the values of the inputs on the extension module. These parameters are the only way of utilizing the inputs on an I/O extension module as signal sources. To connect to an input, choose the setting *Other* in the source selector parameter, then specify the appropriate value parameter (and bit, for digital signals) in group 15.

Note: With the CHDI, you can use up to six additional digital inputs. The CHDI does in no way affect the fixed digital inputs on the control board.

Settings

Parameter group *15 I/O extension module* (page *133*).

Fieldbus control

The drive can be connected to several different automation systems through its fieldbus interfaces. See chapters *Fieldbus control through the embedded fieldbus interface (EFB)* (page *363*) and *Fieldbus control through a fieldbus adapter* (page *391*).

Settings

Parameter groups *50 Fieldbus adapter (FBA)* (page *240*), *51 FBA A settings* (page *244*), *52 FBA A data in* (page *246*), and *53 FBA A data out* (page *246*) and *58 Embedded fieldbus* (page *247*).

Pump control features

Note: ABB recommends reading the pump manufacturer’s instructions for optimal performance.

Reference ramping

Acceleration and deceleration ramping times can be set individually for speed and frequency reference (**Menu - Primary settings - Ramps**).

With a speed or frequency reference, the ramps are defined as the time it takes for the drive to accelerate or decelerate between zero speed or frequency and the value defined by parameter *46.01 Speed scaling* or *46.02 Frequency scaling*. For speed and frequency reference, also the shape of the ramp can be controlled.

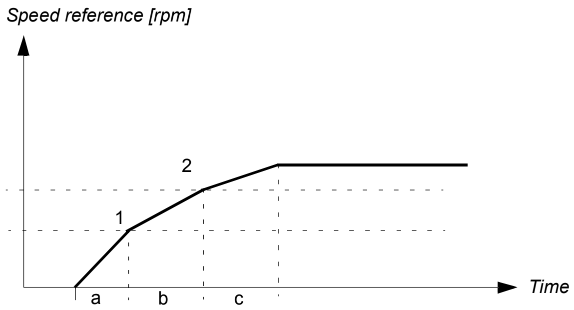
Special acceleration/deceleration ramps

The change rate of the motor potentiometer function (page *80*) is adjustable. The same rate applies in both directions.

A deceleration ramp can be defined for emergency stop (“Off3” mode).

Pump protections - Quick ramps

The quick ramp function allows you to use two additional ramp sets to accelerate or decelerate the pump. The following figure illustrates the acceleration in a quick ramp mode when both additional ramp sets are used.



1	*82.07 Quick ramp 1 upper limit*
2	*82.12 Quick ramp 2 upper limit*
a	First stage of acceleration
b	Second stage of acceleration
c	Third stage of acceleration

In submersible (a.k.a borehole) pumps, the mechanical wearing of bearings can be reduced by ramping the pump quickly to a certain speed.

The following examples describes the first, second and third stage of acceleration in quick ramp mode.

- First stage of acceleration (a) is to lift the impeller so that the fluid protects the bearings and sealings. Otherwise, the pump can get damaged. For example, 0 Hz to 25/30 Hz with ramp time of 1 second.
- Second stage of acceleration (b) is an optional. The pump produces a valid flow in this region, so the reasonable acceleration rate is requested to limit the turbidity. The effective inside region is 25/30 to 43/45 Hz and the ramp times typically are between 10 to 45 seconds.
- Third stage of acceleration (c) is a normal ramp. The pump provides a reasonable flow rate. The drive uses normal ramp times, for example, 60 seconds.

Settings

- **Menu - Primary settings - Ramps**
- Speed reference ramping: Parameters *23.12*…*23.13* and *46.01* (pages *162* and *236*).
- Frequency reference ramping: Parameters *28.72*…*28.73* and *46.02* (pages *173* and *236*).
- Motor potentiometer: Parameter *22.75* (page *161*).
- Emergency stop (“Off3” mode): Parameter *23.23 Emergency stop time* (page *163*).
- Pump protections - Quick ramps: Parameter group *82 Pump protections* (page *274*).

Constant speeds/frequencies

Constant speeds and frequencies are predefined references that can be quickly activated, for example, through digital inputs. It is possible to define up to 7 speeds for speed control and 7 constant frequencies for frequency control.

⚠ **WARNING:** Speeds and frequencies override the normal reference irrespective of where the reference is coming from.

Settings

- Parameter groups *22 Speed reference selection* (page *154*) and *28 Frequency reference chain* (page *167*).

Critical speeds/frequencies

Critical speeds (sometimes called “skip speeds”) can be predefined for applications where it is necessary to avoid certain motor speeds or speed ranges because of, for example, mechanical resonance problems.

The critical speeds function prevents the reference from dwelling within a critical band for extended times. When a changing reference (*22.87 Speed reference act 7*) enters a critical range, the output of the function (*22.01 Speed ref unlimited*) freezes until the reference exits the range. Any instant change in the output is smoothed out by the ramping function further in the reference chain.

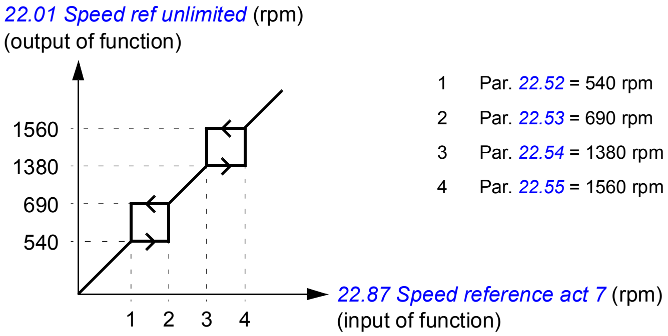
When the drive is limiting the allowed output speeds/frequencies, it limits to the absolutely lowest critical speed (critical speed low or critical frequency low) when accelerating from standstill, unless the speed reference is over the upper critical speed/ frequency limit.

The function is also available for scalar motor control with a frequency reference. The input of the function is shown by *28.96 Frequency ref act 7*.

Example

A pump has vibrations in the range of 540…690 rpm and 1380…1560 rpm. To make the drive avoid these speed ranges,

- the critical speeds function by turning on bit 0 of parameter *22.51 Critical speed function*, and
- set the critical speed ranges as in the figure below.



Settings

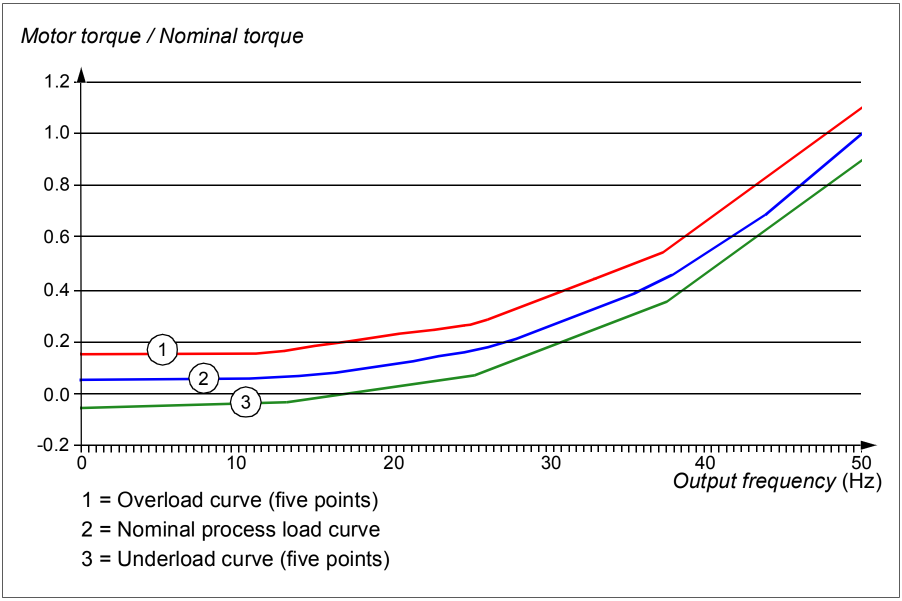
- Critical speeds: parameters *22.51*…*22.57* (page *159*)
- Critical frequencies: parameters *28.51*…*28.57* (page *172*).

User load curve (Condition monitoring)

The User load curve provides a supervisory function that monitors an input signal as a function of frequency or speed, and load. It shows the status of the monitored signal and can give a warning or fault based on the violation of a user defined profile.

The user load curve consists of an overload and an underload curve, or just one of them. Each curve is formed by five points that represent the monitored signal as a function of frequency or speed.

In the example below, the user load curve is constructed from the motor nominal torque to which a 10% margin is added and subtracted. The margin curves define a working envelope for the motor so that excursions outside the envelope can be supervised, timed and detected.



An overload warning and/or fault can be set to occur if the monitored signal stays continuously over the overload curve for a defined time. An underload warning and/or fault can be set to occur if the monitored signal stays continuously under the underload for a defined time.

Overload can be for example used to monitor for a stuck pump or dirty impeller.

Underload can be for example used to monitor for load dropping and for a blockage in pump inlet (suction side).

The load curve can be used as a trigger for the pump cleaning function. (Underload = blocked inlet on the pump, Overload = blockage in the pump impeller or output of the pump).

The user load curve can also, over a longer time period, be used to demonstrate when the efficiency of a pump system may be dropping so it can be used along with a maintenance trigger.

Settings

Parameter group *37 User load curve* (page *210*).

Pump cleaning

The pump cleaning function is mainly used in wastewater applications to prevent solid particles from being stuck on the pump impellers or in the piping. This function consists of a programmable sequence of forward and reverse rotations of the pump to shake off and remove any residue or rags on the impeller or piping.

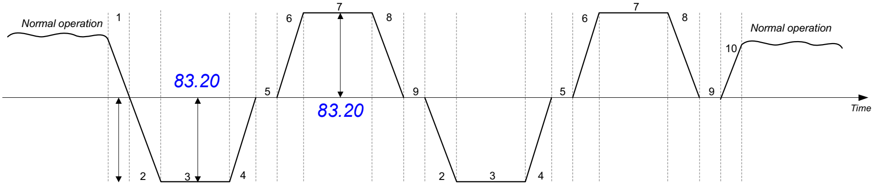
The Pump cleaning function prevents:

- blockages and decreases the need of manual cleaning
- increases the lifetime of the pump, pipes and impellers, and
- improves energy efficiency of the system.

Pump cleaning sequence

The drive starts cleaning with a pulse in the opposite direction of the running direction. The speed step size is same for both positive and negative directions.

The pump cleaning sequence can have several positive and negative direction speed steps in one cleaning sequence.



Sequence	Parameter	Sequence	Parameter
1	*83.26 Time to zero-speed*	6	*83.25 Time to cleaning speed*
2	*83.25 Time to cleaning speed*	7	*83.27 Cleaning on time*
3	*83.27 Cleaning on time*	8	*83.26 Time to zero-speed*
4	*83.26 Time to zero-speed*	9	*83.28 Cleaning off time*
5	*83.28 Cleaning off time*	10	*83.25 Time to cleaning speed*

The time from zero speed to *83.20 Cleaning speed step* is considered as Time to zero speed.

When the negative speed is not allowed, the drive ignores phases 1…4.

Note: Cleaning in a negative direction requires negative minimum speed/frequency in parameter *30.11 Minimum speed* / *30.13 Minimum frequency*.

1. The pump system meets the triggering conditions defined by parameter *83.10 Pump cleaning action*. At this conditions, normal operation stops and the drive uses the target time defined in parameter *83.26 Time to zero-speed* to reach zero speed.
2. Acceleration for cleaning is defined by parameter *83.25 Time to cleaning speed*.
3. The pump runs at cleaning speed for the time defined by parameter *83.27 Cleaning on time*.
4. The pump decelerates to zero-speed. Target time is defined by parameter *83.26 Time to zero-speed*.
5. The pump is stopped until parameter *83.28 Cleaning off time* is elapsed.
6. The pump accelerates the pump speed to positive direction. See parameter *83.25 Time to cleaning speed*.
7. The pump runs at the positive cleaning speed. See parameter *83.27 Cleaning on time*.
8. The pump decreases the pump speed back to zero defined by parameter *83.26 Time to zero-speed*.
9. The drive waits until the parameter *83.28 Cleaning off time* is elapsed. A new cleaning sequence starts or normal operation starts.
10. The pump starts following speed/frequency reference of the active control location. During acceleration to speed/frequency, the drive follows pump cleaning acceleration time *83.25 Time to cleaning speed*.

The drive automatically determines the fastest ramp during the pump cleaning and used to protect the pump. It is possible that the quick ramps are faster than the pump cleaning ramps.

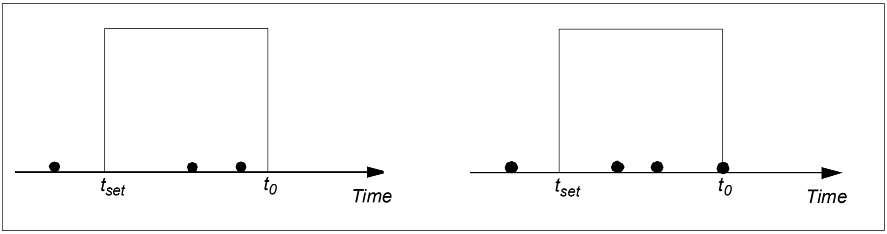
The cleaning sequence starts based on the selected triggering conditions. The cleaning sequence follows the diagram on page *54*. You can start the sequence in these conditions:

- on every start and stop
- based on the monitoring pump condition (for example, supervision 1…3; underload and overload curve, see group *37 User load curve* on *210*)
- based on time interval (for example, at every 10 hours)
- manually (for example, DI4 to DI6, defined by parameter *83.12 Manually force cleaning*)
- through fieldbus, using parameter *83.12 Manually force cleaning*. Set the parameter to a value of 1 (a 2 s pulse) from the fieldbus to start a cleaning cycle from an overriding controller.

Cleaning count monitoring

The cleaning count monitoring function calculates the number of cleaning cycles inside a user-defined monitoring window. Too frequent cleaning attempts may indicate a pump problem (such as blockage) that the pump cleaning function cannot solve alone but it requires manual inspection and cleaning. The following figures describes the operation of cleaning count monitoring.

For example, set the cleaning count time to one hour. The pump cleaning function trips on a fault if it detects too frequent cleaning cycles. The drive completes three pump cleaning cycles. The drive continuous its operation as long as the time interval between three cleanings are over the user defined value (one hour).



The third pump cleaning cycle starts within the preset count time (one hour) and the pump cleaning function trips on a fault and the pump is stopped without performing the third cleaning cycle. After reseting fault, the drive starts with the third pump cleaning cycle.

If the parameter *83.35 Cleaning count fault* is set to *No action*, supervision is not executed. If you change the parameter *83.35 Cleaning count fault* to *Warning* or *Fault*, the pump cleaning count starts from zero.

When the pump cleaning function is active and maximum number of cycles per time unit is reached, the drive displays a warning which appears in the event log.

Settings

Menu - **Primary settings** - **Pump cleaning**

Parameter group *83 Pump cleaning* (page *277*).

Default configurations

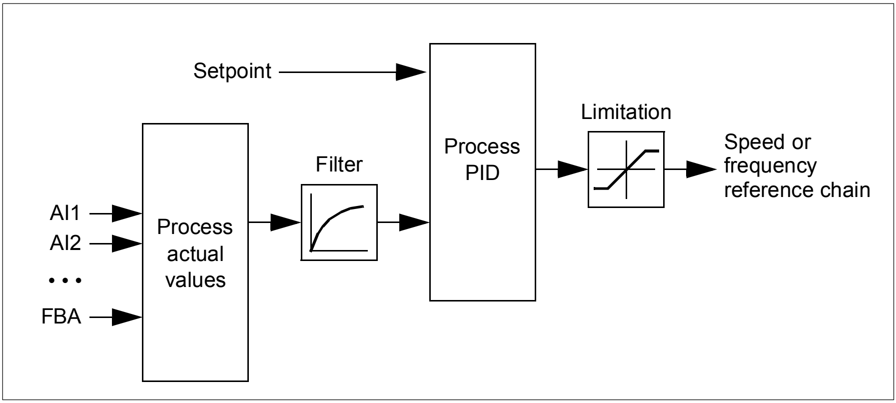
Default configurations are predefined I/O configurations. See chapter *Default configuration* (page *33*).

Process PID control (PID/Loop controller)

There are two built-in process PID controllers (PID set 1 and PID set 2) in the drive. The controller can be used to control process variables such as pressure or flow in the pipe or fluid level in the container.

In process PID control, a process reference (setpoint) is connected to the drive instead of a speed reference. An actual value (process feedback) is also brought back to the drive. The process PID control adjusts the drive speed in order to keep the measured process quantity (actual value) at the desired level (setpoint). This means that user does not need to set a frequency/speed reference to the drive but the drive adjust its operation according to the process PID.

The simplified block diagram below illustrates the process PID control. For more detailed block diagrams, see pages *413* and *414*.



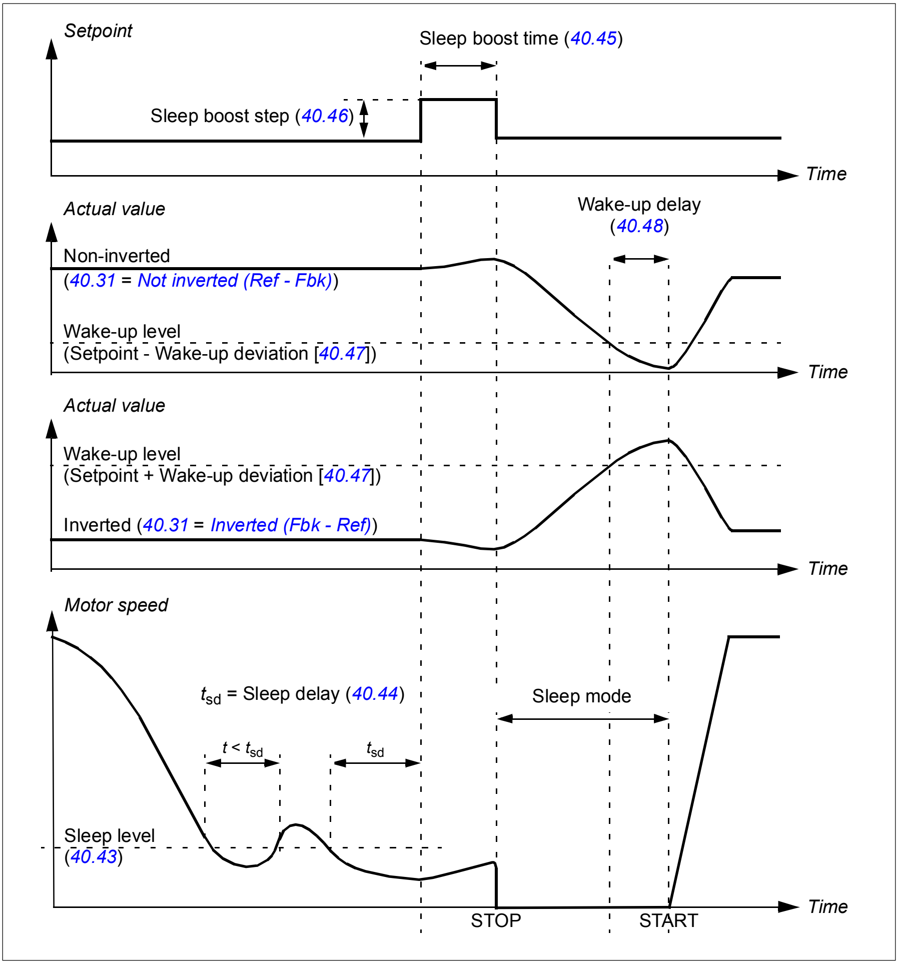
The drive contains two complete sets of process PID controller settings that can be alternated whenever necessary; see parameter *40.57 PID set1/set2 selection*.

Sleep and boost functions for process PID control

The sleep function is suitable for PID control applications where the consumption varies, such as clean water pumping systems. When used, it stops the pump completely during low demand, instead of running the pump slowly below its efficient operating range. The following example visualizes the operation of the function.

Example: The drive controls a pressure boost pump. The water consumption falls at night. As a consequence, the process PID controller decreases the motor speed. However, due to natural losses in the pipes and the low efficiency of the centrifugal pump at low speeds, the motor would never stop rotating. The sleep function detects the slow rotation and stops the unnecessary pumping after the sleep delay has passed. The drive shifts into sleep mode, still monitoring the pressure. The pumping resumes when the pressure falls under the predefined minimum level and the wake-up delay has passed.

The user can extend the PID sleep time by the boost functionality. The boost functionality increases the process setpoint for a predetermined time before the drive enters the sleep mode.



Tracking

In tracking mode, the PID block output is set directly to the value of parameter *40.50* (or *41.50*) *Set 1 tracking ref selection*. The internal I term of the PID controller is set so that no transient is allowed to pass on to the output, so when the tracking mode is left, normal process control operation can be resumed without a significant bump.

Settings

- Parameter groups *40 Process PID set 1* (page *213*) and *41 Process PID set 2* (page *229*).

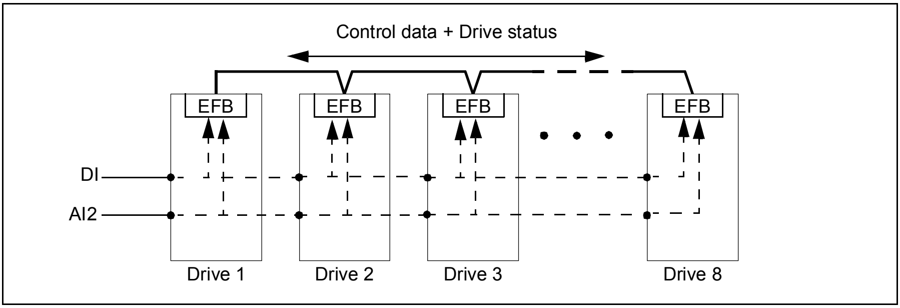
Intelligent pump control (IPC)

The Intelligent pump control (IPC) system can be used to control the speed/frequency of multiple pumps in a pump system. Each pump is connected to a separate drive.

The IPC system supports redundancy, so that in case of a pump failure or a drive is disconnected for maintenance, the system still continues the operation with the remaining drives. The IPC system can be enabled with parameter *76.21 Multipump configuration*.

The IPC system at first increases the pump speed and if this speed is not sufficient, the system will start a new pump based on process demand. While starting a new pump, the speed of the already running pumps is reduced to allow smooth flow of liquid.

In an IPC system, the drives communicates through inverter-to-inverter link on embedded fieldbus. Each drive receives a start command through digital input DI and a process value through analog input AI2.



Starting the IPC system

The IPC system starts operation when the drive receives a start command from external control location EXT2 (parameter *20.08 Ext2 in1 source*). The start command indicates that the pump is available to the IPC system. However, the system sends the actual start command to the follower drives based on the required output of the system.

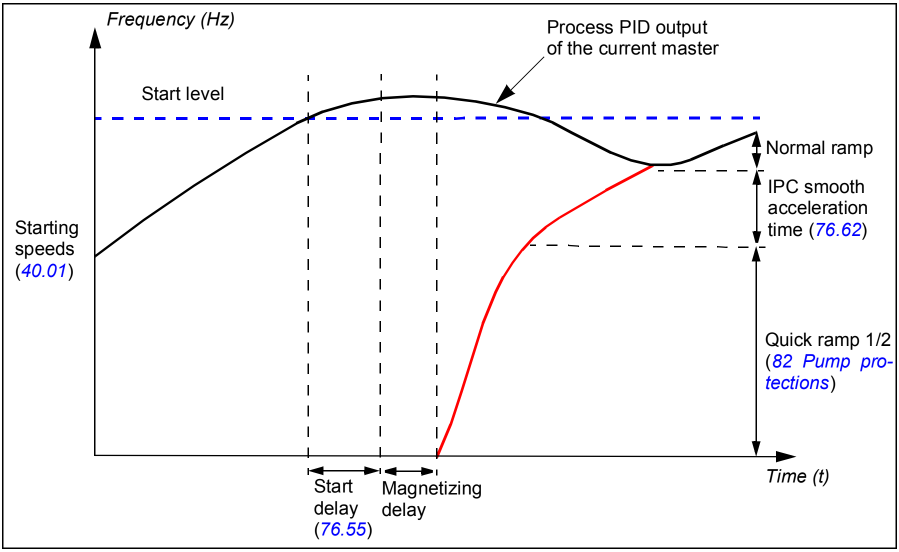
If all drives in the system receive a start command simultaneously, then the drive with the lowest node number will start as the master drive. See parameter *76.22 Multipump node number* (page *257*).

For optimal energy operation, you can combine the PID sleep function with IPC system. For information on PID sleep function, see *Sleep and boost functions for process PID control* (page *57*).

Note: The IPC system is not active on external control location EXT1.

Smooth pump transitions

The figure below shows the smooth pump transitions with different ramp times.



The timing diagram of Smooth pump transitions shows the pump starting steps. In this case, the process PID output of the current master has exceeded the start level (*76.30*...*76.36*).

1. The IPC system starts a new pump after the start delay time (*76.55 Start delay*) is elapsed.
2. After the motor is magnetized and starts rotating, the new pump accelerates using quick ramp 1/2 to obtain productive zone.

   Note: This operation is effective only when quick ramp mode is enabled with parameter *82.01 Quick ramp mode* (page *274*).
3. The new pump then accelerates along IPC smooth ramp time defined with parameter *76.62 IPC smooth acceleration time*.
4. When a new pump is accelerating, the other pumps decelerate to maintain the stable output of the system, shown as Normal ramp in the diagram.
5. After the new pump reaches the speed of the current master pump, the new pump becomes the new master.
6. The new master and all the remaining pumps will start to follow the master drive speed defined by the process PID of the master drive.

Pump priorities

The pumps are prioritized based on energy efficiency and process demand.

High – more energy efficient pumps

Normal – less energy efficient pumps

Low – pumps which do not run unless process demands

You can select the pump priority with parameter *76.77 Pump priority*. The IPC system prefers high priority pumps over normal and low priority pumps. You can limit the time with parameter *76.76 Max stationary time*, so that even the low priority pumps are often run to keep them in operational condition.

Automatic parameter synchronization

Automatic parameter synchronization feature reduces the number of configuration steps in the IPC system.

The synchronized parameter groups are selected with parameter *76.102 IPC synchronization settings*. In addition, there are some drive dependent parameters that are not synchronized, like *76.22 Multipump node number*. To enable synchronization of a parameter group between two or more drives, the group synchronization must be enabled in all the drives.

The synchronization process uses two mechanisms to make sure that the parameter groups are synchronized. When a parameter value is changed in a drive, it broadcasts the changed parameter value to inverter-to-inverter (I2I) link. From the inverter-to-inverter (I2I) link, all the drives that have the synchronization enabled, reads the value and set their own parameter value.

In addition, the drive periodically broadcast the group *CRC* to the inverter-to-inverter (I2I) link along with the time stamp of the last edit time of the group. From this information, the drives can conclude if the group is synchronized and which drive has the latest parameter values. If there is a *CRC* mismatch, the drives request the parameter values from the parameter group and from the drive with the latest values.

Settings

Menu - **Primary settings** - **Multipump Control (IPC)**

Parameter groups *01 Actual values* (page *103*), *40 Process PID set 1* (page *213*), *76 Multipump configuration* (page *256*), *77 Multipump maintenance and monitoring* (page *267*) and *82 Pump protections* (page *274*).

Single pump control (PFC)

The Single pump control (PFC) is used in pump systems consisting of one drive and multiple pumps. The drive controls the speed of one of the pumps and in addition connects (and disconnects) the other pumps directly to the supply network through contactors.

The PFC control logic switches auxiliary motors on and off as required by the capacity changes of the process. In a pump application for example, the drive controls the motor of the first pump, varying the motor speed to control the output of the pump. This pump is the speed regulated pump. When the demand (represented by the process PID reference) exceeds the capacity of the first pump (a user defined speed/frequency limit), the PFC logic automatically starts an auxiliary pump. The logic also reduces the speed of the first pump, controlled by the drive, to account for the addition to the total system output by the auxiliary pump. Then, as before, the PID controller adjusts the speed/frequency of the first pump in such a way that the system output meets the process needs. If the demand continues to increase, the PFC logic adds further auxiliary pumps, in a similar manner as just described.

As the demand drops, making the speed of the first pump fall below a minimum limit (user defined as a speed/frequency limit), the PFC logic automatically stops an auxiliary pump. The PFC logic also increases the speed of the drive controlled pump to account for the missing output of the stopped auxiliary pump.

The Single pump control (PFC) is supported in external control location EXT2 only.

Autochange

Automatic rotation of the start order, or Autochange functionality, serves two main purposes in many PFC type setups. One is to keep the run times of the pumps equal over time to even their wear. The other is to prevent any pump from standing still for too long, which would clog up the unit. In some cases it is desirable to rotate the start order only when all units are stopped, for example to minimize the impact on the process.

The Autochange can also be triggered by the Timed function (see page 72).

Interlock

There is an option to define interlock signals for each motor in the PFC system. When the interlock signal of a motor is Available, the motor participates in the PFC starting sequence. If the signal is Interlocked, the motor is excluded. This feature can be used for informing the PFC logic that a motor is not available (for example due to maintenance or manual direct-on-line starting).

Soft pump control (SPFC)

The Soft pump control (SPFC) logic is a variant of the PFC logic for pump and alternation applications where lower pressure peaks are desirable when a new auxiliary motor is to be started. The SPFC logic is an easy way to implement soft starting of direct on line (auxiliary) motors.

The main difference between traditional PFC and SPFC logic is how the SPFC logic connects auxiliary motors on-line. When the criteria for starting a new motor is fulfilled (see above) the SPFC logic connects the drive controlled motor to the supply network in a flying start, that is, while the motor is still coasting. The drive then connects to the next pump unit to be started and starts controlling the speed of that one, while the previously controlled unit now is connected directly on line through a contactor. Further (auxiliary) motors are started in a similar manner. The motor stopping routine is the same as for the normal PFC routine.

In some cases SPFC makes it possible to soften the start-up current while connecting auxiliary motors on-line. Lower pressure peaks on the pipelines and pumps may be achieved as a result.

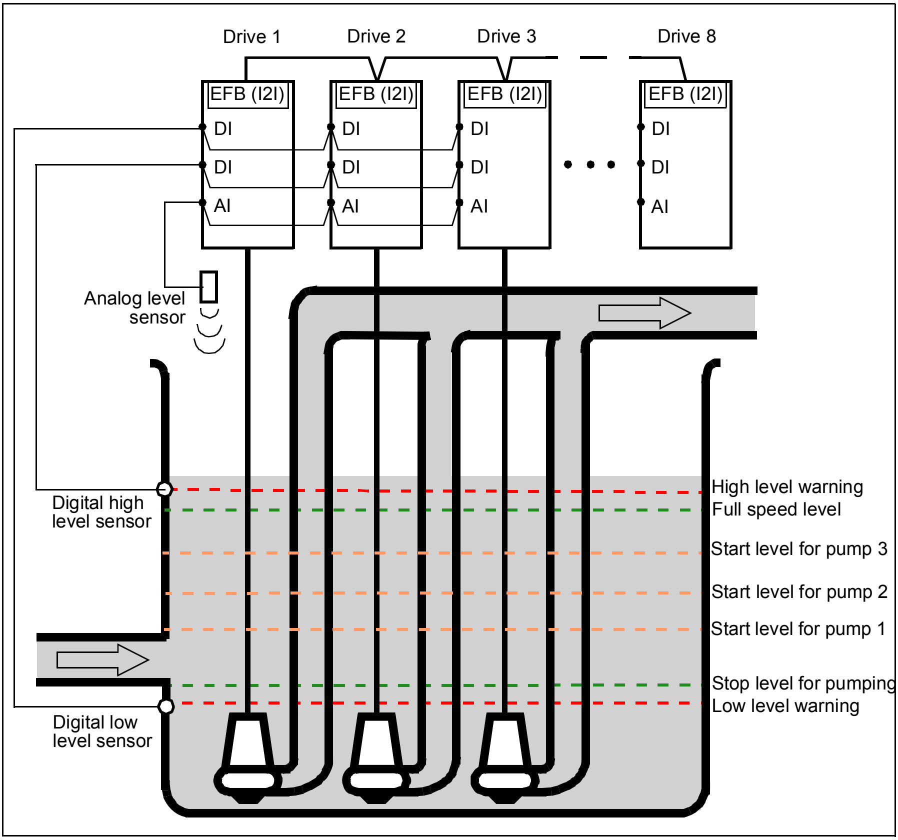
Settings

- Parameter group *10 Standard DI, RO* (page *117*)
- Parameter group *40 Process PID set 1* (page *213*)
- Parameter groups *76 Multipump configuration* (page *256*) and *77 Multipump maintenance and monitoring* (page *267*).

Level control

The Level control function can be used to control the water level in tank filling or emptying application. The function supports up to eight pumps. The function can be enabled by setting parameter *76.21 Multipump configuration* to *Level control - Emptying* or *Level control - Filling*.

The figure below represents a waste water pumping system in emptying mode. The system has varying water level and the pumps will start and stop based on measured level.



The first pump (master) will start when the actual level is above the start point 1. More pumps will start and stop based on the rising (emptying) or falling (filling) water levels of individual pumps. In case of a pump failure or if drive is disconnected for maintenance, the system still continues operation with the remaining pumps and drives.

The digital high level and low level sensors can be used to generate a warning or fault when the water level in the container raises or falls to the abnormal operation area. The analog level sensor connected to an analog input measures the water level.

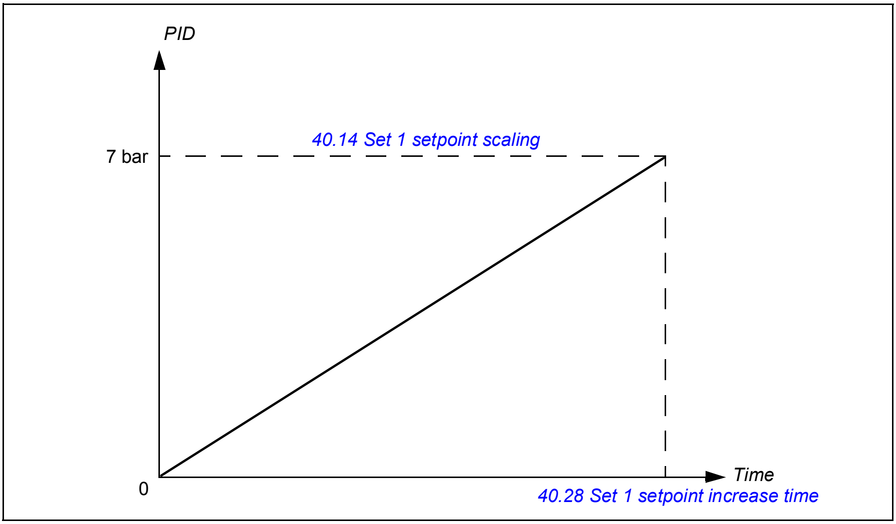
Settings

Parameter group *76 Multipump configuration* (page *256*).

Soft pipe fill

The Soft pipe fill function can be used to fill a empty pipe softly. The function can avoid sudden charge of water and rise in pressure in a closed valve or a nozzle at the end of the pump system.

The figure below illustrates the operation of the Soft pipe fill function.



If the pumping system is leaking or is damaged then the setpoint will not reach in time. To detect such a condition, you can enable soft pipe fill supervision to generate a warning or a fault. The time is calculated with the last reference change in parameter *40.03 Process PID setpoint actual*.

Settings

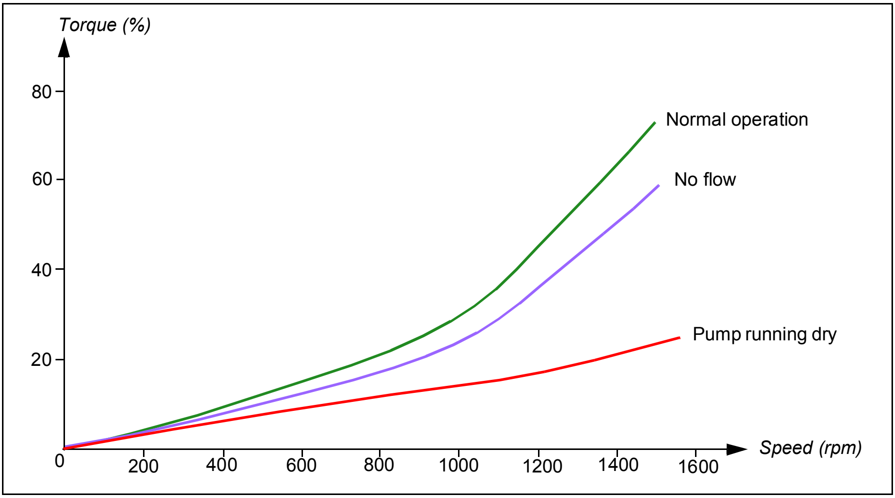
Menu - **Primary settings** - **Pump features** - **Soft pipe fill**

Parameter groups *40 Process PID set 1* (page *213*) and *82 Pump protections* (page *274*).

Dry run protection

The Dry run protection function can be used to protect the pump from getting dry.

The figure below illustrates the operation of dry run protection function.



The dry run can be detected using the underload curve, low level mechanical switch and pressure sensor.

- **Underload curve** - Detects the pump from getting dry and generates a warning or fault.
- **Low/high level mechanical switch** - Indicates the water level in the pump system through a digital input and generates a warning or fault.
- **Pressure sensor** - Connected to Supervision 1...3 through an analog input. The output of supervision indicates the pump inlet getting dry and generates a warning or fault.

Settings

Menu -> **Primary settings** -> **Pump features** -> **Dry pump protection**

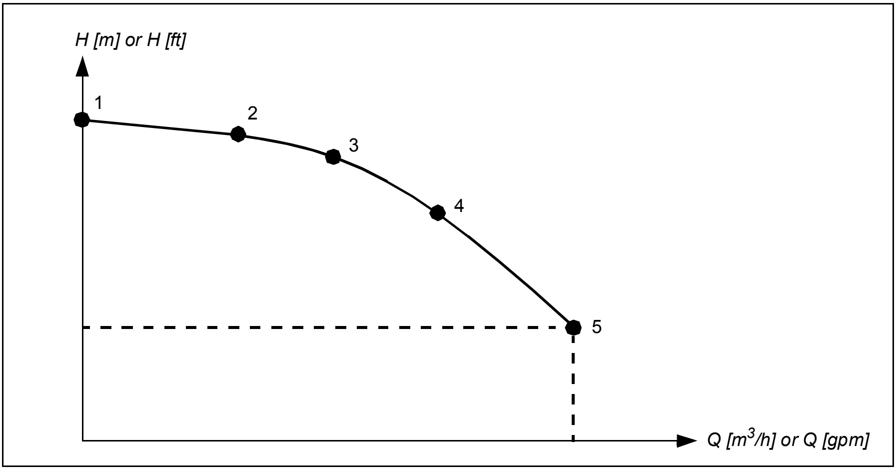
Parameter group *82 Pump protections* (page *274*).

Flow calculation

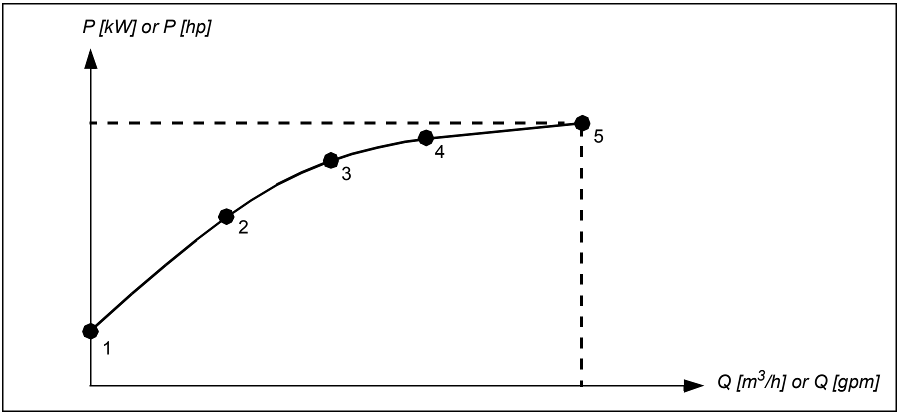
The flow calculation function provides a reasonably accurate (typically ±3…6%) calculation of the flow without the installation of a separate flow meter. The flow is calculated on the basis of parameter data such as pump inlet and outlet diameters, pressure at pump inlet and outlet, height difference of pressure sensors, and pump characteristics.

The user can either define a PQ (power/flow) or HQ (head/flow) performance curve that is used as the basis for the calculation. It is also possible to use differential pressure based flow feedback.

The figure below shows the HQ performance curve of the pump for the flow calculation function.



The figure below shows the PQ performance curve of the pump for the flow calculation function.



Notes:

- The flow calculation function cannot be used for invoicing purposes.
- The flow calculation function cannot be used outside the normal operating range of the pump.
- Head points in HQ curve are expected to be in descending order (H1 > H2 > H3 > H4 > H5).
- Power points in PQ curve are expected to be in ascending order (P1 < P2 < P3 < P4 < P5).

Settings

Parameter group *80 Flow calculation and protection* (page *269*) defines the HQ/PQ or differential pressure based flow feedback and *81 Sensor settings* (page *273*) defines pump inlet and outlet selection for HQ calculation.

Pump inlet and outlet protection

The Pump inlet and outlet protection function monitors pump inlet and outlet pressure and takes the user defined actions in case the pressure is outside the normal range.

The inlet and outlet minimum pressure protection function can first generate a warning when the pump pressure is below minimum pressure warning level for pressure check delay time. If the pressure continues to fall below the minimum pressure fault level, a fault is generated.

The outlet maximum pressure protection function can first generate a warning when the pump outlet pressure is above maximum pressure warning level for pressure check delay time. If the pressure continues to rise above the maximum pressure fault level, a fault is generated.

Settings

Menu -> **Primary settings** -> **Pump features** -> **Pressure protection**

Parameter group *81 Sensor settings* (page *273*) and *82 Pump protections* (page *274*).

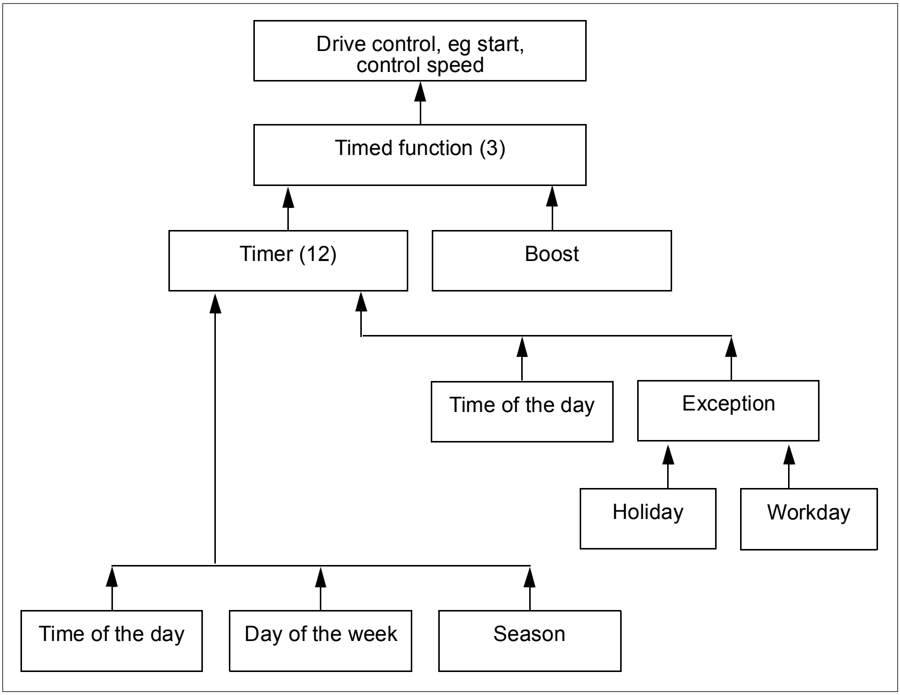
Timed functions

The base entity of Timed functions is called a Timer. A Timer can be active based on time of the day, day of the week and season of the year. In addition to these time related parameters, the Timer activation can be influenced by so called exceptional days (configurable as holiday or workday). For example, 25.12. (Dec 25th) can be defined as holiday in many countries. A Timer can be set to be active or inactive during the exceptional days.

Several Timers can be connected to a Timed function with the OR function. Thus if any of the Timers connected to a Timed function is active, the Timed function is also active. Timed function is then in turn controlling normal drive functions like starting the drive, choosing the right speed or right setpoint for the PID loop controller.

In many cases where a fan or pump is controlled with a Timed function, it is often required that there is a possibility to override the time program for a short while. The overriding functionality is called Boost. The Boost is directly affecting selected Timed function(s) and switches it (them) on for a predefined time. The Boost mode is typically activated through a digital input and its operation time is set in parameters.

A diagram illustrating the relations of the Timed functions entities is shown below.



Settings

Parameter group *34 Timed functions* (page *191*).

Motor potentiometer

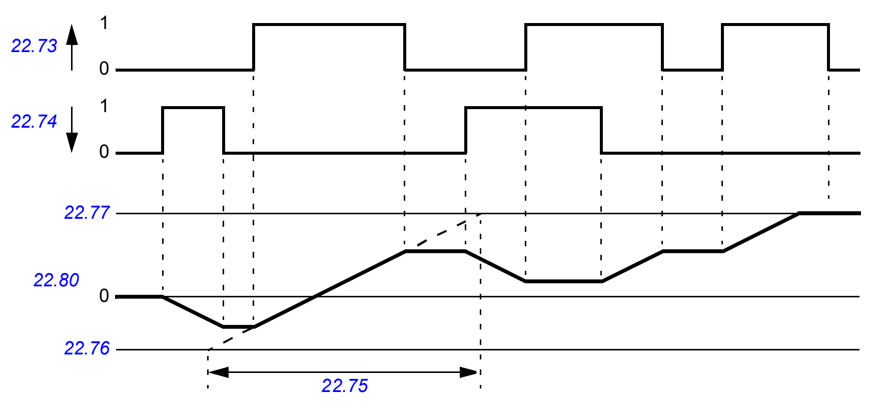
The motor potentiometer is, in effect, a counter whose value can be adjusted up and down using two digital signals selected by parameters *22.73 Motor potentiometer up source* and *22.74 Motor potentiometer down source*.

When enabled by *22.71 Motor potentiometer function*, the motor potentiometer assumes the value set by *22.72 Motor potentiometer initial value*. Depending on the mode selected in *22.71*, the motor potentiometer value is either retained or reset over a power cycle.

The change rate is defined in *22.75 Motor potentiometer ramp time* as the time it would take for the value to change from the minimum (*22.76 Motor potentiometer min value*) to the maximum (*22.77 Motor potentiometer max value*) or vice versa. If the up and down signals are simultaneously on, the motor potentiometer value does not change.

The output of the function is shown by *22.80 Motor potentiometer ref act*, which can directly be set as the reference source in the main selector parameters, or used as an input by other source selector parameters, both in scalar and vector control.

The following example shows the behavior of the motor potentiometer value.



Settings

Parameters *22.71*…*22.80* (page *160*).

Motor control

Motor types

The drive supports asynchronous AC induction, permanent magnet (PM) and synchronous reluctance motors (SynRM).

Motor identification

The performance of vector control is based on an accurate motor model determined during the motor start-up.

A motor Identification magnetization is automatically performed the first time the start command is given. During this first start-up, the motor is magnetized at zero speed for several seconds and the motor and motor cable resistance are measured to allow the motor model to be created. This identification method is suitable for most applications.

In demanding applications a separate Identification run (ID run) can be performed.

Settings

99.13 ID run requested (page *295*).

Scalar motor control

Scalar motor control is the default motor control method. In scalar control mode, the drive is controlled with a frequency reference. However, the excellent performance of vector control is not achieved in scalar control.

It is recommended to activate scalar motor control mode in the following situations:

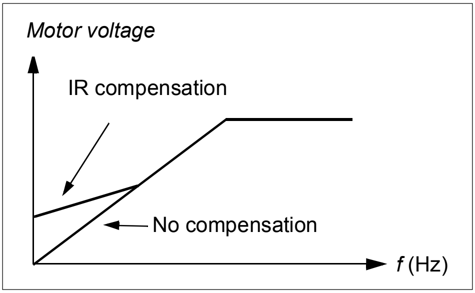
- If the exact nominal motor values are not available or the drive needs to run different motor after the commissioning phase
- If a short commissioning time is needed or no ID run is wanted
- In multimotor systems: 1) if the load is not equally shared between the motors, 2) if the motors are of different sizes, or 3) if the motors are going to be changed after motor identification (ID run)
- If the nominal current of the motor is less than 1/6 of the nominal output current of the drive
- If the drive is used without a motor connected (for example, for test purposes)
- If the drive runs a medium-voltage motor through a step-up transformer.
- If the drive is equipped with a sine filter.

In scalar control, some standard features are not available.

See also section *Operating modes of the drive* (page *40*).

IR compensation for scalar motor control

IR compensation (also known as voltage boost) is available only when the motor control mode is scalar. When IR compensation is activated, the drive gives an extra voltage boost to the motor at low speeds. IR compensation is useful in applications, such as positive displacement pumps, that require a high break-away torque.



In vector control, no IR compensation is possible or needed as it is applied automatically.

Settings

- **Menu - Primary settings - Motor - IR compensation**
- Parameters *97.13 IR compensation* (page *290*) and *99.04 Motor control mode* (page *293*)
- Parameter group *28 Frequency reference chain* (page *167*).

Vector control

Vector control is the motor control mode that is intended for applications where high control accuracy is needed. It offers better control over whole speed range, in particular in applications where slow speed with high torque is needed. It requires an identification run at startup. Vector control cannot be used in all applications, eg when sine filters are being used or there are multiple motors connected to single drive.

The switching of the output semiconductors is controlled to achieve the required stator flux and motor torque. The reference value for the torque controller comes from the speed controller.

Stator flux is calculated by integrating the motor voltage in vector space. Rotor flux can be calculated from stator flux and the motor model.Motor torque is produced by controlling current 90 degrees from the rotor flux.By utilizing the identified motor model, the rotor flux estimate is improved. Actual motor shaft speed is not needed for the motor control.

See also section *DC voltage control* (page *80*).

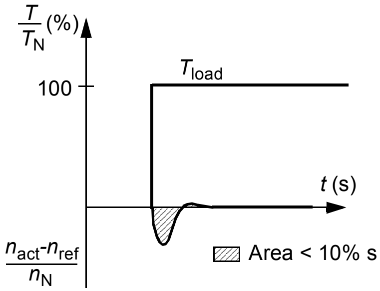
Settings

- **Menu - Primary settings - Motor - Control mode**
- Parameters *99.04 Motor control mode* (page *293*) and *99.13 ID run requested* (page *295*).

Speed control performance figures

The table below shows typical performance figures for speed control.

Speed control	**Performance**
Static accuracy	20% of motor nominal slip
Dynamic accuracy	< 10% s with 100% torque step (with default speed controller tuning)
Dynamic accuracy with tuned speed controller	< 2% s with 100% torque step

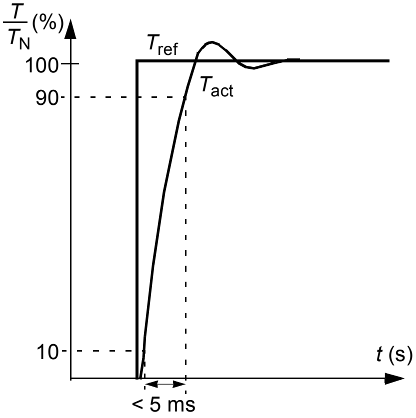


T_N = rated motor torque
n_N = rated motor speed
n_{act} = actual speed
n_{ref} = speed reference

Torque control performance figures

The drive can perform precise torque control in vector control mode without any speed feedback from the motor shaft. The table below shows typical performance figures for vector control.

Torque control	**Performance**
Non-linearity	± 5% with nominal torque (± 20% at the most demanding operating point)
Torque step rise time	< 10 ms with nominal torque



T_N = rated motor torque
T_{ref} = torque reference
T_{act} = actual torque

Power loss ride-through

See section *Undervoltage control (power loss ride-through)* on page *80*.

U/f ratio

The *U*/f function is only available in scalar motor control mode, which uses frequency control.

The function has two modes: linear and squared.

In linear mode, the ratio of voltage to frequency is constant below the field weakening point. This is used in constant torque applications where it may be necessary to produce torque at or near the rated torque of the motor throughout the frequency range.

In squared mode (default), the ratio of the voltage to frequency increases as the square of the frequency below the field weakening point. This is typically used in centrifugal pump applications. For these applications, the torque required follows the square relationship with frequency. Therefore, if the voltage is varied using the square relationship, the motor operates at improved efficiency and lower noise levels in these applications. Thus using squared mode saves energy.

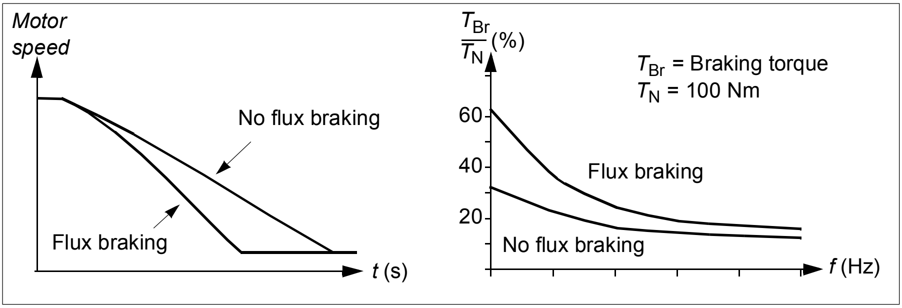
The *U*/f function cannot be used with energy optimization; if parameter *45.11 Energy optimizer* is set to *Enable*, parameter *97.20 U/F ratio* is ignored.

Settings

- **Menu - Primary settings - Motor - U/f ratio**
- Parameter *97.20 U/F ratio* (page *290*).

Flux braking

The drive can provide greater deceleration by raising the level of magnetization in the motor. By increasing the motor flux, the energy generated by the motor during braking can be converted to motor thermal energy.



The drive monitors the motor status continuously, also during flux braking. Therefore, flux braking can be used both for stopping the motor and for changing the speed. The other benefits of flux braking are:

- The braking starts immediately after a stop command is given. The function does not need to wait for the flux reduction before it can start the braking.
- The cooling of the induction motor is efficient. The stator current of the motor increases during flux braking, not the rotor current. The stator cools much more efficiently than the rotor.
- Flux braking can be used with induction motors and permanent magnet synchronous motors.

Two braking power levels are available:

- Moderate braking provides faster deceleration compared to a situation where flux braking is disabled. The flux level of the motor is limited to prevent excessive heating of the motor.
- Full braking exploits almost all available current to convert the mechanical braking energy to motor thermal energy. Braking time is shorter compared to moderate braking. In cyclic use, motor heating may be significant.

⚠ **WARNING:** The motor needs to be rated to absorb the thermal energy generated by flux braking.

Settings

- **Menu - Primary settings - Motor - Flux braking**
- Parameter *97.05 Flux braking* (page *288*).

DC magnetization

The drive has different magnetization functions for different phases of motor start/rotation/stop: pre-magnetization, DC hold, post-magnetization and pre-heating (motor heating).

Pre-magnetization

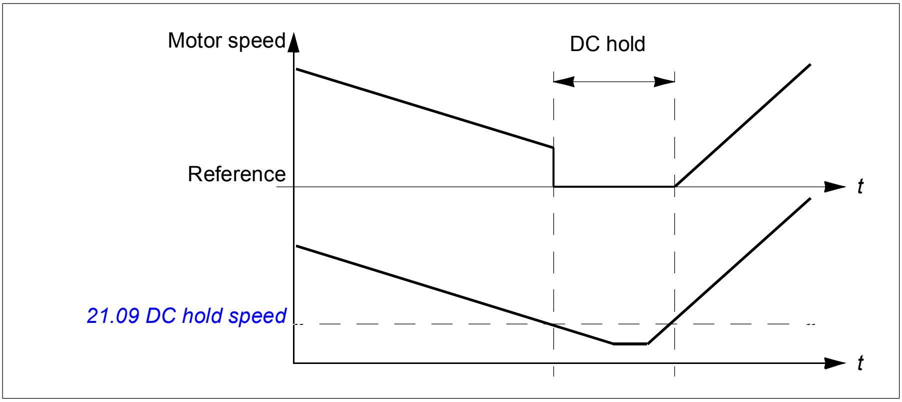
Pre-magnetization refers to DC magnetization of the motor before start. Depending on the selected start mode (*21.01 Start mode* or *21.19 Scalar start mode*), pre-magnetization can be applied to guarantee the highest possible breakaway torque, up to 200% of the nominal torque of the motor. By adjusting the pre-magnetization time (*21.02 Magnetization time*), it is possible to synchronize the motor start and, for example, the release of a mechanical brake.

Settings

Parameters *21.01 Start mode*, *21.19 Scalar start mode*, *21.02 Magnetization time*.

DC hold

The function makes it possible to lock the rotor at (near) zero speed in the middle of normal operation. DC hold is activated by parameter *21.08 DC current control*. When both the reference and motor speed drop below a certain level (parameter *21.09 DC hold speed*), the drive will stop generating sinusoidal current and start to inject DC into the motor. The current is set by parameter *21.10 DC current reference*. When the reference exceeds parameter *21.09 DC hold speed*, normal drive operation continues.



Settings

Parameters *21.08 DC current control* and *21.09 DC hold speed*.

Post-magnetization

The function keeps the motor magnetized for a certain period (parameter *21.11 Post magnetization time*) after stopping. This is to prevent the machinery from moving under load, for example before a mechanical brake can be applied. Post-magnetization is activated by parameter *21.08 DC current control*. The magnetization current is set by parameter *21.10 DC current reference*.

Note: Post-magnetization is only available when ramp stop is selected (see parameter *21.03 Stop mode*). Post-magnetization is only supported in vector control.

Settings

Parameters *21.03 Stop mode* (page *148*), *21.08 DC current control* and *21.11 Pre-heating input source*.

Pre-heating (Motor heating)

The pre-heating function keeps the motor warm and prevents condensation inside the motor by feeding it with DC current when the drive has been stopped. The heating can only be on when the drive is in the stopped state, and starting the drive stops the heating.

When pre-heating is activated and the stop command is given, pre-heating starts immediately if the drive is running below the zero speed limit (see bit 0 in parameter *06.19 Speed control status word*). If the drive is running above the zero speed limit, pre-heating is delayed by 60 seconds to prevent excessive current.

The function can be defined to be always active when the drive is stopped or it can be activated by a digital input, fieldbus, timed function or supervision function. For example, with the help of signal supervision function, the heating can be activated by a thermal measurement signal from the motor.

The pre-heating current fed to the motor can be defined as 0…30% of the nominal motor current.

Notes:

- In applications where the motor keeps rotating for a long time after the modulation is stopped, it is recommended to use ramp stop with pre-heating to prevent a sudden pull at the rotor when the pre-heating is activated.
- The heating function requires that the STO circuit is closed or not triggered open.
- The heating function requires that the drive is not faulted.
- Pre-heating uses DC hold to produce current.

Settings

- **Menu - Primary settings - Motor - Pre-heating**
- Parameters *21.14 Pre-heating input source* and *21.16 Pre-heating current* (page *151*).

Energy optimization

The function optimizes the motor flux so that total energy consumption and motor noise level are reduced when the drive operates below the nominal load. The total efficiency (motor and drive) can be improved by 1…20% depending on load torque and speed. Energy optimization is enabled by default.

Note: With permanent magnet and synchronous reluctance motors, energy optimization is always enabled.

Settings

- **Menu - Energy efficiency**
- Parameter *45.11 Energy optimizer* (page *233*).

Switching frequency

The drive has two switching frequencies: reference switching frequency and minimum switching frequency. The drive tries to keep the highest allowed switching frequency (= reference switching frequency) if thermally possible, and then adjusts dynamically between the reference and minimum switching frequencies depending on the drive temperature. When the drive reaches the minimum switching frequency (= lowest allowed switching frequency), it starts to limit output current as the heating up continues.

For derating, see chapter *Technical data*, section *Switching frequency derating* in the *Hardware manual* of the drive.

Example 1: If you need to fix the switching frequency to a certain value as with some external filters, set both the reference and the minimum switching frequency to this value and the drive will retain this switching frequency.

Example 2: If the reference switching frequency is set to 12 kHz and the minimum switching frequency is set to the smallest available value, the drive maintains the highest possible switching frequency to reduce motor noise and only when the drive heats it will decrease the switching frequency. This is useful, for example, in applications where low noise is necessary but higher noise can be tolerated when the full output current is needed.

Settings

Parameter *97.01 Switching frequency reference* and *97.02 Minimum switching frequency* (page *280*).

DC voltage control

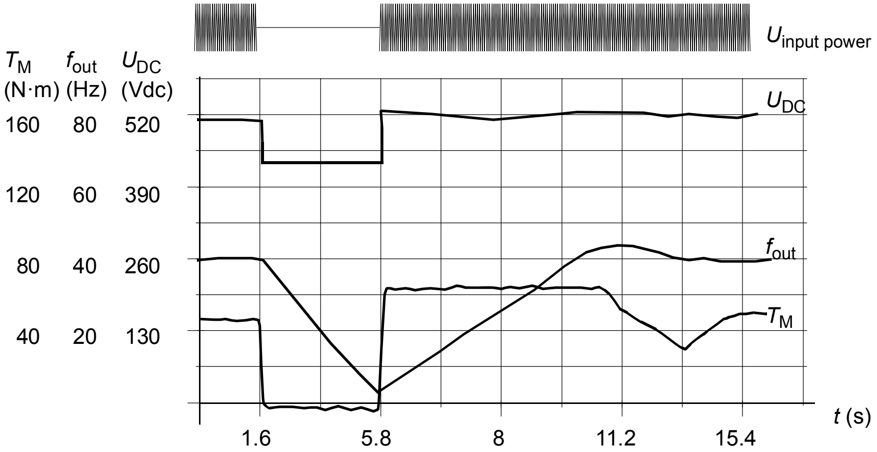
Overvoltage control

Overvoltage control of the intermediate DC link is typically needed when the motor is in generating mode. The motor can generate when it decelerates or when the load overhauls the motor shaft, causing the shaft to turn faster than the applied speed or frequency. To prevent the DC voltage from exceeding the overvoltage control limit, the overvoltage controller automatically decreases the generating torque when the limit is reached.

Undervoltage control (power loss ride-through)

If the incoming supply voltage is cut off, the drive will continue to operate by utilizing the kinetic energy of the rotating motor. The drive will be fully operational as long as the motor rotates and generates energy to the drive. The drive can continue operation after the break if the main contactor (if present) remained closed.

Note: Units equipped with a main contactor must be equipped with a hold circuit (e.g. UPS) to keep the contactor control circuit closed during a short supply break.



U_{DC} = Intermediate circuit voltage of the drive, f_{out} = Output frequency of the drive, T_M = Motor torque

Loss of supply voltage at nominal load (f_{out} = 40 Hz). The intermediate circuit DC voltage drops to the minimum limit. The controller keeps the voltage steady as long as the input power is switched off. The drive runs the motor in generator mode. The motor speed falls but the drive is operational as long as the motor has enough kinetic energy.

Implementing the undervoltage control (power loss ride-through)

Implement the undervoltage control function as follows:

- Check that the undervoltage control function of the drive is enabled with parameter *30.31 Undervoltage control*.
- Parameter *21.01 Start mode* must be set to *Automatic* (in vector mode) or parameter *21.19 Scalar start mode* to *Automatic* (in scalar mode) to make flying start (starting into a rotating motor) possible.

If the installation is equipped with a main contactor, prevent its tripping at the input power break. For example, use a time delay relay (hold) in the contactor control circuit.

⚠ **WARNING!** Make sure that the flying restart of the motor will not cause any danger. If you are in doubt, do not implement the undervoltage control function.

Automatic restart

It is possible to restart the drive automatically after a short (max. 10 seconds) power supply failure by using the Automatic restart function, provided that the drive is allowed to run for 10 seconds without the cooling fans operating.

When enabled, the function takes the following actions upon a supply failure to a successful restart:

- The undervoltage fault is suppressed (but a warning is generated).
- Modulation and cooling is stopped to conserve any remaining energy.
- DC circuit pre-charging is enabled.

If the DC voltage is restored before the expiration of the period defined by parameter *21.18 Auto restart time* and the start signal is still on, normal operation will continue. However, if the DC voltage remains too low at that point, the drive trips on a fault, *3220 DC link undervoltage*.

If parameter *21.34 Force auto restart* is set to *Enable*, the drive never trips on the undervoltage fault and the start signal is on forever. When he DC voltage is restored, the normal operation continues.

⚠ **WARNING!** Before you activate the function, make sure that no dangerous situations can occur. The function restarts the drive automatically and continues operation after a supply break.

Voltage control and trip limits

The control and trip limits of the intermediate DC voltage regulator are relative to the supply voltage as well as drive/inverter type. The DC voltage (U_{DC}) is approximately 1.35 times the line-to-line supply voltage, and is displayed by parameter *01.11 DC voltage*.

The following table shows the values of selected DC voltage levels. Note that the absolute voltages vary according to the drive/inverter type and AC supply voltage range.

	DC voltage level [V]	
See *95.01 Supply voltage*.	**AC supply voltage range [V] 380…415**	**AC supply voltage range [V] 440…480**
Overvoltage fault limit	840	840
Overvoltage control limit	780	780
Internal brake chopper start limit	780	780
Internal brake chopper stop limit	760	760
Overvoltage warning limit	745	745
Undervoltage warning limit	0.85×1.41×par *95.03* value 1) 0.85×1.41×380 = 455 2)	0.85×1.41×par *95.03* value 1) 0.85×1.41×440 = 527 2)
Undervoltage control limit	0.75×1.41×par *95.03* value 1) 0.75×1.41×380 = 402 2)	0.75×1.41×par *95.03* value 1) 0.75×1.41×440 = 465 2)
Charging relay closing limit	0.75×1.41×par *95.03* value 1) 0.75×1.41×380 = 402 2)	0.75×1.41×par *95.03* value 1) 0.75×1.41×440 = 465 2)
Charging relay opening limit	0.65×1.41×par *95.03* value 1) 0.65×1.41×380 = 348 2)	0.65×1.41 ×par *95.03* value 1) 0.65×1.41×440 = 403 2)
DC voltage at upper bound of supply voltage range (U_{DCmax})	560	648
DC voltage at lower bound of supply voltage range (U_{DCmin})	513	594
Charging activation/standby limit 3)	0.65×1.41×par *95.03* value 1) 0.65×1.41×380 = 348 2)	0.65×1.41×par *95.03* value 1) 0.65×1.41×440 = 403 2)
Undervoltage fault limit	0.45×1.41×par *95.03* value 1) 0.45×1.41×380 = 241 2)	0.45×1.41×par *95.03* value 1) 0.45×1.41×440 = 279 2)

1) If parameter *95.01 Supply voltage* is set to *Automatic / not selected* and *95.02 Adaptive voltage limits* is set to *Enable*, the value of parameter *95.03 Estimated AC supply voltage* is used,

2) otherwise the lower limit of the range selected with parameter *95.01 Supply voltage* is used.

3) When standby is activated, drive modulation is stopped, the fan is stopped and the pre-charge circuit is activated. If the voltage exceeds this level again, the drive has to complete charging before it will automatically continue operation.

Settings

Parameters *01.11 DC voltage* (page *103*), *30.30 Overvoltage control* (page *177*), *30.31 Undervoltage control* (page *177*), *95.01 Supply voltage* (page *280*) and *95.02 Adaptive voltage limits* (page *280*).

Safety and protections

Fixed/Standard protections

Overcurrent

If the output current exceeds the internal overcurrent limit, the IGBTs are shut down immediately to protect the drive.

DC overvoltage

See section *Overvoltage control* on page *80*.

DC undervoltage

See section *Undervoltage control (power loss ride-through)* on page *80*.

Drive temperature

If the temperature rises high enough, the drive first starts to limit the switching frequency and then the current to protect itself. If it is still keeps heating up, for example because of a fan failure, an overtemperature fault is generated.

Short circuit

In case of a short circuit, the IGBTs are shut down immediately to protect the drive.

Emergency stop

The emergency stop signal is connected to the input selected by parameter *21.05 Emergency stop source*. An emergency stop can also be generated through fieldbus (parameter *06.01 Main control word*, bits 0…2).

The mode of the emergency stop is selected by parameter *21.04 Emergency stop mode*. The following modes are available:

- Off1: Stop along the standard deceleration ramp defined for the particular reference type in use
- Off2: Stop by coasting
- Off3: Stop by the emergency stop ramp defined by parameter *23.23 Emergency stop time*.
- Stop torque.

With Off1 or Off3 emergency stop modes, the ramp-down of the motor speed can be supervised by parameters *31.32 Emergency ramp supervision* and *31.33 Emergency ramp supervision delay*.

Notes:

- The installer of the equipment is responsible for installing the emergency stop devices and all additional devices needed for the emergency stop function to fulfill the required emergency stop categories. For more information, contact your local ABB representative.
- After an emergency stop signal is detected, the emergency stop function cannot be canceled even though the signal is canceled.
- If the minimum (or maximum) torque limit is set to 0%, the emergency stop function may not be able to stop the drive.

Settings

- Parameters *21.04 Emergency stop mode* (page *149*), *21.05 Emergency stop source* (page *149*), *23.23 Emergency stop time* (page *163*), *31.32 Emergency ramp supervision* (page *183*) and *31.33 Emergency ramp supervision delay* (page *184*).

Motor thermal protection

The control program features two separate motor temperature monitoring functions. The temperature data sources and warning/trip limits can be set up independently for each function.

The motor temperature can be monitored using

- the motor thermal protection model (estimated temperature derived internally inside the drive), or
- sensors installed in the windings. This will result in a more accurate motor model.

Motor thermal protection model

The drive calculates the temperature of the motor on the basis of the following assumptions:

1. When power is applied to the drive for the first time, the motor is assumed to be at ambient temperature (defined by parameter *35.50 Motor ambient temperature*). After this, when power is applied to the drive, the motor is assumed to be at the estimated temperature.
2. Motor temperature is calculated using the user-adjustable motor thermal time and motor load curve. The load curve should be adjusted in case the ambient temperature exceeds 30 °C.

Note: The motor thermal model can be used when only one motor is connected to the inverter.

Insulation

WARNING! IEC 60664 requires double or reinforced insulation between live parts and the surface of accessible parts of electrical equipment which are either non-conductive or conductive but not connected to the protective earth.

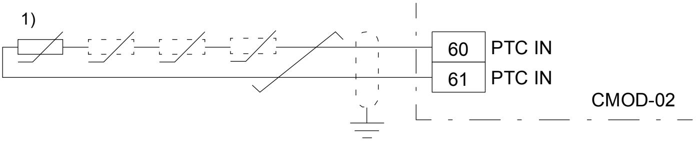
To fulfil this requirement, connect a thermistor to the drive's control terminals using any of these alternatives:

- Separate the thermistor from live parts of the motor with double reinforced insulation.
- Protect all circuits connected to the drive's digital and analog inputs. Protect against contact, and insulate from other low voltage circuits with basic insulation (rated for the same voltage level as the drive's main circuit).
- Use an external thermistor relay. The relay insulation must be rated for the same voltage level as the drive's main circuit.

When CMOD-02 multifunction module is used, it provides sufficient insulation.

Temperature monitoring using PTC sensors

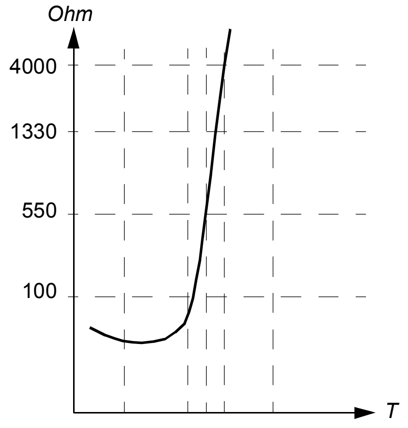
PTC sensors are connected through a CMOD-02 multifunction module (see chapter *Optional I/O extension modules*, section *CMOD-02 multifunction extension module (external 24 V AC/DC and isolated PTC interface)* in the *Hardware manual* of the drive).



[1] One or 3…6 PTC thermistors connected in series.

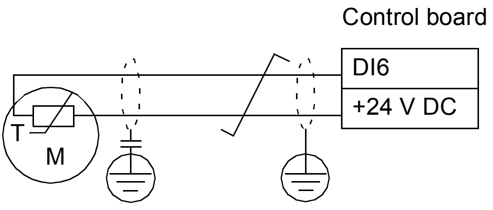
The resistance of the PTC sensor increases when its temperature rises. The increasing resistance of the sensor decreases the voltage at the input, and eventually its state switches from 1 to 0, indicating overtemperature.

The figure below shows typical PTC sensor resistance values as a function of temperature.



One isolated PTC sensor can also be connected directly to digital input DI6. At the motor end, the cable shield should be earthed through a capacitor. If this is not possible, leave the shield unconnected.

See section *Insulation* on page *85*.



Temperature monitoring using Pt100 sensors

1…3 Pt100 sensors can be connected in series to an analog input and an analog output.

The analog output feeds a constant excitation current of 9.1 mA through the sensor. The sensor resistance increases as the motor temperature rises, as does the voltage over the sensor. The temperature measurement function reads the voltage through the analog input and converts it into degrees Celsius.

It is possible to adjust the motor temperature supervision limits and select how the drive reacts when overtemperature is detected.

See section *Insulation* on page *85*.

For the wiring of the sensor, see chapter *Electrical installation*, section *AI1 and AI2 as Pt100, Pt1000, Ni1000, KTY83 and KTY84 sensor inputs (X1)* in the *Hardware manual* of the drive.

Temperature monitoring using Pt1000 sensors

1…3 Pt1000 sensors can be connected in series to an analog input and an analog output.

The analog output feeds a constant excitation current of 0.1 mA through the sensor. The sensor resistance increases as the motor temperature rises, as does the voltage over the sensor. The temperature measurement function reads the voltage through the analog input and converts it into degrees Celsius.

See section *Insulation* on page *85*.

For the wiring of the sensor, see chapter *Electrical installation*, *AI1 and AI2 as Pt100, Pt1000, Ni1000, KTY83 and KTY84 sensor inputs (X1)* in the *Hardware manual* of the rive.

Temperature monitoring using Ni1000 sensors

One Ni1000 sensor can be connected to an analog input and an analog output on the control unit.

The analog output feeds a constant excitation current of 9.1 mA through the sensor. The sensor resistance increases as the motor temperature rises, as does the voltage over the sensor. The temperature measurement function reads the voltage through the analog input and converts it into degrees Celsius.

See section *Insulation* on page *85*.

For the wiring of the sensor, see chapter *Electrical installation*, *AI1 and AI2 as Pt100, Pt1000, Ni1000, KTY83 and KTY84 sensor inputs (X1)* in the *Hardware manual* of the drive.

Temperature monitoring using KTY84 sensors

One KTY84 sensor can be connected to an analog input and an analog output on the control unit.

The analog output feeds a constant excitation current of 2.0 mA through the sensor. The sensor resistance increases as the motor temperature rises, as does the voltage over the sensor. The temperature measurement function reads the voltage through the analog input and converts it into degrees Celsius.

The figure and table on page *88* show typical KTY84 sensor resistance values as a function of the motor operating temperature.

See section *Insulation* on page *85*.

For the wiring of the sensor, see chapter *Electrical installation*, *AI1 and AI2 as Pt100, Pt1000, Ni1000, KTY83 and KTY84 sensor inputs (X1)* in the *Hardware manual* of the drive.

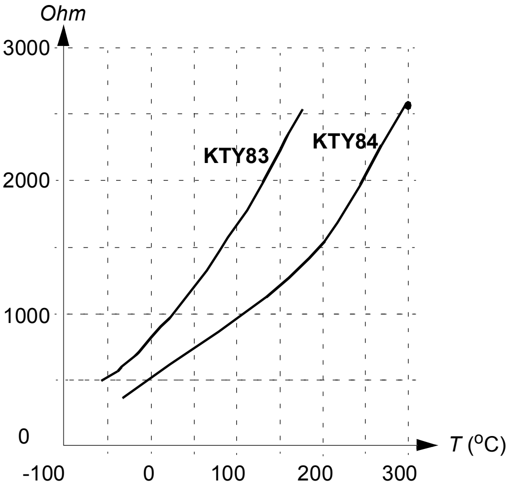
Temperature monitoring using KTY83 sensors

One KTY83 sensor can be connected to an analog input and an analog output on the control unit.

The analog output feeds a constant excitation current of 1.0 mA through the sensor. The sensor resistance increases as the motor temperature rises, as does the voltage over the sensor. The temperature measurement function reads the voltage through the analog input and converts it into degrees Celsius.

The figure and table below show typical KTY83 sensor resistance values as a function of the motor operating temperature.

	Scaling	
	KTY84	**KTY83**
°C	**ohm**	**ohm**
90	936	1569
110	1063	1774
130	1197	1993
150	1340	2225



It is possible to adjust the motor temperature supervision limits and select how the drive reacts when overtemperature is detected.

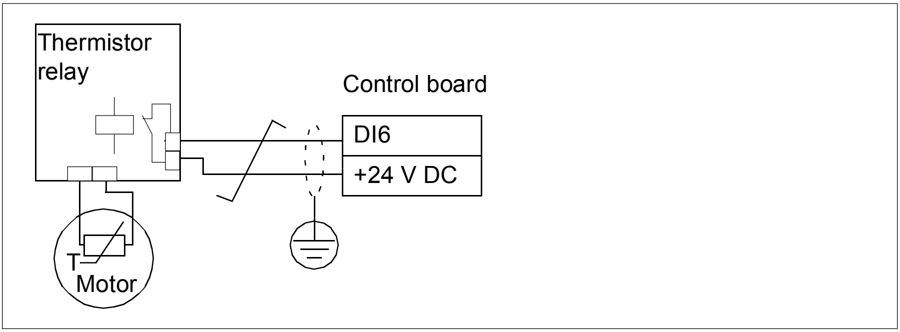
See section *Insulation* on page 85.

For the wiring of the sensor, see chapter *Electrical installation*, *AI1 and AI2 as Pt100, Pt1000, Ni1000, KTY83 and KTY84 sensor inputs (X1)* in the *Hardware manual* of the drive.

Temperature monitoring using thermistor relays

A normally closed or a normally open thermistor relay can be connected to digital input DI6.

See section *Insulation* on page *85*.



Settings

- Parameter group *35 Motor thermal protection* (page *199*).

Programmable protection functions

External events (parameters *31.01*…*31.10*)

Five different event signals from the process can be connected to selectable inputs to generate trips and warnings for the driven equipment. When the signal is lost, an external event (fault, warning, or a mere log entry) is generated. The contents of the messages can be edited on the control panel by selecting **Menu - Primary settings - Advanced functions - External events**.

Motor phase loss detection (parameter *31.19*)

The parameter selects how the drive reacts whenever a motor phase loss is detected.

Earth (Ground) fault detection (parameter *31.20*)

Note that

- an earth fault in the supply cable does not activate the protection
- in a grounded supply, the protection activates within 2 milliseconds
- in an ungrounded supply, the supply capacitance must be 1 microfarad or more
- the capacitive currents caused by shielded motor cables up to 300 meters will not activate the protection
- the protection is deactivated when the drive is stopped.

Supply phase loss detection (parameter *31.21*)

The parameter selects how the drive reacts whenever a supply phase loss is detected.

Safe torque off detection (parameter *31.22*)

The drive monitors the status of the Safe torque off input, and this parameter selects which indications are given when the signals are lost. (The parameter does not affect the operation of the Safe torque off function itself). For more information on the Safe torque off function, see chapter *Planning the electrical installation*, section *Implementing the Safe torque off function* in the *Hardware manual* of the drive.

Swapped supply and motor cabling (parameter *31.23*)

The drive can detect if the supply and motor cables have accidentally been swapped (for example, if the supply is connected to the motor connection of the drive). The parameter selects if a fault is generated or not.

Stall protection (parameters *31.24*…*31.28*)

The drive protects the motor in a stall situation. It is possible to adjust the supervision limits (current, frequency and time) and choose how the drive reacts to a motor stall condition.

Overspeed protection (parameter *31.30*)

The user can set overspeed limits by specifying a margin that is added to the currently-used maximum and minimum speed limits.

Local control loss detection (parameter *49.05*)

The parameter selects how the drive reacts to a control panel or PC tool communication break.

AI supervision (parameters *12.03*…*12.04*)

The parameters select how the drive reacts when an analog input signal moves out of the minimum and/or maximum limits specified for the input. This can be due to broken I/O wiring or sensor.

Automatic fault resets

The drive can automatically reset itself after overcurrent, overvoltage, undervoltage and external faults. The user can also specify a fault that is automatically reset.

By default, automatic resets are off and must be specifically activated by the user.

⚠ **WARNING!** Before you activate the function, make sure that no dangerous situations can occur. The function resets the drive automatically and continues operation after a fault.

Settings

- **Menu - Primary settings - Fault functions - Autoreset faults**
- Parameters *31.12*…*31.16* (page *179*).

Diagnostics

Signal supervision

Six signals can be selected to be supervised by this function. Whenever a supervised signal exceeds or falls below predefined limits, a bit in *32.01 Supervision status* is activated, and a warning or fault generated.

The supervised signal is low-pass filtered.

Settings

Parameter group *32 Supervision* (page *184*).

Energy saving calculators

This feature consists of the following functionalities:

- An energy optimizer that adjusts the motor flux in such a way that the total system efficiency is maximized
- A counter that monitors used and saved energy by the motor and displays them in kWh, currency or volume of CO_2 emissions, and
- A load analyzer showing the load profile of the drive (see separate section on page *93*).

In addition, there are counters that show energy consumption in kWh of the current and previous hour as well as the current and previous day.

The amount of energy that has passed through the drive (in either direction) is counted and shown full as GWh, MWh and kWh. The cumulative energy is also shown as full kWh. All these counters are resettable.

Note: The accuracy of the energy savings calculation is directly dependent on the accuracy of the reference motor power given in parameter *45.19 Comparison power*.

Settings

- **Menu - Energy efficiency**
- Parameter group *45 Energy efficiency* (page *231*).
- Parameters *01.50 Current hour kWh*, *01.51 Previous hour kWh*, *01.52 Current day kWh* and *01.53 Previous day kWh* on page *104*.
- Parameters *01.55 Inverter GWh counter (resettable)*, *01.56 Inverter MWh counter (resettable)*, *01.57 Inverter kWh counter (resettable)* and *01.58 Cumulative inverter energy (resettable)*.

Load analyzer

Peak value logger

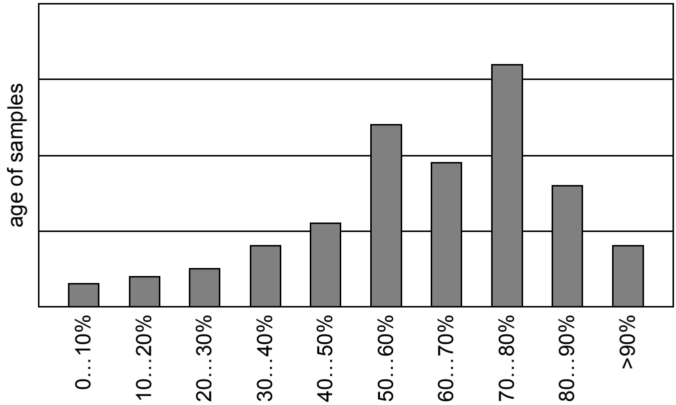
The user can select a signal to be monitored by a peak value logger. The logger records the peak value of the signal along with the time the peak occurred, as well as motor current, DC voltage and motor speed at the time of the peak. The peak value is sampled at 2 ms intervals.

Amplitude loggers

The control program has two amplitude loggers.

For amplitude logger 2, the user can select a signal to be sampled at 200 ms intervals, and specify a value that corresponds to 100%. The collected samples are sorted into 10 read-only parameters according to their amplitude. Each parameter represents an amplitude range 10 age points wide, and displays the age of the collected samples that have fallen within that range.

You can view this graphically with the assistant panel or the Drive composer PC tool.



Amplitude ranges
(parameters *36.40*…*36.49*)

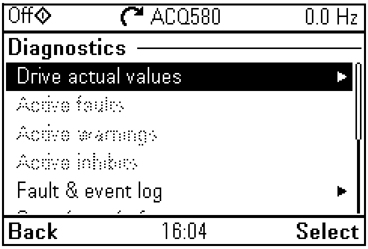
Amplitude logger 1 is fixed to monitor motor current, and cannot be reset. With amplitude logger 1, 100% corresponds to the maximum output current of the drive (I_{max}), which is listed in the *Hardware manual*. The measured current is logged continuously. The distribution of samples is shown by parameters *36.20*…*36.29*.

Settings

- **Menu - Diagnostics - Load profile**
- Parameter group *36 Load analyzer* (page *206*).

Diagnostics menu

The **Diagnostics** menu provides quick information about active faults, warnings and inhibits in the drive and how to fix and reset them. It also helps you to find out why the drive is not starting, stopping or running at the desired speed.



- **Drive actual values:** Use this view to see the drive actual state.
- **Active faults:** Use this view to see currently active faults and how to fix and reset them.
- **Active warnings:** Use this view to see currently active warnings and how to fix them.
- **Active inhibits:** Use this view to see the active inhibits and how to fix them. In addition, in the **Clock, region, display** menu you can disable (enabled by default) and pop-up views showing information on inhibits when you try to start the drive but it is prevented.
- **Fault & event log:** Use this view to see the list of faults, warnings and other events that have occurred in the drive.
- **Start/stop/reference summary:** Use this view to find out where the control comes from if the drive is not starting or stopping as expected, or runs at an undesired speed.
- **Limit status:** Use this view to find out whether any limitations are active if the drive is running at undesired speed.
- **Fieldbus:** Use this view to find out status information and sent and received data from fieldbus.
- **Load profile:** Use this view to see the status information of load distribution (that is, drive running time spent on each load level) and peak load levels.
- **Motor summary:** Use this view to find out motor nominal values, control mode and whether ID run has been completed.

Settings

- **Menu - Diagnostics**
- **Menu - Primary settings - Clock, region, display - Show inhibit pop-up**.

Miscellaneous

Backup and restore

You can make backups of the settings manually to the assistant panel. The assistant panel also keeps one automatic backup. You can restore a backup to another drive, or a new drive replacing a faulty one. You can make backups and restore on the panel or with the Drive composer PC tool.

Backup

Manual backup

Make a backup when necessary, for example, after you have started up the drive or when you want to copy the settings to another drive.

Parameter changes from fieldbus interfaces are ignored unless you have forced parameter saving with parameter *96.07 Parameter save manually*.

Automatic backup

The assistant panel has a dedicated space for one automatic backup. An automatic backup is created two hours after the last parameter change. After completing the backup, the panel waits for 24 hours before checking if there are additional parameter changes. If there are, it creates a new backup overwriting the previous one when two hours have passed after the latest change.

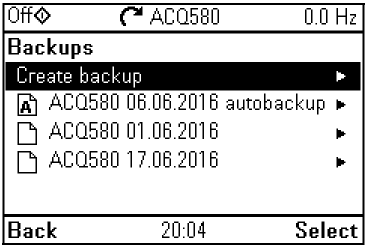
You cannot adjust the delay time or disable the automatic backup function.

Parameter changes from fieldbus interfaces are ignored unless you have forced parameter saving with parameter *96.07 Parameter save manually*.

Restore

The backups are shown on the panel. Automatic backups are marked with icon 🄰 and manual backups with 🗋. To restore a backup, select it and press ⏵. In the following display you can view backup contents and restore all parameters or select a subset to be restored.

Note: To restore a backup, the drive has to be in Local control.



Off◇ ACQ580 0.0 Hz

Backups

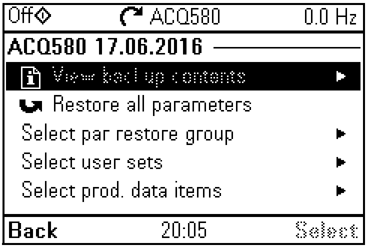
Create backup ▸

🄰 ACQ580 06.06.2016 autobackup ▸

🗋 ACQ580 01.06.2016 ▸

🗋 ACQ580 17.06.2016 ▸

Back 20:04 Select



Off◇ ACQ580 0.0 Hz

ACQ580 17.06.2016

View backup contents ▸

Restore all parameters

Select par restore group ▸

Select user sets ▸

Select prod. data items ▸

Back 20:05 Select

Settings

- **Menu - Backups**
- Parameter *96.07 Parameter save manually* (page *282*).

User parameter sets

The drive supports four user parameter sets that can be saved to the permanent memory and recalled using drive parameters. It is also possible to use digital inputs to switch between user parameter sets. To change a user parameter set, the drive has to be stopped.

A user parameter set contains all editable values in parameter groups 10…99 except

- forced I/O values such as parameters *10.03 DI force selection* and *10.04 DI forced data*
- I/O extension module settings (group 15)
- data storage parameters (group 47)
- fieldbus communication settings (groups 50…53 and 58)
- parameter *95.01 Supply voltage*.

As the motor settings are included in the user parameter sets, make sure the settings correspond to the motor used in the application before recalling a user set. In an application where different motors are used with the drive, the motor ID run needs to be performed with each motor and the results saved to different user sets. The appropriate set can then be recalled when the motor is switched.

Settings

- **Menu - Primary settings - Advanced functions - User sets**
- Parameters *96.10*…*96.13* (page *284*).

Data storage parameters

Twelve (eight 32-bit, four 16-bit) parameters are reserved for data storage. These parameters are unconnected by default and can be used for linking, testing and commissioning purposes. They can be written to and read from using other parameters' source or target selections.

Settings

Parameter group *47 Data storage* (page *238*).

User lock

For better cybersecurity, it is highly recommended that you set a master pass code to prevent eg. the changing of parameter values and/or the loading of firmware and other files.

⚠ **WARNING!** ABB will not be liable for damages or losses caused by the failure to activate the user lock using a new pass code. See *Cybersecurity disclaimer* (page *12*).

- To activate the user lock for the first time:
- Enter the default pass code, 10000000, into *96.02 Pass code*. This will make parameters *96.100*…*96.102* visible.
- Enter a new pass code into *96.100 Change user pass code*. Always use eight digits; if using Drive composer, finish with Enter.
- Confirm the new pass code in *96.101 Confirm user pass code*.

⚠ **WARNING!** Store the pass code in a safe place – the user lock cannot be opened even by ABB if the pass code is lost.

- In *96.102 User lock functionality*, define the actions that you want to prevent (we recommend you select all the actions unless otherwise required by the application).
- Enter an invalid pass code into *96.02 Pass code*.
- Activate *96.08 Control board boot*, or cycle the power to the drive.
- Check that parameters *96.100*…*96.102* are hidden. If they are not, enter another random pass code into *96.02*.

To reopen the lock, enter your pass code into *96.02 Pass code*. This will again make parameters *96.100*…*96.102* visible.

Settings

Parameters *96.02* (page *282*) and *96.100*…*96.102* (page *286*).

Sine filter support

The control program has a setting that enables the use of ABB sine filters (available separately). With a sine filter connected to the output of the drive, bit 1 of *95.01 Special HW settings* must be switched on. The setting forces the drive to use the scalar motor control mode, and limits the switching and output frequencies to

- prevent the drive from operating at filter resonance frequencies, and
- protect the filter from overheating.

Contact your local ABB representative before connecting a sine filter from another manufacturer.

Settings

Parameter *95.01 Special HW settings* (page *280*).

6

Parameters

What this chapter contains

The chapter describes the parameters, including actual signals, of the control program. At the end of the chapter, on page *298*, there is a separate list of the parameters whose default values are different between 50 Hz and 60 Hz supply frequency settings.

Terms and abbreviations

Term	**Definition**
Actual signal	Type of *parameter* that is the result of a measurement or calculation by the drive, or contains status information. Most actual signals are read-only, but some (especially counter-type actual signals) can be reset.
Def	(In the following table, shown on the same row as the parameter name) The default value of a *parameter* when used in the Factory macro. For information on other macro-specific parameter values, see chapter *Default configuration* (page *33*).
FbEq16	(In the following table, shown on the same row as the parameter range, or for each selection) 16-bit fieldbus equivalent: The scaling between the value shown on the panel and the integer used in communication when a 16-bit value is selected for transmission to an external system. A dash (-) indicates that the parameter is not accessible in 16-bit format. The corresponding 32-bit scalings are listed in chapter *Additional parameter data* (page *301*).
Other	The value is taken from another parameter. Choosing “Other” displays a parameter list in which the user can specify the source parameter.
Other [bit]	The value is taken from a specific bit in another parameter. Choosing “Other” displays a parameter list in which the user can specify the source parameter and bit.
Parameter	Either a user-adjustable operating instruction for the drive, or an *actual signal*.
p.u.	Per unit
[parameter number]	Value of the parameter

Summary of parameter groups

Group	Contents	Page
01 Actual values	Basic signals for monitoring the drive.	103
03 Input references	Values of references received from various sources.	106
04 Warnings and faults	Information on warnings and faults that occurred last.	107
05 Diagnostics	Various run-time-type counters and measurements related to drive maintenance.	108
06 Control and status words	Drive control and status words.	110
07 System info	Drive hardware and firmware information.	116
10 Standard DI, RO	Configuration of digital inputs and relay outputs.	117
11 Standard DIO, FI, FO	Configuration of the frequency input.	122
12 Standard AI	Configuration of standard analog inputs.	124
13 Standard AO	Configuration of standard analog outputs.	128
15 I/O extension module	Configuration of the I/O extension module installed in slot 2.	133
19 Operation mode	Selection of local and external control location sources and operating modes.	141
20 Start/stop/direction	Start/stop/direction and run/start enable signal source selection; positive/negative reference enable signal source selection.	142
21 Start/stop mode	Start and stop modes; emergency stop mode and signal source selection; DC magnetization settings.	147
22 Speed reference selection	Speed reference selection; motor potentiometer settings.	154
23 Speed reference ramp	Speed reference ramp settings (programming of the acceleration and deceleration rates for the drive).	162
24 Speed reference conditioning	Speed error calculation; speed error window control configuration; speed error step.	163
25 Speed control	Speed controller settings.	164
28 Frequency reference chain	Settings for the frequency reference chain.	167
30 Limits	Drive operation limits.	174
31 Fault functions	Configuration of external events; selection of behavior of the drive upon fault situations.	177
32 Supervision	Configuration of signal supervision functions 1…6.	184
34 Timed functions	Configuration of the timed functions.	191
35 Motor thermal protection	Motor thermal protection settings such as temperature measurement configuration, load curve definition and motor fan control configuration.	199
36 Load analyzer	Peak value and amplitude logger settings.	206
37 User load curve	Settings for user load curve.	210
40 Process PID set 1	Parameter values for process PID control.	213
41 Process PID set 2	A second set of parameter values for process PID control.	229
45 Energy efficiency	Settings for the energy saving calculators as well as peak and energy loggers.	231
46 Monitoring/scaling settings	Speed supervision settings; actual signal filtering; general scaling settings.	236
47 Data storage	Data storage parameters that can be written to and read from using other parameters’ source and target settings.	238
49 Panel port communication	Communication settings for the control panel port on the drive.	239

Group	**Contents**	**Page**
50 Fieldbus adapter (FBA)	Fieldbus communication configuration.	240
51 FBA A settings	Fieldbus adapter A configuration.	244
52 FBA A data in	Selection of data to be transferred from drive to fieldbus controller through fieldbus adapter A.	246
53 FBA A data out	Selection of data to be transferred from fieldbus controller to drive through fieldbus adapter A.	246
58 Embedded fieldbus	Configuration of the embedded fieldbus (EFB) interface.	247
71 External PID1	Configuration of external PID.	254
76 Multipump configuration	Multipump configuration parameters.	256
77 Multipump maintenance and monitoring	Multipump maintenance and monitoring parameters.	267
80 Flow calculation and protection	Actual flow calculation.	269
81 Sensor settings	Defines the sensor settings for inlet and outlet pressure protection function.	273
82 Pump protections	Settings for quick ramp functions.	274
83 Pump cleaning	Settings for the pump cleaning sequence.	277
95 HW configuration	Various hardware-related settings.	280
96 System	Language selection; access levels; macro selection; parameter save and restore; control unit reboot; user parameter sets; unit selection.	281
97 Motor control	Switching frequency; slip gain; voltage reserve; flux braking; anti-cogging (signal injection); IR compensation.	287
98 User motor parameters	Motor values supplied by the user that are used in the motor model.	291
99 Motor data	Motor configuration settings.	292

Parameter listing

No.	Name/Value	Description	Def/FbEq16
01 Actual values		Basic signals for monitoring the drive. All parameters in this group are read-only unless otherwise noted. **Note:** Values of these actual signals are filtered with the filter time defined in group *46 Monitoring/scaling settings*. The selection lists for parameters in other groups mean the raw value of the actual signal instead. For example, if a selection is “Output frequency” it does not point to the value of parameter *01.06 Output frequency* but to the raw value.	
01.01	*Motor speed used*	Estimated motor speed. A filter time constant for this signal can be defined by parameter *46.11 Filter time motor speed*.	-
	-30000.00… 30000.00 rpm	Estimated motor speed.	See par. *46.01*
01.02	*Motor speed estimated*	Estimated motor speed in rpm. A filter time constant for this signal can be defined by parameter *46.11 Filter time motor speed*.	-
	-30000.00… 30000.00 rpm	Estimated motor speed.	See par. *46.01*
01.03	*Motor speed %*	Motor speed in percent of the synchronous motor speed.	-
	-1000.00… 1000.00%	Motor speed.	10 = 1%
01.06	*Output frequency*	Estimated drive output frequency in Hz. A filter time constant for this signal can be defined by parameter *46.12 Filter time output frequency*.	-
	-500.00…500.00 Hz	Estimated output frequency.	See par. *46.02*
01.07	*Motor current*	Measured (absolute) motor current in A.	-
	0.00…30000.00 A	Motor current.	See par. *46.05*
01.08	*Motor current % of motor nom*	Motor current (drive output current) in percent of the nominal motor current.	-
	0.0…1000.0%	Motor current.	1 = 1%
01.09	*Motor current % of drive nom*	Motor current (drive output current) in percent of the nominal drive current.	-
	0.0…1000.0%	Motor current.	1 = 1%
01.10	*Motor torque*	Motor torque in percent of the nominal motor torque. See also parameter *01.30 Nominal torque scale*. A filter time constant for this signal can be defined by parameter *46.13 Filter time motor torque*.	-
	-1600.0…1600.0%	Motor torque.	See par. *46.03*
01.11	*DC voltage*	Measured DC link voltage.	-
	0.00…2000.00 V	DC link voltage.	10 = 1 V
01.13	*Output voltage*	Calculated motor voltage in V AC.	-
	0…2000 V	Motor voltage.	1 = 1 V

No.	Name/Value	Description	Def/FbEq16
01.14	*Output power*	Drive output power. The unit is selected by parameter *96.16 Unit selection*. A filter time constant for this signal can be defined by parameter *46.14 Filter time power*.	-
	-32768.00… 32767.00 kW or hp	Output power.	1 = 1 unit
01.15	*Output power % of motor nom*	Output power in percent of the nominal motor power.	-
	-300.00… 300.00%	Output power.	1 = 1%
01.16	*Output power % of drive nom*	Output power in percent of the nominal drive power.	-
	-300.00… 300.00%	Output power.	1 = 1%
01.17	*Motor shaft power*	Estimated mechanical power at motor shaft.	-
	-32768.00… 32767.00 kW or hp	Motor shaft power.	1 = 1 unit
01.18	*Inverter GWh counter*	Amount of energy that has passed through the drive (in either direction) in full gigawatt-hours. The minimum value is zero.	-
	0…65535 GWh	Energy in GWh.	1 = 1 GWh
01.19	*Inverter MWh counter*	Amount of energy that has passed through the drive (in either direction) in full megawatt-hours. Whenever the counter rolls over, *01.18 Inverter GWh counter* is incremented. The minimum value is zero.	-
	0…1000 MWh	Energy in MWh.	1 = 1 MWh
01.20	*Inverter kWh counter*	Amount of energy that has passed through the drive (in either direction) in full kilowatt-hours. Whenever the counter rolls over, *01.19 Inverter MWh counter* is incremented. The minimum value is zero.	-
	0…1000 kWh	Energy in kWh.	10 = 1 kWh
01.24	*Flux actual %*	Used flux reference in percent of nominal flux of motor.	-
	0…200%	Flux reference.	1 = 1%
01.30	*Nominal torque scale*	Torque that corresponds to 100% of nominal motor torque. The unit is selected by parameter *96.16 Unit selection*. **Note:** This value is copied from parameter *99.12 Motor nominal torque* if entered. Otherwise the value is calculated from other motor data.	-
	0.000…4000000 N·m or lb·ft	Nominal torque.	1 = 100 unit
01.31	*Ambient temperature*	Ambient temperature of the drive. Only for drive frames R6 or larger.	-
	40.0…120.0 °C or °F	Temperature.	1 = 1 °
01.50	*Current hour kWh*	Current hour energy consumption. This is the energy of the last 60 minutes (not necessarily continuous) the drive has been running, not the energy of a calendar hour. If the power is cycled, after the drive is again up and running, the parameter value is set to the value it had before the power cycle.	-
	0.00… 1000000.00 kWh	Energy.	1 = 1 kWh

No.	Name/Value	Description	Def/FbEq16
01.51	*Previous hour kWh*	Previous hour energy consumption. The value *01.50 Current hour kWh* is stored here when its values has been cumulated for 60 minutes. If the power is cycled, after the drive is again up and running, the parameter value is set to the value it had before the power cycle.	-
	0.00… 1000000.00 kWh	Energy.	1 = 1 kWh
01.52	*Current day kWh*	Current day energy consumption. This is the energy of the last 24 hours (not necessarily continuous) the drive has been running, not the energy of a calendar day. T If the power is cycled, after the drive is again up and running, the parameter value is set to the value it had before the power cycle.	-
	0.00… 1000000.00 kWh	Energy.	1 = 1 kWh
01.53	*Previous day kWh*	Previous day energy consumption. The value *01.52 Current day kWh* is stored here when its value has been cumulated for 24 hours. If the power is cycled, after the drive is again up and running, the parameter value is set to the value it had before the power cycle.	-
	0.00… 1000000.00 kWh	Energy.	1 = 1 kWh
01.54	*Cumulative inverter energy*	Amount of energy that has passed through the drive (in either direction) in full kilowatt-hours. The minimum value is zero.	-
	-200000000.0… 200000000.0 kWh	Energy in kWh.	10 = 1 kWh
01.55	*Inverter GWh counter (resettable)*	Amount of energy that has passed through the drive (in either direction) in full gigawatt-hours. The minimum value is zero. You can reset the value by setting it to zero. Resetting any of parameters *01.55*…*01.58* resets all of them.	-
	0…65535 GWh	Energy in GWh.	1 = 1 GWh
01.56	*Inverter MWh counter (resettable)*	Amount of energy that has passed through the drive (in either direction) in full megawatt-hours. Whenever the counter rolls over, *01.55 Inverter GWh counter (resettable)* is incremented. The minimum value is zero. You can reset the value by setting it to zero. Resetting any of parameters *01.55*…*01.58* resets all of them.	-
	0…1000 MWh	Energy in MWh.	1 = 1 MWh
01.57	*Inverter kWh counter (resettable)*	Amount of energy that has passed through the drive (in either direction) in full kilowatt-hours. Whenever the counter rolls over, *01.56 Inverter MWh counter (resettable)* is incremented. The minimum value is zero. You can reset the value by setting it to zero. Resetting any of parameters *01.55*…*01.58* resets all of them.	-
	0…1000 kWh	Energy in kWh.	10 = 1 kWh
01.58	*Cumulative inverter energy (resettable)*	Amount of energy that has passed through the drive (in either direction) in full kilowatt-hours. The minimum value is zero. You can reset the value by setting it to zero. Resetting any of parameters *01.55*…*01.58* resets all of them.	-
	-200000000.0… 200000000.0 kWh	Energy in kWh.	10 = 1 kWh

No.	Name/Value	Description	Def/FbEq16
01.61	*Abs motor speed used*	Absolute value of parameter *01.01 Motor speed used*.	-
	0.00… 30000.00 rpm	Estimated motor speed.	See par. *46.01*
01.62	*Abs motor speed %*	Absolute value of parameter *01.03 Motor speed %*.	-
	0.00… 1000.00%	Estimated motor speed.	10 = 1%
01.63	*Abs output frequency*	Absolute value of parameter *01.06 Output frequency*.	-
	0.00…500.00 Hz	Estimated output frequency.	See par. *46.02*
01.64	*Abs motor torque*	Absolute value of parameter *01.10 Motor torque*.	-
	0.0…1600.0%	Motor torque.	See par. *46.03*
01.65	*Abs output power*	Absolute value of parameter *01.14 Output power*.	-
	0.00… 32767.00 kW or hp	Output power.	1 = 1 kW
01.66	*Abs output power % motor nom*	Absolute value of parameter *01.15 Output power % of motor nom*.	-
	0.00… 300.00%	Output power.	1 = 1%
01.67	*Abs output power % drive nom*	Absolute value of parameter *01.16 Output power % of drive nom*.	-
	0.00… 300.00%	Output power.	1 = 1%
01.68	*Abs motor shaft power*	Absolute value of parameter *01.17 Motor shaft power*.	-
	0.00… 32767.00 kW or hp	Motor shaft power.	1 = 1 kW
03 Input references		Values of references received from various sources. All parameters in this group are read-only unless otherwise noted.	
03.01	*Panel reference*	Reference 1 given from the control panel or PC tool.	-
	-100000.00… 100000.00	Control panel or PC tool reference.	1 = 10
03.02	*Panel reference remote*	Reference 2 given from the control panel or PC tool.	-
	-100000.00… 100000.00	Control panel or PC tool reference.	1 = 10
03.05	*FB A reference 1*	Reference 1 received through fieldbus adapter A. See also chapter *Fieldbus control through a fieldbus adapter* (page *391*).	-
	-100000.00… 100000.00	Reference 1 from fieldbus adapter A.	1 = 10
03.06	*FB A reference 2*	Reference 2 received through fieldbus adapter A.	-
	-100000.00… 100000.00	Reference 2 from fieldbus adapter A.	1 = 10

No.	**Name/Value**	**Description**	**Def/FbEq16**
03.09	*EFB reference 1*	Scaled reference 1 received through the embedded fieldbus interface.	1 = 10
	-30000.00… 30000.00	Scaled reference 1 received through the embedded fieldbus interface.	1 = 10
03.10	*EFB reference 2*	Scaled reference 2 received through the embedded fieldbus interface.	1 = 10
	-30000.00… 30000.00	Scaled reference 2 received through the embedded fieldbus interface.	1 = 10
04 Warnings and faults		Information on warnings and faults that occurred last. For explanations of individual warning and fault codes, see chapter *Fault tracing*. All parameters in this group are read-only unless otherwise noted.	
04.01	*Tripping fault*	Code of the 1st active fault (the fault that caused the current trip).	-
	0000h…FFFFh	1st active fault.	1 = 1
04.02	*Active fault 2*	Code of the 2nd active fault.	-
	0000h…FFFFh	2nd active fault.	1 = 1
04.03	*Active fault 3*	Code of the 3rd active fault.	-
	0000h…FFFFh	3rd active fault.	1 = 1
04.06	*Active warning 1*	Code of the 1st active warning.	-
	0000h…FFFFh	1st active warning.	1 = 1
04.07	*Active warning 2*	Code of the 2nd active warning.	-
	0000h…FFFFh	2nd active warning.	1 = 1
04.08	*Active warning 3*	Code of the 3rd active warning.	-
	0000h…FFFFh	3rd active warning.	1 = 1
04.11	*Latest fault*	Code of the 1st stored (non-active) fault.	-
	0000h…FFFFh	1st stored fault.	1 = 1
04.12	*2nd latest fault*	Code of the 2nd stored (non-active) fault.	-
	0000h…FFFFh	2nd stored fault.	1 = 1
04.13	*3rd latest fault*	Code of the 3rd stored (non-active) fault.	-
	0000h…FFFFh	3rd stored fault.	1 = 1
04.16	*Latest warning*	Code of the 1st stored (non-active) warning.	-
	0000h…FFFFh	1st stored warning.	1 = 1
04.17	*2nd latest warning*	Code of the 2nd stored (non-active) warning.	-
	0000h…FFFFh	2nd stored warning.	1 = 1
04.18	*3rd latest warning*	Code of the 3rd stored (non-active) warning.	-
	0000h…FFFFh	3rd stored warning.	1 = 1

No.	Name/Value	Description	Def/FbEq16
05 Diagnostics		Various run-time-type counters and measurements related to drive maintenance. All parameters in this group are read-only unless otherwise noted.	
05.01	*On-time counter*	On-time counter. The counter runs when the drive is powered.	-
	0…65535 d	On-time counter.	1 = 1 d
05.02	*Run-time counter*	Motor run-time counter in full days. The counter runs when the inverter modulates.	-
	0…65535 d	Motor run-time counter.	1 = 1 d
05.03	*Hours run*	Corresponding parameter to *05.02 Run-time counter* in hours, that is, 24 * *05.02* value + fractional part of a day.	-
	0.0… 429496729.5 h	Hours.	10 = 1 h
05.04	*Fan on-time counter*	Running time of the drive cooling fan. Can be reset from the control panel by keeping Reset down for over 3 seconds.	-
	0…65535 d	Cooling fan run-time counter.	1 = 1 d
05.10	*Control board temperature*	Measured temperature of the control board	-
	-100… 300 °C or °F	Control board temperature in degrees Celsius or Fahrenheit.	1 = unit
05.11	*Inverter temperature*	Estimated drive temperature in percent of fault limit. The fault limit varies according to the type of the drive. 0.0% = 0 °C (32 °F) 100.0% = Fault limit	-
	-40.0…160.0%	Drive temperature in percent.	1 = 1%

<table>
<tr><th>No.</th><th>Name/Value</th><th>Description</th><th>Def/FbEq16</th></tr>
<tr><td>05.22</td><td>Diagnostic word 3</td><td>Diagnostic word 3. For possible causes and remedies, see chapter Fault tracing.</td><td>-</td></tr>
<tr><td></td><td colspan="3">
<table>
<tr><th>Bit</th><th>Name</th><th>Value</th></tr>
<tr><td>0</td><td>Main circuit pwr ON</td><td>Yes = Main circuit power is on.</td></tr>
<tr><td>1</td><td>Ext. pwr supply</td><td>Yes = Control board is powered on from external power supply, for example, user provided 24 V.</td></tr>
<tr><td>2</td><td>Programming wand</td><td>Yes = Control board is powered on by the Programming wand tool for offline programming or parameterization. Main circuit / power unit is without power.</td></tr>
<tr><td>3</td><td>Panel port comm loss</td><td>Yes = Panel port communication lost.</td></tr>
<tr><td>4</td><td colspan="2">Reserved</td></tr>
<tr><td>5</td><td>Field bus force trip</td><td>Yes = Fault trip forced (requested) from a field bus.</td></tr>
<tr><td>6</td><td>Start inhibited</td><td>Yes = Start inhibited (prevented) due to some reason for example interlock.</td></tr>
<tr><td>7</td><td>Safe Torq Off</td><td>Yes = Safe Torque Off fault active.</td></tr>
<tr><td>8</td><td>STO broken</td><td>Yes = Safe Torque Off circuitry is broken.</td></tr>
<tr><td>9</td><td>kWh pulse</td><td>Yes = kWh pulse is active.</td></tr>
<tr><td>10</td><td>Reserved</td><td></td></tr>
<tr><td>11</td><td>Fan command</td><td>On = Drive fan is rotating above idle speed.</td></tr>
<tr><td>12…15</td><td colspan="2">Reserved</td></tr>
</table>
</td></tr>
<tr><td></td><td>0000h…FFFFh</td><td>Diagnostic word 3.</td><td>1 = 1</td></tr>
</table>

<table>
<tr><th>No.</th><th>Name/Value</th><th>Description</th><th>Def/FbEq16</th></tr>
<tr><td colspan="2">***06 Control and status words***</td><td>Drive control and status words.</td><td></td></tr>
<tr><td>*06.01*</td><td>*Main control word*</td><td>The main control word of the drive. This parameter shows the control signals as received from the selected sources (such as digital inputs, the fieldbus interfaces and the application program).
For the bit descriptions see page *397*. The related status word and state diagram are presented on pages *398* and *399* respectively.
This parameter is read-only.
<table>
<tr><th>Bit</th><th>Name</th></tr>
<tr><td>0</td><td>*Off1 control*</td></tr>
<tr><td>1</td><td>*Off2 control*</td></tr>
<tr><td>2</td><td>*Off3 control*</td></tr>
<tr><td>3</td><td>*Run*</td></tr>
<tr><td>4</td><td>*Ramp out zero*</td></tr>
<tr><td>5</td><td>*Ramp hold*</td></tr>
<tr><td>6</td><td>*Ramp in zero*</td></tr>
<tr><td>7</td><td>*Reset*</td></tr>
<tr><td>8</td><td>Reserved</td></tr>
<tr><td>9</td><td>Reserved</td></tr>
<tr><td>10</td><td>*Remote cmd*</td></tr>
<tr><td>11</td><td>*Ext ctrl loc*</td></tr>
<tr><td>12</td><td>*User bit 0*</td></tr>
<tr><td>13</td><td>*User bit 1*</td></tr>
<tr><td>14</td><td>*User bit 2*</td></tr>
<tr><td>15</td><td>*User bit 3*</td></tr>
</table>
</td><td>-</td></tr>
<tr><td></td><td>0000h…FFFFh</td><td>Main control word.</td><td>1 = 1</td></tr>
</table>

No.	**Name/Value**	**Description**	**Def/FbEq16**
06.11	*Main status word*	Main status word of the drive. For the bit descriptions see page *398*. The related control word and state diagram are presented on pages *397* and *399* respectively. This parameter is read-only.	-

Bit	**Name**
0	*Ready to switch ON*
1	*Ready run*
2	*Ready ref*
3	*Tripped*
4	*Off 2 inactive*
5	*Off 3 inactive*
6	*Switch-on inhibited*
7	*Warning*
8	*At setpoint*
9	*Remote*
10	*Above limit*
11	*User bit 0*
12	*User bit 1*
13	*User bit 2*
14	*User bit 3*
15	*Reserved*

	0000h…FFFFh	Main status word.	1 = 1

No.	Name/Value	Description	Def/FbEq16
06.16	*Drive status word 1*	Drive status word 1. This parameter is read-only.	-

Bit	Name	Description
0	Enabled	1 = If Run permissive (par. *20.40*) and start interlock signals (par. *20.41*…*20.44*) signals are all present. **Note:** This bit is not affected by the presence of a fault.
1	Inhibited	1 = Start inhibited. To start the drive, the inhibiting signal (see par. *06.18*) must be removed and the start signal cycled.
2	DC charged	1 = DC circuit has been charged
3	Ready to start	1 = Drive is ready to receive a start command
4	Following reference	1 = Drive is ready to follow given reference
5	Started	1 = Drive has been started
6	Modulating	1 = Drive is modulating (output stage is being controlled)
7	Limiting	1 = Any operating limit (speed, torque, etc.) is active
8	Local control	1 = Drive is in local control
9	Network control	1 = Drive is in *network control* (see page *11*).
10	Ext1 active	1 = Control location EXT1 active
11	Ext2 active	1 = Control location EXT2 active
12	Reserved	
13	Start request	1 = If Start requested. 0 = When Run permissive signal (see par. *20.40*) is 0.
14…15	Reserved	

No.	Name/Value	Description	Def/FbEq16
	0000h…FFFFh	Drive status word 1.	1 = 1
06.17	*Drive status word 2*	Drive status word 2. This parameter is read-only.	-

Bit	Name	Description
0	Identification run done	1 = Motor identification (ID) run has been performed
1	Magnetized	1 = The motor has been magnetized
2	Reserved	
3	Speed control	1 = Speed control mode active
4	Reserved	
5	Safe reference active	1 = A “safe” reference is applied by functions such as parameters *49.05* and *50.02*
6	Last speed active	1 = A “last speed” reference is applied by functions such as parameters *49.05* and *50.02*
7	Loss of reference	1 = Reference signal lost
8	Emergency stop failed	1 = Emergency stop failed (see parameters *31.32* and *31.33*)
9…12	Reserved	
13	Start delay active	1 = Start delay (par. *21.22*) active.
14…15	Reserved	

No.	Name/Value	Description	Def/FbEq16
	0000h…FFFFh	Drive status word 2.	1 = 1

No.	Name/Value	Description	Def/FbEq16
06.18	*Start inhibit status word*	Start inhibit status word. This word specifies the source of the inhibiting signal that is preventing the drive from starting. The conditions marked with an asterisk (*) only require that the start command is cycled. In all other instances, the inhibiting condition must be removed first. See also parameter *06.16 Drive status word 1*, bit 1. This parameter is read-only. **Note:** At the moment the software does not work as it should. Now bit 5 never changes state, and Start interlock changes bit 6 state, not bit 4 bit state. This will be corrected in the next software version.	-

Bit	Name	Description
0	Not ready run	1 = DC voltage is missing or drive has not been parametrized correctly. Check the parameters in groups 95 and 99.
1	Ctrl location changed	* 1 = Control location has changed
2	SSW inhibit	1 = Control program is keeping itself in inhibited state
3	Fault reset	* 1 = A fault has been reset
4	Start interlocked	1 = Start interlocked
5	Run permissive	1 = Run permissive signal missing
6	Reserved	
7	STO	1 = Safe torque off function active
8	Current calibration ended	* 1 = Current calibration routine has finished
9	ID run ended	* 1 = Motor identification run has finished
10	Reserved	
11	Em Off1	1 = Emergency stop signal (mode off1)
12	Em Off2	1 = Emergency stop signal (mode off2)
13	Em Off3	1 = Emergency stop signal (mode off3)
14	Auto reset inhibit	1 = The autoreset function is inhibiting operation
15	Reserved	

	0000h…FFFFh	Start inhibit status word.	1 = 1
06.19	*Speed control status word*	Speed control status word. This parameter is read-only.	-

Bit	Name	Description
0	Zero speed	1 = Drive has been running below zero speed limit (par. *21.06*) for a time defined by parameter *21.07 Zero speed delay*
1	Forward	1 = Drive is running in forward direction above zero speed limit (par. *21.06*)
2	Reverse	1 = Drive is running in reverse direction above zero speed limit (par. *21.06*)
3…6	Reserved	
7	Any constant speed request	1 = A constant speed or frequency has been selected; see par. *06.20*.
8…15	Reserved	

	0000h…FFFFh	Speed control status word.	1 = 1

No.	Name/Value	Description	Def/FbEq16
06.20	*Constant speed status word*	Constant speed/frequency status word. Indicates which constant speed or frequency is active (if any). See also parameter *06.19 Speed control status word*, bit 7, and section *Constant speeds/frequencies* (page *50*). This parameter is read-only.	-

Bit	Name	Description
0	Constant speed 1	1 = Constant speed or frequency 1 selected
1	Constant speed 2	1 = Constant speed or frequency 2 selected
2	Constant speed 3	1 = Constant speed or frequency 3 selected
3	Constant speed 4	1 = Constant speed or frequency 4 selected
4	Constant speed 5	1 = Constant speed or frequency 5 selected
5	Constant speed 6	1 = Constant speed or frequency 6 selected
6	Constant speed 7	1 = Constant speed or frequency 7 selected
7…15	Reserved	

No.	Name/Value	Description	Def/FbEq16
	0000h…FFFFh	Constant speed/frequency status word.	1 = 1
06.21	*Drive status word 3*	Drive status word 3. This parameter is read-only.	-

Bit	Name	Description
0	DC hold active	1 = DC hold is active
1	Post-magnetizing active	1 = Post-magnetizing is active
2	Motor pre-heating active	1 = Motor pre-heating is active
3	PM smooth start active	1 = PM smooth start active
4…15	Reserved	

No.	Name/Value	Description	Def/FbEq16
	0000h…FFFFh	Drive status word 1.	1 = 1

No.	Name/Value	Description	Def/FbEq16
06.22	*Hand-off-auto status word*	ACQ580 specific status word. This parameter is read-only.	-

Bit	Name	Description
0	Hand mode	0 = Drive is not operated from the panel in the Hand mode; 1 = Drive is operated from the panel in the Hand mode
1	Off mode	0 = Drive is not in the Off mode; 1 = Drive is in the Off mode.
2	Auto mode	0 = Drive is not in the Auto mode; 1 = Drive is in the Auto mode.
3	Reserved	
4	Pre-heating	0 = Motor pre-heating is not active; 1 = Motor pre-heating is active.
5	Damper control	0 = Damper control is not active; 1 = Damper control is active.
6	Reserved	
7	Run permissive	0 = Run permissive is not present, drive is not allowed to run; 1 = Run permissive is present, drive is allowed to run.
8	Start interlock 1	0 = Start interlock 1 is not present, drive is not allowed to start; 1 = Start interlock 1 is present, drive is allowed to start.
9	Start interlock 2	0 = Start interlock 2 is not present, drive is not allowed to start; 1 = Start interlock 2 is present, drive is allowed to start.
10	Start interlock 3	0 = Start interlock 3 is not present, drive is not allowed to start; 1 = Start interlock 3 is present, drive is allowed to start.
11	Start interlock 4	0 = Start interlock 4 is not present, drive is not allowed to start; 1 = Start interlock 4 is present, drive is allowed to start.
12…15	Reserved	

No.	Name/Value	Description	Def/FbEq16
	0000h…FFFFh	Start inhibit status word.	1 = 1
06.30	*MSW bit 11 selection*	Selects a binary source whose status is transmitted as bit 11 (User bit 0) of *06.11 Main status word*.	*Ext ctrl loc*
	False	0.	0
	True	1.	1
	Ext ctrl loc	Bit 11 of *06.01 Main control word* (see page *111*).	2
	Other [bit]	Source selection (see *Terms and abbreviations* on page *100*).	-
06.31	*MSW bit 12 selection*	Selects a binary source whose status is transmitted as bit 12 (User bit 1) of *06.11 Main status word*.	*Run permissive*
	False	0.	0
	True	1.	1
	Run permissive	Status of the external run permissive signal (see parameter *20.40 Run permissive*).	3
	Other [bit]	Source selection (see *Terms and abbreviations* on page *100*).	-
06.32	*MSW bit 13 selection*	Selects a binary source whose status is transmitted as bit 13 (User bit 2) of *06.11 Main status word*.	*False*
	False	0.	0
	True	1.	1
	Other [bit]	Source selection (see *Terms and abbreviations* on page *100*).	-
06.33	*MSW bit 14 selection*	Selects a binary source whose status is transmitted as bit 14 (User bit 3) of *06.11 Main status word*.	*False*
	False	0.	0

No.	Name/Value	Description	Def/FbEq16
	True	1.	1
	Other [bit]	Source selection (see *Terms and abbreviations* on page *100*).	-
07 System info		Drive hardware and firmware information. All parameters in this group are read-only.	
07.03	*Drive rating id*	Type of the drive. (Rating ID in brackets.)	-
07.04	*Firmware name*	Firmware identification.	-
07.05	*Firmware version*	Version number of the firmware.	-
07.06	*Loading package name*	Name of the firmware loading package.	-
07.07	*Loading package version*	Version number of the firmware loading package.	-
07.11	*Cpu usage*	Microprocessor load in percent.	-
	0…100%	Microprocessor load.	1 = 1%
07.25	*Customization package name*	First five ASCII letters of the name given to the customization package. The full name is visible under System info on the control panel or the Drive composer PC tool. _N/A_ = None.	-
07.26	*Customization package version*	Customization package version number. Also visible under System info on the control panel or the Drive composer PC tool.	-
07.30	*Adaptive program status*	Shows the status of the adaptive program. See section *Adaptive programming* (page *43*).	-

Bit	Name	Description
0	Initialized	1 = Adaptive program initialized
1	Editing	1 = Adaptive program is being edited
2	Edit done	1 = Editing of adaptive program finished
3	Running	1 = Adaptive program running
4…13	Reserved	
14	State changing	1 = State change in progress in adaptive programming engine
15	Faulted	1 = Error in adaptive program

	0000h…FFFFh	Adaptive program status.	1 = 1
07.31	*AP sequence state*	Shows the number of the active state of the sequence program part of the adaptive program (AP). If adaptive programming is not running, or it does not contain a sequence program, the parameter is zero.	
	0...20		1 = 1

No.	Name/Value	Description	Def/FbEq16
10 Standard DI, RO		Configuration of digital inputs and relay outputs.	
10.02	*DI delayed status*	Displays the status of digital inputs DI1…DI6. Bits 0…5 reflect the delayed status of DI1…DI6. **Example:** 0000000000010011b = DI5, DI2 and DI1 are on, DI3, DI4 and DI6 are off. This word is updated only after a 2 ms activation/deactivation delay. When the value of a digital input changes, it must remain the same in two consecutive samples, that is for 2 ms, for the new value to be accepted. This parameter is read-only.	-

Bit	Name	Description
0	DI1	1 = Digital input 1 is ON.
1	DI2	1 = Digital input 2 is ON.
2	DI3	1 = Digital input 3 is ON.
3	DI4	1 = Digital input 4 is ON.
4	DI5	1 = Digital input 5 is ON.
5	DI6	1 = Digital input 6 is ON.
6…15	Reserved	

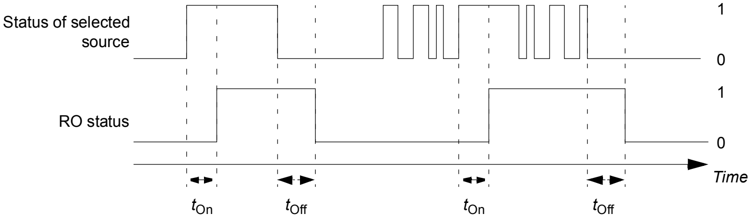
No.	Name/Value	Description	Def/FbEq16
	0000h…FFFFh	Delayed status for digital inputs.	1 = 1
10.03	*DI force selection*	The electrical statuses of the digital inputs can be overridden for eg. testing purposes. A bit in parameter *10.04 DI forced data* is provided for each digital input, and its value is applied whenever the corresponding bit in this parameter is 1. **Note:** Boot and power cycle reset the force selections (parameters *10.03* and *10.04*).	0000h

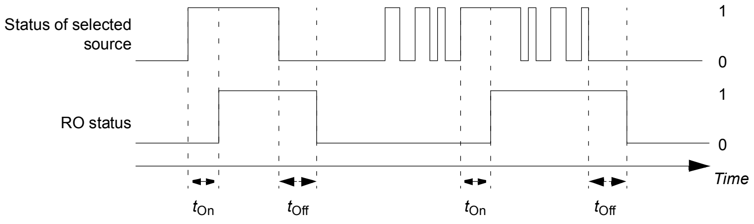
Bit	Value
0	1 = Force DI1 to value of bit 0 of parameter *10.04 DI forced data*. (0 = Normal mode)
1	1 = Force DI2 to value of bit 1 of parameter *10.04 DI forced data*. (0 = Normal mode)
2	1 = Force DI3 to value of bit 2 of parameter *10.04 DI forced data*. (0 = Normal mode)
3	1 = Force DI4 to value of bit 3 of parameter *10.04 DI forced data*. (0 = Normal mode)
4	1 = Force DI5 to value of bit 4 of parameter *10.04 DI forced data*. (0 = Normal mode)
5	1 = Force DI6 to value of bit 5 of parameter *10.04 DI forced data*. (0 = Normal mode)
6…15	Reserved

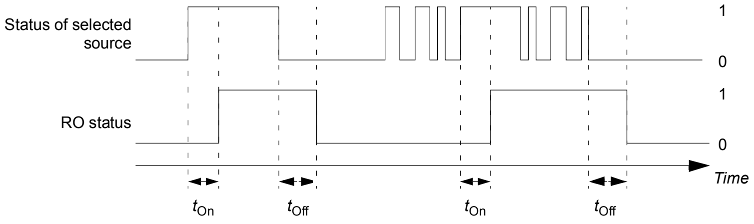
No.	Name/Value	Description	Def/FbEq16
	0000h…FFFFh	Override selection for digital inputs.	1 = 1

<table>
<tr><th>No.</th><th>Name/Value</th><th>Description</th><th>Def/FbEq16</th></tr>
<tr><td>10.04</td><td>DI forced data</td><td>Allows the data value of a forced digital input to be changed from 0 to 1. It is only possible to force an input that has been selected in parameter 10.03 DI force selection.
Bit 0 is the forced value for DI1; bit 5 is the forced value for the DI6.</td><td>0000h</td></tr>
<tr><td colspan="4">
<table>
<tr><th>Bit</th><th>Value</th></tr>
<tr><td>0</td><td>Force the value of this bit to D1, if so defined in parameter 10.03 DI force selection.</td></tr>
<tr><td>1</td><td>Force the value of this bit to D3, if so defined in parameter 10.03 DI force selection.</td></tr>
<tr><td>2</td><td>Force the value of this bit to D3, if so defined in parameter 10.03 DI force selection.</td></tr>
<tr><td>3</td><td>Force the value of this bit to D4, if so defined in parameter 10.03 DI force selection.</td></tr>
<tr><td>4</td><td>Force the value of this bit to D5, if so defined in parameter 10.03 DI force selection.</td></tr>
<tr><td>5</td><td>Force the value of this bit to D6, if so defined in parameter 10.03 DI force selection.</td></tr>
<tr><td>6…15</td><td>Reserved</td></tr>
</table>
</td></tr>
<tr><td></td><td>0000h…FFFFh</td><td>Forced values of digital inputs.</td><td>1 = 1</td></tr>
<tr><td>10.21</td><td>RO status</td><td>Status of relay outputs RO3…RO1.</td><td>-</td></tr>
<tr><td colspan="4">
<table>
<tr><th>Bit</th><th>Value</th></tr>
<tr><td>0</td><td>1 = RO1 is energized.</td></tr>
<tr><td>1</td><td>1 = RO2 is energized.</td></tr>
<tr><td>2</td><td>1 = RO3 is energized.</td></tr>
<tr><td>3…15</td><td>Reserved</td></tr>
</table>
</td></tr>
<tr><td></td><td>0000h…FFFFh</td><td>Status of relay outputs.</td><td>1 = 1</td></tr>
<tr><td>10.22</td><td>RO force selection</td><td>The signals connected to the relay outputs can be overridden for eg. testing purposes. A bit in parameter 10.23 RO forced data is provided for each relay output, and its value is applied whenever the corresponding bit in this parameter is 1.
Note: Boot and power cycle reset the force selections (parameters 10.22 and 10.23).</td><td>0000h</td></tr>
<tr><td colspan="4">
<table>
<tr><th>Bit</th><th>Value</th></tr>
<tr><td>0</td><td>1 = Force RO1 to value of bit 0 of parameter 10.23 RO forced data. (0 = Normal mode)</td></tr>
<tr><td>1</td><td>1 = Force RO2 to value of bit 1 of parameter 10.23 RO forced data. (0 = Normal mode)</td></tr>
<tr><td>2</td><td>1 = Force RO3 to value of bit 2 of parameter 10.23 RO forced data. (0 = Normal mode)</td></tr>
<tr><td>3…15</td><td>Reserved</td></tr>
</table>
</td></tr>
<tr><td></td><td>0000h…FFFFh</td><td>Override selection for relay outputs.</td><td>1 = 1</td></tr>
</table>

<table>
<tr><th>No.</th><th>Name/Value</th><th>Description</th><th>Def/FbEq16</th></tr>
<tr><td>10.23</td><td>RO forced data</td><td>Contains the values of relay outputs that are used instead of the connected signals if selected in parameter 10.22 RO force selection. Bit 0 is the forced value for RO1.</td><td></td></tr>
<tr><td></td><td colspan="3">
<table>
<tr><th>Bit</th><th>Value</th></tr>
<tr><td>0</td><td>Force the value of this bit to RO1, if so defined in parameter 10.22 RO force selection.</td></tr>
<tr><td>1</td><td>Force the value of this bit to RO2, if so defined in parameter 10.22 RO force selection.</td></tr>
<tr><td>2</td><td>Force the value of this bit to RO3, if so defined in parameter 10.22 RO force selection.</td></tr>
<tr><td>3…15</td><td>Reserved</td></tr>
</table>
</td></tr>
<tr><td></td><td>0000h…FFFFh</td><td>Forced RO values.</td><td>1 = 1</td></tr>
<tr><td>10.24</td><td>RO1 source</td><td>Selects a drive signal to be connected to relay output RO1.</td><td>Ready run</td></tr>
<tr><td></td><td>Not energized</td><td>Output is not energized.</td><td>0</td></tr>
<tr><td></td><td>Energized</td><td>Output is energized.</td><td>1</td></tr>
<tr><td></td><td>Ready run</td><td>Bit 1 of 06.11 Main status word (see page 111).</td><td>2</td></tr>
<tr><td></td><td>Enabled</td><td>Bit 0 of 06.16 Drive status word 1 (see page 112).</td><td>4</td></tr>
<tr><td></td><td>Started</td><td>Bit 5 of 06.16 Drive status word 1 (see page 112).</td><td>5</td></tr>
<tr><td></td><td>Magnetized</td><td>Bit 1 of 06.17 Drive status word 2 (see page 112).</td><td>6</td></tr>
<tr><td></td><td>Running</td><td>Bit 6 of 06.16 Drive status word 1 (see page 112).</td><td>7</td></tr>
<tr><td></td><td>Ready ref</td><td>Bit 2 of 06.11 Main status word (see page 111).</td><td>8</td></tr>
<tr><td></td><td>At setpoint</td><td>Bit 8 of 06.11 Main status word (see page 111).</td><td>9</td></tr>
<tr><td></td><td>Reverse</td><td>Bit 2 of 06.19 Speed control status word (see page 113).</td><td>10</td></tr>
<tr><td></td><td>Zero speed</td><td>Bit 0 of 06.19 Speed control status word (see page 113).</td><td>11</td></tr>
<tr><td></td><td>Above limit</td><td>Bit 10 of 06.17 Drive status word 2 (see page 112).</td><td>12</td></tr>
<tr><td></td><td>Warning</td><td>Bit 7 of 06.11 Main status word (see page 111).</td><td>13</td></tr>
<tr><td></td><td>Fault</td><td>Bit 3 of 06.11 Main status word (see page 111).</td><td>14</td></tr>
<tr><td></td><td>Fault (-1)</td><td>Inverted bit 3 of 06.11 Main status word (see page 111).</td><td>15</td></tr>
<tr><td></td><td>Fault/Warning</td><td>Bit 3 of 06.11 Main status word OR bit 7 of 06.11 Main status word (see page 111).</td><td>16</td></tr>
<tr><td></td><td>Overcurrent</td><td>Fault 2310 Overcurrent has occurred.</td><td>17</td></tr>
<tr><td></td><td>Overvoltage</td><td>Fault 3210 DC link overvoltage has occurred.</td><td>18</td></tr>
<tr><td></td><td>Drive temp</td><td>Fault 2381 IGBT overload or 4110 Control board temperature or 4210 IGBT overtemperature or 4290 Cooling or 42F1 IGBT temperature or 4310 Excess temperature or 4380 Excess temperature difference has occurred.</td><td>19</td></tr>
<tr><td></td><td>Undervoltage</td><td>Fault 3220 DC link undervoltage has occurred.</td><td>20</td></tr>
<tr><td></td><td>Motor temp</td><td>Fault 4981 External temperature 1 or 4982 External temperature 2 has occurred.</td><td>21</td></tr>
<tr><td></td><td>Reserved</td><td></td><td>22</td></tr>
<tr><td></td><td>Ext2 active</td><td>Bit 11 of 06.16 Drive status word 1 (see page 112).</td><td>23</td></tr>
<tr><td></td><td>Remote control</td><td>Bit 9 of 06.11 Main status word (see page 111).</td><td>24</td></tr>
<tr><td></td><td>Reserved</td><td></td><td>25…26</td></tr>
<tr><td></td><td>Timed function 1</td><td>Bit 0 of 34.01 Timed functions status (see page 191).</td><td>27</td></tr>
<tr><td></td><td>Timed function 2</td><td>Bit 1 of 34.01 Timed functions status (see page 191).</td><td>28</td></tr>
</table>

No.	Name/Value	Description	Def/FbEq16
	Timed function 3	Bit 2 of *34.01 Timed functions status* (see page *191*).	29
	Reserved		30…32
	Supervision 1	Bit 0 of *32.01 Supervision status* (see page *184*).	33
	Supervision 2	Bit 1 of *32.01 Supervision status* (see page *184*).	34
	Supervision 3	Bit 2 of *32.01 Supervision status* (see page *184*).	35
	Reserved		36…38
	Start delay	Bit 13 of *06.17 Drive status word 2* (see page *112*).	39
	RO/DIO control word bit0	Bit 0 of *10.99 RO/DIO control word* (see page *122*).	40
	RO/DIO control word bit1	Bit 1 of *10.99 RO/DIO control word* (see page *122*).	41
	RO/DIO control word bit2	Bit 2 of *10.99 RO/DIO control word* (see page *122*).	42
	Reserved		43…44
	PFC1	Bit 0 of *76.01 PFC status* (see page *256*).	45
	PFC2	Bit 1 of *76.01 PFC status* (see page *256*).	46
	PFC3	Bit 2 of *76.01 PFC status* (see page *256*).	47
	PFC4	Bit 3 of *76.01 PFC status* (see page *256*).	48
	PFC5	Bit 4 of *76.01 PFC status* (see page *256*).	49
	PFC6	Bit 5 of *76.01 PFC status* (see page *256*).	50
	Other [bit]	Source selection (see *Terms and abbreviations* on page *100*).	-
10.25	*RO1 ON delay*	Defines the activation delay for relay output RO1.  t_{On} = *10.25 RO1 ON delay* t_{Off} = *10.26 RO1 OFF delay*	0.0 s
	0.0 … 3000.0 s	Activation delay for RO1.	10 = 1 s
10.26	*RO1 OFF delay*	Defines the deactivation delay for relay output RO1. See parameter *10.25 RO1 ON delay*.	0.0 s
	0.0 … 3000.0 s	Deactivation delay for RO1.	10 = 1 s
10.27	*RO2 source*	Selects a drive signal to be connected to relay output RO2. For the available selections, see parameter *10.24 RO1 source*.	*Running*

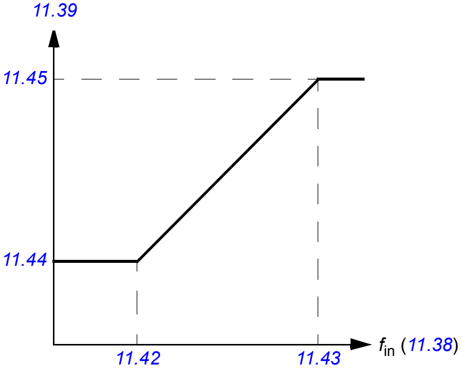
<table>
<tr><th>No.</th><th>Name/Value</th><th>Description</th><th>Def/FbEq16</th></tr>
<tr><td>*10.28*</td><td>*RO2 ON delay*</td><td>Defines the activation delay for relay output RO2.</td><td>0.0 s</td></tr>
<tr><td colspan="4">


t_{On} = *10.28 RO2 ON delay*
t_{Off} = *10.29 RO2 OFF delay*
</td></tr>
<tr><td></td><td>0.0 … 3000.0 s</td><td>Activation delay for RO2.</td><td>10 = 1 s</td></tr>
<tr><td>*10.29*</td><td>*RO2 OFF delay*</td><td>Defines the deactivation delay for relay output RO2. See parameter *10.28 RO2 ON delay*.</td><td>0.0 s</td></tr>
<tr><td></td><td>0.0 … 3000.0 s</td><td>Deactivation delay for RO2.</td><td>10 = 1 s</td></tr>
<tr><td>*10.30*</td><td>*RO3 source*</td><td>Selects a drive signal to be connected to relay output RO3. For the available selections, see parameter *10.24 RO1 source*.</td><td>*Fault (-1)*</td></tr>
<tr><td>*10.31*</td><td>*RO3 ON delay*</td><td>Defines the activation delay for relay output RO3.</td><td>0.0 s</td></tr>
<tr><td colspan="4">


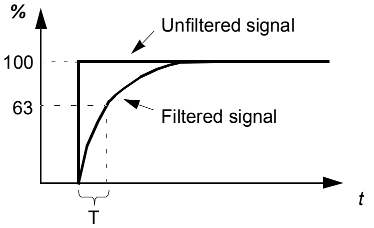
t_{On} = *10.31 RO3 ON delay*
t_{Off} = *10.32 RO3 OFF delay*
</td></tr>
<tr><td></td><td>0.0 … 3000.0 s</td><td>Activation delay for RO3.</td><td>10 = 1 s</td></tr>
<tr><td>*10.32*</td><td>*RO3 OFF delay*</td><td>Defines the deactivation delay for relay output RO3. See parameter *10.31 RO3 ON delay*.</td><td>0.0 s</td></tr>
<tr><td></td><td>0.0 … 3000.0 s</td><td>Deactivation delay for RO3.</td><td>10 = 1 s</td></tr>
</table>

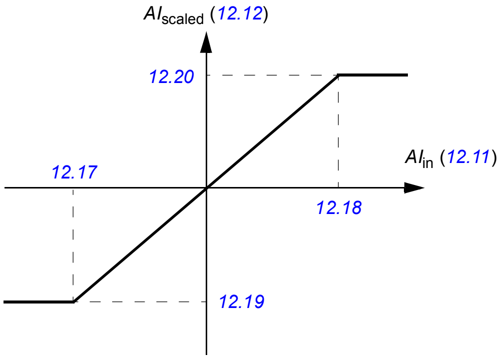
<table>
<tr><th>No.</th><th>Name/Value</th><th>Description</th><th>Def/FbEq16</th></tr>
<tr><td><i>10.99</i></td><td><i>RO/DIO control word</i></td><td>Storage parameter for controlling the relay outputs eg. through the embedded fieldbus interface. To control the relay outputs (RO) of the drive, send a control word with the bit assignments shown below as Modbus I/O data. Set the target selection parameter of that particular data (<i>58.101</i>…<i>58.114</i>) to <i>RO/DIO control word</i>. In the source selection parameter of the desired output, select the appropriate bit of this word.</td><td>0000h</td></tr>
<tr><td colspan="4">
<table>
<tr><th>Bit</th><th>Name</th><th>Description</th></tr>
<tr><td>0</td><td>RO1</td><td rowspan="3">Source bits for relay outputs RO1…RO3. See parameters <i>10.24</i>, <i>10.27</i> and <i>10.30</i>.</td></tr>
<tr><td>1</td><td>RO2</td></tr>
<tr><td>2</td><td>RO3</td></tr>
<tr><td>3</td><td>RO4</td><td rowspan="2">Source bits for relay outputs RO4…RO5 with a CHDI-01 or CMOD-01 extension module. See parameters <i>15.07</i> and.<i>15.10</i>.</td></tr>
<tr><td>4</td><td>RO5</td></tr>
<tr><td>5…7</td><td colspan="2">Reserved</td></tr>
<tr><td>8</td><td>DIO1</td><td>Source bit for digital output DO1 with a CMOD-01 extension module. See parameter <i>15.23</i>.</td></tr>
<tr><td>9…15</td><td colspan="2">Reserved</td></tr>
</table>
</td></tr>
<tr><td></td><td>0000h…FFFFh</td><td>RO/DIO control word.</td><td>1 = 1</td></tr>
<tr><td><i>10.101</i></td><td><i>RO1 toggle counter</i></td><td>Displays the number of times relay output RO1 has changed states.</td><td>-</td></tr>
<tr><td></td><td>0…4294967000</td><td>State change count.</td><td>1 = 1</td></tr>
<tr><td><i>10.102</i></td><td><i>RO2 toggle counter</i></td><td>Displays the number of times relay output RO2 has changed states.</td><td>-</td></tr>
<tr><td></td><td>0…4294967000</td><td>State change count.</td><td>1 = 1</td></tr>
<tr><td><i>10.103</i></td><td><i>RO3 toggle counter</i></td><td>Displays the number of times relay output RO3 has changed states.</td><td>-</td></tr>
<tr><td></td><td>0…4294967000</td><td>State change count.</td><td>1 = 1</td></tr>
</table>

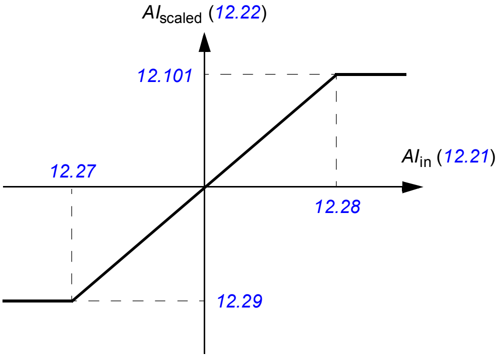
11 Standard DIO, FI, FO		Configuration of the frequency input.	
11.21	*DI5 configuration*	Selects how digital input 5 is used.	*Digital input*
	Digital input	DI5 is used as a digital input.	0
	Frequency input	DI5 is used as a frequency input.	1
11.38	*Freq in 1 actual value*	Displays the value of frequency input 1 (via DI5 when it is used as a frequency input) before scaling. See parameter *11.42 Freq in 1 min*. This parameter is read-only.	-
	0 … 16000 Hz	Unscaled value of frequency input 1.	1 = 1 Hz
11.39	*Freq in 1 scaled value*	Displays the value of frequency input 1 (via DI5 when it is used as a frequency input) after scaling. See parameter *11.42 Freq in 1 min*. This parameter is read-only.	-
	-32768.000… 32767.000	Scaled value of frequency input 1 (DI5).	1 = 1

No.	**Name/Value**	**Description**	**Def/FbEq16**
11.42	*Freq in 1 min*	Defines the minimum for the frequency actually arriving at frequency input 1 (DI5 when it is used as a frequency input). The incoming frequency signal (*11.38 Freq in 1 actual value*) is scaled into an internal signal (*11.39 Freq in 1 scaled value*) by parameters *11.42*…*11.45* as follows:  	0 Hz
	0 … 16000 Hz	Minimum frequency of frequency input 1 (DI5).	1 = 1 Hz
11.43	*Freq in 1 max*	Defines the maximum for the frequency actually arriving at frequency input 1 (DI5 when it is used as a frequency input). See parameter *11.42 Freq in 1 min*.v	16000 Hz
	0 … 16000 Hz	Maximum frequency for frequency input 1 (DI5).	1 = 1 Hz
11.44	*Freq in 1 at scaled min*	Defines the value that is required to correspond internally to the minimum input frequency defined by parameter *11.42 Freq in 1 min*. See diagram at parameter *11.42 Freq in 1 min*.	0.000
	-32768.000… 32767.000	Value corresponding to minimum of frequency input 1.	1 = 1
11.45	*Freq in 1 at scaled max*	Defines the value that is required to correspond internally to the maximum input frequency defined by parameter *11.43 Freq in 1 max*. See diagram at parameter *11.42 Freq in 1 min*.	1500.000; 1800.000 (*95.20* b0)
	-32768.000… 32767.000	Value corresponding to maximum of frequency input 1.	1 = 1

<table>
<tr><th>No.</th><th>Name/Value</th><th>Description</th><th>Def/FbEq16</th></tr>
<tr><td colspan="2">**12 Standard AI**</td><td>Configuration of standard analog inputs.</td><td></td></tr>
<tr><td>12.02</td><td>*AI force selection*</td><td>The true readings of the analog inputs can be overridden for eg. testing purposes. A forced value parameter is provided for each analog input, and its value is applied whenever the corresponding bit in this parameter is 1.
Note: AI filter times (parameters *12.16 AI1 filter time* and *12.26 AI2 filter time*) have no effect on forced AI values (parameters *12.13 AI1 forced value* and *12.23 AI2 forced value*).
Note: Boot and power cycle reset the force selections (parameters *12.02* and *12.03*).</td><td>0000h</td></tr>
<tr><td></td><td colspan="3">
<table>
<tr><th>Bit</th><th>Value</th></tr>
<tr><td>0</td><td>1 = Force AI1 to value of parameter *12.13 AI1 forced value*.</td></tr>
<tr><td>1</td><td>1 = Force AI2 to value of parameter *12.23 AI2 forced value*.</td></tr>
<tr><td>2…15</td><td>Reserved</td></tr>
</table>
</td></tr>
<tr><td></td><td>0000h…FFFFh</td><td>Forced values selector for analog inputs AI1 and AI2.</td><td>1 = 1</td></tr>
<tr><td>12.03</td><td>*AI supervision function*</td><td>Selects how the drive reacts when an analog input signal moves out of the minimum and/or maximum limits specified for the input.
The inputs and the limits to be observed are selected by parameter *12.04 AI supervision selection*.</td><td>*No action*</td></tr>
<tr><td></td><td>No action</td><td>No action taken.</td><td>0</td></tr>
<tr><td></td><td>Fault</td><td>Drive trips on *80A0 AI supervision*.</td><td>1</td></tr>
<tr><td></td><td>Warning</td><td>Drive generates an *A8A0 AI supervision* warning.</td><td>2</td></tr>
<tr><td></td><td>Last speed</td><td>Drive generates a warning (*A8A0 AI supervision*) and freezes the speed (or frequency) to the level the drive was operating at. The speed/frequency is determined on the basis of actual speed using 850 ms low-pass filtering.
⚠ **WARNING!** Make sure that it is safe to continue operation in case of a communication break.</td><td>3</td></tr>
<tr><td></td><td>Speed ref safe</td><td>Drive generates a warning (*A8A0 AI supervision*) and sets the speed to the speed defined by parameter *22.41 Speed ref safe* (or *28.41 Frequency ref safe* when frequency reference is being used).
⚠ **WARNING!** Make sure that it is safe to continue operation in case of a communication break.</td><td>4</td></tr>
<tr><td>12.04</td><td>*AI supervision selection*</td><td>Specifies the analog input limits to be supervised. See parameter *12.03 AI supervision function*.</td><td>0000h</td></tr>
<tr><td></td><td colspan="3">
<table>
<tr><th>Bit</th><th>Name</th><th>Description</th></tr>
<tr><td>0</td><td>AI1 < MIN</td><td>1 = Minimum limit supervision of AI1 active.</td></tr>
<tr><td>1</td><td>AI1 > MAX</td><td>1 = Maximum limit supervision of AI1 active.</td></tr>
<tr><td>2</td><td>AI2 < MIN</td><td>1 = Minimum limit supervision of AI2 active.</td></tr>
<tr><td>3</td><td>AI2 > MAX</td><td>1 = Maximum limit supervision of AI2 active.</td></tr>
<tr><td>4…15</td><td colspan="2">Reserved</td></tr>
</table>
</td></tr>
<tr><td></td><td>0000h…FFFFh</td><td>Activation of analog input supervision.</td><td>1 = 1</td></tr>
</table>

No.	**Name/Value**	**Description**	**Def/FbEq16**
12.11	*AI1 actual value*	Displays the value of analog input AI1 in mA or V (depending on whether the input is set to current or voltage by a hardware setting). This parameter is read-only.	-
	0.000…20.000 mA or 0.000…10.000 V	Value of analog input AI1.	1000 = 1 unit
12.12	*AI1 scaled value*	Displays the value of analog input AI1 after scaling. See parameters *12.19 AI1 scaled at AI1 min* and *12.20 AI1 scaled at AI1 max*. This parameter is read-only.	-
	-32768.000… 32767.000	Scaled value of analog input AI1.	1 = 1
12.13	*AI1 forced value*	Forced value that can be used instead of the true reading of the input. See parameter *12.02 AI force selection*.	-
	0.000…20.000 mA or 0.000…10.000 V	Forced value of analog input AI1.	1000 = 1 unit
12.15	*AI1 unit selection*	Selects the unit for readings and settings related to analog input AI1.	*V*
	V	Volts.	2
	mA	Milliamperes.	10
12.16	*AI1 filter time*	Defines the filter time constant for analog input AI1.  $O = I \times (1 - e^{-t/T})$ I = filter input (step) O = filter output *t* = time T = filter time constant **Note:** The signal is also filtered due to the signal interface hardware (approximately 0.25 ms time constant). This cannot be changed by any parameter.	0.100 s
	0.000…30.000 s	Filter time constant.	1000 = 1 s
12.17	*AI1 min*	Defines the minimum site value for analog input AI1. Set the value actually sent to the drive when the analog signal from plant is wound to its minimum setting. See also parameter *12.19 AI1 scaled at AI1 min*.	4.000 mA or 0.000 V
	0.000…20.000 mA or 0.000…10.000 V	Minimum value of AI1.	1000 = 1 unit

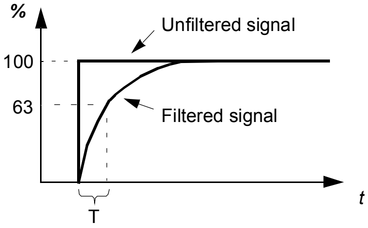
No.	Name/Value	Description	Def/FbEq16
12.18	AI1 max	Defines the maximum site value for analog input AI1. Set the value actually sent to the drive when the analog signal from plant is wound to its maximum setting. See also parameter 12.19 AI1 scaled at AI1 min.	20.000 mA or 10.000 V
	0.000…20.000 mA or 0.000…10.000 V	Maximum value of AI1.	1000 = 1 unit
12.19	AI1 scaled at AI1 min	Defines the real internal value that corresponds to the minimum analog input AI1 value defined by parameter 12.17 AI1 min. (Changing the polarity settings of 12.19 and 12.20 can effectively invert the analog input.) 	0.000
	-32768.000… 32767.000	Real value corresponding to minimum AI1 value.	1 = 1
12.20	AI1 scaled at AI1 max	Defines the real internal value that corresponds to the maximum analog input AI1 value defined by parameter 12.18 AI1 max. See the drawing at parameter 12.19 AI1 scaled at AI1 min.	50.000; 60.000 (95.20 b0)
	-32768.000… 32767.000	Real value corresponding to maximum AI1 value.	1 = 1
12.21	AI2 actual value	Displays the value of analog input AI2 in mA or V (depending on whether the input is set to current or voltage by a hardware setting). This parameter is read-only.	-
	0.000…20.000 mA or 0.000…10.000 V	Value of analog input AI2.	1000 = 1 unit
12.22	AI2 scaled value	Displays the value of analog input AI2 after scaling. See parameters 12.29 AI2 scaled at AI2 min and 12.101 AI1 percent value. This parameter is read-only.	-
	-32768.000… 32767.000	Scaled value of analog input AI2.	1 = 1
12.23	AI2 forced value	Forced value that can be used instead of the true reading of the input. See parameter 12.02 AI force selection.	-
	0.000…20.000 mA or 0.000…10.000 V	Forced value of analog input AI2.	1000 = 1 unit

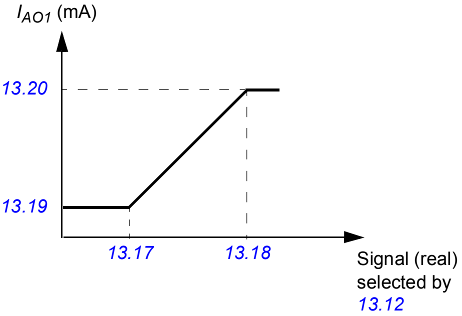
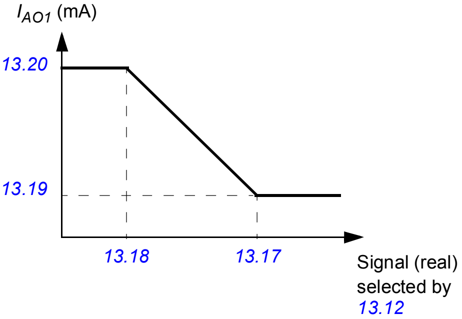
No.	Name/Value	Description	Def/FbEq16
12.25	*AI2 unit selection*	Selects the unit for readings and settings related to analog input AI2.	*mA*
	V	Volts.	2
	mA	Milliamperes.	10
12.26	*AI2 filter time*	Defines the filter time constant for analog input AI2. See parameter *12.16 AI1 filter time*.	0.100 s
	0.000…30.000 s	Filter time constant.	1000 = 1 s
12.27	*AI2 min*	Defines the minimum site value for analog input AI2. Set the value actually sent to the drive when the analog signal from plant is wound to its minimum setting.	
	0.000…20.000 mA or 0.000…10.000 V	Minimum value of AI2.	1000 = 1 unit
12.28	*AI2 max*	Defines the maximum site value for analog input AI2. Set the value actually sent to the drive when the analog signal from plant is wound to its maximum setting.	
	0.000…20.000 mA or 0.000…10.000 V	Maximum value of AI2.	1000 = 1 unit
12.29	*AI2 scaled at AI2 min*	Defines the real value that corresponds to the minimum analog input AI2 value defined by parameter *12.27 AI2 min*. (Changing the polarity settings of *12.29* and *12.101* can effectively invert the analog input.)  	0.000
	-32768.000… 32767.000	Real value corresponding to minimum AI2 value.	1 = 1
12.30	*AI2 scaled at AI2 max*	Defines the real value that corresponds to the minimum analog input AI2 value defined by parameter *12.28 AI2 max*. See the drawing at parameter of *12.29 AI2 scaled at AI2 min*.	50.000
	-32768.000… 32767.000	Real value corresponding to maximum AI2 value.	1 = 1
12.101	*AI1 percent value*	Value of analog input AI1 in percent of AI1 scaling (*12.18 AI1 max* - *12.17 AI1 min*).	-
	0.00…100.00%	AI1 value	100 = 1%
12.102	*AI2 percent value*	Value of analog input AI2 in percent of AI2 scaling (*12.28 AI2 max* - *12.27 AI2 min*).	-
	0.00…100.00%	AI2 value	100 = 1%

No.	Name/Value	Description	Def/FbEq16
13 Standard AO		Configuration of standard analog outputs.	
13.02	*AO force selection*	The source signals of the analog outputs can be overridden for eg. testing purposes. A forced value parameter is provided for each analog output, and its value is applied whenever the corresponding bit in this parameter is 1. **Note:** Boot and power cycle reset the force selections (parameters *13.02* and *13.11*).	0000h

Bit	Value
0	1 = Force AO1 to value of parameter *13.13 AO1 forced value*. (0 = Normal mode)
1	1 = Force AO2 to value of parameter *13.23 AO2 forced value*. (0 = Normal mode)
2…15	Reserved

No.	Name/Value	Description	Def/FbEq16
	0000h…FFFFh	Forced values selector for analog outputs AO1 and AO2.	1 = 1
13.11	*AO1 actual value*	Displays the value of AO1 in mA or V. This parameter is read-only.	-
	0.000…22.000 mA / 0.000…11.000 V	Value of AO1.	1 = 1 mA
13.12	*AO1 source*	Selects a signal to be connected to analog output AO1.	*Output frequency*
	Zero	None.	0
	Motor speed used	*01.01 Motor speed used* (page *103*).	1
	Reserved		2
	Output frequency	*01.06 Output frequency* (page *103*).	3
	Motor current	*01.07 Motor current* (page *103*).	4
	Motor current % of motor nominal	*01.08 Motor current % of motor nom* (page *103*).	5
	Motor torque	*01.10 Motor torque* (page *103*).	6
	DC voltage	*01.11 DC voltage* (page *103*).	7
	Output power	*01.14 Output power* (page *104*).	8
	Reserved		9
	Speed ref ramp in	*23.01 Speed ref ramp input* (page *162*).	10
	Speed ref ramp out	*23.02 Speed ref ramp output* (page *162*).	11
	Speed ref used	*24.01 Used speed reference* (page *163*).	12
	Reserved		13
	Freq ref used	*28.02 Frequency ref ramp output* (page *167*).	14
	Reserved		15
	Process PID out	*40.01 Process PID output actual* (page *213*).	16
	Reserved		17…19
	Temp sensor 1 excitation	The output is used to feed an excitation current to the temperature sensor 1, see parameter *35.11 Temperature 1 source*. See also section *Motor thermal protection* (page *84*).	20
	Temp sensor 2 excitation	The output is used to feed an excitation current to the temperature sensor 2, see parameter *35.21 Temperature 2 source*. See also section *Motor thermal protection* (page *84*).	21

No.	Name/Value	Description	Def/FbEq16
	Reserved		21…25
	Abs motor speed used	*01.61 Abs motor speed used* (page *106*).	26
	Abs motor speed %	*01.62 Abs motor speed %* (page *106*).	27
	Abs output frequency	*01.63 Abs output frequency* (page *106*).	28
	Reserved		29
	Abs motor torque	*01.64 Abs motor torque* (page *106*).	30
	Abs output power	*01.65 Abs output power* (page *106*).	31
	Abs motor shaft power	*01.68 Abs motor shaft power* (page *106*).	32
	External PID1 out	*71.01 External PID act value* ((page *254*).	33
	Reserved		34…36
	AO1 data storage	*13.91 AO1 data storage* (page *133*).	37
	AO2 data storage	*13.92 AO2 data storage* (page *133*).	38
	Other	Source selection (see *Terms and abbreviations* on page *100*).	-
13.13	*AO1 forced value*	Forced value that can be used instead of the selected output signal. See parameter *13.02 AO force selection*.	0.000 mA
	0.000…22.000 mA / 0.000…11.000 V	Forced value for AO1.	1 = 1 unit
13.15	*AO1 unit selection*	Selects the unit for readings and settings related to analog input AO1.	*mA*
	V	Volts.	2
	mA	Milliamperes.	10
13.16	*AO1 filter time*	Defines the filtering time constant for analog output AO1.  O = I × (1 - $e^{-t/T}$) I = filter input (step) O = filter output *t* = time T = filter time constant	0.100 s
	0.000 … 30.000 s	Filter time constant.	1000 = 1 s

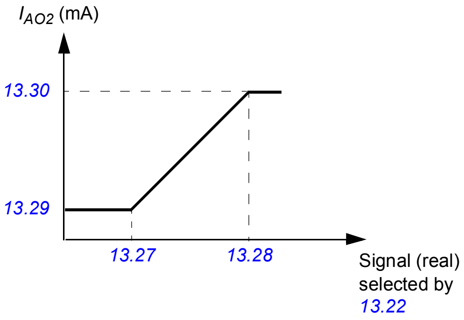
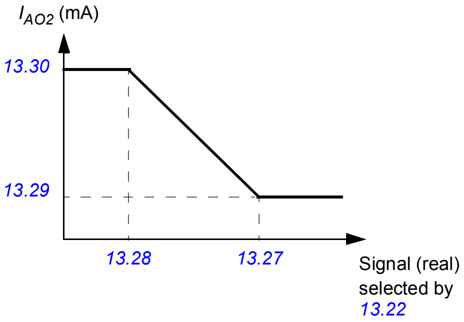
No.	Name/Value	Description	Def/FbEq16
13.17	*AO1 source min*	Defines the real minimum value of the signal (selected by parameter *13.12 AO1 source*) that corresponds to the minimum required AO1 output value (defined by parameter *13.19 AO1 out at AO1 src min*).  Programming *13.17* as the maximum value and *13.18* as the minimum value inverts the output.  	0.0

No.	**Name/Value**	**Description**	**Def/FbEq16**

AO has automatic scaling. Every time the source for the AO is changed, the scaling range is changed accordingly. User given minimum and maximum values override the automatic values.

	13.12 AO1 source, *13.22 AO2 source*	*13.17 AO1 source min*, *13.27 AO2 source min*	*13.18 AO1 source max*, *13.28 AO2 source max*
0	*Zero*	N/A (Output is constant zero.)	
1	*Motor speed used*	0	*46.01 Speed scaling*
3	*Output frequency*	0	*46.02 Frequency scaling*
4	*Motor current*	0	*30.17 Maximum current*
5	*Motor current % of motor nominal*	0%	100%
6	*Motor torque*	0	*46.03 Torque scaling*
7	*DC voltage*	Min. value of *01.11 DC voltage*	Max. value of *01.11 DC voltage*
8	*Output power*	0	*46.04 Power scaling*
10	*Speed ref ramp in*	0	*46.01 Speed scaling*
11	*Speed ref ramp out*	0	*46.01 Speed scaling*
12	*Speed ref used*	0	*46.01 Speed scaling*
14	*Freq ref used*	0	*46.02 Frequency scaling*
16	*Process PID out*	Min. value of *40.01 Process PID output actual*	Max. value of *40.01 Process PID output actual*
20	*Temp sensor 1 excitation*	N/A (Analog output is not scaled; it is determined by the sensor's triggering voltage.)	
21	*Temp sensor 2 excitation*		
26	*Abs motor speed used*	0	*46.01 Speed scaling*
27	*Abs motor speed %*	0	*46.01 Speed scaling*
28	*Abs output frequency*	0	*46.02 Frequency scaling*
30	*Abs motor torque*	0	*46.03 Torque scaling*
31	*Abs output power*	0	*46.04 Power scaling*
32	*Abs motor shaft power*	0	*46.04 Power scaling*
33	*External PID1 out*	Min. value of *71.01 External PID act value*	Max. value of *71.01 External PID act value*
	Other	Min. value of the selected parameter	Max. value of the selected parameter

	-32768.0…32767.0	Real signal value corresponding to minimum AO1 output value.	1 = 1
13.18	*AO1 source max*	Defines the real maximum value of the signal (selected by parameter *13.12 AO1 source*) that corresponds to the maximum required AO1 output value (defined by parameter *13.20 AO1 out at AO1 src max*). See parameter *13.17 AO1 source min*.	50.0; 60.0 (*95.20* b0)
	-32768.0…32767.0	Real signal value corresponding to maximum AO1 output value.	1 = 1
13.19	*AO1 out at AO1 src min*	Defines the minimum output value for analog output AO1. See also drawing at parameter *13.17 AO1 source min*.	0.000 mAV
	0.000…22.000 mA / 0.000…11.000 V	Minimum AO1 output value.	1000 = 1 unit
13.20	*AO1 out at AO1 src max*	Defines the maximum output value for analog output AO1. See also drawing at parameter *13.17 AO1 source min*.	20.000 mA
	0.000…22.000 mA / 0.000…11.000 V	Maximum AO1 output value.	1000 = 1 unit

No.	**Name/Value**	**Description**	**Def/FbEq16**
13.21	*AO2 actual value*	Displays the value of AO2 in mA. This parameter is read-only.	-
	0.000 … 22.000 mA	Value of AO2.	1000 = 1 mA
13.22	*AO2 source*	Selects a signal to be connected to analog output AO2. Alternatively, sets the output to excitation mode to feed a constant current to a temperature sensor. For the selections, see parameter *13.12 AO1 source*.	*Motor current*
13.23	*AO2 forced value*	Forced value that can be used instead of the selected output signal. See parameter *13.02 AO force selection*.	0.000 mA
	0.000 … 22.000 mA	Forced value for AO2.	1000 = 1 mA
13.26	*AO2 filter time*	Defines the filtering time constant for analog output AO2. See parameter *13.16 AO1 filter time*.	0.100 s
	0.000 … 30.000 s	Filter time constant.	1000 = 1 s
13.27	*AO2 source min*	Defines the real minimum value of the signal (selected by parameter *13.22 AO2 source*) that corresponds to the minimum required AO2 output value (defined by parameter *13.29 AO2 out at AO2 src min*). See parameter *13.17 AO1 source min* about the AO automatic scaling.  Programming *13.27* as the maximum value and *13.28* as the minimum value inverts the output. 	0.0
	-32768.0…32767.0	Real signal value corresponding to minimum AO2 output value.	1 = 1

No.	Name/Value	Description	Def/FbEq16
13.28	*AO2 source max*	Defines the real maximum value of the signal (selected by parameter *13.22 AO2 source*) that corresponds to the maximum required AO2 output value (defined by parameter *13.30 AO2 out at AO2 src max*). See parameter *13.27 AO2 source min*. See parameter *13.17 AO1 source min* about the AO automatic scaling.	
	-32768.0…32767.0	Real signal value corresponding to maximum AO2 output value.	1 = 1
13.29	*AO2 out at AO2 src min*	Defines the minimum output value for analog output AO2. See also drawing at parameter *13.27 AO2 source min*.	0.000 mA
	0.000 … 22.000 mA	Minimum AO2 output value.	1000 = 1 mA
13.30	*AO2 out at AO2 src max*	Defines the maximum output value for analog output AO2. See also drawing at parameter *13.27 AO2 source min*.	20.000 mA
	0.000 … 22.000 mA	Maximum AO2 output value.	1000 = 1 mA
13.91	*AO1 data storage*	Storage parameter for controlling analog output AO1 eg. through the embedded fieldbus interface. In parameter *13.12 AO1 source*, select *AO1 data storage*. Then set this parameter as the target of the incoming value data. With the embedded fieldbus interface, simply set the target selection parameter of that particular data (*58.101*…*58.114*) to *AO1 data storage*.	0.00
	-327.68…327.67	Storage parameter for AO1.	100 = 1
13.92	*AO2 data storage*	Storage parameter for controlling analog output AO2 eg. through the embedded fieldbus interface. In parameter *13.22 AO2 source*, select *AO2 data storage*. Then set this parameter as the target of the incoming value data. With the embedded fieldbus interface, simply set the target selection parameter of that particular data (*58.101*…*58.114*) to *AO2 data storage*.	0.00
	-327.68…327.67	Storage parameter for AO2.	100 = 1

15 I/O extension module		Configuration of the I/O extension module installed in slot 2. See also section *Programmable I/O extensions* (page *47*). **Note:** The contents of the parameter group vary according to the selected I/O extension module type.	
15.01	*Extension module type*	Activates (and specifies the type of) I/O extension module. If the value is *None*, when an extension module has been installed and the dive is powered, the drive automatically sets the value to the type it has detected (= value of parameter *15.02 Detected extension module*); otherwise warning *A7AB Extension I/O configuration failure* is generated and you have to set the value of this parameter manually.	*None*
	None	Inactive.	0
	CMOD-01	CMOD-01 multifunction extension module (external 24 V AC/DC and digital I/O).	1
	CMOD-02	CMOD-02 multifunction extension module (external 24 V AC/DC and isolated PTC interface).	2
	CHDI-01	CHDI-01 115/230 V digital input extension module.	3
	CPTC-02	CPTC-02 extension module.	4
15.02	*Detected extension module*	I/O extension module detected on the drive.	*None*
	None	Inactive.	0

No.	Name/Value	Description	Def/FbEq16
	CMOD-01	CMOD-01 multifunction extension module (external 24 V AC/DC and digital I/O).	1
	CMOD-02	CMOD-02 multifunction extension module (external 24 V AC/DC and isolated PTC interface).	2
	CHDI-01	CHDI-01 115/230 V digital input extension module.	3
	CPTC-02		4
15.03	*DI status*	Displays the status of the digital inputs DI7…DI12 on the extension module Bit 0 indicates the status of DI7. **Example:** 001001b = DI7 and DI10 are on, remainder are off. This parameter is read-only.	-

Bit	Name	Description
0	DI7	1 = Digital input 7 is ON.
1	DI8	1 = Digital input 8 is ON.
2	DI9	1 = Digital input 9 is ON.
3	DI10	1 = Digital input 10 is ON.
4	DI11	1 = Digital input 11 is ON.
5	DI12	1 = Digital input 12 is ON.
6…15	Reserved	

No.	Name/Value	Description	Def/FbEq16
	0000h…FFFFh	Status of digital input/outputs.	1 = 1
15.04	*RO/DO status*	Displays the status of the relay outputs RO4 and RO5 and digital output DO1 on the extension module. Bits 0…1 indicates the status of RO4…RO5; bit 5 indicates the status of DO1. **Example:** 100101b = RO4 is on, RO5 is off. and DO1 is on. This parameter is read-only.	-

Bit	Name	Description
0	RO4	1 = Relay output 4 is ON.
1	RO5	1 = Relay output 5 is ON
2…4	Reserved	
5	DO1	1 = Digital output 1 is ON.
6…15	Reserved	

No.	Name/Value	Description	Def/FbEq16
	0000h…FFFFh	Status of relay/digital outputs.	1 = 1

No.	Name/Value	Description	Def/FbEq16
15.05	*RO/DO force selection*	The electrical statuses of the relay/digital outputs can be overridden for eg. testing purposes. A bit in parameter *15.06 RO/DO forced data* is provided for each relay or digital output, and its value is applied whenever the corresponding bit in this parameter is 1. **Note:** Boot and power cycle reset the force selections (parameters *15.05* and *15.06*).	0000h

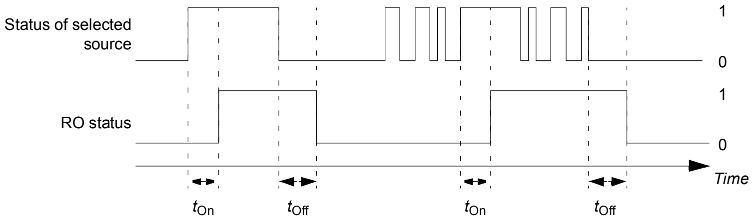
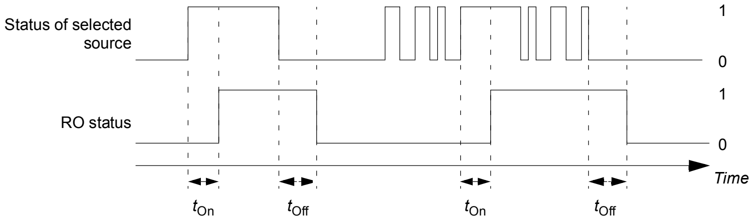
Bit	Value
0	1 = Force RO4 to value of bit 0 of parameter *15.06 RO/DO forced data*.
1	1 = Force RO5 to value of bit 1 of parameter *15.06 RO/DO forced data*.
2…4	Reserved
5	1 = Force DO1 to value of bit 5 of parameter *15.06 RO/DO forced data*.
6…15	Reserved

No.	Name/Value	Description	Def/FbEq16
	0000h…FFFFh	Override selection for relay/digital outputs.	1 = 1
15.06	*RO/DO forced data*	Allows the data value of a forced relay or digital output to be changed from 0 to 1. It is only possible to force an output that has been selected in parameter *15.05 RO/DO force selection*. Bits 0…1 are the forced values for RO4…RO5; bit 5 is the forced value for DO1.	0000h

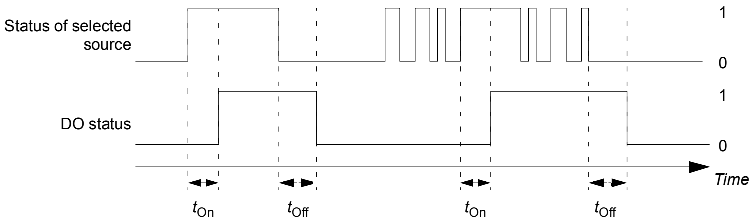
Bit	Name	Description
0	RO4	Force the value of this bit to RO4, if so defined in parameter *15.05 RO/DO force selection*.
1	RO5	Force the value of this bit to RO5, if so defined in parameter *15.05 RO/DO force selection*.
2…4	Reserved	
5	DO1	1Force the value of this bit to DO1 if so defined in parameter *15.05 RO/DO force selection*.
6…15	Reserved	

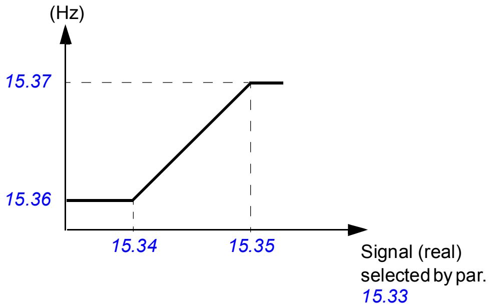
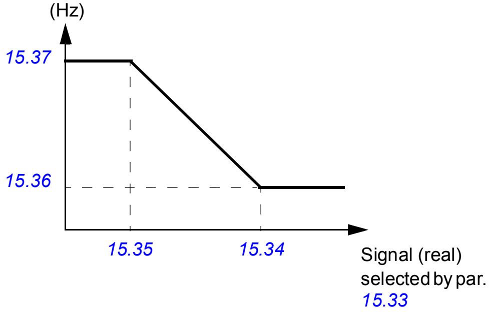
No.	Name/Value	Description	Def/FbEq16
	0000h…FFFFh	Forced values of relay/digital outputs.	1 = 1
15.07	*RO4 source*	Selects a drive signal to be connected to relay output RO4.	*Not energized*
	Not energized	Output is not energized.	0
	Energized	Output is energized.	1
	Ready run	Bit 1 of *06.11 Main status word* (see page *111*).	2
	Reserved		3
	Enabled	Bit 0 of *06.16 Drive status word 1* (see page *112*).	4
	Started	Bit 5 of *06.16 Drive status word 1* (see page *112*).	5
	Magnetized	Bit 1 of *06.17 Drive status word 2* (see page *112*).	6
	Running	Bit 6 of *06.16 Drive status word 1* (see page *112*).	7
	Ready ref	Bit 2 of *06.11 Main status word* (see page *111*).	8
	At setpoint	Bit 8 of *06.11 Main status word* (see page *111*).	9
	Reverse	Bit 2 of *06.19 Speed control status word* (see page *113*).	10
	Zero speed	Bit 0 of *06.19 Speed control status word* (see page *113*).	11

No.	Name/Value	Description	Def/FbEq16
	Above limit	Bit 10 of *06.17 Drive status word 2* (see page *112*).	12
	Warning	Bit 7 of *06.11 Main status word* (see page *111*).	13
	Fault	Bit 3 of *06.11 Main status word* (see page *111*).	14
	Fault (-1)	Inverted bit 3 of *06.11 Main status word* (see page *111*).	15
	Fault/Warning	Bit 3 of *06.11 Main status word* OR bit 7 of *06.11 Main status word* (see page *111*).	16
	Overcurrent	Fault *2310 Overcurrent* has occurred.	17
	Overvoltage	Fault *3210 DC link overvoltage* has occurred.	18
	Drive temp	Fault *2381 IGBT overload* or *4110 Control board temperature* or *4210 IGBT overtemperature* or *4290 Cooling* or *42F1 IGBT temperature* or *4310 Excess temperature* or *4380 Excess temperature difference* has occurred.	19
	Undervoltage	Fault *3220 DC link undervoltage* has occurred.	20
	Motor temp	Fault *4981 External temperature 1* or *4982 External temperature 2* has occurred.	21
	Reserved		22
	Ext2 active	Bit 11 of *06.16 Drive status word 1* (see page *112*).	23
	Remote control	Bit 9 of *06.11 Main status word* (see page *111*).	24
	Reserved		25…26
	Timed function 1	Bit 0 of *34.01 Timed functions status* (see page *191*).	27
	Timed function 2	Bit 1 of *34.01 Timed functions status* (see page *191*).	28
	Timed function 3	Bit 2 of *34.01 Timed functions status* (see page *191*).	29
	Reserved		30…32
	Supervision 1	Bit 0 of *32.01 Supervision status* (see page *184*).	33
	Supervision 2	Bit 1 of *32.01 Supervision status* (see page *184*).	34
	Supervision 3	Bit 2 of *32.01 Supervision status* (see page *184*).	35
	Start delay	Bit 13 of *06.17 Drive status word 2* (see page *112*).	39
	RO/DIO control word bit0	Bit 0 of *10.99 RO/DIO control word* (see page *122*).	40
	RO/DIO control word bit1	Bit 1 of *10.99 RO/DIO control word* (see page *122*).	41
	RO/DIO control word bit2	Bit 2 of *10.99 RO/DIO control word* (see page *122*).	42
	Reserved		43…44
	PFC1	Bit 0 of *76.01 PFC status* (see page *256*).	45
	PFC2	Bit 1 of *76.01 PFC status* (see page *256*).	46
	PFC3	Bit 2 of *76.01 PFC status* (see page *256*).	47
	PFC4	Bit 3 of *76.01 PFC status* (see page *256*).	48
	PFC5	Bit 4 of *76.01 PFC status* (see page *256*).	49
	PFC6	Bit 5 of *76.01 PFC status* (see page *256*).	50
	Other [bit]	Source selection (see *Terms and abbreviations* on page *100*).	-

No.	Name/Value	Description	Def/FbEq16
15.08	*RO4 ON delay*	Defines the activation delay for relay output RO4.	0.0 s
	 t_{On} = *15.08 RO4 ON delay* t_{Off} = *15.09 RO4 OFF delay*		
	0.0 … 3000.0 s	Activation delay for RO4.	10 = 1 s
15.09	*RO4 OFF delay*	Defines the deactivation delay for relay output RO4. See parameter *15.08 RO4 ON delay*.	0.0 s
	0.0 … 3000.0 s	Deactivation delay for RO4.	10 = 1 s
15.10	*RO5 source*	Selects a drive signal to be connected to relay output RO5. For the available selections, see parameter *15.07 RO4 source*.	*Not energized*
15.11	*RO5 ON delay*	Defines the activation delay for relay output RO5.	0.0 s
	 t_{On} = *15.11 RO5 ON delay* t_{Off} = *15.12 RO5 OFF delay*		
	0.0 … 3000.0 s	Activation delay for RO5.	10 = 1 s
15.12	*RO5 OFF delay*	Defines the deactivation delay for relay output RO5. See parameter *15.11 RO5 ON delay*.	0.0 s
	0.0 … 3000.0 s	Deactivation delay for RO5.	10 = 1 s
15.22	*DO1 configuration*	Selects how DO1 is used.	*Digital output*
	Digital output	DO1 is used as a digital output.	0
	Frequency output	DO1 is used as a frequency output.	2
15.23	*DO1 source*	Selects a drive signal to be connected to digital output DO1 when *15.22 DO1 configuration* is set to *Digital output*.	*Not energized*
	Not energized	Output is not energized.	0
	Energized	Output is energized.	1
	Ready run	Bit 1 of *06.11 Main status word* (see page *111*).	2
	Reserved		3
	Enabled	Bit 0 of *06.16 Drive status word 1* (see page *112*).	4
	Started	Bit 5 of *06.16 Drive status word 1* (see page *112*).	5

No.	Name/Value	Description	Def/FbEq16
	Magnetized	Bit 1 of *06.17 Drive status word 2* (see page *112*).	6
	Running	Bit 6 of *06.16 Drive status word 1* (see page *112*).	7
	Ready ref	Bit 2 of *06.11 Main status word* (see page *111*).	8
	At setpoint	Bit 8 of *06.11 Main status word* (see page *111*).	9
	Reverse	Bit 2 of *06.19 Speed control status word* (see page *113*).	10
	Zero speed	Bit 0 of *06.19 Speed control status word* (see page *113*).	11
	Above limit	Bit 10 of *06.17 Drive status word 2* (see page *112*).	12
	Warning	Bit 7 of *06.11 Main status word* (see page *111*).	13
	Fault	Bit 3 of *06.11 Main status word* (see page *111*).	14
	Fault (-1)	Inverted bit 3 of *06.11 Main status word* (see page *111*).	15
	Fault/Warning	Bit 3 of *06.11 Main status word* OR bit 7 of *06.11 Main status word* (see page *111*).	16
	Overcurrent	Fault *2310 Overcurrent* has occurred.	17
	Overvoltage	Fault *3210 DC link overvoltage* has occurred.	18
	Drive temp	Fault *2381 IGBT overload* or *4110 Control board temperature* or *4210 IGBT overtemperature* or *4290 Cooling* or *42F1 IGBT temperature* or *4310 Excess temperature* or *4380 Excess temperature difference* has occurred.	19
	Undervoltage	Fault *3220 DC link undervoltage* has occurred.	20
	Motor temp	Fault *4981 External temperature 1* or *4982 External temperature 2* has occurred.	21
	Reserved		22
	Ext2 active	Bit 11 of *06.16 Drive status word 1* (see page *112*).	23
	Remote control	Bit 9 of *06.11 Main status word* (see page *111*).	24
	Reserved		25…26
	Timed function 1	Bit 0 of *34.01 Timed functions status* (see page *191*).	27
	Timed function 2	Bit 1 of *34.01 Timed functions status* (see page *191*).	28
	Timed function 3	Bit 2 of *34.01 Timed functions status* (see page *191*).	29
	Reserved		30…32
	Supervision 1	Bit 0 of *32.01 Supervision status* (see page *184*).	33
	Supervision 2	Bit 1 of *32.01 Supervision status* (see page *184*).	34
	Supervision 3	Bit 2 of *32.01 Supervision status* (see page *184*).	35
	Start delay	Bit 13 of *06.17 Drive status word 2* (see page *112*).	39
	RO/DIO control word bit0	Bit 0 of *10.99 RO/DIO control word* (see page *122*).	40
	RO/DIO control word bit1	Bit 1 of *10.99 RO/DIO control word* (see page *122*).	41
	RO/DIO control word bit2	Bit 2 of *10.99 RO/DIO control word* (see page *122*).	42
	PFC1	Bit 0 of *76.01 PFC status* (see page *256*).	45
	PFC2	Bit 1 of *76.01 PFC status* (see page *256*).	46
	PFC3	Bit 2 of *76.01 PFC status* (see page *256*).	47
	PFC4	Bit 3 of *76.01 PFC status* (see page *256*).	48
	PFC5	Bit 4 of *76.01 PFC status* (see page *256*).	49

No.	**Name/Value**	**Description**	**Def/FbEq16**
	PFC6	Bit 5 of *76.01 PFC status* (see page *256*).	50
	Other [bit]	Source selection (see *Terms and abbreviations* on page *100*).	-
15.24	*DO1 ON delay*	Defines the activation delay for digital output DO1 when *15.22 DO1 configuration* is set to *Digital output*.	0.0 s
		 t_{On} = *15.24 DO1 ON delay* t_{Off} = *15.25 DO1 OFF delay*	
	0.0 … 3000.0 s	Activation delay for DO1.	10 = 1 s
15.25	*DO1 OFF delay*	Defines the deactivation delay for relay output DO1 when *15.22 DO1 configuration* is set to *Digital output*. See parameter *15.24 DO1 ON delay*.	0.0 s
	0.0 … 3000.0 s	Deactivation delay for DO1.	10 = 1 s
15.32	*Freq out 1 actual value*	Displays the value of frequency output 1 at digital output DO1 when *15.22 DO1 configuration* is set to *Frequency output*. This parameter is read-only.	-
	0 … 16000 Hz	Value of frequency output 1.	1 = 1 Hz
15.33	*Freq out 1 source*	Selects a signal to be connected to digital output DO1 when *15.22 DO1 configuration* is set to *Frequency output*. Alternatively, sets the output to excitation mode to feed a constant current to a temperature sensor.	*Motor speed used*
	Not selected	None.	0
	Motor speed used	*01.01 Motor speed used* (page *103*).	1
	Output frequency	*01.06 Output frequency* (page *103*).	3
	Motor current	*01.07 Motor current* (page *103*).	4
	Motor torque	*01.10 Motor torque* (page *103*).	6
	DC voltage	*01.11 DC voltage* (page *103*).	7
	Output power	*01.14 Output power* (page *104*).	8
	Speed ref ramp in	*23.01 Speed ref ramp input* (page *162*).	10
	Speed ref ramp out	*23.02 Speed ref ramp output* (page *162*).	11
	Speed ref used	*24.01 Used speed reference* (page *163*).	12
	Reserved		13
	Freq ref used	*28.02 Frequency ref ramp output* (page *167*).	14
	Reserved		15
	Process PID out	*40.01 Process PID output actual* (page *213*).	16
	Other	Source selection (see *Terms and abbreviations* on page *100*).	-

No.	Name/Value	Description	Def/FbEq16
15.34	*Freq out 1 src min*	Defines the real value of the signal (selected by parameter *15.33 Freq out 1 source*) that corresponds to the minimum value of frequency output 1 (defined by parameter *15.36 Freq out 1 at src min*). This applies when *15.22 DO1 configuration* is set to *Frequency output*.  	0.000
	-32768.000… 32767.000	Real signal value corresponding to minimum value of frequency output 1.	1 = 1
15.35	*Freq out 1 src max*	Defines the real value of the signal (selected by parameter *15.33 Freq out 1 source*) that corresponds to the maximum value of frequency output 1 (defined by parameter *15.37 Freq out 1 at src max*). This applies when *15.22 DO1 configuration* is set to *Frequency output*. See parameter *15.34 Freq out 1 src min*.	1500.000; 1800.000 (*95.20* b0)
	-32768.000… 32767.000	Real signal value corresponding to maximum value of frequency output 1.	1 = 1
15.36	*Freq out 1 at src min*	Defines the minimum output value of frequency output 1 when *15.22 DO1 configuration* is set to *Frequency output*. See also drawing at parameter *15.34 Freq out 1 src min*.	0 Hz
	0 … 16000 Hz	Minimum frequency output 1 value.	1 = 1 Hz
15.37	*Freq out 1 at src max*	Defines the maximum value of frequency output 1 when *15.22 DO1 configuration* is set to *Frequency output*. See also drawing at parameter *15.34 Freq out 1 src min*.	16000 Hz
	0 … 16000 Hz	Maximum value of frequency output 1.	1 = 1 Hz

No.	Name/Value	Description	Def/FbEq16
19 Operation mode		Selection of local and external control location sources and operating modes. See also section *Operating modes of the drive* (page *40*).	
19.01	*Actual operation mode*	Displays the operating mode currently used. See parameter *19.11*. This parameter is read-only.	-
	Zero	None.	1
	Speed	Speed control (in vector motor control mode).	2
	Reserved		3…9
	Scalar (Hz)	Frequency control in scalar motor control mode (in scalar motor control mode).	10
	Forced magn.	Motor is in magnetizing mode.	20
19.11	*Ext1/Ext2 selection*	Selects the source for external control location EXT1/EXT2 selection. 0 = EXT1 1 = EXT2	*EXT1*
	EXT1	EXT1 (permanently selected).	0
	EXT2	EXT2 (permanently selected).	1
	FBA A MCW bit 11	Control word bit 11 received through fieldbus interface A.	2
	DI1	Digital input DI1 (*10.02 DI delayed status*, bit 0).	3
	DI2	Digital input DI2 (*10.02 DI delayed status*, bit 1).	4
	DI3	Digital input DI3 (*10.02 DI delayed status*, bit 2).	5
	DI4	Digital input DI4 (*10.02 DI delayed status*, bit 3).	6
	DI5	Digital input DI5 (*10.02 DI delayed status*, bit 4).	7
	DI6	Digital input DI6 (*10.02 DI delayed status*, bit 5).	8
	Reserved		9…18
	Timed function 1	Bit 0 of *34.01 Timed functions status* (see page *191*).	19
	Timed function 2	Bit 1 of *34.01 Timed functions status* (see page *191*).	20
	Timed function 3	Bit 2 of *34.01 Timed functions status* (see page *191*).	21
	Reserved		22…24
	Supervision 1	Bit 0 of *32.01 Supervision status* (see page *184*).	25
	Supervision 2	Bit 1 of *32.01 Supervision status* (see page *184*).	26
	Supervision 3	Bit 2 of *32.01 Supervision status* (see page *184*).	27
	Reserved		28…31
	EFB MCW bit 11	Control word bit 11 received through the embedded fieldbus interface.	32
	FBA A connection loss	Detected communication loss of fieldbus interface A changes control mode to EXT2.	33
	EFB connection loss	Detected communication loss of embedded fieldbus interface changes control mode to EXT2.	34
	Other [bit]	Source selection (see *Terms and abbreviations* on page *100*).	-

No.	Name/Value	Description	Def/FbEq16
19.18	*HAND/OFF disable source*	Selects the source for Hand/Off disable. 1 = Hand and/or Off buttons are disabled on the panel and in Drive composer PC tool. Parameter *19.19 HAND/OFF disable action* specifies which buttons are disabled or enabled. If the HAND/OFF disable is activated while the drive is in the Hand mode, the mode will be automatically switched to Off and the motor stops, and the user must start the motor again.	*Not active*
	Not active	0 = Hand and/or Off buttons are enabled and operational.	0
	Active	1 = Hand and/or Off buttons are disabled and not operational.	1
	DI1	Digital input DI1 (*10.02 DI delayed status*, bit 0).	2
	DI2	Digital input DI2 (*10.02 DI delayed status*, bit 1).	3
	DI3	Digital input DI3 (*10.02 DI delayed status*, bit 2).	4
	DI4	Digital input DI4 (*10.02 DI delayed status*, bit 3).	5
	DI5	Digital input DI5 (*10.02 DI delayed status*, bit 4).	6
	DI6	Digital input DI6 (*10.02 DI delayed status*, bit 5).	7
	Comms	DCU profile control word bit 14 received through the embedded fieldbus interface.	8
19.19	*HAND/OFF disable action*	Selects which buttons are disabled on the panel and in the Drive composer PC tool when parameter *19.18 HAND/OFF disable source* is disabled.	*HAND*
	HAND	Hand button disabled.	0
	OFF and HAND	Both Off and Hand buttons disabled.	1

<table>
<tr><td colspan="2">***20 Start/stop/direction***</td><td>Start/stop/direction and run/start enable signal source selection; positive/negative reference enable signal source selection.
For information on control locations, see section *Local control vs. external control* (page *37*).</td><td></td></tr>
<tr><td>*20.01*</td><td>*Ext1 commands*</td><td>Selects the source of start, stop and direction commands for external control location 1 (EXT1).
See also parameters *20.02*…*20.04*.</td><td>*In1 Start*</td></tr>
<tr><td></td><td>Not selected</td><td>No start or stop command sources selected.</td><td>0</td></tr>
<tr><td></td><td>In1 Start</td><td>The source of the start and stop commands is selected by parameter *20.03 Ext1 in1 source*. The state transitions of the source bits are interpreted as follows:
<table>
<tr><th>State of source 1 *(20.03)*</th><th>Command</th></tr>
<tr><td>0 -> 1 (*20.02* = *Edge*)
1 (*20.02* = *Level*)</td><td>Start</td></tr>
<tr><td>0</td><td>Stop</td></tr>
</table>
</td><td>1</td></tr>
<tr><td></td><td>Reserved</td><td></td><td>2…3</td></tr>
</table>

<table>
<tr><th>No.</th><th>Name/Value</th><th>Description</th><th>Def/FbEq16</th></tr>
<tr><td></td><td>In1P Start; In2 Stop</td><td>The sources of the start and stop commands are selected by parameters <i>20.03 Ext1 in1 source</i> and <i>20.04 Ext1 in2 source</i>. The state transitions of the source bits are interpreted as follows:
<table>
<tr><th>State of source 1 <i>(20.03)</i></th><th>State of source 2 <i>(20.04)</i></th><th>Command</th></tr>
<tr><td>0 -> 1</td><td>1</td><td>Start</td></tr>
<tr><td>Any</td><td>0</td><td>Stop</td></tr>
</table>
Notes:
• Parameter <i>20.02 Ext1 start trigger type</i> has no effect with this setting.
• When source 2 is 0, the Start and Stop keys on the control panel are disabled.</td><td>4</td></tr>
<tr><td></td><td>Reserved</td><td></td><td>5…10</td></tr>
<tr><td></td><td>Control panel</td><td>The start and stop commands are taken from the control panel (or PC connected to the panel connector).
Note: This selection requires ACS-AP-I panel that uses Start/Stop/Loc/Rem logic.</td><td>11</td></tr>
<tr><td></td><td>Fieldbus A</td><td>The start and stop commands are taken from fieldbus adapter A.
Note: Set also <i>20.02 Ext1 start trigger type</i> to <i>Level</i>.</td><td>12</td></tr>
<tr><td></td><td>Reserved</td><td></td><td>13</td></tr>
<tr><td></td><td>Embedded fieldbus</td><td>The start and stop commands are taken from the embedded fieldbus interface.
Note: Set also <i>20.02 Ext1 start trigger type</i> to <i>Level</i>.</td><td>14</td></tr>
<tr><td><i>20.02</i></td><td><i>Ext1 start trigger type</i></td><td>Defines whether the start signal for external control location EXT1 is edge-triggered or level-triggered.
Note: This parameter is not effective if a pulse-type start signal is selected. See the descriptions of the selections of parameter <i>20.01 Ext1 commands</i>.</td><td><i>Level</i></td></tr>
<tr><td></td><td>Edge</td><td>The start signal is edge-triggered.</td><td>0</td></tr>
<tr><td></td><td>Level</td><td>The start signal is level-triggered.</td><td>1</td></tr>
<tr><td><i>20.03</i></td><td><i>Ext1 in1 source</i></td><td>Selects source 1 for parameter <i>20.01 Ext1 commands</i>.</td><td><i>DI1</i></td></tr>
<tr><td></td><td>Not selected</td><td>0 (always off).</td><td>0</td></tr>
<tr><td></td><td>Selected</td><td>1 (always on).</td><td>1</td></tr>
<tr><td></td><td>DI1</td><td>Digital input DI1 (<i>10.02 DI delayed status</i>, bit 0).</td><td>2</td></tr>
<tr><td></td><td>DI2</td><td>Digital input DI2 (<i>10.02 DI delayed status</i>, bit 1).</td><td>3</td></tr>
<tr><td></td><td>DI3</td><td>Digital input DI3 (<i>10.02 DI delayed status</i>, bit 2).</td><td>4</td></tr>
<tr><td></td><td>DI4</td><td>Digital input DI4 (<i>10.02 DI delayed status</i>, bit 3).</td><td>5</td></tr>
<tr><td></td><td>DI5</td><td>Digital input DI5 (<i>10.02 DI delayed status</i>, bit 4).</td><td>6</td></tr>
<tr><td></td><td>DI6</td><td>Digital input DI6 (<i>10.02 DI delayed status</i>, bit 5).</td><td>7</td></tr>
<tr><td></td><td>Reserved</td><td></td><td>8…17</td></tr>
<tr><td></td><td>Timed function 1</td><td>Bit 0 of <i>34.01 Timed functions status</i> (see page <i>191</i>).</td><td>18</td></tr>
<tr><td></td><td>Timed function 2</td><td>Bit 1 of <i>34.01 Timed functions status</i> (see page <i>191</i>).</td><td>19</td></tr>
<tr><td></td><td>Timed function 3</td><td>Bit 2 of <i>34.01 Timed functions status</i> (see page <i>191</i>).</td><td>20</td></tr>
<tr><td></td><td>Reserved</td><td></td><td>21…23</td></tr>
<tr><td></td><td>Supervision 1</td><td>Bit 0 of <i>32.01 Supervision status</i> (see page <i>184</i>).</td><td>24</td></tr>
</table>

<table>
<tr><th>No.</th><th>Name/Value</th><th>Description</th><th>Def/FbEq16</th></tr>
<tr><td></td><td>Supervision 2</td><td>Bit 1 of *32.01 Supervision status* (see page *184*).</td><td>25</td></tr>
<tr><td></td><td>Supervision 3</td><td>Bit 2 of *32.01 Supervision status* (see page *184*).</td><td>26</td></tr>
<tr><td></td><td>*Other [bit]*</td><td>Source selection (see *Terms and abbreviations* on page *100*).</td><td>-</td></tr>
<tr><td>*20.04*</td><td>*Ext1 in2 source*</td><td>Selects source 2 for parameter *20.01 Ext1 commands*.
For the available selections, see parameter *20.03 Ext1 in1 source*.</td><td>*Not selected*</td></tr>
<tr><td>*20.06*</td><td>*Ext2 commands*</td><td>Selects the source of start, stop and direction commands for external control location 2 (EXT2).
See also parameters *20.07*…*20.09*.</td><td>*Not selected*</td></tr>
<tr><td></td><td>Not selected</td><td>No start or stop command sources selected.</td><td>0</td></tr>
<tr><td></td><td>In1 Start</td><td>The source of the start and stop commands is selected by parameter *20.08 Ext2 in1 source*. The state transitions of the source bits are interpreted as follows:
<table>
<tr><th>State of source 1 *(20.08)*</th><th>Command</th></tr>
<tr><td>0 -> 1 (*20.07* = *Edge*)
1 (*20.07* = *Level*)</td><td>Start</td></tr>
<tr><td>0</td><td>Stop</td></tr>
</table></td><td>1</td></tr>
<tr><td></td><td>In1P Start; In2 Stop</td><td>The sources of the start and stop commands are selected by parameters *20.08 Ext2 in1 source* and *20.09 Ext2 in2 source*. The state transitions of the source bits are interpreted as follows:
<table>
<tr><th>State of source 1 *(20.08)*</th><th>State of source 2 *(20.09)*</th><th>Command</th></tr>
<tr><td>0 -> 1</td><td>1</td><td>Start</td></tr>
<tr><td>Any</td><td>0</td><td>Stop</td></tr>
</table>
Notes:
• Parameter *20.07 Ext2 start trigger type* has no effect with this setting.
• When source 2 is 0, the Start and Stop keys on the control panel are disabled.</td><td>4</td></tr>
<tr><td></td><td>Reserved</td><td></td><td>7…10</td></tr>
<tr><td></td><td>Control panel</td><td>The start and stop commands are taken from the control panel (or PC connected to the panel connector).
Note: This selection requires ACS-AP-I panel that uses Start/Stop/Loc/Rem logic.</td><td>11</td></tr>
<tr><td></td><td>Fieldbus A</td><td>The start and stop commands are taken from fieldbus adapter A.
Note: Set also *20.07 Ext2 start trigger type* to *Level*.</td><td>12</td></tr>
<tr><td></td><td>Reserved</td><td></td><td>13</td></tr>
<tr><td></td><td>Embedded fieldbus</td><td>The start and stop commands are taken from the embedded fieldbus interface.
Note: Set also *20.07 Ext2 start trigger type* to *Level*.</td><td>14</td></tr>
<tr><td>*20.07*</td><td>*Ext2 start trigger type*</td><td>Defines whether the start signal for external control location EXT2 is edge-triggered or level-triggered.
Note: This parameter is not effective if a pulse-type start signal is selected. See the descriptions of the selections of parameter *20.06 Ext2 commands*.</td><td>*Level*</td></tr>
<tr><td></td><td>Edge</td><td>The start signal is edge-triggered.</td><td>0</td></tr>
</table>

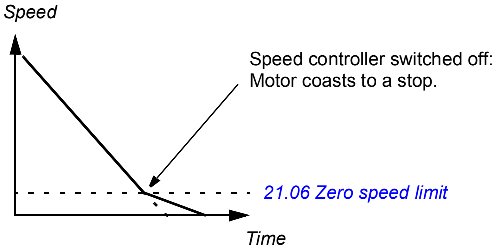
No.	Name/Value	Description	Def/FbEq16
	Level	The start signal is level-triggered.	1
20.08	*Ext2 in1 source*	Selects source 1 for parameter *20.06 Ext2 commands*. For the available selections, see parameter *20.03 Ext1 in1 source*.	*Not selected*
20.09	*Ext2 in2 source*	Selects source 2 for parameter *20.06 Ext2 commands*. For the available selections, see parameter *20.03 Ext1 in1 source*.	*Not selected*
20.40	*Run permissive*	Selects the source of the Run permissive signal. Value 0 of the source deactivates the Run permissive and prevents running. Value 1 of the source activates the Run permissive and permits running.	*Selected*
	Not selected	0.	0
	Selected	1.	1
	DI1	Digital input DI1 (*10.02 DI delayed status*, bit 0).	2
	DI2	Digital input DI2 (*10.02 DI delayed status*, bit 1).	3
	DI3	Digital input DI3 (*10.02 DI delayed status*, bit 2).	4
	DI4	Digital input DI4 (*10.02 DI delayed status*, bit 3).	5
	DI5	Digital input DI5 (*10.02 DI delayed status*, bit 4).	6
	DI6	Digital input DI6 (*10.02 DI delayed status*, bit 5).	7
	-DI1	Digital input DI1 (*10.02 DI delayed status*, bit 0).	8
	-DI2	Digital input DI2 (*10.02 DI delayed status*, bit 1).	9
	-DI3	Digital input DI3 (*10.02 DI delayed status*, bit 2).	10
	-DI4	Digital input DI4 (*10.02 DI delayed status*, bit 3).	11
	-DI5	Digital input DI5 (*10.02 DI delayed status*, bit 4).	12
	-DI6	Digital input DI6 (*10.02 DI delayed status*, bit 5).	13
	Fieldbus adapter	Control word bit 3 received through the fieldbus interface.	14
	Embedded fieldbus	ABB Drives profile: Control word bit 3 received through the embedded fieldbus interface DCU profile: Inverse of control word bit 6 received through the embedded fieldbus interface.	15
	Other [bit]	Source selection (see *Terms and abbreviations* on page *100*).	-
20.41	*Start interlock 1*	Selects the source of the Start interlock 1 signal. Value 0 of the source deactivates the Start interlock 1 signal and inhibits starting. Value 1 of the source activates the Start interlock 1 signal and allows starting.	*DI4*
	Not selected	0.	0
	Selected	1.	1
	DI1	Digital input DI1 (*10.02 DI delayed status*, bit 0).	2
	DI2	Digital input DI2 (*10.02 DI delayed status*, bit 1).	3
	DI3	Digital input DI3 (*10.02 DI delayed status*, bit 2).	4
	DI4	Digital input DI4 (*10.02 DI delayed status*, bit 3).	5
	DI5	Digital input DI5 (*10.02 DI delayed status*, bit 4).	6
	DI6	Digital input DI6 (*10.02 DI delayed status*, bit 5).	7
	-DI1	Digital input DI1 (*10.02 DI delayed status*, bit 0).	8

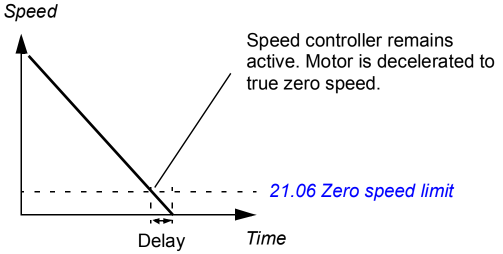
No.	Name/Value	Description	Def/FbEq16
	-DI2	Digital input DI2 (*10.02 DI delayed status*, bit 1).	9
	-DI3	Digital input DI3 (*10.02 DI delayed status*, bit 2).	10
	-DI4	Digital input DI4 (*10.02 DI delayed status*, bit 3).	11
	-DI5	Digital input DI5 (*10.02 DI delayed status*, bit 4).	12
	-DI6	Digital input DI6 (*10.02 DI delayed status*, bit 5).	13
	Fieldbus adapter	This selection cannot be used to control Start interlock with ABB drives profile from the fieldbus adapter. Use *Other [bit]* and map to control word user bits.	14
	Embedded fieldbus	Start interlock 1: DCU profile: Inverse of control word bit 18 received through the embedded fieldbus interface. Start interlock 2: Inverse of bit 19.	15
	Other [bit]	Source selection (see *Terms and abbreviations* on page *100*).	-
20.42	*Start interlock 2*	Selects the source of the Start interlock 2 signal. For the selections, see parameter *20.41 Start interlock 1*.	*Selected*
20.43	*Start interlock 3*	Selects the source of the Start interlock 3 signal. For the selections, see parameter *20.41 Start interlock 1*.	*Selected*
20.44	*Start interlock 4*	Selects the source of the Start interlock 4 signal. For the selections, see parameter *20.41 Start interlock 1*.	*Selected*
20.45	*Start interlock stop mode*	Selects the method of stopping if a Start interlock signal is lost. Applies to *20.41 Start interlock 1*, *20.42 Start interlock 2*, *20.43 Start interlock 3* and *20.44 Start interlock 4*.	*Not used*
	Not used	Not in use.	0
	Coast	The motor coasts to a stop.	1
	Ramp	Stop along the active deceleration ramp.	2
20.46	*Run permissive text*	Alternative alarm texts for the run permissive.	*Run permissive*
	Run permissive		0
	Valve opening		2
	Pre-lube cycle		3
20.47	*Start interlock 1 text*	Alternative alarm texts for the start interlock 1.	*Start interlock 1*
	Start interlock 1		0
	Vibration switch		1
	Firestat		2
	Freeze stat		3
	Overpressure		4
	Vibration trip		5
	Smoke alarm		6
	Auxiliary open		7
	Low suction		8
	Low pressure		9
	Access door		10
	Pressure relief		11
	Motor disconnect open		12

No.	**Name/Value**	**Description**	**Def/FbEq16**
	Full text editor	Enter your own text in the text editor. Not supported yet.	13
20.48	*Start interlock 1 text*	Alternative alarm texts for the start interlock 2. See parameter *20.47 Start interlock 1 text*.	*Start interlock 2*
	Start interlock 2	For other selections, see parameter *20.47 Start interlock 1 text*.	0
20.49	*Start interlock 1 text*	Alternative alarm texts for the start interlock 3. See parameter *20.47 Start interlock 1 text*.	*Start interlock 3*
	Start interlock 3	For other selections, see parameter *20.47 Start interlock 1 text*.	0
20.50	*Start interlock 4 text*	Alternative alarm texts for the start interlock 4. See parameter *20.47 Start interlock 1 text*.	*Start interlock 4*
	Start interlock 4	For other selections, see parameter *20.47 Start interlock 1 text*.	0
20.51	*Start interlock condition*	Selects the condition for start interlock function. This parameter determines if the start command is needed before start interlock warnings are displayed.	*Start command ignored*
	Start command ignored	Start interlock warnings are displayed if the interlocks are missing.	
	Start command required	Start command must be present before the start interlock warnings are displayed if the interlocks are missing.	
21 Start/stop mode		Start and stop modes; emergency stop mode and signal source selection; DC magnetization settings.	
21.01	*Start mode*	Selects the motor start function for the vector motor control mode, ie. when *99.04 Motor control mode* is set to *Vector*. **Notes**: • The start function for the scalar motor control mode is selected by parameter *21.19 Scalar start mode*. • Starting into a rotating motor is not possible when DC magnetizing is selected (*Fast* or *Const time*). • With permanent magnet motors, *Automatic* start mode must be used. • This parameter cannot be changed while the drive is running. See also section *DC magnetization* (page *76*).	*Automatic*
	Fast	The drive pre-magnetizes the motor before start. The pre-magnetizing time is determined automatically, being typically 200 ms to 2 s depending on motor size. This mode should be selected if a high break-away torque is required.	0
	Const time	The drive pre-magnetizes the motor before start. The pre-magnetizing time is defined by parameter *21.02 Magnetization time*. This mode should be selected if constant pre-magnetizing time is required (e.g. if the motor start must be synchronized with the release of a mechanical brake). This setting also guarantees the highest possible break-away torque when the pre-magnetizing time is set long enough. ⚠ **WARNING!** The drive will start after the set magnetizing time has passed even if motor magnetization is not completed. In applications where a full break-away torque is essential, ensure that the constant magnetizing time is long enough to allow generation of full magnetization and torque.	1

<table>
<tr><th>No.</th><th>Name/Value</th><th>Description</th><th>Def/FbEq16</th></tr>
<tr><td></td><td>Automatic</td><td>Automatic start guarantees optimal motor start in most cases. It includes the flying start function (starting into a rotating motor) and the automatic restart function. The drive motor control program identifies the flux as well as the mechanical state of the motor and starts the motor instantly under all conditions.
Note: If parameter <i>99.04 Motor control mode</i> is set to <i>Scalar</i>, no flying start or automatic restart is possible unless parameter <i>21.19 Scalar start mode</i> is set to <i>Automatic</i>.</td><td>2</td></tr>
<tr><td><i>21.02</i></td><td><i>Magnetization time</i></td><td>Defines the pre-magnetization time when
• parameter <i>21.01 Start mode</i> is set to <i>Const time</i> (in vector motor control mode), or
• parameter <i>21.19 Scalar start mode</i> is set to <i>Const time</i> (in scalar motor control mode).
After the start command, the drive automatically premagnetizes the motor for the set time. To ensure full magnetizing, set this parameter to the same value as, or higher than, the rotor time constant. If not known, use the rule-of-thumb value given in the table below:
<table>
<tr><th>Motor rated power</th><th>Constant magnetizing time</th></tr>
<tr><td>< 1 kW</td><td>≥ 50 to 100 ms</td></tr>
<tr><td>1 to 10 kW</td><td>≥ 100 to 200 ms</td></tr>
<tr><td>10 to 200 kW</td><td>≥ 200 to 1000 ms</td></tr>
<tr><td>200 to 1000 kW</td><td>≥ 1000 to 2000 ms</td></tr>
</table>
Note: This parameter cannot be changed while the drive is running.</td><td>500 ms</td></tr>
<tr><td></td><td>0…10000 ms</td><td>Constant DC magnetizing time.</td><td>1 = 1 ms</td></tr>
<tr><td><i>21.03</i></td><td><i>Stop mode</i></td><td>Selects the way the motor is stopped when a stop command is received.
Additional braking is possible by selecting flux braking (see parameter <i>97.05 Flux braking</i>).</td><td><i>Coast</i></td></tr>
<tr><td></td><td>Coast</td><td>Stop by switching off the output semiconductors of the drive. The motor coasts to a stop.
⚠ WARNING! If a mechanical brake is used, ensure it is safe to stop the drive by coasting.</td><td>0</td></tr>
<tr><td></td><td>Ramp</td><td>Stop along the active deceleration ramp. See parameter group <i>23 Speed reference ramp</i> on page <i>162</i> or <i>28 Frequency reference chain</i> on page <i>167</i>.</td><td>1</td></tr>
<tr><td></td><td>Torque limit</td><td>Stop according to torque limits (parameters <i>30.19</i> and <i>30.20</i>). This mode is only possible in vector motor control mode.</td><td>2</td></tr>
</table>

No.	Name/Value	Description	Def/FbEq16
21.04	*Emergency stop mode*	Selects the way the motor is stopped when an emergency stop command is received. The source of the emergency stop signal is selected by parameter *21.05 Emergency stop source*.	*Ramp stop (Off1)*
	Ramp stop (Off1)	With the drive running: • 1 = Normal operation. • 0 = Normal stop along the standard deceleration ramp defined for the particular reference type (see section *DC voltage control* [page *80*]). After the drive has stopped, it can be restarted by removing the emergency stop signal and switching the start signal from 0 to 1. With the drive stopped: • 1 = Starting allowed. • 0 = Starting not allowed.	0
	Coast stop (Off2)	With the drive running: • 1 = Normal operation. • 0 = Stop by coasting. The drive can be restarted by restoring the start interlock signal and switching the start signal from 0 to 1. With the drive stopped: • 1 = Starting allowed. • 0 = Starting not allowed.	1
	Eme ramp stop (Off3)	With the drive running: • 1 = Normal operation • 0 = Stop by ramping along emergency stop ramp defined by parameter *23.23 Emergency stop time*. After the drive has stopped, it can be restarted by removing the emergency stop signal and switching the start signal from 0 to 1. With the drive stopped: • 1 = Starting allowed • 0 = Starting not allowed	2
21.05	*Emergency stop source*	Selects the source of the emergency stop signal. The stop mode is selected by parameter *21.04 Emergency stop mode*. 0 = Emergency stop active 1 = Normal operation **Note:** This parameter cannot be changed while the drive is running.	*Inactive (true)*
	Active (false)	0.	0
	Inactive (true)	1.	1
	Reserved		2
	DI1	Digital input DI1 (*10.02 DI delayed status*, bit 0).	3
	DI2	Digital input DI2 (*10.02 DI delayed status*, bit 1).	4
	DI3	Digital input DI3 (*10.02 DI delayed status*, bit 2).	5
	DI4	Digital input DI4 (*10.02 DI delayed status*, bit 3).	6
	DI5	Digital input DI5 (*10.02 DI delayed status*, bit 4).	7
	DI6	Digital input DI6 (*10.02 DI delayed status*, bit 5).	8
	Other [bit]	Source selection (see *Terms and abbreviations* on page *100*).	-

<table>
<tr><th>No.</th><th>Name/Value</th><th>Description</th><th>Def/FbEq16</th></tr>
<tr><td><i>21.06</i></td><td><i>Zero speed limit</i></td><td>Defines the zero speed limit. The motor is stopped along a speed ramp (when ramped stop is selected or emergency stop time is used) until the defined zero speed limit is reached. After the zero speed delay, the motor coasts to a stop.</td><td>30.00 rpm</td></tr>
<tr><td></td><td>0.00…30000.00 rpm</td><td>Zero speed limit.</td><td>See par. <i>46.01</i></td></tr>
<tr><td><i>21.07</i></td><td><i>Zero speed delay</i></td><td>
<p>Defines the delay for the zero speed delay function. The function is useful in applications where a smooth and quick restarting is essential. During the delay, the drive knows the rotor position accurately.</p>
<p><u>Without zero speed delay</u>:
The drive receives a stop command and decelerates along a ramp. When actual motor speed falls below the value of parameter <i>21.06 Zero speed limit</i>, inverter modulation is stopped and the motor coasts to a standstill.</p>


<p><u>With zero speed delay</u>:
The drive receives a stop command and decelerates along a ramp. When actual motor speed falls below the value of parameter <i>21.06 Zero speed limit</i>, the zero speed delay function activates. During the delay the function keeps the speed controller live: the inverter modulates, motor is magnetized and the drive is ready for a quick restart.</p>


</td><td>0 ms</td></tr>
<tr><td></td><td>0…30000 ms</td><td>Zero speed delay.</td><td>1 = 1 ms</td></tr>
</table>

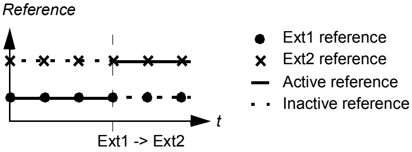
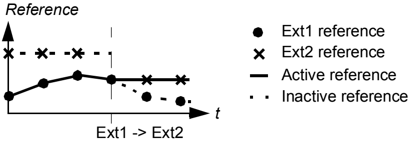
<table>
<tr><th>No.</th><th>Name/Value</th><th>Description</th><th>Def/FbEq16</th></tr>
<tr><td><i>21.08</i></td><td><i>DC current control</i></td><td>Activates/deactivates the DC hold and post-magnetization functions. See section <i>DC magnetization</i> (page <i>76</i>).
Note: DC magnetization causes the motor to heat up. In applications where long DC magnetization times are required, externally ventilated motors should be used. If the DC magnetization period is long, DC magnetization cannot prevent the motor shaft from rotating if a constant load is applied to the motor.</td><td>0000b</td></tr>
<tr><td colspan="4">
<table>
<tr><th>Bit</th><th>Value</th></tr>
<tr><td>0</td><td>1 = Enable DC hold. See section <i>DC hold</i> (page <i>77</i>).
Note: The DC hold function has no effect if the start signal is switched off.</td></tr>
<tr><td>1</td><td>1 = Enable post-magnetization. See section <i>Settings</i> (page <i>77</i>).
Note: Post-magnetization is only available when ramping is the selected stop mode (see parameter <i>21.03 Stop mode</i>).
Note: Post-magnetization with scalar control is not supported at the moment.</td></tr>
<tr><td>2…15</td><td>Reserved</td></tr>
</table>
</td></tr>
<tr><td></td><td>0000b…0011b</td><td>DC magnetization selection.</td><td>1 = 1</td></tr>
<tr><td><i>21.09</i></td><td><i>DC hold speed</i></td><td>Defines the DC hold speed in speed control mode. See parameter <i>21.08 DC current control</i>, and section <i>DC hold</i> (page <i>77</i>).</td><td>5.00 rpm</td></tr>
<tr><td></td><td>0.00…1000.00 rpm</td><td>DC hold speed.</td><td>See par. <i>46.01</i></td></tr>
<tr><td><i>21.10</i></td><td><i>DC current reference</i></td><td>Defines the DC hold current in percent of the motor nominal current. See parameter <i>21.08 DC current control</i>, and section <i>DC magnetization</i> (page <i>76</i>).</td><td>30.0%</td></tr>
<tr><td></td><td>0.0…100.0%</td><td>DC hold current.</td><td>1 = 1%</td></tr>
<tr><td><i>21.11</i></td><td><i>Post magnetization time</i></td><td>Defines the length of time for which post-magnetization is active after stopping the motor. The magnetization current is defined by parameter <i>21.10 DC current reference</i>.
See parameter <i>21.08 DC current control</i>.</td><td>0 s</td></tr>
<tr><td></td><td>0…3000 s</td><td>Post-magnetization time.</td><td>1 = 1 s</td></tr>
<tr><td><i>21.14</i></td><td><i>Pre-heating input source</i></td><td>Selects the source for controlling pre-heating for the motor. The status of the pre-heating is shown as bit 2 of <i>06.21 Drive status word 3</i>.
Notes:
• The heating function requires that STO is not triggered.
• The heating function requires that the drive is not faulted.</td><td><i>Off</i></td></tr>
<tr><td></td><td>Off</td><td>0. Pre-heating is always deactivated.</td><td>0</td></tr>
<tr><td></td><td>On</td><td>1. Pre-heating is always activated when the drive is stopped.</td><td>1</td></tr>
<tr><td></td><td>DI1</td><td>Digital input DI1 (<i>10.02 DI delayed status</i>, bit 0).</td><td>2</td></tr>
<tr><td></td><td>DI2</td><td>Digital input DI2 (<i>10.02 DI delayed status</i>, bit 1).</td><td>3</td></tr>
<tr><td></td><td>DI3</td><td>Digital input DI3 (<i>10.02 DI delayed status</i>, bit 2).</td><td>4</td></tr>
<tr><td></td><td>DI4</td><td>Digital input DI4 (<i>10.02 DI delayed status</i>, bit 3).</td><td>5</td></tr>
<tr><td></td><td>DI5</td><td>Digital input DI5 (<i>10.02 DI delayed status</i>, bit 4).</td><td>6</td></tr>
<tr><td></td><td>DI6</td><td>Digital input DI6 (<i>10.02 DI delayed status</i>, bit 5).</td><td>7</td></tr>
<tr><td></td><td>Supervision 1</td><td>Bit 0 of <i>32.01 Supervision status</i> (see page <i>184</i>).</td><td>8</td></tr>
<tr><td></td><td>Supervision 2</td><td>Bit 1 of <i>32.01 Supervision status</i> (see page <i>184</i>).</td><td>9</td></tr>
</table>

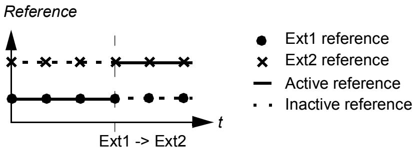
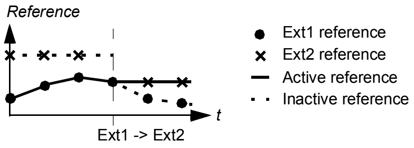
No.	Name/Value	Description	Def/FbEq16
	Supervision 3	Bit 2 of *32.01 Supervision status* (see page *184*).	10
	Timed function 1	Bit 0 of *34.01 Timed functions status* (see page *191*).	11
	Timed function 2	Bit 1 of *34.01 Timed functions status* (see page *191*).	12
	Timed function 3	Bit 2 of *34.01 Timed functions status* (see page *191*).	13
	Other [bit]	Source selection (see *Terms and abbreviations* on page *100*).	-
21.16	*Pre-heating current*	Defines the DC current used to heat the motor. The value is in percent of the nominal motor current.	0.0%
	0.0…30.0%	Pre-heating current.	1 = 1%
21.18	*Auto restart time*	The motor can be automatically started after a short supply power failure using the automatic restart function. See section *Automatic restart* (page *81*). When this parameter is set to 0.0 seconds, automatic restarting is disabled. Otherwise, the parameter defines the maximum duration of the power failure after which restarting is attempted. Note that this time also includes the DC precharging delay. See also parameter *21.34 Force auto restart*. This parameter has effect only if parameter *95.04 Control board supply* is set to *External 24V*. ⚠ **WARNING!** Before you activate the function, make sure that no dangerous situations can occur. The function restarts the drive automatically and continues operation after a supply break.	10.0 s
	0.0 s	Automatic restarting disabled.	0
	0.1…10.0 s	Maximum power failure duration.	1 = 1 s
21.19	*Scalar start mode*	Selects the motor start function for the scalar motor control mode, ie. when *99.04 Motor control mode* is set to *Scalar*. **Notes**: • The start function for the vector motor control mode is selected by parameter *21.01 Start mode*. • With permanent magnet motors, *Automatic* start mode must be used. • This parameter cannot be changed while the drive is running. See also section *DC magnetization* (page *76*).	*Automatic*
	Normal	Immediate start from zero speed.	0
	Const time	The drive pre-magnetizes the motor before start. The pre-magnetizing time is defined by parameter *21.02 Magnetization time*. This mode should be selected if constant pre-magnetizing time is required (e.g. if the motor start must be synchronized with the release of a mechanical brake). This setting also guarantees the highest possible break-away torque when the pre-magnetizing time is set long enough. **Note:** This mode cannot be used to start into a rotating motor. ⚠ **WARNING!** The drive will start after the set pre-magnetizing time has passed even if motor magnetization is not completed. In applications where a full break-away torque is essential, ensure that the constant magnetizing time is long enough to allow generation of full magnetization and torque.	1

No.	**Name/Value**	**Description**	**Def/FbEq16**
	Automatic	The drive automatically selects the correct output frequency to start a rotating motor. This is useful for flying starts: if the motor is already rotating, the drive will start smoothly at the current frequency. **Note:** Cannot be used in multimotor systems.	2
	Torque boost	The drive pre-magnetizes the motor before the start. The pre-magnetizing time is defined by parameter *21.02 Magnetization time*. Torque boost is applied at start. Torque boost is stopped when output frequency exceeds 40% of nominal frequency or when it is equal to the reference value. See parameter *21.26 Torque boost current*. This mode should selected if a high break-away torque is required. **Note:** This mode cannot be used to start into a rotating motor. **WARNING!** The drive will start after the set pre-magnetizing time has passed even if motor magnetization is not completed. In applications where a full break-away torque is essential, ensure that the constant magnetizing time is long enough to allow generation of full magnetization and torque.	3
	Automatic+boost	Automatic start with torque boost. Automatic start is performed first and the motor is magnetized. If the speed is found to be zero, torque boost is applied.	4
21.21	*DC hold frequency*	Defines the DC hold frequency, which is used instead of parameter *21.09 DC hold speed* when the motor is in scalar frequency mode. See parameter *21.08 DC current control*, and section *DC hold* (page *77*).	5.00 Hz
	0.00…1000.00 Hz	DC hold frequency.	1 = 1 Hz
21.22	*Start delay*	Defines the start delay. After the conditions for start have been fulfilled, the drive waits until the delay has elapsed and then starts the motor. During the delay, warning *AFE9 Start delay* is shown. Start delay can be used with all start modes.	0.00 s
	0.00…60.00 s	Start delay	1 = 1 s
21.23	*Smooth start*	Selects the forced current vector rotation mode at low speeds. When the smooth start mode is selected, the rate of acceleration is limited by the acceleration and deceleration ramp times. If the process driven by the permanent magnet synchronous motor has high inertia, slow ramp times are recommended. Can be used for permanent magnet synchronous motors only.	*Disabled*
	Disabled	Disabled.	0
	Enabled always	Enabled always.	1
	Start only	Enabled when starting the motor.	2

No.	Name/Value	Description	Def/FbEq16
21.24	*Smooth start current*	Current used in the current vector rotation at low speeds. Increase the smooth start current if the application requires motor shaft swinging needs to be minimized. Note that accurate torque control is not possible in the current vector rotation mode. Can be used for permanent magnet synchronous motors only.	50.0%
	10.0…100.0%	Value in percent of the nominal motor current.	1 = 1%
21.25	*Smooth start speed*	Output frequency up to which the current vector rotation is used. See parameter *21.19 Scalar start mode*. Can be used for permanent magnet synchronous motors only.	10.0%
	2.0…100.0%	Value as a percentage of the nominal motor frequency.	1 = 1%
21.26	*Torque boost current*	Defines the maximum supplied current to motor when (*21.19 Scalar start mode* is set to *Torque boost* (see page *153*). Parameter value is in percent of the motor nominal current. Nominal value of the parameter is 100.0%. Torque boost is only applied at start, ending when output frequency exceeds 40% of nominal frequency or when output frequency is equal to reference. Can be used in scalar mode only.	100.0%
	15.0…300.0%	Value in percent of the nominal motor current.	1 = 1%
21.34	*Force auto restart*	Forces automatic restart. The parameter is applicable only if parameter *95.04 Control board supply* is set to *External 24V*.	*Enable*
	Disable	Force auto restart disabled. Parameter *21.18 Auto restart time* is in effect if its value is more than 0.0 s.	0
	Enable	Force auto restart enabled. Parameter *21.18 Auto restart time* is ignored. The drive never trips on the undervoltage fault and the start signal is on forever. When he DC voltage is restored, the normal operation continues.	1

22 Speed reference selection		Speed reference selection; motor potentiometer settings. See the control chain diagrams on pages *406*…*410*.	
22.01	*Speed ref unlimited*	Displays the output of the speed reference selection block. See the control chain diagram on page *407*. This parameter is read-only.	-
	-30000.00…30000.00 rpm	Value of the selected speed reference.	See par. *46.01*
22.11	*Ext1 speed ref1*	Selects Ext1 speed reference source 1. A digital source selected by *19.11 Ext1/Ext2 selection* can be used to switch between Ext1 reference and the corresponding Ext2 reference defined by parameter *22.18 Ext2 speed ref1*,.	*AI1 scaled*
	Zero	None.	0
	AI1 scaled	*12.12 AI1 scaled value* (see page *125*).	1
	AI2 scaled	*12.22 AI2 scaled value* (see page *126*).	2
	Reserved		3
	FB A ref1	*03.05 FB A reference 1* (see page *106*).	4
	FB A ref2	*03.06 FB A reference 2* (see page *106*).	5
	Reserved		6…7

No.	**Name/Value**	**Description**	**Def/FbEq16**
	EFB ref1	*03.09 EFB reference 1* (see page *107*).	8
	EFB ref2	*03.10 EFB reference 2* (see page *107*).	9
	Reserved		10…14
	Motor potentiometer	*22.80 Motor potentiometer ref act* (output of the motor potentiometer).	15
	PID	*40.01 Process PID output actual* (output of the process PID controller).	16
	Frequency input	*11.38 Freq in 1 actual value* (when DI5 is used as a frequency input).	17
	Control panel (ref saved)	Panel reference (*03.01 Panel reference*, see page *106*) saved by the control system for the location where the control returns is used as the reference.  	18
	Control panel (ref copied)	Panel reference (*03.01 Panel reference*, see page *106*) for the previous control location is used as the reference when the control location changes if the references for the two locations are of the same type (eg frequency/speed/torque/PID); otherwise, the actual signal is used as the new reference.  	19
	Level control	Parameter *76.07 LC speed ref* (output of the Level control function).	30
	Other	Source selection (see *Terms and abbreviations* on page *100*).	-
22.18	*Ext2 speed ref1*	Selects Ext2 speed reference source 1.	*Zero*
	Zero	None.	0
	AI1 scaled	*12.12 AI1 scaled value* (see page *125*).	1
	AI2 scaled	*12.22 AI2 scaled value* (see page *126*).	2
	Reserved		3
	FB A ref1	*03.05 FB A reference 1* (see page *106*).	4
	FB A ref2	*03.06 FB A reference 2* (see page *106*).	5
	Reserved		6…7
	EFB ref1	*03.09 EFB reference 1* (see page *107*).	8
	EFB ref2	*03.10 EFB reference 2* (see page *107*).	9
	Reserved		10…14
	Motor potentiometer	*22.80 Motor potentiometer ref act* (output of the motor potentiometer).	15

No.	Name/Value	Description	Def/FbEq16
	PID	*40.01 Process PID output actual* (output of the process PID controller).	16
	Frequency input	*11.38 Freq in 1 actual value* (when DI5 is used as a frequency input).	17
	Control panel (ref saved)	Panel reference (*03.01 Panel reference*, see page *106*) saved by the control system for the location where the control returns is used as the reference. 	18
	Control panel (ref copied)	Panel reference (*03.01 Panel reference*, see page *106*) for the previous control location is used as the reference when the control location changes if the references for the two locations are of the same type (eg frequency/speed/torque/PID); otherwise, the actual signal is used as the new reference. 	19
	Level control	Parameter *76.07 LC speed ref* (output of the Level control function).	30
	Other	Source selection (see *Terms and abbreviations* on page *100*).	-

No.	Name/Value	Description	Def/FbEq16
22.21	*Constant speed function*	Determines how constant speeds are selected, and whether the rotation direction signal is considered or not when applying a constant speed.	0001b

Bit	Name	Information
0	Constant speed mode	1 = Packed: 7 constant speeds are selectable using the three sources defined by parameters *22.22*, *22.23* and *22.24*.
		0 = Separate: Constant speeds 1, 2 and 3 are separately activated by the sources defined by parameters *22.22*, *22.23* and *22.24* respectively. In case of conflict, the constant speed with the smaller number takes priority.
1	Direction enable	1 = Start dir: To determine running direction for a constant speed, the sign of the constant speed setting (parameters *22.26*…*22.32*) is multiplied by the direction signal (forward: +1, reverse: -1). This effectively allows the drive to have 14 (7 forward, 7 reverse) constant speeds if all values in *22.26*…*22.32* are positive. ⚠ **WARNING:** If the direction signal is reverse and the active constant speed is negative, the drive will run in the forward direction.
		0 = Accord Par: The running direction for the constant speed is determined by the sign of the constant speed setting (parameters *22.26*…*22.32*).
2…15	Reserved	

No.	Name/Value	Description	Def/FbEq16
	0000h…FFFFh	Constant speed configuration word.	1 = 1
22.22	*Constant speed sel1*	When bit 0 of parameter *22.21 Constant speed function* is 0 (Separate), selects a source that activates constant speed 1. When bit 0 of parameter *22.21 Constant speed function* is 1 (Packed), this parameter and parameters *22.23 Constant speed sel2* and *22.24 Constant speed sel3* select three sources whose states activate constant speeds as follows:	*DI3*

Source defined by par. *22.22*	Source defined by par. *22.23*	Source defined by par. *22.24*	Constant speed active
0	0	0	None
1	0	0	Constant speed 1
0	1	0	Constant speed 2
1	1	0	Constant speed 3
0	0	1	Constant speed 4
1	0	1	Constant speed 5
0	1	1	Constant speed 6
1	1	1	Constant speed 7

No.	Name/Value	Description	Def/FbEq16
	Not selected	0 (always off).	0
	Selected	1 (always on).	1
	DI1	Digital input DI1 (*10.02 DI delayed status*, bit 0).	2
	DI2	Digital input DI2 (*10.02 DI delayed status*, bit 1).	3
	DI3	Digital input DI3 (*10.02 DI delayed status*, bit 2).	4
	DI4	Digital input DI4 (*10.02 DI delayed status*, bit 3).	5
	DI5	Digital input DI5 (*10.02 DI delayed status*, bit 4).	6

No.	Name/Value	Description	Def/FbEq16
	DI6	Digital input DI6 (*10.02 DI delayed status*, bit 5).	7
	Reserved		8…17
	Timed function 1	Bit 0 of *34.01 Timed functions status* (see page *191*).	18
	Timed function 2	Bit 1 of *34.01 Timed functions status* (see page *191*).	19
	Timed function 3	Bit 2 of *34.01 Timed functions status* (see page *191*).	20
	Reserved		21…23
	Supervision 1	Bit 0 of *32.01 Supervision status* (see page *184*).	24
	Supervision 2	Bit 1 of *32.01 Supervision status* (see page *184*).	25
	Supervision 3	Bit 2 of *32.01 Supervision status* (see page *184*).	26
	Other [bit]	Source selection (see *Terms and abbreviations* on page *100*).	-
22.23	*Constant speed sel2*	When bit 0 of parameter *22.21 Constant speed function* is 0 (Separate), selects a source that activates constant speed 2. When bit 0 of parameter *22.21 Constant speed function* is 1 (Packed), this parameter and parameters *22.22 Constant speed sel1* and *22.24 Constant speed sel3* select three sources that are used to activate constant speeds. See table at parameter *22.22 Constant speed sel1*. For the selections, see parameter *22.22 Constant speed sel1*.	*Not selected*
22.24	*Constant speed sel3*	When bit 0 of parameter *22.21 Constant speed function* is 0 (Separate), selects a source that activates constant speed 3. When bit 0 of parameter *22.21 Constant speed function* is 1 (Packed), this parameter and parameters *22.22 Constant speed sel1* and *22.23 Constant speed sel2* select three sources that are used to activate constant speeds. See table at parameter *22.22 Constant speed sel1*. For the selections, see parameter *22.22 Constant speed sel1*.	*Not selected*
22.26	*Constant speed 1*	Defines constant speed 1 (the speed the motor will turn when constant speed 1 is selected).	300.00 rpm; 360.00 rpm (*95.20* b0)
	-30000.00… 30000.00 rpm	Constant speed 1.	See par. *46.01*
22.27	*Constant speed 2*	Defines constant speed 2.	600.00 rpm; 720.00 rpm (*95.20* b0)
	-30000.00… 30000.00 rpm	Constant speed 2.	See par. *46.01*
22.28	*Constant speed 3*	Defines constant speed 3.	900.00 rpm; 1080.00 rpm (*95.20* b0)
	-30000.00… 30000.00 rpm	Constant speed 3.	See par. *46.01*
22.29	*Constant speed 4*	Defines constant speed 4.	1200.00 rpm; 1440.00 rpm (*95.20* b0)
	-30000.00… 30000.00 rpm	Constant speed 4.	See par. *46.01*

No.	Name/Value	Description	Def/FbEq16
22.30	*Constant speed 5*	Defines constant speed 5.	1500.00 rpm; 1800.00 rpm (*95.20* b0)
	-30000.00… 30000.00 rpm	Constant speed 5.	See par. *46.01*
22.31	*Constant speed 6*	Defines constant speed 6.	2400.00 rpm; 2880.00 rpm (*95.20* b0)
	-30000.00… 30000.00 rpm	Constant speed 6.	See par. *46.01*
22.32	*Constant speed 7*	Defines constant speed 7.	3000.00 rpm; 3600.00 rpm (*95.20* b0)
	-30000.00… 30000.00 rpm	Constant speed 7.	See par. *46.01*
22.41	*Speed ref safe*	Defines a safe speed reference value that is used with supervision functions such as • *12.03 AI supervision function* • *49.05 Communication loss action* • *50.02 FBA A comm loss func*.	0.00 rpm
	-30000.00… 30000.00 rpm	Safe speed reference.	See par. *46.01*
22.51	*Critical speed function*	Enables/disables the critical speeds function. Also determines whether the specified ranges are effective in both rotating directions or not. See also section *Critical speeds/frequencies* (page *51*).	0000b

Bit	Name	Information
0	Enable	1 = Enable: Critical speeds enabled.
		0 = Disable: Critical speeds disabled.
1	Sign mode	1 = Signed: The signs of parameters *22.52…22.57* are taken into account.
		0 = Absolute: Parameters *22.52…22.57* are handled as absolute values. Each range is effective in both directions of rotation.
2…15	Reserved	

	0000b…0011b	Critical speeds configuration word.	1 = 1
22.52	*Critical speed 1 low*	Defines the low limit for critical speed range 1. **Note:** This value must be less than or equal to the value of *22.53 Critical speed 1 high*.	0.00 rpm
	-30000.00… 30000.00 rpm	Low limit for critical speed 1.	See par. *46.01*
22.53	*Critical speed 1 high*	Defines the high limit for critical speed range 1. **Note:** This value must be greater than or equal to the value of *22.52 Critical speed 1 low*.	0.00 rpm
	-30000.00… 30000.00 rpm	High limit for critical speed 1.	See par. *46.01*

No.	Name/Value	Description	Def/FbEq16
22.54	*Critical speed 2 low*	Defines the low limit for critical speed range 2. **Note:** This value must be less than or equal to the value of *22.55 Critical speed 2 high*.	0.00 rpm
	-30000.00…30000.00 rpm	Low limit for critical speed 2.	See par. *46.01*
22.55	*Critical speed 2 high*	Defines the high limit for critical speed range 2. **Note:** This value must be greater than or equal to the value of *22.54 Critical speed 2 low*.	0.00 rpm
	-30000.00…30000.00 rpm	High limit for critical speed 2.	See par. *46.01*
22.56	*Critical speed 3 low*	Defines the low limit for critical speed range 3. **Note:** This value must be less than or equal to the value of *22.57 Critical speed 3 high*.	0.00 rpm
	-30000.00…30000.00 rpm	Low limit for critical speed 3.	See par. *46.01*
22.57	*Critical speed 3 high*	Defines the high limit for critical speed range 3. **Note:** This value must be greater than or equal to the value of *22.56 Critical speed 3 low*.	0.00 rpm
	-30000.00…30000.00 rpm	High limit for critical speed 3.	See par. *46.01*
22.71	*Motor potentiometer function*	Activates and selects the mode of the motor potentiometer. See section *DC voltage control* (page *80*).	*Disabled*
	Disabled	Motor potentiometer is disabled and its value set to 0.	0
	Enabled (init at stop /power-up)	When enabled, the motor potentiometer first adopts the value defined by parameter *22.72 Motor potentiometer initial value*. The value can then be adjusted from the up and down sources defined by parameters *22.73 Motor potentiometer up source* and *22.74 Motor potentiometer down source*. A stop or a power cycle will reset the motor potentiometer to the initial value (*22.72*).	1
	Enabled (resume always)	As *Enabled (init at stop /power-up)*, but the motor potentiometer value is retained over a power cycle.	2
	Enabled (init to actual)	Whenever another reference source is selected, the value of the motor potentiometer follows that reference. After the source of reference returns to the motor potentiometer, its value can again be changed by the up and down sources (defined by *22.73* and *22.74*).	3
22.72	*Motor potentiometer initial value*	Defines an initial value (starting point) for the motor potentiometer. See the selections of parameter *22.71 Motor potentiometer function*.	0.00
	-32768.00…32767.00	Initial value for motor potentiometer.	1 = 1
22.73	*Motor potentiometer up source*	Selects the source of motor potentiometer up signal. 0 = No change 1 = Increase motor potentiometer value. (If both the up and down sources are on, the potentiometer value will not change.)	*Not selected*
	Not selected	0.	0
	Selected	1.	1

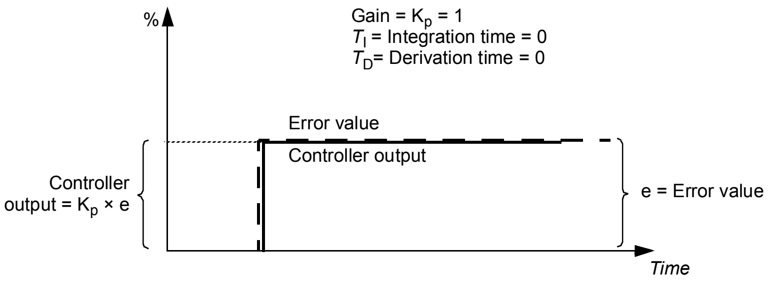
No.	**Name/Value**	**Description**	**Def/FbEq16**
	DI1	Digital input DI1 (*10.02 DI delayed status*, bit 0).	2
	DI2	Digital input DI2 (*10.02 DI delayed status*, bit 1).	3
	DI3	Digital input DI3 (*10.02 DI delayed status*, bit 2).	4
	DI4	Digital input DI4 (*10.02 DI delayed status*, bit 3).	5
	DI5	Digital input DI5 (*10.02 DI delayed status*, bit 4).	6
	DI6	Digital input DI6 (*10.02 DI delayed status*, bit 5).	7
	Reserved		8…17
	Timed function 1	Bit 0 of *34.01 Timed functions status* (see page *191*).	18
	Timed function 2	Bit 1 of *34.01 Timed functions status* (see page *191*).	19
	Timed function 3	Bit 2 of *34.01 Timed functions status* (see page *191*).	20
	Reserved		21…23
	Supervision 1	Bit 0 of *32.01 Supervision status* (see page *184*).	24
	Supervision 2	Bit 1 of *32.01 Supervision status* (see page *184*).	25
	Supervision 3	Bit 2 of *32.01 Supervision status* (see page *184*).	26
	Other [bit]	Source selection (see *Terms and abbreviations* on page *100*).	-
22.74	*Motor potentiometer down source*	Selects the source of motor potentiometer down signal. 0 = No change 1 = Decrease motor potentiometer value. (If both the up and down sources are on, the potentiometer value will not change.) For the selections, see parameter *22.73 Motor potentiometer up source*.	*Not selected*
22.75	*Motor potentiometer ramp time*	Defines the change rate of the motor potentiometer. This parameter specifies the time required for the motor potentiometer to change from minimum (*22.76*) to maximum (*22.77*). The same change rate applies in both directions.	40.0 s
	0.0…3600.0 s	Motor potentiometer change time.	10 = 1 s
22.76	*Motor potentiometer min value*	Defines the minimum value of the motor potentiometer. **Note:** If vector control mode is used, value of this parameter must be changed.	-50.00
	-32768.00… 32767.00	Motor potentiometer minimum.	1 = 1
22.77	*Motor potentiometer max value*	Defines the maximum value of the motor potentiometer. **Note:** If vector control mode is used, value of this parameter must be changed.	50.00
	-32768.00… 32767.00	Motor potentiometer maximum.	1 = 1
22.80	*Motor potentiometer ref act*	The output of the motor potentiometer function. (The motor potentiometer is configured using parameters *22.71*…*22.74*.) This parameter is read-only.	-
	-32768.00… 32767.00	Value of motor potentiometer.	1 = 1

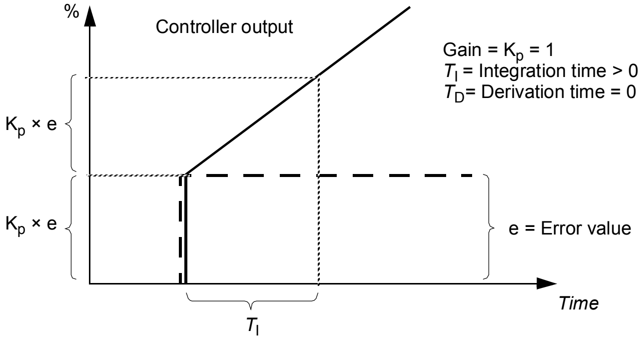
No.	Name/Value	Description	Def/FbEq16
22.86	*Speed reference act 6*	Displays the value of the speed reference (Ext1 or Ext2) that has been selected by *19.11 Ext1/Ext2 selection*. See diagram at *22.11 Ext1 speed ref1* or the control chain diagram on page *406*. This parameter is read-only.	-
	-30000.00… 30000.00 rpm	Speed reference after additive 2.	See par. *46.01*
22.87	*Speed reference act 7*	Displays the value of speed reference before application of critical speeds. See the control chain diagram on page *407*. The value is received from *22.86 Speed reference act 6* unless overridden by • any constant speed • *network control* reference • control panel reference • safe speed reference. This parameter is read-only.	-
	-30000.00… 30000.00 rpm	Speed reference before application of critical speeds.	See par. *46.01*
23 Speed reference ramp		Speed reference ramp settings (programming of the acceleration and deceleration rates for the drive). See the control chain diagram on page *408*.	
23.01	*Speed ref ramp input*	Displays the used speed reference (in rpm) before it enters the ramping and shaping functions. See the control chain diagram on page *408*. This parameter is read-only.	-
	-30000.00… 30000.00 rpm	Speed reference before ramping and shaping.	See par. *46.01*
23.02	*Speed ref ramp output*	Displays the ramped and shaped speed reference in rpm. See the control chain diagram on page *408*. This parameter is read-only.	-
	-30000.00… 30000.00 rpm	Speed reference after ramping and shaping.	See par. *46.01*
23.12	*Acceleration time 1*	Defines acceleration time 1 as the time required for the speed to change from zero to the speed defined by parameter *46.01 Speed scaling* (**not** to parameter *30.12 Maximum speed*). If the speed reference increases faster than the set acceleration rate, the motor speed will follow the acceleration rate. If the speed reference increases slower than the set acceleration rate, the motor speed will follow the reference. If the acceleration time is set too short, the drive will automatically prolong the acceleration in order not to exceed the drive torque limits.	5.000 s
	0.000…1800.000 s	Acceleration time 1.	10 = 1 s

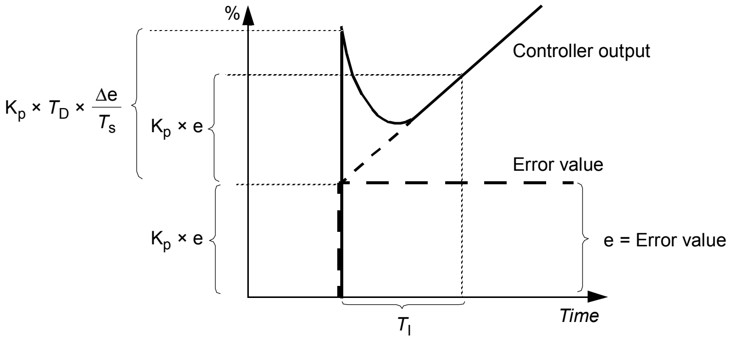
No.	Name/Value	Description	Def/FbEq16
23.13	*Deceleration time 1*	Defines deceleration time 1 as the time required for the speed to change from the speed defined by parameter *46.01 Speed scaling* (**not** from parameter *30.12 Maximum speed*) to zero. If the speed reference decreases slower than the set deceleration rate, the motor speed will follow the reference. If the reference changes faster than the set deceleration rate, the motor speed will follow the deceleration rate. If the deceleration rate is set too short, the drive will automatically prolong the deceleration in order not to exceed drive torque limits (or not to exceed a safe DC link voltage). If there is any doubt about the deceleration time being too short, ensure that DC overvoltage control is on (parameter *30.30 Overvoltage control*). **Note:** If a short deceleration time is needed for a high inertia application, the drive should be equipped with braking equipment such as a brake chopper and brake resistor.	5.000 s
	0.000…1800.000 s	Deceleration time 1.	10 = 1 s
23.23	*Emergency stop time*	Defines the time inside which the drive is stopped if an emergency stop Off3 is activated (ie. the time required for the speed to change from the speed value defined by parameter *46.01 Speed scaling* or *46.02 Frequency scaling* to zero). Emergency stop mode and activation source are selected by parameters *21.04 Emergency stop mode* and *21.05 Emergency stop source* respectively. Emergency stop can also be activated through fieldbus. **Note:** • Emergency stop Off1 uses the standard deceleration ramp as defined by parameters *23.12*…*23.13*. • The same parameter value is also used in frequency control mode (ramp parameters *28.72*…*28.73*).	3.000 s
	0.000…1800.000 s	Emergency stop Off3 deceleration time.	10 = 1 s
23.32	*Shape time 1*	Defines the shape of acceleration ramp at the beginning of acceleration.	0.000
	0.000...1800.000 s	Shape time 1.	

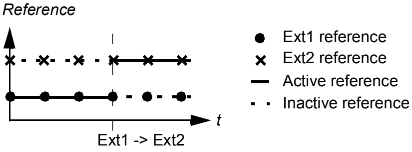
24 Speed reference conditioning		Speed error calculation; speed error window control configuration; speed error step. See the control chain diagram on page *409*.	
24.01	*Used speed reference*	Displays the ramped and corrected speed reference (before speed error calculation). See the control chain diagram on page *409*. This parameter is read-only.	-
	-30000.00… 30000.00 rpm	Speed reference used for speed error calculation.	See par. *46.01*
24.02	*Used speed feedback*	Displays the speed feedback used for speed error calculation. See the control chain diagram on page *409*. This parameter is read-only.	-
	-30000.00… 30000.00 rpm	Speed feedback used for speed error calculation.	See par. *46.01*
24.03	*Speed error filtered*	Displays the filtered speed error. See the control chain diagram on page *409*. This parameter is read-only.	-
	-30000.0… 30000.0 rpm	Filtered speed error.	See par. *46.01*

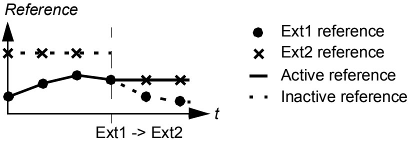
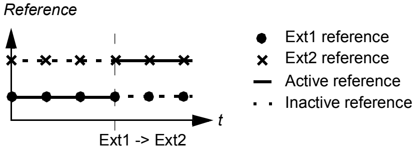
No.	Name/Value	Description	Def/FbEq16
24.04	*Speed error inverted*	Displays the inverted (unfiltered) speed error. See the control chain diagram on page *409*. This parameter is read-only.	-
	-30000.0… 30000.0 rpm	Inverted speed error.	See par. *46.01*
24.11	*Speed correction*	Defines a speed reference correction, ie. a value added to the existing reference between ramping and limitation. This is useful to trim the speed if necessary, for example to adjust draw between sections of a paper machine. See the control chain diagram on page *409*.	0.00 rpm
	-10000.00… 10000.00 rpm	Speed reference correction.	See par. *46.01*
24.12	*Speed error filter time*	Defines the time constant of the speed error low-pass filter. If the used speed reference changes rapidly, the possible interferences in the speed measurement can be filtered with the speed error filter. Reducing the ripple with this filter may cause speed controller tuning problems. A long filter time constant and fast acceleration time contradict one another. A very long filter time results in unstable control.	0 ms
	0…10000 ms	Speed error filtering time constant. 0 = filtering disabled.	1 = 1 ms

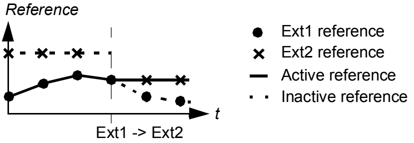
25 Speed control		Speed controller settings. See the control chain diagram on page *409*.	
25.01	*Torque reference speed control*	Displays the speed controller output that is transferred to the torque controller. See the control chain diagram on page *409*. This parameter is read-only.	-
	-1600.0…1600.0%	Limited speed controller output torque.	See par. *46.03*
25.02	*Speed proportional gain*	Defines the proportional gain (K_p) of the speed controller. Too high a gain may cause speed oscillation. The figure below shows the speed controller output after an error step when the error remains constant.  If gain is set to 1, a 10% change in error value (reference - actual value) causes the speed controller output to change by 10%, ie. the output value is input × gain.	10.00
	0.00…250.00	Proportional gain for speed controller.	100 = 1

No.	**Name/Value**	**Description**	**Def/FbEq16**
25.03	*Speed integration time*	Defines the integration time of the speed controller. The integration time defines the rate at which the controller output changes when the error value is constant and the proportional gain of the speed controller is 1. The shorter the integration time, the faster the continuous error value is corrected. This time constant must be set to the same order of magnitude as the time constant (time to respond) of the actual mechanical system being controlled, otherwise instability will result. Setting the integration time to zero disables the I-part of the controller. This is useful to do when tuning the proportional gain; adjust the proportional gain first, then return the integration time. Anti-windup (the integrator just integrates up to 100%) stops the integrator if the controller output is limited. The figure below shows the speed controller output after an error step when the error remains constant.  	1.50 s
	0.00…1000.00 s	Integration time for speed controller.	10 = 1 s

No.	Name/Value	Description	Def/FbEq16
25.04	*Speed derivation time*	Defines the derivation time of the speed controller. Derivative action boosts the controller output if the error value changes. The longer the derivation time, the more the speed controller output is boosted during the change. If the derivation time is set to zero, the controller works as a PI controller, otherwise as a PID controller. The derivation makes the control more responsive for disturbances. For simple applications, derivative time is not normally required and should be left at zero. The speed error derivative must be filtered with a low pass filter to eliminate disturbances. The figure below shows the speed controller output after an error step when the error remains constant.  Gain = K_p = 1 T_I = Integration time > 0 T_D= Derivation time > 0 T_s= Sample time period = 250 µs Δe = Error value change between two samples	0.000 s
	0.000…10.000 s	Derivation time for speed controller.	1000 = 1 s
25.05	*Derivation filter time*	Defines the derivation filter time constant. See parameter *25.04 Speed derivation time*.	8 ms
	0…10000 ms	Derivation filter time constant.	1 = 1 ms
25.15	*Proportional gain em stop*	Defines the proportional gain for the speed controller when an emergency stop is active. See parameter *25.02 Speed proportional gain*.	10.00
	1.00…250.00	Proportional gain upon an emergency stop.	100 = 1
25.53	*Torque prop reference*	Displays the output of the proportional (P) part of the speed controller. See the control chain diagram on page *409*. This parameter is read-only.	-
	-30000.0…30000.0%	P-part output of speed controller.	See par. *46.03*
25.54	*Torque integral reference*	Displays the output of the integral (I) part of the speed controller. See the control chain diagram on page *409*. This parameter is read-only.	-
	-30000.0…30000.0%	I-part output of speed controller.	See par. *46.03*

No.	Name/Value	Description	Def/FbEq16
25.55	*Torque deriv reference*	Displays the output of the derivative (D) part of the speed controller. See the control chain diagram on page *409*. This parameter is read-only.	-
	-30000.0… 30000.0%	D-part output of speed controller.	See par. *46.03*
28 Frequency reference chain		Settings for the frequency reference chain. See the control chain diagrams on pages *404* and *405*.	
28.01	*Frequency ref ramp input*	Displays the used frequency reference before ramping. See the control chain diagram on page *404*. This parameter is read-only.	-
	-500.00…500.00 Hz	Frequency reference before ramping.	See par. *46.02*
28.02	*Frequency ref ramp output*	Displays the final frequency reference (after selection, limitation and ramping). See the control chain diagram on page *404*. This parameter is read-only.	-
	-500.00…500.00 Hz	Final frequency reference.	See par. *46.02*
28.11	*Ext1 frequency ref1*	Selects Ext1 frequency reference source 1.	*AI1 scaled*
	Zero	None.	0
	AI1 scaled	*12.12 AI1 scaled value* (see page *125*).	1
	AI2 scaled	*12.22 AI2 scaled value* (see page *126*).	2
	Reserved		3
	FB A ref1	*03.05 FB A reference 1* (see page *106*).	4
	FB A ref2	*03.06 FB A reference 2* (see page *106*).	5
	Reserved		6…7
	EFB ref1	*03.09 EFB reference 1* (see page *107*).	8
	EFB ref2	*03.10 EFB reference 2* (see page *107*).	9
	Reserved		10…14
	Motor potentiometer	*22.80 Motor potentiometer ref act* (output of the motor potentiometer).	15
	PID	*40.01 Process PID output actual* (output of the process PID controller).	16
	Frequency input	*11.38 Freq in 1 actual value* (when DI5 is used as a frequency input).	17
	Control panel (ref saved)	Panel reference (*03.01 Panel reference*, see page *106*) saved by the control system for the location where the control returns is used as the reference. 	18

No.	Name/Value	Description	Def/FbEq16
	Control panel (ref copied)	Panel reference (*03.01 Panel reference*, see page *106*) for the previous control location is used as the reference when the control location changes if the references for the two locations are of the same type (eg frequency/speed/torque/PID); otherwise, the actual signal is used as the new reference.  	19
	Level control	Parameter *76.07 LC speed ref* (output of the Level control function).	30
	Other	Source selection (see *Terms and abbreviations* on page *100*).	-
28.15	*Ext2 frequency ref1*	Selects Ext2 frequency reference source 1.	*Zero*
	Zero	None.	0
	AI1 scaled	*12.12 AI1 scaled value* (see page *125*).	1
	AI2 scaled	*12.22 AI2 scaled value* (see page *126*).	2
	Reserved		3
	FB A ref1	*03.05 FB A reference 1* (see page *106*).	4
	FB A ref2	*03.06 FB A reference 2* (see page *106*).	5
	Reserved		6…7
	EFB ref1	*03.09 EFB reference 1* (see page *107*).	8
	EFB ref2	*03.10 EFB reference 2* (see page *107*).	9
	Reserved		10…14
	Motor potentiometer	*22.80 Motor potentiometer ref act* (output of the motor potentiometer).	15
	PID	*40.01 Process PID output actual* (output of the process PID controller).	16
	Frequency input	*11.38 Freq in 1 actual value* (when DI5 is used as a frequency input).	17
	Control panel (ref saved)	Panel reference (*03.01 Panel reference*, see page *106*) saved by the control system for the location where the control returns is used as the reference.  	18

No.	Name/Value	Description	Def/FbEq16
	Control panel (ref copied)	Panel reference (*03.01 Panel reference*, see page *106*) for the previous control location is used as the reference when the control location changes if the references for the two locations are of the same type (eg frequency/speed/torque/PID); otherwise, the actual signal is used as the new reference.  	19
	Level control	Parameter *76.07 LC speed ref* (output of the Level control function).	30
	Other	Source selection (see *Terms and abbreviations* on page *100*).	-
28.21	*Constant frequency function*	Determines how constant frequencies are selected, and whether the rotation direction signal is considered or not when applying a constant frequency.	0001b

Bit	Name	Information
0	Const freq mode	1 = Packed: 7 constant frequencies are selectable using the three sources defined by parameters *28.22*, *28.23* and *28.24*.
		0 = Separate: Constant frequencies 1, 2 and 3 are separately activated by the sources defined by parameters *28.22*, *28.23* and *28.24* respectively. In case of conflict, the constant frequency with the smaller number takes priority.
1	Direction enable	1 = Start dir: To determine running direction for a constant speed, the sign of the constant speed setting (parameters *22.26*…*22.32*) is multiplied by the direction signal (forward: +1, reverse: -1). This effectively allows the drive to have 14 (7 forward, 7 reverse) constant speeds if all values in *22.26*…*22.32* are positive. ⚠ **WARNING:** If the direction signal is reverse and the active constant speed is negative, the drive will run in the forward direction.
		0 = Accord Par: The running direction for the constant speed is determined by the sign of the constant speed setting (parameters *22.26*…*22.32*).
2…15	Reserved	

No.	Name/Value	Description	Def/FbEq16
	0000b…0011b	Constant frequency configuration word.	1 = 1

No.	Name/Value	Description	Def/FbEq16
28.22	*Constant frequency sel1*	When bit 0 of parameter *28.21 Constant frequency function* is 0 (Separate), selects a source that activates constant frequency 1. When bit 0 of parameter *28.21 Constant frequency function* is 1 (Packed), this parameter and parameters *28.23 Constant frequency sel2* and *28.24 Constant frequency sel3* select three sources whose states activate constant frequencies as follows:	*DI3*

Source defined by par. *28.22*	**Source defined by par. *28.23***	**Source defined by par. *28.24***	**Constant frequency active**
0	0	0	None
1	0	0	Constant frequency 1
0	1	0	Constant frequency 2
1	1	0	Constant frequency 3
0	0	1	Constant frequency 4
1	0	1	Constant frequency 5
0	1	1	Constant frequency 6
1	1	1	Constant frequency 7

No.	Name/Value	Description	Def/FbEq16
	Not selected	0.	0
	Selected	1.	1
	DI1	Digital input DI1 (*10.02 DI delayed status*, bit 0).	2
	DI2	Digital input DI2 (*10.02 DI delayed status*, bit 1).	3
	DI3	Digital input DI3 (*10.02 DI delayed status*, bit 2).	4
	DI4	Digital input DI4 (*10.02 DI delayed status*, bit 3).	5
	DI5	Digital input DI5 (*10.02 DI delayed status*, bit 4).	6
	DI6	Digital input DI6 (*10.02 DI delayed status*, bit 5).	7
	Reserved		8…17
	Timed function 1	Bit 0 of *34.01 Timed functions status* (see page *191*).	18
	Timed function 2	Bit 1 of *34.01 Timed functions status* (see page *191*).	19
	Timed function 3	Bit 2 of *34.01 Timed functions status* (see page *191*).	20
	Reserved		21…23
	Supervision 1	Bit 0 of *32.01 Supervision status* (see page *184*).	24
	Supervision 2	Bit 1 of *32.01 Supervision status* (see page *184*).	25
	Supervision 3	Bit 2 of *32.01 Supervision status* (see page *184*).	26
	Other [bit]	Source selection (see *Terms and abbreviations* on page *100*).	-
28.23	*Constant frequency sel2*	When bit 0 of parameter *28.21 Constant frequency function* is 0 (Separate), selects a source that activates constant frequency 2. When bit 0 of parameter *28.21 Constant frequency function* is 1 (Packed), this parameter and parameters *28.22 Constant frequency sel1* and *28.24 Constant frequency sel3* select three sources that are used to activate constant frequencies. See table at parameter *28.22 Constant frequency sel1*. For the selections, see parameter *28.22 Constant frequency sel1*.	*Not selected*

No.	**Name/Value**	**Description**	**Def/FbEq16**
28.24	*Constant frequency sel3*	When bit 0 of parameter *28.21 Constant frequency function* is 0 (Separate), selects a source that activates constant frequency 3. When bit 0 of parameter *28.21 Constant frequency function* is 1 (Packed), this parameter and parameters *28.22 Constant frequency sel1* and *28.23 Constant frequency sel2* select three sources that are used to activate constant frequencies. See table at parameter *28.22 Constant frequency sel1*. For the selections, see parameter *28.22 Constant frequency sel1*.	*Not selected*
28.26	*Constant frequency 1*	Defines constant frequency 1 (the frequency the motor will turn when constant frequency 1 is selected).	5.00 Hz; 6.00 Hz (*95.20* b0)
	-500.00…500.00 Hz	Constant frequency 1.	See par. *46.02*
28.27	*Constant frequency 2*	Defines constant frequency 2.	10.00 Hz; 12.00 Hz (*95.20* b0)
	-500.00…500.00 Hz	Constant frequency 2.	See par. *46.02*
28.28	*Constant frequency 3*	Defines constant frequency 3.	15.00 Hz; 18.00 Hz (*95.20* b0)
	-500.00…500.00 Hz	Constant frequency 3.	See par. *46.02*
28.29	*Constant frequency 4*	Defines constant frequency 4.	20.00 Hz; 24.00 Hz (*95.20* b0)
	-500.00…500.00 Hz	Constant frequency 4.	See par. *46.02*
28.30	*Constant frequency 5*	Defines constant frequency 5.	25.00 Hz; 30.00 Hz (*95.20* b0)
	-500.00…500.00 Hz	Constant frequency 5.	See par. *46.02*
28.31	*Constant frequency 6*	Defines constant frequency 6.	40.00 Hz; 48.00 Hz (*95.20* b0)
	-500.00…500.00 Hz	Constant frequency 6.	See par. *46.02*
28.32	*Constant frequency 7*	Defines constant frequency 7.	50.00 Hz; 60.00 Hz (*95.20* b0)
	-500.00…500.00 Hz	Constant frequency 7.	See par. *46.02*

<table>
<tr><th>No.</th><th>Name/Value</th><th>Description</th><th>Def/FbEq16</th></tr>
<tr><td>28.41</td><td>Frequency ref safe</td><td>Defines a safe frequency reference value that is used with supervision functions such as
• 12.03 AI supervision function
• 49.05 Communication loss action
• 50.02 FBA A comm loss func.
• 80.17 Maximum flow protection
• 80.18 Minimum flow protection</td><td>0.00 Hz</td></tr>
<tr><td></td><td>-500.00…500.00 Hz</td><td>Safe frequency reference.</td><td>See par. 46.02</td></tr>
<tr><td>28.51</td><td>Critical frequency function</td><td>Enables/disables the critical frequencies function. Also determines whether the specified ranges are effective in both rotating directions or not.
See also section Critical speeds/frequencies (page 51).</td><td>0000b</td></tr>
<tr><td></td><td colspan="3">
<table>
<tr><th>Bit</th><th>Name</th><th>Information</th></tr>
<tr><td>0</td><td>Crit freq</td><td>1 = Enable: Critical frequencies enabled.</td></tr>
<tr><td></td><td></td><td>0 = Disable: Critical frequencies disabled.</td></tr>
<tr><td>1</td><td>Sign mode</td><td>1 = According to par: The signs of parameters 28.52…28.57 are taken into account.</td></tr>
<tr><td></td><td></td><td>0 = Absolute: Parameters 28.52…28.57 are handled as absolute values. Each range is effective in both directions of rotation.</td></tr>
</table>
</td></tr>
<tr><td></td><td>0000b…0011b</td><td>Critical frequencies configuration word.</td><td>1 = 1</td></tr>
<tr><td>28.52</td><td>Critical frequency 1 low</td><td>Defines the low limit for critical frequency 1.
Note: This value must be less than or equal to the value of 28.53 Critical frequency 1 high.</td><td>0.00 Hz</td></tr>
<tr><td></td><td>-500.00…500.00 Hz</td><td>Low limit for critical frequency 1.</td><td>See par. 46.02</td></tr>
<tr><td>28.53</td><td>Critical frequency 1 high</td><td>Defines the high limit for critical frequency 1.
Note: This value must be greater than or equal to the value of 28.52 Critical frequency 1 low.</td><td>0.00 Hz</td></tr>
<tr><td></td><td>-500.00…500.00 Hz</td><td>High limit for critical frequency 1.</td><td>See par. 46.02</td></tr>
<tr><td>28.54</td><td>Critical frequency 2 low</td><td>Defines the low limit for critical frequency 2.
Note: This value must be less than or equal to the value of 28.55 Critical frequency 2 high.</td><td>0.00 Hz</td></tr>
<tr><td></td><td>-500.00…500.00 Hz</td><td>Low limit for critical frequency 2.</td><td>See par. 46.02</td></tr>
<tr><td>28.55</td><td>Critical frequency 2 high</td><td>Defines the high limit for critical frequency 2.
Note: This value must be greater than or equal to the value of 28.54 Critical frequency 2 low.</td><td>0.00 Hz</td></tr>
<tr><td></td><td>-500.00…500.00 Hz</td><td>High limit for critical frequency 2.</td><td>See par. 46.02</td></tr>
<tr><td>28.56</td><td>Critical frequency 3 low</td><td>Defines the low limit for critical frequency 3.
Note: This value must be less than or equal to the value of 28.57 Critical frequency 3 high.</td><td>0.00 Hz</td></tr>
<tr><td></td><td>-500.00…500.00 Hz</td><td>Low limit for critical frequency 3.</td><td>See par. 46.02</td></tr>
</table>

No.	Name/Value	Description	Def/FbEq16
28.57	*Critical frequency 3 high*	Defines the high limit for critical frequency 3. **Note:** This value must be greater than or equal to the value of *28.56 Critical frequency 3 low*.	0.00 Hz
	-500.00…500.00 Hz	High limit for critical frequency 3.	See par. *46.02*
28.72	*Freq acceleration time 1*	Defines acceleration time 1 as the time required for the frequency to change from zero to the frequency defined by parameter *46.02 Frequency scaling*. After this frequency has been reached, the acceleration continues with the same rate to the value defined by parameter *30.14 Maximum frequency*. If the reference increases faster than the set acceleration rate, the motor will follow the acceleration rate. If the reference increases slower than the set acceleration rate, the motor frequency will follow the reference. If the acceleration time is set too short, the drive will automatically prolong the acceleration in order not to exceed the drive torque limits.	5.0 s
	0.000…1800.000 s	Acceleration time 1.	10 = 1 s
28.73	*Freq deceleration time 1*	Defines deceleration time 1 as the time required for the frequency to change from the frequency defined by parameter *46.02 Frequency scaling* (**not** from parameter *30.14 Maximum frequency*) to zero. If there is any doubt about the deceleration time being too short, ensure that DC overvoltage control (*30.30 Overvoltage control*) is on. **Note:** If a short deceleration time is needed for a high inertia application, the drive should be equipped with braking equipment such as a brake chopper and brake resistor.	5.0 s
	0.000…1800.000 s	Deceleration time 1.	10 = 1 s
28.76	*Freq ramp in zero source*	Selects a source that forces the frequency reference to zero. 0 = Force frequency reference to zero 1 = Normal operation	*Inactive*
	Active	0.	0
	Inactive	1.	1
	DI1	Digital input DI1 (*10.02 DI delayed status*, bit 0).	2
	DI2	Digital input DI2 (*10.02 DI delayed status*, bit 1).	3
	DI3	Digital input DI3 (*10.02 DI delayed status*, bit 2).	4
	DI4	Digital input DI4 (*10.02 DI delayed status*, bit 3).	5
	DI5	Digital input DI5 (*10.02 DI delayed status*, bit 4).	6
	DI6	Digital input DI6 (*10.02 DI delayed status*, bit 5).	7
	Other [bit]	Source selection (see *Terms and abbreviations* on page *100*).	-
28.82	*Shape time 1*	Defines the shape of acceleration ramp at the beginning of acceleration.	0.000
	0.000...1800.000 s	Shape time 1.	10 = 1 s
28.92	*Frequency ref act 3*	Displays the frequency reference after selection (*19.11 Ext1/Ext2 selection*). See the control chain diagram on page *404*. This parameter is read-only.	-
	-500.00 …500.00 Hz	Frequency reference after selection.	See par. *46.02*

No.	Name/Value	Description	Def/FbEq16
28.96	*Frequency ref act 7*	Displays the frequency reference after application of constant frequencies, control panel reference, etc. See the control chain diagram on page *404*. This parameter is read-only.	-
	-500.00 …500.00 Hz	Frequency reference 7.	See par. *46.02*
28.97	*Frequency ref unlimited*	Displays the frequency reference after application of critical frequencies, but before ramping and limiting. See the control chain diagram on page *405*. This parameter is read-only.	-
	-500.00 …500.00 Hz	Frequency reference before ramping and limiting.	See par. *46.02*
30 Limits		Drive operation limits.	
30.01	*Limit word 1*	Displays limit word 1. This parameter is read-only.	-

Bit	Name	Description
0	Torq lim	1 = Drive torque is being limited by the motor control (undervoltage control, current control, load angle control or pull-out control), or by the torque limits defined by parameters.
1…4	Reserved	
5	Tlim max speed	1 = Torque reference is being limited by the rush control because of maximum speed limit (*30.12 Maximum speed*)
6	Tlim min speed	1 = Torque reference is being limited by the rush control because of minimum speed limit (*30.11 Minimum speed*)
7	Max speed ref lim	1 = Speed reference is being limited by *30.12 Maximum speed*
8	Min speed ref lim	1 = Speed reference is being limited by *30.11 Minimum speed*
9	Max freq ref lim	1 = Frequency reference is being limited by *30.14 Maximum frequency*
10	Min freq ref lim	1 = Frequency reference is being limited by *30.13 Minimum frequency*
11…15	Reserved	

	0000h…FFFFh	Limit word 1.	1 = 1

No.	Name/Value	Description	Def/FbEq16
30.02	*Torque limit status*	Displays the torque controller limitation status word. This parameter is read-only.	-

Bit	Name	Description
0	Undervoltage	*1 = Intermediate DC circuit undervoltage
1	Overvoltage	*1 = Intermediate DC circuit overvoltage
2	Minimum torque	*1 = Torque is being limited by *30.19 Minimum torque 1*, *30.26 Power motoring limit* or *30.27 Power generating limit*
3	Maximum torque	*1 = Torque is being limited by *30.20 Maximum torque 1*, *30.26 Power motoring limit* or *30.27 Power generating limit*
4	Internal current	1 = An inverter current limit (identified by bits 8…11) is active
5	Load angle	(With permanent magnet motors and reluctance motors only) 1 = Load angle limit is active, ie. the motor cannot produce any more torque
6	Motor pullout	(With asynchronous motors only) Motor pull-out limit is active, ie. the motor cannot produce any more torque
7	Reserved	
8	Thermal	1 = Input current is being limited by the main circuit thermal limit
9	Max current	*1 = Maximum output current (I_{MAX}) is being limited
10	User current	*1 = Output current is being limited by *30.17 Maximum current*
11	Thermal IGBT	*1 = Output current is being limited by a calculated thermal current value
12…15	Reserved	
*Only one out of bits 0…3, and one out of bits 9…11 can be on simultaneously. The bit typically indicates the limit that is exceeded first.		

	0000h…FFFFh	Torque limitation status word.	1 = 1
30.11	*Minimum speed*	Defines the minimum allowed speed. ⚠ **WARNING!** This value must not be higher than *30.12 Maximum speed*. ⚠ **WARNING!** In speed control mode only. In frequency control mode, use frequency limits (*30.13* and *30.14*).	0.00 rpm
	-30000.00… 30000.00 rpm	Minimum allowed speed.	See par. *46.01*
30.12	*Maximum speed*	Defines the maximum allowed speed. **Note:** This parameter does not affect the speed acceleration and deceleration ramp times. See parameter *46.01 Speed scaling*. ⚠ **WARNING!** This value must not be lower than *30.11 Minimum speed*. ⚠ **WARNING!** In speed control mode only. In frequency control mode, use frequency limits (*30.13* and *30.14*).	1500.00 rpm; 1800.00 rpm (*95.20* b0)
	-30000.00… 30000.00 rpm	Maximum speed.	See par. *46.01*

No.	Name/Value	Description	Def/FbEq16
30.13	*Minimum frequency*	Defines the minimum allowed frequency. ⚠ **WARNING!** This value must not be higher than *30.14 Maximum frequency*. ⚠ **WARNING!** in frequency control mode only.	0.00 Hz
	-500.00…500.00 Hz	Minimum frequency.	See par. *46.02*
30.14	*Maximum frequency*	Defines the maximum allowed frequency. **Note:** This parameter does not affect the frequency acceleration and deceleration ramp times. See parameter *46.02 Frequency scaling*. ⚠ **WARNING!** This value must not be lower than *30.13 Minimum frequency*. ⚠ **WARNING!** in frequency control mode only.	50.00 Hz; 60.00 Hz (*95.20* b0)
	-500.00…500.00 Hz	Maximum frequency.	See par. *46.02*
30.17	*Maximum current*	Defines the maximum allowed motor current. This depends on the drive type; it is automatically determined on the basis of the rating.	0.00 A
	0.00…30000.00 A	Maximum motor current.	1 = 1 A
30.19	*Minimum torque 1*	Defines a minimum torque limit for the drive (in percent of nominal motor torque). **Note:** If your application, like a pump or a fan, requires that the motor must rotate in one direction only, use speed/ frequency limit (*30.11 Minimum speed*/*30.13 Minimum frequency*) to achieve this. Do not set parameter *30.19 Minimum torque 1* or *30.27 Power generating limit* to 0%, as the drive is then not able to stop correctly. ⚠ **WARNING!** In torque control mode (vector motor control) only.	-300.0%
	-1600.0…0.0%	Minimum torque limit 1.	See par. *46.03*
30.20	*Maximum torque 1*	Defines a maximum torque limit for the drive (in percent of nominal motor torque). ⚠ **WARNING!** In torque control mode (vector motor control) only.	300.0%
	0.0…1600.0%	Maximum torque 1.	See par. *46.03*
30.26	*Power motoring limit*	Defines the maximum allowed power fed by the inverter to the motor in percent of nominal motor power.	300.00%
	0.00…600.00%	Maximum motoring power.	1 = 1%
30.27	*Power generating limit*	Defines the maximum allowed power fed by the motor to the inverter in percent of nominal motor power. **Note:** If your application, like a pump or a fan, requires that the motor must rotate in one direction only, use speed/ frequency limit (*30.11 Minimum speed*/*30.13 Minimum frequency*) to achieve this. Do not set parameter *30.19 Minimum torque 1* or *30.27 Power generating limit* to 0%, as the drive is then not able to stop correctly.	-300.00%
	-600.00…0.00%	Maximum generating power.	1 = 1%

No.	Name/Value	Description	Def/FbEq16
30.30	*Overvoltage control*	Enables the overvoltage control of the intermediate DC link. Fast braking of a high inertia load causes the voltage to rise to the overvoltage control limit. To prevent the DC voltage from exceeding the limit, the overvoltage controller automatically decreases the braking torque. **Note:** If the drive is equipped with a brake chopper and resistor, or a regenerative supply unit, the controller must be disabled.	*Enable*
	Disable	Overvoltage control disabled.	0
	Enable	Overvoltage control enabled.	1
30.31	*Undervoltage control*	Enables the undervoltage control of the intermediate DC link. If the DC voltage drops due to input power cut off, the undervoltage controller will automatically decrease the motor torque in order to keep the voltage above the lower limit. By decreasing the motor torque, the inertia of the load will cause regeneration back to the drive, keeping the DC link charged and preventing an undervoltage trip until the motor coasts to a stop. This will act as a power-loss ride-through functionality in systems with high inertia, such as a centrifuge or a fan.	*Enable*
	Disable	Undervoltage control disabled.	0
	Enable	Undervoltage control enabled.	1

31 Fault functions		Configuration of external events; selection of behavior of the drive upon fault situations.	
31.01	*External event 1 source*	Defines the source of external event 1. See also parameter *31.02 External event 1 type*. 0 = Trigger event 1 = Normal operation	*Inactive (true)*
	Active (false)	0.	0
	Inactive (true)	1.	1
	Reserved		2
	DI1	Digital input DI1 (*10.02 DI delayed status*, bit 0).	3
	DI2	Digital input DI2 (*10.02 DI delayed status*, bit 1).	4
	DI3	Digital input DI3 (*10.02 DI delayed status*, bit 2).	5
	DI4	Digital input DI4 (*10.02 DI delayed status*, bit 3).	6
	DI5	Digital input DI5 (*10.02 DI delayed status*, bit 4).	7
	DI6	Digital input DI6 (*10.02 DI delayed status*, bit 5).	8
	Other [bit]	Source selection (see *Terms and abbreviations* on page *100*).	-
31.02	*External event 1 type*	Selects the type of external event 1.	*Fault*
	Fault	The external event generates a fault.	0
	Warning	The external event generates a warning.	1
31.03	*External event 2 source*	Defines the source of external event 2. See also parameter *31.04 External event 2 type*. For the selections, see parameter *31.01 External event 1 source*.	*Inactive (true)*
31.04	*External event 2 type*	Selects the type of external event 2.	*Fault*
	Fault	The external event generates a fault.	0

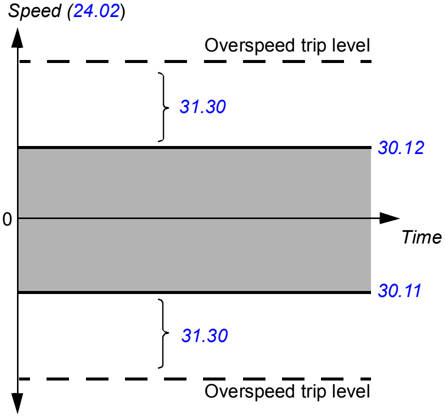
No.	Name/Value	Description	Def/FbEq16
	Warning	The external event generates a warning.	1
31.05	*External event 3 source*	Defines the source of external event 3. See also parameter *31.06 External event 3 type*. For the selections, see parameter *31.01 External event 1 source*.	*Inactive (true)*
31.06	*External event 3 type*	Selects the type of external event 3.	*Fault*
	Fault	The external event generates a fault.	0
	Warning	The external event generates a warning.	1
31.07	*External event 4 source*	Defines the source of external event 4. See also parameter *31.08 External event 4 type*. For the selections, see parameter *31.01 External event 1 source*.	*Inactive (true)*
31.08	*External event 4 type*	Selects the type of external event 4.	*Fault*
	Fault	The external event generates a fault.	0
	Warning	The external event generates a warning.	1
31.09	*External event 5 source*	Defines the source of external event 5. See also parameter *31.10 External event 5 type*. For the selections, see parameter *31.01 External event 1 source*.	*Inactive (true)*
31.10	*External event 5 type*	Selects the type of external event 5.	*Fault*
	Fault	The external event generates a fault.	0
	Warning	The external event generates a warning.	1
31.11	*Fault reset selection*	Selects the source of an external fault reset signal. The signal resets the drive after a fault trip if the cause of the fault no longer exists. 0 -> 1 = Reset **Note:** A fault reset from the fieldbus interface is always observed regardless of this parameter.	*Not selected*
	Not selected	0.	0
	Selected	1.	1
	DI1	Digital input DI1 (*10.02 DI delayed status*, bit 0).	2
	DI2	Digital input DI2 (*10.02 DI delayed status*, bit 1).	3
	DI3	Digital input DI3 (*10.02 DI delayed status*, bit 2).	4
	DI4	Digital input DI4 (*10.02 DI delayed status*, bit 3).	5
	DI5	Digital input DI5 (*10.02 DI delayed status*, bit 4).	6
	DI6	Digital input DI6 (*10.02 DI delayed status*, bit 5).	7
	Reserved		8…17
	Timed function 1	Bit 0 of *34.01 Timed functions status* (see page *191*).	18
	Timed function 2	Bit 1 of *34.01 Timed functions status* (see page *191*).	19
	Timed function 3	Bit 2 of *34.01 Timed functions status* (see page *191*).	20
	Reserved		21…23
	Supervision 1	Bit 0 of *32.01 Supervision status* (see page *184*).	24
	Supervision 2	Bit 1 of *32.01 Supervision status* (see page *184*).	25

<table>
<tr><th>No.</th><th>Name/Value</th><th>Description</th><th>Def/FbEq16</th></tr>
<tr><td></td><td>Supervision 3</td><td>Bit 2 of <i>32.01 Supervision status</i> (see page <i>184</i>).</td><td>26</td></tr>
<tr><td></td><td><i>Other [bit]</i></td><td>Source selection (see <i>Terms and abbreviations</i> on page <i>100</i>).</td><td>-</td></tr>
<tr><td><i>31.12</i></td><td><i>Autoreset selection</i></td><td>Selects faults that are automatically reset. The parameter is a 16-bit word with each bit corresponding to a fault type. Whenever a bit is set to 1, the corresponding fault is automatically reset.
⚠ WARNING! Before you activate the function, make sure that no dangerous situations can occur. The function restarts the drive automatically and continues operation after a fault.
The bits of this binary number correspond to the following faults:</td><td>000Ch
(00…1100b)</td></tr>
<tr><td colspan="4">
<table>
<tr><th>Bit</th><th>Fault</th></tr>
<tr><td>0</td><td>Overcurrent</td></tr>
<tr><td>1</td><td>Overvoltage</td></tr>
<tr><td>2</td><td>Undervoltage</td></tr>
<tr><td>3</td><td>AI supervision fault</td></tr>
<tr><td>4…9</td><td>Reserved</td></tr>
<tr><td>10</td><td>Selectable fault (see parameter <i>31.13 Selectable fault</i>)</td></tr>
<tr><td>11</td><td>External fault 1 (from source selected by parameter <i>31.01 External event 1 source</i>)</td></tr>
<tr><td>12</td><td>External fault 2 (from source selected by parameter <i>31.03 External event 2 source</i>)</td></tr>
<tr><td>13</td><td>External fault 3 (from source selected by parameter <i>31.05 External event 3 source</i>)</td></tr>
<tr><td>14</td><td>External fault 4 (from source selected by parameter <i>31.07 External event 4 source</i>)</td></tr>
<tr><td>15</td><td>External fault 5 (from source selected by parameter <i>31.09 External event 5 source</i>)</td></tr>
</table>
</td></tr>
<tr><td></td><td>0000h…FFFFh</td><td>Automatic reset configuration word.</td><td>1 = 1</td></tr>
<tr><td><i>31.13</i></td><td><i>Selectable fault</i></td><td>Defines the fault that can be automatically reset using parameter <i>31.12 Autoreset selection</i>, bit 10.
Faults are listed in chapter <i>Fault tracing</i> (page <i>351</i>).</td><td>0000h</td></tr>
<tr><td></td><td>0000h…FFFFh</td><td>Fault code.</td><td>10 = 1</td></tr>
<tr><td><i>31.14</i></td><td><i>Number of trials</i></td><td>Defines the number of automatic fault resets the drive performs within the time defined by parameter <i>31.15 Total trials time</i>.</td><td>5</td></tr>
<tr><td></td><td>0…5</td><td>Number of automatic resets.</td><td>10 = 1</td></tr>
<tr><td><i>31.15</i></td><td><i>Total trials time</i></td><td>Defines the time the automatic reset function will attempt to reset the drive. During this time, it will perform the number of automatic resets defined by <i>31.14 Number of trials</i>.</td><td>30.0 s</td></tr>
<tr><td></td><td>1.0…600.0 s</td><td>Time for automatic resets.</td><td>10 = 1 s</td></tr>
<tr><td><i>31.16</i></td><td><i>Delay time</i></td><td>Defines the time that the drive will wait after a fault before attempting an automatic reset. See parameter <i>31.12 Autoreset selection</i>.</td><td>5.0 s</td></tr>
<tr><td></td><td>0.0…120.0 s</td><td>Autoreset delay.</td><td>10 = 1 s</td></tr>
<tr><td><i>31.19</i></td><td><i>Motor phase loss</i></td><td>Selects how the drive reacts when a motor phase loss is detected.</td><td><i>Fault</i></td></tr>
<tr><td></td><td>No action</td><td>No action taken.</td><td>0</td></tr>
<tr><td></td><td>Fault</td><td>The drive trips on fault <i>3381 Output phase loss</i>.</td><td>1</td></tr>
</table>

<table>
<tr><th>No.</th><th>Name/Value</th><th>Description</th><th>Def/FbEq16</th></tr>
<tr><td><i>31.20</i></td><td><i>Earth fault</i></td><td>Selects how the drive reacts when an earth (ground) fault or current unbalance is detected in the motor or the motor cable.</td><td><i>Fault</i></td></tr>
<tr><td></td><td>No action</td><td>No action taken.</td><td>0</td></tr>
<tr><td></td><td>Warning</td><td>The drive generates an <i>A2B3 Earth leakage</i> warning.</td><td>1</td></tr>
<tr><td></td><td>Fault</td><td>The drive trips on fault <i>2330 Earth leakage</i>.</td><td>2</td></tr>
<tr><td><i>31.21</i></td><td><i>Supply phase loss</i></td><td>Selects how the drive reacts when a supply phase loss is detected.</td><td><i>Fault</i></td></tr>
<tr><td></td><td>No action</td><td>No action taken.</td><td>0</td></tr>
<tr><td></td><td>Fault</td><td>The drive trips on fault <i>3130 Input phase loss</i>.</td><td>1</td></tr>
<tr><td><i>31.22</i></td><td><i>STO indication run/stop</i></td><td>Selects which indications are given when one or both Safe torque off (STO) signals are switched off or lost. The indications also depend on whether the drive is running or stopped when this occurs.
The tables at each selection below show the indications generated with that particular setting.
Notes:
This parameter does not affect the operation of the STO function itself. The STO function will operate regardless of the setting of this parameter: a running drive will stop upon removal of one or both STO signals, and will not start until both STO signals are restored and all faults reset.
The loss of only one STO signal always generates a fault as it is interpreted as a malfunction.
For more information on the STO, see chapter <i>The Safe torque off function</i> in the <i>Hardware manual</i> of the drive.</td><td><i>Fault/Fault</i></td></tr>
<tr><td></td><td>Fault/Fault</td><td>
<table>
<tr><th colspan="2">Inputs</th><th rowspan="2">Indication (running or stopped)</th></tr>
<tr><th>IN1</th><th>IN2</th></tr>
<tr><td>0</td><td>0</td><td>Fault <i>5091 Safe torque off</i></td></tr>
<tr><td>0</td><td>1</td><td>Faults <i>5091 Safe torque off</i> and <i>FA81 Safe torque off 1</i></td></tr>
<tr><td>1</td><td>0</td><td>Faults <i>5091 Safe torque off</i> and <i>FA82 Safe torque off 2</i></td></tr>
<tr><td>1</td><td>1</td><td>(Normal operation)</td></tr>
</table>
</td><td>0</td></tr>
<tr><td></td><td>Fault/Warning</td><td>
<table>
<tr><th colspan="2">Inputs</th><th colspan="2">Indication</th></tr>
<tr><th>IN1</th><th>IN2</th><th>Running</th><th>Stopped</th></tr>
<tr><td>0</td><td>0</td><td>Fault <i>5091 Safe torque off</i></td><td>Warning <i>A5A0 Safe torque off</i></td></tr>
<tr><td>0</td><td>1</td><td>Faults <i>5091 Safe torque off</i> and <i>FA81 Safe torque off 1</i></td><td>Warning <i>A5A0 Safe torque off</i> and fault <i>FA81 Safe torque off 1</i></td></tr>
<tr><td>1</td><td>0</td><td>Faults <i>5091 Safe torque off</i> and <i>FA82 Safe torque off 2</i></td><td>Warning <i>A5A0 Safe torque off</i> and fault <i>FA82 Safe torque off 2</i></td></tr>
<tr><td>1</td><td>1</td><td colspan="2">(Normal operation)</td></tr>
</table>
</td><td>1</td></tr>
</table>

<table>
<tr><th>No.</th><th>Name/Value</th><th>Description</th><th>Def/FbEq16</th></tr>
<tr><td></td><td>Fault/Event</td><td>
<table>
<tr><th colspan="2">Inputs</th><th colspan="2">Indication</th></tr>
<tr><th>IN1</th><th>IN2</th><th>Running</th><th>Stopped</th></tr>
<tr><td>0</td><td>0</td><td>Fault <i>5091 Safe torque off</i></td><td>Event <i>B5A0 Safe torque off</i></td></tr>
<tr><td>0</td><td>1</td><td>Faults <i>5091 Safe torque off</i> and <i>FA81 Safe torque off 1</i></td><td>Event <i>B5A0 Safe torque off</i> and fault <i>FA81 Safe torque off 1</i></td></tr>
<tr><td>1</td><td>0</td><td>Faults <i>5091 Safe torque off</i> and <i>FA82 Safe torque off 2</i></td><td>Event <i>B5A0 Safe torque off</i> and fault <i>FA82 Safe torque off 2</i></td></tr>
<tr><td>1</td><td>1</td><td colspan="2">(Normal operation)</td></tr>
</table>
</td><td>2</td></tr>
<tr><td></td><td>Warning/Warning</td><td>
<table>
<tr><th colspan="2">Inputs</th><th rowspan="2">Indication (running or stopped)</th></tr>
<tr><th>IN1</th><th>IN2</th></tr>
<tr><td>0</td><td>0</td><td>Warning <i>A5A0 Safe torque off</i></td></tr>
<tr><td>0</td><td>1</td><td>Warning <i>A5A0 Safe torque off</i> and fault <i>FA81 Safe torque off 1</i></td></tr>
<tr><td>1</td><td>0</td><td>Warning <i>A5A0 Safe torque off</i> and fault <i>FA82 Safe torque off 2</i></td></tr>
<tr><td>1</td><td>1</td><td>(Normal operation)</td></tr>
</table>
</td><td>3</td></tr>
<tr><td></td><td>Event/Event</td><td>
<table>
<tr><th colspan="2">Inputs</th><th rowspan="2">Indication (running or stopped)</th></tr>
<tr><th>IN1</th><th>IN2</th></tr>
<tr><td>0</td><td>0</td><td>Warning <i>A5A0 Safe torque off</i></td></tr>
<tr><td>0</td><td>1</td><td>Warning <i>A5A0 Safe torque off</i> and fault <i>FA81 Safe torque off 1</i></td></tr>
<tr><td>1</td><td>0</td><td>Warning <i>A5A0 Safe torque off</i> and fault <i>FA82 Safe torque off 2</i></td></tr>
<tr><td>1</td><td>1</td><td>(Normal operation)</td></tr>
</table>
</td><td>4</td></tr>
<tr><td></td><td>No indication/No indication</td><td>
<table>
<tr><th colspan="2">Inputs</th><th rowspan="2">Indication (running or stopped)</th></tr>
<tr><th>IN1</th><th>IN2</th></tr>
<tr><td>0</td><td>0</td><td>None</td></tr>
<tr><td>0</td><td>1</td><td>Fault <i>FA81 Safe torque off 1</i></td></tr>
<tr><td>1</td><td>0</td><td>Fault <i>FA82 Safe torque off 2</i></td></tr>
<tr><td>1</td><td>1</td><td>(Normal operation)</td></tr>
</table>
</td><td>5</td></tr>
<tr><td><i>31.23</i></td><td><i>Wiring or earth fault</i></td><td>Selects how the drive reacts to incorrect input power and motor cable connection (ie. input power cable is connected to drive motor connection).</td><td><i>Fault</i></td></tr>
<tr><td></td><td>No action</td><td>No action taken.</td><td>0</td></tr>
<tr><td></td><td>Fault</td><td>The drive trips on fault <i>3181 Wiring or earth fault</i>.</td><td>1</td></tr>
</table>

No.	Name/Value	Description	Def/FbEq16
31.24	*Stall function*	Selects how the drive reacts to a motor stall condition. A stall condition is defined as follows: • The drive exceeds the stall current limit (*31.25 Stall current limit*), and • the output frequency is below the level set by parameter *31.27 Stall frequency limit* or the motor speed is below the level set by parameter *31.26 Stall speed limit*, and • the conditions above have been true longer than the time set by parameter *31.28 Stall time*.	*No action*
	No action	None (stall supervision disabled).	0
	Warning	The drive generates an *A780 Motor stall* warning.	1
	Fault	The drive trips on fault *7121 Motor stall*.	2
31.25	*Stall current limit*	Stall current limit in percent of the nominal current of the motor. See parameter *31.24 Stall function*.	200.0%
	0.0…1600.0%	Stall current limit.	-
31.26	*Stall speed limit*	Stall speed limit in rpm. See parameter *31.24 Stall function*.	150.00 rpm; 180.00 rpm (*95.20* b0)
	0.00…10000.00 rpm	Stall speed limit.	See par. *46.01*
31.27	*Stall frequency limit*	Stall frequency limit. See parameter *31.24 Stall function*. **Note:** Setting the limit below 10 Hz is not recommended.	15.00 Hz; 18.00 Hz (*95.20* b0)
	0.00…1000.00 Hz	Stall frequency limit.	See par. *46.02*
31.28	*Stall time*	Stall time. See parameter *31.24 Stall function*.	20 s
	0…3600 s	Stall time.	-

No.	Name/Value	Description	Def/FbEq16
31.30	*Overspeed trip margin*	Defines, together with *30.11 Minimum speed* and *30.12 Maximum speed*, the maximum allowed speed of the motor (overspeed protection). If the speed (*24.02 Used speed feedback*) exceeds the speed limit defined by parameter *30.11* or *30.12* by more than the value of this parameter, the drive trips on the *7310 Overspeed* fault. **WARNING!** This function only supervises the speed in vector motor control mode. The function is not effective in scalar motor control mode. **Example:** If the maximum speed is 1420 rpm and speed trip margin is 300 rpm, the drive trips at 1720 rpm.  	500.00 rpm; 500.00 rpm (*95.20* b0)
	0.00…10000.00 rpm	Overspeed trip margin.	See par. *46.01*
31.32	*Emergency ramp supervision*	Parameters *31.32 Emergency ramp supervision* and *31.33 Emergency ramp supervision delay*, together with the derivative of *24.02 Used speed feedback*, provide a supervision function for emergency stop modes Off1 and Off3. The supervision is based on either • observing the time within which the motor stops, or • comparing the actual and expected deceleration rates. If this parameter is set to 0%, the maximum stop time is directly set in parameter *31.33*. Otherwise, *31.32* defines the maximum allowed deviation from the expected deceleration rate, which is calculated from parameters *23.12*…*23.13* (Off1) or *23.23 Emergency stop time* (Off3). If the actual deceleration rate (*24.02*) deviates too much from the expected rate, the drive trips on *73B0 Emergency ramp failed*, sets bit 8 of *06.17 Drive status word 2*, and coasts to a stop. If *31.32* is set to 0% and *31.33* is set to 0 s, the emergency stop ramp supervision is disabled. See also parameter *21.04 Emergency stop mode*.	0%
	0…300%	Maximum deviation from expected deceleration rate.	1 = 1%

No.	Name/Value	Description	Def/FbEq16
31.33	*Emergency ramp supervision delay*	If parameter *31.32 Emergency ramp supervision* is set to 0%, this parameter defines the maximum time an emergency stop (mode Off1 or Off3) is allowed to take. If the motor has not stopped when the time elapses, the drive trips on *73B0 Emergency ramp failed*, sets bit 8 of *06.17 Drive status word 2*, and coasts to a stop. If *31.32* is set to a value other than 0%, this parameter defines a delay between the receipt of the emergency stop command and the activation of the supervision. It is recommended to specify a short delay to allow the speed change rate to stabilize.	0 s
	0…100 s	Maximum ramp-down time, or supervision activation delay.	1 = 1 s
31.36	*Aux fan fault bybass*	Temporarily suppresses auxiliary fan faults. Certain drive types (especially those protected to IP55) have an auxiliary fan built into the front cover as standard. If the fan is stuck or disconnected, the control program generates a fault (*5081 Auxiliary fan broken*). If it is necessary to operate the drive without the front cover (for example, during commissioning), this parameter can be activated to temporarily generate a warning (*A582 Auxiliary fan missing*) instead of the fault. **Notes:** • The parameter must be activated within 2 minutes of drive reboot (either by cycling the power or by parameter *96.08*). • The parameter will be in effect until the auxiliary fan is reconnected and detected, or until the next control unit reboot.	*Off*
	Off	Normal operation, Aux fan supervision generates a fault.	0
	Temporarily bypassed	The auxiliary fan fault is temporarily replaced by a warning indication. The setting will revert automatically to *Off*.	1
32 Supervision		Configuration of signal supervision functions 1…6. Six values can be chosen to be monitored; a warning or fault is generated whenever predefined limits are exceeded. See also section *Signal supervision* (page *92*).	
32.01	*Supervision status*	Signal supervision status word. Indicates whether the values monitored by the signal supervision functions are within or outside their respective limits. **Note:** This word is independent of the drive actions defined by parameters *32.06*, *32.16*, *32.26*, *32.36*, *32.46* and *32.56*.	0000b

Bit	Name	Description
0	Supervision 1 active	1 = Signal selected by *32.07* is outside its limits.
1	Supervision 2 active	1 = Signal selected by *32.17* is outside its limits.
2	Supervision 3 active	1 = Signal selected by *32.27* is outside its limits.
3	Supervision 4 active	1 = Signal selected by *32.37* is outside its limits.
4	Supervision 5 active	1 = Signal selected by *32.47* is outside its limits.
5	Supervision 6 active	1 = Signal selected by *32.27* is outside its limits.
6…15	Reserved	

	0000h…FFFFh	Signal supervision status word.	1 = 1

No.	Name/Value	Description	Def/FbEq16
32.05	*Supervision 1 function*	Selects the mode of signal supervision function 1. Determines how the monitored signal (see parameter *32.07*) is compared to its lower and upper limits (*32.09* and *32.10* respectively). The action to be taken when the condition is fulfilled is selected by *32.06*.	*Disabled*
	Disabled	Signal supervision 1 not in use.	0
	Low	Action is taken whenever the signal falls below its lower limit.	1
	High	Action is taken whenever the signal rises above its upper limit.	2
	Abs low	Action is taken whenever the absolute value of the signal falls below its (absolute) lower limit.	3
	Abs high	Action is taken whenever the absolute value of the signal rises above its (absolute) upper limit.	4
	Both	Action is taken whenever the signal falls below its low limit or rises above its high limit.	5
	Abs both	Action is taken whenever the absolute value of the signal falls below its (absolute) low limit or rises above its (absolute) high limit.	6
	Hysteresis	Action is taken whenever the signal rises above the value defined by the limit + 0.5 · hysteresis range (*32.11 Supervision 1 hysteresis*). The action is deactivated when the signal falls below the value defined by the limit - 0.5 · hysteresis range.	7
32.06	*Supervision 1 action*	Selects whether the drive generates a fault, warning or neither when the value monitored by signal supervision 1 exceeds its limits. **Note:** This parameter does not affect the status indicated by *32.01 Supervision status*.	*No action*
	No action	No warning or fault generated.	0
	Warning	Warning *A8B0 ABB Signal supervision 1* is generated.	1
	Fault	Drive trips on fault *80B0 Signal supervision 1*.	2
	Fault if running	If running, the drive trips on fault *80B0 Signal supervision 1*.	3
32.07	*Supervision 1 signal*	Selects the signal to be monitored by signal supervision function 1.	*Frequency*
	Zero	None.	0
	Speed	*01.01 Motor speed used* (page *103*).	1
	Reserved		2
	Frequency	*01.06 Output frequency* (page *103*).	3
	Current	*01.07 Motor current* (page *103*).	4
	Reserved		5
	Torque	*01.10 Motor torque* (page *103*).	6
	DC voltage	*01.11 DC voltage* (page *103*).	7
	Output power	*01.14 Output power* (page *104*).	8
	AI1	*12.11 AI1 actual value* (page *125*).	9
	AI2	*12.21 AI2 actual value* (page *126*).	10
	Reserved		11…17
	Speed ref ramp in	*23.01 Speed ref ramp input* (page *162*).	18

No.	Name/Value	Description	Def/FbEq16
	Speed ref ramp out	*23.02 Speed ref ramp output* (page *162*).	19
	Speed ref used	*24.01 Used speed reference* (page *163*).	20
	Reserved		21
	Freq ref used	*28.02 Frequency ref ramp output* (page *167*).	22
	Inverter temperature	*05.11 Inverter temperature* (page *108*).	23
	Process PID output	*40.01 Process PID output actual* (page *213*).	24
	Process PID feedback	*40.02 Process PID feedback actual* (page *213*).	25
	Process PID setpoint	*40.03 Process PID setpoint actual* (page *213*).	26
	Process PID deviation	*40.04 Process PID deviation actual* (page *213*).	27
	Other	Source selection (see *Terms and abbreviations* on page *100*).	-
32.08	*Supervision 1 filter time*	Defines a filter time constant for the signal monitored by signal supervision 1.	0.000 s
	0.000 … 30.000 s	Signal filter time.	1000 = 1 s
32.09	*Supervision 1 low*	Defines the lower limit for signal supervision 1.	0.00
	-21474836.00… 21474836.00	Low limit.	-
32.10	*Supervision 1 high*	Defines the upper limit for signal supervision 1.	0.00
	-21474836.00… 21474836.00	Upper limit.	-
32.11	*Supervision 1 hysteresis*	Defines the hysteresis for the signal monitored by signal supervision 1.	0.00
	0.00…100000.00	Hysteresis.	-
32.15	*Supervision 2 function*	Selects the mode of signal supervision function 2. Determines how the monitored signal (see parameter *32.17*) is compared to its lower and upper limits (*32.19* and *32.20* respectively). The action to be taken when the condition is fulfilled is selected by *32.16*.	*Disabled*
	Disabled	Signal supervision 2 not in use.	0
	Low	Action is taken whenever the signal falls below its lower limit.	1
	High	Action is taken whenever the signal rises above its upper limit.	2
	Abs low	Action is taken whenever the absolute value of the signal falls below its (absolute) lower limit.	3
	Abs high	Action is taken whenever the absolute value of the signal rises above its (absolute) upper limit.	4
	Both	Action is taken whenever the signal falls below its low limit or rises above its high limit.	5
	Abs both	Action is taken whenever the absolute value of the signal falls below its (absolute) low limit or rises above its (absolute) high limit.	6

No.	Name/Value	Description	Def/FbEq16
	Hysteresis	Action is taken whenever the signal rises above the value defined by the limit + 0.5 · hysteresis range (*32.21 Supervision 2 hysteresis*). The action is deactivated when the signal falls below the value defined by the limit - 0.5 · hysteresis range.	7
32.16	*Supervision 2 action*	Selects whether the drive generates a fault, warning or neither when the value monitored by signal supervision 2 exceeds its limits. **Note:** This parameter does not affect the status indicated by *32.01 Supervision status*.	*No action*
	No action	No warning or fault generated.	0
	Warning	Warning *A8B1 ABB Signal supervision 2* is generated.	1
	Fault	Drive trips on fault *80B1 Signal supervision 2*.	2
	Fault if running	If running, the drive trips on fault *80B0 Signal supervision 1*.	3
32.17	*Supervision 2 signal*	Selects the signal to be monitored by signal supervision function 2. For the available selections, see parameter *32.07 Supervision 1 signal*.	*Current*
32.18	*Supervision 2 filter time*	Defines a filter time constant for the signal monitored by signal supervision 2.	0.000 s
	0.000 … 30.000 s	Signal filter time.	1000 = 1 s
32.19	*Supervision 2 low*	Defines the lower limit for signal supervision 2.	0.00
	-21474836.00… 21474836.00	Low limit.	-
32.20	*Supervision 2 high*	Defines the upper limit for signal supervision 2.	0.00
	-21474836.00… 21474836.00	Upper limit.	-
32.21	*Supervision 2 hysteresis*	Defines the hysteresis for the signal monitored by signal supervision 2.	0.00
	0.00…100000.00	Hysteresis.	-
32.25	*Supervision 3 function*	Selects the mode of signal supervision function 3. Determines how the monitored signal (see parameter *32.27*) is compared to its lower and upper limits (*32.29* and *32.30* respectively). The action to be taken when the condition is fulfilled is selected by *32.26*.	*Disabled*
	Disabled	Signal supervision 3 not in use.	0
	Low	Action is taken whenever the signal falls below its lower limit.	1
	High	Action is taken whenever the signal rises above its upper limit.	2
	Abs low	Action is taken whenever the absolute value of the signal falls below its (absolute) lower limit.	3
	Abs high	Action is taken whenever the absolute value of the signal rises above its (absolute) upper limit.	4
	Both	Action is taken whenever the signal falls below its low limit or rises above its high limit.	5
	Abs both	Action is taken whenever the absolute value of the signal falls below its (absolute) low limit or rises above its (absolute) high limit.	6

No.	Name/Value	Description	Def/FbEq16
	Hysteresis	Action is taken whenever the signal rises above the value defined by the limit + 0.5 · hysteresis range (*32.31 Supervision 3 hysteresis*). The action is deactivated when the signal falls below the value defined by the limit - 0.5 · hysteresis range.	7
32.26	*Supervision 3 action*	Selects whether the drive generates a fault, warning or neither when the value monitored by signal supervision 3 exceeds its limits. **Note:** This parameter does not affect the status indicated by *32.01 Supervision status*.	*No action*
	No action	No warning or fault generated.	0
	Warning	Warning *A8B2 ABB Signal supervision 3* is generated.	1
	Fault	Drive trips on fault *80B2 Signal supervision 3*.	2
	Fault if running	If running, the drive trips on fault *80B0 Signal supervision 1*.	3
32.27	*Supervision 3 signal*	Selects the signal to be monitored by signal supervision function 3. For the available selections, see parameter *32.07 Supervision 1 signal*.	*Torque*
32.28	*Supervision 3 filter time*	Defines a filter time constant for the signal monitored by signal supervision 3.	0.000 s
	0.000 … 30.000 s	Signal filter time.	1000 = 1 s
32.29	*Supervision 3 low*	Defines the lower limit for signal supervision 3.	0.00
	-21474836.00… 21474836.00	Low limit.	-
32.30	*Supervision 3 high*	Defines the upper limit for signal supervision 3.	0.00
	-21474836.00… 21474836.00	Upper limit.	-
32.31	*Supervision 3 hysteresis*	Defines the hysteresis for the signal monitored by signal supervision 3.	0.00
	0.00…100000.00	Hysteresis.	-
32.35	*Supervision 4 function*	Selects the mode of signal supervision function 4. Determines how the monitored signal (see parameter *32.37*) is compared to its lower and upper limits (*32.39* and *32.30* respectively). The action to be taken when the condition is fulfilled is selected by *32.36*.	*Disabled*
	Disabled	Signal supervision 4 not in use.	0
	Low	Action is taken whenever the signal falls below its lower limit.	1
	High	Action is taken whenever the signal rises above its upper limit.	2
	Abs low	Action is taken whenever the absolute value of the signal falls below its (absolute) lower limit.	3
	Abs high	Action is taken whenever the absolute value of the signal rises above its (absolute) upper limit.	4
	Both	Action is taken whenever the signal falls below its low limit or rises above its high limit.	5
	Abs both	Action is taken whenever the absolute value of the signal falls below its (absolute) low limit or rises above its (absolute) high limit.	6

No.	Name/Value	Description	Def/FbEq16
	Hysteresis	Action is taken whenever the signal rises above the value defined by the limit + 0.5 · hysteresis range (*32.41 Supervision 4 hysteresis*). The action is deactivated when the signal falls below the value defined by the limit - 0.5 · hysteresis range.	7
32.36	*Supervision 4 action*	Selects whether the drive generates a fault, warning or neither when the value monitored by signal supervision 4 exceeds its limits. **Note:** This parameter does not affect the status indicated by *32.01 Supervision status*.	*No action*
	No action	No warning or fault generated.	0
	Warning	Warning *A8B3 ABB Signal supervision 4* is generated.	1
	Fault	Drive trips on fault *80B3 Signal supervision 4*.	2
	Fault if running	Drive trips on fault *80B0 Signal supervision 1* if the motor is running.	3
32.37	*Supervision 4 signal*	Selects the signal to be monitored by signal supervision function 4. For the available selections, see parameter *32.07 Supervision 1 signal*.	*Zero*
32.38	*Supervision 4 filter time*	Defines a filter time constant for the signal monitored by signal supervision 4.	0.000 s
	0.000 … 30.000 s	Signal filter time.	1000 = 1 s
32.39	*Supervision 4 low*	Defines the lower limit for signal supervision 4.	0.00
	-21474836.00… 21474836.00	Low limit.	-
32.40	*Supervision 4 high*	Defines the upper limit for signal supervision 4.	0.00
	-21474836.00… 21474836.00	Upper limit.	-
32.41	*Supervision 4 hysteresis*	Defines the hysteresis for the signal monitored by signal supervision 4.	0.00
	0.00…100000.00	Hysteresis.	-
32.45	*Supervision 5 function*	Selects the mode of signal supervision function 5. Determines how the monitored signal (see parameter *32.47*) is compared to its lower and upper limits (*32.49* and *32.40* respectively). The action to be taken when the condition is fulfilled is selected by *32.46*.	*Disabled*
	Disabled	Signal supervision 5 not in use.	0
	Low	Action is taken whenever the signal falls below its lower limit.	1
	High	Action is taken whenever the signal rises above its upper limit.	2
	Abs low	Action is taken whenever the absolute value of the signal falls below its (absolute) lower limit.	3
	Abs high	Action is taken whenever the absolute value of the signal rises above its (absolute) upper limit.	4
	Both	Action is taken whenever the signal falls below its low limit or rises above its high limit.	5
	Abs both	Action is taken whenever the absolute value of the signal falls below its (absolute) low limit or rises above its (absolute) high limit.	6

No.	Name/Value	Description	Def/FbEq16
	Hysteresis	Action is taken whenever the signal rises above the value defined by the limit + 0.5 · hysteresis range (*32.51 Supervision 5 hysteresis*). The action is deactivated when the signal falls below the value defined by the limit - 0.5 · hysteresis range.	7
32.46	*Supervision 5 action*	Selects whether the drive generates a fault, warning or neither when the value monitored by signal supervision 5 exceeds its limits. **Note:** This parameter does not affect the status indicated by *32.01 Supervision status*.	*No action*
	No action	No warning or fault generated.	0
	Warning	Warning *A8B4 ABB Signal supervision 5* is generated.	1
	Fault	Drive trips on fault *80B4 Signal supervision 5*.	2
	Fault if running	Drive trips on fault *80B0 Signal supervision 1* if the motor is running.	3
32.47	*Supervision 5 signal*	Selects the signal to be monitored by signal supervision function 5. For the available selections, see parameter *32.07 Supervision 1 signal*.	*Zero*
32.48	*Supervision 5 filter time*	Defines a filter time constant for the signal monitored by signal supervision 5.	0.000 s
	0.000 … 30.000 s	Signal filter time.	1000 = 1 s
32.49	*Supervision 5 low*	Defines the lower limit for signal supervision 5.	0.00
	-21474836.00… 21474836.00	Low limit.	-
32.50	*Supervision 5 high*	Defines the upper limit for signal supervision 5.	0.00
	-21474836.00… 21474836.00	Upper limit.	-
32.51	*Supervision 5 hysteresis*	Defines the hysteresis for the signal monitored by signal supervision 5.	0.00
	0.00…100000.00	Hysteresis.	-
32.55	*Supervision 6 function*	Selects the mode of signal supervision function 6. Determines how the monitored signal (see parameter *32.57*) is compared to its lower and upper limits (*32.59* and *32.50* respectively). The action to be taken when the condition is fulfilled is selected by *32.56*.	*Disabled*
	Disabled	Signal supervision 6 not in use.	0
	Low	Action is taken whenever the signal falls below its lower limit.	1
	High	Action is taken whenever the signal rises above its upper limit.	2
	Abs low	Action is taken whenever the absolute value of the signal falls below its (absolute) lower limit.	3
	Abs high	Action is taken whenever the absolute value of the signal rises above its (absolute) upper limit.	4
	Both	Action is taken whenever the signal falls below its low limit or rises above its high limit.	5
	Abs both	Action is taken whenever the absolute value of the signal falls below its (absolute) low limit or rises above its (absolute) high limit.	6

No.	Name/Value	Description	Def/FbEq16
	Hysteresis	Action is taken whenever the signal rises above the value defined by the limit + 0.5 · hysteresis range (*32.61 Supervision 6 hysteresis*). The action is deactivated when the signal falls below the value defined by the limit - 0.5 · hysteresis range.	7
32.56	*Supervision 6 action*	Selects whether the drive generates a fault, warning or neither when the value monitored by signal supervision 6 exceeds its limits. **Note:** This parameter does not affect the status indicated by *32.01 Supervision status*.	*No action*
	No action	No warning or fault generated.	0
	Warning	Warning *A8B5 ABB Signal supervision 6* is generated.	1
	Fault	Drive trips on fault *80B5 Signal supervision 6*.	2
	Fault if running	Drive trips on fault *80B0 Signal supervision 1* if the motor is running.	3
32.57	*Supervision 6 signal*	Selects the signal to be monitored by signal supervision function 6. For the available selections, see parameter *32.07 Supervision 1 signal*.	*Zero*
32.58	*Supervision 6 filter time*	Defines a filter time constant for the signal monitored by signal supervision 6.	0.000 s
	0.000 … 30.000 s	Signal filter time.	1000 = 1 s
32.59	*Supervision 6 low*	Defines the lower limit for signal supervision 6.	0.00
	-21474836.00… 21474836.00	Low limit.	-
32.60	*Supervision 6 high*	Defines the upper limit for signal supervision 6.	0.00
	-21474836.00… 21474836.00	Upper limit.	-
32.61	*Supervision 6 hysteresis*	Defines the hysteresis for the signal monitored by signal supervision 6.	0.00
	0.00…100000.00	Hysteresis.	-

34 Timed functions		Configuration of the timed functions. See also section *Timed functions* (page *70*).	
34.01	*Timed functions status*	Status of the combined timers. The status of a combined timer is the logical OR of all timers connected to it. This parameter is read-only.	-

Bit	Name	Description
0	Timed function 1	1 = Active.
1	Timed function 2	1 = Active.
2	Timed function 3	1 = Active.
3…15	Reserved	

	0000h…0FFFFh	Status of combined timers 1…3.	1 = 1

No.	Name/Value	Description	Def/FbEq16
34.02	*Timer status*	Status of timers 1…12. This parameter is read-only.	-

Bit	Name	Description
0	Timer 1	1 = Active.
1	Timer 2	1 = Active.
2	Timer 3	1 = Active.
3	Timer 4	1 = Active.
4	Timer 5	1 = Active.
5	Timer 6	1 = Active.
6	Timer 7	1 = Active.
7	Timer 8	1 = Active.
8	Timer 9	1 = Active.
9	Timer 10	1 = Active.
10	Timer 11	1 = Active.
11	Timer 12	1 = Active.
12…15	Reserved	

No.	Name/Value	Description	Def/FbEq16
	0000h…FFFFh	Timer status.	1 = 1
34.04	*Season/exception day status*	Status of seasons 1…4, exception weekday and exception holiday. Only one season can be active at a time. A day can be a workday and a holiday at the same time. This parameter is read-only.	-

Bit	Name	Description
0	Season 1	1 = Active.
1	Season 2	1 = Active.
2	Season 3	1 = Active.
3	Season 4	1 = Active.
4…9	Reserved	
10	Exception workday	1 = Active.
11	Exception holiday	1 = Active.
12…15	Reserved	

No.	Name/Value	Description	Def/FbEq16
	0000h…FFFFh	Status of the seasons and exception weekday and holiday.	1 = 1
34.10	*Timed functions enable*	Selects the source for the timed functions enable signal. 0 = Disabled. 1 = Enabled.	*Not selected*
	Not selected	0.	0
	Selected	1.	1
	DI1	Digital input DI1 (*10.02 DI delayed status*, bit 0).	2
	DI2	Digital input DI2 (*10.02 DI delayed status*, bit 1).	3
	DI3	Digital input DI3 (*10.02 DI delayed status*, bit 2).	4
	DI4	Digital input DI4 (*10.02 DI delayed status*, bit 3).	5
	DI5	Digital input DI5 (*10.02 DI delayed status*, bit 4).	6
	DI6	Digital input DI6 (*10.02 DI delayed status*, bit 5).	7
	Other [bit]	Source selection (see *Terms and abbreviations* on page *100*).	-

No.	Name/Value	Description	Def/FbEq16
34.11	*Timer 1 configuration*	Defines when timer 1 is active.	0111 1000 0000b

Bit	Name	Description
0	Monday	1 = Monday is an active start day.
1	Tuesday	1 = Tuesday is an active start day.
2	Wednesday	1 = Wednesday is an active start day.
3	Thursday	1 = Thursday is an active start day.
4	Friday	1 = Friday is an active start day.
5	Saturday	1 = Saturday is an active start day.
6	Sunday	1 = Sunday is an active start day.
7	Season 1	1 = Timer is active in season 1.
8	Season 2	1 = Timer is active in season 2.
9	Season 3	1 = Timer is active in season 3.
10	Season 4	1 = Timer is active in season 4.
11	Exceptions	0 = Exceptions days are disabled. The timer follows only weekday and season settings (bits 0…10 in the timer configuration) and the start time and duration of the timer (see *34.12* and *34.13*). Exception day settings, parameters *34.70*…*34.90*, do not have any effect on this timer. 1 = Exception days are enabled. The timer is active during the weekdays and seasons defined with bits 0…10 and the times defined by *34.12* and *34.13*. In addition, the timer is active during the exception days defined with bit 12, bit 13 and parameters *34.70*…*34.90*. If bit 12 and bit 13 are both zero, the timer is inactive during the exception days.
12	Holidays	This bit has no effect unless bit 11 = 1 (Exceptions days are enabled). When bits 11 and 12 are both 1, the timer is active during the weekdays and seasons defined with bits 0…10 and times defined by parameters *34.12* and *34.13*. In addition, the timer is active when the ongoing day is defined as Exception day Holiday by parameters *34.70*…*34.90* and the current time matches with the time range defined by *34.12* and *34.13*. During Exception days, weekday and season bits are ignored.
13	Workdays	This bit has no effect unless bit 11 = 1 (Exceptions enabled). When bits 11 and 13 are both 1, the Timer is active during the weekdays and seasons defined with bits 0…10 and the times defined by parameters *34.12* and *34.13*. In addition, the timer is active when the ongoing day is defined as Exception day Workday by parameters *34.70*…*34.90* and the current time matches with the time range defined by *34.12* and *34.13*. During Exception days, weekday and season bits are ignored.
14…15	Reserved	

No.	Name/Value	Description	Def/FbEq16
		Examples of how the timer configuration defines when the Timer is active are shown below.	

Bits of parameter *34.11 Timer 1 configuration*														
Monday	Tuesday	Wednesday	Thursday	Friday	Saturday	Sunday	Season1	Season2	Season3	Season4	Exceptions	Holidays	Workdays	
1	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	0	0	0	**Example 1:** Timer is active during the times of the day defined by other parameters every Weekday and every Season. Exception day settings (*34.70*…*34.90*) do not have any effect on the Timer.
1	**1**	**1**	**1**	**1**	0	0	1	1	1	1	0	0	0	**Example 2:** Timer is active during the times of the day defined by other parameters from Mon to Fri, every Season. Exception day settings (*34.70*…*34.90*) do not have any effect on the Timer.
1	1	1	1	1	0	0	0	0	**1**	0	0	0	0	**Example 3:** Timer is active during the times of the day defined by other parameters from Mon to Fri, only during Season 3 (can be configured as eg summer). Exception day settings (*34.70*…*34.90*) do not have any effect on the Timer.
1	1	1	1	1	0	0	1	1	1	1	**1**	**1**	0	**Example 4:** Timer is active during the times of the day defined by other parameters from Mon to Fri, every Season. In addition, the Timer is active every Exception day Holidays, regardless what is the day or season.
1	0	1	0	1	0	1	1	1	0	0	**1**	0	**1**	**Example 5:** Timer is active during the times of the day defined by other parameters on Mon, Wed, Fri and Sun, during Season1 and Season 2. In addition, the Timer is active every Exception day Workdays, regardless what is the day or season.
1	1	1	1	1	1	1	1	1	1	1	**1**	**0**	**0**	**Example 6:** Timer is active during the times of the day defined by other parameters every Weekday and every Season. The Timer is inactive during all Exception days.

	0000h…FFFFh	Configuration of timer 1.	1 = 1
34.12	*Timer 1 start time*	Defines the daily start time of timer 1. The time can be changed in second steps. The timer can be started at an other time than the start time. E.g. if the timer's duration is more than one day and the active session starts during the time, the timer is started at 00:00 and stopped when there is no duration left.	00:00:00
	00:00:00…23:59:59	Daily start time of the timer.	1 = 1

No.	Name/Value	Description	Def/FbEq16
34.13	*Timer 1 duration*	Defines the duration of timer 1. The duration can be changed in minute steps. The duration can extend over the change of the day but if an exception day becomes active, the period is interrupted at midnight. In the same way the period started on an exception day stays active only until the end of the day, even if the duration is longer. The timer will continue after a break if there is duration left.	00 00:00
	00 00:00…07 00:00	Timer duration.	1 = 1
34.14	*Timer 2 configuration*	See *34.11 Timer 1 configuration*.	0111 1000 0000b
34.15	*Timer 2 start time*	See *34.12 Timer 1 start time*.	00:00:00
34.16	*Timer 2 duration*	See *34.13 Timer 1 duration*.	00 00:00
34.17	*Timer 3 configuration*	See *34.11 Timer 1 configuration*.	0111 1000 0000b
34.18	*Timer 3 start time*	See *34.12 Timer 1 start time*.	00:00:00
34.19	*Timer 3 duration*	See *34.13 Timer 1 duration*.	00 00:00
34.20	*Timer 4 configuration*	See *34.11 Timer 1 configuration*.	0111 1000 0000b
34.21	*Timer 4 start time*	See *34.12 Timer 1 start time*.	00:00:00
34.22	*Timer 4 duration*	See *34.13 Timer 1 duration*.	00 00:00
34.23	*Timer 5 configuration*	See *34.11 Timer 1 configuration*.	0111 1000 0000b
34.24	*Timer 5 start time*	See *34.12 Timer 1 start time*.	00:00:00
34.25	*Timer 5 duration*	See *34.13 Timer 1 duration*.	00 00:00
34.26	*Timer 6 configuration*	See *34.11 Timer 1 configuration*.	0111 1000 0000b
34.27	*Timer 6 start time*	See *34.12 Timer 1 start time*.	00:00:00
34.28	*Timer 6 duration*	See *34.13 Timer 1 duration*.	00 00:00
34.29	*Timer 7 configuration*	See *34.11 Timer 1 configuration*.	0111 1000 0000b
34.30	*Timer 7 start time*	See *34.12 Timer 1 start time*.	00:00:00
34.31	*Timer 7 duration*	See *34.13 Timer 1 duration*.	00 00:00
34.32	*Timer 8 configuration*	See *34.11 Timer 1 configuration*.	0111 1000 0000b
34.33	*Timer 8 start time*	See *34.12 Timer 1 start time*.	00:00:00
34.34	*Timer 8 duration*	See *34.13 Timer 1 duration*.	00 00:00
34.35	*Timer 9 configuration*	See *34.11 Timer 1 configuration*.	0111 1000 0000b
34.36	*Timer 9 start time*	See *34.12 Timer 1 start time*.	00:00:00
34.37	*Timer 9 duration*	See *34.13 Timer 1 duration*.	00 00:00
34.38	*Timer 10 configuration*	See *34.11 Timer 1 configuration*.	0111 1000 0000b
34.39	*Timer 10 start time*	See *34.12 Timer 1 start time*.	00:00:00
34.40	*Timer 10 duration*	See *34.13 Timer 1 duration*.	00 00:00
34.41	*Timer 11 configuration*	See *34.11 Timer 1 configuration*.	0111 1000 0000b

No.	Name/Value	Description	Def/FbEq16
34.42	*Timer 11 start time*	See *34.12 Timer 1 start time*.	00:00:00
34.43	*Timer 11 duration*	See *34.13 Timer 1 duration*.	00 00:00
34.44	*Timer 12 configuration*	See *34.11 Timer 1 configuration*.	0111 1000 0000b
34.45	*Timer 12 start time*	See *34.12 Timer 1 start time*.	00:00:00
34.46	*Timer 12 duration*	See *34.13 Timer 1 duration*.	00 00:00
34.60	*Season 1 start date*	Defines the start date of season 1 in format dd.mm, where dd is the number of the day and mm is the number of the month. The season changes at midnight. One season can be active at a time. Timers are started on exception days even if they are not inside the active season. The season start dates (1…4) must be given in increasing order to use all seasons. The default value is interpreted that the season is not configured. If the season start dates are not in increasing order and the value is something else than the default value, a season configuration warning is given.	01.01.
	01.01…31.12	Season start date.	
34.61	*Season 2 start date*	Defines the start date of season 2. See *34.60 Season 1 start date*.	01.01.
34.62	*Season 3 start date*	Defines the start date of season 3. See *34.60 Season 1 start date*.	01.01.
34.63	*Season 4 start date*	Defines the start date of season 4. See *34.60 Season 1 start date*.	01.01.
34.70	*Number of active exceptions*	Defines how many of the exceptions are active by specifying the last active one. All preceding exceptions are active. Exceptions 1…3 are periods (duration can be defined) and exceptions 4…16 are days (duration is always 24 hours). **Example:** If the value is 4, exceptions 1…4 are active, and exceptions 5…16 are not active.	3
	0…16	Number of active exception periods or days.	-

No.	Name/Value	Description	Def/FbEq16
34.71	*Exception types*	Defines the types of exceptions 1…16 as workday or holiday. Exceptions 1…3 are periods (duration can be defined) and exceptions 4…16 are days (duration is always 24 hours).	0000b

Bit	Name	Description
0	Exception 1	0 = Workday. 1 = Holiday
1	Exception 2	0 = Workday. 1 = Holiday
2	Exception 3	0 = Workday. 1 = Holiday
3	Exception 4	0 = Workday. 1 = Holiday
4	Exception 5	0 = Workday. 1 = Holiday
5	Exception 6	0 = Workday. 1 = Holiday
6	Exception 7	0 = Workday. 1 = Holiday
7	Exception 8	0 = Workday. 1 = Holiday
8	Exception 9	0 = Workday. 1 = Holiday
9	Exception 10	0 = Workday. 1 = Holiday
10	Exception 11	0 = Workday. 1 = Holiday
11	Exception 12	0 = Workday. 1 = Holiday
12	Exception 13	0 = Workday. 1 = Holiday
13	Exception 14	0 = Workday. 1 = Holiday
14	Exception 15	0 = Workday. 1 = Holiday
15	Exception 16	0 = Workday. 1 = Holiday

No.	Name/Value	Description	Def/FbEq16
	0000h…FFFFh	Types of exception period or days.	1 = 1
34.72	*Exception 1 start*	Defines the start date of the exception period in format dd.mm, where dd is the number of the day and mm is the number of the month. The timer started on an exception day is always stopped at 23:59:59 even if it has duration left. The same date can be configured to be holiday and workday. The date is active if any of exception days are active.	01.01.
	01.01.…31.12.	Start date of exception period 1.	
34.73	*Exception 1 length*	Defines the length of the exception period in days. Exception period is handled the same as a number of consecutive exception days.	0 d
	0…60 d	Length of exception period 1.	1 = 1
34.74	*Exception 2 start*	See *34.72 Exception 1 start*.	01.01.
34.75	*Exception 2 length*	See *34.73 Exception 1 length*.	0 d
34.76	*Exception 3 start*	See *34.72 Exception 1 start*.	01.01.
34.77	*Exception 3 length*	See *34.73 Exception 1 length*.	0 d
34.78	*Exception day 4*	Defines the date of exception day 4.	01.01.
	01.01.…31.12.	Start date of exception day 4. The timer started on an exception day is always stopped at 23:59:59 even if it has duration left.	
34.79	*Exception day 5*	See *34.79 Exception day 4*.	01.01
34.80	*Exception day 6*	See *34.79 Exception day 4*.	01.01
34.81	*Exception day 7*	See *34.79 Exception day 4*	01.01
34.82	*Exception day 8*	See *34.79 Exception day 4*.	01.01
34.83	*Exception day 9*	See *34.79 Exception day 4*.	01.01

No.	Name/Value	Description	Def/FbEq16
34.84	*Exception day 10*	See *34.79 Exception day 4*.	01.01
34.85	*Exception day 11*	See *34.79 Exception day 4*.	01.01
34.86	*Exception day 12*	See *34.79 Exception day 4*.	01.01
34.87	*Exception day 13*	See *34.79 Exception day 4*.	01.01
34.88	*Exception day 14*	See *34.79 Exception day 4*.	01.01
34.89	*Exception day 15*	See *34.79 Exception day 4*.	01.01
34.90	*Exception day 16*	See *34.79 Exception day 4*.	01.01
34.100	*Timed function 1*	Defines which timers are connected to combined timer 1. 0 = Not connected. 1 = Connected. See *34.01 Timed functions status*.	0000b

Bit	Name	Description
0	Timer 1	0 = Inactive. 1 = Active.
1	Timer 2	0 = Inactive. 1 = Active.
2	Timer 3	0 = Inactive. 1 = Active.
3	Timer 4	0 = Inactive. 1 = Active.
4	Timer 5	0 = Inactive. 1 = Active.
5	Timer 6	0 = Inactive. 1 = Active.
6	Timer 7	0 = Inactive. 1 = Active.
7	Timer 8	0 = Inactive. 1 = Active.
8	Timer 9	0 = Inactive. 1 = Active.
9	Timer 10	0 = Inactive. 1 = Active.
10	Timer 11	0 = Inactive. 1 = Active.
11	Timer 12	0 = Inactive. 1 = Active.
12…15	Reserved	

No.	Name/Value	Description	Def/FbEq16
	0000h…FFFFh	Timers connected to combined timer 1.	1 = 1
34.101	*Timed function 2*	Defines which timers are connected to combined timer 2. See *34.01 Timed functions status*.	0000b
34.102	*Timed function 3*	Defines which timers are connected to combined timer 3. See *34.01 Timed functions status*.	0000b
34.110	*Boost time function*	Defines which combined timers (that is, timers that are connected to the combined timers) are activated with the extra time function.	0000b

Bit	Name	Description
0	Timed function 1	0 = Inactive. 1 = Active.
1	Timed function 2	0 = Inactive. 1 = Active.
2	Timed function 3	0 = Inactive. 1 = Active.
3…15	Reserved	

No.	Name/Value	Description	Def/FbEq16
	0000h…FFFFh	Combined timers including the extra timer.	1 = 1
34.111	*Boost time activation source*	Selects the source of extra time activation signal. 0 = Disabled. 1 = Enabled.	*Off*
	Off	0.	0

No.	Name/Value	Description	Def/FbEq16
	On	1.	1
	DI1	Digital input DI1 (*10.02 DI delayed status*, bit 0).	2
	DI2	Digital input DI2 (*10.02 DI delayed status*, bit 1).	3
	DI3	Digital input DI3 (*10.02 DI delayed status*, bit 2).	4
	DI4	Digital input DI4 (*10.02 DI delayed status*, bit 3).	5
	DI5	Digital input DI5 (*10.02 DI delayed status*, bit 4).	6
	DI6	Digital input DI6 (*10.02 DI delayed status*, bit 5).	7
	Other [bit]	Source selection (see *Terms and abbreviations* on page *100*).	-
34.112	*Boost time duration*	Defines the time inside which the extra time is deactivated after extra time activation signal is switched off. **Example:** If parameter *34.111 Boost time activation source* is set to *DI1* and *34.112 Boost time duration* is set to 00 01:30, the extra time is active for 1 hour and 30 minutes after digital input DI is deactivated.	00 00:00
	00 00:00…07 00:00	Extra time duration.	1 = 1

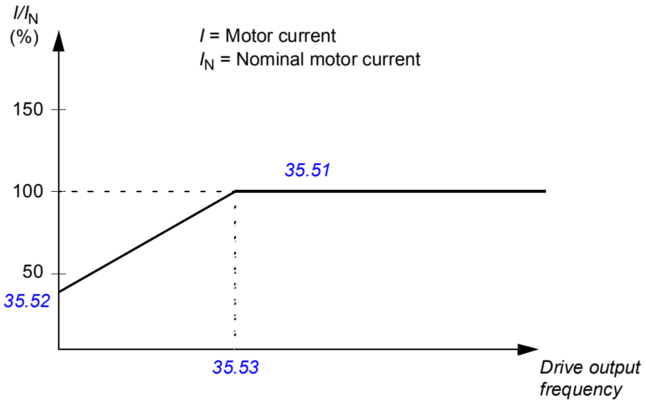
35 Motor thermal protection		Motor thermal protection settings such as temperature measurement configuration, load curve definition and motor fan control configuration. See also section *Motor thermal protection* (page *84*).	
35.01	*Motor estimated temperature*	Displays the motor temperature as estimated by the internal motor thermal protection model (see parameters *35.50*…*35.55*). The unit is selected by parameter *96.16 Unit selection*. This parameter is read-only.	-
	-60…1000 °C or -76…1832 °F	Estimated motor temperature.	1 = 1°
35.02	*Measured temperature 1*	Displays the temperature received through the source defined by parameter *35.11 Temperature 1 source*. The unit is selected by parameter *96.16 Unit selection*. **Note:** With a PTC sensor, the value shown is not a valid measurement. Either 0 ohm (normal temperature) or the value of parameter *35.22 Temperature 2 fault limit* (excessive temperature) is shown. This parameter is read-only.	-
	-60…5000 °C or -76…9032 °F, 0 ohm or [*35.12*] ohm	Measured temperature 1.	1 = 1 unit
35.03	*Measured temperature 2*	Displays the temperature received through the source defined by parameter *35.21 Temperature 2 source*. The unit is selected by parameter *96.16 Unit selection*. **Note:** With a PTC sensor, the value shown is not a valid measurement. Either 0 ohm (normal temperature) or the value of parameter *35.22 Temperature 2 fault limit* (excessive temperature) is shown. This parameter is read-only.	-
	-60…5000 °C or -76…9032 °F, 0 ohm or [*35.22*] ohm	Measured temperature 2.	1 = 1 unit

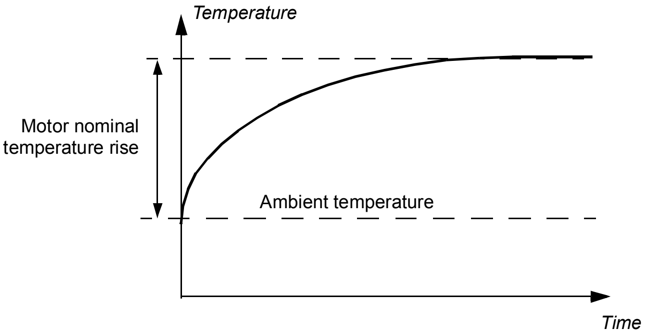
No.	Name/Value	Description	Def/FbEq16
35.11	*Temperature 1 source*	Selects the source from which measured temperature 1 is read. Usually this source is from a sensor connected to the motor controlled by the drive, but it could be used to measure and monitor a temperature from other parts of the process as long as a suitable sensor is used as per the selection list.	*Estimated temperature*
	Disabled	None. Temperature monitoring function 1 is disabled.	0
	Estimated temperature	Estimated motor temperature (see parameter *35.01 Motor estimated temperature*). The temperature is estimated from an internal drive calculation. It is important to set up the ambient temperature of the motor in *35.50 Motor ambient temperature*.	1
	Reserved		3…4
	1 × Pt100 analog I/O	Pt100 sensor connected to a standard analog input selected by parameter *35.14 Temperature 1 AI source* and an analog output. The following settings are required: • Set the hardware jumper or switch related to the analog input to ***U*** (voltage). Any change must be validated by a control unit reboot. • Set the appropriate analog input unit selection parameter in group *12 Standard AI* to *V* (volt). • In parameter group *13 Standard AO*, set the source selection parameter of the analog output to *Temp sensor 1 excitation*. The analog output feeds a constant current through the sensor. As the resistance of the sensor increases along with its temperature, the voltage over the sensor increases. The voltage is read by the analog input and converted into degrees.	5
	2 × Pt100 analog I/O	As selection *1 × Pt100 analog I/O*, but with two sensors connected in series. Using multiple sensors improves measurement accuracy significantly.	6
	3 × Pt100 analog I/O	As selection *1 × Pt100 analog I/O*, but with three sensors connected in series. Using multiple sensors improves measurement accuracy significantly.	7
	PTC DI6	PTC sensor is connected to DI6. **Note:** With a PTC sensor, the value shown is not a valid measurement. Either 0 ohm (normal temperature) or the value of parameter *35.22 Temperature 2 fault limit* (excessive temperature) is shown.	8
	Reserved		9…10
	Direct temperature	The temperature is taken from the source selected by parameter *35.14 Temperature 1 AI source*. The value of the source is assumed to be degrees Celsius.	11
	Reserved		17…18
	PTC extension module	PTC is connected to the CMOD-02 multifunction extension module, which is installed in drive slot 2. See chapter *Optional I/O extension modules, section CMOD-02 multifunction extension module (external 24 V AC/DC and isolated PTC interface)* in the *Hardware manual* of the drive).	19
	Reserved		20

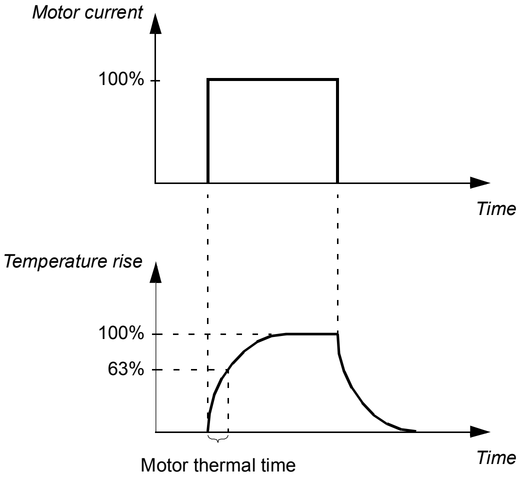
No.	Name/Value	Description	Def/FbEq16
	Therm(0)	PTC sensor or a normally closed thermistor connected relay to digital input DI6. The motor is overheated when the digital input is 0.	21
	Therm(1)	Normally open thermistor relay connected to digital input DI6. The motor is overheated when the digital input is 1.	22
35.12	*Temperature 1 fault limit*	Defines the fault limit for temperature supervision function 1. When measured temperature 1 exceeds the limit, the drive trips on fault *4981 External temperature 1*. The unit is selected by parameter *96.16 Unit selection*. **Note:** With a PTC sensor, changing the value of this parameter has no effect on fault generation. When PTC is over the triggering threshold of the CMOD-02 (see the *Hardware manual*), the drive trips on the fault and when PTC has decreased below recovery threshold of the CMOD-02 (see the *Hardware manual*), the fault is reset.	130 °C or 266 °F
	-60…5000 °C or -76…9032 °F	Fault limit for temperature monitoring function 1.	1 = 1 °
35.13	*Temperature 1 warning limit*	Defines the warning limit for temperature supervision function 1. When measured temperature 1 exceeds the limit, warning *A491 External temperature 1* is generated. The unit is selected by parameter *96.16 Unit selection*. **Note:** With a PTC sensor, changing the value of this parameter has no effect on warning generation. When PTC is over the triggering threshold of the CMOD-02 (see the *Hardware manual*), the drive trips on the fault and when PTC has decreased below recovery threshold of the CMOD-02 (see the *Hardware manual*), the fault is reset.	110 °C or 230 °F
	-60…5000 °C or -76…9032 °F	Warning limit for temperature monitoring function 1.	1 = 1 °
35.14	*Temperature 1 AI source*	Specifies the analog input when the setting of *35.11 Temperature 1 source* requires measurement through an analog input.	*Not selected*
	Not selected	None.	0
	AI1 actual value	Analog input AI1 on the control unit.	1
	AI2 actual value	Analog input AI2 on the control unit.	2
	Other	Source selection (see *Terms and abbreviations* on page *100*).	-
35.21	*Temperature 2 source*	Selects the source from which measured temperature 2 is read. Usually this source is from a sensor connected to the motor controlled by the drive, but it could be used to measure and monitor a temperature from other parts of the process as long as a suitable sensor is used as per the selection list.	*Disabled*
	Disabled	None. Temperature monitoring function 2 is disabled.	0
	Estimated temperature	Estimated motor temperature (see parameter *35.01 Motor estimated temperature*). The temperature is estimated from an internal drive calculation. It is important to set up the ambient temperature of the motor in *35.50 Motor ambient temperature*.	1
	Reserved		3…4

No.	Name/Value	Description	Def/FbEq16
	1 × Pt100 analog I/O	Pt100 sensor connected to a standard analog input selected by parameter *35.24 Temperature 2 AI source* and an analog output. The following settings are required: • Set the hardware jumper or switch related to the analog input to ***U*** (voltage). Any change must be validated by a control unit reboot. • Set the appropriate analog input unit selection parameter in group *12 Standard AI* to *V* (volt). • In parameter group *13 Standard AO*, set the source selection parameter of the analog output to *Temp sensor 2 excitation*. The analog output feeds a constant current through the sensor. As the resistance of the sensor increases along with its temperature, the voltage over the sensor increases. The voltage is read by the analog input and converted into degrees.	5
	2 × Pt100 analog I/O	As selection *1 × Pt100 analog I/O*, but with two sensors connected in series. Using multiple sensors improves measurement accuracy significantly.	6
	3 × Pt100 analog I/O	As selection *1 × Pt100 analog I/O*, but with three sensors connected in series. Using multiple sensors improves measurement accuracy significantly.	7
	PTC DI6	PTC sensor is connected to DI6. **Note:** With a PTC sensor, the value shown is not a valid measurement. Either 0 ohm (normal temperature) or the value of parameter *35.22 Temperature 2 fault limit* (excessive temperature) is shown.	8
	Reserved		19…10
	Direct temperature	The temperature is taken from the source selected by parameter *35.24 Temperature 2 AI source*. The value of the source is assumed to be degrees Celsius.	11
	Reserved		17…18
	PTC extension module	PTC is connected to the CMOD-02 multifunction extension module, which is installed in drive slot 2. See chapter *Optional I/O extension modules, section CMOD-02 multifunction extension module (external 24 V AC/DC and isolated PTC interface)* in the *Hardware manual* of the drive).	19
	Reserved		20
	Therm(0)	PTC sensor or a normally closed thermistor connected relay to digital input DI6. The motor is overheated when the digital input is 0.	21
	Therm(1)	Normally open thermistor relay connected to digital input DI6. The motor is overheated when the digital input is 1.	22

No.	Name/Value	Description	Def/FbEq16
35.22	*Temperature 2 fault limit*	Defines the fault limit for temperature supervision function 2. When measured temperature 1 exceeds the limit, the drive trips on fault *4982 External temperature 2*. The unit is selected by parameter *96.16 Unit selection*. **Note:** With a PTC sensor, changing the value of this parameter has no effect on fault generation. When PTC is over the triggering threshold of the CMOD-02 (see the *Hardware manual*), the drive trips on the fault and when PTC has decreased below recovery threshold of the CMOD-02 (see the *Hardware manual*), the fault is reset.	130 °C or 266 °F
	-60…5000 °C or -76…9032 °F	Fault limit for temperature monitoring function 2.	1 = 1 °
35.23	*Temperature 2 warning limit*	Defines the warning limit for temperature supervision function 2. When measured temperature 1 exceeds the limit, warning *A492 External temperature 2* is generated. The unit is selected by parameter *96.16 Unit selection*. **Note:** With a PTC sensor, changing the value of this parameter has no effect on warning generation. When PTC is over the triggering threshold of the CMOD-02 (see the *Hardware manual*), the drive trips on the fault and when PTC has decreased below recovery threshold of the CMOD-02 (see the *Hardware manual*), the fault is reset.	110 °C or 230 °F
	-60…5000 °C or -76…9032 °F	Warning limit for temperature monitoring function 2.	1 = 1 °
35.24	*Temperature 2 AI source*	Specifies the analog input when the setting of *35.11 Temperature 1 source* requires measurement through an analog input.	*Not selected*
	Not selected	None.	0
	AI1 actual value	Analog input AI1 on the control unit.	1
	AI2 actual value	Analog input AI2 on the control unit.	2
	Other	Source selection (see *Terms and abbreviations* on page *100*).	-
35.31	*Safe motor temperature enable*	Enables safe motor temperature.	*Off*
	Off	Safe motor temperature is off.	
	On	Safe motor temperature is on.	
35.50	*Motor ambient temperature*	Defines the ambient temperature of the motor for the motor thermal protection model. The unit is selected by parameter *96.16 Unit selection*. The motor thermal protection model estimates the motor temperature on the basis of parameters *35.50*…*35.55*. The motor temperature increases if it operates in the region above the load curve, and decreases if it operates in the region below the load curve. ⚠ **WARNING!** The model cannot protect the motor if the motor does not cool properly because of dust, dirt, etc.	20 °C or 68 °F
	-60…100 °C or -76 … 212 °F	Ambient temperature.	1 = 1°

No.	Name/Value	Description	Def/FbEq16
35.51	*Motor load curve*	Defines the motor load curve together with parameters *35.52 Zero speed load* and *35.53 Break point*. The load curve is used by the motor thermal protection model to estimate the motor temperature. When the parameter is set to 100%, the maximum load is taken as the value of parameter *99.06 Motor nominal current* (higher loads heat up the motor). The load curve level should be adjusted if the ambient temperature differs from the nominal value set in *35.50 Motor ambient temperature*.  	110%
	50…150%	Maximum load for the motor load curve.	1 = 1%
35.52	*Zero speed load*	Defines the motor load curve together with parameters *35.51 Motor load curve* and *35.53 Break point*. Defines the maximum motor load at zero speed of the load curve. A higher value can be used if the motor has an external motor fan to boost the cooling. See the motor manufacturer's recommendations. See parameter *35.51 Motor load curve*.	100%
	50…150%	Zero speed load for the motor load curve.	1 = 1%
35.53	*Break point*	Defines the motor load curve together with parameters *35.51 Motor load curve* and *35.52 Zero speed load*. Defines the break point frequency of the load curve ie. the point at which the motor load curve begins to decrease from the value of parameter *35.51 Motor load curve* towards the value of parameter *35.52 Zero speed load*. See parameter *35.51 Motor load curve*.	45.00 Hz
	1.00…500.00 Hz	Break point for the motor load curve.	See par. *46.02*

<table>
<tr><th>No.</th><th>Name/Value</th><th>Description</th><th>Def/FbEq16</th></tr>
<tr><td>35.54</td><td>Motor nominal temperature rise</td><td>Defines the temperature rise of the motor above ambient when the motor is loaded with nominal current. See the motor manufacturer's recommendations.
The unit is selected by parameter 96.16 Unit selection.</td><td>80 °C or 176 °F</td></tr>
<tr><td colspan="4">
</td></tr>
<tr><td></td><td>0…300 °C or 32…572 °F</td><td>Temperature rise.</td><td>1 = 1°</td></tr>
</table>

No.	Name/Value	Description	Def/FbEq16
35.55	*Motor thermal time constant*	Defines the thermal time constant for use with the motor thermal protection model, defined as the time to reach 63% of the nominal motor temperature. See the motor manufacturer's recommendations. For thermal protection according to UL requirements for NEMA class motors, use the rule of thumb: Motor thermal time equals 35 times t6, where t6 (in seconds) is specified by the motor manufacturer as the time that the motor can safely operate at six time its rated current. The thermal time for Class 10 trip curve is 350 s, for Class 20 trip curve 700 s and for Class 30 trip curve 1050 s.  	256 s
	100…10000 s	Motor thermal time constant.	1 = 1 s

36 Load analyzer		Peak value and amplitude logger settings. See also section *Load analyzer* (page *93*).	
36.01	*PVL signal source*	Selects the signal to be monitored by the peak value logger. The signal is filtered using the filtering time specified by parameter *36.02 PVL filter time*. The peak value is stored, along with other pre-selected signals at the time, into parameters *36.10*…*36.15*. The peak value logger can be reset using parameter *36.09 Reset loggers*. The logger is also reset whenever the signal source is changed. The date and time of the last reset are stored into parameters *36.16* and *36.17* respectively.	*Output power*
	Not selected	None (peak value logger disabled).	0
	Motor speed used	*01.01 Motor speed used* (page *103*).	1
	Reserved		2
	Output frequency	*01.06 Output frequency* (page *103*).	3
	Motor current	*01.07 Motor current* (page *103*).	4
	Reserved		5
	Motor torque	*01.10 Motor torque* (page *103*).	6

No.	Name/Value	Description	Def/FbEq16
	DC voltage	*01.11 DC voltage* (page *103*).	7
	Output power	*01.14 Output power* (page *104*).	8
	Reserved		9
	Speed ref ramp in	*23.01 Speed ref ramp input* (page *162*).	10
	Speed ref ramp out	*23.02 Speed ref ramp output* (page *162*).	11
	Speed ref used	*24.01 Used speed reference* (page *163*).	12
	Reserved		13
	Freq ref used	*28.02 Frequency ref ramp output* (page *167*).	14
	Reserved		15
	Process PID out	*40.01 Process PID output actual* (page *213*).	16
	Other	Source selection (see *Terms and abbreviations* on page *100*).	-
36.02	*PVL filter time*	Peak value logger filtering time. See parameter *36.01 PVL signal source*.	2.00 s
	0.00…120.00 s	Peak value logger filtering time.	100 = 1 s
36.06	*AL2 signal source*	Selects the signal to be monitored by amplitude logger 2. The signal is sampled at 200 ms intervals. The results are displayed by parameters *36.40*…*36.49*. Each parameter represents an amplitude range, and shows what portion of the samples fall within that range. The signal value corresponding to 100% is defined by parameter *36.07 AL2 signal scaling*. Amplitude logger 2 can be reset using parameter *36.09 Reset loggers*. The logger is also reset whenever the signal source or scaling is changed. The date and time of the last reset are stored into parameters *36.50* and *36.51* respectively. For the selections, see parameter *36.01 PVL signal source*.	*Motor torque*
36.07	*AL2 signal scaling*	Defines the signal value that corresponds to 100% amplitude.	100.00
	0.00…32767.00	Signal value corresponding to 100%.	1 = 1
36.09	*Reset loggers*	Resets the peak value logger and/or amplitude logger 2. (Amplitude logger 1 cannot be reset.)	*Done*
	Done	Reset completed or not requested (normal operation).	0
	All	Reset both the peak value logger and amplitude logger 2.	1
	PVL	Reset the peak value logger.	2
	AL2	Reset amplitude logger 2.	3
36.10	*PVL peak value*	Peak value recorded by the peak value logger.	0.00
	-32768.00… 32767.00	Peak value.	1 = 1
36.11	*PVL peak date*	The date on which the peak value was recorded.	01.01.1980
	-	Peak occurrence date.	-
36.12	*PVL peak time*	The time at which the peak value was recorded.	00:00:00
	-	Peak occurrence time.	-
36.13	*PVL current at peak*	Motor current at the moment the peak value was recorded.	0.00 A
	-32768.00… 32767.00 A	Motor current at peak.	1 = 1 A

No.	Name/Value	Description	Def/FbEq16
36.14	PVL DC voltage at peak	Voltage in the intermediate DC circuit of the drive at the moment the peak value was recorded.	0.00 V
	0.00…2000.00 V	DC voltage at peak.	10 = 1 V
36.15	PVL speed at peak	Motor speed at the moment the peak value was recorded.	0.00 rpm
	-30000.00… 30000.00 rpm	Motor speed at peak.	See par. 46.01
36.16	PVL reset date	The date on which the peak value logger was last reset.	01.01.1980
	-	Last reset date of the peak value logger.	-
36.17	PVL reset time	The time at which the peak value logger was last reset.	00:00:00
	-	Last reset time of the peak value logger.	-
36.20	AL1 0 to 10%	Percentage of samples recorded by amplitude logger 1 that fall between 0 and 10%. 100% corresponds to the I_{max} value given in the ratings table in chapter Technical data in the *Hardware manual*.	0.00%
	0.00…100.00%	Amplitude logger 1 samples between 0 and 10%.	1 = 1%
36.21	AL1 10 to 20%	Percentage of samples recorded by amplitude logger 1 that fall between 10 and 20%.	0.00%
	0.00…100.00%	Amplitude logger 1 samples between 10 and 20%.	1 = 1%
36.22	AL1 20 to 30%	Percentage of samples recorded by amplitude logger 1 that fall between 20 and 30%.	0.00%
	0.00…100.00%	Amplitude logger 1 samples between 20 and 30%.	1 = 1%
36.23	AL1 30 to 40%	Percentage of samples recorded by amplitude logger 1 that fall between 30 and 40%.	0.00%
	0.00…100.00%	Amplitude logger 1 samples between 30 and 40%.	1 = 1%
36.24	AL1 40 to 50%	Percentage of samples recorded by amplitude logger 1 that fall between 40 and 50%.	0.00%
	0.00…100.00%	Amplitude logger 1 samples between 40 and 50%.	1 = 1%
36.25	AL1 50 to 60%	Percentage of samples recorded by amplitude logger 1 that fall between 50 and 60%.	0.00%
	0.00…100.00%	Amplitude logger 1 samples between 50 and 60%.	1 = 1%
36.26	AL1 60 to 70%	Percentage of samples recorded by amplitude logger 1 that fall between 60 and 70%.	0.00%
	0.00…100.00%	Amplitude logger 1 samples between 60 and 70%.	1 = 1%
36.27	AL1 70 to 80%	Percentage of samples recorded by amplitude logger 1 that fall between 70 and 80%.	0.00%
	0.00…100.00%	Amplitude logger 1 samples between 70 and 80%.	1 = 1%
36.28	AL1 80 to 90%	Percentage of samples recorded by amplitude logger 1 that fall between 80 and 90%.	0.00%
	0.00…100.00%	Amplitude logger 1 samples between 80 and 90%.	1 = 1%
36.29	AL1 over 90%	Percentage of samples recorded by amplitude logger 1 that exceed 90%.	0.00%
	0.00…100.00%	Amplitude logger 1 samples over 90%.	1 = 1%
36.40	AL2 0 to 10%	Percentage of samples recorded by amplitude logger 2 that fall between 0 and 10%.	0.00%
	0.00…100.00%	Amplitude logger 2 samples between 0 and 10%.	1 = 1%

No.	Name/Value	Description	Def/FbEq16
36.41	*AL2 10 to 20%*	Percentage of samples recorded by amplitude logger 2 that fall between 10 and 20%.	0.00%
	0.00…100.00%	Amplitude logger 2 samples between 10 and 20%.	1 = 1%
36.42	*AL2 20 to 30%*	Percentage of samples recorded by amplitude logger 2 that fall between 20 and 30%.	0.00%
	0.00…100.00%	Amplitude logger 2 samples between 20 and 30%.	1 = 1%
36.43	*AL2 30 to 40%*	Percentage of samples recorded by amplitude logger 2 that fall between 30 and 40%.	0.00%
	0.00…100.00%	Amplitude logger 2 samples between 30 and 40%.	1 = 1%
36.44	*AL2 40 to 50%*	Percentage of samples recorded by amplitude logger 2 that fall between 40 and 50%.	0.00%
	0.00…100.00%	Amplitude logger 2 samples between 40 and 50%.	1 = 1%
36.45	*AL2 50 to 60%*	Percentage of samples recorded by amplitude logger 2 that fall between 50 and 60%.	0.00%
	0.00…100.00%	Amplitude logger 2 samples between 50 and 60%.	1 = 1%
36.46	*AL2 60 to 70%*	Percentage of samples recorded by amplitude logger 2 that fall between 60 and 70%.	0.00%
	0.00…100.00%	Amplitude logger 2 samples between 60 and 70%.	1 = 1%
36.47	*AL2 70 to 80%*	Percentage of samples recorded by amplitude logger 2 that fall between 70 and 80%.	0.00%
	0.00…100.00%	Amplitude logger 2 samples between 70 and 80%.	1 = 1%
36.48	*AL2 80 to 90%*	Percentage of samples recorded by amplitude logger 2 that fall between 80 and 90%.	0.00%
	0.00…100.00%	Amplitude logger 2 samples between 80 and 90%.	1 = 1%
36.49	*AL2 over 90%*	Percentage of samples recorded by amplitude logger 2 that exceed 90%.	0.00%
	0.00…100.00%	Amplitude logger 2 samples over 90%.	1 = 1%
36.50	*AL2 reset date*	The date on which amplitude logger 2 was last reset.	01.01.1980
	-	Last reset date of amplitude logger 2.	-
36.51	*AL2 reset time*	The time at which amplitude logger 2 was last reset.	00:00:01
	-	Last reset time of amplitude logger 2.	-

No.	Name/Value	Description	Def/FbEq16
37 User load curve		Settings for user load curve. See also section *User load curve (Condition monitoring)* (page *52*).	
37.01	*ULC output status word*	Displays the status of the monitored signal. The status is shown only while the drive is running. (The status word is independent of the actions and delays selected by parameters *37.03*, *37.04*, *37.41* and *37.42*.) This parameter is read-only.	0000h

Bit	Name	Description
0	Under load limit	1 = Signal lower than the underload curve.
1	Within load range	1 = Signal between the underload and overload curve.
2	Overload limit	1 = Signal higher than the overload curve.
3…15	Reserved	

	0000h…FFFFh	Status of the monitored signal.	1 = 1
37.02	*ULC supervision signal*	Selects the signal to be monitored. The function compares the absolute value of the signal against the load curve.	*Motor torque %*
	Not selected	No signal selected (monitoring disabled).	0
	Motor speed %	*01.03 Motor speed %* (page *103*).	1
	Motor current %	*01.08 Motor current % of motor nom* (page *103*).	2
	Motor torque %	*01.10 Motor torque* (page *103*).	3
	Output power % of motor nominal	*01.15 Output power % of motor nom* (page *104*).	4
	Output power % of drive nominal	*01.16 Output power % of drive nom* (page *104*).	5
	Other	Source selection (see *Terms and abbreviations* on page *100*).	-
37.03	*ULC overload actions*	Selects how the drive reacts if the absolute value of the monitored signal stays continuously above the overload curve for longer than the value of *37.41 ULC overload timer*.	*Disabled*
	Disabled	No action taken.	0
	Warning	The drive generates a warning (*A8BE ULC overload warning*).	1
	Fault	The drive trips on *8002 ULC overload fault*.	2
	Warning/Fault	The drive generates a warning (*A8BE ULC overload warning*) if the signal stays continuously above the overload curve for half of the time defined by parameter *37.41 ULC overload timer*. The drive trips on *8002 ULC overload fault* if the signal stays continuously above the overload curve for a time defined by parameter *37.41 ULC overload timer*.	3
37.04	*ULC underload actions*	Selects how the drive reacts if the absolute value of the monitored signal stays continuously above the overload curve for longer than the value of *37.42 ULC underload timer*.	*Disabled*
	Disabled	No action taken.	0
	Warning	The drive generates a warning (*A8BF ULC underload warning*).	1
	Fault	The drive trips on *8001 ULC underload fault*.	2

No.	Name/Value	Description	Def/FbEq16
	Warning/Fault	The drive generates a warning (*A8BF ULC underload warning*) if the signal stays continuously below the underload curve for half of the time defined by parameter *37.41 ULC overload timer*. The drive trips on *8001 ULC underload fault* if the signal stays continuously above the underload curve for a time defined by parameter *37.42 ULC underload timer*.	3
37.11	*ULC speed table point 1*	Defines the first of the five speed points on the X-axis of the user load curve. Speed points are used if parameter *99.04 Motor control mode* is set to *Vector* or if *99.04 Motor control mode* is set to *Scalar* and the reference unit is rpm. The five points must be in order from lowest to highest. The points are defined as positive values, but the range is symmetrically effective also in the negative direction. The monitoring is not active outside these two areas.	150.0 rpm
	-30000.0…30000.0 rpm	Speed.	1 = 1 rpm
37.12	*ULC speed table point 2*	Defines the second speed point. See parameter *37.11 ULC speed table point 1*.	750.0 rpm
	-30000.0…30000.0 rpm	Speed.	1 = 1 rpm
37.13	*ULC speed table point 3*	Defines the third speed point. See parameter *37.11 ULC speed table point 1*.	1290.0 rpm
	-30000.0…30000.0 rpm	Speed.	1 = 1 rpm
37.14	*ULC speed table point 4*	Defines the fourth speed point. See parameter *37.11 ULC speed table point 1*.	1500.0 rpm
	-30000.0…30000.0 rpm	Speed.	1 = 1 rpm
37.15	*ULC speed table point 5*	Defines the fifth speed point. See parameter *37.11 ULC speed table point 1*.	1800.0 rpm
	-30000.0…30000.0 rpm	Speed.	1 = 1 rpm
37.16	*ULC frequency table point 1*	Defines the first of the five frequency points on the X-axis of the user load curve. Frequency points are used if parameter *99.04 Motor control mode* is set to *Scalar* and the reference unit is Hz. The five points must be in order from lowest to highest. The points are defined as positive values, but the range is symmetrically effective also in the negative direction. The monitoring is not active outside these two areas.	5.0 Hz
	-500.0…500.0 Hz	Frequency.	1 = 1 Hz
37.17	*ULC frequency table point 2*	Defines the second frequency point. See parameter *37.16 ULC frequency table point 1*.	25.0 Hz
	-500.0…500.0 Hz	Frequency.	1 = 1 Hz
37.18	*ULC frequency table point 3*	Defines the third frequency point. See parameter *37.16 ULC frequency table point 1*.	43.0 Hz
	-500.0…500.0 Hz	Frequency.	1 = 1 Hz

No.	Name/Value	Description	Def/FbEq16
37.19	*ULC frequency table point 4*	Defines the fourth frequency point. See parameter *37.16 ULC frequency table point 1*.	50.0 Hz
	-500.0…500.0 Hz	Frequency.	1 = 1 Hz
37.20	*ULC frequency table point 5*	Defines the fifth frequency point. See parameter *37.16 ULC frequency table point 1*.	60.0 Hz
	-500.0…500.0 Hz	Frequency.	1 = 1 Hz
37.21	*ULC underload point 1*	Defines the first of the five points on the Y-axis that together with the corresponding point on the X-axis (*37.11 ULC speed table point 1*…*37.15 ULC speed table point 5* or *37.15 ULC speed table point 5*…*37.20 ULC frequency table point 5*) define the underload (lower) curve. Each point of the underload curve must have a lower value than the corresponding overload point.	10.0%
	-1600.0…1600.0%	Underload point.	1 = 1%
37.22	*ULC underload point 2*	Defines the second underload point. See parameter *37.21 ULC underload point 1*.	15.0%
	-1600.0…1600.0%	Underload point.	1 = 1%
37.23	*ULC underload point 3*	Defines the third underload point. See parameter *37.21 ULC underload point 1*	25.0%
	-1600.0…1600.0%	Underload point.	1 = 1%
37.24	*ULC underload point 4*	Defines the fourth underload point. See parameter *37.21 ULC underload point 1*	30.0%
	-1600.0…1600.0%	Underload point.	1 = 1%
37.25	*ULC underload point 5*	Defines the fifth underload point. See parameter *37.21 ULC underload point 1*	30.0%
	-1600.0…1600.0%	Underload point.	1 = 1%
37.31	*ULC overload point 1*	Defines the first of the five points on the Y-axis that together with the corresponding point on the X-axis (*37.11 ULC speed table point 1*…*37.15 ULC speed table point 5* or *37.15 ULC speed table point 5*…*37.20 ULC frequency table point 5*) define the overload (higher) curve. Each point of the overload curve must have a higher value than the corresponding underload point.	300.0%
	-1600.0…1600.0%	Overload point.	1 = 1%
37.32	*ULC overload point 2*	Defines the second overload point. See parameter *37.31 ULC overload point 1*.	300.0%
	-1600.0…1600.0%	Overload point.	1 = 1%
37.33	*ULC overload point 3*	Defines the third overload point. See parameter *37.31 ULC overload point 1*.	300.0%
	-1600.0…1600.0%	Overload point.	1 = 1%
37.34	*ULC overload point 4*	Defines the fourth overload point. See parameter *37.31 ULC overload point 1*.	300.0%
	-1600.0…1600.0%	Overload point.	1 = 1%
37.35	*ULC overload point 5*	Defines the fifth overload point. See parameter *37.31 ULC overload point 1*.	300.0%
	-1600.0…1600.0%	Overload point.	1 = 1%

No.	Name/Value	Description	Def/FbEq16
37.41	*ULC overload timer*	Defines the time for which the monitored signal must continuously stay above the overload curve before the drive takes the action selected by *37.03 ULC overload actions*.	20.0 s
	0.0…10000.0 s	Overload timer.	1 = 1 s
37.42	*ULC underload timer*	Defines the time for which the monitored signal must continuously stay below the underload curve before the drive takes the action selected by *37.04 ULC underload actions*.	20.0 s
	0.0…10000.0 s	Underload timer	1 = 1 s

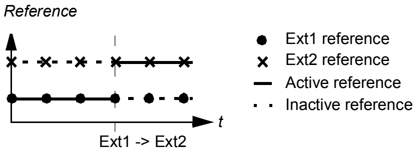
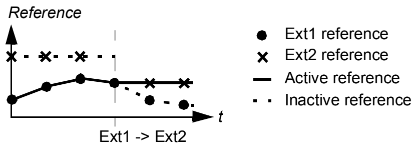
40 Process PID set 1		Parameter values for process PID control. The drive output can be controlled by the process PID. When the process PID control is enabled, the drive controls the process feedback to the reference value. Two different parameter sets can be defined for the process PID. One parameter set is in use at a time. The first set is made up of parameters *40.07*…*40.50*, the second set is defined by the parameters in group *41 Process PID set 2*. The binary source that defines which set is used is selected by parameter *40.57 PID set1/set2 selection*. See also the control chain diagrams on pages *413* and *414*. To set the PID customer unit, select **Menu - Primary settings - PID - Unit** on the panel.	
40.01	*Process PID output actual*	Displays the output of the process PID controller. See the control chain diagram on page *414*. This parameter is read-only.	-
	-200000.00… 200000.00 PID customer units	Process PID controller output.	1 = 1 PID customer unit
40.02	*Process PID feedback actual*	Displays the value of process feedback after source selection, mathematical function (parameter *40.10 Set 1 feedback function*), and filtering. See the control chain diagram on page *413*. This parameter is read-only.	-
	-200000.00… 200000.00 PID customer units	Process feedback.	1 = 1 PID customer unit
40.03	*Process PID setpoint actual*	Displays the value of process PID setpoint after source selection, mathematical function (*40.18 Set 1 setpoint function*), limitation and ramping. See the control chain diagram on page *413*. This parameter is read-only.	-
	-200000…200000 PID customer units	Setpoint for process PID controller.	1 = 1 PID customer unit
40.04	*Process PID deviation actual*	Displays the process PID deviation. By default, this value equals setpoint - feedback, but deviation can be inverted by parameter *40.31 Set 1 deviation inversion*. See the control chain diagram on page *414*. This parameter is read-only.	-
	-200000.00… 200000.00 PID customer units	PID deviation.	1 = 1 PID customer unit

No.	Name/Value	Description	Def/FbEq16
40.06	*Process PID status word*	Displays status information on process PID control. This parameter is read-only.	-

Bit	Name	Value
0	PID active	1 = Process PID control active.
1	Setpoint frozen	1 = Process PID setpoint frozen.
2	Output frozen	1 = Process PID controller output frozen.
3	PID sleep mode	1 = Sleep mode active.
4	Sleep boost	1 = Sleep boost active.
5	Reserved	
6	Tracking mode	1 = Tracking function active.
7	Output limit high	1 = PID output is being limited by par. *40.37*.
8	Output limit low	1 = PID output is being limited by par. *40.36*.
9	Deadband active	1 = PID deviation is in range defined by par. *40.39*.
10	PID set	0 = Parameter set 1 in use. 1 = Parameter set 2 in use.
11	Reserved	
12	Internal setpoint active	1 = Internal setpoint active (see par. *40.16*…*40.23*)
13…15	Reserved	

No.	Name/Value	Description	Def/FbEq16
	0000h…FFFFh	Process PID control status word.	1 = 1
40.07	*Process PID operation mode*	Activates/deactivates process PID control. **Note:** Process PID control is only available in external control; see section *Local control vs. external control* (page *37*).	*Off*
	Off	Process PID control inactive.	0
	On	Process PID control active.	1
	On when drive running	Process PID control is active when the drive is running.	2
40.08	*Set 1 feedback 1 source*	Selects the primary source of process feedback. See the control chain diagram on page *413*.	*AI2 percent*
	Not selected	None.	0
	AI1 scaled	*12.12 AI1 scaled value* (see page *125*).	1
	AI2 scaled	*12.22 AI2 scaled value* (see page *126*).	2
	Freq in scaled	*11.39 Freq in 1 scaled value* (see page *122*).	3
	Reserved		4…7
	AI1 percent	*12.101 AI1 percent value* (see page *127*).	8
	AI2 percent	*12.102 AI2 percent value* (see page *127*).	9
	Feedback data storage	*40.91 Feedback data storage* (see page *229*). (Selection not available for parameter *71.08 Feedback 1 source*.)	10
	Actual flow	Parameter *80.01 Actual flow*.	11
	Actual flow %	Parameter *80.02 Actual flow*.	12
	Other	Source selection (see *Terms and abbreviations* on page *100*).	-

No.	Name/Value	Description	Def/FbEq16
40.09	*Set 1 feedback 2 source*	Selects the second source of process feedback. The second source is used only if the setpoint function requires two inputs. For the selections, see parameter *40.08 Set 1 feedback 1 source*.	*Not selected*
40.10	*Set 1 feedback function*	Defines how process feedback is calculated from the two feedback sources selected by parameters *40.08 Set 1 feedback 1 source* and *40.09 Set 1 feedback 2 source*. The result of the function (for any selection) is multiplied by parameter *40.90 Set 1 feedback multiplier*. (That is why in selections 12 and 13, the multiplier k is constant 1.)	*In1*
	In1	Source 1.	0
	In1+In2	Sum of sources 1 and 2.	1
	In1-In2	Source 2 subtracted from source 1.	2
	In1*In2	Source 1 multiplied by source 2.	3
	In1/In2	Source 1 divided by source 2.	4
	MIN(In1,In2)	Smaller of the two sources.	5
	MAX(In1,In2)	Greater of the two sources.	6
	AVE(In1,In2)	Average of the two sources.	7
	sqrt(In1)	Square root of source 1.	8
	sqrt(In1-In2)	Square root of (source 1 - source 2).	9
	sqrt(In1+In2)	Square root of (source 1 + source 2).	10
	sqrt(In1)+sqrt(In2)	Square root of source 1 + square root of source 2.	11
	k*sqrt(In1)	Square root of source 1. (k = 1)	12
	k*sqrt(In1-In2)	Square root of (source 1 - source 2). (k = 1)	13
40.11	*Set 1 feedback filter time*	Defines the filter time constant for process feedback.	0.000 s
	0.000…30.000 s	Feedback filter time.	1 = 1 s
40.14	*Set 1 setpoint scaling*	Defines, together with parameter *40.15 Set 1 output scaling*, a general scaling factor for the process PID control chain. If the parameter is set to zero, automatic setpoint scaling is activated, where suitable setpoint scale is calculated according to selected setpoint source. Actual setpoint scale is shown in parameter *40.61 Setpoint actual scaling*. The scaling can be utilized when, for example, the process setpoint is input in Hz, and the output of the PID controller is used as an rpm value in speed control. In this case, this parameter might be set to 50, and parameter *40.15* to the nominal motor speed at 50 Hz. In effect, the output of the PID controller = [*40.15*] when deviation (setpoint - feedback) = [*40.14*] and [*40.32*] = 1. **Note:** The scaling is based on the ratio between *40.14* and *40.15*. For example, the values 50 and 1500 would produce the same scaling as 1 and 30.	0.00
	-200000.00… 200000.00	Scaling.	1 = 1

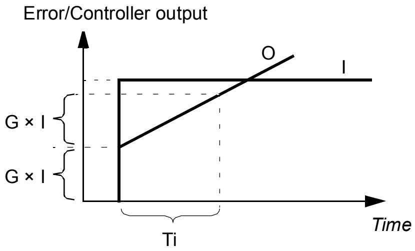
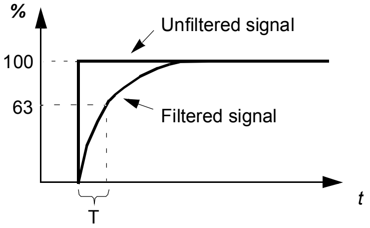
<table>
<tr><th>No.</th><th>Name/Value</th><th>Description</th><th>Def/FbEq16</th></tr>
<tr><td><i>40.15</i></td><td><i>Set 1 output scaling</i></td><td>See parameter <i>40.14 Set 1 setpoint scaling</i>.
If the parameter is set to zero, scaling is automatic:
<table>
<tr><th>Operation mode
(see par. <i>19.01</i>)</th><th>Scaling</th></tr>
<tr><td>Speed control</td><td><i>46.01 Speed scaling</i></td></tr>
<tr><td>Frequency control</td><td><i>46.02 Frequency scaling</i></td></tr>
</table></td><td>0.00</td></tr>
<tr><td></td><td>-200000.00…
200000.00</td><td>Process PID controller output base.</td><td>1 = 1</td></tr>
<tr><td><i>40.16</i></td><td><i>Set 1 setpoint 1 source</i></td><td>Selects the primary source of process PID setpoint. See the control chain diagram on page <i>413</i>.</td><td><i>Internal setpoint</i></td></tr>
<tr><td></td><td>Not selected</td><td>None.</td><td>0</td></tr>
<tr><td></td><td>Reserved</td><td></td><td>1</td></tr>
<tr><td></td><td>Internal setpoint</td><td>Internal setpoint. See parameter <i>40.19 Set 1 internal setpoint sel1</i>.</td><td>2</td></tr>
<tr><td></td><td>AI1 scaled</td><td><i>12.12 AI1 scaled value</i> (see page <i>125</i>).</td><td>3</td></tr>
<tr><td></td><td>AI2 scaled</td><td><i>12.22 AI2 scaled value</i> (see page <i>126</i>).</td><td>4</td></tr>
<tr><td></td><td>Reserved</td><td></td><td>5…7</td></tr>
<tr><td></td><td>Motor potentiometer</td><td><i>22.80 Motor potentiometer ref act</i> (output of the motor potentiometer).</td><td>8</td></tr>
<tr><td></td><td>Reserved</td><td></td><td>9</td></tr>
<tr><td></td><td>Freq in scaled</td><td><i>11.39 Freq in 1 scaled value</i> (see page <i>122</i>).</td><td>10</td></tr>
<tr><td></td><td>AI1 percent</td><td><i>12.101 AI1 percent value</i> (see page <i>127</i>)</td><td>11</td></tr>
<tr><td></td><td>AI2 percent</td><td><i>12.102 AI2 percent value</i> (see page <i>127</i>)</td><td>12</td></tr>
<tr><td></td><td>Control panel (ref saved)</td><td>Panel reference (<i>03.01 Panel reference</i>, see page <i>106</i>) saved by the control system for the location where the control returns is used as the reference.
(Selection not available for parameter <i>71.16 Setpoint 1 source</i>.)

 </td><td>13</td></tr>
<tr><td></td><td>Control panel (ref copied)</td><td>Panel reference (<i>03.01 Panel reference</i>, see page <i>106</i>) for the previous control location is used as the reference when the control location changes if the references for the two locations are of the same type (eg frequency/speed/torque/PID); otherwise, the actual signal is used as the new reference.

 </td><td>14</td></tr>
</table>

No.	Name/Value	Description	Def/FbEq16
	FB A ref1	*03.05 FB A reference 1* (see page *106*).	15
	FB A ref2	*03.06 FB A reference 2* (see page *106*).	16
	Reserved		17…18
	EFB ref1	*03.09 EFB reference 1* (see page *107*).	19
	EFB ref2	*03.10 EFB reference 2* (see page *107*).	20
	Reserved		21…23
	Setpoint data storage	*40.92 Setpoint data storage* (see page *229*). (Selection not available for parameter *71.16 Setpoint 1 source*.)	24
	Compensated setpoint	*40.70 Compensated setpoint* (see page *227*).	25
	Other	Source selection (see *Terms and abbreviations* on page *100*).	-
40.17	*Set 1 setpoint 2 source*	Selects the second source of process setpoint. The second source is used only if the setpoint function requires two inputs. For the selections, see parameter *40.16 Set 1 setpoint 1 source*.	*Not selected*
40.18	*Set 1 setpoint function*	Selects a function between the setpoint sources selected by parameters *40.16 Set 1 setpoint 1 source* and *40.17 Set 1 setpoint 2 source*. The result of the function (for any selection) is multiplied by parameter *40.89 Set 1 setpoint multiplier*. (That is why in selections 12 and 13, the multiplier k is constant 1.)	*In1*
	In1	Source 1.	0
	In1+In2	Sum of sources 1 and 2.	1
	In1-In2	Source 2 subtracted from source 1.	2
	In1*In2	Source 1 multiplied by source 2.	3
	In1/In2	Source 1 divided by source 2.	4
	MIN(In1,In2)	Smaller of the two sources.	5
	MAX(In1,In2)	Greater of the two sources.	6
	AVE(In1,In2)	Average of the two sources.	7
	sqrt(In1)	Square root of source 1.	8
	sqrt(In1-In2)	Square root of (source 1 - source 2).	9
	sqrt(In1+In2)	Square root of (source 1 + source 2).	10
	sqrt(In1)+sqrt(In2)	Square root of source 1 + square root of source 2.	11
	k*sqrt(In1)	Square root of source 1. (k = 1)	12
	k*sqrt(In1-In2)	Square root of (source 1 - source 2). (k = 1)	13

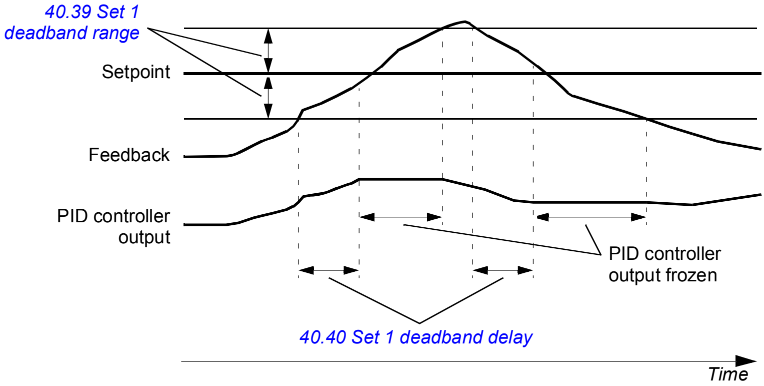
<table>
<tr><th>No.</th><th>Name/Value</th><th>Description</th><th>Def/FbEq16</th></tr>
<tr><td>*40.19*</td><td>*Set 1 internal setpoint sel1*</td><td>Selects together with *40.20 Set 1 internal setpoint sel2* the internal setpoint out of the presets defined by parameters *40.21*…*40.24*.
Note: Parameters *40.16 Set 1 setpoint 1 source* and *40.17 Set 1 setpoint 2 source* must be set to *Internal setpoint*.
<table>
<tr><th>Source defined by par. *40.19*</th><th>Source defined by par. *40.20*</th><th>Setpoint preset active</th></tr>
<tr><td>0</td><td>0</td><td>0 (par. *40.24*)</td></tr>
<tr><td>1</td><td>0</td><td>1 (par. *40.21*)</td></tr>
<tr><td>0</td><td>1</td><td>2 (par. *40.22*)</td></tr>
<tr><td>1</td><td>1</td><td>3 (par. *40.23*)</td></tr>
</table></td><td>*Selected*</td></tr>
<tr><td></td><td>Not selected</td><td>0.</td><td>0</td></tr>
<tr><td></td><td>Selected</td><td>1.</td><td>1</td></tr>
<tr><td></td><td>DI1</td><td>Digital input DI1 (*10.02 DI delayed status*, bit 0).</td><td>2</td></tr>
<tr><td></td><td>DI2</td><td>Digital input DI2 (*10.02 DI delayed status*, bit 1).</td><td>3</td></tr>
<tr><td></td><td>DI3</td><td>Digital input DI3 (*10.02 DI delayed status*, bit 2).</td><td>4</td></tr>
<tr><td></td><td>DI4</td><td>Digital input DI4 (*10.02 DI delayed status*, bit 3).</td><td>5</td></tr>
<tr><td></td><td>DI5</td><td>Digital input DI5 (*10.02 DI delayed status*, bit 4).</td><td>6</td></tr>
<tr><td></td><td>DI6</td><td>Digital input DI6 (*10.02 DI delayed status*, bit 5).</td><td>7</td></tr>
<tr><td></td><td>Reserved</td><td></td><td>8…17</td></tr>
<tr><td></td><td>Timed function 1</td><td>Bit 0 of *34.01 Timed functions status* (see page *191*).</td><td>18</td></tr>
<tr><td></td><td>Timed function 2</td><td>Bit 1 of *34.01 Timed functions status* (see page *191*).</td><td>19</td></tr>
<tr><td></td><td>Timed function 3</td><td>Bit 2 of *34.01 Timed functions status* (see page *191*).</td><td>20</td></tr>
<tr><td></td><td>Supervision 1</td><td>Bit 0 of *32.01 Supervision status* (see page *184*).</td><td>21</td></tr>
<tr><td></td><td>Supervision 2</td><td>Bit 1 of *32.01 Supervision status* (see page *184*).</td><td>22</td></tr>
<tr><td></td><td>Supervision 3</td><td>Bit 2 of *32.01 Supervision status* (see page *184*).</td><td>23</td></tr>
<tr><td></td><td>*Other [bit]*</td><td>Source selection (see *Terms and abbreviations* on page *100*).</td><td>-</td></tr>
<tr><td>*40.20*</td><td>*Set 1 internal setpoint sel2*</td><td>Selects together with *40.19 Set 1 internal setpoint sel1* the internal setpoint used out of the three internal setpoints defined by parameters *40.21*…*40.23*. See table at *40.19 Set 1 internal setpoint sel1*.</td><td>*Not selected*</td></tr>
<tr><td></td><td>Not selected</td><td>0.</td><td>0</td></tr>
<tr><td></td><td>Selected</td><td>1.</td><td>1</td></tr>
<tr><td></td><td>DI1</td><td>Digital input DI1 (*10.02 DI delayed status*, bit 0).</td><td>2</td></tr>
<tr><td></td><td>DI2</td><td>Digital input DI2 (*10.02 DI delayed status*, bit 1).</td><td>3</td></tr>
<tr><td></td><td>DI3</td><td>Digital input DI3 (*10.02 DI delayed status*, bit 2).</td><td>4</td></tr>
<tr><td></td><td>DI4</td><td>Digital input DI4 (*10.02 DI delayed status*, bit 3).</td><td>5</td></tr>
<tr><td></td><td>DI5</td><td>Digital input DI5 (*10.02 DI delayed status*, bit 4).</td><td>6</td></tr>
<tr><td></td><td>DI6</td><td>Digital input DI6 (*10.02 DI delayed status*, bit 5).</td><td>7</td></tr>
<tr><td></td><td>Reserved</td><td></td><td>8…17</td></tr>
<tr><td></td><td>Timed function 1</td><td>Bit 0 of *34.01 Timed functions status* (see page *191*).</td><td>18</td></tr>
<tr><td></td><td>Timed function 2</td><td>Bit 1 of *34.01 Timed functions status* (see page *191*).</td><td>19</td></tr>
<tr><td></td><td>Timed function 3</td><td>Bit 2 of *34.01 Timed functions status* (see page *191*).</td><td>20</td></tr>
</table>

No.	Name/Value	Description	Def/FbEq16
	Supervision 1	Bit 0 of *32.01 Supervision status* (see page *184*).	21
	Supervision 2	Bit 1 of *32.01 Supervision status* (see page *184*).	22
	Supervision 3	Bit 2 of *32.01 Supervision status* (see page *184*).	23
	Other [bit]	Source selection (see *Terms and abbreviations* on page *100*).	-
40.21	*Set 1 internal setpoint 1*	Internal process setpoint 1. See parameter *40.19 Set 1 internal setpoint sel1*.	0.00 PID customer units; 5.00 bar
	-200000.00… 200000.00 PID customer units	Internal process setpoint 1.	1 = 1 PID customer unit
40.22	*Set 1 internal setpoint 2*	Internal process setpoint 2. See parameter *40.19 Set 1 internal setpoint sel1*.	0.00 PID customer units
	-200000.00… 200000.00PID customer units	Internal process setpoint 2.	1 = 1 PID customer unit
40.23	*Set 1 internal setpoint 3*	Internal process setpoint 3. See parameter *40.19 Set 1 internal setpoint sel1*.	0.00 PID customer units
	-200000.00… 200000.00 PID customer units	Internal process setpoint 3.	1 = 1 PID customer unit
40.24	*Set 1 internal setpoint 0*	Internal process setpoint 0. See parameter *40.19 Set 1 internal setpoint sel1*.	0.00 PID customer units
	-200000.00… 200000.00 PID customer units	Internal process setpoint 0.	1 = 1 PID customer unit
40.26	*Set 1 setpoint min*	Defines a minimum limit for the process PID controller setpoint.	0.00
	-200000.00… 200000.00 PID customer units	Minimum limit for process PID controller setpoint.	1 = 1
40.27	*Set 1 setpoint max*	Defines a maximum limit for the process PID controller setpoint.	5.00 bar
	-200000.00… 200000.00 PID customer units	Maximum limit for process PID controller setpoint.	1 = 1
40.28	*Set 1 setpoint increase time*	Defines the minimum time it takes for the setpoint to increase from 0% to 100%.	0.0 s
	0.0…32767.0 s	Setpoint increase time.	1 = 1
40.29	*Set 1 setpoint decrease time*	Defines the minimum time it takes for the setpoint to decrease from 100% to 0%.	0.0 s
	0.0…32767.0 s	Setpoint decrease time.	1 = 1

No.	Name/Value	Description	Def/FbEq16
40.30	*Set 1 setpoint freeze enable*	Freezes, or defines a source that can be used to freeze, the setpoint of the process PID controller. This feature is useful when the reference is based on a process feedback connected to an analog input, and the sensor must be serviced without stopping the process. 1 = Process PID controller setpoint frozen See also parameter *40.38 Set 1 output freeze enable*.	*Not selected*
	Not selected	Process PID controller setpoint not frozen.	0
	Selected	Process PID controller setpoint frozen.	1
	DI1	Digital input DI1 (*10.02 DI delayed status*, bit 0).	2
	DI2	Digital input DI2 (*10.02 DI delayed status*, bit 1).	3
	DI3	Digital input DI3 (*10.02 DI delayed status*, bit 2).	4
	DI4	Digital input DI4 (*10.02 DI delayed status*, bit 3).	5
	DI5	Digital input DI5 (*10.02 DI delayed status*, bit 4).	6
	DI6	Digital input DI6 (*10.02 DI delayed status*, bit 5).	7
	Reserved		8…17
	Timed function 1	Bit 0 of *34.01 Timed functions status* (see page *191*).	18
	Timed function 2	Bit 1 of *34.01 Timed functions status* (see page *191*).	19
	Timed function 3	Bit 2 of *34.01 Timed functions status* (see page *191*).	20
	Supervision 1	Bit 0 of *32.01 Supervision status* (see page *184*).	21
	Supervision 2	Bit 1 of *32.01 Supervision status* (see page *184*).	22
	Supervision 3	Bit 2 of *32.01 Supervision status* (see page *184*).	23
	Other [bit]	Source selection (see *Terms and abbreviations* on page *100*).	-
40.31	*Set 1 deviation inversion*	Inverts the input of the process PID controller. 0 = Deviation not inverted (Deviation = Setpoint - Feedback) 1 = Deviation inverted (Deviation = Feedback - Setpoint) See also section *Sleep and boost functions for process PID control* (page *57*).	*Not inverted (Ref - Fbk)*
	Not inverted (Ref - Fbk)	0.	0
	Inverted (Fbk - Ref)	1.	1
	Other [bit]	Source selection (see *Terms and abbreviations* on page *100*).	-
40.32	*Set 1 gain*	Defines the gain for the process PID controller. See parameter *40.33 Set 1 integration time*.	1.00 s
	0.10…100.00	Gain for PID controller.	100 = 1

No.	Name/Value	Description	Def/FbEq16
40.33	*Set 1 integration time*	Defines the integration time for the process PID controller. This time needs to be set to the same order of magnitude as the reaction time of the process being controlled, otherwise instability will result.  I = controller input (error) O = controller output G = gain Ti = integration time **Note:** Setting this value to 0 disables the “I” part, turning the PID controller into a PD controller.	10.0 s
	0.0…9999.0 s	Integration time.	1 = 1 s
40.34	*Set 1 derivation time*	Defines the derivation time of the process PID controller. The derivative component at the controller output is calculated on basis of two consecutive error values (E_{K-1} and E_K) according to the following formula: PID DERIV TIME × $(E_K - E_{K-1})/T_S$, in which T_S = 2 ms sample time E = Error = Process reference - process feedback.	0.000 s
	0.000…10.000 s	Derivation time.	1000 = 1 s
40.35	*Set 1 derivation filter time*	Defines the time constant of the 1-pole filter used to smooth the derivative component of the process PID controller.  $O = I \times (1 - e^{-t/T})$ I = filter input (step) O = filter output *t* = time T = filter time constant	0.0 s
	0.0…10.0 s	Filter time constant.	10 = 1 s

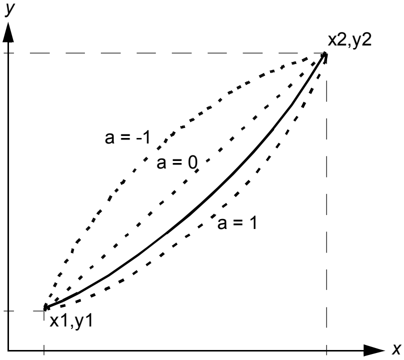
No.	Name/Value	Description	Def/FbEq16
40.36	*Set 1 output min*	Defines the minimum limit for the process PID controller output. Using the minimum and maximum limits, it is possible to restrict the operation range.	0.00
	-200000.00… 200000.00	Minimum limit for process PID controller output.	1 = 1
40.37	*Set 1 output max*	Defines the maximum limit for the process PID controller output. See parameter *40.36 Set 1 output min*.	100.00
	-200000.00… 200000.00	Maximum limit for process PID controller output.	1 = 1
40.38	*Set 1 output freeze enable*	Freezes (or defines a source that can be used to freeze) the output of the process PID controller, keeping the output at the value it was before freeze was enabled. This feature can be used when, for example, a sensor providing process feedback must to be serviced without stopping the process. 1 = Process PID controller output frozen See also parameter *40.30 Set 1 setpoint freeze enable*.	*Not selected*
	Not selected	Process PID controller output not frozen.	0
	Selected	Process PID controller output frozen.	1
	DI1	Digital input DI1 (*10.02 DI delayed status*, bit 0).	2
	DI2	Digital input DI2 (*10.02 DI delayed status*, bit 1).	3
	DI3	Digital input DI3 (*10.02 DI delayed status*, bit 2).	4
	DI4	Digital input DI4 (*10.02 DI delayed status*, bit 3).	5
	DI5	Digital input DI5 (*10.02 DI delayed status*, bit 4).	6
	DI6	Digital input DI6 (*10.02 DI delayed status*, bit 5).	7
	Reserved		8…17
	Timed function 1	Bit 0 of *34.01 Timed functions status* (see page *191*).	18
	Timed function 2	Bit 1 of *34.01 Timed functions status* (see page *191*).	19
	Timed function 3	Bit 2 of *34.01 Timed functions status* (see page *191*).	20
	Supervision 1	Bit 0 of *32.01 Supervision status* (see page *184*).	21
	Supervision 2	Bit 1 of *32.01 Supervision status* (see page *184*).	22
	Supervision 3	Bit 2 of *32.01 Supervision status* (see page *184*).	23
	Other [bit]	Source selection (see *Terms and abbreviations* on page *100*).	-

No.	Name/Value	Description	Def/FbEq16
40.39	*Set 1 deadband range*	Defines a deadband around the setpoint. Whenever process feedback enters the deadband, a delay timer starts. If the feedback remains within the deadband longer than the delay (*40.40 Set 1 deadband delay*), the PID controller output is frozen. Normal operation resumes after the feedback value leaves the deadband.	0.0
			
	0……200000.0	Deadband range.	1 = 1
40.40	*Set 1 deadband delay*	Delay for the deadband. See parameter *40.39 Set 1 deadband range*.	0.0 s
	0.0 … 3600.0 s	Delay for deadband area.	1 = 1 s
40.43	*Set 1 sleep level*	Defines the start limit for the sleep function. If the value is 0.0, set 1 sleep mode is disabled. The sleep function compares PID output (parameter *40.01 Process PID output actual*) to the value of this parameter. If PID output remains below this value longer than the sleep delay defined by *40.44 Set 1 sleep delay*, the drive enters the sleep mode and stops the motor.	0.0
	0.0…200000.0	Sleep start level.	1 = 1
40.44	*Set 1 sleep delay*	Defines a delay before the sleep function actually becomes enabled, to prevent nuisance sleeping. The delay timer starts when the sleep mode is enabled by parameter *40.43 Set 1 sleep level*, and resets when the sleep mode is disabled.	60.0 s
	0.0…3600.0 s	Sleep start delay.	1 = 1 s
40.45	*Set 1 sleep boost time*	Defines a boost time for the sleep boost step. See parameter *40.46 Set 1 sleep boost step*.	0.0 s
	0.0…3600.0 s	Sleep boost time.	1 = 1 s
40.46	*Set 1 sleep boost step*	When the drive is entering sleep mode, the process setpoint is increased by this value for the time defined by parameter *40.45 Set 1 sleep boost time*. If active, sleep boost is aborted when the drive wakes up.	0.0 PID customer units
	0.0…200000.0 PID customer units	Sleep boost step.	1 = 1 PID customer unit

No.	Name/Value	Description	Def/FbEq16
40.47	*Set 1 wake-up deviation*	Defines the wake-up level as deviation between process setpoint and feedback. When the deviation exceeds the value of this parameter, and remains there for the duration of the wake-up delay (*40.48 Set 1 wake-up delay*), the drive wakes up. See also parameter *40.31 Set 1 deviation inversion*.	0.00 PID customer units
	-200000.00…200000.00 PID customer units	Wake-up level (as deviation between process setpoint and feedback).	1 = 1 PID customer unit
40.48	*Set 1 wake-up delay*	Defines a wake-up delay for the sleep function to prevent nuisance wake-ups. See parameter *40.47 Set 1 wake-up deviation*. The delay timer starts when the deviation exceeds the wake-up level (*40.47 Set 1 wake-up deviation*), and resets if the deviation falls below the wake-up level.	0.50 s
	0.00…60.00 s	Wake-up delay.	1 = 1 s
40.49	*Set 1 tracking mode*	Activates (or selects a source that activates) tracking mode. In tracking mode, the value selected by parameter *40.50 Set 1 tracking ref selection* is substituted for the PID controller output. See also section *Tracking* (page *59*). 1 = Tracking mode enabled	*Not selected*
	Not selected	0.	0
	Selected	1.	1
	DI1	Digital input DI1 (*10.02 DI delayed status*, bit 0).	2
	DI2	Digital input DI2 (*10.02 DI delayed status*, bit 1).	3
	DI3	Digital input DI3 (*10.02 DI delayed status*, bit 2).	4
	DI4	Digital input DI4 (*10.02 DI delayed status*, bit 3).	5
	DI5	Digital input DI5 (*10.02 DI delayed status*, bit 4).	6
	DI6	Digital input DI6 (*10.02 DI delayed status*, bit 5).	7
	Reserved		8…17
	Timed function 1	Bit 0 of *34.01 Timed functions status* (see page *191*).	18
	Timed function 2	Bit 1 of *34.01 Timed functions status* (see page *191*).	19
	Timed function 3	Bit 2 of *34.01 Timed functions status* (see page *191*).	20
	Supervision 1	Bit 0 of *32.01 Supervision status* (see page *184*).	21
	Supervision 2	Bit 1 of *32.01 Supervision status* (see page *184*).	22
	Supervision 3	Bit 2 of *32.01 Supervision status* (see page *184*).	23
	Other [bit]	Source selection (see *Terms and abbreviations* on page *100*).	-
40.50	*Set 1 tracking ref selection*	Selects the value source for tracking mode. See parameter *40.49 Set 1 tracking mode*.	*Not selected*
	Not selected	None.	0
	AI1 scaled	*12.12 AI1 scaled value* (see page *125*).	1
	AI2 scaled	*12.22 AI2 scaled value* (see page *126*).	2
	FB A ref1	*03.05 FB A reference 1* (see page *106*).	3
	FB A ref2	*03.06 FB A reference 2* (see page *106*).	4
	Other	Source selection (see *Terms and abbreviations* on page *100*).	-

No.	Name/Value	Description	Def/FbEq16
40.57	*PID set1/set2 selection*	Selects the source that determines whether process PID parameter set 1 (parameters *40.07*…*40.50*) or set 2 (group *41 Process PID set 2*) is used.	*PID set 1*
	PID set 1	0. Process PID parameter set 1 in use.	0
	PID set 2	1. Process PID parameter set 2 in use.	1
	DI1	Digital input DI1 (*10.02 DI delayed status*, bit 0).	2
	DI2	Digital input DI2 (*10.02 DI delayed status*, bit 1).	3
	DI3	Digital input DI3 (*10.02 DI delayed status*, bit 2).	4
	DI4	Digital input DI4 (*10.02 DI delayed status*, bit 3).	5
	DI5	Digital input DI5 (*10.02 DI delayed status*, bit 4).	6
	DI6	Digital input DI6 (*10.02 DI delayed status*, bit 5).	7
	Reserved		8…17
	Timed function 1	Bit 0 of *34.01 Timed functions status* (see page *191*).	18
	Timed function 2	Bit 1 of *34.01 Timed functions status* (see page *191*).	19
	Timed function 3	Bit 2 of *34.01 Timed functions status* (see page *191*).	20
	Supervision 1	Bit 0 of *32.01 Supervision status* (see page *184*).	21
	Supervision 2	Bit 1 of *32.01 Supervision status* (see page *184*).	22
	Supervision 3	Bit 2 of *32.01 Supervision status* (see page *184*).	23
	Other [bit]	Source selection (see *Terms and abbreviations* on page *100*).	-
40.58	*Set 1 increase prevention*	Prevention of PID integration term increase for PID set 1.	*No*
	No	Increase prevention not in use.	0
	Limiting	The PID integration term is not increased if the maximum value for the PID output is reached. This parameter is valid for the PID set 1.	1
	Ext PID min lim	The process PID integration term is not increased when the output of the external PID has reached its minimum limit. In this setup, the external PID is used as a source for the process PID. This parameter is valid for the PID set 1.	2
	Ext PID max lim	The process PID integration term is not increased when the output of the external PID has reached its maximum limit. In this setup, the external PID is used as a source for the process PID. This parameter is valid for the PID set 1.	3
	Other [bit]	Source selection (see *Terms and abbreviations* on page *100*).	-
40.59	*Set 1 decrease prevention*	Prevention of PID integration term decrease for PID set 1.	*No*
	No	Decrease prevention not in use.	0
	Limiting	The PID integration term is not decreased if the minimum value for the PID output is reached. This parameter is valid for the PID set 1.	1
	Ext PID min lim	The process PID integration term is not decreased when the output of the external PID has reached its minimum limit. In this setup, the external PID is used as a source for the process PID. This parameter is valid for the PID set 1.	2
	Ext PID max lim	The process PID integration term is not decreased when the output of the external PID has reached its maximum limit. In this setup, the external PID is used as a source for the process PID. This parameter is valid for the PID set 1.	3

No.	Name/Value	Description	Def/FbEq16
	Other [bit]	Source selection (see *Terms and abbreviations* on page *100*).	-
40.60	*Set 1 PID activation source*	Selects the source of process PID set 1 activation.	*On*
	Off	Set 1 PID activation source is Off.	0
	On	Set 1 PID activation source is On.	1
	Follow Ext1/Ext2 selection	Selection follows the value of parameter *19.11 Ext1/Ext2 selection*. By changing to Ext2 control location, Process PID set 1 is activated.	2
	DI1	Digital input DI1 (*10.02 DI delayed status*, bit 0).	3
	DI2	Digital input DI2 (*10.02 DI delayed status*, bit 1).	4
	DI3	Digital input DI3 (*10.02 DI delayed status*, bit 2).	5
	DI4	Digital input DI4 (*10.02 DI delayed status*, bit 3).	6
	DI5	Digital input DI5 (*10.02 DI delayed status*, bit 4).	7
	DI6	Digital input DI6 (*10.02 DI delayed status*, bit 5).	8
	Other [bit]	Source selection (see *Terms and abbreviations* on page *100*).	-
40.61	*Setpoint actual scaling*	Actual setpoint scaling. See parameter *40.14 Set 1 setpoint scaling*.	50.0
	-200000.00…200000.00 PID customer units	Scaling.	1 = 1 PID customer unit
40.62	*PID internal setpoint actual*	Displays the value of the internal setpoint. See the control chain diagram on page *413*. This parameter is read-only.	-
	-200000.00…200000.00 PID customer units	Process PID internal setpoint.	1 = 1 PID customer unit

No.	Name/Value	Description	Def/FbEq16
40.70	*Compensated setpoint*	Compensated setpoint determined for the input specified by parameter *40.71 Set 1 compensation input source*. The setpoint compensation can be used with long pipelines where the distance between setpoint and sensor is long and the friction losses need to be compensated to get the correct value. The determination of the compensated setpoint is based on the curve specified by points (x1, y1), (x2, y2) and the non-linearity of the curve specified with parameters *40.71*…*40.76*. The compensated setpoint curve will be a mixture of a straight line between the points and a squared line between the points:  *x* = value from *40.71 Set 1 compensation input source* *y* = *40.70 Compensated setpoint* *a* = *40.76 Set 1 compensation non-linearity* Compensated setpoint curve = a ∗ squared function + (1 - a) ∗ linear function	
	-200000.00… 200000.00 PID customer units	Compensated setpoint value.	1 = 1 PID customer unit
40.71	*Set 1 compensation input source*	Selects the source for set 1 compensation input.	*Set1 output min*
	Not selected	None.	0
	Reserved		1
	Internal setpoint	Internal setpoint. See parameter *40.19 Set 1 internal setpoint sel1*.	2
	AI1 scaled	*12.12 AI1 scaled value* (see page *125*).	3
	AI2 scaled	*12.22 AI2 scaled value* (see page *126*).	4
	Reserved		5…7
	Motor potentiometer	*22.80 Motor potentiometer ref act* (output of the motor potentiometer).	8
	Reserved		9
	Freq in scaled	*11.39 Freq in 1 scaled value* (see page *122*).	10
	AI1 percent	*12.101 AI1 percent value* (see page *127*)	11
	AI2 percent	*12.102 AI2 percent value* (see page *127*)	12
	Reserved		13…14

No.	Name/Value	Description	Def/FbEq16
	FB A ref1	*03.05 FB A reference 1* (see page *106*).	15
	FB A ref2	*03.06 FB A reference 2* (see page *106*).	16
	Reserved		17…18
	EFB ref1	*03.09 EFB reference 1* (see page *107*).	19
	EFB ref2	*03.10 EFB reference 2* (see page *107*).	20
	Reserved		21…23
	Setpoint data storage	*40.92 Setpoint data storage* (see page *229*)	24
40.72	*Set 1 compensation input 1*	Point x1 on the setpoint compensation curve, see parameter *40.71 Compensated setpoint*.	
	-200000.00… 200000.00 PID customer units	Setpoint value.	1 = 1 PID customer unit
40.73	*Set 1 compensated output 1*	Point y1 (= the compensated output of parameter *40.72 Set 1 compensation input 1*) on the setpoint compensation curve, see parameter *40.70 Compensated setpoint*.	
	-200000.00… 200000.00 PID customer units	Compensated setpoint value.	1 = 1 PID customer unit
40.74	*Set 1 compensation input 2*	Point x2 on the setpoint compensation curve, see parameter *40.71 Compensated setpoint*.	
	-200000.00… 200000.00	Setpoint value.	1 = 1
40.75	*Set 1 compensated output 2*	Point y2 (= the compensated output of parameter *40.74 Set 1 compensation input 2*) on the setpoint compensation curve, see parameter *40.70 Compensated setpoint*.	
	-200000.00… 200000.00 PID customer units	Compensated setpoint value.	1 = 1 PID customer unit
40.76	*Set 1 compensation non-linearity*	Describes the non-linearity of the setpoint compensation curve, see parameter *40.70 Compensated setpoint*.	
	0…100%	Percentage.	1 = 1
40.80	*Set 1 PID output min source*	Selects the source for set 1 PID output minimum.	*Set1 output min*
	None	None.	0
	Set1 output min	*40.36 Set 1 output min*.	1
40.81	*Set 1 PID output max source*	Selects the source for set 1 PID output minimum.	*Set1 output max*
	None	None.	0
	Set1 output max	*40.37 Set 1 output max*	1
40.89	*Set 1 setpoint multiplier*	Defines the multiplier with which the result of the function specified by parameter *40.18 Set 1 setpoint function* is multiplied.	1.00
	-200000.00… 200000.00	Multiplier.	1 = 1
40.90	*Set 1 feedback multiplier*	Defines the multiplier with which the result of the function specified by parameter *40.10 Set 1 feedback function* is multiplied.	1.00

No.	Name/Value	Description	Def/FbEq16
	-200000.00… 200000.00	Multiplier.	1 = 1
40.91	*Feedback data storage*	Storage parameter for receiving a process feedback value eg. through the embedded fieldbus interface. The value can be sent to the drive as Modbus I/O data. Set the target selection parameter of that particular data (*58.101*…*58.114*) to *Feedback data storage*. In *40.08 Set 1 feedback 1 source* (or *40.09 Set 1 feedback 2 source*), select *Feedback data storage*.	-
	-327.68…327.67	Storage parameter for process feedback.	100 = 1
40.92	*Setpoint data storage*	Storage parameter for receiving a process setpoint value eg. through the embedded fieldbus interface. The value can be sent to the drive as Modbus I/O data. Set the target selection parameter of that particular data (*58.101*…*58.114*)) to *Setpoint data storage*. In *40.16 Set 1 setpoint 1 source* (or *40.17 Set 1 setpoint 2 source*), select *Setpoint data storage*.	-
	-327.68…327.67	Storage parameter for process setpoint.	100 = 1
40.96	*Process PID output %*	Percentage scaled signal of parameter *40.01 Process PID feedback actual*.	0.00%
	-100.00…100.00%	Percentage.	100 = 1%
40.97	*Process PID feedback %*	Percentage scaled signal of parameter *40.02 Process PID feedback actual*.	0.00%
	-100.00…100.00%	Percentage.	100 = 1%
40.98	*Process PID setpoint %*	Percentage scaled signal of parameter *40.03 Process PID setpoint actual*.	0.00%
	-100.00…100.00%	Percentage.	100 = 1%
40.99	*Process PID deviation %*	Percentage scaled signal of parameter *40.04 Process PID deviation actual*.	0.00%
	-100.00…100.00%	.Percentage.	100 = 1%
41 Process PID set 2		A second set of parameter values for process PID control. The selection between this set and first set (parameter group *40 Process PID set 1*) is made by parameter *40.57 PID set1/set2 selection*. See also parameters *40.01*…*40.06*, and the control chain diagrams on pages *413* and *414*.	
41.08	*Set 2 feedback 1 source*	See parameter *40.08 Set 1 feedback 1 source*.	*AI2 percent*
41.09	*Set 2 feedback 2 source*	See parameter *40.09 Set 1 feedback 2 source*.	*Not selected*
41.10	*Set 2 feedback function*	See parameter *40.10 Set 1 feedback function*.	*In1*
41.11	*Set 2 feedback filter time*	See parameter *40.11 Set 1 feedback filter time*.	0.000 s
41.14	*Set 2 setpoint scaling*	See parameter *40.14 Set 1 setpoint scaling*.	0.00
41.15	*Set 2 output scaling*	See parameter *40.15 Set 1 output scaling*.	0.00
41.16	*Set 2 setpoint 1 source*	See parameter *40.16 Set 1 setpoint 1 source*.	*AI1 percent*

No.	Name/Value	Description	Def/FbEq16
41.17	*Set 2 setpoint 2 source*	See parameter *40.17 Set 1 setpoint 2 source*.	*Not selected*
41.18	*Set 2 setpoint function*	See parameter *40.18 Set 1 setpoint function*.	*In1*
41.19	*Set 2 internal setpoint sel1*	See parameter *40.19 Set 1 internal setpoint sel1*.	*Not selected*
41.20	*Set 2 internal setpoint sel2*	See parameter *40.20 Set 1 internal setpoint sel2*.	*Not selected*
41.21	*Set 2 internal setpoint 1*	See parameter *40.21 Set 1 internal setpoint 1*.	0.00 PID customer units
41.22	*Set 2 internal setpoint 2*	See parameter *40.22 Set 1 internal setpoint 2*.	0.00 PID customer units
41.23	*Set 2 internal setpoint 3*	See parameter *40.23 Set 1 internal setpoint 3*.	0.00 PID customer units
41.24	*Set 2 internal setpoint 0*	*40.24 Set 1 internal setpoint 0*.	0.00 PID customer units
41.26	*Set 2 setpoint min*	See parameter *40.26 Set 1 setpoint min*.	0.00
41.27	*Set 2 setpoint max*	See parameter *40.27 Set 1 setpoint max*.	200000.00
41.28	*Set 2 setpoint increase time*	See parameter *40.28 Set 1 setpoint increase time*.	0.0 s
41.29	*Set 2 setpoint decrease time*	See parameter *40.29 Set 1 setpoint decrease time*.	0.0 s
41.30	*Set 2 setpoint freeze enable*	See parameter *40.30 Set 1 setpoint freeze enable*.	*Not selected*
41.31	*Set 2 deviation inversion*	See parameter *40.31 Set 1 deviation inversion*.	*Not inverted (Ref - Fbk)*
41.32	*Set 2 gain*	See parameter *40.32 Set 1 gain*.	2.50
41.33	*Set 2 integration time*	See parameter *40.33 Set 1 integration time*.	3.0 s
41.34	*Set 2 derivation time*	See parameter *40.34 Set 1 derivation time*.	0.000 s
41.35	*Set 2 derivation filter time*	See parameter *40.35 Set 1 derivation filter time*.	0.0 s
41.36	*Set 2 output min*	See parameter *40.36 Set 1 output min*.	0.00
41.37	*Set 2 output max*	See parameter *40.37 Set 1 output max*.	100.00
41.38	*Set 2 output freeze enable*	See parameter *40.38 Set 1 output freeze enable*.	*Not selected*
41.39	*Set 2 deadband range*	See parameter *40.39 Set 1 deadband range*.	0.0
41.40	*Set 2 deadband delay*	See parameter *40.40 Set 1 deadband delay*.	0.0 s
41.43	*Set 2 sleep level*	See parameter *40.43 Set 1 sleep level*.	0.0
41.44	*Set 2 sleep delay*	See parameter *40.44 Set 1 sleep delay*.	60.0 s
41.45	*Set 2 sleep boost time*	See parameter *40.45 Set 1 sleep boost time*.	0.0 s

No.	Name/Value	Description	Def/FbEq16
41.46	*Set 2 sleep boost step*	See parameter *40.46 Set 1 sleep boost step*.	0.0 PID customer units
41.47	*Set 2 wake-up deviation*	See parameter *40.47 Set 1 wake-up deviation*.	0.00 PID customer units
41.48	*Set 2 wake-up delay*	See parameter *40.48 Set 1 wake-up delay*.	0.50 s
41.49	*Set 2 tracking mode*	See parameter *40.49 Set 1 tracking mode*.	*Not selected*
41.50	*Set 2 tracking ref selection*	See parameter *40.50 Set 1 tracking ref selection*.	*Not selected*
41.58	*Set 2 increase prevention*	See parameter *40.58 Set 1 increase prevention*.	*No*
41.59	*Set 2 decrease prevention*	See parameter *40.59 Set 1 decrease prevention*.	*No*
41.60	*Set 2 PID activation source*	See parameter *40.60 Set 1 PID activation source*.	*On*
41.71	*Set 2 compensation input source*	See parameter *40.71 Set 1 compensation input source*.	*Set1 output min*
41.72	*Set 2 compensation input 1*	See parameter *40.72 Set 1 compensation input 1*.	
41.73	*Set 2 compensated output 1*	See parameter *40.73 Set 1 compensated output 1*.	
41.74	*Set 2 compensation input 2*	See parameter *40.74 Set 1 compensation input 2*.	
41.75	*Set 2 compensated output 2*	See parameter *40.75 Set 1 compensated output 2*.	
41.76	*Set 2 compensation non-linearity*	See parameter *40.76 Set 1 compensation non-linearity*.	
41.80	*Set 2 PID output min source*	See parameter *40.80 Set 1 PID output min source*.	*Set1 output min*
41.81	*Set 2 PID output max source*	See parameter *40.81 Set 1 PID output max source*.	*Set1 output max*
41.89	*Set 2 setpoint multiplier*	See parameter *40.89 Set 1 setpoint multiplier*.	1.00
41.90	*Set 2 feedback multiplier*	Defines the multiplier k used in formulas of parameter *41.10 Set 2 feedback function*. See parameter *40.90 Set 1 feedback multiplier*.	1.00

45 Energy efficiency		Settings for the energy saving calculators as well as peak and energy loggers. See also section *Energy saving calculators* (page *92*).	
45.01	*Saved GW hours*	Energy saved in GWh compared to direct-on-line motor connection. This parameter is incremented when *45.02 Saved MW hours* rolls over. This parameter is read-only (see parameter *45.21 Energy calculations reset*).	-
	0…65535 GWh	Energy savings in GWh.	1 = 1 GWh

No.	Name/Value	Description	Def/FbEq16
45.02	*Saved MW hours*	Energy saved in MWh compared to direct-on-line motor connection. This parameter is incremented when *45.03 Saved kW hours* rolls over. When this parameter rolls over, parameter *45.01 Saved GW hours* is incremented. This parameter is read-only (see parameter *45.21 Energy calculations reset*).	-
	0…999 MWh	Energy savings in MWh.	1 = 1 MWh
45.03	*Saved kW hours*	Energy saved in kWh compared to direct-on-line motor connection. If the internal brake chopper of the drive is enabled, all energy fed by the motor to the drive is assumed to be converted into heat, but the calculation still records savings made by controlling the speed. If the chopper is disabled, then regenerated energy from the motor is also recorded here. When this parameter rolls over, parameter *45.02 Saved MW hours* is incremented. This parameter is read-only (see parameter *45.21 Energy calculations reset*).	-
	0.0…999.9 kWh	Energy savings in kWh.	10 = 1 kWh
45.04	*Saved energy*	Energy saved in kWh compared to direct-on-line motor connection. If the internal brake chopper of the drive is enabled, all energy fed by the motor to the drive is assumed to be converted into heat. This parameter is read-only (see parameter *45.21 Energy calculations reset*).	-
	0.0…214748364.0 kWh	Energy savings in kWh.	1 = 1 kWh
45.05	*Saved money x1000*	Monetary savings in thousands compared to direct-on-line motor connection. This parameter is incremented when *45.06 Saved money* rolls over. If you have not set the currency during the first start-up, you can specify it in **Main menu - Primary settings - Clock, region display - Units - Currency**. This parameter is read-only (see parameter *45.21 Energy calculations reset*).	-
	0…4294967295 thousands	Monetary savings in thousands of units.	1 = 1 unit
45.06	*Saved money*	Monetary savings compared to direct-on-line motor connection. This value is a calculated by multiplying the saved energy in kWh by the currently active energy tariff (*45.14 Tariff selection*). When this parameter rolls over, parameter *45.05 Saved money x1000* is incremented. If you have not set the currency during the first start-up, you can specify it in **Main menu - Primary settings - Clock, region display - Units - Currency**. This parameter is read-only (see parameter *45.21 Energy calculations reset*).	-
	0.00…999.99 units	Monetary savings.	1 = 1 unit

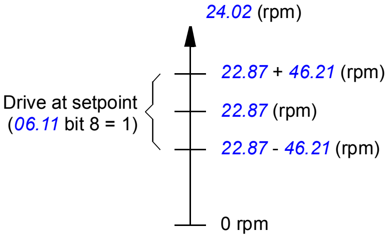
No.	Name/Value	Description	Def/FbEq16
45.07	*Saved amount*	Monetary savings compared to direct-on-line motor connection. This value is a calculated by multiplying the saved energy in kWh by the currently active energy tariff (*45.14 Tariff selection*). If you have not set the currency during the first start-up, you can specify it in **Main menu - Primary settings - Clock, region display - Units - Currency**. This parameter is read-only (see parameter *45.21 Energy calculations reset*).	-
	0.00… 21474830.08 units	Monetary savings.	1 = 1 unit
45.08	*CO2 reduction in kilotons*	Reduction in CO_2 emissions in metric kilotons compared to direct-on-line motor connection. This value is incremented when parameter *45.09 CO2 reduction in tons* rolls over. This parameter is read-only (see parameter *45.21 Energy calculations reset*).	-
	0…65535 metric kilotons	Reduction in CO_2 emissions in metric kilotons.	1 = 1 metric kiloton
45.09	*CO2 reduction in tons*	Reduction in CO_2 emissions in metric tons compared to direct-on-line motor connection. This value is calculated by multiplying the saved energy in MWh by the value of parameter *45.18 CO2 conversion factor* (by default, 0.5 metric tons/MWh). When this parameter rolls over, parameter *45.08 CO2 reduction in kilotons* is incremented. This parameter is read-only (see parameter *45.21 Energy calculations reset*).	-
	0.0…999.9 metric tons	Reduction in CO_2 emissions in metric tons.	1 = 1 metric ton
45.10	*Total saved CO2*	Reduction in CO_2 emissions in metric tons compared to direct-on-line motor connection. This value is calculated by multiplying the saved energy in MWh by the value of parameter *45.18 CO2 conversion factor* (by default, 0.5 metric tons/MWh). This parameter is read-only (see parameter *45.21 Energy calculations reset*).	-
	0.0…214748300.8 metric tons	Reduction in CO_2 emissions in metric tons.	1 = 1 metric ton
45.11	*Energy optimizer*	Enables/disables the energy optimization function. The function optimizes the motor flux so that total energy consumption and motor noise level are reduced when the drive operates below the nominal load. The total efficiency (motor and drive) can be improved by 1…20% depending on load torque and speed. **Note:** With a permanent magnet motor and a synchronous reluctance motor, energy optimization is always enabled regardless of this parameter.	*Enable*
	Disable	Energy optimization disabled.	0
	Enable	Energy optimization enabled.	1

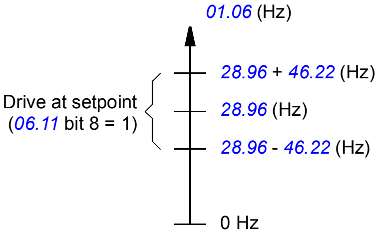
No.	Name/Value	Description	Def/FbEq16
45.12	*Energy tariff 1*	Defines energy tariff 1 (price of energy per kWh). Depending on the setting of parameter *45.14 Tariff selection*, either this value or *45.13 Energy tariff 2* is used for reference when monetary savings are calculated. If you have not set the currency during the first start-up, you can specify it in **Main menu - Primary settings - Clock, region display - Units - Currency**. **Note:** Tariffs are read only at the instant of selection, and are not applied retroactively.	0.100 units
	0.000… 4294966.296 units	Energy tariff 1.	-
45.13	*Energy tariff 2*	Defines energy tariff 2 (price of energy per kWh). See parameter *45.12 Energy tariff 1*.	0.200 units
	0.000… 4294966.296 units	Energy tariff 2.	-
45.14	*Tariff selection*	Selects (or defines a source that selects) which pre-defined energy tariff is used. 0 = *45.12 Energy tariff 1* 1 = *45.13 Energy tariff 2*	*Energy tariff 1*
	Energy tariff 1	0.	0
	Energy tariff 2	1.	1
	DI1	Digital input DI1 (*10.02 DI delayed status*, bit 0).	2
	DI2	Digital input DI2 (*10.02 DI delayed status*, bit 1).	3
	DI3	Digital input DI3 (*10.02 DI delayed status*, bit 2).	4
	DI4	Digital input DI4 (*10.02 DI delayed status*, bit 3).	5
	DI5	Digital input DI5 (*10.02 DI delayed status*, bit 4).	6
	DI6	Digital input DI6 (*10.02 DI delayed status*, bit 5).	7
	Other [bit]	Source selection (see *Terms and abbreviations* on page *100*).	-
45.18	*CO2 conversion factor*	Defines a factor for conversion of saved energy into CO_2 emissions (kg/kWh or tn/MWh).	0.500 tn/MWh (metric ton)
	0.000…65.535 tn/MWh	Factor for conversion of saved energy into CO_2 emissions.	1 = 1 tn/MWh
45.19	*Comparison power*	Actual power that the motor absorbs when connected direct-on-line and operating the application. The value is used for reference when energy savings are calculated. **Note:** The accuracy of the energy savings calculation is directly dependent on the accuracy of this value. If nothing is entered here, then the nominal motor power is used by the calculation, but that may inflate the energy savings reported as many motors do not absorb nameplate power.	0.00 kW
	0.00…10000000.00 kW	Motor power.	1 = 1 kW
45.21	*Energy calculations reset*	Resets the savings counter parameters *45.01*…*45.10*.	*Done*
	Done	Reset not requested (normal operation), or reset complete.	0
	Reset	Reset the savings counter parameters. The value reverts automatically to *Done*.	1

No.	Name/Value	Description	Def/FbEq16
45.24	*Hourly peak power value*	Value of the peak power during the last hour, that is, the most recent 60 minutes after the drive has been powered up. The parameter is updated once every 10 minutes unless the hourly peak is found in the most recent 10 minutes. In that case, the values is shown immediately.	0.00 kW
	-3000.00 … 3000.00 kW	Peak power value.	10 = 1 kW
45.25	*Hourly peak power time*	Time of the peak power value during the last hour.	00:00:00
		Time.	N/A
45.26	*Hourly total energy (resettable)*	Total energy consumption during the last hour, that is, the most recent 60 minutes. You can reset the value by setting it to zero.	0.00 kWh
	-3000.00 … 3000.00 kWh	Total energy.	10 = 1 kWh
45.27	*Daily peak power value (resettable)*	Value of the peak power since midnight of the present day. You can reset the value by setting it to zero.	0.00 kW
	-3000.00 … 3000.00 kW	Peak power value.	10 = 1 kW
45.28	*Daily peak power time*	Time of the peak power since midnight of the present day.	00:00:00
		Time.	N/A
45.29	*Daily total energy (resettable)*	Total energy consumption since midnight of the present day. You can reset the value by setting it to zero.	0.00 kWh
	-30000.00 … 30000.00 kWh	Total energy.	1 = 1 kWh
45.30	*Last day total energy*	Total energy consumption during the previous day, that is, between midnight of the previous day and midnight of the present day	0.00 kWh
	-30000.00 … 30000.00 kWh	Total energy.	1 = 1 kWh
45.31	*Monthly peak power value (resettable)*	Value of the peak power during the present month, that is, since midnight of the first day of the present month. You can reset the value by setting it to zero.	0.00 kW
	-3000.00 … 3000.00 kW	Peak power value.	10 = 1 kW
45.32	*Monthly peak power date*	Date of the peak power during the present month.	1.1.1980
		Date.	N/A
45.33	*Monthly peak power time*	Time of the peak power during the present month.	00:00:00
		Time.	N/A
45.34	*Monthly total energy (resettable)*	Total energy consumption from the beginning of the present month. You can reset the value by setting it to zero.	0.00 kWh
	-1000000.00 … 1000000.00 kWh	Total energy.	0.01 = 1 kWh

No.	Name/Value	Description	Def/FbEq16
45.35	*Last month total energy*	Total energy consumption during the previous month, that is, between midnight of the first day or the previous month and midnight of the first day of the present month.	0.00 kWh
	-1000000.00 … 1000000.00 kWh		0.01 = 1 kWh
45.36	*Lifetime peak power value*	Value of the peak power over the drive lifetime.	0.00 kW
	-3000.00 … 3000.00 kW	Peak power value.	10 = 1 kW
45.37	*Lifetime peak power date*	Date of the peak power over the drive lifetime.	1.1.1980
		Date.	N/A
45.38	*Lifetime peak power time*	Time of the peak power over the drive lifetime.	00:00:00
		Time,	N/A

46 Monitoring/scaling settings		Speed supervision settings; actual signal filtering; general scaling settings.	
46.01	*Speed scaling*	Defines the maximum speed value used to define the acceleration ramp rate and the initial speed value used to define the deceleration ramp rate (see parameter group *23 Speed reference ramp*). The speed acceleration and deceleration ramp times are therefore related to this value (**not** to parameter *30.12 Maximum speed*). Also defines the 16-bit scaling of speed-related parameters. The value of this parameter corresponds to 20000 in eg. fieldbus communication.	1500.00 rpm; 1800.00 rpm (*95.20* b0)
	0.10…30000.00 rpm	Acceleration/deceleration terminal/initial speed.	1 = 1 rpm
46.02	*Frequency scaling*	Defines the maximum frequency value used to define the acceleration ramp rate and the initial frequency value used to define deceleration ramp rate (see parameter group *28 Frequency reference chain*). The frequency acceleration and deceleration ramp times are therefore related to this value (**not** to parameter *30.14 Maximum frequency*). Also defines the 16-bit scaling of frequency-related parameters. The value of this parameter corresponds to 20000 in eg. fieldbus communication.	50.00 Hz; 60.00 Hz (*95.20* b0)
	0.10…1000.00 Hz	Acceleration/deceleration terminal/initial frequency.	10 = 1 Hz
46.03	*Torque scaling*	Defines the 16-bit scaling of torque parameters. The value of this parameter (in percent of nominal motor torque) corresponds to 10000 in eg. fieldbus communication.	100.0%
	0.1…1000.0%	Torque corresponding to 10000 on fieldbus.	10 = 1%
46.04	*Power scaling*	Defines the output power value that corresponds to 10000 in eg. fieldbus communication. The unit is selected by parameter *96.16 Unit selection*.	1000.00 kW or hp
	0.10 …30000.00 kW or 0.10 …40200.00 hp	Power corresponding to 10000 on fieldbus.	1 = 1 unit

No.	Name/Value	Description	Def/FbEq16
46.05	*Current scaling*	Defines the 16-bit scaling of current parameters. The value of this parameter corresponds to 10000 in fieldbus communication.	10000 A
	0…30000 A		
46.06	*Speed ref zero scaling*	Defines a speed corresponding to a zero reference received from fieldbus (either the embedded fieldbus interface, or interface FBA A). For example, with a setting of 500, the fieldbus reference range of 0…20000 would correspond to a speed of 500…[*46.01*] rpm. **Note:** This parameter is effective only with the ABB Drives communication profile.	0.00 rpm
	0.00 … 30000.00 rpm	Speed corresponding to minimum fieldbus reference.	1 = 1 rpm
46.11	*Filter time motor speed*	Defines a filter time for signals *01.01 Motor speed used* and *01.02 Motor speed estimated*.	500 ms
	2…20000 ms	Motor speed signal filter time.	1 = 1 ms
46.12	*Filter time output frequency*	Defines a filter time for signal *01.06 Output frequency*.	500 ms
	2…20000 ms	Output frequency signal filter time.	1 = 1 ms
46.13	*Filter time motor torque*	Defines a filter time for signal *01.10 Motor torque*.	100 ms
	2…20000 ms	Motor torque signal filter time.	1 = 1 ms
46.14	*Filter time power*	Defines a filter time for signal *01.14 Output power*.	100 ms
	2…20000 ms	Output power signal filter time.	1 = 1 ms
46.21	*At speed hysteresis*	Defines the “at setpoint” limits for speed control of the drive. When the difference between reference (*22.87 Speed reference act 7*) and the speed (*24.02 Used speed feedback*) is smaller than *46.21 At speed hysteresis*, the drive is considered to be “at setpoint”. This is indicated by bit 8 of *06.11 Main status word*. 	50.00 rpm
	0.00…30000.00 rpm	Limit for “at setpoint” indication in speed control.	See par. *46.01*

No.	Name/Value	Description	Def/FbEq16
46.22	*At frequency hysteresis*	Defines the “at setpoint” limits for frequency control of the drive. When the absolute difference between reference (*28.96 Frequency ref ramp input*) and actual frequency (*01.06 Output frequency*) is smaller than *46.22 At frequency hysteresis*, the drive is considered to be “at setpoint”. This is indicated by bit 8 of *06.11 Main status word*.  	2.00 Hz
	0.00…1000.00 Hz	Limit for “at setpoint” indication in frequency control.	See par. *46.02*
46.31	*Above speed limit*	Defines the trigger level for “above limit” indication in speed control. When actual speed exceeds the limit, bit 10 of *06.17 Drive status word 2* is set.	1500.00 rpm; 1800.00 rpm (*95.20* b0)
	0.00…30000.00 rpm	“Above limit” indication trigger level for speed control.	See par. *46.01*
46.32	*Above frequency limit*	Defines the trigger level for “above limit” indication in frequency control. When actual frequency exceeds the limit, bit 10 of *06.17 Drive status word 2* is set.	50.00 Hz; 60.00 Hz (*95.20* b0)
	0.00…1000.00 Hz	“Above limit” indication trigger level for frequency control.	See par. *46.02*
46.41	*kWh pulse scaling*	Defines the trigger level for the “kWh pulse” on for 50 ms. The output of the pulse is bit 9 of *05.22 Diagnostic word 3*.	1.000 kWh
	0.001… 1000.000 kWh	“kWh pulse” on trigger level.	1 = 1 kWh
47 Data storage		Data storage parameters that can be written to and read from using other parameters’ source and target settings. Note that there are different storage parameters for different data types. See also section *Data storage parameters* (page *96*).	
47.01	*Data storage 1 real32*	Data storage parameter 1.	0.000
	-2147483.000… 2147483.000	32-bit data.	-
47.02	*Data storage 2 real32*	Data storage parameter 2.	0.000
	-2147483.000… 2147483.000	32-bit data.	-
47.03	*Data storage 3 real32*	Data storage parameter 3.	0.000
	-2147483.000… 2147483.000	32-bit data.	-

No.	Name/Value	Description	Def/FbEq16
47.04	*Data storage 4 real32*	Data storage parameter 4.	0.000
	-2147483.000… 2147483.000	32-bit data.	-
47.11	*Data storage 1 int32*	Data storage parameter 9.	0
	-2147483648… 2147483647	32-bit data.	-
47.12	*Data storage 2 int32*	Data storage parameter 10.	0
	-2147483648… 2147483647	32-bit data.	-
47.13	*Data storage 3 int32*	Data storage parameter 11.	0
	-2147483648… 2147483647	32-bit data.	-
47.14	*Data storage 4 int32*	Data storage parameter 12.	0
	-2147483648… 2147483647	32-bit data.	-
47.21	*Data storage 1 int16*	Data storage parameter 17.	0
	-32768…32767	16-bit data.	1 = 1
47.22	*Data storage 2 int16*	Data storage parameter 18.	0
	-32768…32767	16-bit data.	1 = 1
47.23	*Data storage 3 int16*	Data storage parameter 19.	0
	-32768…32767	16-bit data.	1 = 1
47.24	*Data storage 4 int16*	Data storage parameter 20.	0
	-32768…32767	16-bit data.	1 = 1
49 Panel port communication		Communication settings for the control panel port on the drive.	
49.01	*Node ID number*	Defines the node ID of the drive. All devices connected to the network must have a unique node ID. **Note:** For networked drives, it is advisable to reserve ID 1 for spare/replacement drives.	1
	1…32	Node ID.	1 = 1
49.03	*Baud rate*	Defines the transfer rate of the link.	*115.2 kbps*
	38.4 kbps	38.4 kbit/s.	1
	57.6 kbps	57.6 kbit/s.	2
	86.4 kbps	86.4 kbit/s.	3
	115.2 kbps	115.2 kbit/s.	4
	230.4 kbps	230.4 kbit/s.	5

No.	Name/Value	Description	Def/FbEq16
49.04	*Communication loss time*	Sets a timeout for control panel (or PC tool) communication. If a communication break lasts longer than the timeout, the action specified by parameter *49.05 Communication loss action* is taken.	10.0 s
	0.3…3000.0 s	Panel/PC tool communication timeout.	10 = 1 s
49.05	*Communication loss action*	Selects how the drive reacts to a control panel (or PC tool) communication break.	*Fault*
	No action	No action taken.	0
	Fault	Drive trips on *7081 Control panel loss*.	1
	Last speed	Drive generates an *A7EE Panel loss* warning and freezes the speed to the level the drive was operating at. The speed is determined on the basis of actual speed using 850 ms low-pass filtering. ⚠ **WARNING!** Make sure that it is safe to continue operation in case of a communication break.	2
	Speed ref safe	Drive generates an *A7EE Panel loss* warning and sets the speed to the speed defined by parameter *22.41 Speed ref safe* (or *28.41 Frequency ref safe* when frequency reference is being used). ⚠ **WARNING!** Make sure that it is safe to continue operation in case of a communication break.	3
49.06	*Refresh settings*	Applies the settings of parameters *49.01*…*49.05*. **Note:** Refreshing may cause a communication break, so reconnecting the drive may be required.	*Done*
	Done	Refresh done or not requested.	0
	Configure	Refresh parameters *49.01*…*49.05*. The value reverts automatically to *Done*.	1

50 Fieldbus adapter (FBA)		Fieldbus communication configuration. See also chapter *Fieldbus control through a fieldbus adapter* (page *391*).	
50.01	*FBA A enable*	Enables/disables communication between the drive and fieldbus adapter A, and specifies the slot the adapter is installed into.	*Disable*
	Disable	Communication between drive and fieldbus adapter A disabled.	0
	Enable	Communication between drive and fieldbus adapter A enabled. The adapter is in slot 1.	1
50.02	*FBA A comm loss func*	Selects how the drive reacts upon a fieldbus communication break. The time delay is defined by parameter *50.03 FBA A comm loss t out*.	*No action*
	No action	No action taken.	0
	Fault	Drive trips on *7510 FBA A communication*. This only occurs if control is expected from the fieldbus (FBA A selected as source of start/stop/reference in the currently active control location).	1

<table>
<tr><th>No.</th><th>Name/Value</th><th>Description</th><th>Def/FbEq16</th></tr>
<tr><td></td><td>Last speed</td><td>Drive generates a warning (<i>A7C1 FBA A communication</i>) and freezes the speed to the level the drive was operating at. This only occurs if control is expected from the fieldbus.
The speed is determined on the basis of actual speed using 850 ms low-pass filtering.
⚠ WARNING! Make sure that it is safe to continue operation in case of a communication break.</td><td>2</td></tr>
<tr><td></td><td>Speed ref safe</td><td>Drive generates a warning (<i>A7C1 FBA A communication</i>) and sets the speed to the value defined by parameter <i>22.41 Speed ref safe</i> (when speed reference is being used) or <i>28.41 Frequency ref safe</i> (when frequency reference is being used). This only occurs if control is expected from the fieldbus.
⚠ WARNING! Make sure that it is safe to continue operation in case of a communication break.</td><td>3</td></tr>
<tr><td></td><td>Fault always</td><td>Drive trips on <i>7510 FBA A communication</i>. This occurs even though no control is expected from the fieldbus.</td><td>4</td></tr>
<tr><td></td><td>Warning</td><td>Drive generates an <i>A7C1 FBA A communication</i> warning. This only occurs if control is expected from the fieldbus.
⚠ WARNING! Make sure that it is safe to continue operation in case of a communication break.</td><td>5</td></tr>
<tr><td><i>50.03</i></td><td><i>FBA A comm loss t out</i></td><td>Defines the time delay before the action defined by parameter <i>50.02 FBA A comm loss func</i> is taken. Time count starts when the communication link fails to update the message.</td><td>0.3 s</td></tr>
<tr><td></td><td>0.3…6553.5 s</td><td>Time delay.</td><td>1 = 1 s</td></tr>
<tr><td><i>50.04</i></td><td><i>FBA A ref1 type</i></td><td>Selects the type and scaling of reference 1 received from fieldbus adapter A. The scaling of the reference is defined by parameters <i>46.01</i>…<i>46.04</i>, depending on which reference type is selected by this parameter.</td><td><i>Speed or frequency</i></td></tr>
<tr><td></td><td>Speed or frequency</td><td>Type and scaling is chosen automatically according to the currently active operation mode as follows:
<table>
<tr><th>Operation mode
(see par. <i>19.01</i>)</th><th>Reference 1 type</th></tr>
<tr><td>Speed control</td><td><i>Speed</i></td></tr>
<tr><td>Frequency control</td><td><i>Frequency</i></td></tr>
</table>
</td><td>0</td></tr>
<tr><td></td><td>Transparent</td><td>No scaling is applied.</td><td>1</td></tr>
<tr><td></td><td>General</td><td>Generic reference without a specific unit.</td><td>2</td></tr>
<tr><td></td><td>Reserved</td><td></td><td>3</td></tr>
<tr><td></td><td>Speed</td><td>The scaling is defined by parameter <i>46.01 Speed scaling</i>.</td><td>4</td></tr>
<tr><td></td><td>Frequency</td><td>The scaling is defined by parameter <i>46.02 Frequency scaling</i>.</td><td>5</td></tr>
</table>

<table>
<tr><th>No.</th><th>Name/Value</th><th>Description</th><th>Def/FbEq16</th></tr>
<tr><td>50.05</td><td>FBA A ref2 type</td><td>Selects the type and scaling of reference 2 received from fieldbus adapter A. The scaling of the reference is defined by parameters 46.01…46.04, depending on which reference type is selected by this parameter.</td><td>Speed or frequency</td></tr>
<tr><td></td><td>Speed or frequency</td><td>Type and scaling is chosen automatically according to the currently active operation mode as follows:
<table>
<tr><th>Operation mode
(see par. 19.01)</th><th>Reference 2 type</th></tr>
<tr><td>Speed control</td><td>Speed</td></tr>
<tr><td>Frequency control</td><td>Frequency</td></tr>
</table>
Please select Speed (selection 4) or Frequency (selection 5) manually.</td><td>0</td></tr>
<tr><td></td><td>Transparent</td><td>No scaling is applied.</td><td>1</td></tr>
<tr><td></td><td>General</td><td>Generic reference without a specific unit.</td><td>2</td></tr>
<tr><td></td><td>Reserved</td><td></td><td>3</td></tr>
<tr><td></td><td>Speed</td><td>The scaling is defined by parameter 46.01 Speed scaling.</td><td>4</td></tr>
<tr><td></td><td>Frequency</td><td>The scaling is defined by parameter 46.02 Frequency scaling.</td><td>5</td></tr>
<tr><td>50.06</td><td>FBA A SW sel</td><td>Selects the source of the Status word to be sent to the fieldbus network through fieldbus adapter A.</td><td>Auto</td></tr>
<tr><td></td><td>Auto</td><td>Source of the Status word is chosen automatically.</td><td>0</td></tr>
<tr><td></td><td>Transparent mode</td><td>The source selected by parameter 50.09 FBA A SW transparent source is transmitted as the Status word to the fieldbus network through fieldbus adapter A.</td><td>1</td></tr>
<tr><td>50.07</td><td>FBA A actual 1 type</td><td>Selects the type and scaling of actual value 1 transmitted to the fieldbus network through fieldbus adapter A. The scaling of the value is defined by parameters 46.01…46.04, depending on which actual value type is selected by this parameter.</td><td>Speed or frequency</td></tr>
<tr><td></td><td>Speed or frequency</td><td>Type and scaling is chosen automatically according to the currently active operation mode as follows:
<table>
<tr><th>Operation mode
(see par. 19.01)</th><th>Actual value 1 type</th></tr>
<tr><td>Speed control</td><td>Speed</td></tr>
<tr><td>Frequency control</td><td>Frequency</td></tr>
</table></td><td>0</td></tr>
<tr><td></td><td>Transparent</td><td>No scaling is applied.</td><td>1</td></tr>
<tr><td></td><td>General</td><td>Generic reference without a specific unit.</td><td>2</td></tr>
<tr><td></td><td>Reserved</td><td></td><td>3</td></tr>
<tr><td></td><td>Speed</td><td>The scaling is defined by parameter 46.01 Speed scaling.</td><td>4</td></tr>
<tr><td></td><td>Frequency</td><td>The scaling is defined by parameter 46.02 Frequency scaling.</td><td>5</td></tr>
</table>

<table>
<tr><th>No.</th><th>Name/Value</th><th>Description</th><th>Def/FbEq16</th></tr>
<tr><td><i>50.08</i></td><td><i>FBA A actual 2 type</i></td><td>Selects the type and scaling of actual value 2 transmitted to the fieldbus network through fieldbus adapter A. The scaling of the value is defined by parameters <i>46.01</i>…<i>46.04</i>, depending on which actual value type is selected by this parameter.</td><td><i>Speed or frequency</i></td></tr>
<tr><td></td><td>Speed or frequency</td><td>Type and scaling is chosen automatically according to the currently active operation mode as follows:
<table>
<tr><th>Operation mode
(see par. <i>19.01</i>)</th><th>Actual value 2 type</th></tr>
<tr><td>Speed control</td><td><i>Speed</i></td></tr>
<tr><td>Frequency control</td><td><i>Frequency</i></td></tr>
</table>
Please select Speed (selection 4) or Frequency (selection 5) manually.</td><td>0</td></tr>
<tr><td></td><td>Transparent</td><td>No scaling is applied.</td><td>1</td></tr>
<tr><td></td><td>General</td><td>Generic reference without a specific unit.</td><td>2</td></tr>
<tr><td></td><td>Reserved</td><td></td><td>3</td></tr>
<tr><td></td><td>Speed</td><td>The scaling is defined by parameter <i>46.01 Speed scaling</i>.</td><td>4</td></tr>
<tr><td></td><td>Frequency</td><td>The scaling is defined by parameter <i>46.02 Frequency scaling</i>.</td><td>5</td></tr>
<tr><td><i>50.09</i></td><td><i>FBA A SW transparent source</i></td><td>Selects the source of the fieldbus status word when parameter <i>50.06 FBA A SW sel</i> is set to <i>Transparent mode</i>.</td><td><i>Not selected</i></td></tr>
<tr><td></td><td>Not selected</td><td>No source selected.</td><td>-</td></tr>
<tr><td></td><td><i>Other</i></td><td>Source selection (see <i>Terms and abbreviations</i> on page <i>100</i>).</td><td>-</td></tr>
<tr><td><i>50.10</i></td><td><i>FBA A act1 transparent source</i></td><td>When parameter <i>50.07 FBA A actual 1 type</i> is set to <i>Transparent</i>, this parameter selects the source of actual value 1 transmitted to the fieldbus network through fieldbus adapter A.</td><td><i>Not selected</i></td></tr>
<tr><td></td><td>Not selected</td><td>No source selected.</td><td>-</td></tr>
<tr><td></td><td><i>Other</i></td><td>Source selection (see <i>Terms and abbreviations</i> on page <i>100</i>).</td><td>-</td></tr>
<tr><td><i>50.11</i></td><td><i>FBA A act2 transparent source</i></td><td>When parameter <i>50.08 FBA A actual 2 type</i> is set to <i>Transparent</i>, this parameter selects the source of actual value 2 transmitted to the fieldbus network through fieldbus adapter A.</td><td><i>Not selected</i></td></tr>
<tr><td></td><td>Not selected</td><td>No source selected.</td><td>-</td></tr>
<tr><td></td><td><i>Other</i></td><td>Source selection (see <i>Terms and abbreviations</i> on page <i>100</i>).</td><td>-</td></tr>
<tr><td><i>50.12</i></td><td><i>FBA A debug mode</i></td><td>This parameter enables debug mode. Displays raw (unmodified) data received from and sent to fieldbus adapter A in parameters <i>50.13</i>…<i>50.18</i>.</td><td><i>Disable</i></td></tr>
<tr><td></td><td>Disable</td><td>Debug mode disabled.</td><td>0</td></tr>
<tr><td></td><td>Fast</td><td>Debug mode enabled. Cyclical data update is as fast as possible which increases CPU load on the drive.</td><td>1</td></tr>
<tr><td><i>50.13</i></td><td><i>FBA A control word</i></td><td>Displays the raw (unmodified) control word sent by the master (PLC) to fieldbus adapter A if debugging is enabled by parameter <i>50.12 FBA A debug mode</i>.
This parameter is read-only.</td><td>-</td></tr>
<tr><td></td><td>00000000h…
FFFFFFFFh</td><td>Control word sent by master to fieldbus adapter A.</td><td>-</td></tr>
</table>

No.	Name/Value	Description	Def/FbEq16
50.14	*FBA A reference 1*	Displays raw (unmodified) reference REF1 sent by the master (PLC) to fieldbus adapter A if debugging is enabled by parameter *50.12 FBA A debug mode*. This parameter is read-only.	-
	-2147483648… 2147483647	Raw REF1 sent by master to fieldbus adapter A.	-
50.15	*FBA A reference 2*	Displays raw (unmodified) reference REF2 sent by the master (PLC) to fieldbus adapter A if debugging is enabled by parameter *50.12 FBA A debug mode*. This parameter is read-only.	-
	-2147483648… 2147483647	Raw REF2 sent by master to fieldbus adapter A.	-
50.16	*FBA A status word*	Displays the raw (unmodified) status word sent by fieldbus adapter A to the master (PLC) if debugging is enabled by parameter *50.12 FBA A debug mode*. This parameter is read-only.	-
	00000000h… FFFFFFFFh	Status word sent by fieldbus adapter A to master.	-
50.17	*FBA A actual value 1*	Displays raw (unmodified) actual value ACT1 sent by fieldbus adapter A to the master (PLC) if debugging is enabled by parameter *50.12 FBA A debug mode*. This parameter is read-only.	-
	-2147483648… 2147483647	Raw ACT1 sent by fieldbus adapter A to master.	-
50.18	*FBA A actual value 2*	Displays raw (unmodified) actual value ACT2 sent by fieldbus adapter A to the master (PLC) if debugging is enabled by parameter *50.12 FBA A debug mode*. This parameter is read-only.	-
	-2147483648… 2147483647	Raw ACT2 sent by fieldbus adapter A to master.	-

51 FBA A settings		Fieldbus adapter A configuration.	
51.01	*FBA A type*	Displays the type of the connected fieldbus adapter module. **0** = None. Module is not found or is not properly connected, or is disabled by parameter *50.01 FBA A enable* **1** = PROFIBUS-DP **32** = CANopen **37** = DeviceNet **128** = Ethernet **132** = PROFInet IO **135** = EtherCAT **136** = ETH Pwrlink **485** = RS-485 comm **101** = ControlNet **2222 =** Ethernet/IP **502 =** Modbus/TCP This parameter is read-only.	-

No.	Name/Value	Description	Def/FbEq16
51.02	*FBA A Par2*	Parameters *51.02*…*51.26* are adapter module-specific. For more information, see the documentation of the fieldbus adapter module. Note that not all of these parameters are necessarily in use.	-
	0…65535	Fieldbus adapter configuration parameter.	1 = 1
…	…	…	…
51.26	*FBA A Par26*	See parameter *51.02 FBA A Par2*.	-
	0…65535	Fieldbus adapter configuration parameter.	1 = 1
51.27	*FBA A par refresh*	Validates any changed fieldbus adapter module configuration settings. After refreshing, the value reverts automatically to *Done*. **Note:** This parameter cannot be changed while the drive is running.	*Done*
	Done	Refreshing done.	0
	Configure	Refreshing.	1
51.28	*FBA A par table ver*	Displays the parameter table revision of the fieldbus adapter module mapping file (stored in the memory of the drive). In format axyz, where ax = major table revision number; yz = minor table revision number. This parameter is read-only.	-
		Parameter table revision of adapter module.	-
51.29	*FBA A drive type code*	Displays the drive type code in the fieldbus adapter module mapping file (stored in the memory of the drive). This parameter is read-only.	-
	0…65535	Drive type code stored in the mapping file.	1 = 1
51.30	*FBA A mapping file ver*	Displays the fieldbus adapter module mapping file revision stored in the memory of the drive in decimal format. This parameter is read-only.	-
	0…65535	Mapping file revision.	1 = 1
51.31	*D2FBA A comm status*	Displays the status of the fieldbus adapter module communication.	*Not configured*
	Not configured	Adapter is not configured.	0
	Initializing	Adapter is initializing.	1
	Time out	A timeout has occurred in the communication between the adapter and the drive.	2
	Configuration error	Adapter configuration error: mapping file not found in the file system of the drive, or mapping file upload has failed more than three times.	3
	Off-line	Fieldbus communication is off-line.	4
	On-line	Fieldbus communication is on-line, or fieldbus adapter has been configured not to detect a communication break. For more information, see the documentation of the fieldbus adapter.	5
	Reset	Adapter is performing a hardware reset.	6
51.32	*FBA A comm SW ver*	Displays the common program revision of the adapter module in format axyz, where a = major revision number, xy = minor revision number, z = correction number or letter. Example: 190A = revision 1.90A.	
		Common program revision of adapter module.	-

No.	Name/Value	Description	Def/FbEq16
51.33	*FBA A appl SW ver*	Displays the application program revision of the adapter module in format axyz, where a = major revision number, xy = minor revision number, z = correction number or letter. Example: 190A = revision 1.90A.	
		Application program version of adapter module.	-

52 FBA A data in		Selection of data to be transferred from drive to fieldbus controller through fieldbus adapter A. **Note:** 32-bit values require two consecutive parameters. Whenever a 32-bit value is selected in a data parameter, the next parameter is automatically reserved.	
52.01	*FBA A data in1*	Parameters *52.01…52.12* select data to be transferred from the drive to the fieldbus controller through fieldbus adapter A.	*None*
	None	None.	0
	CW 16bit	Control Word (16 bits)	1
	Ref1 16bit	Reference REF1 (16 bits)	2
	Ref2 16bit	Reference REF2 (16 bits)	3
	SW 16bit	Status Word (16 bits)	4
	Act1 16bit	Actual value ACT1 (16 bits)	5
	Act2 16bit	Actual value ACT2 (16 bits)	6
	Reserved		7…10
	CW 32bit	Control Word (32 bits)	11
	Ref1 32bit	Reference REF1 (32 bits)	12
	Ref2 32bit	Reference REF2 (32 bits)	13
	SW 32bit	Status Word (32 bits)	14
	Act1 32bit	Actual value ACT1 (32 bits)	15
	Act2 32bit	Actual value ACT2 (32 bits)	16
	Reserved		17…23
	SW2 16bit	Status Word 2 (16 bits)	24
	Other	Source selection (see *Terms and abbreviations* on page *100*).	-
…	…	…	…
52.12	*FBA A data in12*	See parameter *52.01 FBA A data in1.*	*None*

53 FBA A data out		Selection of data to be transferred from fieldbus controller to drive through fieldbus adapter A. **Note:** 32-bit values require two consecutive parameters. Whenever a 32-bit value is selected in a data parameter, the next parameter is automatically reserved.	
53.01	*FBA A data out1*	Parameters *53.01…53.12* select data to be transferred from the fieldbus controller to the drive through fieldbus adapter A.	*None*
	None	None.	0
	CW 16bit	Control Word (16 bits)	1
	Ref1 16bit	Reference REF1 (16 bits)	2
	Ref2 16bit	Reference REF2 (16 bits)	3
	Reserved		7…10
	CW 32bit	Control Word (32 bits)	11

No.	Name/Value	Description	Def/FbEq16
	Ref1 32bit	Reference REF1 (32 bits)	12
	Ref2 32bit	Reference REF2 (32 bits)	13
	Reserved		14…20
	CW2 16bit	Control Word 2 (16 bits)	21
	Other	Source selection (see *Terms and abbreviations* on page *100*).	-
…	…	…	…
53.12	*FBA A data out12*	See parameter *53.01 FBA A data out1*.	*None*
58 Embedded fieldbus		Configuration of the embedded fieldbus (EFB) interface. See also chapter *Fieldbus control through the embedded fieldbus interface (EFB)* (page *363*).	
58.01	*Protocol enable*	Enables/disables the embedded fieldbus interface and selects the protocol to use.	*None*
	None	None (communication disabled).	0
	Modbus RTU	Embedded fieldbus interface is enabled and uses the Modbus RTU protocol.	1
	None / IPC communication	EFB communication reserved for IPC / Level Control communication.	4
58.02	*Protocol ID*	Displays the protocol ID and revision. First 4 bits specify the protocol ID and last 12 bits specify the revision. This parameter is read-only.	-
		Protocol ID and revision.	1 = 1
58.03	*Node address*	Defines the node address of the drive on the fieldbus link. Values 1…247 are allowable. Also called Station ID, MAC Address or Device Address. Two devices with the same address are not allowed on-line. Changes to this parameter take effect after the control unit is rebooted or the new settings validated by parameter *58.06 Communication control* (*Refresh settings*).	1
	0…255	Node address (values 1…247 are allowed).	1 = 1
58.04	*Baud rate*	Selects the transfer rate of the fieldbus link. When using selection *Autodetect*, the parity setting of the bus must be known and configured in parameter *58.05 Parity*. When parameter *58.04 Baud rate* is set to *Autodetect*, the EFB settings must be refreshed with parameter *58.06*. The bus is monitored for a period of time and the detected baud rate is set as the value of this parameter. Changes to this parameter take effect after the control unit is rebooted or the new settings validated by parameter *58.06 Communication control* (*Refresh settings*).	Modbus: *19.2 kbps*
	Autodetect	Baud rate detected automatically.	0
	4.8 kbps	4.8 kbit/s.	1
	9.6 kbps	9.6 kbit/s.	2
	19.2 kbps	19.2 kbit/s.	3
	38.4 kbps	38.4 kbit/s.	4
	57.6 kbps	57.6 kbit/s.	5
	76.8 kbps	76.8 kbit/s.	6
	115.2 kbps	115.2 kbit/s.	7

No.	Name/Value	Description	Def/FbEq16
58.05	*Parity*	Selects the type of parity bit and number of stop bits. Changes to this parameter take effect after the control unit is rebooted or the new settings validated by parameter *58.06 Communication control* (*Refresh settings*).	*8 EVEN 1*
	8 NONE 1	Eight data bits, no parity bit, one stop bit.	0
	8 NONE 2	Eight data bits, no parity bit, two stop bits.	1
	8 EVEN 1	Eight data bits, even parity bit, one stop bit.	2
	8 ODD 1	Eight data bits, odd parity bit, one stop bit.	3
58.06	*Communication control*	Takes changed EFB settings in use, or activates silent mode.	*Enabled*
	Enabled	Normal operation.	0
	Refresh settings	Refreshes settings (parameters *58.01*…*58.05*, *58.14*…*58.17*, *58.25*, *58.28*…*58.34*) and takes changed EFB configuration settings in use. Reverts automatically to *Enabled*.	1
	Silent mode	Activates silent mode (no messages are transmitted). Silent mode can be terminated by activating the *Refresh settings* selection of this parameter.	2
58.07	*Communication diagnostics*	Displays the status of the EFB communication. This parameter is read-only. Note that the name is only visible when the error is present (bit value is 1).	-

Bit	Name	Description
0	Init failed	1 = EFB initialization failed
1	Addr config err	1 = Node address not allowed by protocol
2	Silent mode	1 = Drive not allowed to transmit 0 = Drive allowed to transmit
3	Autobauding	1 = Automatic detection of baud rate is in use (see parameter *58.04*)
4	Wiring error	1 = Errors detected (A/B wires possibly swapped)
5	Parity error	1 = Error detected: check parameters *58.04* and *58.05*
6	Baud rate error	1 = Error detected: check parameters *58.05* and *58.04*
7	No bus activity	1 = 0 bytes received during last 5 seconds
8	No packets	1 = 0 packets (addressed to any device) detected during last 5 seconds
9	Noise or addressing error	1 = Errors detected (interference, or another device with the same address on line)
10	Comm loss	1 = 0 packets addressed to the drive received within timeout (*58.16*)
11	CW/Ref loss	1 = No control word or references received within timeout (*58.16*)
12…14	Reserved	
15	Internal error	1 = Internal error occurred. Contact your local ABB representative.

	0000h…FFFFh	EFB communication status.	1 = 1

No.	Name/Value	Description	Def/FbEq16
58.08	*Received packets*	Displays a count of valid packets addressed to the drive. During normal operation, this number increases constantly. Can be reset from the control panel by keeping Reset down for over 3 seconds.	-
	0…4294967295	Number of received packets addressed to the drive.	1 = 1
58.09	*Transmitted packets*	Displays a count of valid packets transmitted by the drive. During normal operation, this number increases constantly. Can be reset from the control panel by keeping Reset down for over 3 seconds.	-
	0…4294967295	Number of transmitted packets.	1 = 1
58.10	*All packets*	Displays a count of valid packets addressed to any device on the bus. During normal operation, this number increases constantly. Can be reset from the control panel by keeping Reset down for over 3 seconds.	-
	0…4294967295	Number of all received packets.	1 = 1
58.11	*UART errors*	Displays a count of character errors received by the drive. An increasing count indicates a configuration problem on the bus. Can be reset from the control panel by keeping Reset down for over 3 seconds.	-
	0…4294967295	Number of UART errors.	1 = 1
58.12	*CRC errors*	Displays a count of packets with a CRC error received by the drive. An increasing count indicates interference on the bus. Can be reset from the control panel by keeping Reset down for over 3 seconds.	-
	0…4294967295	Number of CRC errors.	1 = 1
58.14	*Communication loss action*	Selects how the drive reacts to an EFB communication break. Changes to this parameter take effect after the control unit is rebooted or the new settings validated by parameter *58.06 Communication control* (*Refresh settings*). See also parameters *58.15 Communication loss mode* and *58.16 Communication loss time*.	*Fault*
	No action	No action taken (monitoring disabled).	0
	Fault	The drive monitors communication loss when start/stop is expected from the EFB on the currently active control location. The drive trips on *6681 EFB comm loss* if control in the currently active control location is expected from the EFB or reference is coming from the EFB, and the communication is lost.	1
	Last speed	Drive generates an *A7CE EFB comm loss* warning and freezes the speed to the level the drive was operating at. The speed is determined on the basis of actual speed using 850 ms low-pass filtering. This occurs if control or reference is expected from the EFB. **WARNING!** Make sure that it is safe to continue operation in case of a communication break.	2

No.	Name/Value	Description	Def/FbEq16
	Speed ref safe	Drive generates an *A7CE EFB comm loss* warning and sets the speed to the speed defined by parameter *22.41 Speed ref safe* (or *28.41 Frequency ref safe* when frequency reference is being used). This occurs if control or reference is expected from the EFB. ⚠ **WARNING!** Make sure that it is safe to continue operation in case of a communication break.	3
	Fault always	Drive continuously monitors for communication loss. Drive trips on *6681 EFB comm loss*. This happens even though the drive is in a control location where the EFB start/stop or reference is not used.	4
	Warning	Drive generates an *A7CE EFB comm loss* warning. This occurs even though no control is expected from the EFB. ⚠ **WARNING!** Make sure that it is safe to continue operation in case of a communication break.	5
58.15	*Communication loss mode*	Defines which message types reset the timeout counter for detecting an EFB communication loss. Changes to this parameter take effect after the control unit is rebooted or the new settings validated by parameter *58.06 Communication control* (*Refresh settings*). See also parameters *58.14 Communication loss action* and *58.16 Communication loss time*.	*Cw / Ref1 / Ref2*
	Any message	Any message addressed to the drive resets the timeout.	1
	Cw / Ref1 / Ref2	A write of the control word or a reference resets the timeout.	2
58.16	*Communication loss time*	Sets a timeout for EFB communication. If a communication break lasts longer than the timeout, the action specified by parameter *58.14 Communication loss action* is taken. Changes to this parameter take effect after the control unit is rebooted or the new settings validated by parameter *58.06 Communication control* (*Refresh settings*). See also parameter *58.15 Communication loss mode*.	30.0 s
	0.0…6000.0 s	EFB communication timeout.	1 = 1
58.17	*Transmit delay*	Defines a minimum response delay in addition to any fixed delay imposed by the protocol. Changes to this parameter take effect after the control unit is rebooted or the new settings validated by parameter *58.06 Communication control* (*Refresh settings*).	0 ms
	0…65535 ms	Minimum response delay.	1 = 1
58.18	*EFB control word*	Displays the raw (unmodified) control word sent by the Modbus controller to the drive. For debugging purposes. This parameter is read-only.	-
	00000000h… FFFFFFFFh	Control word sent by Modbus controller to the drive.	1 = 1
58.19	*EFB status word*	Displays the raw (unmodified) status word for debugging purposes. This parameter is read-only.	-
	00000000h… FFFFFFFFh	Status word sent by the drive to the Modbus controller.	1 = 1

<table>
<tr><th>No.</th><th>Name/Value</th><th>Description</th><th>Def/FbEq16</th></tr>
<tr><td><i>58.25</i></td><td><i>Control profile</i></td><td>Defines the communication profile used by the Modbus protocol.
Changes to this parameter take effect after the control unit is rebooted or the new settings validated by parameter <i>58.06 Communication control</i> (<i>Refresh settings</i>).
See section <i>About the control profiles</i> on page <i>371</i>.</td><td><i>ABB Drives</i></td></tr>
<tr><td></td><td>ABB Drives</td><td>ABB Drives control profile (with a 16-bit control word)</td><td>0</td></tr>
<tr><td></td><td>DCU Profile</td><td>DCU control profile (with a 16 or 32-bit control word)</td><td>5</td></tr>
<tr><td><i>58.26</i></td><td><i>EFB ref1 type</i></td><td>Selects the type and scaling of reference 1 received through the embedded fieldbus interface.
The scaled reference is displayed by <i>03.09 EFB reference 1</i>.</td><td><i>Speed or frequency</i></td></tr>
<tr><td></td><td>Speed or frequency</td><td>Type and scaling is chosen automatically according to the currently active operation mode as follows.
<table>
<tr><th>Operation mode
(see par. <i>19.01</i>)</th><th>Reference 1 type</th></tr>
<tr><td>Speed control</td><td><i>Speed</i></td></tr>
<tr><td>Frequency control</td><td><i>Frequency</i></td></tr>
</table></td><td>0</td></tr>
<tr><td></td><td>Transparent</td><td>No scaling is applied.</td><td>1</td></tr>
<tr><td></td><td>General</td><td>Generic reference without a specific unit. Scaling: 1 = 100.</td><td>2</td></tr>
<tr><td></td><td>Reserved</td><td></td><td>3</td></tr>
<tr><td></td><td>Speed</td><td>Speed reference. The scaling is defined by parameter <i>46.01 Speed scaling</i>.</td><td>4</td></tr>
<tr><td></td><td>Frequency</td><td>Frequency reference. The scaling is defined by parameter <i>46.02 Frequency scaling</i>.</td><td>5</td></tr>
<tr><td><i>58.27</i></td><td><i>EFB ref2 type</i></td><td>Selects the type and scaling of reference 2 received through the embedded fieldbus interface. The scaled reference is displayed by <i>03.10 EFB reference 2</i>.
(The panel at the moment shows Torque as the default, which cannot be used.)</td><td><i>Speed or frequency</i></td></tr>
<tr><td><i>58.28</i></td><td><i>EFB act1 type</i></td><td>Selects the type of actual value 1.</td><td><i>Speed or frequency</i></td></tr>
<tr><td></td><td>Speed or frequency</td><td>Type and scaling is chosen automatically according to the currently active operation mode as follows.
<table>
<tr><th>Operation mode
(see par. <i>19.01</i>)</th><th>Actual 1 type</th></tr>
<tr><td>Speed control</td><td><i>Speed</i></td></tr>
<tr><td>Frequency control</td><td><i>Frequency</i></td></tr>
</table></td><td>0</td></tr>
<tr><td></td><td>Transparent</td><td>No scaling is applied.</td><td>1</td></tr>
<tr><td></td><td>General</td><td>Generic reference without a specific unit. Scaling: 1 = 100.</td><td>2</td></tr>
<tr><td></td><td>Reserved</td><td></td><td>3</td></tr>
<tr><td></td><td>Speed</td><td>Scaling is defined by parameter <i>46.01 Speed scaling</i>.</td><td>4</td></tr>
<tr><td></td><td>Frequency</td><td>Scaling is defined by parameter <i>46.02 Frequency scaling</i>.</td><td>5</td></tr>
<tr><td><i>58.29</i></td><td><i>EFB act2 type</i></td><td>Selects the type of actual value 2.
For the selections, see parameter <i>58.28 EFB act1 type</i>.</td><td><i>Transparent</i></td></tr>
</table>

No.	Name/Value	Description	Def/FbEq16
58.31	*EFB act1 transparent source*	Selects the source of actual value 1 when parameter *58.28 EFB act1 type* is set to *Transparent*.	*Not selected*
	Not selected	None.	0
	Other	Source selection (see *Terms and abbreviations* on page *100*).	-
58.32	*EFB act2 transparent source*	Selects the source of actual value 2 when parameter *58.29 EFB act2 type* is set to *Transparent*.	*Other* (par. *01.07 Motor current*)
	Not selected	None.	0
	Other	Source selection (see *Terms and abbreviations* on page *100*).	-
58.33	*Addressing mode*	Defines the mapping between parameters and holding registers in the 400101…465535 Modbus register range. Changes to this parameter take effect after the control unit is rebooted or the new settings validated by parameter *58.06 Communication control* (*Refresh settings*).	*Mode 0*
	Mode 0	16-bit values (groups 1…99, indexes 1…99): Register address = 400000 + 100 × parameter group + parameter index. For example, parameter 22.80 would be mapped to register 400000 + 2200 + 80 = 402280. 32-bit values (groups 1…99, indexes 1…99): Register address = 420000 + 200 × parameter group + 2 × parameter index. For example, parameter 22.80 would be mapped to register 420000 + 4400 + 160 = 424560.	0
	Mode 1	16-bit values (groups 1…255, indexes 1…255): Register address = 400000 + 256 × parameter group + parameter index. For example, parameter 22.80 would be mapped to register 400000 + 5632 + 80 = 405712.	1
	Mode 2	32-bit values (groups 1…127, indexes 1…255): Register address = 400000 + 512 × parameter group + 2 × parameter index. For example, parameter 22.80 would be mapped to register 400000 + 11264 + 160 = 411424.	2
58.34	*Word order*	Selects in which order 16-bit registers of 32-bit parameters are transferred. For each register, the first byte contains the high order byte and the second byte contains the low order byte. Changes to this parameter take effect after the control unit is rebooted or the new settings validated by parameter *58.06 Communication control* (*Refresh settings*).	*LO-HI*
	HI-LO	The first register contains the high order word, the second contains the low order word.	0
	LO-HI	The first register contains the low order word, the second contains the high order word.	1
58.101	*Data I/O 1*	Defines the address in the drive which the Modbus master accesses when it reads from or writes to the register address corresponding to Modbus register 1 (400001). The master defines the type of the data (input or output). The value is transmitted in a Modbus frame consisting of two 16-bit words. If the value is 16-bit, it is transmitted in the LSW (least significant word). If the value is 32-bit, the subsequent parameter is also reserved for it and must be set to *None*.	*CW 16bit*
	None	No mapping, register is always zero.	0
	CW 16bit	*ABB Drives* profile: 16-bit ABB drives control word; *DCU Profile*: lower 16 bits of the DCU control word	1
	Ref1 16bit	Reference REF1 (16 bits)	2

No.	Name/Value	Description	Def/FbEq16
	Ref2 16bit	Reference REF2 (16 bits)	3
	SW 16bit	*ABB Drives* profile: 16-bit ABB drives status word; *DCU Profile*: lower 16 bits of the DCU status word	4
	Act1 16bit	Actual value ACT1 (16 bits)	5
	Act2 16bit	Actual value ACT2 (16 bits)	6
	Reserved		7…10
	CW 32bit	Control Word (32 bits)	11
	Ref1 32bit	Reference REF1 (32 bits)	12
	Ref2 32bit	Reference REF2 (32 bits)	13
	SW 32bit	Status Word (32 bits)	14
	Act1 32bit	Actual value ACT1 (32 bits)	15
	Act2 32bit	Actual value ACT2 (32 bits)	16
	Reserved		17…20
	CW2 16bit	*ABB Drives* profile: not used; *DCU Profile*: upper 16 bits of the DCU control word	21
	SW2 16bit	*ABB Drives* profile: not used / always zero; *DCU Profile*: upper 16 bits of the DCU status word	24
	Reserved		25…30
	RO/DIO control word	Parameter *10.99 RO/DIO control word*.	31
	AO1 data storage	Parameter *13.91 AO1 data storage*.	32
	AO2 data storage	Parameter *13.92 AO2 data storage*.	33
	Reserved		34…39
	Feedback data storage	Parameter *40.91 Feedback data storage*.	40
	Setpoint data storage	Parameter *40.92 Setpoint data storage*.	41
	Other	Source selection (see *Terms and abbreviations* on page *100*).	-
58.102	*Data I/O 2*	Defines the address in the drive which the Modbus master accesses when it reads from or writes to register address 400002. For the selections, see parameter *58.101 Data I/O 1*.	*Ref1 16bit*
58.103	*Data I/O 3*	Defines the address in the drive which the Modbus master accesses when it reads from or writes to register address 400003. For the selections, see parameter *58.101 Data I/O 1*.	*Ref2 16bit*
58.104	*Data I/O 4*	Defines the address in the drive which the Modbus master accesses when it reads from or writes to register address 400004. For the selections, see parameter *58.101 Data I/O 1*.	*SW 16bit*
58.105	*Data I/O 5*	Defines the address in the drive which the Modbus master accesses when it reads from or writes to register address 400005. For the selections, see parameter *58.101 Data I/O 1*.	*Act1 16bit*
58.106	*Data I/O 6*	Defines the address in the drive which the Modbus master accesses when it reads from or writes to register address 400006. For the selections, see parameter *58.101 Data I/O 1*.	*Act2 16bit*

No.	Name/Value	Description	Def/FbEq16
58.107	*Data I/O 7*	Parameter selector for Modbus register address 400007. For the selections, see parameter *58.101 Data I/O 1*.	*None*
…	…	…	…
58.114	*Data I/O 14*	Parameter selector for Modbus register address 400014. For the selections, see parameter *58.101 Data I/O 1*.	*None*

71 External PID1		Configuration of external PID. See the control chain diagrams on pages *415* and *416*.	
71.01	*External PID act value*	See parameter *40.01 Process PID output actual*.	-
71.02	*Feedback act value*	See parameter *40.02 Process PID feedback actual*.	-
71.03	*Setpoint act value*	See parameter *40.03 Process PID setpoint actual*.	-
71.04	*Deviation act value*	See parameter *40.04 Process PID deviation actual*.	-
71.06	*PID status word*	Displays status information on process external PID control. This parameter is read-only.	-

Bit	Name	Value
0	PID active	1 = Process PID control active.
1	Reserved	
2	Output frozen	1 = Process PID controller output frozen. Bit is set if parameter *71.38 Output freeze enable* is TRUE, or the deadband function is active (bit 9 is set).
3…6	Reserved	
7	Output limit high	1 = PID output is being limited by par. *71.37*.
8	Output limit low	1 = PID output is being limited by par. *71.36*.
9	Deadband active	1 = Deadband is active.
10…11	Reserved	
12	Internal setpoint active	1 = Internal setpoint active (see par. *71.16*…*71.23*)
13…15	Reserved	

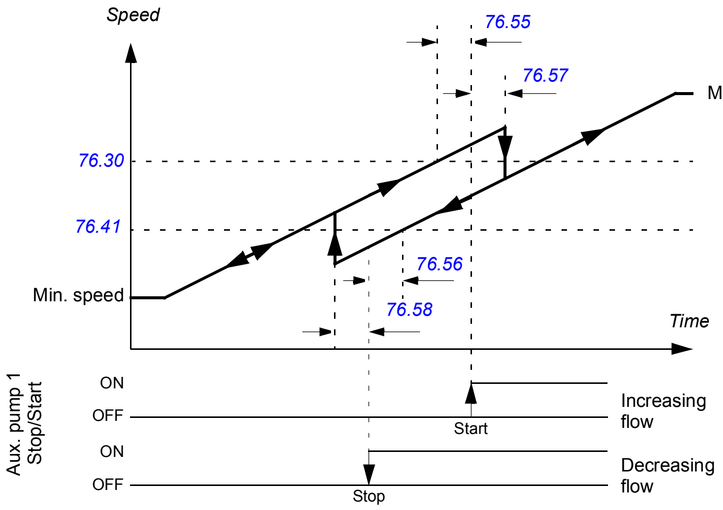
	0000h…FFFFh	Process PID control status word.	1 = 1
71.07	*PID operation mode*	See parameter *40.07 Process PID operation mode*.	*Off*
71.08	*Feedback 1 source*	See parameter *40.08 Set 1 feedback 1 source*.	*AI2 percent*
71.11	*Feedback filter time*	See parameter *40.11 Set 1 feedback filter time*.	0.000 s
71.14	*Setpoint scaling*	Defines, together with parameter *71.15 Output scaling*, a general scaling factor for the external PID control chain. The scaling can be utilized when, for example, the process setpoint is input in Hz, and the output of the PID controller is used as an rpm value in speed control. In this case, this parameter might be set to 50, and parameter *71.15* to the nominal motor speed at 50 Hz. In effect, the output of the PID controller [*71.15*] when deviation (setpoint - feedback) = [*71.14*] and [*71.32*] = 1. **Note:** The scaling is based on the ratio between *71.14* and *71.15*. For example, the values 50 and 1500 would produce the same scaling as 1 and 3.	100.00
	-200000.00… 200000.0	Process setpoint base.	1 = 1
71.15	*Output scaling*	See parameter *71.14 Setpoint scaling*.	100.00

No.	Name/Value	Description	Def/FbEq16
	-200000.00… 200000.0	Process PID controller output base.	1 = 1
71.16	*Setpoint 1 source*	See parameter *40.16 Set 1 setpoint 1 source*.	*AI1 percent*
71.19	*Internal setpoint sel1*	See parameter *40.19 Set 1 internal setpoint sel1*.	*Not selected*
71.20	*Internal setpoint sel2*	See parameter *40.20 Set 1 internal setpoint sel2*.	*Not selected*
71.21	*Internal setpoint 1*	See parameter *40.21 Set 1 internal setpoint 1*.	0.00 PID customer units
71.22	*Internal setpoint 2*	See parameter *40.22 Set 1 internal setpoint 2*.	0.00 PID customer units
71.23	*Internal setpoint 3*	See parameter *40.23 Set 1 internal setpoint 3*.	0.00 PID customer units
71.26	*Setpoint min*	See parameter *40.26 Set 1 setpoint min*.	0.00
71.27	*Setpoint max*	See parameter *40.27 Set 1 setpoint max*.	200000.00
71.31	*Deviation inversion*	See parameter *40.31 Set 1 deviation inversion*.	*Not inverted (Ref - Fbk)*
71.32	*Gain*	See parameter *40.32 Set 1 gain*.	1.00
71.33	*Integration time*	See parameter *40.33 Set 1 integration time*.	60.0 s
71.34	*Derivation time*	See parameter *40.34 Set 1 derivation time*.	0.000 s
71.35	*Derivation filter time*	See parameter *40.35 Set 1 derivation filter time*.	0.0 s
71.36	*Output min*	See parameter *40.36 Set 1 output min*.	-200000.00
71.37	*Output max*	See parameter *40.37 Set 1 output max*.	200000.00
71.38	*Output freeze enable*	See parameter *40.38 Set 1 output freeze enable*.	*Not selected*
71.39	*Deadband range*	The control program compares the absolute value of parameter *71.04 Deviation act value* to the deadband range defined by this parameter. If the absolute value is within the deadband range for the time period defined by parameter *71.40 Deadband delay*, PID's deadband mode is activated and *71.06 PID status word* bit 9 *Deadband active* is set. Then PID's output is frozen and *71.06 PID status word* bit 2 *Output frozen* is set. If the absolute value is equal or greater than the deadband range, PID's deadband mode is deactivated.	0.0
	0.0…200000.0	Range	1 = 1
71.40	*Deadband delay*	Defines the deadband delay for the deadband function. See parameter *71.39 Deadband range*.	0.0 s
	0.0…3600.0 s	Delay	1 = 1 s
71.58	*Increase prevention*	See parameter *40.58 Set 1 increase prevention*.	*No*
71.59	*Decrease prevention*	See parameter *40.59 Set 1 decrease prevention*.	*No*
71.62	*Internal setpoint actual*	See parameter *40.62 PID internal setpoint actual*.	-

<table>
<tr><th>No.</th><th>Name/Value</th><th>Description</th><th>Def/FbEq16</th></tr>
<tr><td colspan="2"><i>76 Multipump configuration</i></td><td>Multipump configuration parameters.
See sections <i>Intelligent pump control (IPC)</i> (page <i>60</i>), <i>Single pump control (PFC)</i> (page <i>63</i>) and <i>Level control</i> (page <i>65</i>).
Note: Parameters are dynamically hidden based on selection of pumping mode (<i>76.21 Multipump configuration</i>) and number of motors (<i>76.25 Number of motors</i>).</td><td></td></tr>
<tr><td><i>76.01</i></td><td><i>PFC status</i></td><td>Displays the running/stopped status of the PFC motors. PFC1, PFC2, PFC3, PFC4, PFC5 and PFC6 always correspond to the 1st…46th motor of the PFC system. If <i>76.74 Autochange auxiliary PFC</i> auxiliary PFC is set to <i>Aux motors only</i>, PFC1 represents the motor connected to the drive and PFC2 the first auxiliary motor (the 2nd motor of the system). If <i>76.74</i> is set to <i>All motors</i>, PFC1 is the first motor, PFC2 the 2nd. The drive can be connected to any of these motors depending on the Autochange functionality.</td><td>-</td></tr>
<tr><td></td><td colspan="3">
<table>
<tr><th>Bit</th><th>Name</th><th>Value</th></tr>
<tr><td>0</td><td>PFC 1 running</td><td>0 = Stop, 1 = Start</td></tr>
<tr><td>1</td><td>PFC 2 running</td><td>0 = Stop, 1 = Start</td></tr>
<tr><td>2</td><td>PFC 3 running</td><td>0 = Stop, 1 = Start</td></tr>
<tr><td>3</td><td>PFC 4 running</td><td>0 = Stop, 1 = Start</td></tr>
<tr><td>4</td><td>PFC 5 running</td><td>0 = Stop, 1 = Start</td></tr>
<tr><td>5</td><td>PFC 6 running</td><td>0 = Stop, 1 = Start</td></tr>
<tr><td>6…15</td><td colspan="2">Reserved</td></tr>
</table>
</td></tr>
<tr><td></td><td>0000h…FFFFh</td><td>Status of the PFC relay outputs.</td><td>1 = 1</td></tr>
<tr><td><i>76.02</i></td><td><i>Multipump system status</i></td><td>Displays the status of multipump system in text from.
This parameter provides a quick system overview, e.g. if the parameter is added to the Home view on the control panel.</td><td>PFC disabled</td></tr>
<tr><td><i>76.05</i></td><td><i>Measured level</i></td><td>Displays the measured level.
This parameter is active when parameter <i>76.21 Multipump configuration</i> is set to <i>Level control - Emptying</i> or <i>Level control - Filling</i>.</td><td></td></tr>
<tr><td></td><td>0.00...32767.00 m</td><td>Measured level in meters.</td><td>1 = 1 m</td></tr>
<tr><td><i>76.06</i></td><td><i>Measured level %</i></td><td>Displays the measured level as a percentage of level control operation area.
The signal is scaled to stop level 1 and full speed level.</td><td></td></tr>
<tr><td></td><td>0...100 %</td><td>Measured level in %.</td><td>1 = 1 %</td></tr>
<tr><td><i>76.07</i></td><td><i>LC speed ref</i></td><td>Displays the level control speed reference.</td><td></td></tr>
<tr><td></td><td>-2147483648...
2147483648 rpm</td><td>Level control speed reference.</td><td>1 = 1 rpm</td></tr>
</table>

<table>
<tr><th>No.</th><th>Name/Value</th><th>Description</th><th>Def/FbEq16</th></tr>
<tr><td>*76.11*</td><td>*Pump status 1*</td><td>Shows the status of pump or fan 1.</td><td>-</td></tr>
<tr><td colspan="4">
<table>
<tr><th>Bit</th><th>Name</th><th>Value</th></tr>
<tr><td>0</td><td>Ready</td><td>0 = False, 1 = True</td></tr>
<tr><td>1</td><td>CRC mismatch</td><td>0 = False, 1 = True</td></tr>
<tr><td>2</td><td>Running</td><td>0 = False, 1 = True</td></tr>
<tr><td>3...4</td><td colspan="2">Reserved</td></tr>
<tr><td>5</td><td>In PFC control</td><td>0 = False, 1 = True</td></tr>
<tr><td>6</td><td>In IPC control</td><td>0 = False, 1 = True</td></tr>
<tr><td>7</td><td>Master enable</td><td>0 = False, 1 = True</td></tr>
<tr><td>8</td><td>Active master</td><td>0 = False, 1 = True</td></tr>
<tr><td>9...10</td><td colspan="2">Reserved</td></tr>
<tr><td>11</td><td>Interlocked</td><td>0 = False, 1 = True</td></tr>
<tr><td>12</td><td>Local mode</td><td>0 = False, 1 = True</td></tr>
<tr><td>13</td><td colspan="2">Reserved</td></tr>
<tr><td>14</td><td>Drive start active</td><td>0 = False, 1 = True</td></tr>
<tr><td>15</td><td>Max stationary time elapsed</td><td>0 = False, 1 = True</td></tr>
</table>
</td></tr>
<tr><td></td><td>0000h…FFFFh</td><td>Status of pump 1.</td><td>1 = 1</td></tr>
<tr><td>*76.12*</td><td>*Pump status 2*</td><td>See parameter *76.11 Pump status 1*.</td><td>-</td></tr>
<tr><td>*76.13*</td><td>*Pump status 3*</td><td>See parameter *76.11 Pump status 1*.</td><td>-</td></tr>
<tr><td>*76.14*</td><td>*Pump status 4*</td><td>See parameter *76.11 Pump status 1*.</td><td>-</td></tr>
<tr><td>*76.15*</td><td>*Pump status 5*</td><td>See parameter *76.11 Pump status 1*.</td><td>-</td></tr>
<tr><td>*76.16*</td><td>*Pump status 6*</td><td>See parameter *76.11 Pump status 1*.</td><td>-</td></tr>
<tr><td>*76.17*</td><td>*Pump status 7*</td><td>See parameter *76.11 Pump status 1*.</td><td>-</td></tr>
<tr><td>*76.18*</td><td>*Pump status 8*</td><td>See parameter *76.11 Pump status 1*.</td><td>-</td></tr>
<tr><td>*76.21*</td><td>*Multipump configuration*</td><td>Selects the multipump mode.</td><td>*Off*</td></tr>
<tr><td></td><td>Off</td><td>PFC disabled.</td><td>0</td></tr>
<tr><td></td><td>IPC</td><td>IPC enabled. See *Intelligent pump control (IPC)* on page *60*.</td><td>1</td></tr>
<tr><td></td><td>PFC</td><td>PFC enabled. One pump at a time is controlled by the drive. The remaining pumps are direct-on-line pumps that are started and stopped by the drive logic
The frequency (group *28 Frequency reference chain*) / speed (group *22 Speed reference selection*) reference must be defined as PID for the PFC functionality to work properly.</td><td>2</td></tr>
<tr><td></td><td>SPFC</td><td>SPFC enabled. See section *Soft pump control (SPFC)* on page.*64*</td><td>3</td></tr>
<tr><td></td><td>Level control - Emptying</td><td>Level control - Emptying is enabled.
See section *Level control* on page *65*.</td><td>4</td></tr>
<tr><td></td><td>Level control - Filling</td><td>Level control - Filling is enabled.
See section *Level control* on page *65*.</td><td>5</td></tr>
<tr><td>*76.22*</td><td>*Multipump node number*</td><td>Node number of the drive on inverter-to-inverter link.
Note:
• Each drive on the link has a unique node number.
• If the drive is not given a priority class, the node number is also used in determining the starting order of the pumps.</td><td>1</td></tr>
</table>

No.	Name/Value	Description	Def/FbEq16
	0...8	IPC node number.	
76.23	*Master enable*	Selects if this pump operate as a master drive of the IPC system. The master drive must have sensor connection in order to control the process.	*Selected*
	Not selected	The drive can only be a follower on a inverter-to-inverter link.	
	Selected	The drive can be a master on a inverter-to-inverter link.	
76.25	*Number of motors*	Total number of motors used in the application, including the motor connected directly to the drive. **Note:** Parameters are dynamically hidden based on selection of number of motors.	1
	1…8	Number of motors.	1 = 1
76.26	*Min number of motors allowed*	Minimum number of motors running simultaneously.	1
	0…8	Minimum number of motors.	1 = 1
76.27	*Max number of motors allowed*	Maximum number of motors running simultaneously.	1
	1…8	Maximum number of motors.	1 = 1

<table>
<tr><th>No.</th><th>Name/Value</th><th>Description</th><th>Def/FbEq16</th></tr>
<tr><td>76.30</td><td>Start point 1</td><td>Defines the start point for the first auxiliary motor. As the motor speed or frequency exceeds the limit defined by this parameter, a new auxiliary motor is started.
To avoid nuisance starts of the second auxiliary motor, the speed of the variable speed motor should be higher than the start speed for the duration defined by parameter 76.55 Start delay. If the speed decreases below the start speed, the auxiliary motor is not started.
To maintain the process conditions during the start of the second auxiliary motor, a speed hold on time can be defined with parameter 76.57 PFC speed hold on. Certain pump types do not produce significant flow with low frequencies. The speed hold on time can be used to compensate the time needed to accelerate the second auxiliary motor to a speed where it produces flow. The start of the second auxiliary motor is not aborted if the speed of the first auxiliary motor decreases</td><td>Vector:
1300 rpm;
Scalar 48 Hz;
58 Hz
(95.20 b0);
20.00; 30.00</td></tr>
<tr><td colspan="4">
</td></tr>
<tr><td></td><td>0.00…32767.00 [rpm/Hz] [m]</td><td>Speed/frequency.</td><td>1 = 1 unit</td></tr>
<tr><td>76.31</td><td>Start point 2</td><td>Defines the start point for the second auxiliary motor. See parameter 76.31 Start point 1.</td><td>Vector:
1300 rpm;
Scalar 48 Hz;
58 Hz
(95.20 b0);
25.00</td></tr>
<tr><td>76.32</td><td>Start point 3</td><td>Defines the start point for the third auxiliary motor. See parameter 76.31 Start point 1.</td><td>Vector:
1300 rpm;
Scalar 48 Hz;
58 Hz
(95.20 b0);
30.00; 20.00</td></tr>
</table>

No.	Name/Value	Description	Def/FbEq16
76.33	*Start point 4*	Defines the start point for the fourth follower pump/auxiliary motor. See parameter *76.30 Start point 1*.	Vector: 1300 rpm; Scalar 48 Hz; 58 Hz (*95.20* b0); 32.50; 17.50
76.34	*Start point 5*	Defines the start point for the fifth follower pump/auxiliary motor. See parameter *76.30 Start point 1*.	Vector: 1300 rpm; Scalar 48 Hz; 58 Hz (*95.20* b0); 35.00; 15.00
76.35	*Start point 6*	Defines the start point for the sixth follower pump/auxiliary motor. See parameter *76.30 Start point 1*.	Vector: 1300 rpm; Scalar 48 Hz; 58 Hz (*95.20* b0); 37.50; 12.50
76.36	*Start point 7*	Defines the start point for the seventh follower pump/auxiliary motor. See parameter *76.30 Start point 1*.	Vector: 1300 rpm; Scalar 48 Hz; 58 Hz (*95.20* b0); 40.00; 10.00
76.37	*Start point 8*	Defines the start point for the eighth follower pump/auxiliary motor. See parameter *76.30 Start point 1*. **Note:** This parameter is active only in the Level control only.	42.50; 7.50
76.41	*Stop point 1*	Defines the stop point for the first auxiliary motor. When the speed of the motor connected directly to the drive falls below this value and one auxiliary motor is running, the stop delay defined by parameter *76.56 Stop delay* is started. If the speed is still at the same level or lower when the stop delay elapses, the first auxiliary motor stops. The running speed of the drive is increased by [*Start point 1* - *Stop point 1*] after the auxiliary motor stops	Vector: 800 rpm; Scalar 25 Hz; 30 Hz (*95.20* b0); 15.00; 35.00
	0.00…32767.00 [rpm/Hz] [m]	Speed/frequency	1 = 1 unit
76.42	*Stop point 2*	Defines the stop point for the second auxiliary motor. See parameter *76.41 Stop point 1*.	Vector: 800 rpm; Scalar 25 Hz; 30 Hz (*95.20* b0); 15.00; 35.00
76.43	*Stop point 3*	Defines the stop point for the third auxiliary motor. See parameter *76.41 Stop point 1*.	Vector: 800 rpm; Scalar 25 Hz; 30 Hz (*95.20* b0); 15.00; 35.00
76.44	*Stop point 4*	Defines the stop point for the fourth follower pump/auxiliary motor. See parameter *76.41 Stop point 1*.	Vector: 800 rpm; Scalar 25 Hz; 30 Hz (*95.20* b0); 15.00; 35.00

No.	Name/Value	Description	Def/FbEq16
76.45	*Stop point 5*	Defines the stop point for the fifth follower pump/auxiliary motor. See parameter *76.41 Stop point 1*.	Vector: 800 rpm; Scalar 25 Hz; 30 Hz (*95.20* b0); 15.00; 35.00
76.46	*Stop point 6*	Defines the stop point for the sixth follower pump/auxiliary motor. See parameter *76.41 Stop point 1*.	Vector: 800 rpm; Scalar 25 Hz; 30 Hz (*95.20* b0); 15.00; 35.00
76.47	*Stop point 7*	Defines the stop point for the seventh follower pump/auxiliary motor. See parameter *76.41 Stop point 1*.	Vector: 800 rpm; Scalar 25 Hz; 30 Hz (*95.20* b0); 15.00; 35.00
76.48	*Stop point 8*	Defines the stop point for the eighth follower pump/auxiliary motor. See parameter *76.41 Stop point 1*. **Note:** This parameter is active only in Level control only.	15.00; 35.00
76.50	*LC full speed point*	Defines the level at which all the pumps will run at maximum speed/frequency defined with parameter *30.12 Maximum speed* or *30.14 Maximum frequency*.	45.00; 5.00
	0.00...32767.00 m	Level control full speed level.	1 = 1 m
76.51	*LC level source*	Defines the source for level measurement.	*AI2 scaled*
	AI1 scaled	*12.12 AI1 scaled value* (see page *125*).	1
	AI2 scaled	*12.22 AI2 scaled value* (see page *126*).	2
	AI1 percent	*12.101 AI1 percent value* (see page *127*).	8
	AI2 percent	*12.102 AI2 percent value* (see page *127*).	9
76.52	*LC level unit*	Defines the unit for level control measurement (parameter *76.05 Measured level*).	*meters*
	percent	Level control is measured in percent.	4
	feet	Level control is measured in feet.	27
	centimeters	Level control is measured in centimeter.	69
	meters	Level control is measured in meter.	72
	inches	Level control is measured in inch.	73
76.53	*LC efficient speed*	Defines the most economical speed for pumping. The level control follows this speed as long as the speed is below the level defined with parameter *76.50 LC full speed point*.	1300
	-2147483648... 2147483648 rpm	Efficient speed for pumping.	1 = 1 rpm
76.54	*LC max time at level*	Defines the maximum time that the tank level can be between two start levels before forcing already running pumps to full speed. With constant inflow, the new starting pump will change the level to avoid caking.	1.0
	0.0...1800.0 h	Level control maximum time in hours.	1 = 1

No.	Name/Value	Description	Def/FbEq16
76.55	*Start delay*	Defines the delay time for starting the auxiliary motors. See parameter *76.31 Start point 1*.	10.00 s
	0.00…12600.00 s	Time delay.	1 = 1 s
76.56	*Stop delay*	Defines the delay time for stopping the auxiliary motors. See parameter *76.31 Stop point 1*.	10.00 s
	0.00…12600.00 s	Time delay.	1 = 1 s
76.57	*PFC speed hold on*	Hold time for auxiliary motor switch-on. See parameter *76.31 Start point 1*.	0.00 s
	0.00…1000.00 s	Time.	1 = 1 s
76.58	*PFC speed hold off*	Hold time for auxiliary motor switch-off. See parameter *76.31 Stop point 1*.	0.00 s
	0.00…1000.00 s	Time.	1 = 1 s
76.59	*PFC contactor delay*	Start delay for the motor that is directly controlled by the drive. This does not affect the starting of the auxiliary motors. **WARNING!** There must always be a delay set if the motors are equipped with star-delta starters. The delay must be set longer than the time setting of the starter. After the motor is switched on by the relay output of the drive, there must be enough time for the star-delta starter to first switch to star and then back to delta before the motor is connected to the drive.	0.50 s
	0.20…600.00 s	Time delay.	1 = 1 s
76.60	*PFC ramp acceleration time*	Defines the acceleration time for the drive motor speed compensation, when an auxiliary motor is stopped. This ramp time is also used for the drive motor to accelerate after an autochange has occurred. The parameter sets the ramp-up time as seconds from zero to maximum frequency (not from the previous reference to the new reference).	1.00 s
	0.00…1800.00 s	Time.	1 = 1 s
76.61	*PFC ramp deceleration time*	Defines the deceleration time for the drive motor speed compensation, when an auxiliary motor is started. This ramp time is also used for the drive motor to decelerate after an autochange has occurred. The parameter sets the ramp-up time as seconds from maximum to zero frequency (not from the previous reference to the new reference).	1.00 s
	0.00…1800.00 s	Time.	1 = 1 s
76.62	*IPC smooth acceleration time*	Defines the ramp time of a new starting pump. A pump that is started by current master follows the speed until all the pumps rotate at the same speed and master role is changed. The smooth acceleration time must be longer than the time defined with parameter *40.33 Set 1 integration time*. **Note:** Quick ramp overrides the smooth ramp. See parameter group *82 Pump protections* on page *274*.	20.00
	3.00...1800.00 s	IPC smooth acceleration time in seconds.	1 = 1 s

No.	Name/Value	Description	Def/FbEq16
76.63	*IPC smooth deceleration time*	Defines the ramp time that is used to stop the pump. A pump that is stopped by current master follows the speed until it is stopped completely. The smooth deceleration time must be longer than the time defined with parameter *40.33 Set 1 integration time*. **Note:** Quick ramps overrides the smooth ramp. See parameter group *82 Pump protections* on page *274*.	20.00
	3.00...1800.00 s	IPC smooth deceleration time in seconds.	1 = 1 s
76.70	*PFC Autochange*	Defines the way the autochange is triggered. In all cases except *Even wear*, the start order is moved one step forward each time the autochange occurs. If the start order initially is 1-2-3-4, after the first autochange the order will be 2-3-4-1, etc. For *Even wear*, the start order will be determined so that the running times of all motors remain within the defined limit. **Note:** Autochange only occurs when the speed of the drive is below the speed defined by parameter *76.73 Autochange level*. See also section *Autochange* on page *63*. **Note:** This parameter is applicable for PFC/SPFC only.	*Not selected*
	Not selected	Autochange disabled.	0
	Selected	Rising edge starts the autochange if autochange conditions are met.	1
	DI1	Autochange triggered by the rising edge of digital input DI1 (*10.02 DI delayed status*, bit 0).	2
	DI2	Autochange triggered by the rising edge of digital input DI2 (*10.02 DI delayed status*, bit 1).	3
	DI3	Autochange triggered by the rising edge of digital input DI3 (*10.02 DI delayed status*, bit 2).	4
	DI4	Autochange triggered by the rising edge of digital input DI4 (*10.02 DI delayed status*, bit 3).	5
	DI5	Autochange triggered by the rising edge of digital input DI5 (*10.02 DI delayed status*, bit 4).	6
	DI6	Autochange triggered by the rising edge of digital input DI6 (*10.02 DI delayed status*, bit 5).	7
	Timed function 1	Autochange triggered by timed function 1 (bit 0 of *34.01 Timed functions status* (see page *191*)).	8
	Timed function 2	Autochange triggered by timed function 2 (bit 1 of *34.01 Timed functions status* (see page *191*)).	9
	Timed function 3	Autochange triggered by timed function 3 (bit 2 of *34.01 Timed functions status* (see page *191*)).	10
	Fixed interval	Autochange is done when the interval determined in the parameter *76.71 PFC Autochange interval* has elapsed.	11
	All stop	Autochange is done when all the motors are stopped. The PID sleep feature (parameters *40.43 Set 1 sleep level* … *40.48 Set 1 wake-up delay*) must be used for the drive to stop when the process demand is low.	12

No.	Name/Value	Description	Def/FbEq16
	Even wear	The running time of the motors are balanced by the drive. When the difference in running time between the motors with the least and most running hours exceeds the time defined by parameter *76.72 Maximum wear imbalance*, the autochange occurs. The running hours of the motors can be found in group *77 Multipump maintenance and monitoring*	13
	Other [bit]	Source selection (see *Terms and abbreviations* on page *100*).	-
76.71	*PFC Autochange interval*	Specifies the interval that is used in setting *Fixed interval* of parameter *76.70 PFC Autochange*.	1.00 h
	0.00…42949672.95 h	Time.	1 = 1 h
76.72	*Maximum wear imbalance*	Specifies the maximum wear imbalance, or difference in running times between any motor, used by the *Even wear* setting of parameter *76.70 PFC Autochange*.	10.00 h
	0.00… 1000000.00 h	Time.	1 = 1 h
76.73	*Autochange level*	Upper speed limit for the Autochange to occur. The Autochange occurs when: • the condition defined in *76.70 PFC Autochange* is fulfilled and, • the speed of the drive motor *01.03 Motor speed %* is below the speed limit defined in this parameter. **Note:** When the value is selected as 0%, this speed limit check is disabled.	100.0%
	0.0…300.0%	Speed/frequency in percentage of the nominal speed or frequency of the drive motor.	1 = 1%
76.74	*Autochange auxiliary PFC*	Selects whether only auxiliary motors or all motors are included in the Autochange function.	*Aux motors only*
	All motors	All motors, including the one connected to the drive participates in the autochange. The Autochange logic will connect the drive to each of the motors according to setting of parameter *76.70 PFC Autochange*. **Note:** The first motor (PFC1) also requires the appropriate hardware contactor connections and PFC1 must be defined in one of the relay output source parameters.	0
	Aux motors only	Only auxiliary (direct-on-line) motors are affected by the autochange function. **Note:** PFC1 refers to the motor that is fixed to the drive and must not be selected in any of the relay output source parameters. Only the starting order of the auxiliary motors will be rotated.	1
76.76	*Max stationary time*	Defines the maximum time that a low priority pump can be stationary. The IPC system uses pump priorities to start/stop the pumps. This parameter sets the upper limit for stationary time so that the pump blockage can be avoided.	0.0
	0.0...214748368.0 h	Maximum stationary time in hours.	1 = 1 h
76.77	*Pump priority*	Selects the priority of the pump in an IPC system. **Note:** Parameter *76.76 Max stationary time* defines the maximum time that a low priority pump can be stationary.	*Normal*

No.	Name/Value	Description	Def/FbEq16
	High	High priority pump. The IPC system prefers high priority pump.	
	Normal	Normal priority pump.	
	Low	Low priority pump. The low priority pump runs as little as possible. It is started only when the demand requires full pumping capacity.	
76.81	*PFC 1 interlock*	Defines if the PFC motor 1 can be started. An interlocked PFC motor cannot be started. 0 = Interlocked (not available), 1 = Available.	*Available. PFC motor is available*
	Interlocked. PFC motor is not in use	PFC motor is interlocked and not available.	0
	Available. PFC motor is available	PFC motor is available.	1
	DI1	Digital input DI1 (*10.02 DI delayed status*, bit 0).	2
	DI2	Digital input DI2 (*10.02 DI delayed status*, bit 1).	3
	DI3	Digital input DI3 (*10.02 DI delayed status*, bit 2).	4
	DI4	Digital input DI4 (*10.02 DI delayed status*, bit 3).	5
	DI5	Digital input DI5 (*10.02 DI delayed status*, bit 4).	6
	DI6	Digital input DI6 (*10.02 DI delayed status*, bit 5).	7
	Timed function 1	Bit 0 of *34.01 Timed functions status* (see page *191*).	8
	Timed function 2	Bit 1 of *34.01 Timed functions status* (see page *191*).	9
	Timed function 3	Bit 2 of *34.01 Timed functions status* (see page *191*).	10
	Other [bit]	Source selection (see *Terms and abbreviations* on page *100*).	-
76.82	*PFC 2 interlock*	See parameter *76.81 PFC 1 interlock*.	*Available. PFC motor is available*
76.83	*PFC 3 interlock*	See parameter *76.81 PFC 1 interlock*.	*Available. PFC motor is available*
76.84	*PFC 4 interlock*	See parameter *76.81 PFC 1 interlock*.	*Available. PFC motor is available*
76.85	*PFC 5 interlock*	See parameter *76.81 PFC 1 interlock*.	*Available. PFC motor is available*
76.86	*PFC 6 interlock*	See parameter *76.81 PFC 1 interlock*.	*Available. PFC motor is available*
76.90	*LC low level switch*	Selects the source for digital low level switch.	*Selected*
	Not selected	Low level switch is inactive.	0
	Selected	Low level switch is active.	1
	DI1	Digital input DI1 (*10.02 DI delayed status*, bit 0).	2
	DI2	Digital input DI2 (*10.02 DI delayed status*, bit 1).	3
	DI3	Digital input DI3 (*10.02 DI delayed status*, bit 2).	4
	DI4	Digital input DI4 (*10.02 DI delayed status*, bit 3).	5
	DI5	Digital input DI5 (*10.02 DI delayed status*, bit 4).	6
	DI6	Digital input DI6 (*10.02 DI delayed status*, bit 5).	7

No.	Name/Value	Description	Def/FbEq16
	Supervision 1	Bit 0 of *32.01 Supervision status* (see page *184*).	8
	Supervision 2	Bit 1 of *32.01 Supervision status* (see page *184*).	9
	Supervision 3	Bit 2 of *32.01 Supervision status* (see page *184*).	10
	Other [bit]	Source selection (see *Terms and abbreviations* on page *100*).	-
76.91	*LC high level switch*	Selects the source for digital high level switch.	*Selected*
	Not selected	High level switch is inactive.	0
	Selected	High level switch is active.	1
	DI1	Digital input DI1 (*10.02 DI delayed status*, bit 0).	2
	DI2	Digital input DI2 (*10.02 DI delayed status*, bit 1).	3
	DI3	Digital input DI3 (*10.02 DI delayed status*, bit 2).	4
	DI4	Digital input DI4 (*10.02 DI delayed status*, bit 3).	5
	DI5	Digital input DI5 (*10.02 DI delayed status*, bit 4).	6
	DI6	Digital input DI6 (*10.02 DI delayed status*, bit 5).	7
	Supervision 1	Bit 0 of *32.01 Supervision status* (see page *184*).	8
	Supervision 2	Bit 1 of *32.01 Supervision status* (see page *184*).	9
	Supervision 3	Bit 2 of *32.01 Supervision status* (see page *184*).	10
	Other [bit]	Source selection (see *Terms and abbreviations* on page *100*).	-
76.92	*LC low level action*	Selects the action for drive to indicate when digital low level switch is activated. See parameter *76.90 LC low level switch* (page *265*).	*Warning*
	No action	Low level switch is disabled and does not generate any event.	0
	Warning	Low level switch generates *0xD509 Low level* warning.	1
	Fault	Low level switch generates *0xD403 Low level* fault.	2
76.93	*LC high level action*	Selects the action for drive to indicate when digital high level switch is activated. See parameter *76.91 LC high level switch* (page *266*).	*Warning*
	No action	High level switch is disabled and does not generate any event.	0
	Warning	High level switch generates *0xD508 High level* warning.	1
	Fault	High level switch generates *0xD402 High level* fault.	2
76.95	*Regulator bypass control*	Defines if direct-on-line pumps are automatically started and stopped. This setting can be used in applications with a low number of sensors and low accuracy requirements.	*Disable*
	Disable	Automatic starting and stopping is disabled.	0
	Enable	Automatic starting and stopping is enabled.	1
	Other [bit]	Source selection (see *Terms and abbreviations* on page *100*).	-
76.101	*IPC parameter synchronization*	Defines parameter synchronization in IPC system.	*Enable*
	Enable	Parameter synchronization is enabled.	
	Disable	Parameter synchronization is disabled.	
76.102	*IPC synchronization settings*	Selects the settings that are synchronized between drives in inverter-to-inverter communication bus. The process PID and IPC parameters are synchronized. **Note:** This parameter does not synchronize AI parameters.	0b0110

Bit	Name	Value
0	AI parameters	Parameter group *12 Standard AI*.
1	Process PID set 1 parameters	Parameter group *40 Process PID set 1*. Parameters *19.11 Ext1/Ext2 selection*, *20.06 Ext2 commands*, *20.08 Ext2 in1 source*, *22.18 Ext2 speed ref1* and *28.15 Ext2 frequency ref1*.
2	IPC parameters	Parameter group *76 Multipump configuration* and *77 Multipump maintenance and monitoring*.
3…15	Reserved	

No.	Name/Value	Description	Def/FbEq16
76.105	*IPC synchronization checksum*	Displays the calculated parameter checksum (CRC) of the parameter groups selected with parameter *76.102 IPC synchronization settings*. If the value of this parameter is same on all the drives, then the configuration is also synchronized correctly.	
77 Multipump maintenance and monitoring		Multipump maintenance and monitoring parameters.	
77.10	*PFC runtime change*	Enables the reset, or arbitrary setting, of *77.11 Pump 1 running time* … *77.18 Pump 8 running time*.	*Done*
	Done	The parameter automatically reverts back to this value.	0
	Set any PFC run time	Enables the setting of *77.11 Pump 1 running time* … *77.18 Pump 8 running time* to an arbitrary value.	1
	Reset PFC1 run time	Resets parameter *77.11 Pump 1 running time*.	2
	Reset PFC2 run time	Resets parameter *77.12 Pump 2 running time*.	3
	Reset PFC3 run time	Resets parameter *77.13 Pump 3 running time*.	4
	Reset PFC4 run time	Resets parameter *77.14 Pump 4 running time*.	4
	Reset PFC5 run time	Resets parameter *77.15 Pump 5 running time*.	6
	Reset PFC6 run time	Resets parameter *77.16 Pump 6 running time*.	7
	Reset PFC7 run time	Resets parameter *77.17 Pump 7 running time*.	8
	Reset PFC8 run time	Resets parameter *77.18 Pump 8 running time*.	9
77.11	*Pump 1 running time*	Running time counter of pump 1. Can be set or reset by parameter *77.10 Pump 1 running time*.	0.00 h
	0.00… 42949672.95 h	Time	1 = 1 h
77.12	*Pump 2 running time*	See parameter *77.11 Pump 1 running time*.	0.00 h
77.13	*Pump 3 running time*	See parameter *77.11 Pump 1 running time*.	0.00 h

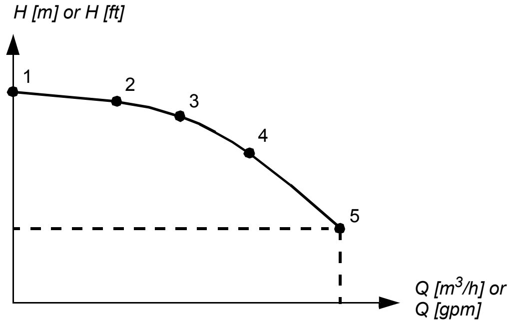
No.	Name/Value	Description	Def/FbEq16
77.14	*Pump 4 running time*	See parameter *77.11 Pump 1 running time*.	0.00 h
77.15	*Pump 5 running time*	See parameter *77.11 Pump 1 running time*.	0.00 h
77.16	*Pump 6 running time*	See parameter *77.11 Pump 1 running time*.	0.00 h
77.17	*Pump 7 running time*	See parameter *77.11 Pump 1 running time*.	0.00 h
77.18	*Pump 8 running time*	See parameter *77.11 Pump 1 running time*.	0.00 h
77.20	*IPC online pumps*	Displays the pumps which can establish connection through inverter-to-inverter communication. For example, in a three pump system, drive 1 and drive 2 can see each other but drive 3 cannot see other drives. Drive 1 = 0011b, Drive 2 = 0011b, Drive 3 = 0100b	

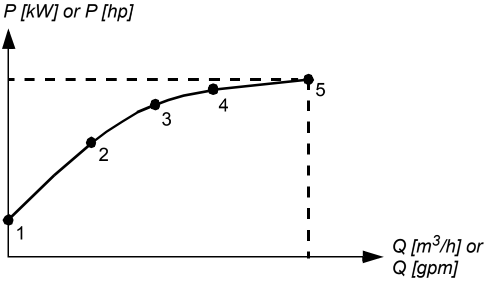
Bit	Name	Descriptions
0	Node 1	Pump 1 is online.
1	Node 2	Pump 2 is online.
2	Node 3	Pump 3 is online.
3	Node 4	Pump 4 is online.
4	Node 5	Pump 5 is online.
5	Node 6	Pump 6 is online.
6	Node 7	Pump 7 is online.
7	Node 8	Pump 8 is online.
8…15	Reserved	

No.	Name/Value	Description	Def/FbEq16
77.21	*IPC comm loss status*	Displays the drives communication loss status. You can override default communication loss actions by setting start interlock or constant speed based on the bit values. **Note:** Bits will reset to zero when communication is restored.	

Bit	Name	Descriptions
0	Running master in comm loss	The running master drive has lost the connection to other drives. By default, this drive continues as a running master.
1	Running follower (master enable) in comm loss	The running follower drive which is set as master enabled drive has lost the connection to other drives. By default, this drive will be a master (offline).
2	Standby master enabled in comm loss	The master enabled drive which is in standby mode has lost the connection to other drives. By default, this drive remains in standby mode if already running drives can maintain the process.
3	Standby master disabled in comm loss	The master disabled drive which is in standby mode has lost the connection to other drives. By default, this drive remains in standby mode.
4…15	Reserved	

No.	Name/Value	Description	Def/FbEq16
80	***Flow calculation and protection***	Actual flow calculation. **Note:** Parameters are dynamically hidden based on selection of flow calculation mode. Parameters are visible according to the selection of parameter *80.13 Flow feedback function*.	
80.01	*Actual flow*	Actual system flow that is either calculated from the pressure difference, measured directly or estimated from the pump curves. The calculation method is selected with parameter *80.13 Flow feedback function*. See the control chain diagram on page *412*.	-
	-200000.00… 200000.00 m^3/h	Calculated flow.	1 = 1 m^3/h
80.02	*Actual flow percentage*	Shows the percentage of parameter *80.01 Actual flow* from *80.15 Maximum flow*.	0.00
	-100.00…100.00%	Flow percentage.	100 = 1%
80.03	*Total flow*	Shows cumulative calculated flow.	0.00
	0.00... 21474836.00 m^3	Total calculated flow.	1 = 1 m^3
80.04	*Specific energy*	Shows the ratio of pump flow rate and power input.	0.00
	0.00... 32767.95 m^3/kWh	Specific energy of the pump.	1 = 1 m^3/kWh
80.05	*Estimated pump head*	Shows the estimated head produced by the pump.	0.00
	0.00...32767.00 m	Estimated pump head.	1 = 1 m
80.11	*Flow feedback 1 source*	Selects the source for the flow feedback 1.	*Not selected*
	Not selected	Feedback not used.	0
	AI1 scaled	*12.12 AI1 scaled value* (see page *125*).	1
	AI2 scaled	*12.22 AI2 scaled value* (see page *126*).	2
	Freq in scaled	*11.39 Freq in 1 scaled value* (see page *122*).	3
	AI1 percent	*12.101 AI1 percent value* (see page *127*).	8
	AI2 percent	*12.102 AI2 percent value* (see page *127*).	9
	Feedback data storage	*40.91 Feedback data storage* (see page *229*).	10
80.12	*Flow feedback 2 source*	Selects the source for the flow feedback 2.	*Not selected*
	Not selected	Feedback not used.	0
	AI1 scaled	*12.12 AI1 scaled value* (see page *125*).	1
	AI2 scaled	*12.22 AI2 scaled value* (see page *126*).	2
	Freq in scaled	*11.39 Freq in 1 scaled value* (see page *122*).	3
	AI1 percent	*12.101 AI1 percent value* (see page *127*).	8
	AI2 percent	*12.102 AI2 percent value* (see page *127*).	9
	Feedback data storage	*40.91 Feedback data storage* (see page *229*).	10

No.	Name/Value	Description	Def/FbEq16
80.13	*Flow feedback function*	Selects a function between the flow feedback sources selected by parameters *80.11 Flow feedback 1 source* and *80.12 Flow feedback 2 source*. The result of the function (for any selection) is multiplied by parameter *80.14 Flow feedback multiplier*.	*In1*
	In1	Use *80.11 Flow feedback 1 source* directly as the flow value.	0
	In2	Use *80.12 Flow feedback 2 source* directly as the flow value.	1
	Reserved		2…7
	sqrt(In1)	Flow is calculated as a square root of a differential pressure measurement: $k\sqrt{\Delta P}$ The differential pressure value is selected with *80.11 Flow feedback 1 source*.	8
	sqrt(In1-In2)	Flow is calculated as a square root of two measured absolute pressure measurements: $k\sqrt{(P_1 - P_2)}$ The pressure measurement sources are selected with *80.11 Flow feedback 1 source* and *80.12 Flow feedback 2 source*.	9
	HQ curve	The HQ curve is used for flow calculation. You can configure pressure sensor settings with parameter group *81 Sensor settings*. The figure below shows the HQ performance curve of the pump for the flow calculation function.  	100

No.	Name/Value	Description	Def/FbEq16
	PQ curve	The PQ curve is used for flow calculation. You can configure pressure sensor settings with parameter group *81 Sensor settings*. The figure below shows the PQ performance curve of the pump for the flow calculation function.  	101
80.14	*Flow feedback multiplier*	Defines the multiplier (k) used with the flow calculation The output value of *80.13 Flow feedback function* is multiplied by this value.	1.00
	-200000.00… 200000.00	Multiplier.	1 = 1
80.15	*Maximum flow*	Defines the nominal maximum flow of the system. This value is used to calculate the actual flow percentage value so that the value 100% for *80.02* corresponds to the value of this parameter.	1000.00
	-200000.00… 200000.00	Sets the limit for maximum flow protection.	1 = 1
80.16	*Minimum flow*	Defines the nominal minimum flow of the system.	1.00
	-200000.00... 200000.00 m^3/h	Sets the limit for minimum flow protection.	1 = 1 m^3/h
80.17	*Maximum flow protection*	Selects the action for maximum flow protection function.	*No action*
	No action	Maximum flow protection is disabled.	0
	Warning	Generates *D50C Maximum flow protection* warning.	1
	Fault	Generates *D406 Maximum flow protection* fault.	2
	Speed ref safe	Speed reference safe is activated.	3
80.18	*Minimum flow protection*	Selects the action for minimum flow protection function.	*No action*
	No action	Minimum flow protection is disabled.	0
	Warning	Generates *D50D Minimum flow protection* warning.	1
	Fault	Generates *D407 Minimum flow protection* fault.	2
	Speed ref safe	Speed reference safe is activated.	3
80.19	*Flow check delay*	Defines the time after motor start when the flow protection is active.	5.00
	0.00...3600.00 s	Flow check delay.	1 = 1 s
80.22	*Pump inlet diameter*	Defines the pump inlet pipe diameter.	0.100
	0.010... 32767.000 cm	Pump inlet pipe diameter.	1 = 1 cm

No.	Name/Value	Description	Def/FbEq16
80.23	*Pump outlet diameter*	Defines the pump outlet pipe diameter.	0.100
	0.010... 32767.000 cm	Pump outlet pipe diameter.	1 = 1 cm
80.26	*Calculation minimum speed*	Defines the speed limit below which flow is not calculated.	5.00
	0.00...32767.00 Hz	Minimum speed limit for flow calculation.	1 = 1 Hz
80.28	*Density*	Defines the density of the fluid to be pumped for the flow calculation function.	1000.00
	0.00... 32767.00 kg/m^3	Fluid density.	1 = 1 kg/m^3
80.29	*Total flow reset*	Resets the signal *80.02 Total flow*.	*Not selected*
	Not selected	Total flow reset is not selected.	0
	Reset	Resets cumulative flow counter. **Note:** The value reverts automatically to *Not selected* after the flow is reset.	1
80.40	*HQ curve H1*	Defines the head at point 1 of the HQ performance curve. See section *Flow calculation* (page *68*).	0.00
	0.00...32767.00 m	Head at point 1 of the HQ curve.	1 = 1 m
80.41	*HQ curve H2*	Defines the head at point 2 of the HQ performance curve. See parameter *80.40 HQ curve H1* (page *272*).	0.00
80.42	*HQ curve H3*	Defines the head at point 3 of the HQ performance curve. See parameter *80.40 HQ curve H1* (page *272*).	0.00
80.43	*HQ curve H4*	Defines the head at point 4 of the HQ performance curve. See parameter *80.40 HQ curve H1* (page *272*).	0.00
80.44	*HQ curve H5*	Defines the head at point 5 of the HQ performance curve. See parameter *80.40 HQ curve H1* (page *272*).	0.00
80.50	*PQ curve P1*	Defines the power input of pump at point 1 on the PQ performance curve. See section *Flow calculation* (page *68*).	0.00
	0.00...32767.00 kW	Power input of pump at point 1.	
80.51	*PQ curve P2*	Defines the power input of pump at point 2 on the PQ performance curve. See parameter *80.50 PQ curve P1* (page *272*).	0.00
80.52	*PQ curve P3*	Defines the power input of pump at point 3 on the PQ performance curve. See parameter *80.50 PQ curve P1* (page *272*).	0.00
80.53	*PQ curve P4*	Defines the power input of pump at point 4 on the PQ performance curve. See parameter *80.50 PQ curve P1* (page *272*).	0.00
80.54	*PQ curve P5*	Defines the power input of pump at point 5 on the PQ performance curve. See parameter *80.50 PQ curve P1* (page *272*).	0.00
80.60	*Q value Q1*	Defines the flow rate at point 1 on the PQ performance curve. See section *Flow calculation* (page *68*).	0.00
	0.00... 200000.00 m^3/h	Flow rate at point 1 of the PQ curve.	1 = 1

No.	Name/Value	Description	Def/FbEq16
80.61	*Q value Q2*	Defines the flow rate at point 2 on the PQ performance curve. See parameter *80.60 Q value Q1* (page *272*).	0.00
80.62	*Q value Q3*	Defines the flow rate at point 3 on the PQ performance curve. See parameter *80.60 Q value Q1* (page *272*).	0.00
80.63	*Q value Q4*	Defines the flow rate at point 4 on the PQ performance curve. See parameter *80.60 Q value Q1* (page *272*).	0.00
80.64	*Q value Q5*	Defines the flow rate at point 5 on the PQ performance curve. See parameter *80.60 Q value Q1* (page *272*).	0.00

81 Sensor settings		Defines the sensor settings for inlet and outlet pressure protection function.	
81.01	*Actual inlet pressure*	Shows the actual inlet pressure. **Note:** By default the parameter unit will be bar. However, the unit can be changed according to the parameter *81.20 Pressure unit*.	0.00
	0.00...32767.00 bar	Actual inlet pressure.	1 = 1 bar
81.02	*Actual outlet pressure*	Shows the actual outlet pressure.	0.00
	0.00...32767.00 bar	Actual outlet pressure.	1 = 1 bar
81.10	*Inlet pressure source*	Selects the primary source used for pump inlet pressure measurement.	*AI1 scaled*
	Not selected	None	0
	AI1 scaled	Parameter *12.12 AI1 scaled value*.	1
	AI2 scaled	Parameter *12.22 AI2 scaled value*.	2
	Freq in scaled	Parameter *11.39 Freq in 1 scaled value*.	3
	AI1 percent	Parameter *12.101 AI1 percent value*.	8
	AI2 percent	Parameter *12.102 AI2 percent value*.	9
	Feedback storage	Parameter *40.91 Feedback data storage*.	10
	Other [bit]	Source selection (see *Terms and abbreviations* on page *100*).	-
81.11	*Outlet pressure source*	Selects the primary source used for pump outlet pressure measurement.	*AI2 scaled*
	Not selected	None	0
	AI1 scaled	Parameter *12.12 AI1 scaled value*.	1
	AI2 scaled	Parameter *12.22 AI2 scaled value*.	2
	Freq in scaled	Parameter *11.39 Freq in 1 scaled value*.	3
	AI1 percent	Parameter *12.101 AI1 percent value*.	8
	AI2 percent	Parameter *12.102 AI2 percent value*.	9
	Feedback storage	Parameter *40.91 Feedback data storage*.	10
	Other [bit]	Source selection (see *Terms and abbreviations* on page *100*).	-
81.12	*Sensors height difference*	Defines the height difference between inlet and outlet pressure sensors for flow calculation.	0.00
	0.00...32767.00 m	Sensors height difference.	1 = 1 m
81.20	*Pressure unit*	Selects the unit of pressure.	*bar*
	bar	Pressure	0

No.	Name/Value	Description	Def/FbEq16
	kPa	Kilo pascal	1
	psi	Pound per square inch	2
	Pa	Pascal	3
81.21	*Flow unit*	Selects the unit of flow. The selection affects total flow and specific energy units.	*m3/h*
	m^3/h	Cubic meter per hour.	0
	l/s	Liters per second.	1
	gpm	US gallon per minute.	2
81.22	*Length unit*	Selects the unit of estimated head points, sensors height difference and pump inlet/outlet diameters.	*centimeters*
	centimeters	Length unit in centimeter.	69
	meter	Length unit in meter.	72
	Inch	Length unit in inch.	73
	feet	Length unit in feet.	27
81.23	*Density unit*	Selects the unit of density.	*kg/m3*
	kg/m^3	Kilograms per cubic meter.	0
	kg/l	Kilograms per liter.	1
	lb/gal	Pounds per US gallon.	2

82 Pump protections		Settings for quick ramp functions. See section *Pump protections - Quick ramps* (page *49*).	
82.01	*Quick ramp mode*	Enables quick ramp mode with quick ramp set 1 or set 2. Quick ramp set 1 consists of *82.05 Quick ramp 1 accel. time* and *82.06 Quick ramp 1 decel. time*. Quick ramp set 2 consists of *82.10 Quick ramp 2 accel. time* and *82.11 Quick ramp 2 decel. time*.	*Disabled*
	Disabled	Quick ramp mode is disabled.	0
	Use 1 quick ramp	Quick ramp set 1 is used.	1
	Use 2 quick ramps	Both quick ramp set 1 and set 2 are used.	2
82.05	*Quick ramp 1 accel. time*	Defines the quick ramp set 1 acceleration time. The time required for the speed to change from zero to the speed value defined by parameter *46.01 Speed scaling* or *46.02 Frequency scaling*. This ramp is effective from zero to speed/frequency defined by parameter *82.07 Quick ramp 1 upper limit*.	1.00
	0.10...5.00 s	Time	100 = 1s
82.06	*Quick ramp 1 decel. time*	Defines the quick ramp set 1 deceleration time. The time required for the speed to change from the speed value to zero is defined by parameters *46.01 Speed scaling* or *46.02 Frequency scaling*. This ramp is effective from speed/frequency defined by parameter *82.07 Quick ramp 1 upper limit* to zero.	
	0.10...5.00 s	Time	100 = 1s
82.07	*Quick ramp 1 upper limit*	Defines the maximum speed/frequency for quick ramp 1. Above this speed/frequency, the drive uses either quick ramp 2 and normal ramp time or only normal ramp time depending on parameter *82.01 Quick ramp mode*.	30
	15...100 Hz	Frequency/Speed limit	1 = 1Hz

No.	Name/Value	Description	Def/FbEq16
82.10	*Quick ramp 2 accel. time*	Defines the quick ramp set 2 acceleration time. The time required for the speed to change from zero to the speed value defined by parameter *46.01 Speed scaling* or *46.02 Frequency scaling*. This ramp is effective in speed/frequency range defined by parameters *82.07 Quick ramp 1 upper limit* and *82.12 Quick ramp 2 upper limit*.	10.00
	0.10...20.00 s	Time	100 = 1s
82.11	*Quick ramp 2 decel. time*	Defines the quick ramp set 2 deceleration time. The time required for the speed to change from the speed value to zero is defined by parameters *46.01 Speed scaling* or *46.02 Frequency scaling*. This ramp is effective in speed/frequency range defined by parameters *82.07 Quick ramp 1 upper limit* and *82.12 Quick ramp 2 upper limit*.	10.00
	0.10...20.00 s	Time	100 = 1s
82.12	*Quick ramp 2 upper limit*	Defines the maximum speed/frequency for the quick ramp 2. Above this speed/frequency, the drive either uses quick ramp 2 or normal ramp time depending on selection in parameter *82.01 Quick ramp mode*.	45
	15...100 Hz	Frequency/Speed limit	1 = 1Hz
82.20	*Dry run protection*	Selects dry run protection mode.	*No action*
	No action	Dry run protection is disabled.	0
	Warning	Dry run protection generates *0xD50A Running dry* warning.	1
	Fault	Dry run protection generates *D409 Outlet maximum pressure* fault.	2
	Fault if running	Dry run protection generates a fault if the source signal is high when running.	3
82.21	*Dry run source*	Selects the source for dry run protection.	*Under load curve*
	Under load curve	Activates dry run protection (parameter *37.01 ULC output status word*, bit 0). See section *User load curve (Condition monitoring)* (page *52*).	0
	DI1	Digital input DI1.	1
	DI2	Digital input DI2.	2
	DI3	Digital input DI3.	3
	DI4	Digital input DI4.	4
	DI5	Digital input DI5.	5
	DI6	Digital input DI6.	6
	Supervision 1	Activates dry run protection.	7
	Supervision 2	Activates dry run protection.	8
	Supervision 3	Activates dry run protection.	9
82.25	*Soft pipe fill supervision*	Selects the drive action in case the system does not reach the setpoint in time defined with parameter *82.26 Time-out limit*. The time is calculated with the last reference change in parameter *40.03 Process PID setpoint actual*.	*No action*
	No action	Soft pipe fill time-out is disabled.	0
	Warning	Generates *D405 Pipe fill-timeout* warning.	1

No.	Name/Value	Description	Def/FbEq16
	Fault	Generates *D50B Pipe fill-timeout* fault.	2
82.26	*Time-out limit*	Defines the delay time at which setpoint must be reached after last change in PID reference ramp output.	60.0
	0.0...1800.0 s	Time-out limit in seconds.	1 = 1 s
82.30	*Outlet minimum pressure protection*	Enables outlet minimum pressure protection function.	*Disabled*
	Disabled	Outlet minimum pressure protection function is disabled.	0
	Warning	Outlet minimum pressure protection function generates *D50E Outlet minimum pressure* warning when the outlet minimum pressure is below the level defined with parameter *82.31 Outlet minimum pressure warning level* for a time set in *82.45 Pressure check delay*.	1
	Fault	Outlet minimum pressure protection function generates *D408 Outlet minimum pressure* fault when the outlet minimum pressure is below the level defined with parameter *82.32 Outlet minimum pressure fault level* for a time set in parameter *82.45 Pressure check delay*.	2
	Warning/Fault	Outlet minimum pressure protection function first generates a warning when the pressure is below the level defined with parameter *82.31 Outlet minimum pressure warning level* for a time set in parameter *82.45 Pressure check delay*. If the pressure continues to fall below the level defined with parameter *82.32 Outlet minimum pressure fault level*, outlet minimum pressure fault is generated.	3
82.31	*Outlet minimum pressure warning level*	Defines the level at which drive should generate the outlet minimum pressure warning.	0.00
	0.00...32767.00 bar	Outlet minimum pressure warning level.	1 = 1 bar
82.32	*Outlet minimum pressure fault level*	Defines the level at which drive should generate the outlet minimum pressure fault.	0.00
	0.00...32767.00 bar	Outlet minimum pressure fault level.	1 = 1 bar
82.35	*Outlet maximum pressure protection*	Enables outlet maximum pressure protection function.	*Disabled*
	Disabled	Outlet maximum pressure protection is disabled.	0
	Warning	Outlet maximum pressure protection function generates *D50F Outlet maximum pressure* warning when the pressure is above the level defined with parameter *82.37 Outlet maximum pressure warning level* for a time set in parameter *82.45 Pressure check delay*.	1
	Fault	Outlet maximum pressure protection function generates *D409 Outlet maximum pressure* fault when the pressure is above the level defined with parameter *82.38 Outlet maximum pressure fault level* for a time set in parameter *82.45 Pressure check delay*.	2
	Warning/Fault	Outlet maximum pressure protection function first generates a warning when the pressure is above the level defined with parameter *82.37 Outlet maximum pressure warning level* for a time set in parameter *82.45 Pressure check delay*. If the pressure raises above the level defined with parameter *82.38 Outlet maximum pressure fault level*, outlet maximum pressure fault is generated.	3

No.	Name/Value	Description	Def/FbEq16
82.37	*Outlet maximum pressure warning level*	Defines the level at which drive should generate the outlet maximum pressure warning.	0.00
	0.00...32767.00 bar	Outlet maximum pressure warning level.	1 = 1 bar
82.38	*Outlet maximum pressure fault level*	Defines the level at which drive should generate the outlet maximum pressure fault.	0.00
	0.00...32767.00 bar	Outlet maximum pressure fault level.	1 = 1 bar
82.40	*Inlet minimum pressure protection*	Enables inlet minimum pressure protection function.	*Disabled*
	Disabled	Inlet minimum pressure protection is disabled.	0
	Warning	Inlet minimum pressure protection function generates *D510 Inlet minimum pressure* warning when the pressure is below the level defined with parameter *82.41 Inlet minimum pressure warning level* for a time set in *82.45 Pressure check delay*.	1
	Fault	Inlet minimum pressure protection function generates *D40A Inlet minimum pressure* fault when the pressure is below the level defined with parameter *82.42 Inlet minimum pressure fault level* for a time set in *82.45 Pressure check delay*.	2
	Warning/Fault	Inlet minimum pressure protection function first generates a warning when the pressure is below the level defined with parameter *82.41 Inlet minimum pressure warning level* for a time set in *82.45 Pressure check delay*. If the pressure continues to fall below the level defined with parameter *82.42 Inlet minimum pressure fault level*, a fault is generated.	3
82.41	*Inlet minimum pressure warning level*	Defines the level at which drive should generate the inlet minimum pressure warning.	0.00
	0.00...32767.00 bar	Inlet minimum pressure warning level.	1 = 1 bar
82.42	*Inlet minimum pressure fault level*	Defines the level at which drive should generate the inlet minimum pressure fault.	0.00
	0.00...32767.00 bar	Inlet minimum pressure fault level.	1 = 1 bar
82.45	*Pressure check delay*	Defines the delay time at which the pressure supervisions are inactive. You can adjust check delay for a system in which the pressure does not increase immediately after starting the motor.	3.00
	0.00...3600.00 s	Pressure check delay time.	1 = 1 s

83 Pump cleaning		Settings for the pump cleaning sequence. See section *Pump cleaning* (page *54*).	
83.01	*Pump cleaning status*	Displays the status of pump cleaning.	*Disabled*
	Disabled	Cleaning sequence is disabled.	0
	Pump clean	Cleaning sequence is active.	1
	No triggers configured	Triggers are not configured.	2
	Waiting for triggering	Waiting for triggering signal.	3

No.	Name/Value	Description	Def/FbEq16
	Triggered	Cleaning sequence is triggered by parameter *83.11* specifies warning generation only.	4
83.02	*Pump cleaning progress*	Displays the pump cleaning progress.	0.0
	0.0...100.0%	Percentage	10 = 1%
83.03	*Total cleaning count*	Displays the total cleaning count.	0
	0...1000000	Total cleaning count.	1 = 1
83.10	*Pump cleaning action*	Enables the pump cleaning action.	*Cleaning*
	Off	Pump cleaning is disabled.	0
	Cleaning	Pump cleaning is started based on triggers.	1
	Warning only	Generates warning message based on triggers.	2
83.11	*Pump cleaning triggers*	Enables/disables the pump cleaning sequence for the drive, and defines the triggering conditions. **Note:** If DI1 remains On after cleaning is finished, no cleaning sequence is started. The drive starts cleaning on next start, if the trigger signal is On when motor is started.	0b0000

Bit	Name	Description
0	Reserved	
1	Every start	Cleaning starts at every start.
2	Every stop	Cleaning starts at every stop.
3	Reserved	
4	Overload detection	Cleaning sequence starts when overload situation is detected. To set up the overload curve, see parameters in group *37 User load curve*.
5	Underload detection	Cleaning sequence starts when underload situation is detected. To set up the overload curve, see parameters in group *37 User load curve*.
6	Fixed time interval	Time interval defined by parameter *83.15 Fixed time interval*.
7	Combined timer1	Combined timer 1 of timed functions starts cleaning.
8...9	Reserved	
10	Supervision 1	Cleaning sequence starts when Supervision 1 is high.
11	Supervision 2	Cleaning sequence starts when Supervision 2 is high.
12	Supervision 3	Cleaning sequence starts when Supervision 3 is high.
13	DI4	Cleaning sequence starts when DI4 is high.
14	DI5	Cleaning sequence starts when DI5 is high.
15	DI6	Cleaning sequence starts when DI6 is high.

No.	Name/Value	Description	Def/FbEq16
83.12	*Manually force cleaning*	Starts pump cleaning.	*Not active*
	Not active	Pump cleaning is not active.	0
	Start cleaning now	Starts pump cleaning immediately.	1
	DI4	Starts pump cleaning when DI4 goes high.	2
	DI5	Starts pump cleaning when DI5 goes high.	3
	DI4	Starts pump cleaning when DI6 goes high.	4
	Other [bit]	Source selection (see *Terms and abbreviations* on page *100*).	-

No.	Name/Value	Description	Def/FbEq16
83.15	*Fixed time interval*	Defines the constant time interval between cleaning cycles. This parameter is used only when cleaning is triggered by time interval.	02:00:00h
	00:00:00...45:12:15 h	Time	1 = 1h
83.16	*Cycles in cleaning program*	Defines the number of cycles performed in cleaning program. For example, 1 cycle = 1 forward + 1 reverse step.	3
	1...65535	Value range	
83.20	*Cleaning speed step*	Defines the speed/frequency step size in pump cleaning. Cleaning speed step is same for positive and negative directions. **Note:** If you have disabled the negative rotation direction by speed limits, the pump cleaning does not operate in the negative direction.	80
	0...100%	Percentage of the cleaning speed/frequency value.	1 = 1%
83.25	*Time to cleaning speed*	Defines the time required for the drive to reach cleaning speed set by parameter *83.20 Cleaning speed step*.	3.000
	0.000...60.000 s	Time	1 = 1s
83.26	*Time to zero-speed*	Defines the time required for the drive to reach zero speed from the cleaning speed set by parameter *83.20 Cleaning speed step*.	3.000
	0.000...60.000 s	Time	1 = 1s
83.27	*Cleaning on time*	Defines the cleaning On time when the drive is running at cleaning speed set by parameter *83.20 Cleaning speed step*.	10.000
	0.000...1000.000 s	Time	1 = 1s
83.28	*Cleaning off time*	Defines the cleaning Off time when the drive stays at zero speed between positive and negative pulses and after one cleaning cycle before starting a new cleaning cycle.	5.000
	0.000...1000.000 s	Time	1 = 1s
83.35	*Cleaning count fault*	Activates the cleaning count monitoring, and selects the action it takes if it detects too many cleaning starts within the time defined by parameter *83.36 Cleaning count time*. See section *Cleaning count monitoring* (page *56*).	*No action*
	No action	No action	0
	Warning	Warning	1
	Fault	Fault	2
83.36	*Cleaning count time*	Defines the time for cleaning count monitoring. See section *Cleaning count monitoring* (page *56*).	00:01:00h
	00:00:00...45:12:15 h	Time	1 = 1h
83.37	*Maximum cleaning count*	Defines the maximum cleaning counts allowed. See section *Cleaning count monitoring* (page *56*).	5
	0...30	Maximum cleaning counts.	1 = 1

No.	Name/Value	Description	Def/FbEq16
95 HW configuration		Various hardware-related settings.	
95.01	*Supply voltage*	Selects the supply voltage range. This parameter is used by the drive to determine the nominal voltage of the supply network. The parameter also affects the current ratings and the DC voltage control functions (trip and brake chopper activation limits) of the drive. ⚠ **WARNING!** An incorrect setting may cause the motor to rush uncontrollably, or the brake chopper or resistor to overload. **Note:** The selections shown depend on the hardware of the drive. If only one voltage range is valid for the drive in question, it is selected by default.	*Automatic / not selected*
	Automatic / not selected	No voltage range selected. The drive will not start modulating before a range is selected, unless parameter *95.02 Adaptive voltage limits* is set to *Enable*, in which case the drive estimates the supply voltage itself.	0
	380…415 V	380…415 V	2
	440…480 V	440…480 V	3
95.02	*Adaptive voltage limits*	Enables adaptive voltage limits. Adaptive voltage limits can be used if, for example, an IGBT supply unit is used to raise the DC voltage level. If the communication between the inverter and IGBT supply unit is active, the voltage limits are related to the DC voltage reference from the IGBT supply unit. Otherwise the limits are calculated based on the measured DC voltage at the end of the pre-charging sequence. This function is also useful if the AC supply voltage to the drive is high, as the warning levels are raised accordingly.	*Enable*
	Disable	Adaptive voltage limits disabled.	0
	Enable	Adaptive voltage limits enabled.	1
95.03	*Estimated AC supply voltage*	AC supply voltage estimated by calculation. Estimation is done every time the drive is powered up and is based on the rise speed of voltage level of the DC bus while the drive charges the DC bus.	-
	0…65535 V	Voltage.	10 = 1 V
95.04	*Control board supply*	Specifies how the control board of the drive is powered.	*Internal 24V*
	Internal 24V	The drive control board is powered from the drive power unit it is connected to.	0
	External 24V	The drive control board is powered from an external power supply.	1

No.	Name/Value	Description	Def/FbEq16
95.15	*Special HW settings*	Contains hardware-related settings that can be enabled and disabled by toggling the specific bits. **Note:** The installation of the hardware specified by this parameter may require derating of drive output, or impose other limitations. Refer to the hardware manual of the drive.	

Bit	Name	Information
0	EX motor	
1	ABB Sine filter	1 = An ABB sine filter is connected to the output of the drive.
2…15	Reserved	

No.	Name/Value	Description	Def/FbEq16
	00000000h… FFFFFFFFh	Hardware options configuration word.	1 = 1
95.20	*HW options word 1*	Specifies hardware-related options that require differentiated parameter defaults. This parameter is not affected by a parameter restore.	

Bit	Name	Value
0	Supply frequency 60 Hz	See section *Differences in the default values between 50 Hz and 60 Hz supply frequency settings* on page *298*. 0 = 50 Hz. 1 = 60 Hz.
1…12	Reserved	
12	du/dt filter activation	When active, an external du/dt filter is connected to the drive/inverter output. The setting will limit the output switching frequency, and force the fan of the drive/inverter module to full speed. 0 = du/dt filter inactive. 1 = du/dt filter active.
14…15	Reserved	

No.	Name/Value	Description	Def/FbEq16
	0000h…FFFFh	Hardware options configuration word.	1 = 1

96 System		Language selection; access levels; macro selection; parameter save and restore; control unit reboot; user parameter sets; unit selection.	
96.01	*Language*	Selects the language of the parameter interface and other displayed information when viewed on the control panel. **Notes:** • Not all languages listed below are necessarily supported. • This parameter does not affect the languages visible in the Drive composer PC tool. (Those are specified under **View** - **Settings** - **Drive default language**.)	*Not selected*
	Not selected	None.	0
	English	English.	1033
	Deutsch	German.	1031
	Italiano	Italian.	1040
	Español	Spanish.	3082
	Français	French.	1036
	Suomi	Finnish.	1035

No.	Name/Value	Description	Def/FbEq16
	Svenska	Swedish.	1053
	Russki	Russian.	1049
	Cesky	Czech.	1029
96.02	*Pass code*	Pass codes can be entered into this parameter to activate further access levels (see parameter *96.03 Access level status*) or to configure the user lock. Entering “358” toggles the parameter lock, which prevents the changing of all other parameters through the control panel or the Drive composer PC tool. Entering the user pass code (by default, “10000000”) enables parameters *96.100…96.102*, which can be used to define a new user pass code and to select the actions that are to be prevented. Entering an invalid pass code will close the user lock if open, ie. hide parameters *96.100…96.102*. After entering the code, check that the parameters are in fact hidden. If they are not, enter another (random) pass code. **Note:** You must change the default user pass code to maintain a high level of cybersecurity. Store the code in a safe place – the protection cannot be disabled even by ABB if the code is lost. See also section *User lock* (page *97*).	
	0…99999999	Pass code.	-
96.03	*Access level status*	Shows which access levels have been activated by pass codes entered into parameter *96.02 Pass code*.	0001b

Bit	Name
0	End user
1	Service
2	Advanced programmer
3…10	Reserved
11	OEM access level 1
12	OEM access level 2
13	OEM access level 3
14	Parameter lock
15	Reserved

	00000000h… FFFFFFFFh	Active access levels.	-
96.06	*Parameter restore*	Restores the original settings of the control program, ie. parameter default values. **Note:** This parameter cannot be changed while the drive is running.	*Done*
	Done	Restoring is completed.	0

No.	Name/Value	Description	Def/FbEq16
	Restore defaults	Restores all editable parameter values to default values, except • motor data and ID run results • I/O extension module settings • end user texts, such as customized warnings and faults, and the drive name • control panel/PC communication settings • fieldbus adapter settings • control macro selection and the parameter defaults implemented by it • parameter *95.01 Supply voltage* • differentiated defaults implemented by parameters *95.20 HW options word 1* • user lock configuration parameters *96.100*…*96.102*.	8
	Clear all	Restores all editable parameter values to default values, except • end user texts, such as customized warnings and faults, and the drive name • control panel/PC communication settings • user lock configuration parameters *96.100*…*96.102*. • group *49 Panel port communication* parameters.	62
	Reset all fieldbus settings	Restores all fieldbus and communication related settings to default values. **Note:** Fieldbus, control panel and PC tool communication are interrupted during the restore.	32
	Reset home view	Restores the home view layout back to show the values of the default parameters defined by the control macro in use	512
	Reset end user texts	Restores all end user texts to default values, including the drive name, contact info, customized fault and warning texts, PID unit and currency unit.	1024
	Reset motor data	Restores all motor nominal values and motor ID run results to default values.	2
	All to factory defaults	• Restores all drive parameters and settings back to initial factory values.	34560
96.07	*Parameter save manually*	Saves the valid parameter values to the permanent memory on the drive control unit to ensure that operation can continue after cycling the power. Save the parameters with this parameter • to store values sent from the fieldbus • when using external +24 V DC power supply to the control unit: to save parameter changes before you power down the control unit. The supply has a very short hold-up time when powered off. **Note:** A new parameter value is saved automatically when changed from the PC tool or control panel but not when altered through a fieldbus adapter connection.	*Done*
	Done	Save completed.	0
	Save	Save in progress.	1
96.08	*Control board boot*	Changing the value of this parameter to 1 reboots the control unit (without requiring a power off/on cycle of the complete drive module). The value reverts to 0 automatically.	*No action*
	No action	1 = No action.	0
	Reboot	1 = Reboot the control unit.	1

No.	Name/Value	Description	Def/FbEq16
96.10	*User set status*	Shows the status of the user parameter sets. This parameter is read-only. See also section *User parameter sets* (page *96*).	-
	n/a	No user parameter sets have been saved.	0
	Loading	A user set is being loaded.	1
	Saving	A user set is being saved.	2
	Faulted	Invalid or empty parameter set.	3
	User1 IO active	User set 1 has been selected by parameters *96.12 User set I/O mode in1* and *96.13 User set I/O mode in2*.	4
	User2 IO active	User set 2 has been selected by parameters *96.12 User set I/O mode in1* and *96.13 User set I/O mode in2*.	5
	User3 IO active	User set 3 has been selected by parameters *96.12 User set I/O mode in1* and *96.13 User set I/O mode in2*.	6
	User4 IO active	User set 4 has been selected by parameters *96.12 User set I/O mode in1* and *96.13 User set I/O mode in2*.	7
	Reserved		8…19
	User1 backup	User set 1 has been saved or loaded.	20
	User2 backup	User set 2 has been saved or loaded.	21
	User3 backup	User set 3 has been saved or loaded.	22
	User4 backup	User set 4 has been saved or loaded.	23
96.11	*User set save/load*	Enables the saving and restoring of up to four custom sets of parameter settings. The set that was in use before powering down the drive is in use after the next power-up. **Notes:** • Some hardware configuration settings, such as I/O extension module and fieldbus configuration parameters (groups 14…16, 47, 50…58 and 92…93) are not included in user parameter sets. • Parameter changes made after loading a set are not automatically stored – they must be saved using this parameter. • This parameter cannot be changed while the drive is running	*No action*
	No action	Load or save operation complete; normal operation.	0
	User set I/O mode	Load user parameter set using parameters *96.12 User set I/O mode in1* and *96.13 User set I/O mode in2*.	1
	Load set 1	Load user parameter set 1.	2
	Load set 2	Load user parameter set 2.	3
	Load set 3	Load user parameter set 3.	4
	Load set 4	Load user parameter set 4.	5
	Reserved		6…17
	Save to set 1	Save user parameter set 1.	18
	Save to set 2	Save user parameter set 2.	19
	Save to set 3	Save user parameter set 3.	20
	Save to set 4	Save user parameter set 4.	21

<table>
<tr><th>No.</th><th>Name/Value</th><th>Description</th><th>Def/FbEq16</th></tr>
<tr><td><i>96.12</i></td><td><i>User set I/O mode in1</i></td><td>When parameter <i>96.11 User set save/load</i> is set to <i>User set I/O mode</i>, selects the user parameter set together with parameter <i>96.13 User set I/O mode in2</i> as follows:
<table>
<tr><th>Status of source defined by par. <i>96.12</i></th><th>Status of source defined by par. <i>96.13</i></th><th>User parameter set selected</th></tr>
<tr><td>0</td><td>0</td><td>Set 1</td></tr>
<tr><td>1</td><td>0</td><td>Set 2</td></tr>
<tr><td>0</td><td>1</td><td>Set 3</td></tr>
<tr><td>1</td><td>1</td><td>Set 4</td></tr>
</table></td><td><i>Not selected</i></td></tr>
<tr><td></td><td>Not selected</td><td>0.</td><td>0</td></tr>
<tr><td></td><td>Selected</td><td>1.</td><td>1</td></tr>
<tr><td></td><td>DI1</td><td>Digital input DI1 (<i>10.02 DI delayed status</i>, bit 0).</td><td>2</td></tr>
<tr><td></td><td>DI2</td><td>Digital input DI2 (<i>10.02 DI delayed status</i>, bit 1).</td><td>3</td></tr>
<tr><td></td><td>DI3</td><td>Digital input DI3 (<i>10.02 DI delayed status</i>, bit 2).</td><td>4</td></tr>
<tr><td></td><td>DI4</td><td>Digital input DI4 (<i>10.02 DI delayed status</i>, bit 3).</td><td>5</td></tr>
<tr><td></td><td>DI5</td><td>Digital input DI5 (<i>10.02 DI delayed status</i>, bit 4).</td><td>6</td></tr>
<tr><td></td><td>DI6</td><td>Digital input DI6 (<i>10.02 DI delayed status</i>, bit 5).</td><td>7</td></tr>
<tr><td></td><td>Reserved</td><td></td><td>8…17</td></tr>
<tr><td></td><td>Timed function 1</td><td>Bit 0 of <i>34.01 Timed functions status</i> (see page <i>191</i>).</td><td>18</td></tr>
<tr><td></td><td>Timed function 2</td><td>Bit 1 of <i>34.01 Timed functions status</i> (see page <i>191</i>).</td><td>19</td></tr>
<tr><td></td><td>Timed function 3</td><td>Bit 2 of <i>34.01 Timed functions status</i> (see page <i>191</i>).</td><td>20</td></tr>
<tr><td></td><td>Reserved</td><td></td><td>21…23</td></tr>
<tr><td></td><td>Supervision 1</td><td>Bit 0 of <i>32.01 Supervision status</i> (see page <i>184</i>).</td><td>24</td></tr>
<tr><td></td><td>Supervision 2</td><td>Bit 1 of <i>32.01 Supervision status</i> (see page <i>184</i>).</td><td>25</td></tr>
<tr><td></td><td>Supervision 3</td><td>Bit 2 of <i>32.01 Supervision status</i> (see page <i>184</i>).</td><td>26</td></tr>
<tr><td></td><td><i>Other [bit]</i></td><td>Source selection (see <i>Terms and abbreviations</i> on page <i>100</i>).</td><td>-</td></tr>
<tr><td><i>96.13</i></td><td><i>User set I/O mode in2</i></td><td>See parameter <i>96.12 User set I/O mode in1</i>.</td><td><i>Not selected</i></td></tr>
</table>

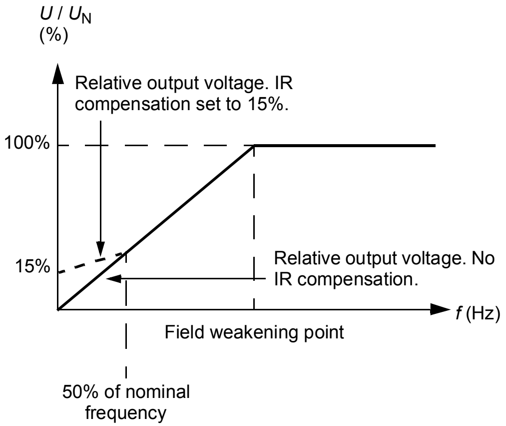
<table>
<tr><th>No.</th><th>Name/Value</th><th>Description</th><th>Def/FbEq16</th></tr>
<tr><td><i>96.16</i></td><td><i>Unit selection</i></td><td>Selects the unit of parameters indicating power, temperature and torque.</td><td>0000b</td></tr>
<tr><td></td><td colspan="3">
<table>
<tr><th>Bit</th><th>Name</th><th>Information</th></tr>
<tr><td rowspan="2">0</td><td rowspan="2">Power unit</td><td>0 = kW</td></tr>
<tr><td>1 = hp</td></tr>
<tr><td>1</td><td colspan="2">Reserved</td></tr>
<tr><td rowspan="2">2</td><td rowspan="2">Temperature unit</td><td>0 = °C</td></tr>
<tr><td>1 = °F</td></tr>
<tr><td>3</td><td colspan="2">Reserved</td></tr>
<tr><td rowspan="2">4</td><td rowspan="2">Torque unit</td><td>0 = Nm (N·m)</td></tr>
<tr><td>1 = lbft (lb·ft)</td></tr>
<tr><td>5…15</td><td colspan="2">Reserved</td></tr>
</table>
</td></tr>
<tr><td></td><td>0000h…FFFFh</td><td>Unit selection word.</td><td>1 = 1</td></tr>
<tr><td><i>96.20</i></td><td><i>Time sync primary source</i></td><td>Defines the 1st priority external source for synchronization of the drive’s time and date.</td><td><i>Panel link</i></td></tr>
<tr><td></td><td>Internal</td><td>No external source selected.</td><td>0</td></tr>
<tr><td></td><td>Fieldbus A</td><td>Fieldbus interface A.</td><td>2</td></tr>
<tr><td></td><td>Embedded FB</td><td>Embedded fieldbus interface.</td><td>6</td></tr>
<tr><td></td><td>Panel link</td><td>Control panel, or Drive composer PC tool connected to the control panel.</td><td>8</td></tr>
<tr><td></td><td>Ethernet tool link</td><td>Drive composer PC tool through an FENA module.</td><td>9</td></tr>
<tr><td><i>96.51</i></td><td><i>Clear fault and event logger</i></td><td>Clears all events from the drive’s fault and event logs.</td><td><i>Done</i></td></tr>
<tr><td></td><td>Done</td><td>0 = No action</td><td>0</td></tr>
<tr><td></td><td>Clear</td><td>1 = Clear the loggers.</td><td>1</td></tr>
<tr><td></td><td>0…1</td><td></td><td>1 = 1</td></tr>
<tr><td><i>96.70</i></td><td><i>Disable adaptive program</i></td><td>Enables/disables the adaptive program (if present).
See also section <i>Adaptive programming</i> (page <i>43</i>).</td><td><i>Yes</i></td></tr>
<tr><td></td><td>No</td><td>Adaptive program enabled.</td><td>0</td></tr>
<tr><td></td><td>Yes</td><td>Adaptive program disabled.</td><td>1</td></tr>
<tr><td><i>96.100</i></td><td><i>Change user pass code</i></td><td><i>(Visible when user lock is open)</i>
To change the current user pass code, enter a new code into this parameter as well as <i>96.101 Confirm user pass code</i>. A warning will be active until the new pass code is confirmed.
To cancel changing the pass code, close the user lock without confirming. To close the lock, enter an invalid pass code in parameter <i>96.02 Pass code</i>, activate parameter <i>96.08 Control board boot</i>, or cycle the power.
See also section <i>User lock</i> (page <i>97</i>).</td><td>10000000</td></tr>
<tr><td></td><td>10000000…
99999999</td><td>New user pass code.</td><td>-</td></tr>
<tr><td><i>96.101</i></td><td><i>Confirm user pass code</i></td><td><i>(Visible when user lock is open)</i>
Confirms the new user pass code entered in <i>96.100 Change user pass code</i>.</td><td></td></tr>
<tr><td></td><td>10000000…
99999999</td><td>Confirmation of new user pass code.</td><td>-</td></tr>
</table>

<table>
<tr><th>No.</th><th>Name/Value</th><th>Description</th><th>Def/FbEq16</th></tr>
<tr><td>*96.102*</td><td>*User lock functionality*</td><td>*(Visible when user lock is open)*
Selects the actions or functionalities to be prevented by the user lock. Note that the changes made take effect only when the user lock is closed. See parameter *96.02 Pass code*.
Note: We recommend you select all the actions and functionalities unless otherwise required by the application.</td><td>0000h</td></tr>
<tr><td></td><td colspan="3">
<table>
<tr><th>Bit</th><th>Name</th><th>Information</th></tr>
<tr><td>0</td><td>Disable ABB access levels</td><td>1 = ABB access levels (service, advanced programmer, etc.; see *96.03*) disabled</td></tr>
<tr><td>1</td><td>Freeze parameter lock state</td><td>1 = Changing the parameter lock state prevented, ie. pass code 358 has no effect</td></tr>
<tr><td>2</td><td>Disable file download</td><td>1 = Loading of files to drive prevented. This applies to
• firmware upgrades
• parameter restore
• loading an adaptive program
• changing home view of control panel
• editing drive texts
• editing the favorite parameters list on control panel
• configuration settings made through control panel such as time/date formats and enabling/disabling clock display.</td></tr>
<tr><td>3…10</td><td colspan="2">Reserved</td></tr>
<tr><td>11</td><td>Disable OEM access level 1</td><td>1 = OEM access level 1 disabled</td></tr>
<tr><td>12</td><td>Disable OEM access level 2</td><td>1 = OEM access level 2 disabled</td></tr>
<tr><td>13</td><td>Disable OEM access level 3</td><td>1 = OEM access level 3 disabled</td></tr>
<tr><td>14…15</td><td colspan="2">Reserved</td></tr>
</table>
</td></tr>
<tr><td></td><td>0000h…FFFFh</td><td>Selection of actions to be prevented by user lock.</td><td>-</td></tr>
</table>

97 Motor control		Switching frequency; slip gain; voltage reserve; flux braking; anti-cogging (signal injection); IR compensation.	
97.01	*Switching frequency reference*	Defines the switching frequency of the drive that is used as long as the drive stays below the thermal limit. See section *Switching frequency* on page *79*. Higher switching frequency results in lower acoustic motor noise. Lower switching frequency generates less switching losses and reduce EMC emissions. **Note:** If you have a multimotor system, contact your local ABB representative.	*4 kHz*
	2 kHz	2 kHz.	2

No.	Name/Value	Description	Def/FbEq16
	4 kHz	4 kHz.	4
	8 kHz	8 kHz.	8
97.02	*Minimum switching frequency*	Lowest switching frequency value that is allowed. Depends on the frame size. When drive is reaching the thermal limit, it will automatically start to reduce the switching frequency until the minimum allowed value is reached. Once the minimum has been reached, the drive will automatically start limiting the output current to keep the temperature below the thermal limit. Inverter temperature is shown by parameter *05.11 Inverter temperature*.	*2 kHz*
	2 kHz	2 kHz.	2
	4 kHz	4 kHz.	4
	8 kHz	8 kHz.	8
97.03	*Slip gain*	Defines the slip gain which is used to improve the estimated motor slip. 100% means full slip gain; 0% means no slip gain. The default value is 100%. Other values can be used if a static speed error is detected despite having the setting at full slip gain. **Example** (with nominal load and nominal slip of 40 rpm): A 1000 rpm constant speed reference is given to the drive. Despite having full slip gain (= 100%), a manual tachometer measurement from the motor axis gives a speed value of 998 rpm. The static speed error is 1000 rpm - 998 rpm = 2 rpm. To compensate the error, the slip gain should be increased to 105% (2 rpm / 40 rpm = 5%).	100%
	0…200%	Slip gain.	1 = 1%
97.04	*Voltage reserve*	Defines the minimum allowed voltage reserve. When the voltage reserve has decreased to the set value, the drive enters the field weakening area. **Note:** This is an expert level parameter and should not be adjusted without appropriate skill. If the intermediate circuit DC voltage U_{dc} = 550 V and the voltage reserve is 5%, the RMS value of the maximum output voltage in steady-state operation is 0.95 × 550 V / sqrt(2) = 369 V The dynamic performance of the motor control in the field weakening area can be improved by increasing the voltage reserve value, but the drive enters the field weakening area earlier.	-2%
	-4…50%	Voltage reserve.	1 = 1%
97.05	*Flux braking*	Defines the level of flux braking power. (Other stopping and braking modes can be configured in parameter group *21 Start/stop mode*). **Note:** This is an expert level parameter and should not be adjusted without appropriate skill.	*Disabled*
	Disabled	Flux braking is disabled.	0
	Moderate	Flux level is limited during the braking. Deceleration time is longer compared to full braking.	1

No.	**Name/Value**	**Description**	**Def/FbEq16**
	Full	Maximum braking power. Almost all available current is used to convert the mechanical braking energy to thermal energy in the motor. ⚠ **WARNING!** Using full flux braking heats up the motor especially in cyclic operation. Make sure that the motor can withstand this if you have a cyclic application.	2
97.08	*Optimizer minimum torque*	This parameter can be used to improve the control dynamics of a synchronous reluctance motor or a salient permanent magnet synchronous motor. As a rule of thumb, define a level to which the output torque must rise with minimum delay. This will increase the motor current and improve the torque response at low speeds.	0.0%
	0.0 … 1600.0%	Optimizer torque limit.	10 = 1%
97.09	*Switching frequency mode*	An optimization setting for balancing between control performance and motor noise level. **Note:** This is an expert level parameter and should not be adjusted without appropriate skill	*Normal*
	Normal	Control performance optimized for long motor cables.	0
	Low noise	Minimizes motor noise. **Note:** This setting requires derating. Refer to the rating data in the *Hardware manual*.	1
97.10	*Signal injection*	Enables the anti-cogging function: a high-frequency alternating signal is injected to the motor in the low speed region to improve the stability of torque control. This removes the “cogging” that can sometimes be seen as the rotor passes the motor magnetic poles. Anti-cogging can be enabled with different amplitude levels. **Notes:** • This is an expert level parameter and should not be adjusted without appropriate skill. • Use as low a level as possible that gives satisfactory performance. • Signal injection cannot be applied to asynchronous motors.	*Disabled*
	Disabled	Anti-cogging disabled.	0
	Enabled (5%)	Anti-cogging enabled with amplitude level of 5%.	1
	Enabled (10%)	Anti-cogging enabled with amplitude level of 10%.	2
	Enabled (15%)	Anti-cogging enabled with amplitude level of 15%.	3
	Enabled (20%)	Anti-cogging enabled with amplitude level of 20%.	4
97.11	*TR tuning*	Rotor time constant tuning. This parameter can be used to improve torque accuracy in closed-loop control of an induction motor. Normally, the motor identification run provides sufficient torque accuracy, but manual fine-tuning can be applied in exceptionally demanding applications to achieve optimal performance. **Note:** This is an expert level parameter and should not be adjusted without appropriate skill.	100%
	25…400%	Rotor time constant tuning.	1 = 1%

No.	Name/Value	Description	Def/FbEq16
97.13	*IR compensation*	Defines the relative output voltage boost at zero speed (IR compensation). The function is useful in applications with a high break-away torque where vector control cannot be applied.  See also section *IR compensation for scalar motor control* on page *73*.	3.50%
	0.00…50.00%	Voltage boost at zero speed in percent of nominal motor voltage.	1 = 1%
97.15	*Motor model temperature adaptation*	Enables the motor model temperature adaptation. Estimated motor temperature can be used to adapt temperature dependent parameters (e.g. resistances) of motor model.	*Disabled*
	Disabled	Temperature adaptation disabled.	0
	Estimated temperature	Temperature adaptation with motor temperature estimate (parameter *35.01 Motor estimated temperature*).	1
97.20	*U/F ratio*	Selects the form for the *U/f* (voltage to frequency) ratio below field weakening point. For scalar control only. **Note:** The U/f function cannot be used with energy optimization; if *45.11 Energy optimizer* is set to *Enable*, parameter *97.20 U/F ratio* is ignored.	*Squared*
	Linear	Linear ratio for constant torque applications.	0
	Squared	Squared ratio for centrifugal pump and fan applications. With squared U/f ratio the noise level is lower for most operating frequencies. Not recommended for permanent magnet motors.	1

No.	Name/Value	Description	Def/FbEq16
98 User motor parameters		Motor values supplied by the user that are used in the motor model. These parameters are useful for non-standard motors, or to just get more accurate motor control of the motor on site. A better motor model always improves the shaft performance.	
98.01	User motor model mode	Activates the motor model parameters 98.02…98.12 and 98.14. **Notes**: • Parameter value is automatically set to zero when ID run is selected by parameter 99.13 ID run requested. The values of parameters 98.02…98.12 are then updated according to the motor characteristics identified during the ID run. • Measurements made directly from the motor terminals during the ID run are likely to produce slightly different values than those on a data sheet from a motor manufacturer. • This parameter cannot be changed while the drive is running.	Not selected
	Not selected	Parameters 98.02…98.12 inactive.	0
	Motor parameters	The values of parameters 98.02… 98.12 are used as the motor model.	1
98.02	Rs user	Defines the stator resistance R_S of the motor model. With a star-connected motor, R_S is the resistance of one winding. With a delta-connected motor, R_S is one-third of the resistance of one winding.	0.00000 p.u.
	0.00000…0.50000 p.u.	Stator resistance in per unit.	-
98.03	Rr user	Defines the rotor resistance R_R of the motor model. **Note:** This parameter is valid only for asynchronous motors.	0.00000 p.u.
	0.00000…0.50000 p.u.	Rotor resistance in per unit.	-
98.04	Lm user	Defines the main inductance L_M of the motor model. **Note:** This parameter is valid only for asynchronous motors.	0.00000 p.u.
	0.00000…10.00000 p.u.	Main inductance in per unit.	-
98.05	SigmaL user	Defines the leakage inductance σL_S. **Note:** This parameter is valid only for asynchronous motors.	0.00000 p.u.
	0.00000…1.00000 p.u.	Leakage inductance in per unit.	-
98.06	Ld user	Defines the direct axis (synchronous) inductance. **Note:** This parameter is valid only for permanent magnet motors.	0.00000 p.u.
	0.00000…10.00000 p.u	Direct axis inductance in per unit.	-
98.07	Lq user	Defines the quadrature axis (synchronous) inductance. **Note:** This parameter is valid only for permanent magnet motors.	0.00000 p.u.
	0.00000…10.00000 p.u	Quadrature axis inductance in per unit.	-

No.	Name/Value	Description	Def/FbEq16
98.08	*PM flux user*	Defines the permanent magnet flux. **Note:** This parameter is valid only for permanent magnet motors.	0.00000 p.u.
	0.00000… 2.00000 p.u	Permanent magnet flux in per unit.	-
98.09	*Rs user SI*	Defines the stator resistance R_S of the motor model.	0.00000 ohm
	0.00000…100.00000 ohm	Stator resistance.	-
98.10	*Rr user SI*	Defines the rotor resistance R_R of the motor model. **Note:** This parameter is valid only for asynchronous motors.	0.00000 ohm
	0.00000…100.00000 ohm	Rotor resistance.	-
98.11	*Lm user SI*	Defines the main inductance L_M of the motor model. **Note:** This parameter is valid only for asynchronous motors.	0.00 mH
	0.00…100000.00 mH	Main inductance.	1 = 10000 mH
98.12	*SigmaL user SI*	Defines the leakage inductance σL_S. **Note:** This parameter is valid only for asynchronous motors.	0.00 mH
	0.00…100000.00 mH	Leakage inductance.	1 = 10000 mH
98.13	*Ld user SI*	Defines the direct axis (synchronous) inductance. **Note:** This parameter is valid only for permanent magnet motors.	0.00 mH
	0.00…100000.00 mH	Direct axis inductance.	1 = 10000 mH
98.14	*Lq user SI*	Defines the quadrature axis (synchronous) inductance. **Note:** This parameter is valid only for permanent magnet motors.	0.00 mH
	0.00…100000.00 mH	Quadrature axis inductance.	1 = 10000 mH
99 Motor data		Motor configuration settings.	
99.03	*Motor type*	Selects the motor type. **Note:** This parameter cannot be changed while the drive is running.	*Asynchronous motor*
	Asynchronous motor	Standard squirrel cage AC induction motor (asynchronous induction motor).	0
	Permanent magnet motor	Permanent magnet motor. Three-phase AC synchronous motor with permanent magnet rotor and sinusoidal BackEMF voltage. **Note:** With permanent magnet motors special attention must be paid on setting the motor nominal values correctly in parameter group *99 Motor data*. You must use vector control. If the nominal BackEMF voltage of the motor is not available, a full ID run should be performed for improving performance.	1
	SynRM	Synchronous reluctance motor. Three-phase AC synchronous motor with salient pole rotor without permanent magnets. You must use vector control.	2

No.	Name/Value	Description	Def/FbEq16
99.04	*Motor control mode*	Selects the motor control mode.	*Scalar*
	Vector	Vector control. Vector control has better accuracy than scalar control but cannot be used in all situations (see selection *Scalar* below). Requires motor identification run (ID run). See parameter *99.13 ID run requested*. **Note:** In vector control the drive performs a standstill ID run at the first start if ID run has not been previously performed. A new start command is required after standstill ID run. **Note:** To achieve a better motor control performance, you can perform a normal ID run without load. See also section *Operating modes of the drive* (page *40*).	0
	Scalar	Scalar control. Suitable for most applications, if top performance is not required. Motor identification run is not required. **Note:** Scalar control must be used in the following situations: • with multimotor systems 1) if the load is not equally shared between the motors, 2) if the motors are of different sizes, or 3) if the motors are going to be changed after the motor identification (ID run) • if the nominal current of the motor is less than 1/6 of the nominal output current of the drive • if the drive is used with no motor connected (for example, for test purposes). **Note:** Correct motor operation requires that the magnetizing current of the motor does not exceed 90% of the nominal current of the inverter. See also section *DC voltage control* (page *80*), and section *Operating modes of the drive* (page *40*).	1
99.06	*Motor nominal current*	Defines the nominal motor current. Must be equal to the value on the motor rating plate. If multiple motors are connected to the drive, enter the total current of the motors. **Notes:** • Correct motor operation requires that the magnetizing current of the motor does not exceed 90% of the nominal current of the drive. • This parameter cannot be changed while the drive is running.	0.0 A
	0.0…6400.0 A	Nominal current of the motor. The allowable range is 1/6…2 × I_N of the drive (0…2 × I_N with scalar control mode).	1 = 1 A
99.07	*Motor nominal voltage*	Defines the nominal motor voltage supplied to the motor. This setting must match the value on the rating plate of the motor. **Notes:** • With permanent magnet motors, the nominal voltage is the BackEMF voltage at nominal speed of the motor. If the voltage is given as voltage per rpm, e.g. 60 V per 1000 rpm, the voltage for a nominal speed of 3000 rpm is 3 × 60 V = 180 V. • The stress on the motor insulation is always dependent on the drive supply voltage. This also applies to the case where the motor voltage rating is lower than that of the drive and the supply. • This parameter cannot be changed while the drive is running.	0.0 V
	0.0…960.0 V	Nominal voltage of the motor.	10 = 1 V

No.	Name/Value	Description	Def/FbEq16
99.08	*Motor nominal frequency*	Defines the nominal motor frequency. This setting must match the value on the rating plate of the motor. **Note:** This parameter cannot be changed while the drive is running.	50.0 Hz
	0.0…500.0 Hz	Nominal frequency of the motor.	10 = 1 Hz
99.09	*Motor nominal speed*	Defines the nominal motor speed. The setting must match the value on the rating plate of the motor. **Note:** This parameter cannot be changed while the drive is running.	0 rpm
	0…30000 rpm	Nominal speed of the motor.	1 = 1 rpm
99.10	*Motor nominal power*	Defines the nominal motor power. The setting must match the value on the rating plate of the motor. If multiple motors are connected to the drive, enter the total power of the motors. The unit is selected by parameter *96.16 Unit selection*. **Note:** This parameter cannot be changed while the drive is running.	0.00 kW or hp
	0.00… 10000.00 kW or 0.00… 13404.83 hp	Nominal power of the motor.	1 = 1 unit
99.11	*Motor nominal cos Φ*	Defines the cosphi of the motor for a more accurate motor model. The value is not obligatory, but is useful with an asynchronous motor, especially when performing a standstill identification run. With a permanent magnet or synchronous reluctance motor, this value is not needed. **Notes:** • Do not enter an estimated value. If you do not know the exact value, leave the parameter at zero. • This parameter cannot be changed while the drive is running.	0.00
	0.00…1.00	Cosphi of the motor.	100 = 1
99.12	*Motor nominal torque*	Defines the nominal motor shaft torque for a more accurate motor model. Not obligatory. The unit is selected by parameter *96.16 Unit selection*. **Note:** This parameter cannot be changed while the drive is running.	0.000 N·m or lb·ft
	0.000…4000000.000 N·m or 0.000…2950248.597 lb·ft	Nominal motor torque.	1 = 100 unit

No.	Name/Value	Description	Def/FbEq16
99.13	*ID run requested*	Selects the type of the motor identification routine (ID run) performed at the next start of the drive. During the ID run, the drive will identify the characteristics of the motor for optimum motor control. If no ID run has been performed yet (or if default parameter values have been restored using parameter *96.06 Parameter restore*), this parameter is automatically set to *Standstill*, signifying that an ID run must be performed. After the ID run, the drive stops and this parameter is automatically set to *None*. **Notes:** • To ensure that the ID run can work properly, the drive limits in group *30* (maximum speed and minimum speed, and maximum torque and minimum torque) must to be large enough (the range specified by the limits must be wide enough. If eg. speed limits are less than the motor nominal speed, the ID run cannot be completed. • For the *Advanced* ID run, the machinery must always be de-coupled from the motor. • With a permanent magnet or synchronous reluctance motor, a *Normal*, *Reduced* or *Standstill* ID run requires that the motor shaft is NOT locked and the load torque is less than 10%. • With scalar control mode (*99.04 Motor control mode* = *Scalar*), the ID run is not requested automatically. However, an ID run can be performed for more accurate torque estimation. • Once the ID run is activated, it can be canceled by stopping the drive. • The ID run must be performed every time any of the motor parameters (*99.04*, *99.06*…*99.12*) have been changed. • Ensure that the Safe Torque Off and emergency stop circuits (if any) are closed during the ID run. • Mechanical brake (if present) is not opened by the logic for the ID run. • This parameter cannot be changed while the drive is running.	*None*
	None	No motor ID run is requested. This mode can be selected only if the ID run (*Normal*/*Reduced*/*Standstill*/*Advanced*) has already been performed once.	0
	Normal	Normal ID run. Guarantees good control accuracy for all cases. The ID run takes about 90 seconds. This mode should be selected whenever it is possible. **Notes:** • If the load torque will be higher than 20% of motor nominal torque, or if the machinery is not able to withstand the nominal torque transient during the ID run, then the driven machinery must be de-coupled from the motor during a Normal ID run. • Check the direction of rotation of the motor before starting the ID run. During the run, the motor will rotate in the forward direction. ⚠ **WARNING!** The motor will run at up to approximately 50…100% of the nominal speed during the ID run. ENSURE THAT IT IS SAFE TO RUN THE MOTOR BEFORE PERFORMING THE ID RUN!	1

No.	Name/Value	Description	Def/FbEq16
	Reduced	Reduced ID run. This mode should be selected instead of the *Normal* or *Advanced* ID Run if • mechanical losses are higher than 20% (ie. the motor cannot be de-coupled from the driven equipment), or if • flux reduction is not allowed while the motor is running (ie. in case of a motor with an integrated brake supplied from the motor terminals). With this ID run mode, the resultant motor control in the field weakening area or at high torques is not necessarily as accurate as motor control following a Normal ID run. Reduced ID run is completed faster than the Normal ID Run (< 90 seconds). **Note:** Check the direction of rotation of the motor before starting the ID run. During the run, the motor will rotate in the forward direction. ⚠ **WARNING!** The motor will run at up to approximately 50…100% of the nominal speed during the ID run. ENSURE THAT IT IS SAFE TO RUN THE MOTOR BEFORE PERFORMING THE ID RUN!	2
	Standstill	Standstill ID run. The motor is injected with DC current. With an AC induction (asynchronous) motor, the motor shaft is not rotated. With a permanent magnet motor, the shaft can rotate up to half a revolution. **Note:** This mode should be selected only if the *Normal*, *Reduced* or *Advanced* ID run is not possible due to the restrictions caused by the connected mechanics (e.g. with lift or crane applications).	3
	Reserved		4…5
	Advanced	Advanced ID run. Guarantees the best possible control accuracy. The ID run takes a very long time to complete. This mode should be selected when top performance is needed across the whole operating area. **Note:** The driven machinery must be de-coupled from the motor because of high torque and speed transients that are applied. ⚠ **WARNING!** The motor may run at up to the maximum (positive) and minimum (negative) allowed speed during the ID run. Several accelerations and decelerations are done. The maximum torque, current and speed allowed by the limit parameters may be utilized. ENSURE THAT IT IS SAFE TO RUN THE MOTOR BEFORE PERFORMING THE ID RUN!	6
99.14	*Last ID run performed*	Shows the type of ID run that was performed last. For more information about the different modes, see the selections of parameter *99.13 ID run requested*.	*None*
	None	No ID run has been performed.	0
	Normal	*Normal* ID run.	1
	Reduced	*Reduced* ID run.	2
	Standstill	*Standstill* ID run.	3
	Reserved		4…5
	Advanced	*Advanced* ID run.	6

No.	Name/Value	Description	Def/FbEq16
99.15	*Motor polepairs calculated*	Calculated number of pole pairs in the motor.	0
	0…1000	Number of pole pairs.	1 = 1
99.16	*Motor phase order*	Switches the rotation direction of motor. This parameter can be used if the motor turns in the wrong direction (for example, because of the wrong phase order in the motor cable), and correcting the cabling is considered impractical. **Note:** • Changing this parameter does not affect speed reference polarities, so positive speed reference will rotate the motor forward. The phase order selection just ensures that “forward” is in fact the correct direction.	*U V W*
	U V W	Normal.	0
	U W V	Reversed rotation direction.	1

Differences in the default values between 50 Hz and 60 Hz supply frequency settings

Parameter *95.20 HW options word 1* bit 0 *Supply frequency 60 Hz* changes the drive parameter default values according to the supply frequency, 50 Hz or 60 Hz. The bit is set according to the market before the drive is delivered.

If you need to change from 50 Hz to 60 Hz, or vice versa, change the value of the bit and then do a complete reset to the drive. After that you have to reselect the macro to be used.

The table below shows the parameters whose default values depend on the supply frequency setting. The supply frequency setting, with the type designation of the drive, also affects Group *99 Motor data* parameter values though these parameters are not listed in the table.

No	**Name**	*95.20 HW options word 1* bit *Supply frequency 60 Hz* = **50 Hz**	*95.20 HW options word 1* bit *Supply frequency 60 Hz* = **60 Hz**
11.45	*Freq in 1 at scaled max*	1500.000	1800.000
15.35	*Freq out 1 src max*	1500.000	1800.000
12.20	*AI1 scaled at AI1 max*	50.000	60.000
13.18	*AO1 source max*	50.0	60.0
22.26	*Constant speed 1*	300.00 rpm	360.00 rpm
22.27	*Constant speed 2*	600.00 rpm	720.00 rpm
22.28	*Constant speed 3*	900 .00 rpm	1080.00 rpm
22.29	*Constant speed 4*	1200.00 rpm	1440.00 rpm
22.30	*Constant speed 5*	1500.00 rpm	1800.00 rpm
22.30	*Constant speed 6*	2400.00 rpm	2880.00 rpm
22.31	*Constant speed 7*	3000.00 rpm	3600.00 rpm
28.26	*Constant frequency 1*	5.00 Hz	6.00 Hz
28.27	*Constant frequency 2*	10.00 Hz	12.00 Hz
28.28	*Constant frequency 3*	15.00 Hz	18.00 Hz
28.29	*Constant frequency 4*	20.00 Hz	24.00 Hz
28.30	*Constant frequency 5*	25.00 Hz	30.00 Hz
28.31	*Constant frequency 6*	40.00 Hz	48.00 Hz
28.32	*Constant frequency 7*	50.00 Hz	60.00 Hz

No	**Name**	*95.20 HW options word 1* bit *Supply frequency 60 Hz* = **50 Hz**	*95.20 HW options word 1* bit *Supply frequency 60 Hz* = **60 Hz**
30.12	*Maximum speed*	1500.00 rpm	1800.00 rpm
30.14	*Maximum frequency*	50.00 Hz	60.00 Hz
31.26	*Stall speed limit*	150.00 rpm	180.00 rpm
31.27	*Stall frequency limit*	15.00 Hz	18.00 Hz
31.30	*Overspeed trip margin*	500.00 rpm	500.00 rpm
46.01	*Speed scaling*	1500.00 rpm	1800.00 rpm
46.02	*Frequency scaling*	50.00 Hz	60.00 Hz
46.31	*Above speed limit*	1500.00 rpm	1800.00 rpm
46.32	*Above frequency limit*	50.00 Hz	60.00 Hz

7

Additional parameter data

What this chapter contains

This chapter lists the parameters with some additional data such as their ranges and 32-bit fieldbus scaling. For parameter descriptions, see chapter *Parameters* (page *99*).

Terms and abbreviations

Term	**Definition**
Actual signal	Signal measured or calculated by the drive. Usually can only be monitored but not adjusted; some counter-type signals can however be reset.
Analog src	Analog source: the parameter can be set to the value of another parameter by choosing “Other”, and selecting the source parameter from a list. In addition to the “Other” selection, the parameter may offer other pre-selected settings.
Binary src	Binary source: the value of the parameter can be taken from a specific bit in another parameter value (“Other”). Sometimes the value can be fixed to 0 (false) or 1 (true). In addition, the parameter may offer other pre-selected settings.
Data	Data parameter
FbEq32	32-bit fieldbus equivalent: The scaling between the value shown on the panel and the integer used in communication when a 32-bit value is selected for transmission to an external system. The corresponding 16-bit scalings are listed in chapter *Parameters* (page *99*).
List	Selection list.

Term	**Definition**
No.	Parameter number.
PB	Packed Boolean (bit list).
Real	Real number.
Type	Parameter type. See *Analog src*, *Binary src*, *List*, *PB*, *Real*.

Fieldbus addresses

Refer to the *User's manual* of the fieldbus adapter.

Parameter groups 1…9

No.	Name	Type	Range	Unit	FbEq32
01 Actual values					
01.01	Motor speed used	*Real*	-30000.00…30000.00	rpm	100 = 1 rpm
01.02	Motor speed estimated	*Real*	-30000.00…30000.00	rpm	100 = 1 rpm
01.03	Motor speed %	*Real*	-1000.00…1000.00	%	100 = 1%
01.06	Output frequency	*Real*	-500.00…500.00	Hz	100 = 1 Hz
01.07	Motor current	*Real*	0.00…30000.00	A	100 = 1 A
01.08	Motor current % of motor nom	*Real*	0.0…1000.0	%	10 = 1%
01.09	Motor current % of drive nom	*Real*	0.0…1000.0	%	10 = 1%
01.10	Motor torque	*Real*	-1600.0…1600.0	%	10 = 1%
01.11	DC voltage	*Real*	0.00…2000.00	V	100 = 1 V
01.13	Output voltage	*Real*	0…2000	V	1 = 1 V
01.14	Output power	*Real*	-32768.00…32767.00	kW or hp	100 = 1 unit
01.15	Output power % of motor nom	*Real*	-300.00…300.00	%	100 = 1%
01.16	Output power % of drive nom	*Real*	-300.00…300.00	%	100 = 1%
01.17	Motor shaft power	*Real*	-32768.00…32767.00	kW or hp	100 = 1 unit
01.18	Inverter GWh counter	*Real*	0…65535	GWh	1 = 1 GWh
01.19	Inverter MWh counter	*Real*	0…1000	MWh	1 = 1 MWh
01.20	Inverter kWh counter	*Real*	0…1000	kWh	1 = 1 kWh
01.24	Flux actual %	*Real*	0…200	%	1 = 1%
01.30	Nominal torque scale	*Real*	0.000…4000000	N·m or lb·ft	1000 = 1 unit
01.31	Ambient temperature	*Real*	-40.0…120.0	°C or °F	10 = 1 °
01.50	Current hour kWh	*Real*	0.00…1000000.00	kWh	100 = 1 kWh
01.51	Previous hour kWh	*Real*	0.00…1000000.00	kWh	100 = 1 kWh
01.52	Current day kWh	*Real*	0.00…1000000.00	kWh	100 = 1 kWh
01.53	Previous day kWh	*Real*	0.00…1000000.00	kWh	100 = 1 kWh
01.54	Cumulative inverter energy	*Real*	-200000000.0… 200000000.0	kWh	1 = 1 kWh
01.55	Inverter GWh counter (resettable)	*Real*	0…65535	GWh	1 = 1 GWh
01.56	Inverter MWh counter (resettable)	*Real*	0…1000	MWh	1 = 1 MWh
01.57	Inverter kWh counter (resettable)	*Real*	0…1000	kWh	1 = 1 kWh
01.58	Cumulative inverter energy (resettable)	*Real*	-200000000.0… 200000000.0	kWh	1 = 1 kWh
01.61	Abs motor speed used	*Real*	0.00…30000.00	rpm	100 = 1 rpm
01.62	Abs motor speed %	*Real*	0.00…1000.00%	%	100 = 1%
01.63	Abs output frequency	*Real*	0.00…500.00 Hz	Hz	100 = 1 Hz
01.64	Abs motor torque	*Real*	0.0…1600.0	%	10 = 1%
01.65	Abs output power	*Real*	0.00…32767.00	kW	100 = 1 kW
01.66	Abs output power % motor nom	*Real*	0.00…300.00	%	100 = 1%

No.	Name	Type	Range	Unit	FbEq32
01.67	Abs output power % drive nom	*Real*	0.00…300.00	%	100 = 1%
01.68	Abs motor shaft power	*Real*	0.00…32767.00	kW	100 = 1 kW
03 Input references					
03.01	Panel reference	*Real*	-100000.00…100000.00	-	100 = 1
03.02	Panel reference remote	*Real*	-100000.00…100000.00	-	100 = 1
03.05	FB A reference 1	*Real*	-100000.00…100000.00	-	100 = 1
03.06	FB A reference 2	*Real*	-100000.00…100000.00	-	100 = 1
03.09	EFB reference 1	*Real*	-30000.00…30000.00	-	100 = 1
03.10	EFB reference 2	*Real*	-30000.00…30000.00	-	100 = 1
04 Warnings and faults					
04.01	Tripping fault	*Data*	0000h…FFFFh	-	1 = 1
04.02	Active fault 2	*Data*	0000h…FFFFh	-	1 = 1
04.03	Active fault 3	*Data*	0000h…FFFFh	-	1 = 1
04.06	Active warning 1	*Data*	0000h…FFFFh	-	1 = 1
04.07	Active warning 2	*Data*	0000h…FFFFh	-	1 = 1
04.08	Active warning 3	*Data*	0000h…FFFFh	-	1 = 1
04.11	Latest fault	*Data*	0000h…FFFFh	-	1 = 1
04.12	2nd latest fault	*Data*	0000h…FFFFh	-	1 = 1
04.13	3rd latest fault	*Data*	0000h…FFFFh	-	1 = 1
04.16	Latest warning	*Data*	0000h…FFFFh	-	1 = 1
04.17	2nd latest warning	*Data*	0000h…FFFFh	-	1 = 1
04.18	3rd latest warning	*Data*	0000h…FFFFh	-	1 = 1
05 Diagnostics					
05.01	On-time counter	*Real*	0…65535	d	1 = 1 d
05.02	Run-time counter	*Real*	0…65535	d	1 = 1 d
05.03	Hours run	*Real*	0.0…429496729.5	h	10 = 1 h
05.04	Fan on-time counter	*Real*	0…65535	d	1 = 1 d
05.10	Control board temperature	*Real*	-100…300	°C or °F	10 = 1 °
05.11	Inverter temperature	*Real*	-40.0…160.0	%	10 = 1%
05.22	Diagnostic word 3	*PB*	0000h…FFFFh	-	
06 Control and status words					
06.01	Main control word	*PB*	0000h…FFFFh	-	1 = 1
06.11	Main status word	*PB*	0000h…FFFFh	-	1 = 1
06.16	Drive status word 1	*PB*	0000h…FFFFh	-	1 = 1
06.17	Drive status word 2	*PB*	0000h…FFFFh	-	1 = 1
06.18	Start inhibit status word	*PB*	0000h…FFFFh	-	1 = 1
06.19	Speed control status word	*PB*	0000h…FFFFh	-	1 = 1
06.20	Constant speed status word	*PB*	0000h…FFFFh	-	1 = 1
06.21	Drive status word 3	*PB*	0000h…FFFFh	-	1 = 1
06.22	Hand-off-auto status word	*PB*	0000h…FFFFh	-	1 = 1

No.	Name	Type	Range	Unit	FbEq32
06.30	MSW bit 11 selection	*Binary src*	-	-	1 = 1
06.31	MSW bit 12 selection	*Binary src*	-	-	1 = 1
06.32	MSW bit 13 selection	*Binary src*	-	-	1 = 1
06.33	MSW bit 14 selection	*Binary src*	-	-	1 = 1
07 System info					
07.03	Drive rating id	*List*	0…999	-	1 = 1
07.04	Firmware name	*List*	-	-	1 = 1
07.05	Firmware version	*Data*	-	-	1 = 1
07.06	Loading package name	*List*	-	-	1 = 1
07.07	Loading package version	*Data*	-	-	1 = 1
07.11	Cpu usage	*Real*	0…100	%	1 = 1%
07.25	Customization package name	*Data*	-	-	1 = 1
07.26	Customization package version	*Data*	-	-	1 = 1
07.30	Adaptive program status	*PB*	0000h…FFFFh	-	1 = 1
07.31	AP sequence state	*Data*	0…20	-	1 = 1

Parameter groups 10…99

No.	Name	Type	Range	Unit	FbEq32
10 Standard DI, RO					
10.02	DI delayed status	*PB*	0000h…FFFFh	-	1 = 1
10.03	DI force selection	*PB*	0000h…FFFFh	-	1 = 1
10.04	DI forced data	*PB*	0000h…FFFFh	-	1 = 1
10.21	RO status	*PB*	0000h…FFFFh	-	1 = 1
10.22	RO force selection	*PB*	0000h…FFFFh	-	1 = 1
10.23	RO forced data	*PB*	0000h…FFFFh	-	1 = 1
10.24	RO1 source	*Binary src*	-	-	1 = 1
10.25	RO1 ON delay	*Real*	0.0…3000.0	s	10 = 1 s
10.26	RO1 OFF delay	*Real*	0.0…3000.0	s	10 = 1 s
10.27	RO2 source	*Binary src*	-	-	1 = 1
10.28	RO2 ON delay	*Real*	0.0…3000.0	s	10 = 1 s
10.29	RO2 OFF delay	*Real*	0.0…3000.0	s	10 = 1 s
10.30	RO3 source	*Binary src*	-	-	1 = 1
10.31	RO3 ON delay	*Real*	0.0…3000.0	s	10 = 1 s
10.32	RO3 OFF delay	*Real*	0.0…3000.0	s	10 = 1 s
10.99	RO/DIO control word	*PB*	0000h…FFFFh	-	1 = 1
10.101	RO1 toggle counter	*Real*	0…4294967000	-	1 = 1
10.102	RO2 toggle counter	*Real*	0…4294967000	-	1 = 1
10.103	RO3 toggle counter	*Real*	0…4294967000	-	1 = 1
11 Standard DIO, FI, FO					
11.21	DI5 configuration	*List*	0…1	-	1 = 1
11.38	Freq in 1 actual value	*Real*	0…16000	Hz	1 = 1 Hz
11.39	Freq in 1 scaled value	*Real*	-32768.000…32767.000	-	1000 = 1
11.42	Freq in 1 min	*Real*	0…16000	Hz	1 = 1 Hz
11.43	Freq in 1 max	*Real*	0…16000	Hz	1 = 1 Hz
11.44	Freq in 1 at scaled min	*Real*	-32768.000…32767.000	-	1000 = 1
11.45	Freq in 1 at scaled max	*Real*	-32768.000…32767.000	-	1000 = 1
12 Standard AI					
12.02	AI force selection	*PB*	0000h…FFFFh	-	1 = 1
12.03	AI supervision function	*List*	0…4	-	1 = 1
12.04	AI supervision selection	*PB*	0000h…FFFFh	-	1 = 1
12.11	AI1 actual value	*Real*	0.000…20.000 mA or 0.000…10.000 V	mA or V	1000 = 1 unit
12.12	AI1 scaled value	*Real*	-32768.000…32767.000	-	1000 = 1
12.13	AI1 forced value	*Real*	0.000…20.000 mA or 0.000…10.000 V	mA or V	1000 = 1 unit
12.15	AI1 unit selection	*List*	2, 10	-	1 = 1

No.	Name	Type	Range	Unit	FbEq32
12.16	AI1 filter time	*Real*	0.000…30.000	s	1000 = 1 s
12.17	AI1 min	*Real*	0.000…20.000 mA or 0.000…10.000 V	mA or V	1000 = 1 unit
12.18	AI1 max	*Real*	0.000…20.000 mA or 0.000…10.000 V	mA or V	1000 = 1 unit
12.19	AI1 scaled at AI1 min	*Real*	-32768.000…32767.000	-	1000 = 1
12.20	AI1 scaled at AI1 max	*Real*	-32768.000…32767.000	-	1000 = 1
12.21	AI2 actual value	*Real*	0.000…20.000 mA or 0.000…10.000 V	mA or V	1000 = 1 unit
12.22	AI2 scaled value	*Real*	-32768.000…32767.000	-	1000 = 1
12.23	AI2 forced value	*Real*	0.000…20.000 mA or 0.000…10.000 V	mA or V	1000 = 1 unit
12.25	AI2 unit selection	*List*	2, 10	-	1 = 1
12.26	AI2 filter time	*Real*	0.000…30.000	s	1000 = 1 s
12.27	AI2 min	*Real*	0.000…20.000 mA or 0.000…10.000 V	mA or V	1000 = 1 unit
12.28	AI2 max	*Real*	0.000…20.000 mA or 0.000…10.000 V	mA or V	1000 = 1 unit
12.29	AI2 scaled at AI2 min	*Real*	-32768.000…32767.000	-	1000 = 1
12.30	AI2 scaled at AI2 max	*Real*	-32768.000…32767.000	-	1000 = 1
12.101	AI1 percent value	*Real*	0.00…100.00	%	100 = 1%
12.102	AI2 percent value	*Real*	0.00…100.00	%	100 = 1%
13 Standard AO					
13.02	AO force selection	*PB*	0000h…FFFFh	-	1 = 1
13.11	AO1 actual value	*Real*	0.000…22.000 or 0.000…11000 V	mA	1000 = 1 mA
13.12	AO1 source	*Analog src*	-	-	1 = 1
13.13	AO1 forced value	*Real*	0.000…22.000 or 0.000…11000 V	mA	1000 = 1 mA
13.15	AO1 unit selection	*List*	2, 10	-	1 = 1
13.16	AO1 filter time	*Real*	0.000…30.000	s	1000 = 1 s
13.17	AO1 source min	*Real*	-32768.0…32767.0	-	10 = 1
13.18	AO1 source max	*Real*	-32768.0…32767.0	-	10 = 1
13.19	AO1 out at AO1 src min	*Real*	0.000…22.000 or 0.000…11000 V	mA	1000 = 1 mA
13.20	AO1 out at AO1 src max	*Real*	0.000…22.000 or 0.000…11000 V	mA	1000 = 1 mA
13.21	AO2 actual value	*Real*	0.000…22.000	mA	1000 = 1 mA
13.22	AO2 source	*Analog src*	-	-	1 = 1
13.23	AO2 forced value	*Real*	0.000…22.000	mA	1000 = 1 mA
13.26	AO2 filter time	*Real*	0.000…30.000	s	1000 = 1 s
13.27	AO2 source min	*Real*	-32768.0…32767.0	-	10 = 1
13.28	AO2 source max	*Real*	-32768.0…32767.0	-	10 = 1

No.	Name	Type	Range	Unit	FbEq32
13.29	AO2 out at AO2 src min	*Real*	0.000…22.000	mA	1000 = 1 mA
13.30	AO2 out at AO2 src max	*Real*	0.000…22.000	mA	1000 = 1 mA
13.91	AO1 data storage	*Real*	-327.68…327.67	-	100 = 1
13.92	AO2 data storage	*Real*	-327.68…327.67	-	100 = 1
15 I/O extension module					
15.01	Extension module type	*List*	0…3	-	1 = 1
15.02	Detected extension module	*List*	0…3	-	1 = 1
15.03	DI status	*PB*	0000h…FFFFh	-	1 = 1
15.04	RO/DO status	*PB*	0000h…FFFFh	-	1 = 1
15.05	RO/DO force selection	*PB*	0000h…FFFFh	-	1 = 1
15.06	RO/DO forced data	*PB*	0000h…FFFFh	-	1 = 1
15.07	RO4 source	*Binary src*	-	-	1 = 1
15.08	RO4 ON delay	*Real*	0.0…3000.0	s	10 = 1 s
15.09	RO4 OFF delay	*Real*	0.0…3000.0	s	10 = 1 s
15.10	RO5 source	*Binary src*	-	-	1 = 1
15.11	RO5 ON delay	*Real*	0.0…3000.0	s	10 = 1 s
15.12	RO5 OFF delay	*Real*	0.0…3000.0	s	10 = 1 s
15.22	DO1 configuration	*List*	0, 2	-	1 = 1
15.23	DO1 source	*Binary src*	-	-	1 = 1
15.24	DO1 ON delay	*Real*	0.0…3000.0	s	10 = 1 s
15.25	DO1 OFF delay	*Real*	0.0…3000.0	s	10 = 1 s
15.32	Freq out 1 actual value	*Real*	0…16000	Hz	1 = 1 Hz
15.33	Freq out 1 source	*Analog src*	-	-	1 = 1
15.34	Freq out 1 src min	*Real*	-32768.0…32767.0	-	1000 = 1
15.35	Freq out 1 src max	*Real*	-32768.0…32767.0	-	1000 = 1
15.36	Freq out 1 at src min	*Real*	0…16000	Hz	1 = 1 Hz
15.37	Freq out 1 at src max	*Real*	0…16000	Hz	1 = 1 Hz
19 Operation mode					
19.01	Actual operation mode	*List*	1…2, 10, 20	-	1 = 1
19.11	Ext1/Ext2 selection	*Binary src*	-	-	1 = 1
19.18	HAND/OFF disable source	*Binary src*	-	-	1 = 1
19.19	HAND/OFF disable action	*List*	0…1	-	1 = 1
20 Start/stop/direction					
20.01	Ext1 commands	*List*	0…1, 4, 11…12, 14	-	1 = 1
20.02	Ext1 start trigger type	*List*	0…1	-	1 = 1
20.03	Ext1 in1 source	*Binary src*	-	-	1 = 1

No.	Name	Type	Range	Unit	FbEq32
20.04	Ext1 in2 source	*Binary src*	-	-	1 = 1
20.06	Ext2 commands	*List*	0…6, 11…12, 14	-	1 = 1
20.07	Ext2 start trigger type	*List*	0…1	-	1 = 1
20.08	Ext2 in1 source	*Binary src*	-	-	1 = 1
20.09	Ext2 in2 source	*Binary src*	-	-	1 = 1
20.40	Run permissive	*Binary src*	-	-	1 = 1
20.41	Start interlock 1	*Binary src*	-	-	1 = 1
20.42	Start interlock 2	*Binary src*	-	-	1 = 1
20.43	Start interlock 3	*Binary src*	-	-	1 = 1
20.44	Start interlock 4	*Binary src*	-	-	1 = 1
20.45	Start interlock stop mode	*Binary src*	-	-	1 = 1
20.46	Run permissive text	*Binary src*	-	-	1 = 1
20.47	Start interlock 1 text	*Binary src*	-	-	1 = 1
20.48	Start interlock 2 text	*Binary src*	-	-	1 = 1
20.49	Start interlock 3 text	*Binary src*	-	-	1 = 1
20.50	Start interlock 4 text	*Binary src*	-	-	1 = 1
20.51	Start interlock condition	*Binary src*	-	-	1 = 1
21 Start/stop mode					
21.01	Start mode	*List*	0…2	-	1 = 1
21.02	Magnetization time	*Real*	0…10000	ms	1 = 1 ms
21.03	Stop mode	*List*	0…2	-	1 = 1
21.04	Emergency stop mode	*List*	0…2	-	1 = 1
21.05	Emergency stop source	*Binary src*	-	-	1 = 1
21.06	Zero speed limit	*Real*	0.00…30000.00	rpm	100 = 1 rpm
21.07	Zero speed delay	*Real*	0…30000	ms	1 = 1 ms
21.08	DC current control	*PB*	0000b…0011b	-	1 = 1
21.09	DC hold speed	*Real*	0.00…1000.00	rpm	100 = 1 rpm
21.10	DC current reference	*Real*	0.0…100.0	%	10 = 1%
21.11	Post magnetization time	*Real*	0…3000	s	1 = 1 s
21.14	Pre-heating input source	*Binary src*	-	-	1 = 1

No.	Name	Type	Range	Unit	FbEq32
21.16	Pre-heating current	*Real*	0.0…30.0	%	10 = 1%
21.18	Auto restart time	*Real*	0.0, 0.1…10.0	s	10 = 1 s
21.19	Scalar start mode	*List*	0…4	-	1 = 1
21.21	DC hold frequency	*Real*	0.00…1000.00	Hz	100 = 1 Hz
21.22	Start delay	*Real*	0.00…60.00	s	100 = 1 s
21.23	Smooth start	*Real*	0…2	-	1 = 1
21.24	Smooth start current	*Real*	10.0…100.0	%	100 = 1%
21.25	Smooth start speed	*Real*	2.0…100.0	%	100 = 1%
21.26	Torque boost current	*Real*	15.0…300.0	%	100 = 1%
21.34	Force auto restart	*List*	0…1	-	1 = 1
22 Speed reference selection					
22.01	Speed ref unlimited	*Real*	-30000.00…30000.00	rpm	100 = 1 rpm
22.11	Ext1 speed ref1	*Analog src*	-	-	1 = 1
22.18	Ext2 speed ref1	*Analog src*	-	-	1 = 1
22.21	Constant speed function	*PB*	0000h…FFFFh	-	1 = 1
22.22	Constant speed sel1	*Binary src*	-	-	1 = 1
22.23	Constant speed sel2	*Binary src*	-	-	1 = 1
22.24	Constant speed sel3	*Binary src*	-	-	1 = 1
22.26	Constant speed 1	*Real*	-30000.00…30000.00	rpm	100 = 1 rpm
22.27	Constant speed 2	*Real*	-30000.00…30000.00	rpm	100 = 1 rpm
22.28	Constant speed 3	*Real*	-30000.00…30000.00	rpm	100 = 1 rpm
22.29	Constant speed 4	*Real*	-30000.00…30000.00	rpm	100 = 1 rpm
22.30	Constant speed 5	*Real*	-30000.00…30000.00	rpm	100 = 1 rpm
22.31	Constant speed 6	*Real*	-30000.00…30000.00	rpm	100 = 1 rpm
22.32	Constant speed 7	*Real*	-30000.00…30000.00	rpm	100 = 1 rpm
22.41	Speed ref safe	*Real*	-30000.00…30000.00	rpm	100 = 1 rpm
22.51	Critical speed function	*PB*	00b…11b	-	1 = 1
22.52	Critical speed 1 low	*Real*	-30000.00…30000.00	rpm	100 = 1 rpm
22.53	Critical speed 1 high	*Real*	-30000.00…30000.00	rpm	100 = 1 rpm
22.54	Critical speed 2 low	*Real*	-30000.00…30000.00	rpm	100 = 1 rpm
22.55	Critical speed 2 high	*Real*	-30000.00…30000.00	rpm	100 = 1 rpm
22.56	Critical speed 3 low	*Real*	-30000.00…30000.00	rpm	100 = 1 rpm
22.57	Critical speed 3 high	*Real*	-30000.00…30000.00	rpm	100 = 1 rpm
22.71	Motor potentiometer function	*List*	0…3	-	1 = 1
22.72	Motor potentiometer initial value	*Real*	-32768.00…32767.00	-	100 = 1
22.73	Motor potentiometer up source	*Binary src*	-	-	1 = 1

No.	Name	Type	Range	Unit	FbEq32
22.74	Motor potentiometer down source	*Binary src*	-	-	1 = 1
22.75	Motor potentiometer ramp time	*Real*	0.0…3600.0	s	10 = 1 s
22.76	Motor potentiometer min value	*Real*	-32768.00…32767.00	-	100 = 1
22.77	Motor potentiometer max value	*Real*	-32768.00…32767.00	-	100 = 1
22.80	Motor potentiometer ref act	*Real*	-32768.00…32767.00	-	100 = 1
22.86	Speed reference act 6	*Real*	-30000.00…30000.00	rpm	100 = 1 rpm
22.87	Speed reference act 7	*Real*	-30000.00…30000.00	rpm	100 = 1 rpm
23 Speed reference ramp					
23.01	Speed ref ramp input	*Real*	-30000.00…30000.00	rpm	100 = 1 rpm
23.02	Speed ref ramp output	*Real*	-30000.00…30000.00	rpm	100 = 1 rpm
23.12	Acceleration time 1	*Real*	0.000…1800.000	s	1000 = 1 s
23.13	Deceleration time 1	*Real*	0.000…1800.000	s	1000 = 1 s
23.23	Emergency stop time	*Real*	0.000…1800.000	s	1000 = 1 s
23.32	Shape time 1	*Real*	0.000...1800.000	s	1000 = 1 s
24 Speed reference conditioning					
24.01	Used speed reference	*Real*	-30000.00…30000.00	rpm	100 = 1 rpm
24.02	Used speed feedback	*Real*	-30000.00…30000.00	rpm	100 = 1 rpm
24.03	Speed error filtered	*Real*	-30000.0…30000.0	rpm	100 = 1 rpm
24.04	Speed error inverted	*Real*	-30000.0…30000.0	rpm	100 = 1 rpm
24.11	Speed correction	*Real*	-10000.00…10000.00	rpm	100 = 1 rpm
24.12	Speed error filter time	*Real*	0…10000	ms	1 = 1 ms
25 Speed control					
25.01	Torque reference speed control	*Real*	-1600.0…1600.0	%	10 = 1%
25.02	Speed proportional gain	*Real*	0.00…250.00	-	100 = 1
25.03	Speed integration time	*Real*	0.00…1000.00	s	100 = 1 s
25.04	Speed derivation time	*Real*	0.000…10.000	s	1000 = 1 s
25.05	Derivation filter time	*Real*	0…10000	ms	1 = 1 ms
25.15	Proportional gain em stop	*Real*	1.00…250.00	-	100 = 1
25.53	Torque prop reference	*Real*	-30000.0…30000.0	%	10 = 1%
25.54	Torque integral reference	*Real*	-30000.0…30000.0	%	10 = 1%
25.55	Torque deriv reference	*Real*	-30000.0…30000.0	%	10 = 1%
28 Frequency reference chain					
28.01	Frequency ref ramp input	*Real*	-500.00…500.00	Hz	100 = 1 Hz
28.02	Frequency ref ramp output	*Real*	-500.00…500.00	Hz	100 = 1 Hz
28.11	Ext1 frequency ref1	*Analog src*	-	-	1 = 1
28.15	Ext2 frequency ref1	*Analog src*	-	-	1 = 1
28.21	Constant frequency function	*PB*	00b…11b	-	1 = 1

No.	Name	Type	Range	Unit	FbEq32
28.22	Constant frequency sel1	*Binary src*	-	-	1 = 1
28.23	Constant frequency sel2	*Binary src*	-	-	1 = 1
28.24	Constant frequency sel3	*Binary src*	-	-	1 = 1
28.26	Constant frequency 1	*Real*	-500.00…500.00	Hz	100 = 1 Hz
28.27	Constant frequency 2	*Real*	-500.00…500.00	Hz	100 = 1 Hz
28.28	Constant frequency 3	*Real*	-500.00…500.00	Hz	100 = 1 Hz
28.29	Constant frequency 4	*Real*	-500.00…500.00	Hz	100 = 1 Hz
28.30	Constant frequency 5	*Real*	-500.00…500.00	Hz	100 = 1 Hz
28.31	Constant frequency 6	*Real*	-500.00…500.00	Hz	100 = 1 Hz
28.32	Constant frequency 7	*Real*	-500.00…500.00	Hz	100 = 1 Hz
28.41	Frequency ref safe	*Real*	-500.00…500.00	Hz	100 = 1 Hz
28.51	Critical frequency function	*PB*	00b…11b	-	1 = 1
28.52	Critical frequency 1 low	*Real*	-500.00…500.00	Hz	100 = 1 Hz
28.53	Critical frequency 1 high	*Real*	-500.00…500.00	Hz	100 = 1 Hz
28.54	Critical frequency 2 low	*Real*	-500.00…500.00	Hz	100 = 1 Hz
28.55	Critical frequency 2 high	*Real*	-500.00…500.00	Hz	100 = 1 Hz
28.56	Critical frequency 3 low	*Real*	-500.00…500.00	Hz	100 = 1 Hz
28.57	Critical frequency 3 high	*Real*	-500.00…500.00	Hz	100 = 1 Hz
28.72	Freq acceleration time 1	*Real*	0.000…1800.000	s	1000 = 1 s
28.73	Freq deceleration time 1	*Real*	0.000…1800.000	s	1000 = 1 s
28.76	Freq ramp in zero source	*Binary src*	-	-	1 = 1
28.82	Shape time 1	*Real*	0.000...1800.000	s	1000 = 1 s
28.92	Frequency ref act 3	*Real*	-500.00…500.00	Hz	100 = 1 Hz
28.96	Frequency ref act 7	*Real*	-500.00…500.00	Hz	100 = 1 Hz
28.97	Frequency ref unlimited	*Real*	-500.00…500.00	Hz	100 = 1 Hz
30 Limits					
30.01	Limit word 1	*PB*	0000h…FFFFh	-	1 = 1
30.02	Torque limit status	*PB*	0000h…FFFFh	-	1 = 1
30.11	Minimum speed	*Real*	-30000.00…30000.00	rpm	100 = 1 rpm
30.12	Maximum speed	*Real*	-30000.00…30000.00	rpm	100 = 1 rpm
30.13	Minimum frequency	*Real*	-500.00…500.00	Hz	100 = 1 Hz
30.14	Maximum frequency	*Real*	-500.00…500.00	Hz	100 = 1 Hz
30.17	Maximum current	*Real*	0.00…30000.00	A	100 = 1 A
30.19	Minimum torque 1	*Real*	-1600.0…0.0	%	10 = 1%
30.20	Maximum torque 1	*Real*	0.0…1600.0	%	10 = 1%
30.26	Power motoring limit	*Real*	0.00…600.00	%	100 = 1%
30.27	Power generating limit	*Real*	-600.00…0.00	%	100 = 1%
30.30	Overvoltage control	*List*	0…1	-	1 = 1

No.	Name	Type	Range	Unit	FbEq32
30.31	Undervoltage control	*List*	0…1	-	1 = 1
31 Fault functions					
31.01	External event 1 source	*Binary src*	-	-	1 = 1
31.02	External event 1 type	*List*	0…1	-	1 = 1
31.03	External event 2 source	*Binary src*	-	-	1 = 1
31.04	External event 2 type	*List*	0…1	-	1 = 1
31.05	External event 3 source	*Binary src*	-	-	1 = 1
31.06	External event 3 type	*List*	0…1	-	1 = 1
31.07	External event 4 source	*Binary src*	-	-	1 = 1
31.08	External event 4 type	*List*	0…1	-	1 = 1
31.09	External event 5 source	*Binary src*	-	-	1 = 1
31.10	External event 5 type	*List*	0…1	-	1 = 1
31.11	Fault reset selection	*Binary src*	-	-	1 = 1
31.12	Autoreset selection	*PB*	0000h…FFFFh	-	1 = 1
31.13	Selectable fault	*Real*	0000h…FFFFh	-	1 = 1
31.14	Number of trials	*Real*	0…5	-	1 = 1
31.15	Total trials time	*Real*	1.0…600.0	s	10 = 1 s
31.16	Delay time	*Real*	0.0…120.0	s	10 = 1 s
31.19	Motor phase loss	*List*	0…1	-	1 = 1
31.20	Earth fault	*List*	0…2	-	1 = 1
31.21	Supply phase loss	*List*	0…1	-	1 = 1
31.22	STO indication run/stop	*List*	0…3	-	1 = 1
31.23	Wiring or earth fault	*List*	0…1	-	1 = 1
31.24	Stall function	*List*	0…2	-	1 = 1
31.25	Stall current limit	*Real*	0.0…1600.0	%	10 = 1%
31.26	Stall speed limit	*Real*	0.00…10000.00	rpm	100 = 1 rpm
31.27	Stall frequency limit	*Real*	0.00…1000.00	Hz	100 = 1 Hz
31.28	Stall time	*Real*	0…3600	s	1 = 1 s
31.30	Overspeed trip margin	*Real*	0.00…10000.00	rpm	100 = 1 rpm
31.32	Emergency ramp supervision	*Real*	0…300	%	1 = 1%
31.33	Emergency ramp supervision delay	*Real*	0…100	s	1 = 1 s
31.36	Aux fan fault bybass	*List*	0…1	-	1 = 1
32 Supervision					
32.01	Supervision status	*PB*	0000h…FFFFh	-	1 = 1
32.05	Supervision 1 function	*List*	0…7	-	1 = 1
32.06	Supervision 1 action	*List*	0…3	-	1 = 1

No.	Name	Type	Range	Unit	FbEq32
32.07	Supervision 1 signal	*Analog src*	-	-	1 = 1
32.08	Supervision 1 filter time	*Real*	0.000…30.000	s	1000 = 1 s
32.09	Supervision 1 low	*Real*	-21474836.00… 21474836.00	-	100 = 1
32.10	Supervision 1 high	*Real*	-21474836.00… 21474836.00	-	100 = 1
32.11	Supervision 1 hysteresis	*Real*	0.00…100000.00	-	100 = 1
32.15	Supervision 2 function	*List*	0…7	-	1 = 1
32.16	Supervision 2 action	*List*	0…3	-	1 = 1
32.17	Supervision 2 signal	*Analog src*	-	-	1 = 1
32.18	Supervision 2 filter time	*Real*	0.000…30.000	s	1000 = 1 s
32.19	Supervision 2 low	*Real*	-21474836.00… 21474836.00	-	100 = 1
32.20	Supervision 2 high	*Real*	-21474836.00… 21474836.00	-	100 = 1
32.21	Supervision 2 hysteresis	*Real*	0.00…100000.00	-	100 = 1
32.25	Supervision 3 function	*List*	0…7	-	1 = 1
32.26	Supervision 3 action	*List*	0…3	-	1 = 1
32.27	Supervision 3 signal	*Analog src*	-	-	1 = 1
32.28	Supervision 3 filter time	*Real*	0.000…30.000	s	1000 = 1 s
32.29	Supervision 3 low	*Real*	-21474836.00… 21474836.00	-	100 = 1
32.30	Supervision 3 high	*Real*	-21474836.00… 21474836.00	-	100 = 1
32.31	Supervision 3 hysteresis	*Real*	0.00…100000.00	-	100 = 1
32.35	Supervision 4 function	*List*	0…7	-	1 = 1
32.36	Supervision 4 action	*List*	0…3	-	1 = 1
32.37	Supervision 4 signal	*Analog src*	-	-	1 = 1
32.38	Supervision 4 filter time	*Real*	0.000…30.000	s	1000 = 1 s
32.39	Supervision 4 low	*Real*	-21474836.00… 21474836.00	-	100 = 1
32.40	Supervision 4 high	*Real*	-21474836.00… 21474836.00	-	100 = 1
32.41	Supervision 4 hysteresis	*Real*	0.00…100000.00	-	100 = 1
32.45	Supervision 5 function	*List*	0…7	-	1 = 1
32.46	Supervision 5 action	*List*	0…3	-	1 = 1
32.47	Supervision 5 signal	*Analog src*	-	-	1 = 1
32.48	Supervision 5 filter time	*Real*	0.000…30.000	s	1000 = 1 s
32.49	Supervision 5 low	*Real*	-21474836.00… 21474836.00	-	100 = 1

No.	Name	Type	Range	Unit	FbEq32
32.50	Supervision 5 high	*Real*	-21474836.00… 21474836.00	-	100 = 1
32.51	Supervision 5 hysteresis	*Real*	0.00…100000.00	-	100 = 1
32.55	Supervision 6 function	*List*	0…7	-	1 = 1
32.56	Supervision 6 action	*List*	0…3	-	1 = 1
32.57	Supervision 6 signal	*Analog src*	-	-	1 = 1
32.58	Supervision 6 filter time	*Real*	0.000…30.000	s	1000 = 1 s
32.59	Supervision 6 low	*Real*	-21474836.00… 21474836.00	-	100 = 1
32.60	Supervision 6 high	*Real*	-21474836.00… 21474836.00	-	100 = 1
32.61	Supervision 6 hysteresis	*Real*	0.00…100000.00	-	100 = 1
34 Timed functions					
34.01	Timed functions status	*PB*	0000h…FFFFh	-	1 = 1
34.02	Timer status	*PB*	0000h…FFFFh	-	1 = 1
34.04	Season/exception day status	*PB*	0000h…FFFFh	-	1 = 1
34.10	Timed functions enable	*Binary src*	-	-	1 = 1
34.11	Timer 1 configuration	*PB*	0000h…FFFFh	-	1 = 1
34.12	Timer 1 start time	Time	00:00:00…23:59:59	s	1 = 1 s
34.13	Timer 1 duration	Duration	00 00:00…07 00:00	min	1 = 1 min
34.14	Timer 2 configuration	*PB*	0000h…FFFFh	-	1 = 1
34.15	Timer 2 start time	Time	00:00:00…23:59:59	s	1 = 1 s
34.16	Timer 2 duration	Duration	00 00:00…07 00:00	min	1 = 1 min
34.17	Timer 3 configuration	*PB*	0000h…FFFFh	-	1 = 1
34.18	Timer 3 start time	Time	00:00:00…23:59:59	s	1 = 1 s
34.19	Timer 3 duration	Duration	00 00:00…07 00:00	min	1 = 1 min
34.20	Timer 4 configuration	*PB*	0000h…FFFFh	-	1 = 1
34.21	Timer 4 start time	Time	00:00:00…23:59:59	s	1 = 1 s
34.22	Timer 4 duration	Duration	00 00:00…07 00:00	min	1 = 1 min
34.23	Timer 5 configuration	*PB*	0000h…FFFFh	-	1 = 1
34.24	Timer 5 start time	Time	00:00:00…23:59:59	s	1 = 1 s
34.25	Timer 5 duration	Duration	00 00:00…07 00:00	min	1 = 1 min
34.26	Timer 6 configuration	*PB*	0000h…FFFFh	-	1 = 1
34.27	Timer 6 start time	Time	00:00:00…23:59:59	s	1 = 1 s
34.28	Timer 6 duration	Duration	00 00:00…07 00:00	min	1 = 1 min
34.29	Timer 7 configuration	*PB*	0000h…FFFFh	-	1 = 1
34.30	Timer 7 start time	Time	00:00:00…23:59:59	s	1 = 1 s
34.31	Timer 7 duration	Duration	00 00:00…07 00:00	min	1 = 1 min
34.32	Timer 8 configuration	*PB*	0000h…FFFFh	-	1 = 1
34.33	Timer 8 start time	Time	00:00:00…23:59:59	s	1 = 1 s
34.34	Timer 8 duration	Duration	00 00:00…07 00:00	min	1 = 1 min

No.	Name	Type	Range	Unit	FbEq32
34.35	Timer 9 configuration	*PB*	0000h…FFFFh	-	1 = 1
34.36	Timer 9 start time	Time	00:00:00…23:59:59	s	1 = 1 s
34.37	Timer 9 duration	Duration	00 00:00…07 00:00	min	1 = 1 min
34.38	Timer 10 configuration	*PB*	0000h…FFFFh	-	1 = 1
34.39	Timer 10 start time	Time	00:00:00…23:59:59	s	1 = 1 s
34.40	Timer 10 duration	Duration	00 00:00…07 00:00	min	1 = 1 min
34.41	Timer 11 configuration	*PB*	0000h…FFFFh	-	1 = 1
34.42	Timer 11 start time	Time	00:00:00…23:59:59	s	1 = 1 s
34.43	Timer 11 duration	Duration	00 00:00…07 00:00	min	1 = 1 min
34.44	Timer 12 configuration	*PB*	0000h…FFFFh	-	1 = 1
34.45	Timer 12 start time	Time	00:00:00…23:59:59	s	1 = 1 s
34.46	Timer 12 duration	Duration	00 00:00…07 00:00	min	1 = 1 min
34.60	Season 1 start date	Date	01.01…31.12	d	1 = 1 d
34.61	Season 2 start date	Date	01.01…31.12	d	1 = 1 d
34.62	Season 3 start date	Date	01.01…31.12	d	1 = 1 d
34.63	Season 4 start date	Date	01.01…31.12	d	1 = 1 d
34.70	Number of active exceptions	*Real*	0…16	-	1 = 1
34.71	Exception types	*PB*	0000h…FFFFh	-	1 = 1
34.72	Exception 1 start	Date	01.01…31.12	d	1 = 1 d
34.73	Exception 1 length	*Real*	0…60	d	1 = 1 d
34.74	Exception 2 start	Date	01.01…31.12	d	1 = 1 d
34.75	Exception 2 length	*Real*	0…60	d	1 = 1 d
34.76	Exception 3 start	Date	01.01…31.12	d	1 = 1 d
34.77	Exception 3 length	*Real*	0…60	d	1 = 1 d
34.78	Exception day 4	Date	01.01…31.12	d	1 = 1 d
34.79	Exception day 5	Date	01.01…31.12	d	1 = 1 d
34.80	Exception day 6	Date	01.01…31.12	d	1 = 1 d
34.81	Exception day 7	Date	01.01…31.12	d	1 = 1 d
34.82	Exception day 8	Date	01.01…31.12	d	1 = 1 d
34.83	Exception day 9	Date	01.01…31.12	d	1 = 1 d
34.84	Exception day 10	Date	01.01…31.12	d	1 = 1 d
34.85	Exception day 11	Date	01.01…31.12	d	1 = 1 d
34.86	Exception day 12	Date	01.01…31.12	d	1 = 1 d
34.87	Exception day 13	Date	01.01…31.12	d	1 = 1 d
34.88	Exception day 14	Date	01.01…31.12	d	1 = 1 d
34.89	Exception day 15	Date	01.01…31.12	d	1 = 1 d
34.90	Exception day 16	Date	01.01…31.12	d	1 = 1 d
34.100	Timed function 1	*PB*	0000h…FFFFh	-	1 = 1
34.101	Timed function 2	*PB*	0000h…FFFFh	-	1 = 1
34.102	Timed function 3	*PB*	0000h…FFFFh	-	1 = 1
34.110	Boost time function	*PB*	0000h…FFFFh	-	1 = 1

No.	Name	Type	Range	Unit	FbEq32
34.111	Boost time activation source	*Binary src*	-	-	1 = 1
34.112	Boost time duration	Duration	00 00:00…07 00:00	min	1 = 1 min
35 Motor thermal protection					
35.01	Motor estimated temperature	*Real*	-60…1000 °C or -76…1832 °F	°C or °F	1 = 1 °
35.02	Measured temperature 1	*Real*	-60…5000 °C or -76…9032 °F, 0 ohm or [*35.12*] ohm	°C, °F or ohm	1 = 1 unit
35.03	Measured temperature 2	*Real*	-60…5000 °C or -76…9032 °F, 0 ohm or [*35.12*] ohm	°C, °F or ohm	1 = 1 unit
35.11	Temperature 1 source	*List*	0…2, 5…8, 11…16, 19, 21, 22	-	1 = 1
35.12	Temperature 1 fault limit	*Real*	-60…5000 °C or -76…9032 °F	°C, °F or ohm	1 = 1 unit
35.13	Temperature 1 warning limit	*Real*	-60…5000 °C or -76…9032 °F	°C, °F or ohm	1 = 1 unit
35.14	Temperature 1 AI source	*Analog src*	-	-	1 = 1
35.21	Temperature 2 source	*List*	0…2, 5…8, 11…16, 19	-	1 = 1
35.22	Temperature 2 fault limit	*Real*	-60…5000 °C or -76…9032 °F	°C, °F or ohm	1 = 1 unit
35.23	Temperature 2 warning limit	*Real*	-60…5000 °C or -76…9032 °F	°C, °F or ohm	1 = 1 unit
35.24	Temperature 2 AI source	*Analog src*	-	-	1 = 1
35.31	Safe motor temperature enable	*List*	-	-	1 = 1
35.50	Motor ambient temperature	*Real*	-60…100 °C or -76 … 212 °F	°C	1 = 1 °
35.51	Motor load curve	*Real*	50…150	%	1 = 1%
35.52	Zero speed load	*Real*	50…150	%	1 = 1%
35.53	Break point	*Real*	1.00 … 500.00	Hz	100 = 1 Hz
35.54	Motor nominal temperature rise	*Real*	0…300 °C or 32…572 °F	°C or °F	1 = 1 °
35.55	Motor thermal time constant	*Real*	100…10000	s	1 = 1 s
36 Load analyzer					
36.01	PVL signal source	*Analog src*	-	-	1 = 1
36.02	PVL filter time	*Real*	0.00…120.00	s	100 = 1 s
36.06	AL2 signal source	*Analog src*	-	-	1 = 1
36.07	AL2 signal scaling	*Real*	0.00…32767.00	-	100 = 1
36.09	Reset loggers	*List*	0…3	-	1 = 1
36.10	PVL peak value	*Real*	-32768.00…32767.00	-	100 = 1

No.	Name	Type	Range	Unit	FbEq32
36.11	PVL peak date	*Data*	-	-	1 = 1
36.12	PVL peak time	*Data*	-	-	1 = 1
36.13	PVL current at peak	*Real*	-32768.00…32767.00	A	100 = 1 A
36.14	PVL DC voltage at peak	*Real*	0.00…2000.00	V	100 = 1 V
36.15	PVL speed at peak	*Real*	-30000.00… 30000.00	rpm	100 = 1 rpm
36.16	PVL reset date	*Data*	-	-	1 = 1
36.17	PVL reset time	*Data*	-	-	1 = 1
36.20	AL1 0 to 10%	*Real*	0.00…100.00	%	100 = 1%
36.21	AL1 10 to 20%	*Real*	0.00…100.00	%	100 = 1%
36.22	AL1 20 to 30%	*Real*	0.00…100.00	%	100 = 1%
36.23	AL1 30 to 40%	*Real*	0.00…100.00	%	100 = 1%
36.24	AL1 40 to 50%	*Real*	0.00…100.00	%	100 = 1%
36.25	AL1 50 to 60%	*Real*	0.00…100.00	%	100 = 1%
36.26	AL1 60 to 70%	*Real*	0.00…100.00	%	100 = 1%
36.27	AL1 70 to 80%	*Real*	0.00…100.00	%	100 = 1%
36.28	AL1 80 to 90%	*Real*	0.00…100.00	%	100 = 1%
36.29	AL1 over 90%	*Real*	0.00…100.00	%	100 = 1%
36.40	AL2 0 to 10%	*Real*	0.00…100.00	%	100 = 1%
36.41	AL2 10 to 20%	*Real*	0.00…100.00	%	100 = 1%
36.42	AL2 20 to 30%	*Real*	0.00…100.00	%	100 = 1%
36.43	AL2 30 to 40%	*Real*	0.00…100.00	%	100 = 1%
36.44	AL2 40 to 50%	*Real*	0.00…100.00	%	100 = 1%
36.45	AL2 50 to 60%	*Real*	0.00…100.00	%	100 = 1%
36.46	AL2 60 to 70%	*Real*	0.00…100.00	%	100 = 1%
36.47	AL2 70 to 80%	*Real*	0.00…100.00	%	100 = 1%
36.48	AL2 80 to 90%	*Real*	0.00…100.00	%	100 = 1%
36.49	AL2 over 90%	*Real*	0.00…100.00	%	100 = 1%
36.50	AL2 reset date	*Data*	-	-	1 = 1
36.51	AL2 reset time	*Data*	-	-	1 = 1
37 User load curve					
37.01	ULC output status word	*PB*	0000h…FFFFh	-	1 = 1
37.02	ULC supervision signal	*Analog src*	-	-	1 = 1
37.03	ULC overload actions	*List*	0…3	-	1 = 1
37.04	ULC underload actions	*List*	0…3	-	1 = 1
37.11	ULC speed table point 1	*Real*	-30000.0…30000.0	rpm	10 = 1 rpm
37.12	ULC speed table point 2	*Real*	-30000.0…30000.0	rpm	10 = 1 rpm
37.13	ULC speed table point 3	*Real*	-30000.0…30000.0	rpm	10 = 1 rpm
37.14	ULC speed table point 4	*Real*	-30000.0…30000.0	rpm	10 = 1 rpm
37.15	ULC speed table point 5	*Real*	-30000.0…30000.0	rpm	10 = 1 rpm
37.16	ULC frequency table point 1	*Real*	-500.0…500.0	Hz	10 = 1 Hz

No.	Name	Type	Range	Unit	FbEq32
37.17	ULC frequency table point 2	*Real*	-500.0…500.0	Hz	10 = 1 Hz
37.18	ULC frequency table point 3	*Real*	-500.0…500.0	Hz	10 = 1 Hz
37.19	ULC frequency table point 4	*Real*	-500.0…500.0	Hz	10 = 1 Hz
37.20	ULC frequency table point 5	*Real*	-500.0…500.0	Hz	10 = 1 Hz
37.21	ULC underload point 1	*Real*	-1600.0…1600.0	%	10 = 1%
37.22	ULC underload point 2	*Real*	-1600.0…1600.0	%	10 = 1%
37.23	ULC underload point 3	*Real*	-1600.0…1600.0	%	10 = 1%
37.24	ULC underload point 4	*Real*	-1600.0…1600.0	%	10 = 1%
37.25	ULC underload point 5	*Real*	-1600.0…1600.0	%	10 = 1%
37.31	ULC overload point 1	*Real*	-1600.0…1600.0	%	10 = 1%
37.32	ULC overload point 2	*Real*	-1600.0…1600.0	%	10 = 1%
37.33	ULC overload point 3	*Real*	-1600.0…1600.0	%	10 = 1%
37.34	ULC overload point 4	*Real*	-1600.0…1600.0	%	10 = 1%
37.35	ULC overload point 5	*Real*	-1600.0…1600.0	%	10 = 1%
37.41	ULC overload timer	*Real*	0.0…10000.0	s	10 = 1 s
37.42	ULC underload timer	*Real*	0.0…10000.0	s	10 = 1 s
40 Process PID set 1					
40.01	Process PID output actual	*Real*	-200000.00…200000.00	%	100 = 1 PID customer unit
40.02	Process PID feedback actual	*Real*	-200000.00…200000.00	PID customer units	100 = 1 PID customer unit
40.03	Process PID setpoint actual	*Real*	-200000…200000	PID customer units	100 = 1 PID customer unit
40.04	Process PID deviation actual	*Real*	-200000.00…200000.00	PID customer units	100 = 1 PID customer unit
40.06	Process PID status word	*PB*	0000h…FFFFh	-	1 = 1
40.07	Process PID operation mode	*List*	0…2	-	1 = 1
40.08	Set 1 feedback 1 source	*Analog src*	-	-	1 = 1
40.09	Set 1 feedback 2 source	*Analog src*	-	-	1 = 1
40.10	Set 1 feedback function	*List*	0…13	-	1 = 1
40.11	Set 1 feedback filter time	*Real*	0.000…30.000	s	1000 = 1 s
40.14	Set 1 setpoint scaling	*Real*	-200000.00…200000.00	-	100 = 1
40.15	Set 1 output scaling	*Real*	-200000.00…200000.00	-	100 = 1
40.16	Set 1 setpoint 1 source	*Analog src*	-	-	1 = 1
40.17	Set 1 setpoint 2 source	*Analog src*	-	-	1 = 1
40.18	Set 1 setpoint function	*List*	0…13	-	1 = 1
40.19	Set 1 internal setpoint sel1	*Binary src*	-	-	1 = 1

No.	Name	Type	Range	Unit	FbEq32
40.20	Set 1 internal setpoint sel2	*Binary src*	-	-	1 = 1
40.21	Set 1 internal setpoint 1	*Real*	-200000.00…200000.00	PID customer units	100 = 1 PID customer unit
40.22	Set 1 internal setpoint 2	*Real*	-200000.00…200000.00	PID customer units	100 = 1 PID customer unit
40.23	Set 1 internal setpoint 3	*Real*	-200000.00…200000.00	PID customer units	100 = 1 PID customer unit
40.24	Set 1 internal setpoint 0	*Real*	-200000.00…200000.00	PID customer units	100 = 1 PID customer unit
40.26	Set 1 setpoint min	*Real*	-200000.00…200000.00	PID customer units	100 = 1
40.27	Set 1 setpoint max	*Real*	-200000.00…200000.00	PID customer units	100 = 1
40.28	Set 1 setpoint increase time	*Real*	0.0…32767.0	s	10 = 1 s
40.29	Set 1 setpoint decrease time	*Real*	0.0…32767.0	s	10 = 1 s
40.30	Set 1 setpoint freeze enable	*Binary src*	-	-	1 = 1
40.31	Set 1 deviation inversion	*Binary src*	-	-	1 = 1
40.32	Set 1 gain	*Real*	0.10…100.00	-	100 = 1
40.33	Set 1 integration time	*Real*	0.0…9999.0	s	10 = 1 s
40.34	Set 1 derivation time	*Real*	0.000…10.000	s	1000 = 1 s
40.35	Set 1 derivation filter time	*Real*	0.0…10.0	s	10 = 1 s
40.36	Set 1 output min	*Real*	-200000.00…200000.00	-	100 = 1
40.37	Set 1 output max	*Real*	-200000.00…200000.00	-	100 = 1
40.38	Set 1 output freeze enable	*Binary src*	-	-	1 = 1
40.39	Set 1 deadband range	*Real*	0……200000.0	-	10 = 1
40.40	Set 1 deadband delay	*Real*	0.0 … 3600.0	s	10 = 1 s
40.43	Set 1 sleep level	*Real*	0.0…200000.0	-	10 = 1
40.44	Set 1 sleep delay	*Real*	0.0…3600.0	s	10 = 1 s
40.45	Set 1 sleep boost time	*Real*	0.0…3600.0	s	10 = 1 s
40.46	Set 1 sleep boost step	*Real*	0.0…200000.0	PID customer units	10 = 1 PID customer unit
40.47	Set 1 wake-up deviation	*Real*	-200000.00…200000.00	PID customer units	100 = 1 PID customer unit
40.48	Set 1 wake-up delay	*Real*	0.00…60.00	s	100 = 1 s
40.49	Set 1 tracking mode	*Binary src*	-	-	1 = 1

No.	Name	Type	Range	Unit	FbEq32
40.50	Set 1 tracking ref selection	*Analog src*	-	-	1 = 1
40.57	PID set1/set2 selection	*Binary src*	-	-	1 = 1
40.58	Set 1 increase prevention	*Binary src*	-	-	1 = 1
40.59	Set 1 decrease prevention	*Binary src*	-	-	1 = 1
40.60	Set 1 PID activation source	*Binary src*	-	-	1 = 1
40.61	Setpoint actual scaling	*Real*	-200000.00…200000.00	-	100 = 1
40.62	PID internal setpoint actual	*Real*	-200000.00…200000.00	PID customer units	100 = 1 PID customer unit
40.70	Compensated setpoint	*Real*	-200000.00…200000.00	PID customer units	100 = 1 PID customer unit
40.71	Set 1 compensation input source	*List*	0, 2…4, 8, 10…12, 15…16, 19…20, 24	-	1 = 1
40.72	Set 1 compensation input 1	*Real*	-200000.00…200000.00	-	100 = 1
40.73	Set 1 compensated output 1	*Real*	-200000.00…200000.00	-	100 = 1
40.74	Set 1 compensation input 2	*Real*	-200000.00…200000.00	-	100 = 1
40.75	Set 1 compensated output 2	*Real*	-200000.00…200000.00	-	100 = 1
40.76	Set 1 compensation non-linearity	*Real*	0…100	%	1= 1
40.80	Set 1 PID output min source	*List*	0…1	-	1 = 1
40.81	Set 1 PID output max source	*List*	0…1	-	1 = 1
40.89	Set 1 setpoint multiplier	*Real*	-200000.00…200000.00	-	100 = 1
40.90	Set 1 feedback multiplier	*Real*	--200000.00…200000.00	-	100 = 1
40.91	Feedback data storage	*Real*	-327.68…327.67	-	100 = 1
40.92	Setpoint data storage	*Real*	-327.68…327.67	-	100 = 1
40.96	Process PID output %	*Real*	-100.00…100.00	%	100 = 1
40.97	Process PID feedback %	*Real*	-100.00…100.00	%	100 = 1
40.98	Process PID setpoint %	*Real*	-100.00…100.00	%	100 = 1
40.99	Process PID deviation %	*Real*	-100.00…100.00	%	100 = 1
41 Process PID set 2					
41.08	Set 2 feedback 1 source	*Analog src*	-	-	1 = 1
41.09	Set 2 feedback 2 source	*Analog src*	-	-	1 = 1
41.10	Set 2 feedback function	*List*	0…13	-	1 = 1
41.11	Set 2 feedback filter time	*Real*	0.000…30.000	s	1000 = 1 s
41.14	Set 2 setpoint scaling	*Real*	-200000.00…200000.00	-	100 = 1
41.15	Set 2 output scaling	*Real*	-200000.00…200000.00	-	100 = 1
41.16	Set 2 setpoint 1 source	*Analog src*	-	-	1 = 1

No.	Name	Type	Range	Unit	FbEq32
41.17	Set 2 setpoint 2 source	*Analog src*	-	-	1 = 1
41.18	Set 2 setpoint function	*List*	0…13	-	1 = 1
41.19	Set 2 internal setpoint sel1	*Binary src*	-	-	1 = 1
41.20	Set 2 internal setpoint sel2	*Binary src*	-	-	1 = 1
41.21	Set 2 internal setpoint 1	*Real*	-200000.00…200000.00	PID customer unit	100 = 1 PID customer unit
41.22	Set 2 internal setpoint 2	*Real*	-200000.00…200000.00	PID customer units	100 = 1 PID customer unit
41.23	Set 2 internal setpoint 3	*Real*	-200000.00…200000.00	PID customer units	100 = 1 PID customer unit
41.24	Set 2 internal setpoint 0	*Real*	-200000.00…200000.00	PID customer units	100 = 1 PID customer unit
41.26	Set 2 setpoint min	*Real*	-200000.00…200000.00	PID customer units	100 = 1
41.27	Set 2 setpoint max	*Real*	-200000.00…200000.00	PID customer units	100 = 1
41.28	Set 2 setpoint increase time	*Real*	0.0…32767.0	s	10 = 1 s
41.29	Set 2 setpoint decrease time	*Real*	0.0…32767.0	s	10 = 1 s
41.30	Set 2 setpoint freeze enable	*Binary src*	-	-	1 = 1
41.31	Set 2 deviation inversion	*Binary src*	-	-	1 = 1
41.32	Set 2 gain	*Real*	0.10…100.00	-	100 = 1
41.33	Set 2 integration time	*Real*	0.0…9999.0	s	10 = 1 s
41.34	Set 2 derivation time	*Real*	0.000…10.000	s	1000 = 1 s
41.35	Set 2 derivation filter time	*Real*	0.0…10.0	s	10 = 1 s
41.36	Set 2 output min	*Real*	-200000.00…200000.00	-	100 = 1
41.37	Set 2 output max	*Real*	-200000.00…200000.00	-	100 = 1
41.38	Set 2 output freeze enable	*Binary src*	-	-	1 = 1
41.39	Set 2 deadband range	*Real*	0……200000.0	-	10 = 1
41.40	Set 2 deadband delay	*Real*	0.0 … 3600.0	s	10 = 1 s
41.43	Set 2 sleep level	*Real*	0.0…200000.0	-	10 = 1
41.44	Set 2 sleep delay	*Real*	0.0…3600.0	s	10 = 1 s
41.45	Set 2 sleep boost time	*Real*	0.0…3600.0	s	10 = 1 s
41.46	Set 2 sleep boost step	*Real*	0.0…200000.0	PID customer units	10 = 1 PID customer unit

No.	Name	Type	Range	Unit	FbEq32
41.47	Set 2 wake-up deviation	*Real*	-200000.00…200000.00	PID customer units	100 = 1 PID customer unit
41.48	Set 2 wake-up delay	*Real*	0.00…60.00	s	100 = 1 s
41.49	Set 2 tracking mode	*Binary src*	-	-	1 = 1
41.50	Set 2 tracking ref selection	*Analog src*	-	-	1 = 1
41.58	Set 2 increase prevention	*Binary src*	-	-	1 = 1
41.59	Set 2 decrease prevention	*Binary src*	-	-	1 = 1
41.60	Set 2 PID activation source	*Binary src*	-	-	1 = 1
41.71	Set 2 compensation input source	*List*	0, 2…4, 8, 10…12, 15…16, 19…20, 24	-	1 = 1
41.72	Set 2 compensation input 1	*Real*	-200000.00…200000.00	-	100 = 1
41.73	Set 2 compensated output 1	*Real*	-200000.00…200000.00	-	100 = 1
41.74	Set 2 compensation input 2	*Real*	-200000.00…200000.00	-	100 = 1
41.75	Set 2 compensated output 2	*Real*	-200000.00…200000.00	-	100 = 1
41.76	Set 2 compensation non-linearity	*Real*	0…100	%	1= 1
41.80	Set 2 PID output min source	*List*	0…1	-	1 = 1
41.81	Set 2 PID output max source	*List*	0…1	-	1 = 1
41.89	Set 2 setpoint multiplier	*Real*	-200000.00…200000.00	-	100 = 1
41.90	Set 2 feedback multiplier	*Real*	-200000.00…200000.00	-	100 = 1
45 Energy efficiency					
45.01	Saved GW hours	*Real*	0…65535	GWh	1 = 1 GWh
45.02	Saved MW hours	*Real*	0…999	MWh	1 = 1 MWh
45.03	Saved kW hours	*Real*	0.0…999.9	kWh	10 = 1 kWh
45.04	Saved energy	*Real*	0.0…214748364.0	kWh	10 = 1 kWh
45.05	Saved money x1000	*Real*	0…4294967295 thousands	(definable)	1 = 1 currency unit
45.06	Saved money	*Real*	0.00…999.99	(definable)	100 = 1 currency unit
45.07	Saved amount	*Real*	0.00…21474830.08	(definable)	100 = 1 currency unit
45.08	CO2 reduction in kilotons	*Real*	0…65535	metric kiloton	1 = 1 metric kiloton
45.09	CO2 reduction in tons	*Real*	0.0…999.9	metric ton	10 = 1 metric ton
45.10	Total saved CO2	*Real*	0.0…214748300.8	metric ton	10 = 1 metric ton
45.11	Energy optimizer	*List*	0…1	-	1 = 1

No.	Name	Type	Range	Unit	FbEq32
45.12	Energy tariff 1	*Real*	0.000…4294966.296	(definable)	1000 = 1 currency unit
45.13	Energy tariff 2	*Real*	0.000…4294966.296	(definable)	1000 = 1 currency unit
45.14	Tariff selection	*Binary src*	-	-	1 = 1
45.18	CO2 conversion factor	*Real*	0.000…65.535	tn/ MWh	1000 = 1 tn/MWh
45.19	Comparison power	*Real*	0.00…10000000.00	kW	10 = 1 kW
45.21	Energy calculations reset	*List*	0…1	-	1 = 1
45.24	Hourly peak power value	*Real*	-3000.00 … 3000.00	kW	1 = 1 kW
45.25	Hourly peak power time	*Real*			N/A
45.26	Hourly total energy (resettable)	*Real*	-3000.00 … 3000.00	kWh	1 = 1 kWh
45.27	Daily peak power value (resettable)	*Real*	-3000.00 … 3000.00	kW	1 = 1 kW
45.28	Daily peak power time	*Real*			N/A
45.29	Daily total energy (resettable)	*Real*	-30000.00 … 30000.00	kWh	1 = 1 kWh
45.30	Last day total energy	*Real*	-30000.00 … 30000.00	kWh	1 = 1 kWh
45.31	Monthly peak power value (resettable)	*Real*	-3000.00 … 3000.00	kW	1 = 1 kW
45.32	Monthly peak power date	*Real*			N/A
45.33	Monthly peak power time	*Real*			N/A
45.34	Monthly total energy (resettable)	*Real*	-1000000.00 … 1000000.00	kWh	1 = 1 kWh
45.35	Last month total energy	*Real*	-1000000.00 … 1000000.00	kWh	1 = 1 kWh
45.36	Lifetime peak power value	*Real*	-3000.00 … 3000.00	kW	1 = 1 kW
45.37	Lifetime peak power date	*Real*			N/A
45.38	Lifetime peak power time	*Real*			N/A
46 Monitoring/scaling settings					
46.01	Speed scaling	*Real*	0.00…30000.00	rpm	100 = 1 rpm
46.02	Frequency scaling	*Real*	0.10…1000.00	Hz	100 = 1 Hz
46.03	Torque scaling	*Real*	0.1…1000.0	%	10 = 1%
46.04	Power scaling	*Real*	0.10…30000.00 kW or 0.10…40200.00 hp	kW or hp	10 = 1 unit
46.05	Current scaling	*Real*	0…30000	A	1 = 1 A
46.06	Speed ref zero scaling	*Real*	0.00 … 30000.00	rpm	100 = 1 rpm
46.11	Filter time motor speed	*Real*	2…20000	ms	1 = 1 ms
46.12	Filter time output frequency	*Real*	2…20000	ms	1 = 1 ms
46.13	Filter time motor torque	*Real*	2…20000	ms	1 = 1 ms
46.14	Filter time power	*Real*	2…20000	ms	1 = 1 ms
46.21	At speed hysteresis	*Real*	0.00…30000.00	rpm	100 = 1 rpm
46.22	At frequency hysteresis	*Real*	0.00…1000.00	Hz	100 = 1 Hz
46.31	Above speed limit	*Real*	0.00…30000.00	rpm	100 = 1 rpm
46.32	Above frequency limit	*Real*	0.00…1000.00	Hz	100 = 1 Hz

No.	Name	Type	Range	Unit	FbEq32
46.41	kWh pulse scaling	*Real*	0.001…1000.000	kWh	1000 = 1 kWh
47 Data storage					
47.01	Data storage 1 real32	*Real*	-2147483.000… 2147483.000	-	1000 = 1
47.02	Data storage 2 real32	*Real*	-2147483.000… 2147483.000	-	1000 = 1
47.03	Data storage 3 real32	*Real*	-2147483.000… 2147483.000	-	1000 = 1
47.04	Data storage 4 real32	*Real*	-2147483.000… 2147483.000	-	1000 = 1
47.11	Data storage 1 int32	*Real*	-2147483648… 2147483647	-	1 = 1
47.12	Data storage 2 int32	*Real*	-2147483648… 2147483647	-	1 = 1
47.13	Data storage 3 int32	*Real*	-2147483648… 2147483647	-	1 = 1
47.14	Data storage 4 int32	*Real*	-2147483648… 2147483647	-	1 = 1
47.21	Data storage 1 int16	*Real*	-32768…32767	-	1 = 1
47.22	Data storage 2 int16	*Real*	-32768…32767	-	1 = 1
47.23	Data storage 3 int16	*Real*	-32768…32767	-	1 = 1
47.24	Data storage 4 int16	*Real*	-32768…32767	-	1 = 1
49 Panel port communication					
49.01	Node ID number	*Real*	1…32	-	1 = 1
49.03	Baud rate	*List*	1…5	-	1 = 1
49.04	Communication loss time	*Real*	0.3…3000.0	s	10 = 1 s
49.05	Communication loss action	*List*	0…3	-	1 = 1
49.06	Refresh settings	*List*	0…1	-	1 = 1
50 Fieldbus adapter (FBA)					
50.01	FBA A enable	*List*	0…1	-	1 = 1
50.02	FBA A comm loss func	*List*	0…5	-	1 = 1
50.03	FBA A comm loss t out	*Real*	0.3…6553.5	s	10 = 1 s
50.04	FBA A ref1 type	*List*	0…5	-	1 = 1
50.05	FBA A ref2 type	*List*	0…5	-	1 = 1
50.06	FBA A SW sel	*List*	0…1	-	1 = 1
50.07	FBA A actual 1 type	*List*	0…5	-	1 = 1
50.08	FBA A actual 2 type	*List*	0…5	-	1 = 1
50.09	FBA A SW transparent source	*Analog src*	-	-	1 = 1
50.10	FBA A act1 transparent source	*Analog src*	-	-	1 = 1
50.11	FBA A act2 transparent source	*Analog src*	-	-	1 = 1
50.12	FBA A debug mode	*List*	0…1	-	1 = 1

No.	Name	Type	Range	Unit	FbEq32
50.13	FBA A control word	*Data*	00000000h…FFFFFFFFh	-	1 = 1
50.14	FBA A reference 1	*Real*	-2147483648… 2147483647	-	1 = 1
50.15	FBA A reference 2	*Real*	-2147483648… 2147483647	-	1 = 1
50.16	FBA A status word	*Data*	00000000h…FFFFFFFFh	-	1 = 1
50.17	FBA A actual value 1	*Real*	-2147483648… 2147483647	-	1 = 1
50.18	FBA A actual value 2	*Real*	-2147483648… 2147483647	-	1 = 1
51 FBA A settings					
51.01	FBA A type	*List*	-	-	1 = 1
51.02	FBA A Par2	*Real*	0…65535	-	1 = 1
…	…	…	…	…	
51.26	FBA A Par26	*Real*	0…65535	-	1 = 1
51.27	FBA A par refresh	*List*	0…1	-	1 = 1
51.28	FBA A par table ver	*Data*	-	-	1 = 1
51.29	FBA A drive type code	*Real*	0…65535	-	1 = 1
51.30	FBA A mapping file ver	*Real*	0…65535	-	1 = 1
51.31	D2FBA A comm status	*List*	0…6	-	1 = 1
51.32	FBA A comm SW ver	*Data*	-	-	1 = 1
51.33	FBA A appl SW ver	*Data*	-	-	1 = 1
52 FBA A data in					
52.01	FBA A data in1	*List*	-	-	1 = 1
…	…	…	…	…	
52.12	FBA A data in12	*List*	-	-	1 = 1
53 FBA A data out					
53.01	FBA A data out1	*List*	-	-	1 = 1
…	…	…	…	…	
53.12	FBA A data out12	*List*	-	-	1 = 1
58 Embedded fieldbus					
58.01	Protocol enable	*List*	0…1	-	1 = 1
58.02	Protocol ID	*Real*	0000h…FFFFh	-	1 = 1
58.03	Node address	*Real*	0…255	-	1 = 1
58.04	Baud rate	*List*	0…7	-	1 = 1
58.05	Parity	*List*	0…3	-	1 = 1
58.06	Communication control	*List*	0…2	-	1 = 1
58.07	Communication diagnostics	*PB*	0000h…FFFFh	-	1 = 1
58.08	Received packets	*Real*	0…4294967295	-	1 = 1
58.09	Transmitted packets	*Real*	0…4294967295	-	1 = 1
58.10	All packets	*Real*	0…4294967295	-	1 = 1
58.11	UART errors	*Real*	0…4294967295	-	1 = 1

No.	Name	Type	Range	Unit	FbEq32
58.12	CRC errors	*Real*	0…4294967295	-	1 = 1
58.14	Communication loss action	*List*	0…5	-	1 = 1
58.15	Communication loss mode	*List*	1…2	-	1 = 1
58.16	Communication loss time	*Real*	0.0…6000.0	s	10 = 1 s
58.17	Transmit delay	*Real*	0…65535	ms	1 = 1 ms
58.18	EFB control word	*PB*	00000000h…FFFFFFFFh	-	1 = 1
58.19	EFB status word	*PB*	00000000h…FFFFFFFFh	-	1 = 1
58.25	Control profile	*List*	0, 5	-	1 = 1
58.26	EFB ref1 type	*List*	0…2, 4…5	-	1 = 1
58.27	EFB ref2 type	*List*	0…2, 4…5	-	1 = 1
58.28	EFB act1 type	*List*	0…2, 4…5	-	1 = 1
58.29	EFB act2 type	*List*	0…2, 4…5	-	1 = 1
58.31	EFB act1 transparent source	*Analog src*	-	-	1 = 1
58.32	EFB act2 transparent source	*Analog src*	-	-	1 = 1
58.33	Addressing mode	*List*	0…2	-	1 = 1
58.34	Word order	*List*	0…1	-	1 = 1
58.101	Data I/O 1	*Analog src*	-	-	1 = 1
58.102	Data I/O 2	*Analog src*	-	-	1 = 1
58.103	Data I/O 3	*Analog src*	-	-	1 = 1
58.104	Data I/O 4	*Analog src*	-	-	1 = 1
58.105	Data I/O 5	*Analog src*	-	-	1 = 1
58.106	Data I/O 6	*Analog src*	-	-	1 = 1
58.107	Data I/O 7	*Analog src*	-	-	1 = 1
…	…	…	…	…	
58.114	Data I/O 14	*Analog src*	-	-	1 = 1
71 External PID1					
71.01	External PID act value	*Real*	-200000.00…200000.00	%	100 = 1 PID customer unit
71.02	Feedback act value	*Real*	-200000.00…200000.00	PID customer units	100 = 1 PID customer unit
71.03	Setpoint act value	*Real*	-200000.00…200000.00	PID customer units	100 = 1 PID customer unit
71.04	Deviation act value	*Real*	-200000.00…200000.00	PID customer units	100 = 1 PID customer unit

No.	Name	Type	Range	Unit	FbEq32
71.06	PID status word	*PB*	0000h…FFFFh	-	1 = 1
71.07	PID operation mode	*List*	0…2	-	1 = 1
71.08	Feedback 1 source	*Analog src*	-	-	1 = 1
71.11	Feedback filter time	*Real*	0.000…30.000	s	1000 = 1 s
71.14	Setpoint scaling	*Real*	-200000.00…200000.00	-	100 = 1
71.15	Output scaling	*Real*	-200000.00…200000.00	-	100 = 1
71.16	Setpoint 1 source	*Analog src*	-	-	1 = 1
71.19	Internal setpoint sel1	*Binary src*	-	-	1 = 1
71.20	Internal setpoint sel2	*Binary src*	-	-	1 = 1
71.21	Internal setpoint 1	*Real*	-200000.00…200000.00	PID customer units	100 = 1 PID customer unit
71.22	Internal setpoint 2	*Real*	-200000.00…200000.00	PID customer units	100 = 1 PID customer unit
71.23	Internal setpoint 3	*Real*	-200000.00…200000.00	PID customer units	100 = 1 PID customer unit
71.26	Setpoint min	*Real*	-200000.00…200000.00	-	100 = 1
71.27	Setpoint max	*Real*	-200000.00…200000.00	-	100 = 1
71.31	Deviation inversion	*Binary src*	-	-	1 = 1
71.32	Gain	*Real*	0.10…100.00	-	100 = 1
71.33	Integration time	*Real*	0.0…9999.0	s	10 = 1 s
71.34	Derivation time	*Real*	0.000…10.000	s	1000 = 1 s
71.35	Derivation filter time	*Real*	0.0…10.0	s	10 = 1 s
71.36	Output min	*Real*	-200000.00…200000.00	-	10 = 1
71.37	Output max	*Real*	-200000.00…200000.00	-	10 = 1
71.38	Output freeze enable	*Binary src*	-	-	1 = 1
71.39	Deadband range	*Real*	0.0…200000.0	-	10 = 1
71.40	Deadband delay	*Real*	0.0…3600.0	s	10 = 1 s
71.58	Increase prevention	*Binary src*	-	-	1 = 1
71.59	Decrease prevention	*Binary src*	-	-	1 = 1
71.62	Internal setpoint actual	*Real*	-200000.00…200000.00	PID customer units	100 = 1 PID customer unit

No.	Name	Type	Range	Unit	FbEq32
76 Multipump configuration					
76.01	PFC status	*PB*	0000h…FFFFh	-	1 = 1
76.02	Multipump system status	*List*	0…3, 100…103, 200…202, 300…302, 400, 500, 600, 700, 800…801, 4…9	-	1 = 1
76.05	Measured level	*Real*	0.00...32767.00	m	10 = 1
76.06	Measured level %	*Real*	0...100	%	1 = 1
76.07	LC speed ref	*Real*	-2147483648...2147483648	rpm	1 = 1
76.11	Pump status 1	*PB*	0000h…FFFFh	-	1 = 1
76.12	Pump status 2	*PB*	0000h…FFFFh	-	1 = 1
76.13	Pump status 3	*PB*	0000h…FFFFh	-	1 = 1
76.14	Pump status 4	*PB*	0000h…FFFFh	-	1 = 1
76.15	Pump status 5	*PB*	0000h…FFFFh	-	1 = 1
76.16	Pump status 6	*PB*	0000h…FFFFh	-	1 = 1
76.17	Pump status 7	*PB*	0000h…FFFFh	-	1 = 1
76.18	Pump status 8	*PB*	0000h…FFFFh	-	1 = 1
76.21	Multipump configuration	*List*	-	-	1 = 1
76.22	Multipump node number	*Real*	0...8	-	1 = 1
76.23	Master enable	*List*	-	-	1 = 1
76.25	Number of motors	*Real*	1…8	-	1 = 1
76.26	Min number of motors allowed	*Real*	0…8	-	1 = 1
76.27	Max number of motors allowed	*Real*	1…8	-	1 = 1
76.30	Start point 1	*Real*	0.00…32767.00	[rpm/Hz] [m]	1 = 1 unit
76.31	Start point 2	*Real*	0.00…32767.00	[rpm/Hz] [m]	1 = 1 unit
76.32	Start point 3	*Real*	0.00…32767.00	[rpm/Hz] [m]	1 = 1 unit
76.33	Start point 4	*Real*	0.00…32767.00	[rpm/Hz] [m]	1 = 1 unit
76.34	Start point 5	*Real*	0.00…32767.00	[rpm/Hz] [m]	1 = 1 unit
76.35	Start point 6	*Real*	0.00…32767.00	[rpm/Hz] [m]	1 = 1 unit
76.36	Start point 7	*Real*	0.00…32767.00	[rpm/Hz] [m]	1 = 1 unit
76.37	Start point 8	*Real*	0.00…32767.00	[rpm/Hz] [m]	1 = 1 unit
76.41	Stop point 1	*Real*	0.00…32767.00	[rpm/Hz] [m]	1 = 1 unit
76.42	Stop point 2	*Real*	0.00…32767.00	[rpm/Hz] [m]	1 = 1 unit
76.43	Stop point 3	*Real*	0.00…32767.00	[rpm/Hz] [m]	1 = 1 unit
76.44	Stop point 4	*Real*	0.00…32767.00	[rpm/Hz] [m]	1 = 1 unit

No.	Name	Type	Range	Unit	FbEq32
76.45	Stop point 5	*Real*	0.00…32767.00	[rpm/Hz] [m]	1 = 1 unit
76.46	Stop point 6	*Real*	0.00…32767.00	[rpm/Hz] [m]	1 = 1 unit
76.47	Stop point 7	*Real*	0.00…32767.00	[rpm/Hz] [m]	1 = 1 unit
76.48	Stop point 8	*Real*	0.00…32767.00	[rpm/Hz] [m]	1 = 1 m
76.50	LC full speed point	*Real*	0.00…32767.00	m	1 = 1 m
76.51	LC level source	*List*	-	-	1 = 1
76.52	LC level unit	*List*	-	-	1 = 1
76.53	LC efficient speed	*Real*	-2147483648...2147483648	rpm	1 = 1 rpm
76.54	LC max time at level	*Real*	0.0...1800.0	h	100 = 1 h
76.55	Start delay	*Real*	0.00…12600.00	s	100 = 1 s
76.56	Stop delay	*Real*	0.00…12600.00	s	100 = 1 s
76.57	PFC speed hold on	*Real*	0.00…1000.00	s	100 = 1 s
76.58	PFC speed hold off	*Real*	0.00…1000.00	s	100 = 1 s
76.59	PFC contactor delay	*Real*	0.20…600.00	s	100 = 1 s
76.60	PFC ramp acceleration time	*Real*	0.00…1800.00	s	100 = 1 s
76.61	PFC ramp deceleration time	*Real*	0.00…1800.00	s	100 = 1 s
76.62	IPC smooth acceleration time	*Real*	3.00...1800.00	s	100 = 1 s
76.63	IPC smooth deceleration time	*Real*	3.00...1800.00	s	100 = 1 s
76.70	PFC Autochange	*List*	-	-	1 = 1
76.71	PFC Autochange interval	*Real*	0.00…42949672.95	h	100 = 1 h
76.72	Maximum wear imbalance	*Real*	0.00…1000000.00	h	100 = 1 h
76.73	Autochange level	*Real*	0.0…300.0	%	10 = 1%
76.74	Autochange auxiliary PFC	*List*	-	-	-
76.76	Max stationary time	*Real*	0.0...214748368.0	h	10 = 1 h
76.77	Pump priority	*Binary src*	-	-	-
76.81	PFC 1 interlock	*List*	-	-	1 = 1
76.82	PFC 2 interlock	*List*	-	-	1 = 1
76.83	PFC 3 interlock	*List*	-	-	1 = 1
76.84	PFC 4 interlock	*List*	-	-	1 = 1
76.85	PFC 5 interlock	*List*	-	-	1 = 1
76.86	PFC 6 interlock	*List*	-	-	1 = 1
76.90	LC low level switch	*List*	-	-	1 = 1
76.91	LC high level switch	*List*	-	-	1 = 1
76.92	LC low level action	*List*	-	-	1 = 1
76.93	LC high level action	*List*	-	-	1 = 1
76.95	Regulator bypass control	*Binary src*	-	-	-

No.	Name	Type	Range	Unit	FbEq32
76.101	IPC parameter synchronization	*Binary src*	-	-	-
76.102	IPC synchronization settings	*PB*	0000h…FFFFh	-	1 = 1
76.105	IPC synchronization checksum	*PB*	-	-	1 = 1
77 Multipump maintenance and monitoring					
77.10	PFC runtime change	*List*	-	-	1 = 1
77.11	Pump 1 running time	*Real*	0.00…42949672.95	h	100 = 1 h
77.12	Pump 2 running time	*Real*	0.00…42949672.95	h	100 = 1 h
77.13	Pump 3 running time	*Real*	0.00…42949672.95	h	100 = 1 h
77.14	Pump 4 running time	*Real*	0.00…42949672.95	h	100 = 1 h
77.15	Pump 5 running time	*Real*	0.00…42949672.95	h	100 = 1 h
77.16	Pump 6 running time	*Real*	0.00…42949672.95	h	100 = 1 h
77.17	Pump 7 running time	*Real*	0.00…42949672.95	h	100 = 1 h
77.18	Pump 8 running time	*Real*	0.00…42949672.95	h	100 = 1 h
77.20	IPC online pumps	*PB*	0b0000...0b1111 1111 1111 1111	-	-
77.21	IPC comm loss status	*PB*	0b0000...0b1111 1111 1111 1111	-	-
80 Flow calculation and protection					
80.01	Actual flow	*Real*	-200000.00...200000.00	m^3/h	100 = 1
80.02	Actual flow percentage	*Real*	-100.00…100.00	%	100 = 1
80.03	Total flow	*Real*	0.00...21474836.00	m^3	100 = 1
80.04	Specific energy	*Real*	0.00...32767.95	m^3/kWh	100 = 1
80.05	Estimated pump head	*Real*	0.00...32767.00	m	100 = 1
80.11	Flow feedback 1 source	*List*	0…3, 8…10,	-	1 = 1
80.12	Flow feedback 2 source	*List*	0…3, 8…10,	-	1 = 1
80.13	Flow feedback function	*List*	0…1, 8…9,	-	1 = 1
80.14	Flow feedback multiplier	*Real*	-200000.00…200000.00	-	100 = 1
80.15	Maximum flow	*Real*	-200000.00…200000.00	-	100 = 1
80.16	Minimum flow	*Real*	-200000.00…200000.00	m^3/h	100 = 1
80.17	Maximum flow protection	*List*	-	-	1 = 1
80.18	Minimum flow protection	*List*	-	-	1 = 1
80.19	Flow check delay	*Real*	0.00...3600.00	s	100 = 1
80.22	Pump inlet diameter	*Real*	0.010...32767.000	cm	1000 = 1
80.23	Pump outlet diameter	*Real*	0.010...32767.000	cm	1000 = 1
80.26	Calculation minimum speed	*Real*	0.00...32767.00	Hz	100 = 1
80.28	Density	*Real*	0.00...32767.00	kg/m^3	
80.29	Total flow reset	*Real*	-	-	1 = 1
80.40	HQ curve H1	*Real*	0.00...32767.00	m	100 = 1
80.41	HQ curve H2	*Real*	0.00...32767.00	m	100 = 1
80.42	HQ curve H3	*Real*	0.00...32767.00	m	100 = 1
80.43	HQ curve H4	*Real*	0.00...32767.00	m	100 = 1

No.	Name	Type	Range	Unit	FbEq32
80.44	HQ curve H5	*Real*	0.00...32767.00	m	100 = 1
80.50	PQ curve P1	*Real*	0.00...32767.00	kW	100 = 1
80.51	PQ curve P2	*Real*	0.00...32767.00	kW	100 = 1
80.52	PQ curve P3	*Real*	0.00...32767.00	kW	100 = 1
80.53	PQ curve P4	*Real*	0.00...32767.00	kW	100 = 1
80.54	PQ curve P5	*Real*	0.00...32767.00	kW	100 = 1
80.60	Q value Q1	*Real*	0.00...200000.00	m^3/h	100 = 1
80.61	Q value Q2	*Real*	0.00...200000.00	m^3/h	100 = 1
80.62	Q value Q3	*Real*	0.00...200000.00	m^3/h	100 = 1
80.63	Q value Q4	*Real*	0.00...200000.00	m^3/h	100 = 1
80.64	Q value Q5	*Real*	0.00...200000.00	m^3/h	100 = 1
81 Sensor settings					
81.01	Actual inlet pressure	*Real*	0.00...32767.00	bar	100 = 1
81.02	Actual outlet pressure	*Real*	0.00...32767.00	bar	100 = 1
81.10	Inlet pressure source	*List*	-	-	1 = 1
81.11	Outlet pressure source	*List*	-	-	1 = 1
81.12	Sensors height difference	*Real*	0.00...32767.00	m	100 = 1
81.20	Pressure unit	*List*	-	-	1 = 1
81.21	Flow unit	*List*	-	-	1 = 1
81.22	Length unit	*List*	-	-	1 = 1
81.23	Density unit	*List*	-	-	1 = 1
82 Pump protections					
82.01	Quick ramp mode	*List*	0...2	-	1 = 1
82.05	Quick ramp 1 accel. time	*Real*	0.10...5.00	s	1 = 1
82.06	Quick ramp 1 decel. time	*Real*	0.10...5.00	s	1 = 1
82.07	Quick ramp 1 upper limit	*Real*	15...100	Hz	1 = 1
82.10	Quick ramp 2 accel. time	*Real*	0.10...20.00	s	1 = 1
82.11	Quick ramp 2 decel. time	*Real*	0.10...20.00	s	1 = 1
82.12	Quick ramp 2 upper limit	*Real*	15...100	Hz	1 = 1
82.20	Dry run protection	*List*	-	-	1 = 1
82.21	Dry run source	*List*	-	-	1 = 1
82.25	Soft pipe fill supervision	*List*	-	-	1 = 1
82.26	Time-out limit	*Real*	0.0...1800.0	s	10 = 1
82.30	Outlet minimum pressure protection	*List*	-	-	1 = 1
82.31	Outlet minimum pressure warning level	*Real*	0.00...32767.00	bar	100 = 1
82.32	Outlet minimum pressure fault level	*Real*	0.00...32767.00	bar	100 = 1
82.35	Outlet maximum pressure protection	*List*	-	-	1 = 1
82.37	Outlet maximum pressure warning level	*Real*	0.00...32767.00	bar	100 = 1

No.	Name	Type	Range	Unit	FbEq32
82.38	Outlet maximum pressure fault level	*Real*	0.00...32767.00	bar	100 = 1
82.40	Inlet minimum pressure protection	*List*	-	-	1 = 1
82.41	Inlet minimum pressure warning level	*Real*	0.00...32767.00	bar	100 = 1
82.42	Inlet minimum pressure fault level	*Real*	0.00...32767.00	bar	100 = 1
82.45	Pressure check delay	*Real*	0.00...3600.00	s	100 = 1
83 Pump cleaning					
83.01	Pump cleaning status	*Binary src*	-	-	-
83.02	Pump cleaning progress	*Real*	0.0...100.0	%	1 = 1
83.03	Total cleaning count	*Real*	0...1000000	-	1 = 1
83.10	Pump cleaning action	*Binary src*	-	-	-
83.11	Pump cleaning triggers	*PB*	0000h…FFFFh	-	1 = 1
83.12	Manually force cleaning	*Binary src*	-	-	-
83.15	Fixed time interval	Time	00:00:00...45:12:15	s	1 = 1
83.16	Cycles in cleaning program	*Real*	1...65535	-	1 = 1
83.20	Cleaning speed step	*Real*	0...100	%	1 = 1
83.25	Time to cleaning speed	*Real*	0.000...60.000	s	1 = 1
83.26	Time to zero-speed	*Real*	0.000...60.000	s	1 = 1
83.27	Cleaning on time	*Real*	0.000...1000.000	s	1 = 1
83.28	Cleaning off time	*Real*	0.000...1000.000	s	1 = 1
83.35	Cleaning count fault	*Binary src*	-	-	1 = 1
83.36	Cleaning count time	Time	00:00:00...45:12:15	s	1 = 1
83.37	Maximum cleaning count	*Real*	0...30	-	1 = 1
95 HW configuration					
95.01	Supply voltage	*List*	0, 2…3	-	1 = 1
95.02	Adaptive voltage limits	*List*	0…1	-	1 = 1
95.03	Estimated AC supply voltage	*Real*	0…65535	V	1 = 1 V
95.04	Control board supply	*List*	0…1	-	1 = 1
95.15	Special HW settings	*PB*	00000000h…FFFFFFFFh	-	1 = 1
95.20	HW options word 1	*PB*	0000h…FFFFh	-	1 = 1
96 System					
96.01	Language	*List*	-	-	1 = 1
96.02	Pass code	*Data*	0…99999999	-	1 = 1
96.03	Access level status	*PB*	00000000h…FFFFFFFFh	-	1 = 1
96.06	Parameter restore	*List*	0, 2, 8, 32, 62, 512, 1024, 34560	-	1 = 1
96.07	Parameter save manually	*List*	0…1	-	1 = 1

No.	Name	Type	Range	Unit	FbEq32
96.08	Control board boot	*List*	0…1	-	1 = 1
96.10	User set status	*List*	0…7, 20…23	-	1 = 1
96.11	User set save/load	*List*	0…5, 18…21	-	1 = 1
96.12	User set I/O mode in1	*Binary src*	-	-	-
96.13	User set I/O mode in2	*Binary src*	-	-	-
96.16	Unit selection	*PB*	000h…FFFFh		1 = 1
96.20	Time sync primary source	*List*	0, 2, 6, 8, 9	-	1 = 1
96.51	Clear fault and event logger	*Real*	0…1	-	1 = 1
96.70	Disable adaptive program	*List*	0…1	-	1 = 1
96.100	Change user pass code	*Data*	10000000…99999999	-	1 = 1
96.101	Confirm user pass code	*Data*	10000000…99999999	-	1 = 1
96.102	User lock functionality	*PB*	0000h…FFFFh	-	1 = 1
97 Motor control					
97.01	Switching frequency reference	*List*	4, 8, 12	kHz	1 = 1 kHz
97.02	Minimum switching frequency	*List*	2, 4, 8, 12	kHz	1 = 1 kHz
97.03	Slip gain	*Real*	0…200	%	1 = 1%
97.04	Voltage reserve	*Real*	-4…50	%	1 = 1%
97.05	Flux braking	*List*	0…2	-	1 = 1
97.08	Optimizer minimum torque	*Real*	0.0 … 1600.0	%	10 = 1%
97.09	Switching frequency mode	*List*	0…1	-	1 = 1
97.10	Signal injection	*List*	0…4	-	1 = 1
97.11	TR tuning	*Real*	25…400	%	1 = 1%
97.13	IR compensation	*Real*	0.00…50.00	%	100 = 1%
97.15	Motor model temperature adaptation	*List*	0…1	-	1 = 1
97.20	U/F ratio	*List*	0…1	-	1 = 1
98 User motor parameters					
98.01	User motor model mode	*List*	0…1	-	1 = 1
98.02	Rs user	*Real*	0.0000…0.50000	p.u.	100000 = 1 p.u.
98.03	Rr user	*Real*	0.0000…0.50000	p.u.	100000 = 1 p.u.
98.04	Lm user	*Real*	0.00000…10.00000	p.u.	100000 = 1 p.u.
98.05	SigmaL user	*Real*	0.00000…1.00000	p.u.	100000 = 1 p.u.
98.06	Ld user	*Real*	0.00000…10.00000	p.u.	100000 = 1 p.u.
98.07	Lq user	*Real*	0.00000…10.00000	p.u.	100000 = 1 p.u.
98.08	PM flux user	*Real*	0.00000…2.00000	p.u.	100000 = 1 p.u.

No.	Name	Type	Range	Unit	FbEq32
98.09	Rs user SI	*Real*	0.00000…100.00000	ohm	100000 = 1 p.u.
98.10	Rr user SI	*Real*	0.00000…100.00000	ohm	100000 = 1 p.u.
98.11	Lm user SI	*Real*	0.00…100000.00	mH	100 = 1 mH
98.12	SigmaL user SI	*Real*	0.00…100000.00	mH	100 = 1 mH
98.13	Ld user SI	*Real*	0.00…100000.00	mH	100 = 1 mH
98.14	Lq user SI	*Real*	0.00…100000.00	mH	100 = 1 mH
99 Motor data					
99.03	Motor type	*List*	0…2	-	1 = 1
99.04	Motor control mode	*List*	0…1	-	1 = 1
99.06	Motor nominal current	*Real*	0.0…6400.0	A	10 = 1 A
99.07	Motor nominal voltage	*Real*	0.0…960.0	V	10 = 1 V
99.08	Motor nominal frequency	*Real*	0.0 … 500.0	Hz	10 = 1 Hz
99.09	Motor nominal speed	*Real*	0 … 30000	rpm	1 = 1 rpm
99.10	Motor nominal power	*Real*	0.00…10000.00 kW or 0.00 … 13404.83 hp	kW or hp	100 = 1 unit
99.11	Motor nominal cos Φ	*Real*	0.00 … 1.00	-	100 = 1
99.12	Motor nominal torque	*Real*	0.000…4000000.000 N·m or 0.000…2950248.597 lb·ft	N·m or lb·ft	1000 = 1 unit
99.13	ID run requested	*List*	0…3, 6	-	1 = 1
99.14	Last ID run performed	*List*	0…3, 6	-	1 = 1
99.15	Motor polepairs calculated	*Real*	0…1000	-	1 = 1
99.16	Motor phase order	*List*	0…1	-	1 = 1

8

Fault tracing

What this chapter contains

The chapter lists the warning and fault messages including possible causes and corrective actions. The causes of most warnings and faults can be identified and corrected using the information in this chapter. If not, contact an ABB service representative. If you have a possibility to use the Drive composer PC tool, send the Support package created by the Drive composer to the ABB service representative.

Warnings and faults are listed below in separate tables. Each table is sorted by warning/fault code.

Safety

⚠ **WARNING!** Only qualified electricians are allowed to service the drive. Read the instructions in chapter *Safety instructions* at the beginning of the *Hardware manual* of the drive before working on the drive.

Indications

Warnings and faults

Warnings and faults indicate an abnormal drive status. The codes and names of active warnings and faults are displayed on the control panel of the drive as well as in the Drive composer PC tool. Only the codes of warnings and faults are available over fieldbus.

Warnings do not need to be reset; they stop showing when the cause of the warning ceases. Warnings do not trip the drive and it will continue to operate the motor.

Faults latch inside the drive and cause the drive to trip, and the motor stops. After the cause of a fault has been removed, the fault can be reset from the panel or from a selectable source (parameter *31.11 Fault reset selection*) such as the digital inputs of the drive. Reseting the fault creates an event *64FF Fault reset*. After the reset, the drive can be restarted.

Note that some faults require a reboot of the control unit either by switching the power off and on, or using parameter *96.08 Control board boot* – this is mentioned in the fault listing wherever appropriate.

Pure events

In addition to warnings and faults, there are pure events that are only recorded in the event log of the drive. The codes of these events are included in the *Warning messages* table on page (*340*).

Editable messages

For external events, the action (fault or warning), name and the message text can be edited. To specify external events, select **Menu** - **Primary settings** - **Advanced functions** - **External events**.

Contact information can also be included and the text edited. To specify contact information, select **Menu** - **Primary settings** - **Clock, region, display** - **Contact info view**.

Warning/fault history

Event log

All indications are stored in the event log with a time stamp and other information. The event log stores information on

- the last 8 fault recordings, that is, faults that tripped the drive or fault resets
- the last 10 warnings or pure events that occurred.

See section *Viewing warning/fault information* on page *338*.

Auxiliary codes

Some events generate an auxiliary code that often helps in pinpointing the problem. On the control panel, the auxiliary code is stored as part of the details of the event; in the Drive composer PC tool, the auxiliary code is shown in the event listing.

Viewing warning/fault information

The drive is able to store a list of the active faults actually causing the drive to trip at the present time. The drive also stores a list of faults and warnings that have previously occurred.

For active faults and warnings, see

- **Menu - Diagnostics - Active faults**
- **Menu - Diagnostics - Active warnings**
- parameters in group *04 Warnings and faults* (page *107*).

For previously occurred faults and warnings, see

- **Menu - Diagnostics - Fault & event log**
- parameters in group *04 Warnings and faults* (page *107*).

The event log can also be accessed (and reset) using the Drive composer PC tool. See *Drive composer PC tool user's manual* (3AUA0000094606 [English]).

QR code generation for mobile service application

A QR code (or a series of QR codes) can be generated by the drive for display on the control panel. The QR code contains drive identification data, information on the latest events, and values of status and counter parameters. The code can be read with a mobile device containing the ABB service application, which then sends the data to ABB for analysis. For more information on the application, contact your local ABB service representative.

To generate the QR code, select **Menu** - **System info** - **QR code**.

Note: If a control panel which does not support QR code generation (version older than v.6.4x) is used, the **QR code** menu entry will disappear totally and will not be available any longer either with control panels supporting the QR code generation.

Warning messages

Note: The list also contains events that only appear in the Event log.

Code (hex)	**Warning / Aux. code**	**Cause**	**What to do**
64FF	Fault reset	A fault has been reset from the panel, Drive composer PC tool, fieldbus or I/O.	Event. Informative only.
A2B1	Overcurrent	Output current has exceeded internal fault limit. In addition to an actual overcurrent situation, this warning may also be caused by an earth fault or supply phase loss.	Check motor load. Check acceleration times in parameter group *23 Speed reference ramp* (speed control) or *28 Frequency reference chain* (frequency control). Also check parameters *46.01 Speed scaling*, *46.02 Frequency scaling* and *46.03 Torque scaling*. Check motor and motor cable (including phasing and delta/star connection). Check for an earth fault in motor or motor cables by measuring the insulation resistances of motor and motor cable. See chapter *Electrical installation*, section *Checking the insulation of the assembly* in the *Hardware manual* of the drive. Check there are no contactors opening and closing in motor cable. Check that the start-up data in parameter group *99 Motor data* corresponds to the motor rating plate. Check that there are no power factor correction capacitors or surge absorbers in motor cable.
A2B3	Earth leakage	Drive has detected load unbalance typically due to earth fault in motor or motor cable.	Check there are no power factor correction capacitors or surge absorbers in motor cable. Check for an earth fault in motor or motor cables by measuring the insulation resistances of motor and motor cable. See chapter *Electrical installation*, section *Checking the insulation of the assembly* in the *Hardware manual* of the drive. If an earth fault is found, fix or change the motor cable and/or motor. If no earth fault can be detected, contact your local ABB representative.

Code (hex)	**Warning / Aux. code**	**Cause**	**What to do**
A2B4	Short circuit	Short-circuit in motor cable(s) or motor.	Check motor and motor cable for cabling errors. Check motor and motor cable (including phasing and delta/star connection). Check for an earth fault in motor or motor cables by measuring the insulation resistances of motor and motor cable. See chapter *Electrical installation*, section *Checking the insulation of the assembly* in the *Hardware manual* of the drive. Check there are no power factor correction capacitors or surge absorbers in motor cable.
A2BA	IGBT overload	Excessive IGBT junction to case temperature. This warning protects the IGBT(s) and can be activated by a short circuit in the motor cable.	Check motor cable. Check ambient conditions. Check air flow and fan operation. Check heatsink fins for dust pick-up. Check motor power against drive power.
A3A1	DC link overvoltage	Intermediate circuit DC voltage too high (when the drive is stopped).	Check the supply voltage setting (parameter *95.01 Supply voltage*). Note that the wrong setting of the parameter may cause the motor to rush uncontrollably, or may overload the resistor. Check the supply voltage. If the problem persists, contact your local ABB representative.
A3A2	DC link undervoltage	Intermediate circuit DC voltage too low (when the drive is stopped).	
A3AA	DC not charged	The voltage of the intermediate DC circuit has not yet risen to operating level.	
A490	Incorrect temperature sensor setup	Temperature cannot be supervised due to incorrect adapter setup.	Check the settings of temperature source parameters *35.11* and *35.21*.
A491	External temperature 1 (Editable message text)	Measured temperature 1 has exceeded warning limit.	Check the value of parameter *35.02 Measured temperature 1*. Check the cooling of the motor (or other equipment whose temperature is being measured). Check the value of *35.13 Temperature 1 warning limit*.
A492	External temperature 2 (Editable message text)	Measured temperature 2 has exceeded warning limit.	Check the value of parameter *35.03 Measured temperature 2*. Check the cooling of the motor (or other equipment whose temperature is being measured). Check the value of *35.23 Temperature 2 warning limit*.
A4A0	Control board temperature	Control board temperature is too high.	Check the auxiliary code. See actions for each code below.
	(none)	Temperature above warning limit	Check ambient conditions. Check air flow and fan operation. Check heatsink fins for dust pick-up.
	1	Thermistor broken	Contact an ABB service representative for control board replacement.

Code (hex)	**Warning / Aux. code**	**Cause**	**What to do**
A4A1	IGBT overtemperature	Estimated drive IGBT temperature is excessive.	Check ambient conditions. Check air flow and fan operation. Check heatsink fins for dust pick-up. Check motor power against drive power.
A4A9	Cooling	Drive module temperature is excessive.	Check ambient temperature. If it exceeds 40 °C/104 °F (IP21 frames R4…R9) or if it exceeds 50 °C /122 °F (IP21 frames R0…R9), ensure that load current does not exceed derated load capacity of drive. For all P55 frames, check the derating temperatures. See chapter *Technical data*, section *Derating* in the *Hardware manual* of the drive. Check drive module cooling air flow and fan operation. Check inside of cabinet and heatsink of drive module for dust pick-up. Clean whenever necessary.
A4B0	Excess temperature	Power unit module temperature is excessive.	Check ambient conditions. Check air flow and fan operation. Check heatsink fins for dust pick-up. Check motor power against drive power.
A4B1	Excess temperature difference	High temperature difference between the IGBTs of different phases.	Check the motor cabling. Check cooling of drive module(s).
A4F6	IGBT temperature	Drive IGBT temperature is excessive.	Check ambient conditions. Check air flow and fan operation. Check heatsink fins for dust pick-up. Check motor power against drive power.
A581	Fan	Cooling fan feedback missing.	Check the auxiliary code to identify the fan. Code **0** denotes main fan 1. Other codes (format XYZ): “X” specifies state code (**1:** ID run, **2:** normal). “Y” = 0, “Z” specifies the index of the fan (**1:** Main fan 1, **2:** Main fan 2, **3:** Main fan 3). Check fan operation and connection. Replace fan if faulty.
A582	Auxiliary fan missing	An auxiliary cooling fan (IP55 internal fan) is stuck or disconnected.	Check the auxiliary code. Check the auxiliary fan and connection. Replace faulty fan. Make sure the front cover of the drive is in place and tightened. If the commissioning of the drive requires that the cover is off, this warning will be generated even if the corresponding fault is defeated. See fault *5081 Auxiliary fan broken* (page *353*).

Code (hex)	**Warning / Aux. code**	**Cause**	**What to do**
A5A0	Safe torque off Programmable warning: *31.22 STO indication run/stop*	Safe torque off function is active, ie safety circuit signal(s) connected to connector STO is lost.	Check safety circuit connections. For more information, chapter *The Safe torque off function* in the *Hardware manual* of the drive and description of parameter *31.22 STO indication run/stop* (page 180). Check the value of parameter *95.04 Control board supply*.
A5EA	Measurement circuit temperature	Problem with internal temperature measurement of the drive.	Contact your local ABB representative.
A5EB	PU board powerfail	Power unit power supply failure.	Contact your local ABB representative.
A5ED	Measurement circuit ADC	Measurement circuit fault.	Contact your local ABB representative.
A5EE	Measurement circuit DFF	Measurement circuit fault.	Contact your local ABB representative.
A5EF	PU state feedback	State feedback from output phases does not match control signals.	Contact your local ABB representative.
A5F0	Charging feedback	Charging feedback signal missing.	Check the feedback signal coming from the charging system.
A682	Flash erase speed exceeded	The flash memory (in the memory unit) has been erased too frequently, compromising the lifetime of the memory.	Avoid forcing unnecessary parameter saves by parameter *96.07* or cyclic parameter writes (such as user logger triggering through parameters). Check the auxiliary code (format XYYY YZZZ). “X” specifies the source of warning (**1:** generic flash erase supervision). “ZZZ” specifies the flash subsector number that generated the warning.
A6A4	Motor nominal value	The motor parameters are set incorrectly.	Check the auxiliary code. See actions for each code below.
		The drive is not dimensioned correctly.	
	0001	Slip frequency is too small.	Check the settings of the motor configuration parameters in groups 98 and 99. Check that the drive is sized correctly for the motor.
	0002	Synchronous and nominal speeds differ too much.	
	0003	Nominal speed is higher than synchronous speed with 1 pole pair.	
	0004	Nominal current is outside limits	
	0005	Nominal voltage is outside limits.	
	0006	Nominal power is higher than apparent power.	
	0007	Nominal power not consistent with nominal speed and torque.	

Code (hex)	**Warning / Aux. code**	**Cause**	**What to do**
A6A5	No motor data	Parameters in group 99 have not been set.	Check that all the required parameters in group 99 have been set. **Note:** It is normal for this warning to appear during the start-up and continue until the motor data is entered.
A6A6	Voltage category unselected	The voltage category has not been defined.	Set voltage category in parameter *95.01 Supply voltage*.
A6A7	System time not set	System time is not set. Timed functions cannot be used and fault log dates are not correct.	Set the system time manually or connect the panel to the drive to synchronize the clock. If basic panel is used, synchronize the clock through the EFB or a fieldbus module. Set parameter *34.10 Timed functions enable* to *Not selected* to disable the timed functions if they are not used.
A6B0	User lock is open	The user lock is open, ie. user lock configuration parameters *96.100*…*96.102* are visible.	Close the user lock by entering an invalid pass code in parameter *96.02 Pass code*. See section *User lock* (page *97*).
A6B1	User pass code not confirmed	A new user pass code has been entered in parameter *96.100* but not confirmed in *96.101*.	Confirm the new pass code by entering the same code in *96.101*. To cancel, close the user lock without confirming the new code. See section *User lock* (page *97*).
A6D1	FBA A parameter conflict	The drive does not have a functionality requested by a PLC, or requested functionality has not been activated.	Check PLC programming. Check settings of parameter groups *50 Fieldbus adapter (FBA)*.
A6E5	AI parametrization	The current/voltage hardware setting of an analog input does not correspond to parameter settings.	Check the event log for an auxiliary code. The code identifies the analog input whose settings are in conflict. Adjust either the hardware setting (on the drive control unit) or parameter *12.15*/*12.25*. **Note:** Control board reboot (either by cycling the power or through parameter *96.08 Control board boot*) is required to validate any changes in the hardware settings.
A6E6	ULC configuration	User load curve configuration error.	Check the auxiliary code (format XXXX ZZZZ). “ZZZZ” indicates the problem (see actions for each code below).
	0000	Speed points inconsistent.	Check that each speed point (parameters *37.11*…*37.15*) has a higher value than the previous point.
	0001	Frequency points inconsistent.	Check that each frequency point (*37.20*…*37.16*) has a higher value than the previous point.
	0002	Underload point above overload point.	Check that each overload point (*37.31*…*37.35*) has a higher value than the corresponding underload point (*37.21*…*37.25*).
	0003	Overload point below underload point.	

Code (hex)	**Warning / Aux. code**	**Cause**	**What to do**
A780	Motor stall Programmable warning: *31.24 Stall function*	Motor is operating in stall region because of e.g. excessive load or insufficient motor power.	Check motor load and drive ratings. Check fault function parameters.
A7AB	Extension I/O configuration failure	Installed CMOD module is not the same as configured.	Check that the installed module (shown by parameter *15.02 Detected extension module*) is the same as selected by parameter *15.01 Extension module type*.
A7C1	FBA A communication Programmable warning: *50.02 FBA A comm loss func*	Cyclical communication between drive and fieldbus adapter module A or between PLC and fieldbus adapter module A is lost.	Check status of fieldbus communication. See user documentation of fieldbus interface. Check settings of parameter groups *50 Fieldbus adapter (FBA)*, *51 FBA A settings*, *52 FBA A data in* and *53 FBA A data out*. Check cable connections. Check if communication master is able to communicate.
A7CE	EFB comm loss Programmable warning: *58.14 Communication loss action*	Communication break in embedded fieldbus (EFB) communication.	Check the status of the fieldbus master (online/offline/error etc.). Check cable connections to the EIA-485/X5 terminals 29, 30 and 31 on the control unit.
A7EE	Panel loss Programmable warning: *49.05 Communication loss action*	Control panel or PC tool selected as active control location for drive has ceased communicating.	Check PC tool or control panel connection. Check control panel connector. Check mounting platform if being used. Disconnect and reconnect the control panel.
A88F	Cooling fan	Maintenance timer limit exceeded.	Consider changing the cooling fan. Parameter *05.04 Fan on-time counter* shows the running time of the cooling fan.
A8A0	AI supervision Programmable warning: *12.03 AI supervision function*	An analog signal is outside the limits specified for the analog input.	Check signal level at the analog input. Check the wiring connected to the input. Check the minimum and maximum limits of the input in parameter group *12 Standard AI*.
A8A1	RO life warning	The relay has changed states more than the recommended number of times.	Change the control board or stop using the relay output.
	0001	Relay output 1	Change the control board or stop using relay output 1.
	0002	Relay output 2	Change the control board or stop using relay output 2.
	0003	Relay output 3	Change the control board or stop using relay output 3.

Code (hex)	Warning / Aux. code	Cause	What to do
A8A2	RO toggle warning	The relay output is changing states faster than recommended, eg. if a fast changing frequency signal is connected to it. The relay lifetime will be exceeded shortly.	Replace the signal connected to the relay output source with a less frequently changing signal.
	0001	Relay output 1	Select a different signal with parameter *10.24 RO1 source*.
	0002	Relay output 2	Select a different signal with parameter *10.27 RO2 source*.
	0003	Relay output 3	Select a different signal with parameter *10.30 RO3 source*.
A8B0	ABB Signal supervision 1 (Editable message text) Programmable warning: *32.06 Supervision 1 action*	Warning generated by the signal supervision function 1.	Check the source of the warning (parameter *32.07 Supervision 1 signal*).
A8B1	ABB Signal supervision 2 (Editable message text) Programmable warning: *32.16 Supervision 2 action*	Warning generated by the signal supervision function 2.	Check the source of the warning (parameter *32.17 Supervision 2 signal*).
A8B2	ABB Signal supervision 3 (Editable message text) Programmable warning: *32.26 Supervision 3 action*	Warning generated by the signal supervision function 3.	Check the source of the warning (parameter *32.27 Supervision 3 signal*).
A8B3	ABB Signal supervision 4 (Editable message text) Programmable warning: *32.36 Supervision 4 action*	Warning generated by the signal supervision function 4.	Check the source of the warning (parameter *32.37 Supervision 4 signal*).
A8B4	ABB Signal supervision 5 (Editable message text) Programmable warning: *32.46 Supervision 5 action*	Warning generated by the signal supervision function 5.	Check the source of the warning (parameter *32.47 Supervision 5 signal*).
A8B5	ABB Signal supervision 6 (Editable message text) Programmable warning: *32.56 Supervision 6 action*	Warning generated by the signal supervision function 6.	Check the source of the warning (parameter *32.57 Supervision 6 signal*).
A8BE	ULC overload warning Programmable fault: *37.03 ULC overload actions*	Selected signal has exceeded the user overload curve.	Check for any operating conditions increasing the monitored signal (for example, the loading of the motor if the torque or current is being monitored). Check the definition of the load curve (parameter group *37 User load curve*).

Code (hex)	**Warning / Aux. code**	**Cause**	**What to do**
A8BF	ULC underload warning Programmable fault: *37.04 ULC underload actions*	Selected signal has fallen below the user underload curve.	Check for any operating conditions decreasing the monitored signal (for example, loss of load if the torque or current is being monitored). Check the definition of the load curve (parameter group *37 User load curve*).
A981	External warning 1 (Editable message text) Programmable warning: *31.01 External event 1 source* *31.02 External event 1 type*	Fault in external device 1.	Check the external device. Check setting of parameter *31.01 External event 1 source*.
A982	External warning 2 (Editable message text) Programmable warning: *31.03 External event 2 source* *31.04 External event 2 type*	Fault in external device 2.	Check the external device. Check setting of parameter *31.03 External event 2 source*.
A983	External warning 3 (Editable message text) Programmable warning: *31.05 External event 3 source* *31.06 External event 3 type*	Fault in external device 3.	Check the external device. Check setting of parameter *31.05 External event 3 source*.
A984	External warning 4 (Editable message text) Programmable warning: *31.07 External event 4 source* *31.08 External event 4 type*	Fault in external device 4.	Check the external device. Check setting of parameter *31.07 External event 4 source*.
A985	External warning 5 (Editable message text) Programmable warning: *31.09 External event 5 source* *31.10 External event 5 type*	Fault in external device 5.	Check the external device. Check setting of parameter *31.09 External event 5 source*.
AF88	Season configuration warning	You have configured a season which starts before the previous season.	Configure the seasons with increasing start dates, see parameters *34.60 Season 1 start date*…*34.63 Season 4 start date*.
AF8C	Process PID sleep mode	The drive is entering sleep mode.	Informative warning. See section *Sleep and boost functions for process PID control* (page *57*), and parameters *40.43*…*40.48*.
AFAA	Autoreset	A fault is about to be autoreset.	Informative warning. See the settings in parameter group *31 Fault functions*.
AFE1	Emergency stop (off2)	Drive has received an emergency stop (mode selection off2) command.	Check that it is safe to continue operation. Then return emergency stop push button to normal position. Restart drive. If the emergency stop was unintentional, check the source selected by parameter *21.05 Emergency stop source*.
AFE2	Emergency stop (off1 or off3)	Drive has received an emergency stop (mode selection off1 or off3) command.	

Code (hex)	**Warning / Aux. code**	**Cause**	**What to do**
AFE9	Start delay	The start delay is active and the drive will start the motor after a predefined delay.	Informative warning. See parameter *21.22 Start delay*.
AFED	Run permissive	Run permissive is keeping the drive from running the motor.	Check the setting of (and source selected by) parameter *20.40 Run permissive*.
AFEE	Start interlock 1	Start interlock 1 is keeping the drive from starting.	Check the signal source selected for parameter *20.41 Start interlock 1*.
AFEF	Start interlock 2	Start interlock 2 is keeping the drive from starting.	Check the signal source selected for parameter *20.42 Start interlock 2*.
AFF0	Start interlock 3	Start interlock 3 is keeping the drive from starting.	Check the signal source selected for parameter *20.43 Start interlock 3*.
AFF1	Start interlock 4	Start interlock 4 is keeping the drive from starting.	Check the signal source selected for parameter *20.44 Start interlock 4*.
AFF6	Identification run	Motor ID run will occur at next start.	Informative warning.
AFF8	Motor heating active	Pre-heating is being performed	Informative warning. Motor pre-heating is active. Current specified by parameter *21.16 Pre-heating current* is being passed through the motor.
B5A0	STO event Programmable event: *31.22 STO indication run/stop*	Safe torque off function is active, ie. safety circuit signal(s) connected to connector STO is lost.	Informative warning. Check safety circuit connections. For more information, see chapter *The Safe torque off function* in the *Hardware manual* of the drive and description of parameter *31.22 STO indication run/stop* (page *180*).
D405	Pipe fill-timeout Programmable warning: *82.25 Soft pipe fill supervision*	Soft pipe fill is reached the timeout limit. The PID output is not reached the setpoint after reference ramping is ended and timeout limit is elapsed.	Check the pipe for possible leakage. See parameter *82.25 Soft pipe fill supervision* and *82.26 Time-out limit*.
D501	No more available PFC motors	No more PFC motors can be started because they can be interlocked or in the Hand mode.	Check that there are no interlocked PFC motors, see parameters: *76.81*…*76.84*. If all motors are in use, the PFC system is not adequately dimensioned to handle the demand.
D502	All motors interlocked	All the motors in the PFC system are interlocked.	Check that there are no interlocked PFC motors, see parameters *76.81*…*76.84*.
D503	VSD controlled PFC motor interlocked	The motor connected to the drive is interlocked (unavailable).	Motor connected to the drive is interlocked and thus cannot be started. Remove the corresponding interlock to start the drive controlled PFC motor. See parameters *76.81*…*76.84*.
0xD505	Max cleaning warning Programmable warning: *83.35 Cleaning count fault*	Maximum number of cleanings are reached in defined time. The Pump cleaning is unable to clean the pump and hence, manual cleaning is required.	Check the pump for blockages. Clean the pump manually if needed. Check parameters *83.35 Cleaning count fault* to *83.37 Maximum cleaning count*.

Code (hex)	**Warning / Aux. code**	**Cause**	**What to do**
0xD506	Pump cleaning not possible	Pump cleaning cannot be started. The drive needs to be in remote control and start signal is activated.	Change control location to Auto.
0xD507	Pump cleaning needed	Dirt detection indicates that the pump needs cleaning but automatic pump cleaning is not allowed.	Perform pump cleaning manually. Start pump cleaning by changing parameter *83.12 Manually force cleaning* to *Start cleaning now*.
0xD508	High level Programmable warning: *76.93 LC high level action*	Water level is reached the high level limit. Level control is unable to control the level for the following reasons: • running out of pumping capacity. • analog feedback sensor failure.	Check analog level sensor. Check that all the pumps are operating normally. Check parameters *76.91 LC high level switch* and *76.93 LC high level action*.
0xD509	Low level Programmable warning: *76.92 LC low level action*	Water level is reached the low level limit. Level control is unable to control the level for the following reasons: • running out of pumping capacity. • analog feedback sensor failure.	Check analog level sensor. Check that all the pumps are operating normally. Check parameters *76.90 LC low level switch* and *76.92 LC low level action*.
0xD50A	Running dry Programmable warning: *82.20 Dry run protection*	Dry run protection is activated.	Check the pump inlet for sufficient water level. Check dry run protection settings in parameters *82.20 Dry run protection* and *82.21 Dry run source*.
D50C	Maximum flow protection Programmable warning: *80.17 Maximum flow protection*	Actual flow is exceeded the defined warning level.	Check the system for leakages. Check flow protection settings in parameters *80.15 Maximum flow*, *80.17 Maximum flow protection* and *80.19 Flow check delay*.
D50D	Minimum flow protection Programmable warning: *80.18 Minimum flow protection*	Actual flow is below the defined warning level.	Check that the inlet and outlet valves are open. Check flow protection settings in parameters *80.16 Minimum flow*, *80.18 Minimum flow protection* and *80.19 Flow check delay*.
D50E	Outlet minimum pressure Programmable warning: *82.30 Outlet minimum pressure protection*	Measured outlet pressure is below the defined warning limit.	Check the pump outlet for leakages. Check the configuration of outlet pressure protection. See parameters *82.30 Outlet minimum pressure protection* and *82.31 Outlet minimum pressure warning level*.
D50F	Outlet maximum pressure Programmable warning: *82.35 Outlet maximum pressure protection*	Measured outlet pressure is above the defined warning limit.	Check the pump outlet for blockages or closed valve. Check the configuration of outlet pressure protection. See parameters *82.35 Outlet maximum pressure protection* and *82.37 Outlet maximum pressure warning level*.

Code (hex)	**Warning / Aux. code**	**Cause**	**What to do**
D510	Inlet minimum pressure Programmable warning: *82.40 Inlet minimum pressure protection*	Measured inlet pressure is below the defined warning level.	Check the pump inlet for blockages or closed valve. Check the configuration of inlet pressure protection. See parameters *82.40 Inlet minimum pressure protection* and *82.41 Inlet minimum pressure warning level*.

Fault messages

Code (hex)	**Fault / Aux. code**	**Cause**	**What to do**
1080	Backup/Restore timeout	Panel or PC tool has failed to communicate with the drive when backup was being made or restored.	Request backup or restore again.
1081	Rating ID fault	Drive software has not been able to read the rating ID of the drive.	Reset the fault to make the drive try to reread the rating ID. If the fault reappears, cycle the power to the drive. You may have to be repeat this. If the fault persists, contact your local ABB representative.
2310	Overcurrent	Output current has exceeded internal fault limit. In addition to an actual overcurrent situation, this fault may also be caused by an earth fault or supply phase loss.	Check motor load. Check acceleration times in parameter group *23 Speed reference ramp* (speed control) or *28 Frequency reference chain* (frequency control). Also check parameters *46.01 Speed scaling*, *46.02 Frequency scaling* and *46.03 Torque scaling*. Check motor and motor cable (including phasing and delta/star connection). Check there are no contactors opening and closing in motor cable. Check that the start-up data in parameter group 99 corresponds to the motor rating plate. Check that there are no power factor correction capacitors or surge absorbers in motor cable. Check for an earth fault in motor or motor cables by measuring the insulation resistances of motor and motor cable. See chapter *Electrical installation*, section *Checking the insulation of the assembly* in the *Hardware manual* of the drive.
2330	Earth leakage Programmable fault: *31.20 Earth fault*	Drive has detected load unbalance typically due to earth fault in motor or motor cable.	Check there are no power factor correction capacitors or surge absorbers in motor cable. Check for an earth fault in motor or motor cables by measuring the insulation resistances of motor and motor cable. Try running the motor in scalar control mode if allowed. (See parameter *99.04 Motor control mode*.) If no earth fault can be detected, contact your local ABB representative.

Code (hex)	**Fault / Aux. code**	**Cause**	**What to do**
2340	Short circuit	Short-circuit in motor cable(s) or motor	Check motor and motor cable for cabling errors. Check there are no power factor correction capacitors or surge absorbers in motor cable. Cycle the power to the drive.
2381	IGBT overload	Excessive IGBT junction to case temperature. This fault protects the IGBT(s) and can be activated by a short circuit in the motor cable.	Check motor cable. Check ambient conditions. Check air flow and fan operation. Check heatsink fins for dust pick-up. Check motor power against drive power.
3130	Input phase loss Programmable fault: *31.21 Supply phase loss*	Intermediate circuit DC voltage is oscillating due to missing input power line phase or blown fuse.	Check input power line fuses. Check for loose power cable connections. Check for input power supply imbalance.
3181	Wiring or earth fault Programmable fault: *31.23 Wiring or earth fault*	Incorrect input power and motor cable connection (ie. input power cable is connected to drive motor connection).	Check input power connections.
3210	DC link overvoltage	Excessive intermediate circuit DC voltage.	Check that overvoltage control is on (parameter *30.30 Overvoltage control*). Check that the supply voltage matches the nominal input voltage of the drive. Check the supply line for static or transient overvoltage. Check resistor (if present). Check deceleration time. Use coast-to-stop function (if applicable). Retrofit drive with brake resistor. Check that the brake resistor is dimensioned properly and the resistance is between acceptable range for the drive.
3220	DC link undervoltage	Intermediate circuit DC voltage is not sufficient because of a missing supply phase, blown fuse or fault in the rectifier bridge.	Check supply cabling, fuses and switchgear.
3381	Output phase loss Programmable fault: *31.19 Motor phase loss*	Motor circuit fault due to missing motor connection (all three phases are not connected).	Connect motor cable.
4110	Control board temperature	Control board temperature is too high.	Check proper cooling of the drive. Check the auxiliary cooling fan.
4210	IGBT overtemperature	Estimated drive IGBT temperature is excessive.	Check ambient conditions. Check air flow and fan operation. Check heatsink fins for dust pick-up. Check motor power against drive power.

Code (hex)	**Fault / Aux. code**	**Cause**	**What to do**
4290	Cooling	Drive module temperature is excessive.	Check ambient temperature. If it exceeds 40 °C/104 °F (IP21 frames R4…R9) or if it exceeds 50 °C /122 °F (IP21 frames R0…R9), ensure that load current does not exceed derated load capacity of drive. For all P55 frames, check the derating temperatures. See chapter *Technical data*, section *Derating* in the *Hardware manual* of the drive. Check drive module cooling air flow and fan operation. Check inside of cabinet and heatsink of drive module for dust pick-up. Clean whenever necessary.
42F1	IGBT temperature	Drive IGBT temperature is excessive.	Check ambient conditions. Check air flow and fan operation. Check heatsink fins for dust pick-up. Check motor power against drive power.
4310	Excess temperature	Power unit module temperature is excessive.	Check ambient conditions. Check air flow and fan operation. Check heatsink fins for dust pick-up. Check motor power against drive power.
4380	Excess temperature difference	High temperature difference between the IGBTs of different phases.	Check the motor cabling. Check cooling of drive module(s).
4981	External temperature 1 (Editable message text)	Measured temperature 1 has exceeded fault limit.	Check the value of parameter *35.02 Measured temperature 1*. Check the cooling of the motor (or other equipment whose temperature is being measured).
4982	External temperature 2 (Editable message text)	Measured temperature 2 has exceeded fault limit.	Check the value of parameter *35.03 Measured temperature 2*. Check the cooling of the motor (or other equipment whose temperature is being measured).
5080	Fan	Cooling fan feedback missing.	See *A581 Fan* (page *342*).
5081	Auxiliary fan broken	An auxiliary cooling fan (connected to the fan connectors on the control unit) is stuck or disconnected.	Check the auxiliary code. Check auxiliary fan(s) and connection(s). Replace fan if faulty. Make sure the front cover of the drive is in place and tightened. If the commissioning of the drive requires th the cover is off, activate parameter *31.36 Aux fan fault bybass* within 2 min from control unit reboot to temporarily suppress the fault. Reboot the control unit (using parameter *96.08 Control board boot*) or by cycling power.
	0001	Auxiliary fan 1 broken.	

Code (hex)	**Fault / Aux. code**	**Cause**	**What to do**
	0002	Auxiliary fan 2 broken.	
5090	STO hardware failure	STO hardware diagnostics has detected hardware failure.	Contact your local ABB representative for hardware replacement.
5091	Safe torque off Programmable fault: *31.22 STO indication run/stop*	Safe torque off function is active, ie. safety circuit signal(s) connected to connector STO is broken during start or run.	Check safety circuit connections. For more information, see chapter *The Safe torque off function* in the *Hardware manual* of the drive and description of parameter *31.22 STO indication run/stop* (page *180*). Check the value of parameter *95.04 Control board supply*.
5092	PU logic error	Power unit memory has cleared.	Contact your local ABB representative.
5093	Rating ID mismatch	The hardware of the drive does not match the information stored in the memory. This may occur eg. after a firmware update.	Cycle the power to the drive. You may have to be repeat this.
5094	Measurement circuit temperature	Problem with internal temperature measurement of the drive.	Contact your local ABB representative.
5098	I/O communication loss	Internal standard I/O communication failure.	Try resetting the fault or reboot the drive.
50A0	Fan	Cooling fan stuck or disconnected.	Check fan operation and connection. Replace fan if faulty.
5682	Power unit lost	Connection between the drive control unit and the power unit is lost.	Check the connection between the control unit and the power unit.
5691	Measurement circuit ADC	Measurement circuit fault.	Contact your local ABB representative.
5692	PU board powerfail	Power unit power supply failure.	Contact your local ABB representative.
5693	Measurement circuit DFF	Measurement circuit fault.	Contact your local ABB representative.
5696	PU state feedback	State feedback from output phases does not match control signals.	Contact your local ABB representative.
5697	Charging feedback	Charging feedback signal missing.	Check the feedback signal coming from the charging system
5698	Unknown PU fault	The power unit logic has generated a fault which is not known by the software.	Check the logic and software compatibility.
6181	FPGA version incompatible	Firmware and FPGA versions are incompatible.	Reboot the control unit (using parameter *96.08 Control board boot*) or by cycling power. If the problem persists, contact your local ABB representative
6306	FBA A mapping file	Fieldbus adapter A mapping file read error.	Contact your local ABB representative.

Code (hex)	**Fault / Aux. code**	**Cause**	**What to do**
6481	Task overload	Internal fault.	Reboot the control unit (using parameter *96.08 Control board boot*) or by cycling power. If the problem persists, contact your local ABB representative
6487	Stack overflow	Internal fault.	Reboot the control unit (using parameter *96.08 Control board boot*) or by cycling power. If the problem persists, contact your local ABB representative
64A1	Internal file load	File read error.	Reboot the control unit (using parameter *96.08 Control board boot*) or by cycling power. If the problem persists, contact your local ABB representative
64A4	Rating ID fault	Rating ID load error.	Contact your local ABB representative.
64A6	Adaptive program	Error running the adaptive program.	Check the auxiliary code (format XXYY ZZZZ). “XX” specifies the number of the state (00=base program) and “YY” specifies the number of the function block (0000=generic error). ”ZZZZ” indicates the problem.
	000A	Program corrupted or block non-existent	Restore the template program or download the program to the drive.
	000C	Required block input missing	Check the inputs of the block.
	000E	Program corrupted or block non-existent	Restore the template program or download the program to the drive.
	0011	Program too large.	Remove blocks until the error stops.
	0012	Program is empty.	Correct the program and download it to the drive.
	001C	A non-existing parameter or block is used in the program.	Edit the program to correct the parameter reference, or to use an existing block.
	001D	Parameter type invalid for selected pin.	Edit the program to correct the parameter reference.
	001E	Output to parameter failed because the parameter was write-protected.	Check the parameter reference in the program. Check for other sources affecting the target parameter.
	0023	Program file incompatible with current firmware version.	Adapt the program to current block library and firmware version.
	0024		
	Other	–	Contact your local ABB representative, quoting the auxiliary code.
64B1	Internal SSW fault	Internal fault.	Reboot the control unit (using parameter *96.08 Control board boot*) or by cycling power. If the problem persists, contact your local ABB representative.

Code (hex)	Fault / Aux. code	Cause	What to do
64B2	User set fault	Loading of user parameter set failed because • requested set does not exist • set is not compatible with control program • drive was switched off during loading.	Ensure that a valid user parameter set exists. Reload if uncertain.
64E1	Kernel overload	Operating system error.	Reboot the control unit (using parameter *96.08 Control board boot*) or by cycling power. If the problem persists, contact your local ABB representative.
64B1	Fault reset	A fault has been reset. The cause of the fault no longer exists and the fault reset has been requested and completed.	Informative fault.
6581	Parameter system	Parameter load or save failed.	Try forcing a save using parameter *96.07 Parameter save manually*. Retry.
6591	Backup/Restore timeout	During backup creating or restoring operation a panel or PC-tool has failed to communicate with the drive as part this operation.	Check panel or PC-tool communication and if it is still in backup or restore state.
65A1	FBA A parameter conflict	The drive does not have a functionality requested by PLC, or requested functionality has not been activated.	Check PLC programming. Check settings of parameter groups *50 Fieldbus adapter (FBA)* and *51 FBA A settings*.
6681	EFB comm loss Programmable fault: *58.14 Communication loss action*	Communication break in embedded fieldbus (EFB) communication.	Check the status of the fieldbus master (online/offline/error etc.). Check cable connections to the EIA-485/X5 terminals 29, 30 and 31 on the control unit.
6682	EFB config file	Embedded fieldbus (EFB) configuration file could not be read.	Contact your local ABB representative.
6683	EFB invalid parameterization	Embedded fieldbus (EFB) parameter settings inconsistent or not compatible with selected protocol.	Check the settings in parameter group *58 Embedded fieldbus*.
6684	EFB load fault	Embedded fieldbus (EFB) protocol firmware could not be loaded.	Contact your local ABB representative.
		Version mismatch between EFB protocol firmware and drive firmware.	
6685	EFB fault 2	Fault reserved for the EFB protocol application.	Check the documentation of the protocol.
6686	EFB fault 3	Fault reserved for the EFB protocol application.	Check the documentation of the protocol.

Code (hex)	**Fault / Aux. code**	**Cause**	**What to do**
6882	Text 32-bit table overflow	Internal fault.	Reset the fault. Contact your local ABB representative if the fault persists.
6885	Text file overflow	Internal fault.	Reset the fault. Contact your local ABB representative if the fault persists.
7081	Control panel loss Programmable fault: *49.05 Communication loss action*	Control panel or PC tool selected as active control location for drive has ceased communicating.	Check PC tool or control panel connection. Check control panel connector. Disconnect and reconnect the control panel.
7085	Incompatible option module	Fieldbus option module not supported.	Replace the module with a supported type.
7100	Excitation current	Excitation current feedback low or missing	
7121	Motor stall Programmable fault: *31.24 Stall function*	Motor is operating in stall region because of e.g. excessive load or insufficient motor power.	Check motor load and drive ratings. Check fault function parameters.
7310	Overspeed	Motor is turning faster than highest allowed speed due to incorrectly set minimum/maximum speed, insufficient braking torque or changes in load when using torque reference.	Check minimum/maximum speed settings, parameters *30.11 Minimum speed* and *30.12 Maximum speed*. Check adequacy of motor braking torque. Check applicability of torque control.
73F0	Overfrequency	Maximum allowed output frequency exceeded.	Contact your local ABB representative.
73B0	Emergency ramp failed	Emergency stop did not finish within expected time.	Check the settings of parameters *31.32 Emergency ramp supervision* and *31.33 Emergency ramp supervision delay*. Check the predefined ramp times (*23.12*…*23.13* for mode Off1, *23.23* for mode Off3).
7510	FBA A communication Programmable fault: *50.02 FBA A comm loss func*	Cyclical communication between drive and fieldbus adapter module A or between PLC and fieldbus adapter module A is lost.	Check status of fieldbus communication. See user documentation of fieldbus interface. Check settings of parameter groups *50 Fieldbus adapter (FBA)*, *51 FBA A settings*, *52 FBA A data in* and *53 FBA A data out*. Check cable connections. Check if communication master is able to communicate.
8001	ULC underload fault	User load curve: Signal has been too long under the underload curve.	See parameter *37.04 ULC underload actions*.
8002	ULC overload fault	User load curve: Signal has been too long over the overload curve.	See parameter *37.03 ULC overload actions*.

Code (hex)	**Fault / Aux. code**	**Cause**	**What to do**
80A0	AI supervision Programmable fault: *12.03 AI supervision function*	An analog signal is outside the limits specified for the analog input.	Check signal level at the analog input. Check the auxiliary code. Check the wiring connected to the input. Check the minimum and maximum limits of the input in parameter group *12 Standard AI*.
	0001	AI1LessMIN	
	0002	AI1GreaterMAX	
	0003	AI2LessMIN.	
	0004	AI2GreaterMAX	
80B0	Signal supervision 1 (Editable message text) Programmable fault: *32.06 Supervision 1 action*	Fault generated by the signal supervision function 1.	Check the source of the fault (parameter *32.07 Supervision 1 signal*).
80B1	Signal supervision 2 (Editable message text) Programmable fault: *32.16 Supervision 2 action*	Fault generated by the signal supervision function 2.	Check the source of the fault (parameter *32.17 Supervision 2 signal*).
80B2	Signal supervision 3 (Editable message text) Programmable fault: *32.26 Supervision 3 action*	Fault generated by the signal supervision function 3.	Check the source of the fault (parameter *32.27 Supervision 3 signal*).
80B3	Signal supervision 4 (Editable message text) Programmable fault: *32.36 Supervision 4 action*	Fault generated by the signal supervision function 4.	Check the source of the fault (parameter *32.37 Supervision 4 signal*).
80B4	Signal supervision 5 (Editable message text) Programmable fault: *32.46 Supervision 5 action*	Fault generated by the signal supervision function 5.	Check the source of the fault (parameter *32.47 Supervision 5 signal*).
80B5	Signal supervision 6 (Editable message text) Programmable fault: *32.56 Supervision 6 action*	Fault generated by the signal supervision function 6.	Check the source of the fault (parameter *32.57 Supervision 6 signal*).
9081	External fault 1 (Editable message text) Programmable fault: *31.01 External event 1 source* *31.02 External event 1 type*	Fault in external device 1.	Check the external device. Check setting of parameter *31.01 External event 1 source*.
9082	External fault 2 (Editable message text) Programmable fault: *31.03 External event 2 source* *31.04 External event 2 type*	Fault in external device 2.	Check the external device. Check setting of parameter *31.03 External event 2 source*.
9083	External fault 3 (Editable message text) Programmable fault: *31.05 External event 3 source* *31.06 External event 3 type*	Fault in external device 3.	Check the external device. Check setting of parameter *31.05 External event 3 source*.

Code (hex)	**Fault / Aux. code**	**Cause**	**What to do**
9084	External fault 4 (Editable message text) Programmable fault: *31.07 External event 4 source* *31.08 External event 4 type*	Fault in external device 4.	Check the external device. Check setting of parameter *31.07 External event 4 source*.
9085	External fault 5 (Editable message text) Programmable fault: *31.09 External event 5 source* *31.10 External event 5 type*	Fault in external device 5.	Check the external device. Check setting of parameter *31.09 External event 5 source*.
FA81	Safe torque off 1	Safe torque off function is active, ie. STO circuit 1 is broken.	Check safety circuit connections. For more information, see chapter *The Safe torque off function* in the *Hardware manual* of the drive and description of parameter *31.22 STO indication run/stop* (page *180*). Check the value of parameter *95.04 Control board supply*.
FA82	Safe torque off 2	Safe torque off function is active, ie. STO circuit 2 is broken.	
FF61	ID run	Motor ID run was not completed successfully.	Check the nominal motor values in parameter group *99 Motor data*. Check that no external control system is connected to the drive. Cycle the power to the drive (and its control unit, if powered separately). Check that no operation limits prevent the completion of the ID run. Restore parameters to default settings and try again. Check that the motor shaft is not locked. Check the auxiliary code. The second number of the code indicates the problem (see actions for each code below).
	0001	Maximum current limit too low.	Check settings of parameters *99.06 Motor nominal current* and *30.17 Maximum current*. Make sure that *30.17* > *99.06*. Check that the drive is dimensioned correctly according to the motor.
	0002	Maximum speed limit or calculated field weakening point too low.	Check settings of parameters • *30.11 Minimum speed* • *30.12 Maximum speed* • *99.07 Motor nominal voltage* • *99.08 Motor nominal frequency* • *99.09 Motor nominal speed*. Make sure that • *30.12* > (0.55 × *99.09*) > (0.50 × synchronous speed) • *30.11* ≤ 0, and • supply voltage ≥ (0.66 × *99.07*).

Code (hex)	**Fault / Aux. code**	**Cause**	**What to do**
	0003	Maximum torque limit too low.	Check settings of parameter *99.12 Motor nominal torque*, and the torque limits in group *30 Limits*. Make sure that the maximum torque limit in force is greater than 100%.
	0004	Current measurement calibration did not finish within reasonable time	Contact your local ABB representative.
	0005…0008	Internal error.	Contact your local ABB representative.
	0009	(Asynchronous motors only) Acceleration did not finish within reasonable time.	Contact your local ABB representative.
	000A	(Asynchronous motors only) Deceleration did not finish within reasonable time.	Contact your local ABB representative.
	000B	(Asynchronous motors only) Speed dropped to zero during ID run.	Contact your local ABB representative.
	000C	(Permanent magnet motors only) First acceleration did not finish within reasonable time.	Contact your local ABB representative.
	000D	(Permanent magnet motors only) Second acceleration did not finish within reasonable time.	Contact your local ABB representative.
	000E…0010	Internal error.	Contact your local ABB representative.
	0011	(Synchronous reluctance motors only) Pulse test error.	Contact your local ABB representative.
	0012	Motor too large for advanced standstill ID run.	Check that the motor and drive sizes are compatible. Contact your local ABB representative.
	0013	(Asynchronous motors only) Motor data error.	Check that the motor nominal value settings in the drive are the same as in the motor nameplate. Contact your local ABB representative.
FF63	STO diagnostics failure.	SW internal malfunction.	Reboot the control unit (using parameter *96.08 Control board boot*) or by cycling power.
FF81	FB A force trip	A fault trip command has been received through fieldbus adapter A.	Check the fault information provided by the PLC.
FF8E	EFB force trip	A fault trip command has been received through the embedded fieldbus interface.	Check the fault information provided by the PLC.

Code (hex)	**Fault / Aux. code**	**Cause**	**What to do**
D406	Maximum flow protection Programmable fault: *80.17 Maximum flow protection*	Actual flow is exceeded the defined fault level.	Check the system for leakages. Check flow protection settings in parameters *80.15 Maximum flow*, *80.17 Maximum flow protection* and *80.19 Flow check delay*.
D407	Minimum flow protection Programmable fault: *80.18 Minimum flow protection*	Actual flow is below the defined fault level.	Check that the inlet and outlet valves are open. Check flow protection settings in parameters *80.16 Minimum flow*, *80.18 Minimum flow protection* and *80.19 Flow check delay*.
D408	Outlet minimum pressure Programmable fault: *82.30 Outlet minimum pressure protection*	The measured outlet pressure is below the defined fault limit.	Check the pump outlet for leakages. Check the configuration of outlet pressure protection. See parameter *82.30 Outlet minimum pressure protection* and *82.32 Outlet minimum pressure fault level*.
D409	Outlet maximum pressure Programmable fault: *82.35 Outlet maximum pressure protection*	The measured outlet pressure is above the defined fault limit.	Check the pump outlet for blockages or closed valve. Check the configuration of outlet pressure protection. See parameters *82.35 Outlet maximum pressure protection* and *82.38 Outlet maximum pressure fault level*.
D40A	Inlet minimum pressure Programmable fault: *82.40 Inlet minimum pressure protection*	The measured inlet pressure is below the defined fault level.	Check the pump inlet for blockages or closed valve. Check the configuration of inlet pressure protection. See parameters *82.40 Inlet minimum pressure protection* and *82.42 Inlet minimum pressure fault level*.
D50B	Pipe fill-timeout Programmable fault: *82.25 Soft pipe fill supervision*	Soft pipe fill has reached timeout limit. The PID output is not reached the setpoint after reference ramping is ended and the timeout limit is elapsed.	Check the pipe for possible leakage. See parameter *82.25 Soft pipe fill supervision* and *82.26 Time-out limit*.
0xD401	Max cleaning fault Programmable fault: *83.35 Cleaning count fault*	The maximum number of cleanings are reached in the defined time. The pump cleaning is unable to clean the pump and hence, manual cleaning is required.	Check the pump for blockages. Clean the pump manually if needed. Check parameters *83.35 Cleaning count fault* to *83.37 Maximum cleaning count*.
0xD402	High level Programmable fault: *76.93 LC high level action*	Water level is reached the high level limit. Level control is unable to control the level for the following reasons: • running out of pumping capacity or • analog feedback sensor failure.	Check the analog level sensor. Check that all pumps are operating normally. Check parameters *76.91 LC high level switch* and *76.93 LC high level action*.

Code (hex)	**Fault / Aux. code**	**Cause**	**What to do**
0xD403	Low level Programmable fault: *76.92 LC low level action*	Water level is reached the low level limit. Level control is unable to control the level for the following reasons: • running out of pumping capacity or • analog feedback sensor failure.	Check the analog level sensor. Check that all pumps are operating normally. Check parameters *76.90 LC low level switch* and *76.92 LC low level action*.
0xD404	Running dry Programmable fault: *82.20 Dry run protection*	Dry run protection is activated.	Check the pump inlet for sufficient water level. Check dry run protection settings in parameters *82.20 Dry run protection* and *82.21 Dry run source*.

9

Fieldbus control through the embedded fieldbus interface (EFB)

What this chapter contains

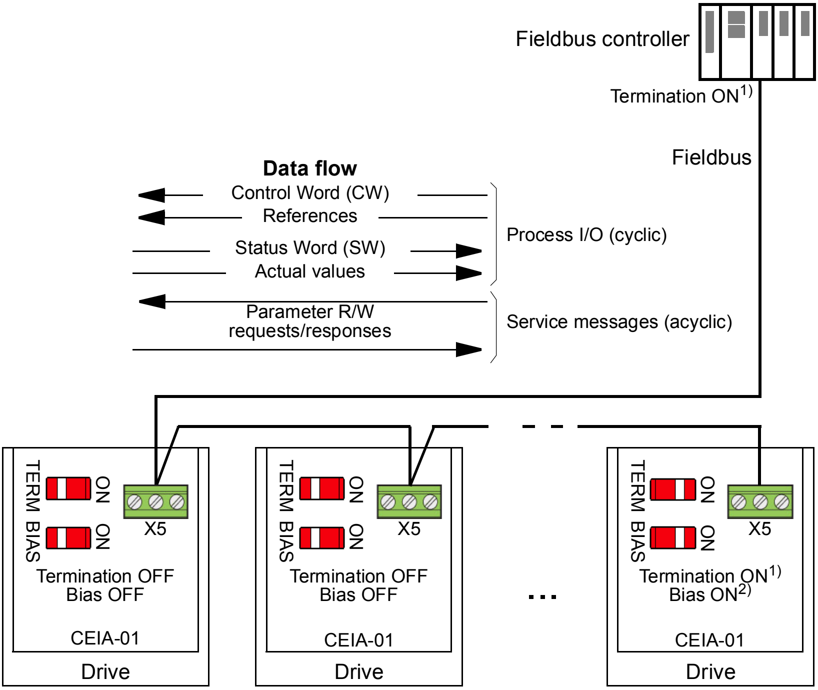
The chapter describes how the drive can be controlled by external devices over a communication network (fieldbus) using the embedded fieldbus interface.

System overview

The drive can be connected to an external control system through a communication link using either a fieldbus adapter or the embedded fieldbus interface.

The embedded fieldbus interface supports the Modbus RTU protocol. The drive control program can handle 10 Modbus registers in a 10-millisecond time level. For example, if the drive receives a request to read 20 registers, it will start its response within 22 ms of receiving the request – 20 ms for processing the request and 2 ms overhead for handling the bus. The actual response time depends on other factors as well, such as the baud rate (a parameter setting in the drive).

The drive can be set to receive all of its control information through the fieldbus interface, or the control can be distributed between the embedded fieldbus interface and other available sources, for example, digital and analog inputs.



[1] The device at both ends on the fieldbus must have termination on.
[2] One device, preferably at the end on the fieldbus must have bias on.

Connecting the fieldbus to the drive

Connect the fieldbus to terminal X5 on the CEIA-01, which is attached on the control unit of the drive.

Setting up the embedded fieldbus interface

Set the drive up for the embedded fieldbus communication with the parameters shown in the table below. The **Setting for fieldbus control** column gives either the value to use or the default value. The **Function/Information column** gives a description of the parameter.

Parameter	**Setting for fieldbus control**	**Function/Information**
COMMUNICATION INITIALIZATION		
58.01 *Protocol enable*	*Modbus RTU*	Initializes embedded fieldbus communication.
EMBEDDED MODBUS CONFIGURATION		
58.03 *Node address*	1 (default)	Node address. There must be no two nodes with the same node address online.
58.04 *Baud rate*	*19.2 kbps* (default)	Defines the communication speed of the link. Use the same setting as in the master station.
58.05 *Parity*	*8 EVEN 1* (default)	Selects the parity and stop bit setting. Use the same setting as in the master station.
58.14 *Communication loss action*	*Fault* (default)	Defines the action taken when a communication loss is detected.
58.15 *Communication loss mode*	*Cw / Ref1 / Ref2* (default)	Enables/disables communication loss monitoring and defines the means for resetting the counter of the communication loss delay.
58.16 *Communication loss time*	3.0 s (default)	Defines the timeout limit for the communication monitoring.
58.17 *Transmit delay*	0 ms (default)	Defines a response delay for the drive.
58.25 *Control profile*	*ABB Drives* (default)	Selects the control profile used by the drive. See section *Basics of the embedded fieldbus interface* (page *368*).
58.26 *EFB ref1 type* *58.27* *EFB ref2 type*	*Speed or frequency* (default for *58.26*), *Transparent*, *General*,*Transparent* (default for *58.27*) *Speed*, *Frequency*	Defines the types of fieldbus references 1 and 2. The scaling for each reference type is defined by parameters *46.01*…*46.03*. With the *Speed or frequency* setting, the type is selected automatically according to the currently active drive control mode.
58.28 *EFB act1 type* *58.29* *EFB act2 type*	*Speed or frequency* (default for *58.28*), *Transparent* (default for *58.29*), *General*, *Speed*, *Frequency*	Defines the types of actual values 1 and 2. The scaling for each actual value type is defined by parameters *46.01*…*46.03*. With the *Speed or frequency* setting, the type is selected automatically according to the currently active drive control mode.

Parameter		**Setting for fieldbus control**	**Function/Information**
58.31 *58.32*	*EFB act1 transparent source* *EFB act2 transparent source*	*Other*	Defines the source of actual values 1 and 2 when the *58.26 EFB ref1 type* (*58.27 EFB ref2 type*) is set to *Transparent*.
58.33	*Addressing mode*	*Mode 0* (default)	Defines the mapping between parameters and holding registers in the 400001…465536 (100…65535) Modbus register range.
58.34	*Word order*	*LO-HI* (default)	Defines the order of the data words in the Modbus message frame.
58.101 … *58.114*	*Data I/O 1* … *Data I/O 14*	For example, the default settings (I/Os 1…6 contain the control word, the status word, two references and two actual values)	Defines the address of the drive parameter which the Modbus master accesses when it reads from or writes to the register address corresponding to Modbus In/Out parameters. Select the parameters that you want to read or write through the Modbus I/O words.
		RO/DIO control word, *AO1 data storage*, *AO2 data storage*, *Feedback data storage*, *Setpoint data storage*	These settings write the incoming data into storage parameters *10.99 RO/DIO control word*, *13.91 AO1 data storage*, *13.92 AO2 data storage*, *40.91 Feedback data storage* or *40.92 Setpoint data storage*.
58.06	*Communication control*	*Refresh settings*	Validates the settings of the configuration parameters.

The new settings will take effect when the drive is powered up the next time, or when they are validated by parameter *58.06 Communication control* (*Refresh settings*).

Setting the drive control parameters

After the embedded fieldbus interface has been set up, check and adjust the drive control parameters listed in the table below. The **Setting for fieldbus control** column gives the value or values to use when the embedded fieldbus signal is the desired source or destination for that particular drive control signal. The **Function/Information** column gives a description of the parameter.

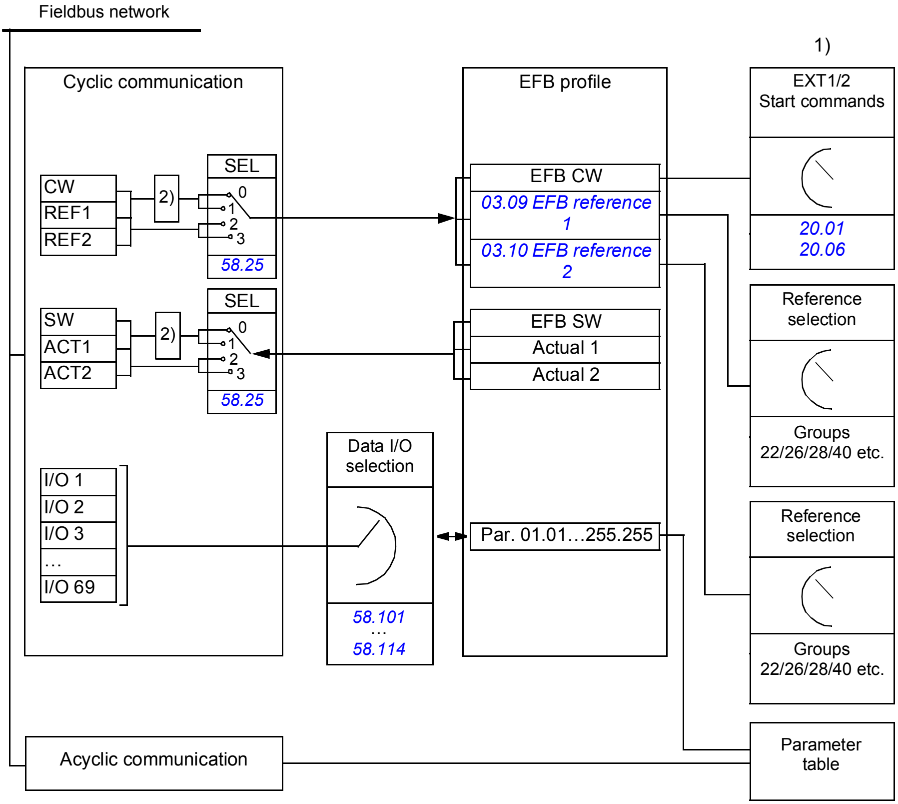
Parameter	**Setting for fieldbus control**	**Function/Information**
CONTROL COMMAND SOURCE SELECTION		
20.01 Ext1 commands	*Embedded fieldbus*	Selects fieldbus as the source for the start and stop commands when EXT1 is selected as the active control location.

Parameter	**Setting for fieldbus control**	**Function/Information**
20.06 Ext2 commands	*Embedded fieldbus*	Selects fieldbus as the source for the start and stop commands when EXT2 is selected as the active control location.
SPEED REFERENCE SELECTION		
22.11 Ext1 speed ref1	*EFB ref1*	Selects a reference received through the embedded fieldbus interface as speed reference 1.
22.18 Ext2 speed ref1	*EFB ref1*	Selects a reference received through the embedded fieldbus interface as speed reference 2.
FREQUENCY REFERENCE SELECTION		
28.11 Ext1 frequency ref1	*EFB ref1*	Selects a reference received through the embedded fieldbus interface as frequency reference 1.
28.15 Ext2 frequency ref1	*EFB ref1*	Selects a reference received through the embedded fieldbus interface as frequency reference 2.
OTHER SELECTIONS		
EFB references can be selected as the source at virtually any signal selector parameter by selecting *Other*, then either *03.09 EFB reference 1* or *03.10 EFB reference 2*.		
SYSTEM CONTROL INPUTS		
96.07 Parameter save manually	*Save* (reverts to *Done*)	Saves parameter value changes (including those made through fieldbus control) to permanent memory.

Basics of the embedded fieldbus interface

The cyclic communication between a fieldbus system and the drive consists of 16-bit data words or 32-bit data words (with a transparent control profile).

The diagram below illustrates the operation of the embedded fieldbus interface. The signals transferred in the cyclic communication are explained further below the diagram.



1. See also other parameters which can be controlled through fieldbus.
2. Data conversion if parameter *58.25 Control profile* is set to *ABB Drives*. See section *About the control profiles* (page *371*).

Control word and Status word

The Control Word (CW) is a 16-bit or 32-bit packed boolean word. It is the principal means of controlling the drive from a fieldbus system. The CW is sent by the fieldbus controller to the drive. With drive parameters, the user selects the EFB CW as the source of drive control commands (such as start/stop, emergency stop, selection between external control locations 1/2, or fault reset). The drive switches between its states according to the bit-coded instructions of the CW.

The fieldbus CW is either written to the drive as it is or the data is converted. See section *About the control profiles* (page *371*).

The fieldbus Status Word (SW) is a 16-bit or 32-bit packed boolean word. It contains status information from the drive to the fieldbus controller. The drive SW is either written to the fieldbus SW as it is or the data is converted. See section *About the control profiles* (page *371*).

References

EFB references 1 and 2 are 16-bit or 32-bit signed integers. The contents of each reference word can be used as the source of virtually any signal, such as the speed, frequency or process reference. In embedded fieldbus communication, references 1 and 2 are displayed by *03.09 EFB reference 1* and *03.10 EFB reference 2* respectively. Whether the references are scaled or not depends on the settings of *58.26 EFB ref1 type* and *58.27 EFB ref2 type*. See section *About the control profiles* (page *371*).

Actual values

Fieldbus actual signals (ACT1 and ACT2) are 16-bit or 32-bit signed integers. They convey selected drive parameter values from the drive to the master. Whether the actual values are scaled or not depends on the settings of *58.28 EFB act1 type* and *58.29 EFB act2 type*. See section *About the control profiles* (page *371*).

Data input/outputs

Data input/outputs are 16-bit or 32-bit words containing selected drive parameter values. Parameters *58.101 Data I/O 1* … *58.114 Data I/O 14* define the addresses from which the master either reads data (input) or to which it writes data (output).

Register addressing

The address field of Modbus requests for accessing holding registers is 16 bits. This allows the Modbus protocol to support addressing of 65536 holding registers.

Historically, Modbus master devices used 5-digit decimal addresses from 40001 to 49999 to represent holding register addresses. The 5-digit decimal addressing limited to 9999 the number of holding registers that could be addressed.

Modern Modbus master devices typically provide a means to access the full range of 65536 Modbus holding registers. One of these methods is to use 6-digit decimal addresses from 400001 to 465536. This manual uses 6-digit decimal addressing to represent Modbus holding register addresses.

Modbus master devices that are limited to the 5-digit decimal addressing may still access registers 400001 to 409999 by using 5-digit decimal addresses 40001 to 49999. Registers 410000-465536 are inaccessible to these masters.

See parameter *58.33 Addressing mode*.

Note: Register addresses of 32-bit parameters cannot be accessed by using 5-digit register numbers.

About the control profiles

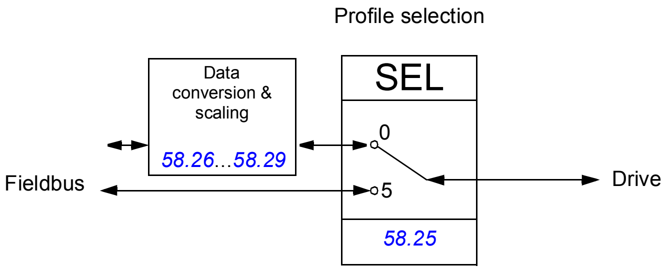
A control profile defines the rules for data transfer between the drive and the fieldbus master, for example:

- if packed boolean words are converted and how
- if signal values are scaled and how
- how drive register addresses are mapped for the fieldbus master.

You can configure the drive to receive and send messages according to one of the two profiles:

- *ABB Drives*
- *DCU Profile*.

For the ABB Drives profile, the embedded fieldbus interface of the drive converts the fieldbus data to and from the native data used in the drive. The DCU Profile involves no data conversion or scaling. The figure below illustrates the effect of the profile selection.



Control profile selection with parameter *58.25 Control profile* is:

- (0) *ABB Drives*
- (5) *DCU Profile*.

Control Word

Control Word for the ABB Drives profile

The table below shows the contents of the fieldbus Control Word for the ABB Drives control profile. The embedded fieldbus interface converts this word to the form in which it is used in the drive. The upper case boldface text refers to the states shown in *State transition diagram for the ABB Drives profile* on page *379*.

Bit	Name	Value	STATE/Description
0	OFF1_ CONTROL	1	Proceed to READY TO OPERATE.
		0	Stop along currently active deceleration ramp. Proceed to **OFF1 ACTIVE**; proceed to **READY TO SWITCH ON** unless other interlocks (OFF2, OFF3) are active.
1	OFF2_ CONTROL	1	Continue operation (OFF2 inactive).
		0	Emergency OFF, coast to stop. Proceed to **OFF2 ACTIVE**, proceed to **SWITCH-ON INHIBITED**.
2	OFF3_ CONTROL	1	Continue operation (OFF3 inactive).
		0	Emergency stop, stop within time defined by drive parameter. Proceed to **OFF3 ACTIVE**; proceed to **SWITCH-ON INHIBITED**. **Warning:** Ensure that the motor and driven machine can be stopped using this stop mode.
3	INHIBIT_ OPERATION	1	Proceed to **OPERATION D**. **Note:** Run enable signal must be active; see the drive documentation. If the drive is set to receive the Run enable signal from the fieldbus, this bit activates the signal.
		0	Inhibit operation. Proceed to **OPERATION INHIBITED**.
4	RAMP_OUT_ ZERO	1	Normal operation. Proceed to **RAMP FUNCTION GENERATOR: OUTPUT D**.
		0	Force Ramp Function Generator output to zero. Drive ramps to stop (current and DC voltage limits in force).
5	RAMP_HOLD	1	ramp function. Proceed to **RAMP FUNCTION GENERATOR: ACCELERATOR D**.
		0	Halt ramping (Ramp Function Generator output held).
6	RAMP_IN_ ZERO	1	Normal operation. Proceed to **OPERATING**. **Note:** This bit is effective only if the fieldbus interface is set as the source for this signal by drive parameters.
		0	Force Ramp Function Generator input to zero.
7	RESET	0=>1	Fault reset if an active fault exists. Proceed to **SWITCH-ON INHIBITED**. **Note:** This bit is effective only if the fieldbus interface is set as the source for this signal by drive parameters.
		0	Continue normal operation.

Bit	Name	Value	STATE/Description
8	Reserved		
9	Reserved		
10	REMOTE_ CMD	1	Fieldbus control d.
		0	Control Word <> 0 or Reference <> 0: Retain last Control Word and Reference. Control Word = 0 and Reference = 0: Fieldbus control d. Reference and deceleration/acceleration ramp are locked.
11	EXT_CTRL_ LOC	1	Select External Control Location EXT2. Effective if the control location is parameterized to be selected from the fieldbus.
		0	Select External Control Location EXT1. Effective if the control location is parameterized to be selected from the fieldbus.
12	USER_0		Writable control bits that can be combined with drive logic for application-specific functionality.
13	USER_1		
14	USER_2		
15	USER_3		

Control Word for the DCU Profile

The embedded fieldbus interface writes the fieldbus Control Word as is to the drive Control Word bits 0 to 15. Bits 16 to 32 of the drive Control Word are not in use.

<table>
<tr><th>Bit</th><th>Name</th><th>Value</th><th>State/Description</th></tr>
<tr><td rowspan="2">0</td><td rowspan="2">STOP</td><td>1</td><td>Stop according to the Stop Mode parameter or the stop mode request bits (bits 7…9).</td></tr>
<tr><td>0</td><td>(no op)</td></tr>
<tr><td rowspan="2">1</td><td rowspan="2">START</td><td>1</td><td>Start the drive.</td></tr>
<tr><td>0</td><td>(no op)</td></tr>
<tr><td rowspan="2">2</td><td rowspan="2">REVERSE</td><td>1</td><td>Reverse direction of motor rotation. See in the table below how this bit and sign of the reference effect the direction of the motor direction.
<table>
<tr><th rowspan="2"></th><th colspan="2">Sign of the reference</th></tr>
<tr><th>Positive (+)</th><th>Negative (-)</th></tr>
<tr><td>**Bit REVERSE = 0**</td><td>Forward</td><td>Reverse</td></tr>
<tr><td>**Bit REVERSE = 1**</td><td>Reverse</td><td>Forward</td></tr>
</table></td></tr>
<tr><td>0</td><td>(no op)</td></tr>
<tr><td>3</td><td>Reserved</td><td></td><td></td></tr>
<tr><td rowspan="2">4</td><td rowspan="2">RESET</td><td>0=>1</td><td>Fault reset if an active fault exists.</td></tr>
<tr><td>0</td><td>(no op)</td></tr>
</table>

Bit	**Name**	**Value**	**State/Description**
5	EXT2	1	Select External control location EXT2. Effective if the control location is parameterized to be selected from the fieldbus.
		0	Select External control location EXT1. Effective if the control location is parameterized to be selected from the fieldbus.
6	RUN_DISABLE	1	Run disable. If the drive is set to receive the run enable signal from the fieldbus, this bit deactivates the signal.
		0	Run enable. If the drive is set to receive the run enable signal from the fieldbus, this bit activates the signal.
7	STOPMODE_RAMP	1	Normal ramp stop mode
		0	(no op) Default to parameter stop mode if bits 7…9 are all 0.
8	STOPMODE_EMERGENCY_RAMP	1	Emergency ramp stop mode.
		0	(no op) Default to parameter stop mode if bits 7…9 are all 0.
9	STOPMODE_COAST	1	Coast stop mode.
		0	(no op) Default to parameter stop mode if bits 7…9 are all 0.
10	RAMP_PAIR _2	1	(no op)
		0	Select ramp set 1 (Acceleration time 1 / Deceleration time 1).
11	RAMP_OUT_ZERO	1	Force Ramp Function Generator output to zero. Drive ramps to stop (current and DC voltage limits in force).
		0	Normal operation.
12	RAMP_HOLD	1	Halt ramping (Ramp Function Generator output held).
		0	Normal operation.
13	RAMP_IN_ZERO	1	Force Ramp Function Generator input to zero.
		0	Normal operation.
14	REQ_LOCAL_LOCK	1	Drive does not switch to local control mode (see parameter *19.18 HAND/OFF disable source*).
		0	Drive can switch between local and external control modes.
16	FB_LOCAL_CTL	1	Local mode for control from the fieldbus is requested. Steal control from the active source.
		0	(no op)
17	FB_LOCAL_REF	1	Local mode for reference from the fieldbus is requested. Steal reference from the active source.
		0	(no op)
18	Reserved for RUN_DISABLE_1		Not yet implemented.
19	Reserved		
20	Reserved		

Bit	**Name**	**Value**	**State/Description**
21	Reserved		
22	USER_0		Writable control bits that can be combined with drive logic for application-specific functionality.
23	USER_1		
24	USER_2		
25	USER_3		
26… 31	Reserved		

Status Word

Status Word for the ABB Drives profile

The table below shows the fieldbus Status Word for the ABB Drives control profile. The embedded fieldbus interface converts the drive Status Word into this form for the fieldbus. The upper case boldface text refers to the states shown in *State transition diagram for the ABB Drives profile* on page *379*.

Bit	Name	Value	STATE/Description
0	RDY_ON	1	**READY TO SWITCH ON**.
		0	**NOT READY TO SWITCH ON**.
1	RDY_RUN	1	**READY TO OPERATE**.
		0	**OFF1 ACTIVE**.
2	RDY_REF	1	**OPERATION D**.
		0	**OPERATION INHIBITED**.
3	TRIPPED	1	**FAULT**.
		0	No fault.
4	OFF_2_STATUS	1	OFF2 inactive.
		0	**OFF2 ACTIVE**.
5	OFF_3_STATUS	1	OFF3 inactive.
		0	**OFF3 ACTIVE**.
6	SWC_ON_ INHIB	1	**SWITCH-ON INHIBITED**.
		0	–
7	ALARM	1	Warning/Alarm.
		0	No warning/alarm.
8	AT_ SETPOINT	1	**OPERATING**. Actual value equals Reference (is within tolerance limits, e.g. in speed control, speed error is 10% max. of nominal motor speed).
		0	Actual value differs from Reference (is outside tolerance limits).
9	REMOTE	1	Drive control location: REMOTE (EXT1 or EXT2).
		0	Drive control location: LOCAL.
10	ABOVE_ LIMIT	1	Actual frequency or speed equals or exceeds supervision limit (set by drive parameter). Valid in both directions of rotation.
		0	Actual frequency or speed within supervision limit.
11	USER_0		Status bits that can be combined with drive logic for application-specific functionality.
12	USER_1		
13	USER_2		
14	USER_3		
15	Reserved		

Status Word for the DCU Profile

The embedded fieldbus interface writes the drive Status Word bits 0 to 15 to the fieldbus Status Word as is. Bits 16 to 32 of the drive Status Word are not in use.

Bit	Name	Value	State/Description
0	READY	1	Drive is ready to receive the start command.
		0	Drive is not ready.
1	D	1	External run enable signal is active.
		0	External run enable signal is not active.
2	Reserved for D_TO_ROTATE		Not yet implemented.
3	RUNNING	1	Drive is modulating.
		0	Drive is not modulating.
4	ZERO_SPEED	1	Drive is at zero speed.
		0	Drive is not at zero speed.
5	ACCELERATING	1	Drive speed is increasing.
		0	Drive speed is not increasing.
6	DECELERATING	1	Drive speed is decreasing.
		0	Drive speed is not decreasing.
7	AT_SETPOINT	1	Drive is at setpoint.
		0	Drive is not at setpoint.
8	LIMIT	1	Drive operation is limited.
		0	Drive operation is not limited.
9	SUPERVISION	1	Actual value (speed, frequency or torque) is above a limit. Limit is set with parameters 46.31…46.33
		0	Actual value (speed, frequency or torque) is within limits.
10	REVERSE_REF	1	Drive reference is in the reverse direction.
		0	Drive reference is in the forward direction
11	REVERSE_ACT	1	Drive is running in the reverse direction
		0	Drive is running in the forward direction
12	PANEL_LOCAL	1	Panel/keypad (or PC tool) is in local control mode.
		0	Panel/keypad (or PC tool) is not in local control mode.
13	FIELDBUS_LOCAL	1	Fieldbus is in local control mode.
		0	Fieldbus is not in local control mode.
14	EXT2_ACT	1	External control location EXT2 is active.
		0	External control location EXT1 is active.
15	FAULT	1	Drive is faulted.
		0	Drive is not faulted.

Bit	**Name**	**Value**	**State/Description**
16	ALARM	1	Warning/Alarm is active.
		0	No warning/alarm.
17	Reserved		
18	Reserved for DIRECTION_LOCK		Not yet implemented.
19	Reserved		
20	Reserved		
21	Reserved		
22	USER_0		Status bits that can be combined with drive logic for application-specific functionality.
23	USER_1		
24	USER_2		
25	USER_3		
26	REQ_CTL	1	Control is requested in this channel.
		0	Control is not requested in this channel.
27…31	Reserved		

State transition diagrams

State transition diagram for the ABB Drives profile

The diagram below shows the state transitions in the drive when the drive is using the ABB Drives profile and the drive is configured to follow the commands of the control word from the embedded fieldbus interface. The upper case texts refer to the states which are used in the tables representing the fieldbus Control and Status words. See sections *Control Word for the ABB Drives profile* on page *372* and *Status Word for the ABB Drives profile* on page *376*.

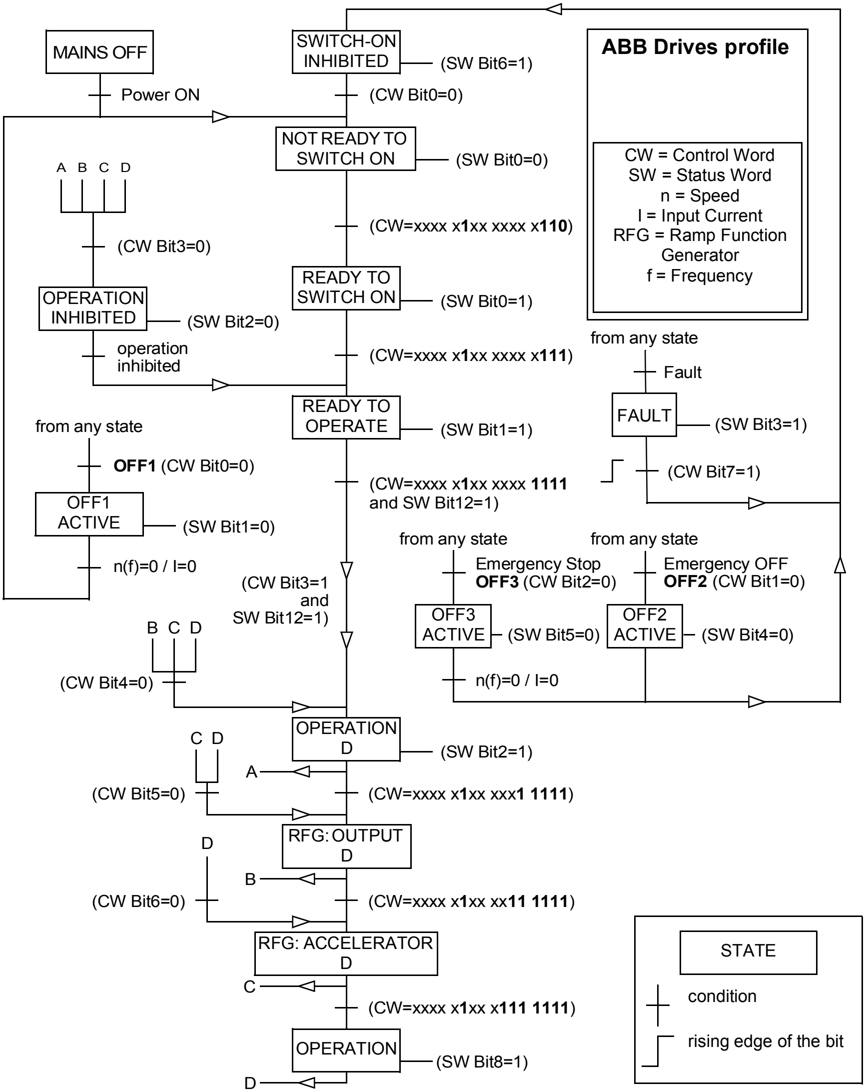


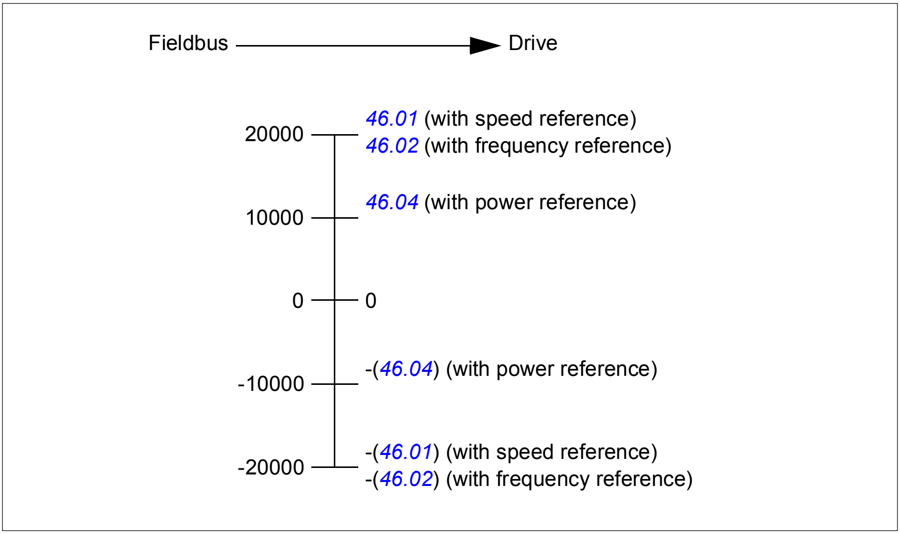
ABB Drives profile
CW = Control Word
SW = Status Word
n = Speed
I = Input Current
RFG = Ramp Function Generator
f = Frequency
MAINS OFF
Power ON
SWITCH-ON INHIBITED
(SW Bit6=1)
(CW Bit0=0)
NOT READY TO SWITCH ON
(SW Bit0=0)
A B C D
(CW=xxxx x1xx xxxx x110)
(CW Bit3=0)
READY TO SWITCH ON
(SW Bit0=1)
OPERATION INHIBITED
(SW Bit2=0)
operation inhibited
(CW=xxxx x1xx xxxx x111)
from any state
Fault
READY TO OPERATE
(SW Bit1=1)
FAULT
(SW Bit3=1)
from any state
OFF1 (CW Bit0=0)
(CW Bit7=1)
(CW=xxxx x1xx xxxx 1111 and SW Bit12=1)
OFF1 ACTIVE
(SW Bit1=0)
from any state
from any state
n(f)=0 / I=0
Emergency Stop OFF3 (CW Bit2=0)
Emergency OFF OFF2 (CW Bit1=0)
(CW Bit3=1 and SW Bit12=1)
OFF3 ACTIVE
(SW Bit5=0)
OFF2 ACTIVE
(SW Bit4=0)
B C D
n(f)=0 / I=0
(CW Bit4=0)
OPERATION D
(SW Bit2=1)
C D
A
(CW Bit5=0)
(CW=xxxx x1xx xxx1 1111)
RFG: OUTPUT D
D
B
(CW Bit6=0)
(CW=xxxx x1xx xx11 1111)
RFG: ACCELERATOR D
C
(CW=xxxx x1xx x111 1111)
OPERATION
(SW Bit8=1)
D
STATE
condition
rising edge of the bit

References

References for the ABB Drives profile and DCU Profile

The ABB Drives profile supports the use of two references, EFB reference 1 and EFB reference 2. The references are 16-bit words each containing a sign bit and a 15-bit integer. A negative reference is formed by calculating the two’s complement from the corresponding positive reference.

The references are scaled as defined by parameters *46.01…46.04*; which scaling is in use depends on the setting of *58.26 EFB ref1 type* and *58.27 EFB ref2 type* (see page *251*).



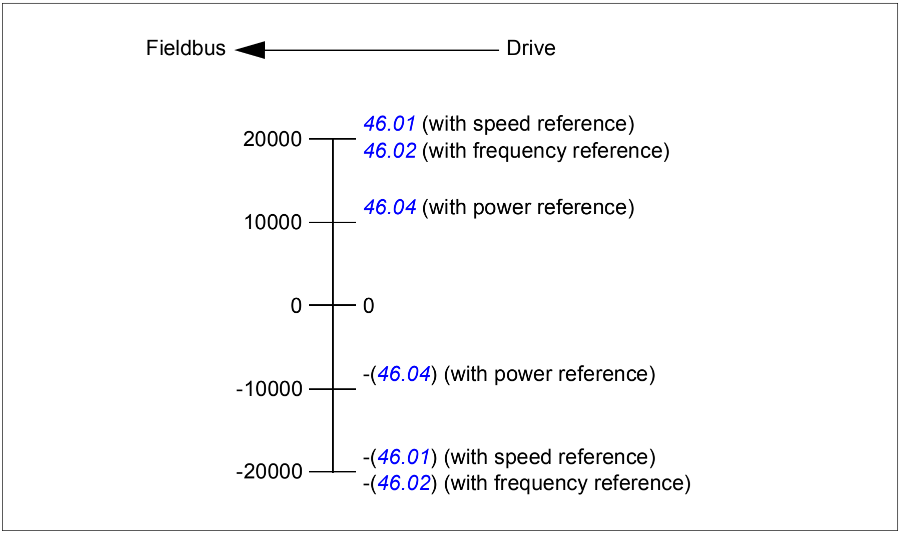
The scaled references are shown by parameters *03.09 EFB reference 1* and *03.10 EFB reference 2*.

Actual values

Actual values for the ABB Drives profile and DCU Profile

The ABB Drives profile supports the use of two fieldbus actual values, ACT1 and ACT2. The actual values are 16-bit words each containing a sign bit and a 15-bit integer. A negative value is formed by calculating the two’s complement from the corresponding positive value.

The actual values are scaled as defined by parameters *46.01…46.04*; which scaling is in use depends on the setting of parameters *58.28 EFB act1 type* and *58.29 EFB act2 type* (see page *251*).



Modbus holding register addresses

Modbus holding register addresses for the ABB Drives profile and DCU Profile

The table below shows the default Modbus holding register addresses for the drive data with the ABB Drives profile. This profile provides a converted 16-bit access to the drive data.

Note: Only the 16 least significant bits of the drive’s 32-bit Control and Status Words can be accessed.

Note: Bits 16 through 32 of the DCU Control/Status word are not in use if 16-bit control/status word is used with the DCU Profile.

Register address	**Register data (16-bit words)**
400001	Default: Control word (*CW 16bit*). See sections *Control Word for the ABB Drives profile* (page *372*) and *Control Word for the DCU Profile* (page *373*). The selection can be changed using parameter *58.101 Data I/O 1*.
400002	Default: Reference 1 (*Ref1 16bit*). The selection can be changed using parameter *58.102 Data I/O 2*.
400003	Default: Reference 2 (*Ref2 16bit*). The selection can be changed using parameter *58.102 Data I/O 2*.
400004	Default: Status Word (*SW 16bit*). See sections *Status Word for the ABB Drives profile* (page *376*) and *Status Word for the DCU Profile* (page *377*). The selection can be changed using parameter *58.102 Data I/O 2*.
400005	Default: Actual value 1 (*Act1 16bit*). The selection can be changed using parameter *58.105 Data I/O 5*.
400006	Actual value 2 (*Act2 16bit*). The selection can be changed using parameter *58.106 Data I/O 6*.
400007…400014	Data in/out 7…14. Selected by parameters *58.107 Data I/O 7* …*58.114 Data I/O 14*.
400015...400089	Unused
400090...400100	Error code access. See section *Error code registers (holding registers 400090…400100)* (page *390*).
400101...465536	Parameter read/write. Parameters are mapped to register addresses according to parameter *58.33 Addressing mode*.

Modbus function codes

The table below shows the Modbus function codes supported by the embedded fieldbus interface.

Code	Function name	Description
01h	Read Coils	Reads the 0/1 status of coils (0X references).
02h	Read Discrete Inputs	Reads the 0/1 status of discrete inputs (1X references).
03h	Read Holding Registers	Reads the binary contents of holding registers (4X references).
05h	Write Single Coil	Forces a single coil (0X reference) to 0 or 1.
06h	Write Single Register	Writes a single holding register (4X reference).
08h	Diagnostics	Provides a series of tests for checking the communication, or for checking various internal error conditions. Supported subcodes: • 00h Return Query Data: Echo/loopback test. • 01h Restart Comm Option: Restarts and initializes the EFB, clears communications event counters. • 04h Force Listen Only Mode • 0Ah Clear Counters and Diagnostic Register • 0Bh Return Bus Message Count • 0Ch Return Bus Comm. Error Count • 0Dh Return Bus Exception Error Count • 0Eh Return Slave Message Count • 0Fh Return Slave No Response Count • 10h Return Slave NAK (negative acknowledge) Count • 11h Return Slave Busy Count • 12h Return Bus Character Overrun Count • 14h Clear Overrun Counter and Flag
0Bh	Get Comm Event Counter	Returns a status word and an event count.
0Fh	Write Multiple Coils	Forces a sequence of coils (0X references) to 0 or 1.
10h	Write Multiple Registers	Writes the contents of a contiguous block of holding registers (4X references).
16h	Mask Write Register	Modifies the contents of a 4X register using a combination of an AND mask, an OR mask, and the register’s current contents.
17h	Read/Write Multiple Registers	Writes the contents of a contiguous block of 4X registers, then reads the contents of another group of registers (the same or different than those written) in a server device.

Code	**Function name**	**Description**
2Bh / 0Eh	Encapsulated Interface Transport	Supported subcodes: • 0Eh Read Device Identification: Allows reading the identification and other information. Supported ID codes (access type): • 00h: Request to get the basic device identification (stream access) • 04h: Request to get one specific identification object (individual access) Supported Object IDs: • 00h: Vendor Name (“ABB”) • 01h: Product Code (for example, “AQAKx”) • 02h: Major Minor Revision (combination of contents of parameters *07.05 Firmware version* and *58.02 Protocol ID*). • 03h: Vendor URL (“www.abb.com”) • 04h: Product name: (“ACQ580”).

Exception codes

The table below shows the Modbus exception codes supported by the embedded fieldbus interface.

Code	**Name**	**Description**
01h	ILLEGAL FUNCTION	The function code received in the query is not an allowable action for the server.
02h	ILLEGAL ADDRESS	The data address received in the query is not an allowable address for the server.
03h	ILLEGAL VALUE	The requested quantity of registers is larger than the device can handle. This error does not mean that a value written to the device is outside of the valid range.
04h	DEVICE FAILURE	An unrecoverable error occurred while the server was attempting to perform the requested action. See section *Error code registers (holding registers 400090…400100)* on page *390*.

Coils (0xxxx reference set)

Coils are 1-bit read/write values. Control Word bits are exposed with this data type. The table below summarizes the Modbus coils (0xxxx reference set). Note that the references are 1-based index which match the address transmitted on the wire.

Reference	ABB Drives profile	DCU Profile
000001	OFF1_CONTROL	STOP
000002	OFF2_CONTROL	START
000003	OFF3_CONTROL	Reserved
000004	INHIBIT_OPERATION	Reserved
000005	RAMP_OUT_ZERO	RESET
000006	RAMP_HOLD	EXT2
000007	RAMP_IN_ZERO	RUN_DISABLE
000008	RESET	STOPMODE_RAMP
000009	Not for ACH580/ACQ580	STOPMODE_EMERGENCY_RAMP
000010	Not for ACH580/ACQ580	STOPMODE_COAST
000011	REMOTE_CMD	Reserved
000012	EXT_CTRL_LOC	RAMP_OUT_ZERO
000013	USER_0	RAMP_HOLD
000014	USER_1	RAMP_IN_ZERO
000015	USER_2	Reserved
000016	USER_3	Reserved
000017	Reserved	FB_LOCAL_CTL
000018	Reserved	FB_LOCAL_REF
000019	Reserved	Reserved
000020	Reserved	Reserved
000021	Reserved	Reserved
000022	Reserved	Reserved
000023	Reserved	USER_0
000024	Reserved	USER_1
000025	Reserved	USER_2
000026	Reserved	USER_3
000027	Reserved	Reserved
000028	Reserved	Reserved
000029	Reserved	Reserved
000030	Reserved	Reserved
000031	Reserved	Reserved
000032	Reserved	Reserved

Reference	ABB Drives profile	DCU Profile
000033	Control for relay output RO1 (parameter *10.99 RO/DIO control word*, bit 0)	Control for relay output RO1 (parameter *10.99 RO/DIO control word*, bit 0)
000034	Control for relay output RO2 (parameter *10.99 RO/DIO control word*, bit 1)	Control for relay output RO2 (parameter *10.99 RO/DIO control word*, bit 1)
000035	Control for relay output RO3 (parameter *10.99 RO/DIO control word*, bit 2)	Control for relay output RO3 (parameter *10.99 RO/DIO control word*, bit 2)
000036	Control for relay output RO4 (parameter *10.99 RO/DIO control word*, bit 3)	Control for relay output RO4 (parameter *10.99 RO/DIO control word*, bit 3)
000037	Control for relay output RO5 (parameter *10.99 RO/DIO control word*, bit 4)	Control for relay output RO5 (parameter *10.99 RO/DIO control word*, bit 4)

Discrete inputs (1xxxx reference set)

Discrete inputs are 1-bit read-only values. Status Word bits are exposed with this data type. The table below summarizes the Modbus discrete inputs (1xxxx reference set). Note that the references are 1-based index which match the address transmitted on the wire.

Reference	ABB Drives profile	DCU Profile
100001	RDY_ON	READY
100002	RDY_RUN	D
100003	RDY_REF	Reserved
100004	TRIPPED	RUNNING
100005	OFF_2_STATUS	ZERO_SPEED
100006	OFF_3_STATUS	Reserved
100007	SWC_ON_INHIB	Reserved
100008	ALARM	AT_SETPOINT
100009	AT_SETPOINT	LIMIT
100010	REMOTE	SUPERVISION
100011	ABOVE_LIMIT	Reserved
100012	USER_0	Reserved
100013	USER_1	PANEL_LOCAL
100014	USER_2	FIELDBUS_LOCAL
100015	USER_3	EXT2_ACT
100016	Reserved	FAULT
100017	Reserved	ALARM
100018	Reserved	Reserved
100019	Reserved	Reserved
100020	Reserved	Reserved
100021	Reserved	Reserved
100022	Reserved	Reserved
100023	Reserved	USER_0
100024	Reserved	USER_1
100025	Reserved	USER_2
100026	Reserved	USER_3
100027	Reserved	REQ_CTL
100028	Reserved	Reserved
100029	Reserved	Reserved
100030	Reserved	Reserved
100031	Reserved	Reserved
100032	Reserved	Reserved

Reference	**ABB Drives profile**	**DCU Profile**
100033	Delayed status of digital input DI1 (parameter *10.02 DI delayed status*, bit 0)	Delayed status of digital input DI1 (parameter *10.02 DI delayed status*, bit 0)
100034	Delayed status of digital input DI2 (parameter *10.02 DI delayed status*, bit 1)	Delayed status of digital input DI2 (parameter *10.02 DI delayed status*, bit 1)
100035	Delayed status of digital input DI3 (parameter *10.02 DI delayed status*, bit 2)	Delayed status of digital input DI3 (parameter *10.02 DI delayed status*, bit 2)
100036	Delayed status of digital input DI4 (parameter *10.02 DI delayed status*, bit 3)	Delayed status of digital input DI4 (parameter *10.02 DI delayed status*, bit 3)
100037	Delayed status of digital input DI5 (parameter *10.02 DI delayed status*, bit 4)	Delayed status of digital input DI5 (parameter *10.02 DI delayed status*, bit 4)
100038	Delayed status of digital input DI6 (parameter *10.02 DI delayed status*, bit 5)	Delayed status of digital input DI6 (parameter *10.02 DI delayed status*, bit 5)

Error code registers (holding registers 400090…400100)

These registers contain information about the last query. The error register is cleared when a query has finished successfully.

Reference	**Name**	**Description**
400090	Reset Error Registers	1 = Reset internal error registers (91…95). 0 = Do nothing.
400091	Error Function Code	Function code of the failed query.
400092	Error Code	Set when exception code 04h is generated (see table above). • 00h No error • 02h Low/High limit exceeded • 03h Faulty Index: Unavailable index of an array parameter • 05h Incorrect Data Type: Value does not match the data type of the parameter • 65h General Error: Undefined error when handling query
400093	Failed Register	The last register (discrete input, coil, input register or holding register) that failed to be read or written.
400094	Last Register Written Successfully	The last register (discrete input, coil, input register or holding register) that was written successfully.
400095	Last Register Read Successfully	The last register (discrete input, coil, input register or holding register) that was read successfully.

10

Fieldbus control through a fieldbus adapter

What this chapter contains

This chapter describes how the drive can be controlled by external devices over a communication network (fieldbus) through an optional fieldbus adapter module.

The fieldbus control interface of the drive is described first, followed by a configuration example.

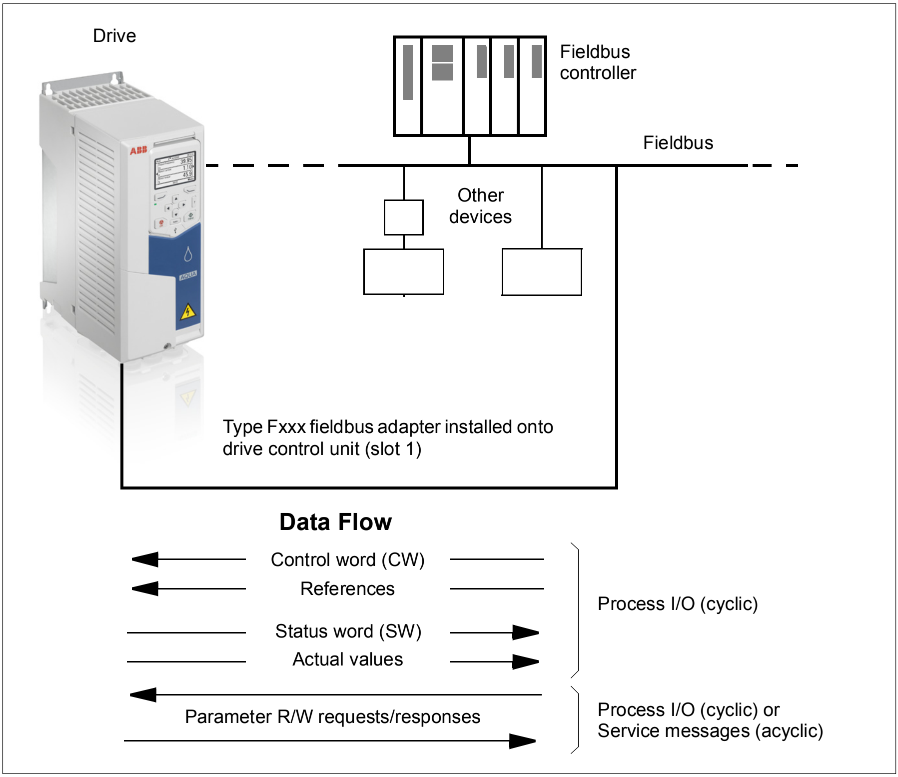
System overview

The drive can be connected to an external control system through an optional fieldbus adapter (“fieldbus adapter A” = FBA A) mounted onto the control unit of the drive. The drive can be configured to receive all of its control information through the fieldbus interface, or the control can be distributed between the fieldbus interface and other available sources such as digital and analog inputs, depending on how control locations EXT1 and EXT2 are configured.

Fieldbus adapters are available for various communication systems and protocols, for example

- CANopen (FCAN-01 adapter)
- DeviceNet^{TM} (FDNA-01 adapter)
- EtherNet/IP^{TM} (FENA-11/-21 adapter)
- ModbusTCP (FENA-11/-21 adapter)
- PROFInet IO (FENA-11/-21 adapter)
- PROFIBUS DP (FPBA-01 adapter)

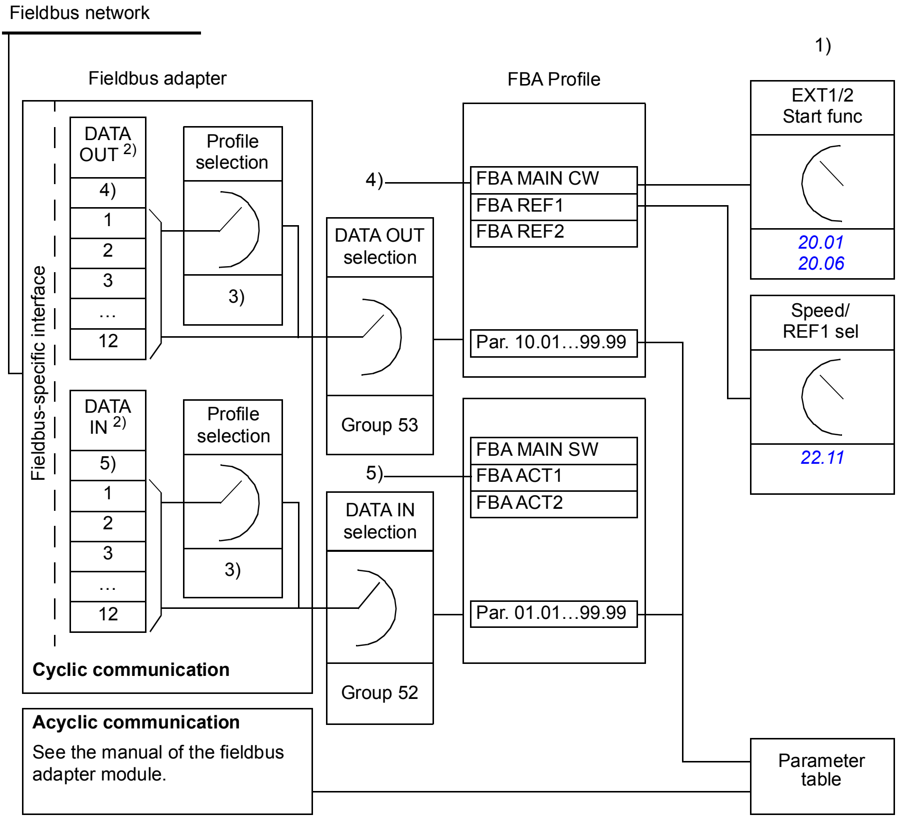
Note: The text and examples in this chapter describe the configuration of one fieldbus adapter (FBA A) by parameters *50.01*…*50.18* and parameter groups *51 FBA A settings*…*53 FBA A data out*.



Basics of the fieldbus control interface

The cyclic communication between a fieldbus system and the drive consists of 16- or 32-bit input and output data words. The drive is able to support a maximum of 12 data words (16 bits) in each direction.

Data transmitted from the drive to the fieldbus controller is defined by parameters *52.01 FBA A data in1* … *52.12 FBA A data in12*. The data transmitted from the fieldbus controller to the drive is defined by parameters *53.01 FBA A data out1* … *53.12 FBA A data out12*.



1) See also other parameters which can be controlled from fieldbus.
2) The maximum number of data words used is protocol-dependent.
3) Profile/instance selection parameters. Fieldbus module specific parameters. For more information, see the *User's manual* of the appropriate fieldbus adapter module.
4) With DeviceNet, the control part is transmitted directly.
5) With DeviceNet, the actual value part is transmitted directly.

Control word and Status word

The Control word is the principal means for controlling the drive from a fieldbus system. It is sent by the fieldbus master station to the drive through the adapter module. The drive switches between its states according to the bit-coded instructions in the Control word, and returns status information to the master in the Status word.

The contents of the Control word and the Status word are detailed on pages *397* and *398* respectively. The drive states are presented in the state diagram (page *399*).

Debugging the network words

If parameter *50.12 FBA A debug mode* is set to *Fast*, the Control word received from the fieldbus is shown by parameter *50.13 FBA A control word*, and the Status word transmitted to the fieldbus network by *50.16 FBA A status word*. This “raw” data is very useful to determine if the fieldbus master is transmitting the correct data before handing control to the fieldbus network.

References

References are 16-bit words containing a sign bit and a 15-bit integer. A negative reference (indicating reversed direction of rotation) is formed by calculating the two's complement from the corresponding positive reference.

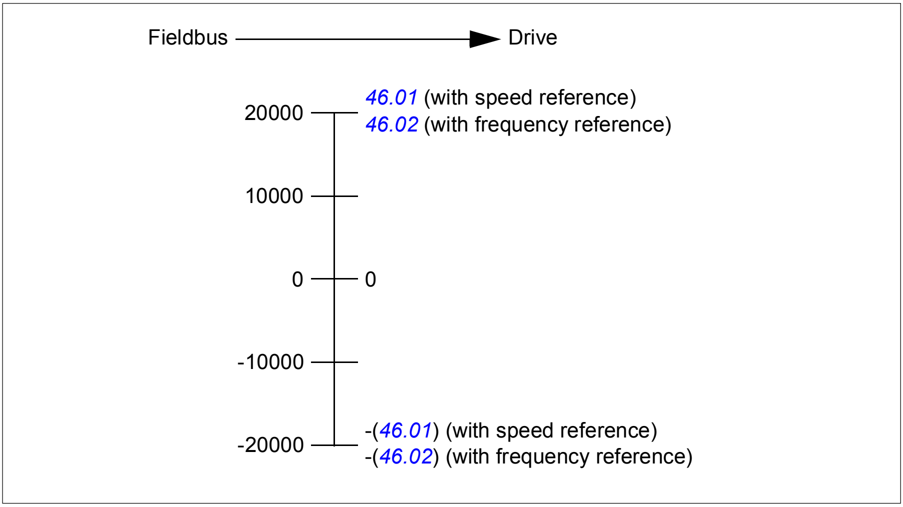
ABB drives can receive control information from multiple sources including analog and digital inputs, the drive control panel and a fieldbus adapter module. In order to have the drive controlled through the fieldbus, the module must be defined as the source for control information such as reference. This is done using the source selection parameters in groups *22 Speed reference selection* and *28 Frequency reference chain*.

Debugging the network words

If parameter *50.12 FBA A debug mode* is set to *Fast*, the references received from the fieldbus are displayed by *50.14 FBA A reference 1* and *50.15 FBA A reference 2*.

Scaling of references

The references are scaled as defined by parameters *46.01*…*46.04*; which scaling is in use depends on the setting of *50.04 FBA A ref1 type* and *50.05 FBA A ref2 type*.



The scaled references are shown by parameters *03.05 FB A reference 1* and *03.06 FB A reference 2*.

Actual values

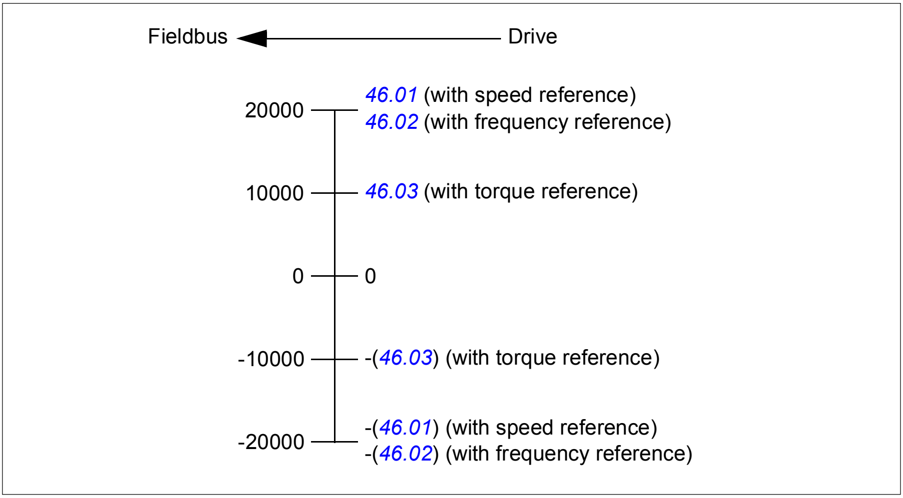
Actual values are 16-bit words containing information on the operation of the drive. The types of the monitored signals are selected by parameters *50.07 FBA A actual 1 type* and *50.08 FBA A actual 2 type*.

Debugging the network words

If parameter *50.12 FBA A debug mode* is set to *Fast*, the actual values sent to the fieldbus are displayed by *50.17 FBA A actual value 1* and *50.18 FBA A actual value 2*.

Scaling of actual values

The actual values are scaled as defined by parameters *46.01*…*46.04*; which scaling is in use depends on the setting of parameters *50.07 FBA A actual 1 type* and *50.08 FBA A actual 2 type*.



Contents of the fieldbus Control word

The upper case boldface text refers to the states shown in the state diagram (page *399*).

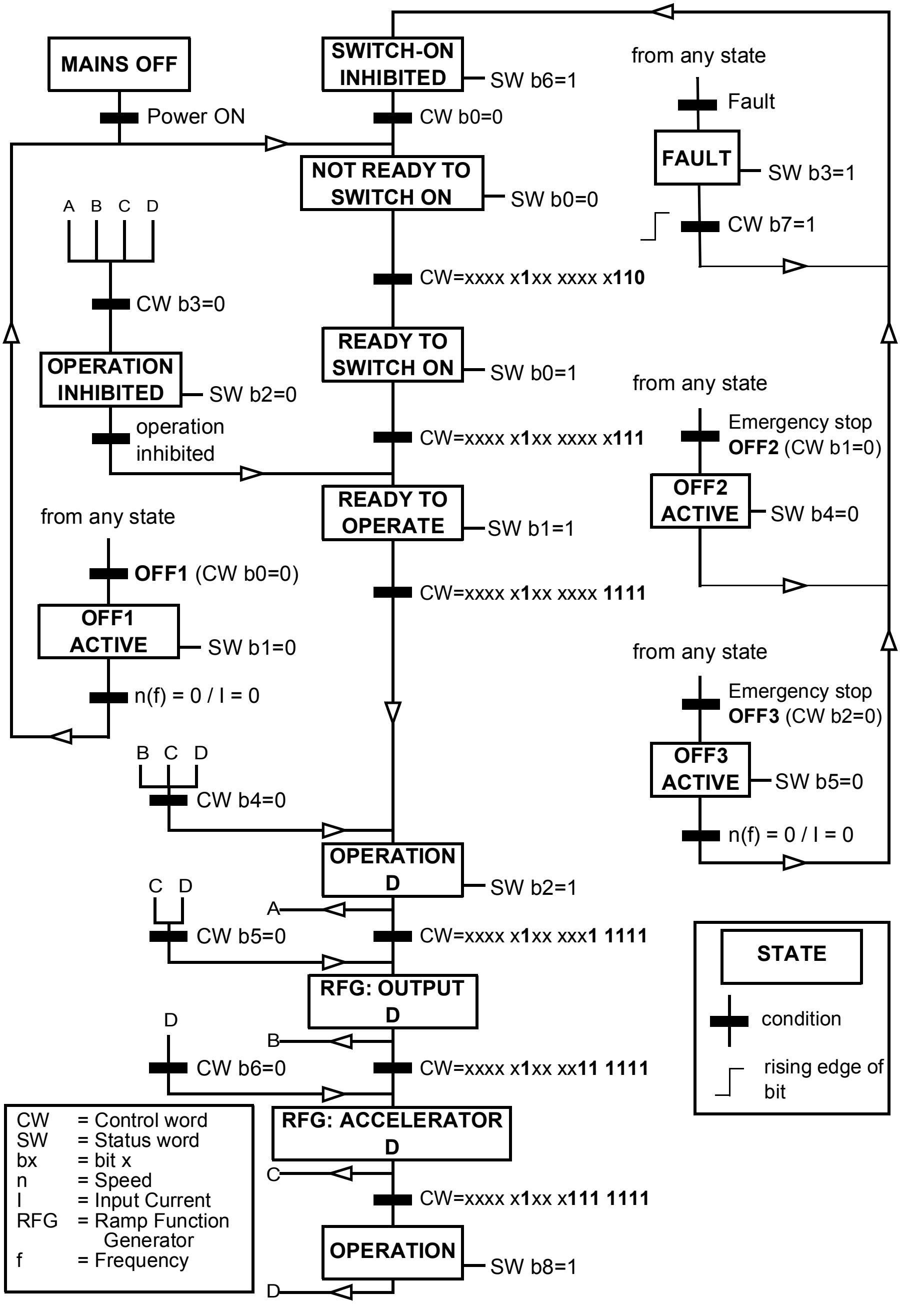
Bit	Name	Value	STATE/Description
0	Off1 control	1	Proceed to **READY TO OPERATE**.
		0	Stop along currently active deceleration ramp. Proceed to **OFF1 ACTIVE**; proceed to **READY TO SWITCH ON** unless other interlocks (OFF2, OFF3) are active.
1	Off2 control	1	Continue operation (OFF2 inactive).
		0	Emergency OFF, coast to a stop. Proceed to **OFF2 ACTIVE**, proceed to **SWITCH-ON INHIBITED**.
2	Off3 control	1	Continue operation (OFF3 inactive).
		0	Emergency stop, stop within time defined by drive parameter. Proceed to **OFF3 ACTIVE**; proceed to **SWITCH-ON INHIBITED**. ⚠ **WARNING:** Ensure motor and driven machine can be stopped using this stop mode.
3	Run	1	Proceed to **OPERATION D**. **Note:** Run enable signal must be active; see drive documentation. If the drive is set to receive the Run enable signal from the fieldbus, this bit activates the signal.
		0	Inhibit operation. Proceed to **OPERATION INHIBITED**.
4	Ramp out zero	1	Normal operation. Proceed to **RAMP FUNCTION GENERATOR: OUTPUT D**.
		0	Force Ramp function generator output to zero. The drive will immediately decelerate to zero speed (observing the torque limits).
5	Ramp hold	1	ramp function. Proceed to **RAMP FUNCTION GENERATOR: ACCELERATOR D**.
		0	Halt ramping (Ramp Function Generator output held).
6	Ramp in zero	1	Normal operation. Proceed to **OPERATING**. **Note:** This bit is effective only if the fieldbus interface is set as the source for this signal by drive parameters.
		0	Force Ramp function generator input to zero.
7	Reset	0=>1	Fault reset if an active fault exists. Proceed to **SWITCH-ON INHIBITED**. **Note:** This bit is effective only if the fieldbus interface is set as the source of the reset signal by drive parameters.
		0	Continue normal operation.
8…9	Reserved		
10	Remote cmd	1	Fieldbus control enabled.
		0	Control word and reference not getting through to the drive, except for bits 0…2.
11	Ext ctrl loc	1	Select External Control Location EXT2. Effective if control location is parameterized to be selected from fieldbus.
		0	Select External Control Location EXT1. Effective if control location is parameterized to be selected from fieldbus.
12	User bit 0	1	User configurable
		0	
13	User bit 1	1	
		0	
14	User bit 2	1	
		0	
15	User bit 3	1	
		0	

Contents of the fieldbus Status word

The upper case boldface text refers to the states shown in the state diagram (page *399*).

Bit	**Name**	**Value**	**STATE/Description**
0	Ready to switch ON	1	**READY TO SWITCH ON**.
		0	**NOT READY TO SWITCH ON**.
1	Ready run	1	**READY TO OPERATE**.
		0	**OFF1 ACTIVE**.
2	Ready ref	1	**OPERATION D**.
		0	**OPERATION INHIBITED**.
3	Tripped	1	**FAULT**.
		0	No fault.
4	Off 2 inactive	1	OFF2 inactive.
		0	**OFF2 ACTIVE**.
5	Off 3 inactive	1	OFF3 inactive.
		0	**OFF3 ACTIVE**.
6	Switch-on inhibited	1	**SWITCH-ON INHIBITED**.
		0	–
7	Warning	1	Warning active.
		0	No warning active.
8	At setpoint	1	**OPERATING**. Actual value equals reference = is within tolerance limits (see parameters *46.21*…*46.22*).
		0	Actual value differs from reference = is outside tolerance limits.
9	Remote	1	Drive control location: REMOTE (EXT1 or EXT2).
		0	Drive control location: LOCAL.
10	Above limit	-	See bit 10 of *06.17 Drive status word 2*.
11	User bit 0	-	See parameter *06.30 MSW bit 11 selection*.
12	User bit 1	-	See parameter *06.31 MSW bit 12 selection*.
13	User bit 2	-	See parameter *06.32 MSW bit 13 selection*.
14	User bit 3	-	See parameter *06.33 MSW bit 14 selection*.
15	Reserved		

The state diagram



Setting up the drive for fieldbus control

1. Install the fieldbus adapter module mechanically and electrically according to the instructions given in the *User's manual* of the module.
2. Power up the drive.
3. the communication between the drive and the fieldbus adapter module with parameter *50.01 FBA A enable*.
4. With *50.02 FBA A comm loss func*, select how the drive should react to a fieldbus communication break.
   Note: This function monitors both the communication between the fieldbus master and the adapter module and the communication between the adapter module and the drive.
5. With *50.03 FBA A comm loss t out*, define the time between communication break detection and the selected action.
6. Select application-specific values for the rest of the parameters in group *50 Fieldbus adapter (FBA)*, starting from *50.04*. Examples of appropriate values are shown in the tables below.
7. Set the fieldbus adapter module configuration parameters in group *51 FBA A settings*. As a minimum, set the required node address and the communication profile.
8. Define the process data transferred to and from the drive in parameter groups *52 FBA A data in* and *53 FBA A data out*.
   Note: Depending on the communication protocol and profile being used, the Control word and Status word may already be configured to be sent/received by the communication system.
9. Save the valid parameter values to permanent memory by setting parameter *96.07 Parameter save manually* to *Save*.
10. Validate the settings made in parameter groups 51, 52 and 53 by setting parameter *51.27 FBA A par refresh* to *Configure*.
11. Configure control locations EXT1 and EXT2 to allow control and reference signals to come from the fieldbus. Examples of appropriate values are shown in the tables below.

Parameter setting example: FPBA (PROFIBUS DP)

This example shows how to configure a basic speed control application that uses the PROFIdrive communication profile with PPO Type 2. The start/stop commands and reference are according to the PROFIdrive profile, speed control mode.

The reference values sent over the fieldbus have to be scaled within the drive so they have the desired effect. The reference value ±16384 (4000h) corresponds to the range of speed set in parameter *46.01 Speed scaling* (both forward and reverse directions). For example, if *46.01* is set to 480 rpm, then 4000h sent over fieldbus will request 480 rpm.

Direction	**PZD1**	**PZD2**	**PZD3**	**PZD4**	**PZD5**	**PZD6**
Out	Control word	Speed reference	Acc time 1		Dec time 1	
In	Status word	Speed actual value	Motor current		DC voltage	

The table below gives the recommended drive parameter settings.

Drive parameter	**Setting for ACX580 drives**	**Description**
50.01 FBA A enable	**1** = [slot number]	s communication between the drive and the fieldbus adapter module.
50.04 FBA A ref1 type	**4** = *Speed*	Selects the fieldbus A reference 1 type and scaling.
50.07 FBA A actual 1 type	**0** = *Speed or frequency*	Selects the actual value type and scaling according to the currently active Ref1 mode defined in parameter *50.04*.
51.01 FBA A type	**1** = FPBA$^{1)}$	Displays the type of the fieldbus adapter module.
51.02 Node address	3$^{2)}$	Defines the PROFIBUS node address of the fieldbus adapter module.
51.03 Baud rate	12000$^{1)}$	Displays the current baud rate on the PROFIBUS network in kbit/s.
51.04 MSG type	**1** = PPO2$^{1)}$	Displays the telegram type selected by the PLC configuration tool.
51.05 Profile	**0** = PROFIdrive	Selects the Control word according to the PROFIdrive profile (speed control mode).
51.07 RPBA mode	**0** = Disabled	Disables the RPBA emulation mode.
52.01 FBA data in1	**4** = SW 16bit$^{1)}$	Status word
52.02 FBA data in2	**5** = Act1 16bit	Actual value 1
52.03 FBA data in3	01.07$^{2)}$	Motor current
52.05 FBA data in5	01.11$^{2)}$	DC voltage
53.01 FBA data out1	**1** = CW 16bit$^{1)}$	Control word
53.02 FBA data out2	**2** = Ref1 16bit	Reference 1 (speed)
53.03 FBA data out3	23.12$^{2)}$	Acceleration time 1

Drive parameter	**Setting for ACX580 drives**	**Description**
53.05 FBA data out5	23.13[2)]	Deceleration time 1
51.27 FBA A par refresh	**1** = *Configure*	Validates the configuration parameter settings.
20.01 Ext1 commands	**12** = *Fieldbus A*	Selects fieldbus adapter A as the source of the start and stop commands for external control location EXT1.
20.02 Ext1 start trigger type	**1** = *Level*	Selects a level-triggered start signal for external control location EXT1.
22.11 Ext1 speed ref1	**4** = *FB A ref1*	Selects fieldbus A reference 1 as the source for speed reference 1.

[1)] Read-only or automatically detected/set

[2)] Example

The start sequence for the parameter example above is given below.

Control word:

- 477h (1143 decimal) –> READY TO SWITCH ON
- 47Fh (1151 decimal) –> OPERATING (Speed mode)

11

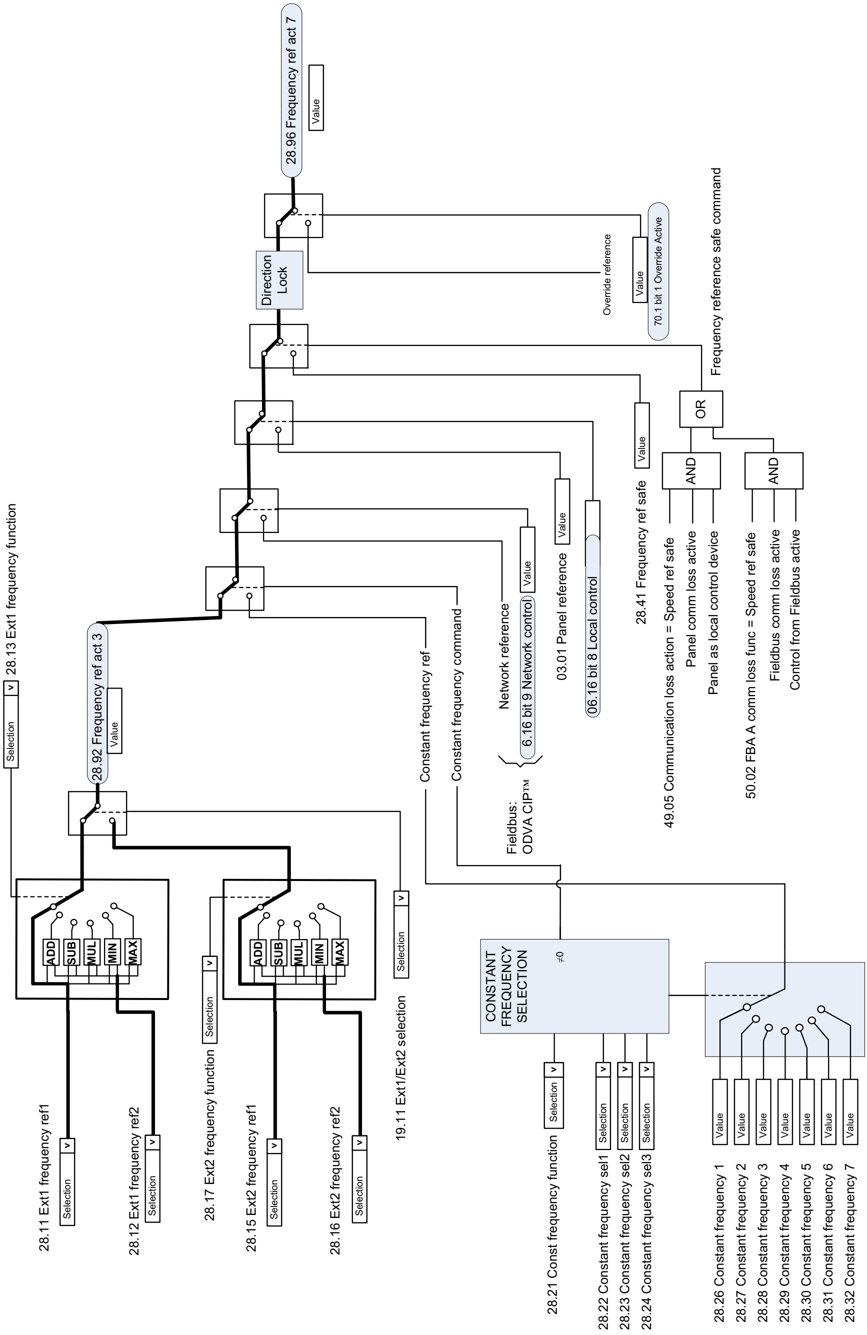
Control chain diagrams

Contents of this chapter

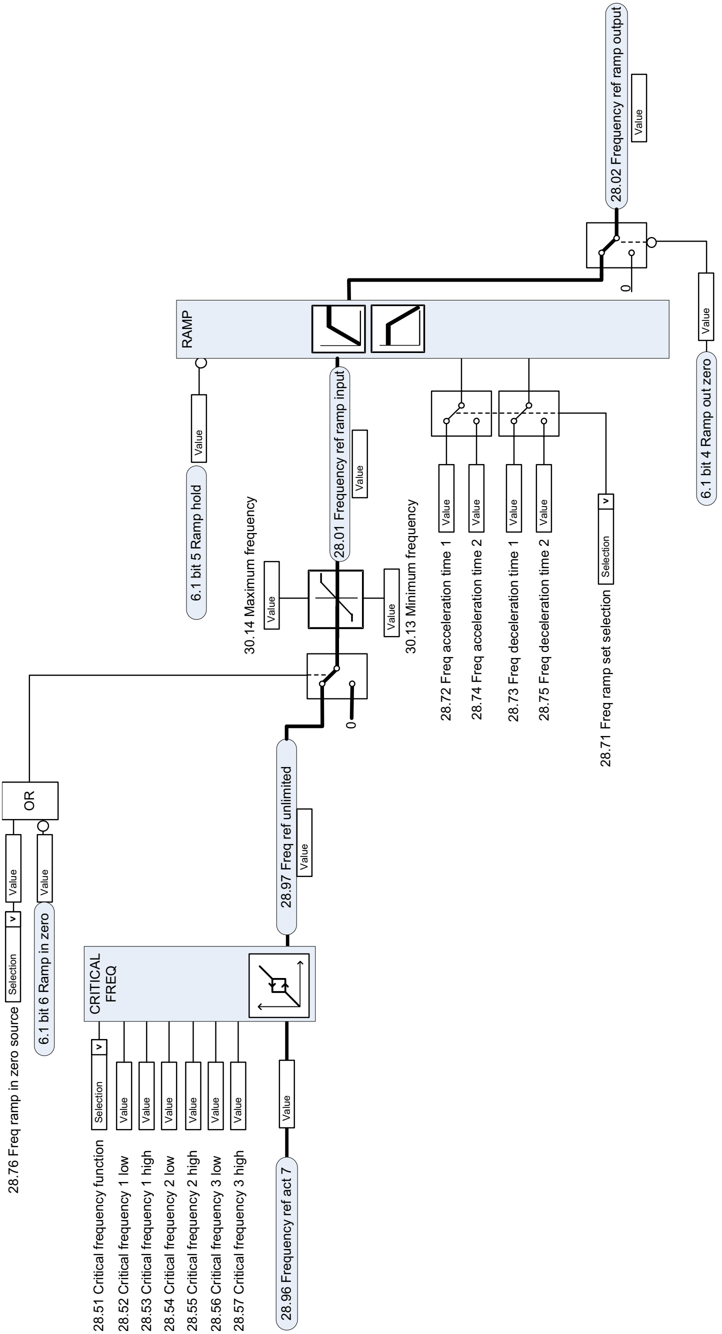
The chapter presents the reference chains of the drive. The control chain diagrams can be used to trace how parameters interact and where parameters have an effect within the drive parameter system.

For a more general diagram, see section *Operating modes of the drive* (page *40*).

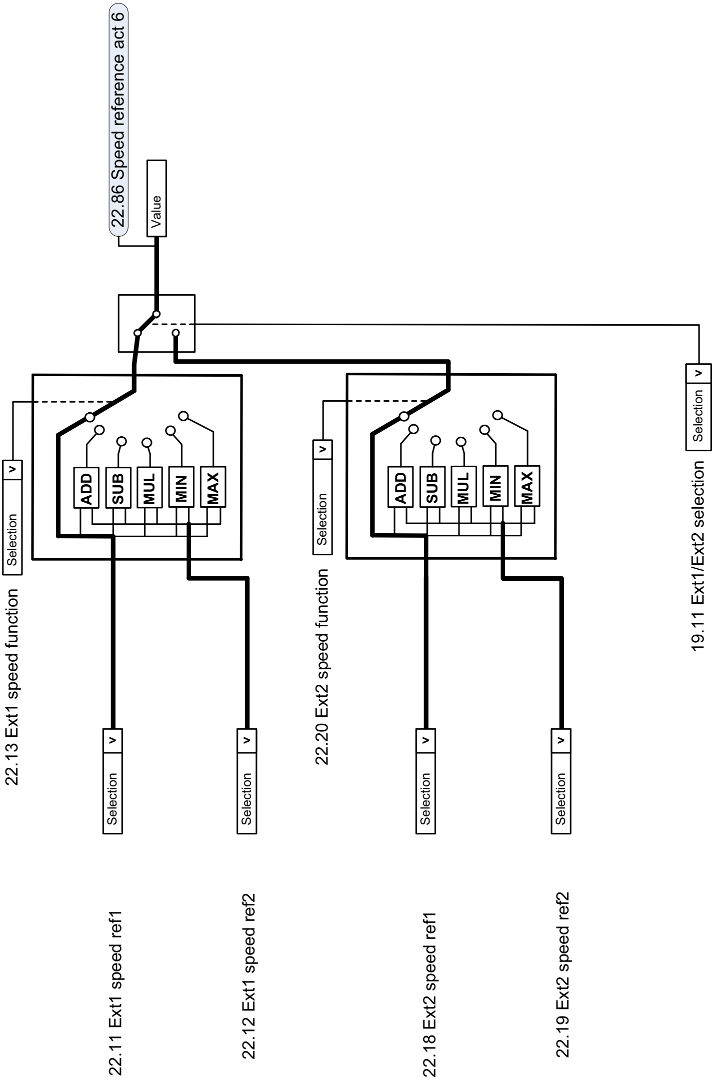
Frequency reference selection



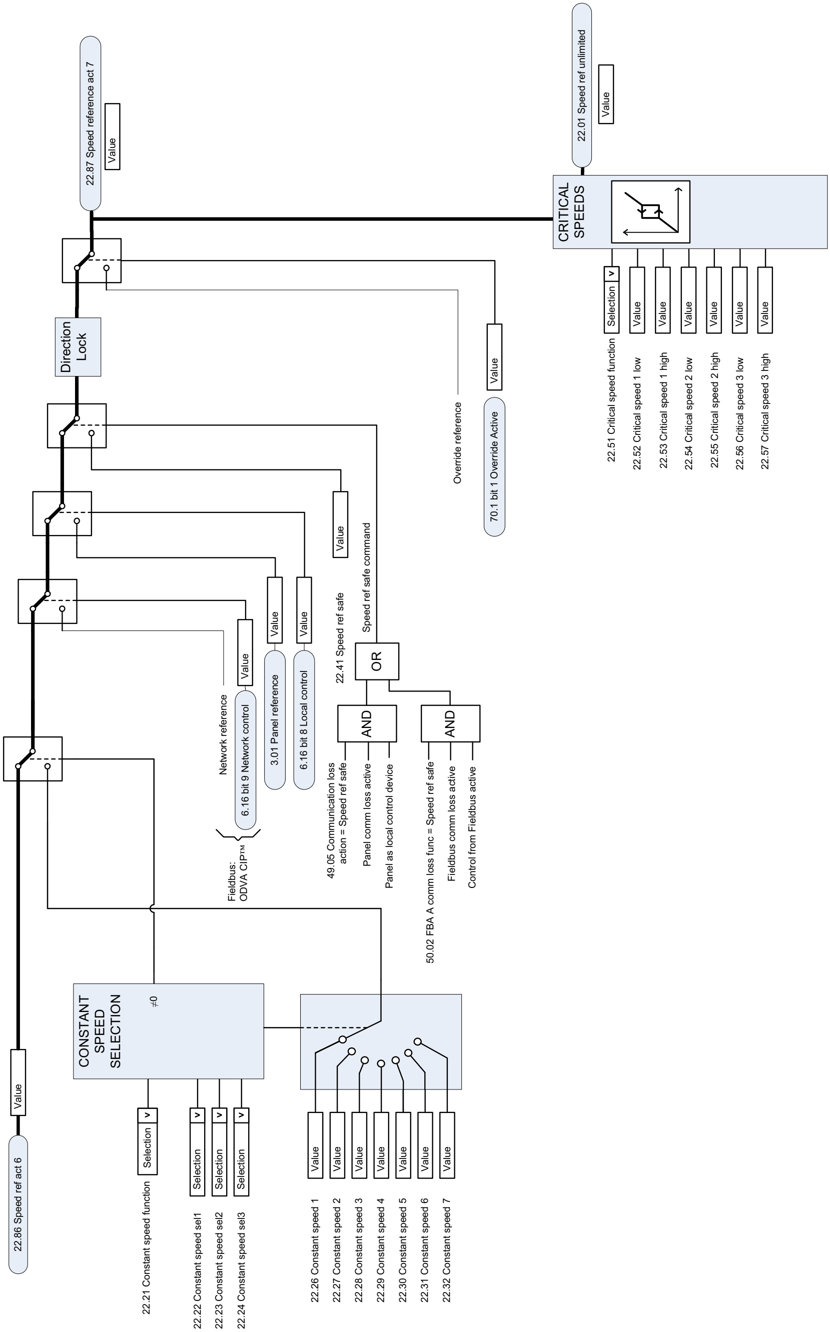
Frequency reference modification



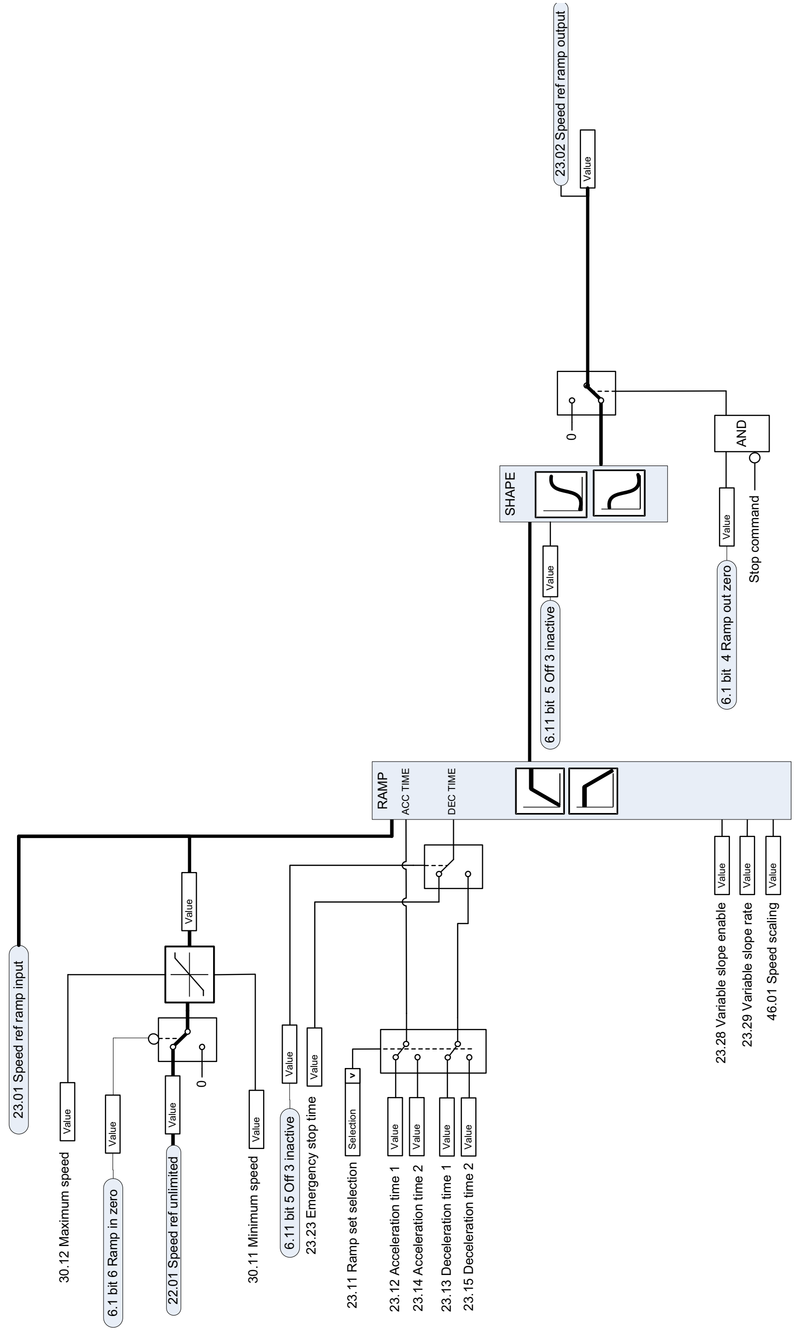
Speed reference source selection I



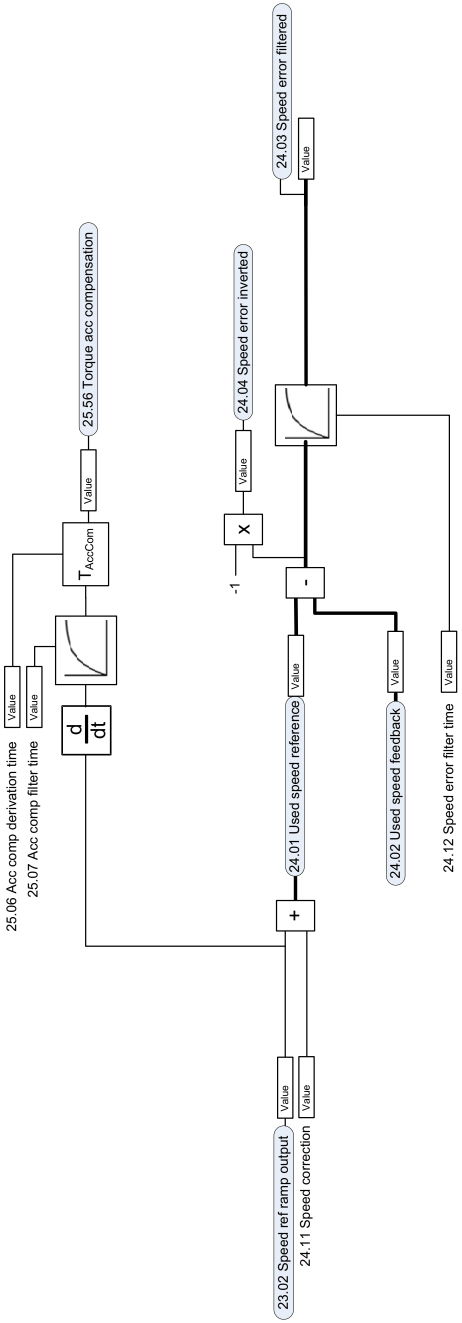
Speed reference source selection II



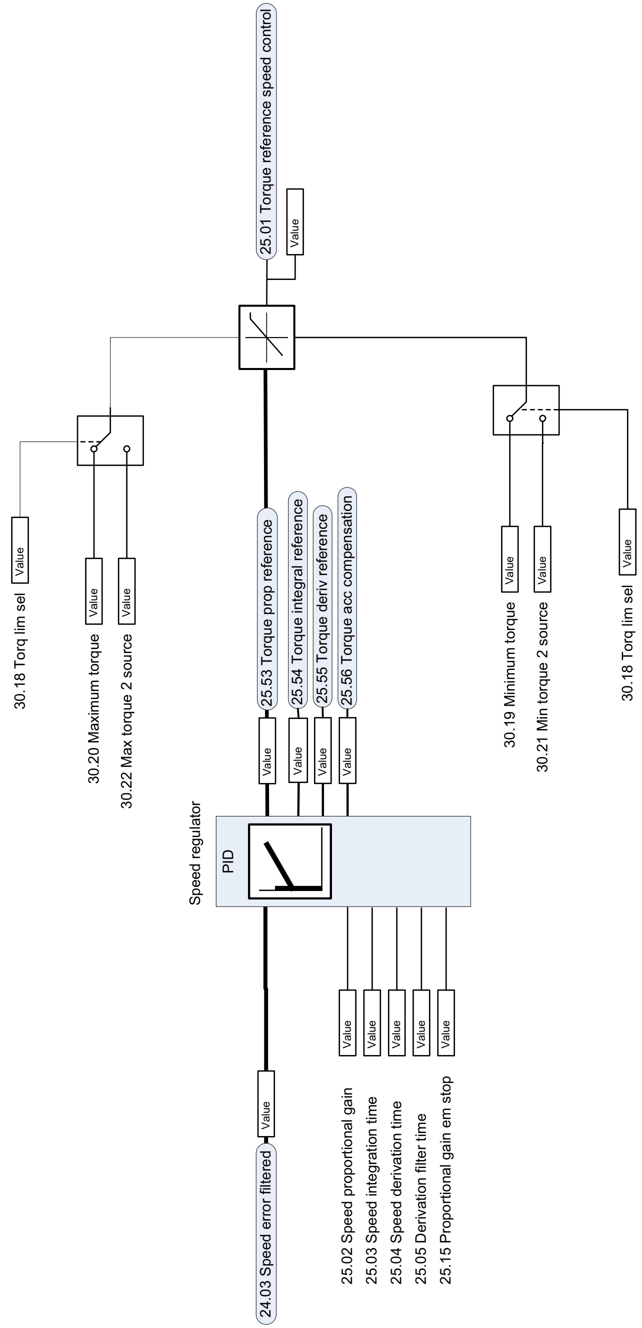
Speed reference ramping and shaping



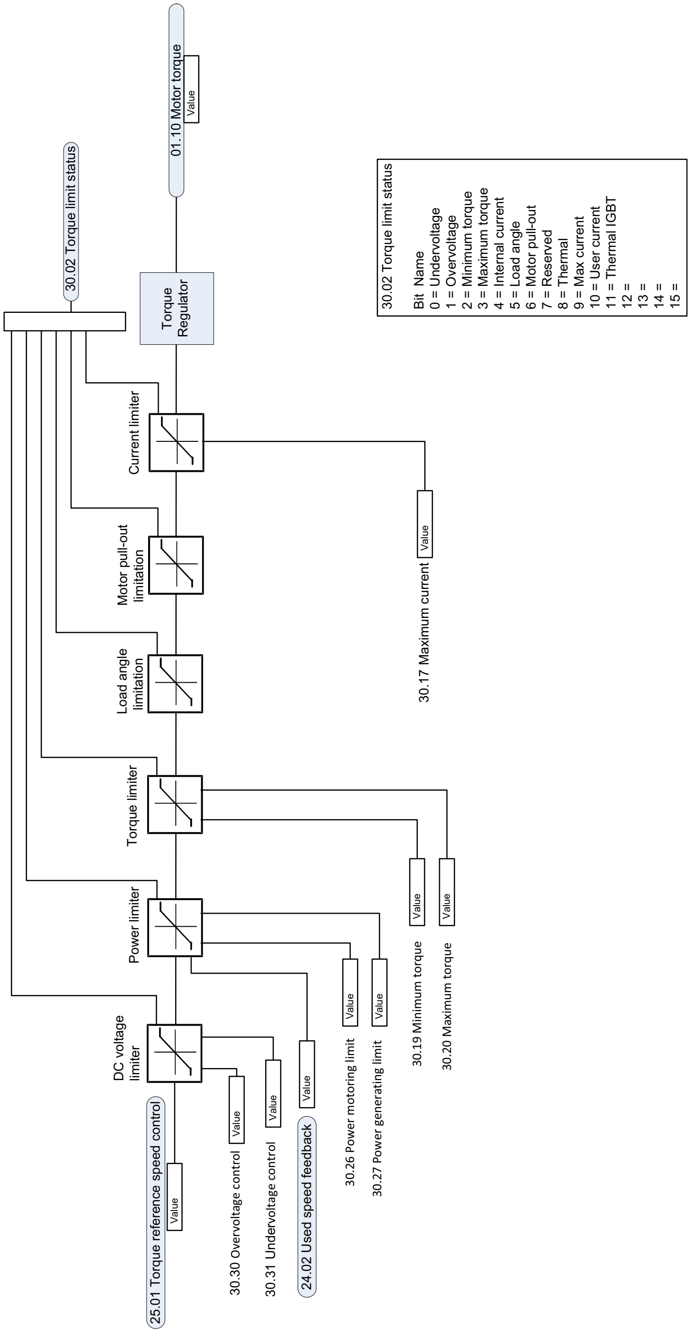
Speed error calculation



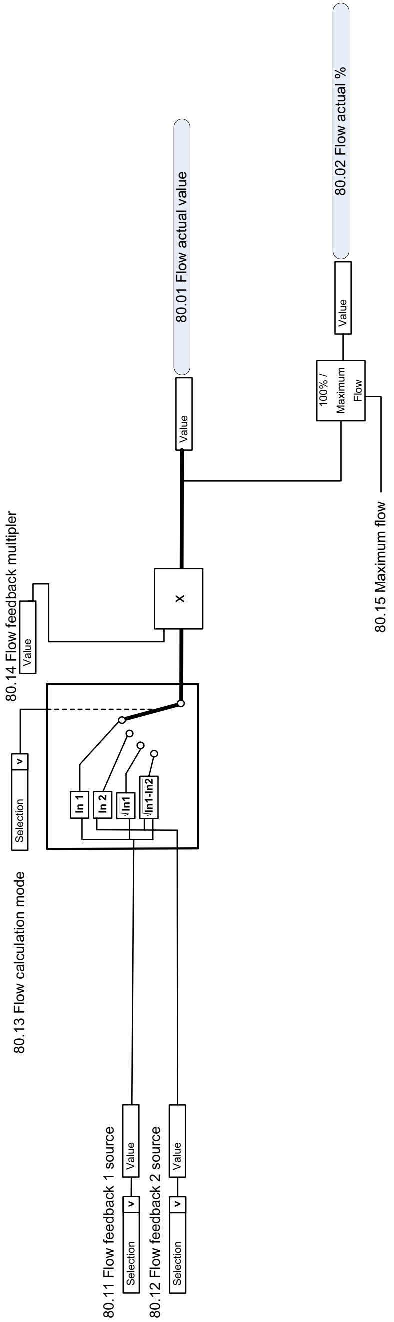
Speed controller



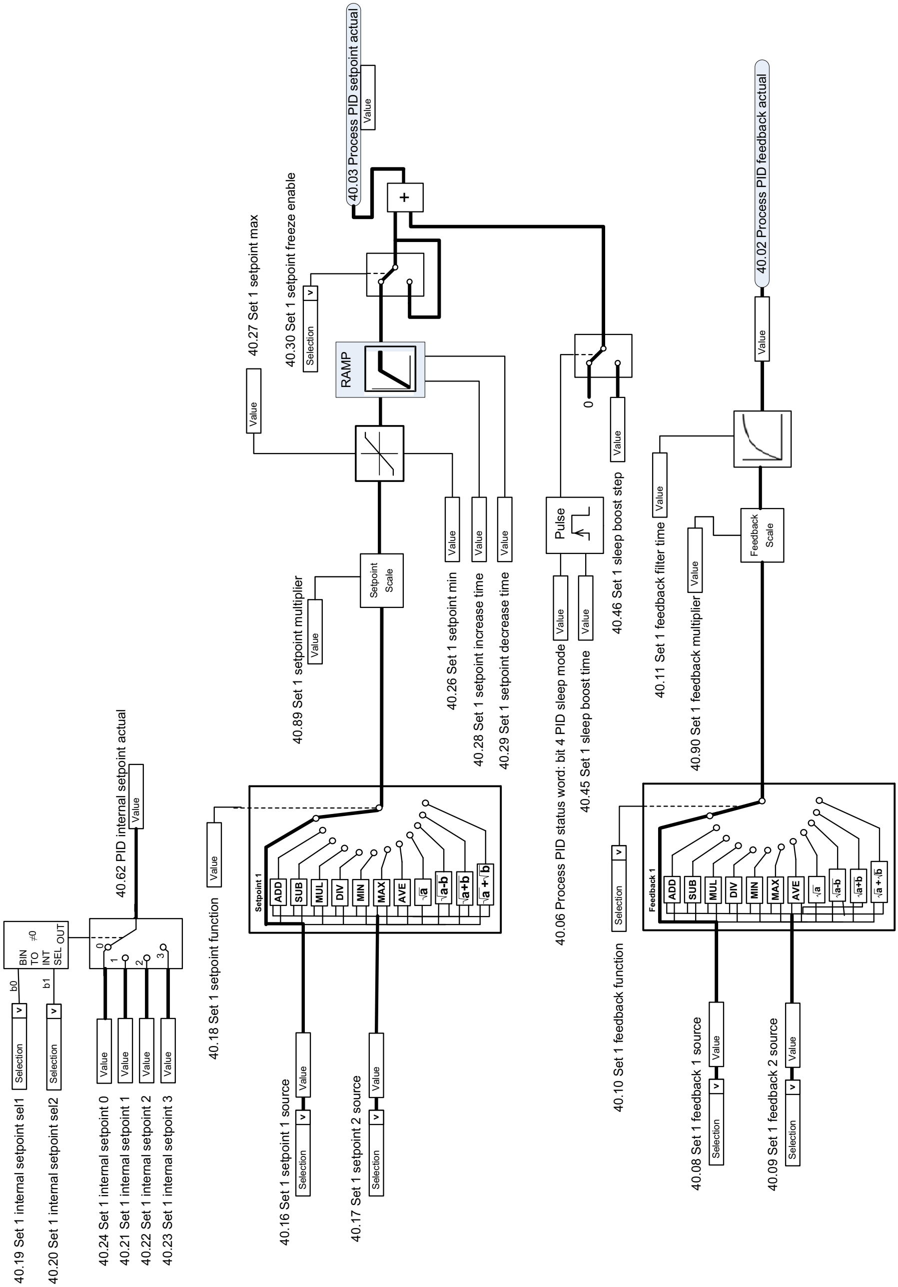
Torque limitation



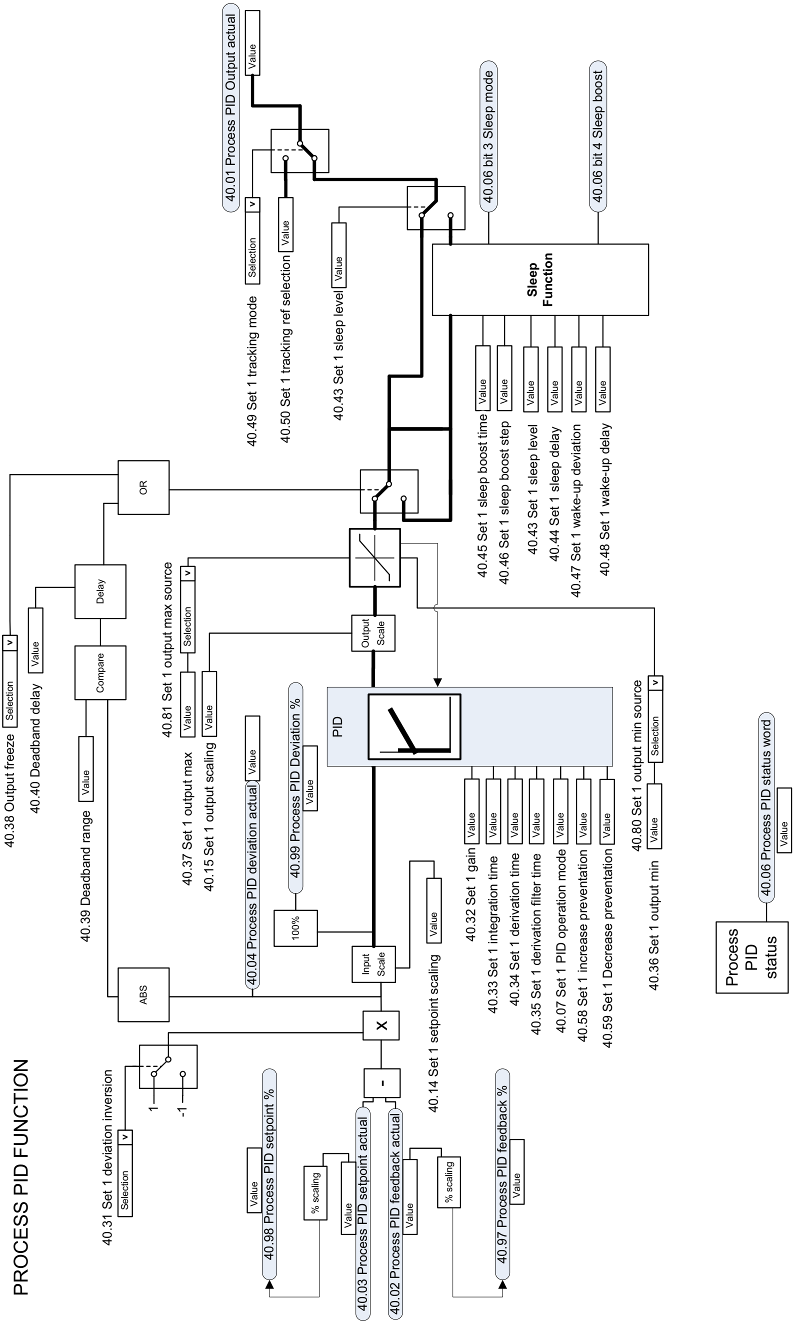
Flow calculation



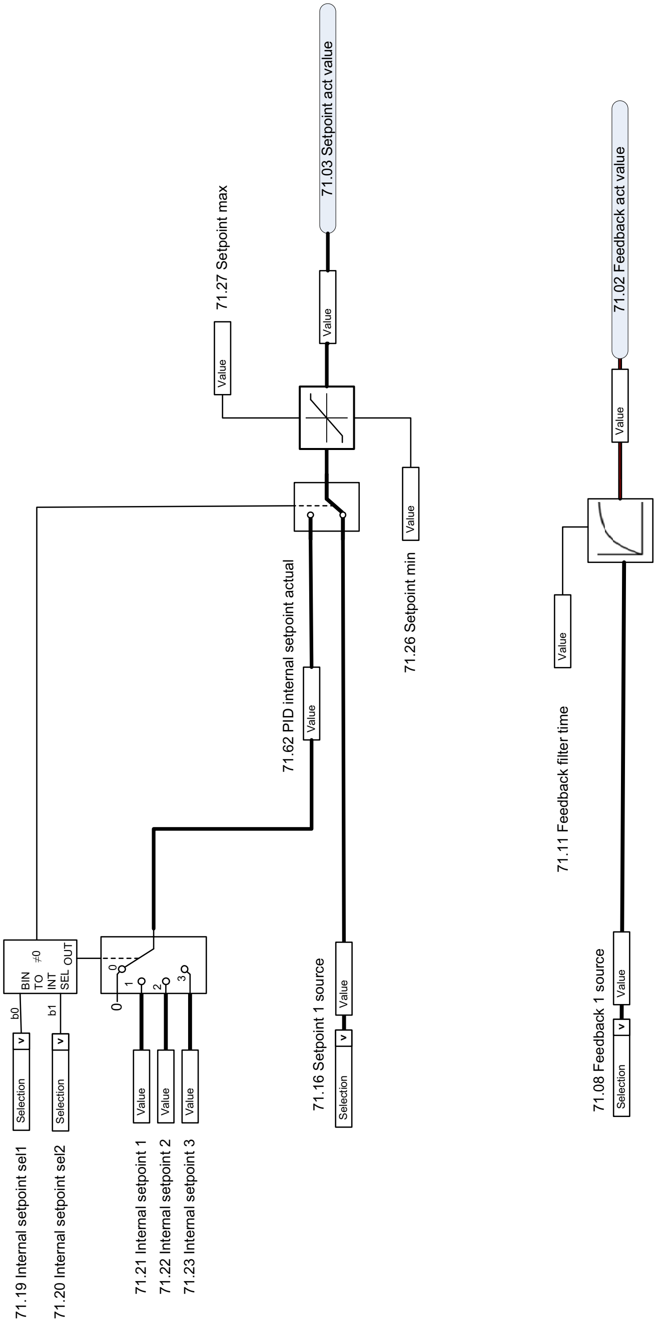
Process PID setpoint and feedback source selection



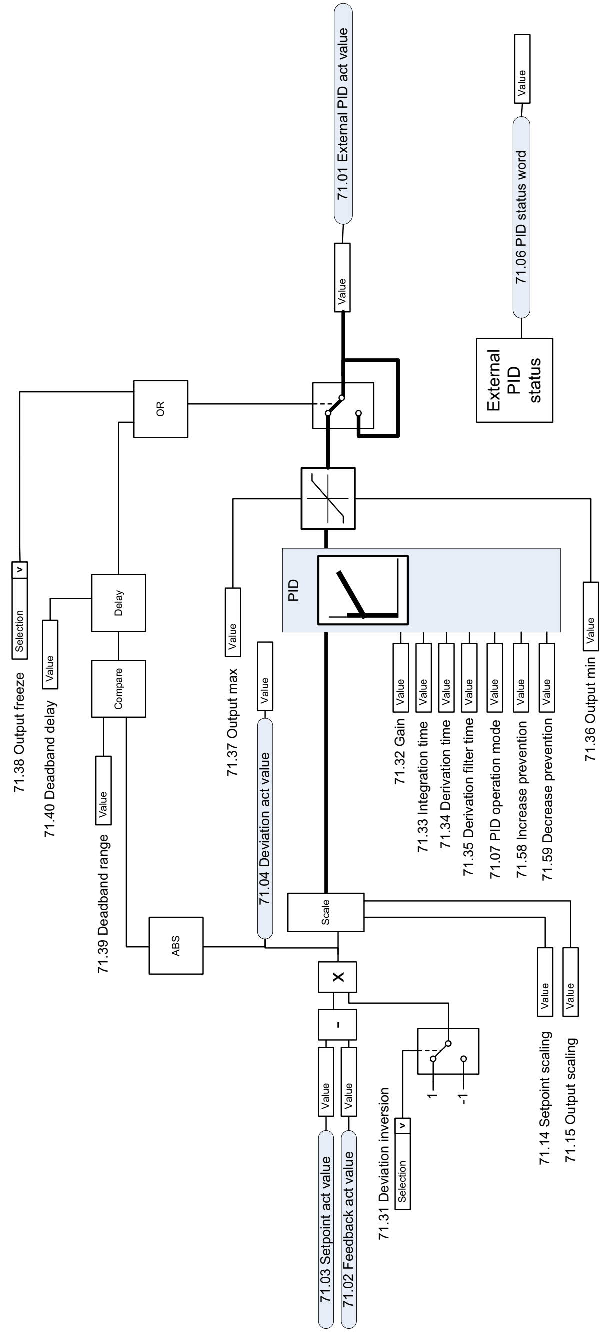
Process PID controller



External PID setpoint and feedback source selection



External PID controller



Further information

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