ABB industrial drives

Firmware manual
ACS880 PCP/ESP control program

Power and productivity
for a better world™

List of related manuals

Drive hardware manuals	**Code (English)**
ACS880-01 drives hardware manual	3AUA0000078093
ACS880-07 drives (45 to 250 kW, 60 to 300 hp) hardware manual	3AUA0000105718
ACS880-07 drives (560 to 2800 kW) hardware manual	3AUA0000143261
ACS880-104 inverter modules hardware manual	3AUA0000104271
ACS880-107 inverter units hardware manual	3AUA0000102519

Drive firmware manuals and guides	
ACS880 primary control program firmware manual	3AUA0000085967
ACS880 drives with primary control program, quick start-up guide	3AUA0000098062
ACS880 PCP/ESP control program firmware manual	3AXD50000016186

Option manuals and guides	
ACS-AP-x assistant control panels user's manual	3AUA0000085685
Drive composer Start-up and maintenance PC tool User's manual	3AUA0000094606
Manuals and quick guides for I/O extension modules, fieldbus adapters, encoder interfaces, etc.	

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.

ACS880-01 manuals

ACS880-07 manuals

Firmware manual

ACS880 PCP/ESP control program

3AXD50000016186 Rev B
EN
EFFECTIVE: 2015-10-27

Table of contents

6. Standard programposi features

7. Default control connections

8. Parameters

9. Additional parameter data

10. Fault tracing

11. Fieldbus control through the embedded fieldbus interface (EFB)

12. Fieldbus control through a fieldbus adapter

13. Control chain diagrams

14. Appendix: ESP with step-up transformer and sine filter

Further information

1

Introduction

Contents of this chapter

This chapter describes the compatibility, safety instructions, intended audience and contents of this manual. It also contains a list of terms and abbreviations used in this manual.

Applicability

This manual applies to the ACS880 PCP/ESP control program (version 2.12 or later).

The firmware version of the control program is visible in parameter *07.05 Firmware version*, or the **System info** in the main menu on the control panel.

The application version of the control is visible in the **System info** in the main menu on the control panel.

Safety instructions

Obey all safety instructions for the drive.

- Read the **complete safety instructions** before you install, commission, or use the drive. The complete safety instructions are delivered with the drive as either part of the *Hardware manual*, or, in the case of ACS880 multidrives, as a separate document.
- 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*.

Target audience

This manual is intended for people who design, commission, or operate the drive system.

Contents of the manual

This manual contains the following chapters:

- *Quick start-up guide for ACS880 drives* (page *15*) describes the start-up sequence of the pump control program.
- *PCP/ESP control start-up* (page *23*) describes the start-up sequence of the pump control program.
- *Using the control panel* (page *29*) refers to the instructions for using the control panel.
- *PCP/ESP program features* (page *31*) describes the program features specific to the progressive cavity pump (PCP)/Electric submersible pump (ESP) applications.
- *Standard programposi features* (page *51*) describes the control locations and operation modes as well as the program features that are not specific to PCP/ESP applications.
- *Default control connections* (page *95*) presents the default connection diagram of the PCP/ESP control application.
- *Parameters* (page *101*) describes the parameters of the drive.
- *Additional parameter data* (page *361*) contains further information on the parameters.
- *Fault tracing* (page *405*) lists the warning and fault messages with possible causes and remedies.
- *Fieldbus control through the embedded fieldbus interface (EFB)* (page *437*) describes the communication to and from a fieldbus network using the embedded fieldbus interface of the drive.
- *Fieldbus control through a fieldbus adapter* (page *461*) describes the communication to and from a fieldbus network using an optional fieldbus adapter module.
- *Control chain diagrams* (page *475*) shows the parameter structure within the drive.
- *Appendix: ESP with step-up transformer and sine filter* (page *487*) provides an overview of ESP with step-up transformer and sine filter.

Related documents

A list of related manuals is printed on the inside of the front cover.

Terms and abbreviations

Term/abbreviation	Definition
AC 800M	Type of programmable controller manufactured by ABB.
ACS-AP-I	Type of control panel used with ACS880 drives
AI	Analog input; interface for analog input signals
AO	Analog output; interface for analog output signals
BCU	Type of control unit used in ACS880 drives, primarily those with parallel-connected inverter or supply modules.
DC link	DC circuit between rectifier and inverter
DI	Digital input; interface for digital input signals
DIO	Digital input/output; interface that can be used as a digital input or output
DO	Digital output; interface for digital output signals
Drive	Frequency converter for controlling AC motors. The drive consists of a rectifier and an inverter connected together by the DC link. In drives up to approximately 500 kW, these are integrated into a single module (drive module). Larger drives typically consist of separate supply and inverter units. The ACS880 PCP/ESP control program is used to control the inverter part of the drive.
DriveBus	A communication link used by, for example, ABB controllers. ACS880 drives can be connected to the DriveBus link of the controller.
DTC	Direct torque control. See page *57*.
EFB	Embedded fieldbus
ESP	Electric submersible pump. See also *Electric submersible pump (ESP)* on page *33*.
FBA	Fieldbus adapter
FEN-01	Optional TTL encoder interface module
FEN-11	Optional absolute encoder interface module
FEN-21	Optional resolver interface module
FEN-31	Optional HTL encoder interface module
FEX-01	Optional temperature measurement module for potentially explosive atmospheres. Not released for sales at the time of publication.
FIO-01	Optional digital I/O extension module
FIO-11	Optional analog I/O extension module
FCAN-01	Optional CANopen adapter
FCNA-01	Optional ControlNet adapter
FDNA-01	Optional DeviceNet adapter
FECA-01	Optional EtherCAT® adapter
FENA-11	Optional Ethernet/IP, Modbus/TCP and PROFINET IO adapter
FENA-21	Optional dual-port Ethernet/IP, Modbus/TCP and PROFINET IO adapter
FEX-01	Optional temperature measurement module for potentially explosive atmospheres. Not released for sales at the time of publication.
FEPL-02	Optional POWERLINK adapter
FPBA-01	Optional PROFIBUS DP adapter
FPTC-01	Optional temperature measurement module. Not released for sales at the time of publication.
FSCA-01	Optional Modbus/RTU adapter

Term/abbreviation	Definition
FSO-xx	Optional safety functions module
HTL	High-threshold logic
IGBT	Insulated gate bipolar transistor; a voltage-controlled semiconductor type widely used in inverters due to their easy controllability and high switching frequency
I/O	Input/Output
ID run	Motor identification run. During the identification run, the drive will identify the characteristics of the motor for optimum motor control.
LSB	Least significant bit
LSW	Least significant word
ModuleBus	A communication link used by, for example, ABB controllers. ACS880 drives can be connected to the optical ModuleBus link of the controller.
MSB	Most significant bit
MSW	Most significant word
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 Ethernet adapter module User's manual* (3AUA0000093568 [English]).
Parameter	User-adjustable operation instruction to the drive, or signal measured or calculated by the drive
PCP	Progressive cavity pump. See also *Progressive cavity pump (PCP)* on page 32.
PID controller	Proportional–integral–derivative controller. Drive speed control is based on PID algorithm.
PLC	Programmable logic controller
Power unit	Contains the power electronics and connections of the drive. The drive control unit is connected to the power unit.
Prpm	Pump rpm, units for pump speed.
PTC	Positive temperature coefficient
RFG	Ramp function generator.
RO	Relay output; interface for a digital output signal. Implemented with a relay.
SSI	Synchronous serial interface
STO	Safe torque off
TTL	Transistor-transistor logic
UPS	Uninterrupted power supply; power supply equipment with battery to maintain output voltage during power failure
ZCON	Type of control board used in ACS880 drives. The board is either integrated into the drive or fitted in a plastic housing. See *ZCU*.
ZCU	Type of control unit used in ACS880 drives that consists of a ZCON board built into a plastic housing. The control unit may be fitted onto the drive/inverter module, or installed separately.

2

Quick start-up guide for ACS880 drives

About this guide

This guide describes the basic start-up sequence of an ACS880 drive. Complete documentation of the drive firmware can be found in *Firmware manual* (see list of manuals on the inside of the front cover).

In this guide, the drive is set up using the start-up assistant on the ACS-AP-I control panel. The start-up assistant guides the user through the essential drive settings.

The start-up assistant is not available in the Drive composer PC tool as such, but the same settings (apart from those related to the control panel itself) can also be made through drive parameters using Drive composer. For more information, refer to *Drive composer Start-up and maintenance PC tool User's manual* (3AUA0000094606 [English]).

Before you start

Ensure that the drive has been mechanically and electrically installed as described in the appropriate *Quick installation guide* and/or *Hardware manual.*

The data presented on the rating plate of the motor is needed during the start-up.

Safety

WARNING! All electrical installation and maintenance work on the drive should be carried out by qualified electricians only.

Never work on the drive, the braking chopper circuit, the motor cable or the motor when power is applied to the drive. Always ensure by measuring that no voltage is actually present.

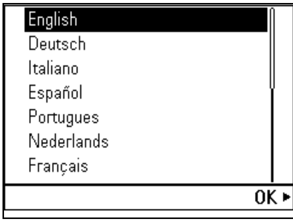
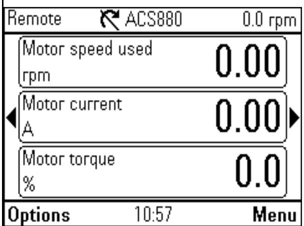
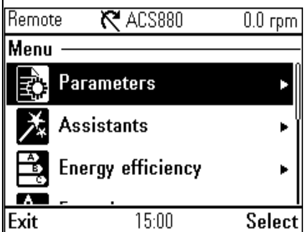
Start-up

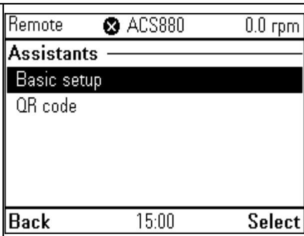
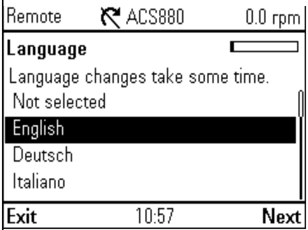
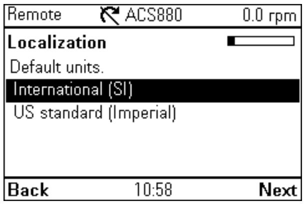
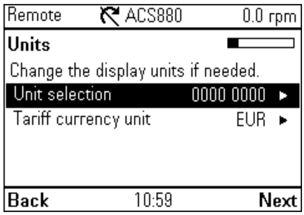
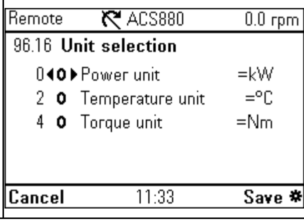
Safety

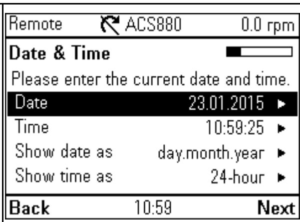
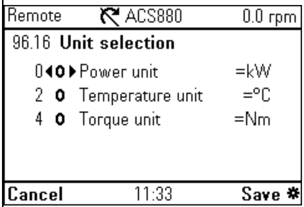
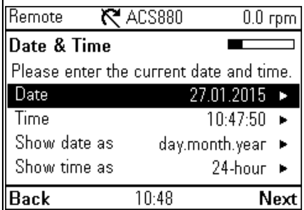
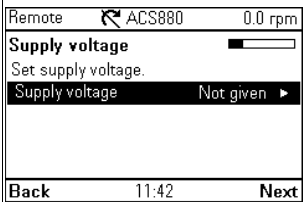
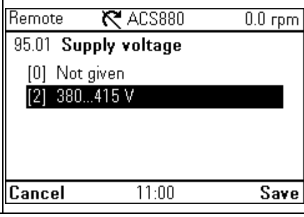
The start-up may only be carried out by a qualified electrician.
The safety instructions must be followed during the start-up procedure. See the safety instructions on the first pages of the appropriate *Hardware manual*.

☐	Check the installation. See the installation checklist in the appropriate *Hardware manual*.	
☐	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.	

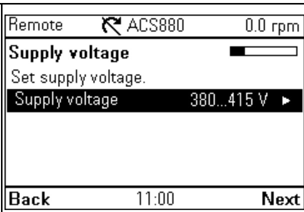
1 – Power-up, language, date and time settings

☐	Power up the drive. The language selection menu appears.	
☐	Wait until the loading finishes and the **Home** view appears. **Note:** During the start-up, it is normal that warning messages are displayed either in the top or main pane of the display. The messages can be ignored at this point. To hide any warnings displayed in the main pane, press (**Hide**). The two commands at the bottom of the display (in this case, **Options** and **Menu**), show the functions of the two softkeys and located below the display. The commands assigned to the softkeys vary depending on the context.	
☐	In the **Home** view, press (**Menu**). The main **Menu** appears.	

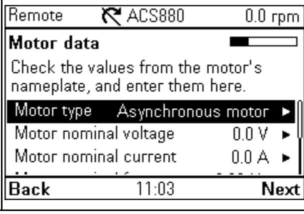
<table>
<tr>
<td>☐</td>
<td>Highlight Assistants on the menu using and and press (Select).
A listing of available assistants appears.</td>
<td>
</td>
</tr>
<tr>
<td>☐</td>
<td>Highlight Basic setup on the menu using and and press (Select).
The first setting of the assistant appears.
At any point, use to return to the previous setting (and ultimately cancel the assistant).
During the assistant, a progress bar shows how much of the assistant has been completed.</td>
<td>
</td>
</tr>
<tr>
<td>☐</td>
<td>Highlight the desired language on the list using and and then press (Next).
The default units settings appear.</td>
<td>
</td>
</tr>
<tr>
<td>☐</td>
<td>Highlight the desired unit on the list using and and then press (Next).
The Units settings appear.</td>
<td>
</td>
</tr>
<tr>
<td>☐</td>
<td>To change any of the unit settings, highlight it on the list using and and then press .
As an example, the changing of unit is shown on the right.</td>
<td>
</td>
</tr>
</table>

☐	Highlight the desired unit on the list using and and then press (**Next**). The date and time settings appear.	
☐	To change any of the settings, highlight it on the list using and and then press . As an example, the adjustment of date is shown on the right.	
☐	To set the correct date: • Use and to move the cursor left and right. • Use and to change the value. • Press (**Save**) to accept the new date and return to the date and time settings.	
☐	Make the necessary changes in the other date and time settings and press (**Next**). The screen for selecting the supply voltage appears.	
2 – Supply voltage and motor data settings		
☐	To define the supply voltage, press . The adjustment screen for parameter 95.01 appears. **Note:** The list of selections available in this parameter depends on the drive hardware.	

☐ Highlight the correct setting on the list and press (**Save**) to return to the previous screen.



☐ Press (**Next**).
The motor data screen appears.



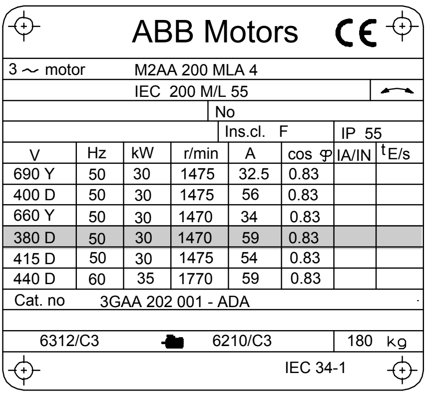
☐ Use to enter the adjustment screen for each motor value.
Notes:

- Enter the values exactly as shown on the motor nameplate (examples shown below).
- With permanent magnet motors, the nominal voltage is the BackEMF voltage at nominal speed. If the voltage is given in volt/rpm (eg. 60 V per 1000 rpm), the voltage at a nominal speed of 3000 rpm is 3 × 60 V = 180 V. Note that nominal voltage is not the same as equivalent DC motor voltage (EDCM) given by some manufacturers. The nominal voltage can be calculated by dividing the EDCM voltage by 1.7 (or square root of 3).
- With permanent magnet motors, if the nominal frequency is not shown on the nameplate, it can be calculated using the following formula:

  $f = n \times p / 60$

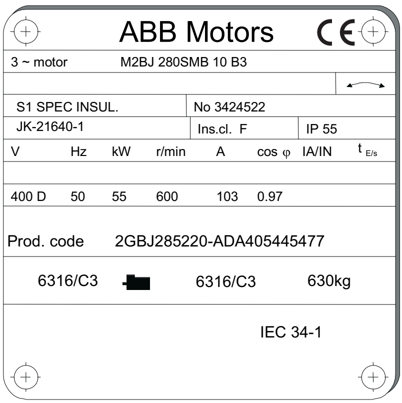
  where n = nominal motor speed, p = number of pole pairs.
- If the nominal power is not known, leave the setting at 0, and specify nominal torque in the advanced motor settings screen (the next stage).

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



V	Hz	kW	r/min	A	cos φ	IA/IN	$t_{E/s}$
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		

Example of a nameplate of a permanent magnet motor:

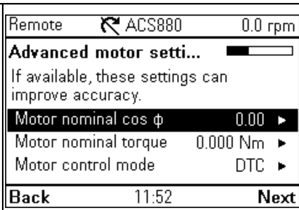


V	Hz	kW	r/min	A	cos φ	IA/IN	$t_{E/s}$
400 D	50	55	600	103	0.97		

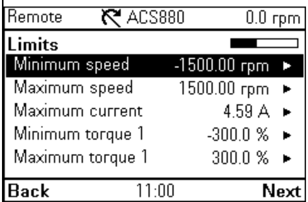
☐ After setting the values, press (**Next**).
The advanced motor settings screen appears. These values are not obligatory, but improve the accuracy of motor control if set correctly.

Notes:

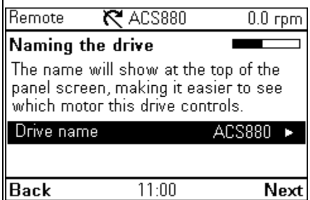
- The cos phi value is especially useful with asynchronous motors that cannot be de-coupled from the machinery for the identification run (see further below).
- Enter the nominal torque only if the nominal power is not known and could not be specified in the previous screen.
- The DTC motor control mode is suitable for most cases. Scalar mode is recommended if
  - the nominal current of the motor is less than 1/6 of the nominal current of the drive,
  - the drive is used for test purposes with no motor connected, or
  - the drive controls multiple motors and the number of motors connected is variable.



☐ After setting the values, press (**Next**).
The limit settings screen appears.
Check the limits, and adjust if necessary.

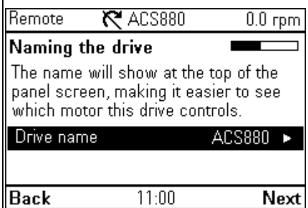


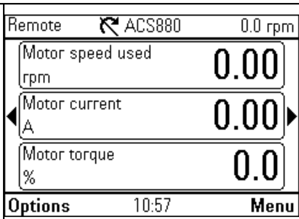
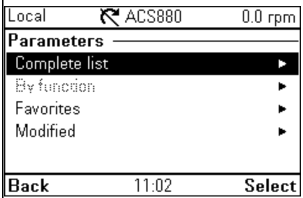
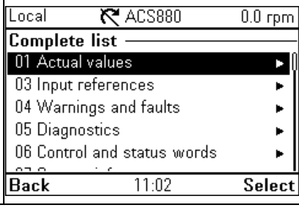
☐ After setting the limits, press (**Next**).
The drive name screen appears.



☐ To rename the drive, press ▶. (To skip, press (**Next**).)
In the drive name screen,

- Use ◀ and ▶ to move the cursor left and right. The maximum length of the drive name is 15 characters.
- Use ▲ and ▼ to select a character.
  - When the character ◀▶ is highlighted, you can switch between character sets (lowercase, uppercase, numerals, special characters) using ◀ and ▶. Press ▲ and ▼ to apply selection.
- Press (**Save**) to accept the new name.



☐	Switch to local control to ensure that external control is disabled by pressing the Loc/Rem key. Local control is indicated by the text “Local” in the top pane.	
☐	Highlight **Parameters** and press (**Select**).	
☐	Highlight **Complete list** using ▲ and ▼ and press (**Select**). A listing of parameter groups is displayed.	
Make the following parameter settings in the same manner.		
☐	**99.13 Identification run request** This parameter selects the mode of the identification run (DTC motor control mode only). ⚠ **WARNING!** The identification run modes marked thus * will run the motor in the forward direction (see below for details). Make sure it is safe to run the motor before choosing any of these modes. ***Normal** mode should be selected whenever possible. The driven machinery must be de-coupled from the motor if • the load torque is higher than 20%, or • the machinery is not able to withstand the nominal torque transient during the identification run. *__Reduced__ mode should be selected if the mechanical losses are higher than 20%, ie. the load cannot be de-coupled, or full flux is required to keep the motor brake open (eg. with conical motors). The **Standstill** mode should be selected if neither the ***Normal** or ***Reduced** mode can be used. **Notes**: • This mode cannot be used with a permanent magnet motor if the load torque is higher than 20% of nominal. • Mechanical brake is not opened by the logic for the identification run.	
☐	Ensure that the Safe torque off and emergency stop circuits (if present) are closed.	
☐	Start the identification run by pressing the (Start) button.	A warning will indicate that the identification run is in progress.

3

PCP/ESP control start-up

Contents of this chapter

This chapter contains the start-up sequence of the PCP/ESP control program.

PCP/ESP control start-up

This section contains the following alternative control schemes for starting up the drive with the control program:

- High pressure switch set up
- Optional speed reduction at maximum torque

In addition, this section describes how to configure the following program features:

The checklist for PCP/ESP control start up is given below:

	I/O wiring	
☐	Connect the digital and analog I/Os according to the wiring diagram shown in page *96*.	
	I/O wiring parameter settings	
☐	Select the source of the start for external control location 1 (EXT1).	*20.01 Ext1 commands*
☐	Select the level-triggered signal type.	*20.02 Ext1 start trigger type*
☐	Select the start signal. By default, the drive starts/stops according to the status of digital input DI1 (0 = Stop, 1 = Start).	*20.03 Ext1 in1 source*

☐	Select the way motor is stopped when the run enable signal switches off.	*20.11 Run enable stop mode*
☐	Select the source of the external run enable signal. If the run enable signal is switched off, the drive will not start.	*20.12 Run enable 1 source*
☐	Select the way motor is stopped when an emergency stop command is received.	*21.04 Emergency stop mode*
☐	Select the source of the emergency stop signal.	*21.05 Emergency stop source*
☐	Select 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.	*31.11 Fault reset selection*
Basic pump set up		
	The following information is required to complete the set up: $$\text{Gear reduction ratio} = \frac{\text{pump sheave diameter} * \text{gear box ratio}}{\text{motor sheave diameter}}$$ Maximum rod torque in lbft or Nm.	
☐	Enable the pump functions.	*74.01 Pump enable*
☐	Define the transmission reduction ratio. **Note**: Not applicable for ESP.	*74.03 Gear reduction ratio*
☐	Select the reference type between motor speed or pump speed. **Note**: Not applicable for ESP.	*74.04 Speed ref type*
☐	Select the source for the speed reference. **Note**: If parameter *74.05 Speed ref source* is selected as *AI1 scaled*, set the minimum and maximum values of AI1.	*74.05 Speed ref source* *12.19 AI1 scaled at AI1 min* *12.20 AI1 scaled at AI1 max*
☐	Set the speed reference if parameter *74.05 Speed ref source* is selected as *Constant ref* (Prpm, rpm or Hz).	*74.06 Speed ref*

☐	Define the minimum allowed rod/pump speed. ⚠ **Warning!** This value must not be higher than *74.06 Speed ref* (Prpm, rpm or Hz).	*74.07 Minimum rod speed*
☐	Define the maximum allowed rod/pump speed. ⚠ **Warning!** This value must not be lower than *74.07 Minimum rod speed* (Prpm, rpm or Hz).	*74.08 Maximum rod speed*
☐	Define maximum allowed torque reference (Nm or lbft).	*74.19 Maximum rod torq ref*
☐	Define the acceleration time for rod/pump: from zero to *74.08 Maximum rod speed* (s).	*74.10 Rod acc time*
☐	Define the deceleration time for rod/pump: from *74.08 Maximum rod speed* to zero speed.	*74.11 Rod dec time*
☐	Activate Backspin function to control the reverse rotation of pump caused by back flow.	*80.01 Backspin enable*
☐	Define the reference speed/frequency limit for the Backspin function (Prpm, rpm or Hz). ⚠ **Warning!** If *80.02 Backspin ref limit* is set to 0, the *Pump backspin control* function is not effective.	*80.02 Backspin ref limit*
☐	Define the acceleration time for the Backspin function: from zero to *80.02 Backspin ref limit* (s).	*80.03 Backspin acc time*
☐	Define a torque limit for the Backspin function. When the actual torque is below the limit, Backspin function is complete and it gives coast to stop command to the drive (Nm or lbft).	*80.04 Backspin stop torque*
☐	Set the speed reference regulation range for the Backspin function. **Note**: Default = 0% is recommended because it is the safe range for backspin operation to avoid rod damages and drive overvoltage.	*80.05 Backspin speed range trim*
Check pump rotation		

	Set a small speed reference. Start the drive. The motor rotates at a slow rate. Check that the rotation is correct for the pump. If the rotation is not correct, power down the drive and swap two of the motor cables (V2 and W2) at the drive terminal block. Re-apply power and check the rotation again.	
	Set back speed reference as required.	
High pressure switch set up		
	If high pressure switch is present, wire the switch between the +24 V (XD24:2 or XD24:4) on I/O control board and required DI (XDI:1-6).	
☐	Enable pump pressure protection function.	*76.01 Pressure protection function*
☐	Define the latching type for pump pressure protection.	*76.02 Pressure protection latching*
☐	Enable the source of digital feedback for high pressure protection.	*76.03 Digital feedback source enable*
☐	Select the source of digital feedback for high pressure protection.	*76.04 Digital feedback source*
Optional speed reduction at maximum torque		
	If it is desired to reduce the speed at maximum torque in a situation as the sand entering into the pump, the following parameters need to be set. If pump is unable to overcome the high torque situation (the solids cannot pass through the pump), the parameters setting causes the drive to trip.	
☐	Select the display type to view the Rod torque limit for pump torque protection.	*77.01 Rod torq limit display*
☐	Enable the Rod torque 1 function for pump torque protection.	*77.02 Rod torq1 function*
☐	Select the Rod torque 1 limit type of the fault condition in *77.04 Rod torq1 limit*. **Note**: The warning *D204 Rod torque 1 limit* is displayed during the shutdown process.	*77.03 Rod torq1 limit type*
☐	Define the torque limit for Rod torque 1 function in engineering units (Nm, lbft or A).	*77.04 Rod torq1 limit*
☐	Define the speed limit for rod torque 1 functionality in engineering units (Prpm, rpm or Hz).	*77.05 Rod torq1 speed*

☐	Define the time period for confirming the high torque 1 condition(s).	*77.06 Rod torq1 delay time*

For more information on ESP with step-up transformer and sine filter, see *Appendix: ESP with step-up transformer and sine filter* (page *487*).

4

Using the control panel

Refer to *ACS-AP-x assistant control panels user's manual* (*3AUA0000085685* [English]).

5

PCP/ESP program features

Contents of this chapter

This chapter describes the functions within the control program that are specific to PCP/ESP applications, how to use them and how to program them to operate.

Overview of PCP/ESP control program

The Progressive cavity pumping (PCP)/ Electric submersible pumping (ESP) control program is a drive application program used in oil pump stations and other related areas that require pumping of viscous liquids. The control program includes functions for protection of the pump and optimization of production rates.

- **Protection** is provided by monitoring selectable input signals. The control program can shut down the pump during conditions that could harm the equipment.
- **Optimization** is performed through automatic pump speed adjustments based on control set points and limits.

The PCP application uses *Direct torque control (DTC)* with speed reference in rpm or Prpm. The ESP application uses scalar control with the speed reference in Hz.

The PCP/ESP control program also features an automatic backspin control feature that prevents the unit from uncontrolled reverse rotation caused by back flow of fluid.

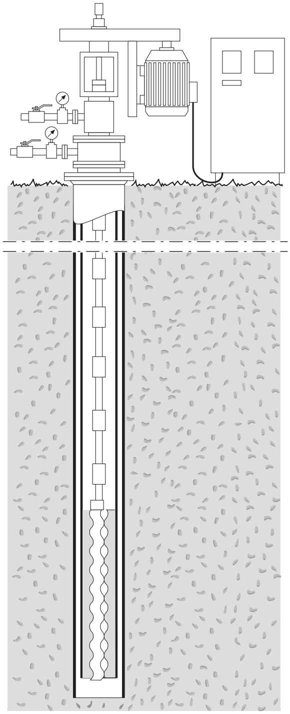
See *Pump backspin control* (page *47*).

Construction of PCP/ESP system

ABB industrial drive modules with the pump control program can be used to control the following pump types:

- *Progressive cavity pump (PCP)*
- *Electric submersible pump (ESP)*

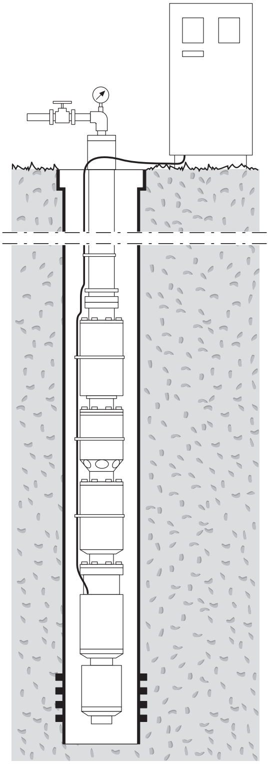
Progressive cavity pump (PCP)



The PCP system consists of a surface drive, a drive string and a down hole PC pump. The PC pump comprises of a single helical-shaped rotor that turns inside a double helical elastomer-lined stator. The stator is attached to the production tubing string and remains stationary during pumping.

In most cases the rotor is attached to a sucker rod string which is suspended and rotated by the surface drive.

Electric submersible pump (ESP)



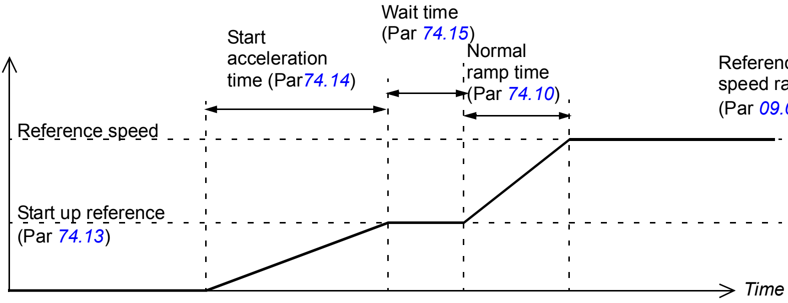
The ESP system incorporates an electric motor and centrifugal pump unit running on a production string. The system is connected back to the surface control mechanism and transformer unit through an electric power cable.

Pump starting speed

The pump starting speed function allows the user to define a starting speed and acceleration time to run the pump according to requirements. For example, a faster start up acceleration time can be used for cleaning purposes and slower acceleration time can be used for equipment protection. The user can enable this function using parameter *74.12 Starting speed enable*. The pump runs at starting speed in the starting speed acceleration time and then releases control to run the pump at reference speed in the normal acceleration time.

Timing diagram

At start, the pump starting speed function controls the pump to run in the start acceleration time. After a defined delay time is passed, the function releases control and the pumps shifts to normal acceleration time to reach the reference speed.



Settings

Parameters: *74.12 Starting speed enable*, *74.13 Starting speed*, *74.14 Starting speed acc time* and *74.15 Starting speed time delay*.

Signals: *09.06 Motor speed reference* and *09.14 Pump status word* (Bit 14)

Warnings: -

Faults: -

Pump level control

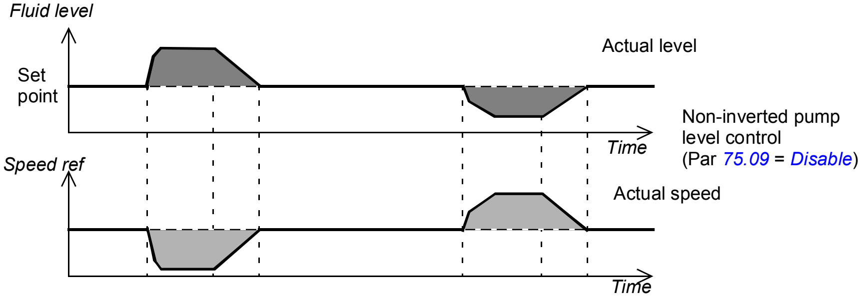
The pump level control is a fluid level PI regulator for maintaining fluid level at a certain set point. The pump speed is adjusted based on the requirements during the working process. The actual fluid level value comes through a dedicated input, that reads the signal from one or several sensors. The fluid level is maintained through continuous speed adjustment in PI regulator. The user can enable this function in the parameter *75.01 Level control enable*.

Note: The pump level control provides fluid level data even if the level control is disabled. It is also possible to check the fluid level through pressure data, since the values are in direct relation.

Timing diagram

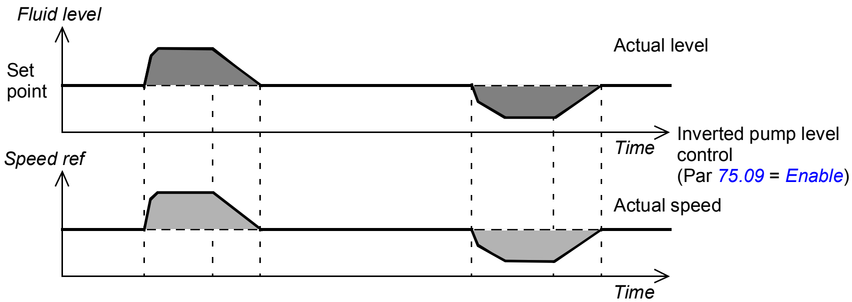
Non-inverted level control

When feedback from fluid level source is higher than fluid level set point, the PI regulator output decreases, causing the speed reference to decrease. The grey shaded areas indicate fluid level maintained through continuous PI adjustment to speed.



Inverted level control

When feedback from fluid level source is higher than fluid level set point, the PI regulator output increases, causing the speed reference to increase. The grey shaded areas indicate fluid level maintained through continuous PI adjustment to speed.



Settings

Parameters: *75.01* to *75.09*.

Signals: *09.08 Fluid level*

Warnings: -

Faults: -

Sleep and wake up function

The sleep and wake up function reduces energy consumption by running the pump only when it is required. If start command is given then sleep function constantly monitor *09.15 Sleep feedback value* and generates start and stop commands according to sleep and wake up levels. When condition for sleep mode is triggered (see timing diagram), then sleep function generates a stop command for the drive.

The pump goes to backspin mode, if backspin function *80.01 Backspin enable* is enabled. See *Pump backspin control*, *47*). After this, the drive goes to sleep mode. If condition to wake up is triggered (see timing diagrams) then wake up function generates a start command for the drive. Sleep time is limited by parameter *75.20 Maximum sleep time*. Wake up function generates start command if parameter *09.16 Sleep time* exceeds maximum sleep time. To skip this function, set value of parameter *75.20 Maximum sleep time* to 0.

Note: The sleep command is deactivated by the wake up command. The wake up level has higher priority than the sleep level.

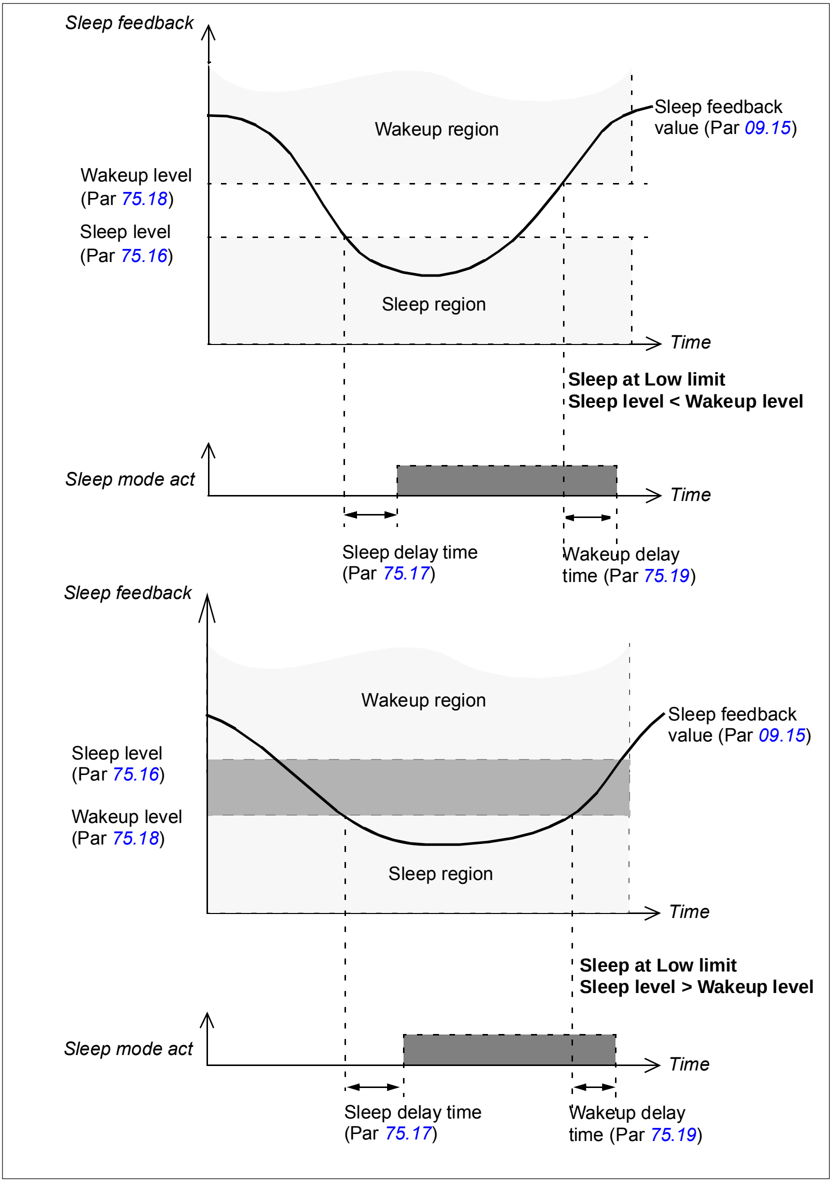
The user can enable this function in the parameter *75.10 Sleep control enable*. The user can also define the sleep level and delay time parameters according to process requirements. The user also defines the sleep limit type (parameter *75.12*): whether sleep starts after *09.15 Sleep feedback value* goes below the sleep limit (Low limit) or exceeds it (High limit).

The timing diagrams below illustrate the operation of the function:

- with the limit type selection as Low and High
- when the sleep limit is lower than the wake-up limit and vice versa.

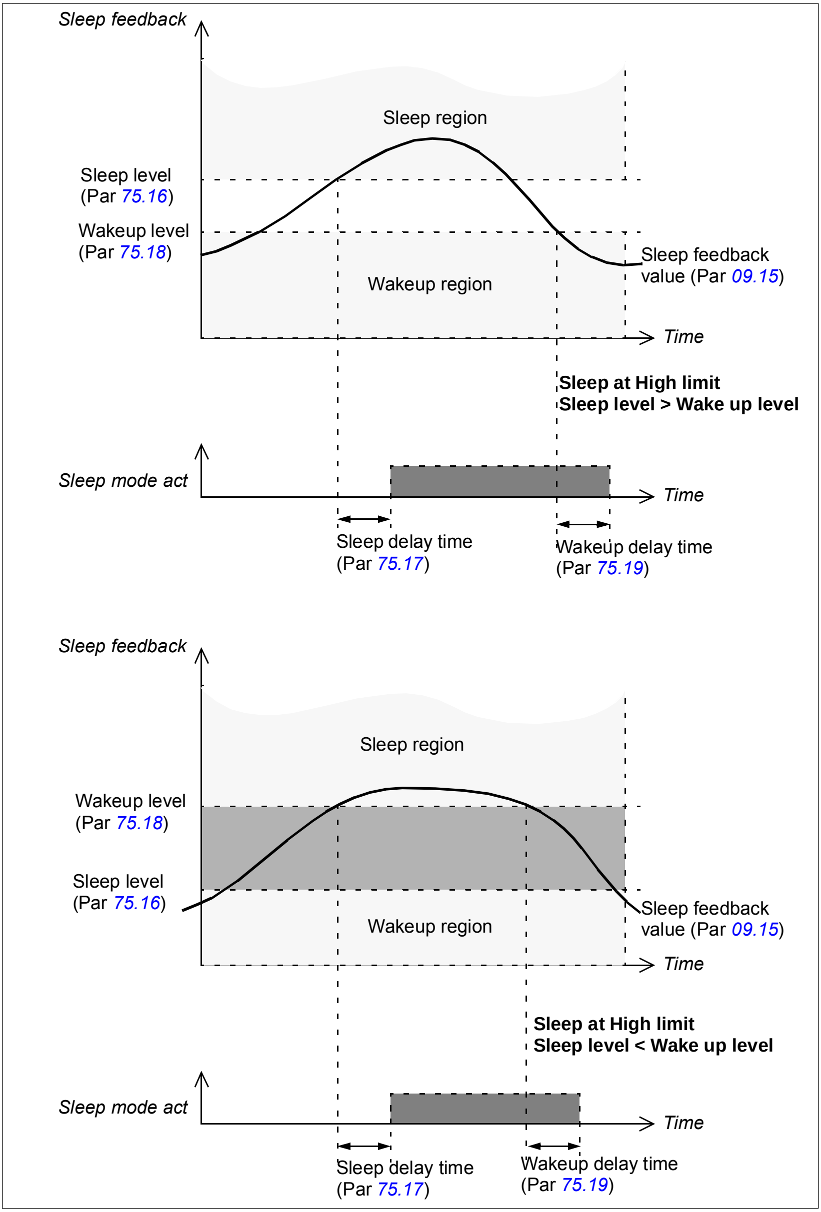
Timing diagram 1

This diagram depicts the sleep region for sleep limit type as Low. In this limit type, sleep starts only after the sleep feedback value is below sleep level and wake up level.The sleep function is activated when the sleep feedback value reaches sleep level (see diagram, *Sleep level* < *Wakeup level*). The drive shifts to sleep mode after sleep delay time is passed. The sleep function is active until the sleep feedback value reaches the wakeup level (see diagram, *Sleep level* > *Wakeup level*). The wakeup function is activated when the sleep feedback value reaches wakeup level. The drive shifts to wakeup mode after wakeup delay time is passed.


Sleep feedback
Wakeup region
Sleep feedback value (Par 09.15)
Wakeup level (Par 75.18)
Sleep level (Par 75.16)
Sleep region
Time
Sleep at Low limit
Sleep level < Wakeup level
Sleep mode act
Time
Sleep delay time (Par 75.17)
Wakeup delay time (Par 75.19)
Sleep feedback
Wakeup region
Sleep feedback value (Par 09.15)
Sleep level (Par 75.16)
Wakeup level (Par 75.18)
Sleep region
Time
Sleep at Low limit
Sleep level > Wakeup level
Sleep mode act
Time
Sleep delay time (Par 75.17)
Wakeup delay time (Par 75.19)

Timing diagram 2

This diagram depicts the sleep region for sleep limit type as High. In this limit type, sleep starts only after the sleep feedback value is more than sleep level and wake up level. The sleep function is activated when the sleep feedback value reaches sleep level (see diagram, *Sleep level* > *Wakeup level*). The drive shifts to sleep mode after sleep delay time is passed. The sleep function is active until the sleep feedback value reaches wakeup level (see diagram, *Sleep level* < *Wakeup level*). The wakeup function is activated when the sleep feedback value reaches the wakeup level. The drive shifts to wakeup mode after the wakeup delay time is passed.



Sleep feedback
Sleep region
Sleep level
(Par 75.16)
Wakeup level
(Par 75.18)
Wakeup region
Sleep feedback
value (Par 09.15)
Time
Sleep at High limit
Sleep level > Wake up level
Sleep mode act
Time
Sleep delay time
(Par 75.17)
Wakeup delay time
(Par 75.19)
Sleep feedback
Sleep region
Wakeup level
(Par 75.18)
Sleep level
(Par 75.16)
Wakeup region
Sleep feedback
value (Par 09.15)
Time
Sleep at High limit
Sleep level < Wake up level
Sleep mode act
Time
Sleep delay time
(Par 75.17)
Wakeup delay time
(Par 75.19)

Settings

Parameters: *75.10* to *75.20*.

Signals: *09.14 Pump status word* (Bit 10), *09.15 Sleep feedback value* and *09.16 Sleep time*.

Warnings: *D207 Sleep mode*

Faults: -

Pump pressure protection

The pump pressure protection function protects the pump from high pressure.The user can enable this function in the parameter *76.01 Pressure protection function*. Pressure is monitored through analog or digital signals. In high pressure conditions, the pump pressure protection generates a stop command for the drive. The pump goes to backspin mode, if backspin function (*80.01*) is enabled.

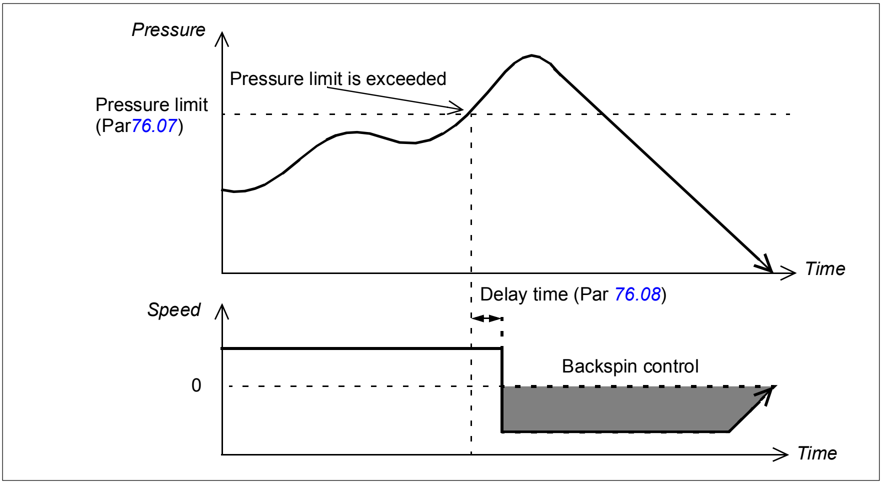
As soon as the safe condition is stabilized, the drive ramps up again or remains stopped according to the selected option: Non latching type (pump starts automatically after clearing the high pressure condition), Latching type (pump trips instead of auto restarting), Latch zero speed (enables Non latching type if speed is below zero or enables Latching type if speed is above zero).

The user can also select the notification for high pump pressure reaction: Warning, Fault or a selection between them depending on the pump speed.

Note: The pump pressure protection function provides pressure data even when pressure protection is disabled.

Timing diagram

The pump pressure function is activated when the measured pressure reaches the pressure limit. The pump goes to backspin mode after the delay time is passed and thereafter stops.



Settings

Parameter group: *76 Pump pressure protection* on page *310*.

Signals: *09.09 Pressure* and *09.14 Pump status word* (Bits 3, 4 and 5)

Warnings: *D201 Pressure*

Faults: *D101 Pressure fault*

Pump torque protection

The pump torque protection function protects the pump from overload or under load condition and triggers warnings and faults. This function is activated when the measured rod torque exceeds the defined torque limit and when the measured speed exceeds the defined speed limit. The rod torque protection is based on the measurement of rod torque value. This function also enables pump protection with motor current. The user can select this option in parameter *77.01 Rod torq limit display*.

- If *Torque* is selected, there is rod torque protection.
- If *Current* is selected, there is motor current protection.

The rod torque function operates in two different modes: Rod torque 1 and Rod torque 2.

- In Rod torque 1, the function maintains torque constant and controls speed.
- In Rod torque 2, the function maintains speed constant and controls torque.

The user can select the Rod torque limit type as Low or High, based on the rod torque value at lower or higher side of the predefined limit.

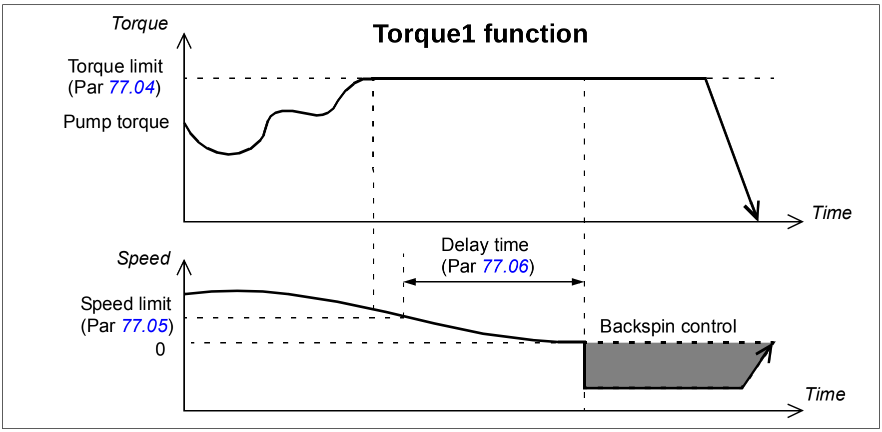
- For limit type low, a hysteresis (of Rod torque * 5%) is present in the comparator meaning, once the condition is set, it latches until the Rod torque increases to a value of [Rod torq1 limit + (Rod torque * 0.05)].
- For limit type high, a hysteresis (of Rod torque * 5%) is present in the comparator meaning, once the condition is set, it latches until the Rod torque decreases to a value of [Rod torq1 limit - (Rod torque * 0.05)].

Rod torque 1 function

This function monitors the actual torque and speed values. If the torque and speed values exceed the defined Rod torque1 limits, the drive stops the motor and notifies a warning (*D204*). The user can enable this function in the parameter *77.02 Rod torq1 function*. For under load protection, user can define the limit as low or high in parameter *77.03 Rod torq1 limit type*.

Timing diagram

The Rod torque 1 function is activated after the pump torque signal reaches the defined torque and speed limit. The pump torque is maintained constant, while the pump speed drops to zero in the defined delay time. After the delay time is passed, the drive shifts to backspin control.



Settings

Parameters: *77.02 Rod torq1 function*, *77.03 Rod torq1 limit type*, *77.04 Rod torq1 limit*, *77.05 Rod torq1 speed* and *77.06 Rod torq1 delay time*.

Signals: *09.01 Rod torque*, *09.02 Maximum rod torque*, *09.05 Rod speed* and *09.14 Pump status word* (Bit 7).

Warnings: *D204 Rod torque 1 limit*

Faults: *D103 Rod torque 1 limit fault*

Rod torque 2 function

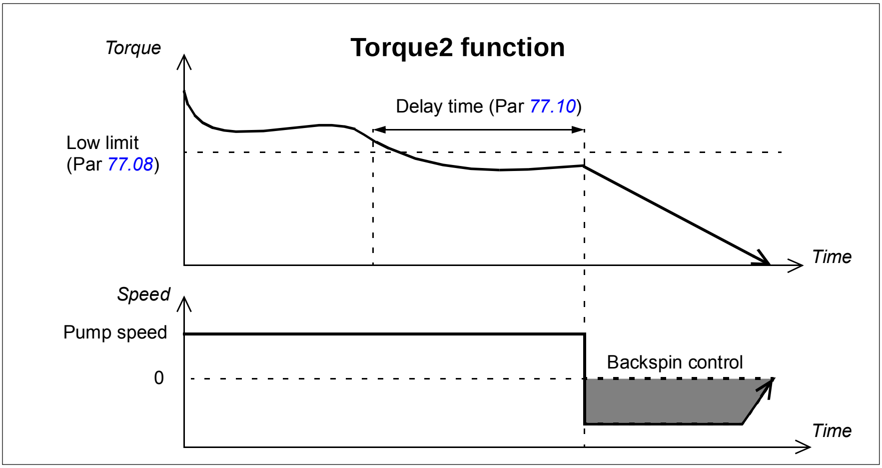
This function monitors the actual torque and speed values. If the torque and speed values exceed the defined Rod torque2 limits, the function adds an additional speed reference to maintain constant speed before the drive shifts to backspin control. The user can enable this function in the parameter *77.07 Rod torq2 function*. For under load protection, user can define the limit as low or high in parameter *77.08 Rod torq2 limit type*.

Low limit: The control program triggers the Torque pressure protection function when measured torque and speed are less than or equal to defined Torque2 limits for a period of time greater than the Rod torque2 delay time.

High limit: The control program triggers the Torque pressure protection function when measured torque and speed are greater than or equal to defined Torque2 limits for a period of time greater than Rod torque2 delay time.

Timing diagram

This timing diagram depicts the Rod torque2 function with limit type as Low. The Rod torque 2 function is activated after the pump torque signal reaches the defined torque and speed limit. The pump speed is maintained constant, while the pump torque is lowered below the limit in the defined delay time. After the delay time is passed, the drive shifts to backspin control.



Settings

Parameters, *77.07 Rod torq2 function*, *77.08 Rod torq2 limit type*, *77.09 Rod torq2 limit*, *77.10 Rod torq2 delay time*, *77.11 Rod torq2 additive speed ref*, *77.12 Rod torq2 speed delay time*, *77.13 Rod torq2 limit counter* and *77.14 Rod torq2 time window*.

Signals: *09.01 Rod torque*, *09.02 Maximum rod torque*, *09.05 Rod speed* and *09.14 Pump status word* (Bits 8 and 15).

Warnings: *D205 Rod torque 2 speed* and *D206 Rod torque 2 limit*.

Faults: *D104 Rod torque 2 limit fault*

Pump underload protection

This function supervises the load condition of the pump. For example, fluid with gas, lack of fluid in the well or a broken rod. User can define the monitoring curve for the normal load if the function is speed (load points). If the load goes below the curve, the function detects an underload condition.

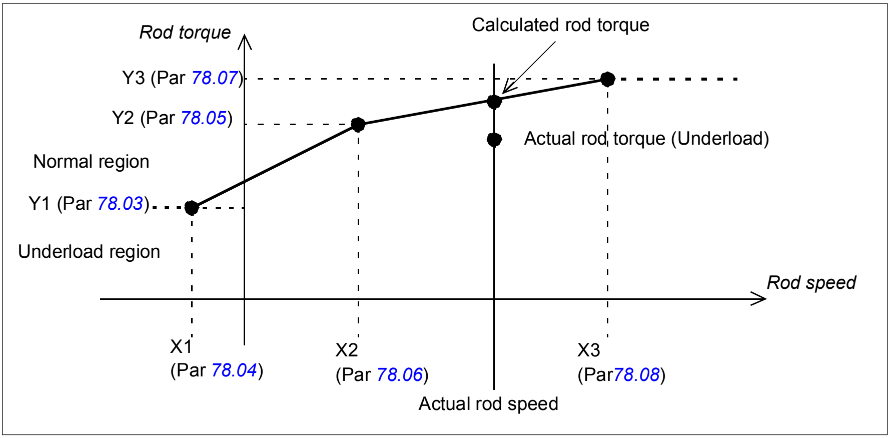
The pump underload protection is based on the measurement of rod torque value. This function also enables pump protection with motor current. The user can select this option in parameter *78.01 Underload limit display*.

- If *Torque* is selected, there is rod torque protection.
- If *Current* is selected, there is motor current protection.

User can also select the reaction for the pump underload condition (*78.02*): Warning, Fault or no reaction. This function is based on linear interpolation method.

Timing diagram

The points (X1, Y1), (X2, Y2) and (X3, Y3) on the user defined monitoring curve are taken as reference to calculate the underload condition. The actual rod torque is compared with the interpolated points on the curve. If the value lies below the curve, it is interpreted as underload condition.The pump underload protection function is active after the delay time is passed.



Settings

Parameter group: *78 Pump underload protection*

Signals: *09.01 Rod torque*, *09.05 Rod speed* and *09.14 Pump status word* (Bit 6).

Warnings: *D202 Underload*

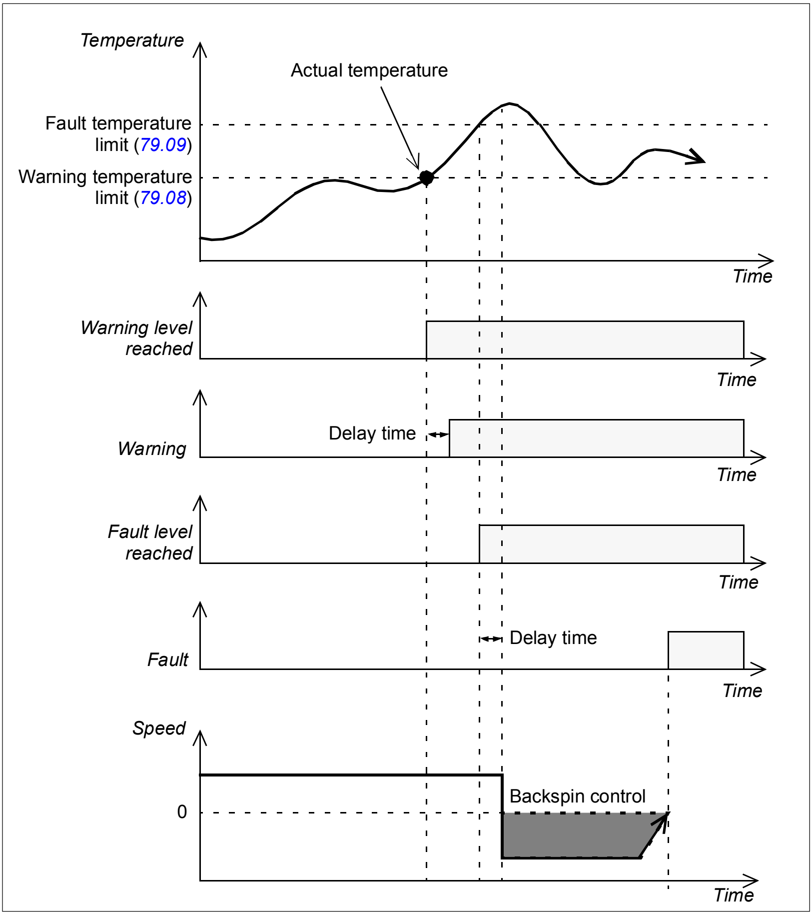
Faults: *D102 Underload fault*

Pump temperature protection

This function protects the pump from overheating. User can select the reaction on overheating condition: Warning, Fault or no reaction. The temperature feedback comes through analog input (PT-100) or digital input (Klixon), or both the sources can be connected and used simultaneously. The pump temperature protection function provides temperature data through analog sensor even if temperature protection is disabled.

Timing diagram

The measured temperature is compared against the defined fault and warning temperature limits. When the measured value reaches the warning limit, the temperature protection function is activated. After the delay time in 5 seconds, a warning message is triggered. The temperature protection function is still active. After the fault limit is reached, temperature monitoring continues. After the delay time in 5 seconds, the pump temperature protection generates a stop command for the drive. The pump goes to backspin mode, if backspin function (*80.01*) is enabled.



Settings

Parameter group: *79 Pump temperature protection* on page *315*

Signals: *09.10 Measured temperature* and *09.14 Pump status word* (Bits 0, 1 and 2)

Warnings: *D200 Overtemperature*

Faults: *D100 Overtemperature fault*

Shutdown procedure

There are two ways to stop the drive: by coast stop or backspin control. If Backspin control is disabled, then the drive performs normal coast stop.

Pump backspin control

Pump backspin control protects the pump during shutdown process. Backspin control may be performed by two different function: backspin function and start delay function.

Backspin function eliminates the effect of uncontrollable rotation of the pump in opposite direction, that is caused by the back flow of fluid. Backspin function allows to keep this reverse rotation below the defined speed limit. This sequence can be performed with any stop command. User can enable this function using parameter *80.01 Backspin enable*.

When zero speed is reached, the drive begins ramping to the backspin speed reference with an acceleration time in parameter *80.03 Backspin acc time*. If the torque in the pump is driving the motor in the reverse direction, then the actual backspin speed is equal to the backspin speed reference. If torque in the pump is not driving the motor in reverse, the actual speed is not equal to backspin speed reference.

Backspin speed reference is based on actual torque.

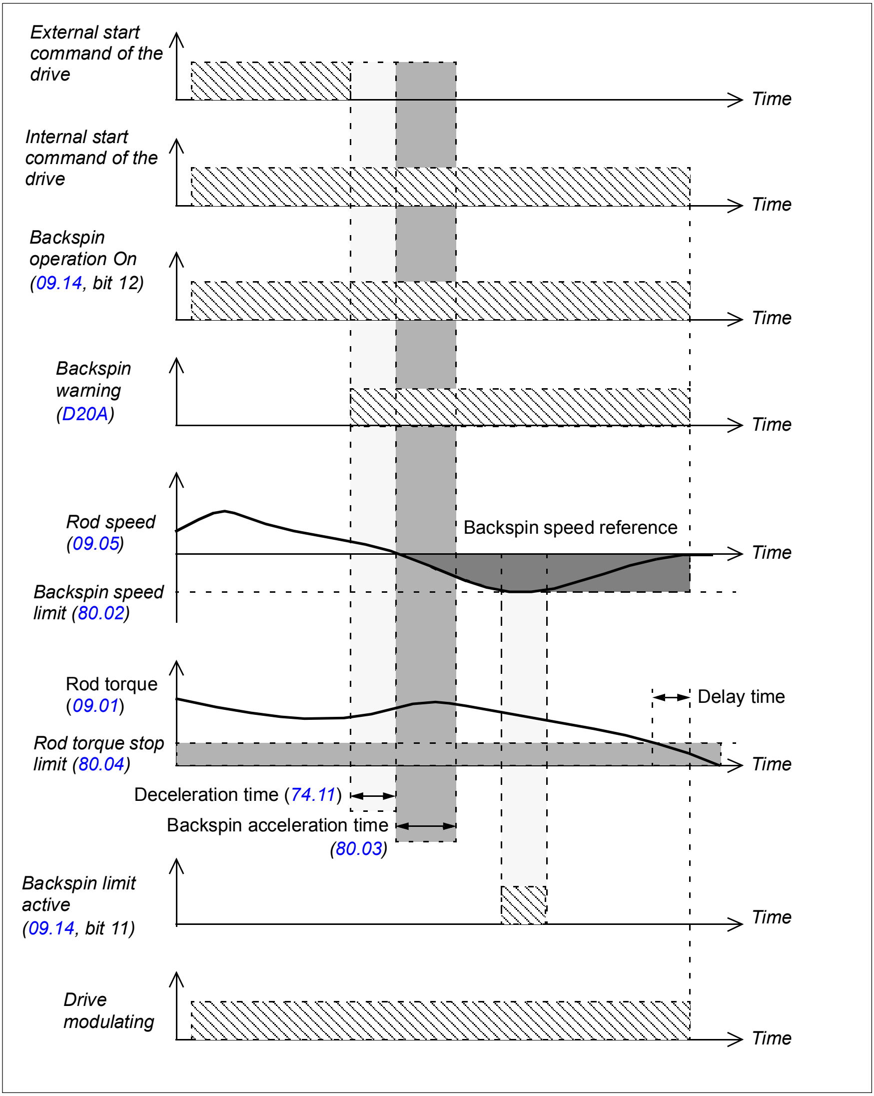
$$\text{Backspin Speed Ref} = \text{Backspin Limit} - \frac{\text{Actual Torque Filtered}}{\text{Max Torque}} * \text{Backspin Limit} * \text{Backspin Speed Range}$$

As torque decreases, backspin speed reference increases. If torque is constant, backspin speed range increases with the decrease in backspin speed reference.

The following procedure and time scheme describes the operation of backspin function:

1. The Drive receives an external stop command and starts to decelerate the pump down along the defined ramp (*74.11 Rod dec time*).
2. At zero speed, the fluid starts flowing back from the pipe. The function keeps the drive operational (delaying the internal stop command).
3. Backward flow accelerates the pump in reverse direction. The Backspin function keeps the acceleration rate under the acceleration level (*80.03 Backspin acc time*).
4. The Backspin function keeps the reverse speed under the Backspin speed limit (*80.05 Backspin speed range trim*) until the back flow starts running out and the torque starts decreasing.
5. When the actual torque goes below the limit (*80.04 Backspin stop torque*), the function stops and initiates the Coast to stop command to the drive.

Timing diagram



Settings

Parameters: *80.01 Backspin enable*, *80.02 Backspin ref limit*, *80.03 Backspin acc time*, *80.04 Backspin stop torque* and *80.05 Backspin speed range trim*.

Signals: *09.11 Backspin speed reference* and *09.13 Backspin status word* (bits 0, 1 and 2).

Warnings: *D208 Backspin limit* and *D209 Backspin active*

Faults: -

Start delay

Start delay function blocks any start command when stop command is given. User can enable this function using parameter *80.11 Start delay enable*. Pump will not able to make start during defined time period *80.12 Start delay time*. This delay time has to be equal or longer then time period needed to complete shutdown process.

Time remained to allow drive to start is indicating in actual signal *09.12 Start delay remain*.

If drive is stopped due to power failure and then after power supply is retained, the stopped time period will be deducted from start delay time. In case, if battery of ZCU board is empty, time will not be deducted from start delay time in case of power failure.

Settings

Parameters: *80.11 Start delay enable* and *80.12 Start delay time*.

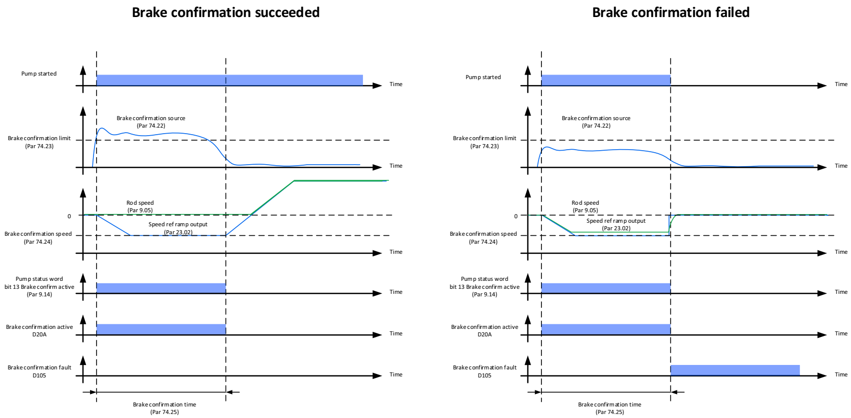
Signals: *09.12 Start delay remain*, *09.13 Backspin status word* (bits 10 and 11).

Warnings: *D20C Start delay active*.

Faults: -

Brake confirmation

The brake confirmation function is optional. This function controls the operation of the mechanical brake. If a pressure feedback is available from the mechanical brake then this function can be used to detect the failure of the brake before starting the pump. If the mechanical brake is defective, this function generates a fault and also forbids the start command.



Settings

Parameters: *74.21 Brake confirmation enable*, *74.22 Brake confirmation source*, *74.23 Brake confirmation limit*, *74.24 Brake confirmation speed* and *74.25 Brake confirmation time*.

Signals: *09.14 Pump status word* (Bit 13)

Warnings: *D20A Brake confirmation active*

Faults: *D105 Brake confirmation fault*

6

Standard programposi features

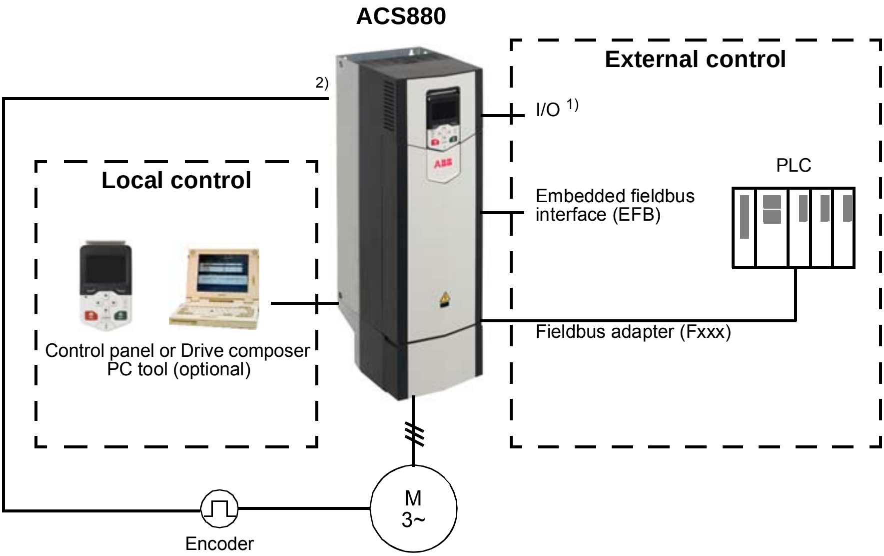
Contents of this chapter

This chapter describes the control locations and operating modes supported by the control program.

Local control vs. external control

The ACS880 has two main control locations.

- External control
- Internal control



1) Extra inputs/outputs can be added by installing optional I/O extension modules (FIO-xx) in drive slots.

2) Encoder or resolver interface module(s) (FEN-xx) installed in drive slots.

The control location is selected with the Loc/Rem key on the control panel or in the PC tool.

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 for local control and frequency mode is available when scalar motor control mode is used. See parameter *19.16 Local control mode* (page *179*).

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 *19.17 Local control disable* (page *179*).

Select the parameter *49.05 Communication loss action* (page *284*) and check 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

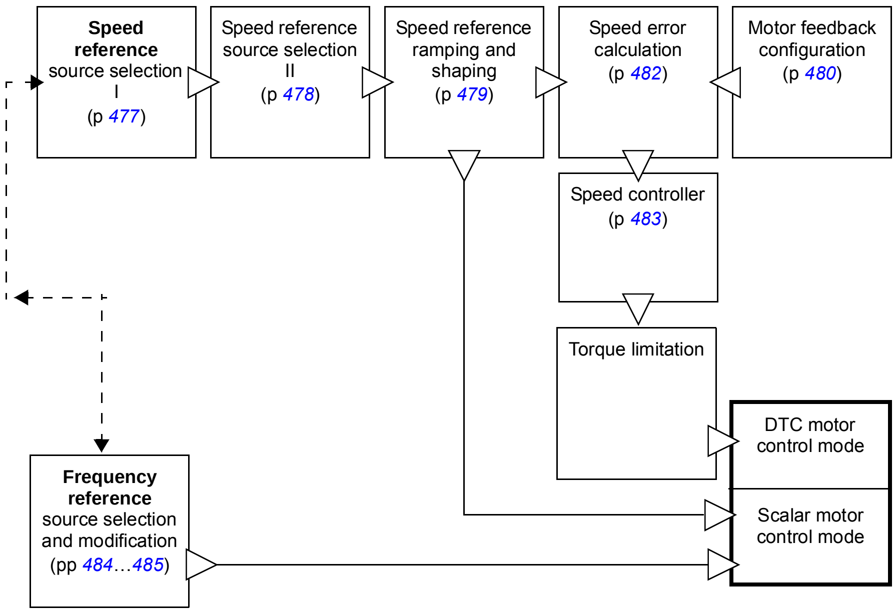
- I/O terminals (digital and analog inputs), or optional I/O extension modules
- embedded fieldbus interface or an optional fieldbus adapter module.

Two external control locations, EXT1 and EXT2 are available. The user can select the sources of start and stop commands separately for each location using parameters *20.01*...*20.10*. Select the operating mode separately for each location (in parameter group *19 Operation mode*), which enables quick switching between different operating modes. For example, speed control. Selection between EXT1 and EXT2 is done through any binary source such as a digital input or fieldbus control word (see parameter *19.11 Ext1/Ext2 selection* (page *178*). The source of reference is selectable for each operating mode separately.

Operating modes of the drive

The drive operates 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*.

The following is a general representation of the reference types and control chains. The page numbers refer to detailed diagrams in chapter *Control chain diagrams*.



Speed control mode

The motor follows a speed reference given to the drive. This mode is used either with estimated speed used as feedback, or with an encoder or resolver for better speed control accuracy.

Speed control mode is available in both local and external control. It is also available both in DTC (Direct Torque Control) and scalar motor control modes.

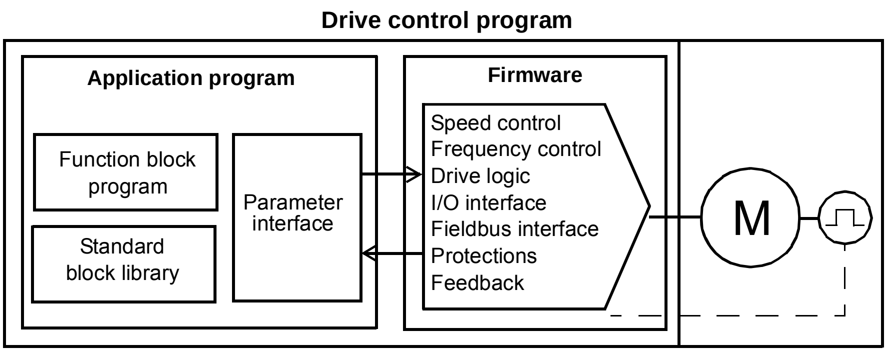
Frequency control mode

The motor follows a frequency reference given to the drive. Frequency control is only available for scalar motor control.

Drive configuration and programming

The drive control program is divided into two parts:

- Application program and
- Firmware program.



The firmware program performs the main control functions, including speed control, drive logic (start/stop), I/O, feedback, communication and protection functions. Firmware functions are configured and programmed with parameters, and can be extended by application programming.

Programming through parameters

Parameters configure all standard drive operations and can be set through

- the control panel, as described in chapter *Using the 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 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*.

Application programming

The functions of the firmware program can be extended with application programming. (A standard drive delivery does not include an application program.) Application programs can be built with function blocks based on the IEC 61131-3 standard using a PC tool available separately.

For more information, see *Programming manual: Drive application programming (IEC 61131-3)* (3AUA0000127808 [English]).

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 -10…10 V) or current (0/4…20 mA) input by a jumper or switch on the control unit. Each input can be filtered, inverted and scaled. The number of analog inputs are increased by installing FIO-11 or FAIO-01 I/O extensions (see *Programmable I/O extensions*).

Settings

See parameter group *12 Standard AI* (page *140*).

Programmable analog outputs

The control unit has two current (0…20 mA) analog outputs. Each output is filtered, inverted and scaled. The number of analog outputs are increased using FIO-xx I/O extensions. See *Programmable I/O extensions* (page *56*).

Settings

See parameter group *13 Standard AO*.

Programmable digital inputs and outputs

The control unit has six digital inputs, a digital start interlock input, and two digital input/outputs.

One digital input (DI6) doubles as a PTC thermistor input. See section *Motor thermal protection* (page *83*).

Digital input/output DIO1 is used as a frequency input, DIO2 as a frequency output.

The number of digital inputs/outputs are increased using FIO-xx I/O extensions. See *Programmable I/O extensions* (page *56*).

Settings

See parameter groups

- *10 Standard DI, RO*
- *11 Standard DIO, FI, FO*

Programmable relay outputs

The control unit has three relay outputs. The signal is indicated by the outputs are selected using parameters.

Relay outputs are added using FIO-0x I/O extensions.

Settings

See parameter group *10 Standard DI, RO* (page *128*).

Programmable I/O extensions

Inputs and outputs are added using FIO-xx I/O extension modules. One to three modules are mounted on the slots of the control unit.

The table below shows the number of I/O on the control unit as well as optional FIO-xx I/O extension modules.

Location	Digital inputs (DI)	Digital I/Os (DIO)	Analog inputs (AI)	Analog outputs (AO)	Relay outputs (RO)
Control unit	7	2	2	2	3
FIO-01	-	4	-	-	2
FIO-11	-	2	3	1	-

Three I/O extension modules are activated and configured using parameter groups 14...16.

Note: Each configuration parameter group contains parameters that display the values of the inputs on that particular extension module. These parameters are the only way of utilizing the inputs on I/O extension modules 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 14, 15 or 16.

Settings

See parameter groups:

- *14 I/O extension module 1*
- *15 I/O extension module 2*
- *16 I/O extension module 3*

Fieldbus control

The drive is connected to several different automation systems through its fieldbus interfaces. See chapter *Fieldbus control through a fieldbus adapter* (page *461*) and *Fieldbus control through a fieldbus adapter* (page *461*).

Settings

See parameter groups

- *50 Fieldbus adapter (FBA)*
- *51 FBA A settings*
- *52 FBA A data in*
- *53 FBA A data out*
- *54 FBA B settings*
- *55 FBA B data in*
- *56 FBA B data out*
- *58 Embedded fieldbus*

Motor control

Direct torque control (DTC)

The motor control of the ACS880 is based on direct torque control (DTC). The switching of the output semiconductors is controlled to achieve the required stator flux and motor torque. The switching frequency is changed only if the actual torque and stator flux values differ from their reference values by more than the allowed hysteresis. The reference value for the torque controller comes from the speed controller or directly from an external torque reference source.

Motor control requires measurement of DC voltage and two motor phase currents. Stator flux is calculated by integrating the motor voltage in vector space. Motor torque is calculated as a cross product of the stator flux and the rotor current. By utilizing the identified motor model, the stator flux estimate is improved. Actual motor shaft speed is not needed for motor control.

The main difference between traditional control and DTC is that torque control has the same time level as the power switch control. There is no separate voltage and frequency controlled PWM modulator. The output stage switching is based on the electromagnetic state of the motor.

The best motor control accuracy is achieved by activating a separate motor identification run (ID run).

See also section *Scalar motor control* (page *71*).

Settings

See parameters

- *99.04 Motor ctrl mode*
- *99.13 ID run requested*

Reference ramping

Acceleration and deceleration ramping times can be set individually for speed and frequency reference.

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*. The user can switch between two preset ramp sets using a binary source such as a digital input. For speed reference, the shape of the ramp can be controlled.

Special acceleration/deceleration ramps

The acceleration/deceleration times for the jogging function can be defined separately; see section *Jogging* (page *69*).

The change rate of the motor potentiometer function (page *78*) is adjustable. The same rate applies in both directions.

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

Settings

- Speed reference ramping: Parameters *23.11*…*23.19* and *46.01* (pages *204* and *280*).
- Frequency reference ramping: Parameters *28.71*…*28.75* and *46.02* (pages *232* and *280*).
- Jogging: Parameters *23.20* and *23.21* (page *207*).
- Motor potentiometer: Parameter *22.75* (page *202*).
- Emergency stop (“Off3” mode): Parameter *23.23 Emergency stop time* (page *207*).

Critical speeds (frequencies)

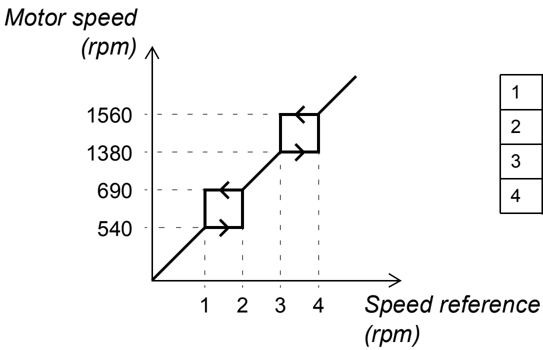
A critical speed function is available for applications where it is necessary to avoid certain problems in motor speeds or speed ranges, for example, mechanical resonance problems.

A similar function is available for scalar motor control with a frequency reference.

Example

A fan has vibrations in the range of 540 to 690 rpm and 1380 to 1560 rpm. To make the drive jump over these speed ranges,

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



1	Par. *22.52* = 540 rpm
2	Par. *22.53* = 690 rpm
3	Par. *22.54* = 1380 rpm
4	Par. *22.55* = 1560 rpm

Settings

See parameter groups

- Critical speeds: parameters *22.51*…*22.57*
- Critical frequencies: parameters *28.51*…*28.57*

Speed controller autotune

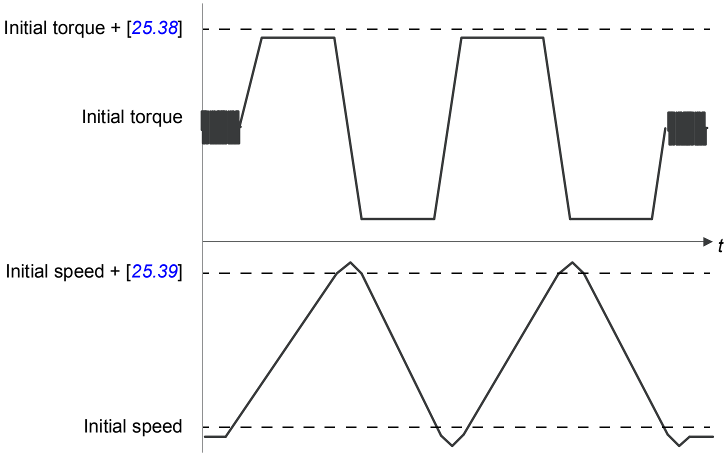
The speed controller of the drive can be automatically adjusted using the autotune function. Autotuning is based on an estimation of the mechanical time constant (inertia) of the motor and machine.

The autotune routine will run the motor through a series of acceleration/deceleration cycles, the number of which can be adjusted by parameter *25.40 Autotune repeat times*. Higher values will produce more accurate results, especially if the difference between initial and maximum speeds is small.

The maximum torque reference used during autotuning will be the initial torque (ie. torque when the routine is activated) plus *25.38 Autotune torque step*, unless limited by the maximum torque limit (parameter group *30 Limits*) or the nominal motor torque

(*99 Motor data*). The calculated maximum speed during the routine is the initial speed (ie. speed when the routine is activated) + *25.39 Autotune speed step*, unless limited by *30.12 Maximum speed* or *99.09 Motor nominal speed*.

The diagram below shows the behavior of speed and torque during the autotune routine. In this example, *25.40 Autotune repeat times* is set to 2.



Notes:

- If the drive cannot produce the requested braking power during the routine, the results will be based on the acceleration stages only, and not as accurate as with full braking power.
- The motor will exceed the calculated maximum speed slightly at the end of each acceleration stage.

Before activating the autotune routine

The prerequisites for performing the autotune routine are:

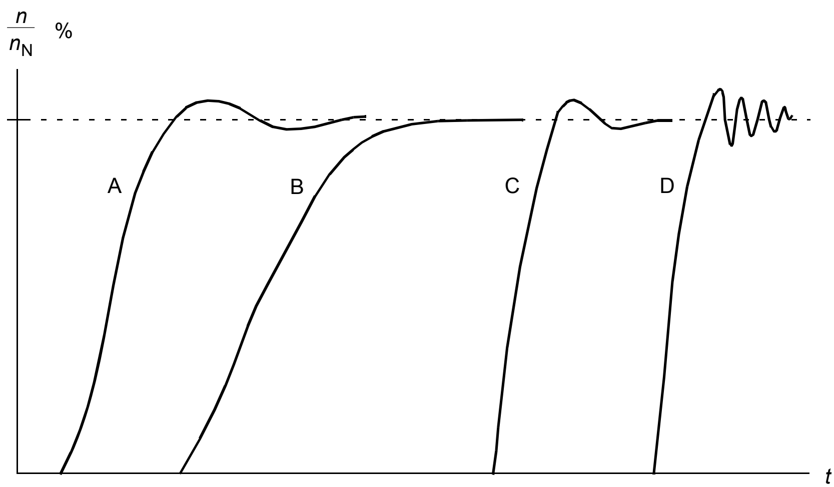
- The motor identification run (ID run) has been successfully completed
- Speed and torque limits (parameter group *30 Limits*) have been set
- The speed feedback has been monitored for noise, vibrations and other disturbances caused by the mechanics of the system, and
  - speed feedback filtering (parameter group *90 Feedback selection*)
  - speed error filtering (*24 Speed reference conditioning*) and
  - zero speed (parameters *21.06* and *21.07*)

  have been set to eliminate these disturbances.
- The drive has been started and is running in speed control mode.

After these conditions have been fulfilled, autotuning can be activated by parameter *25.33 Speed controller autotune* (or the signal source selected by it).

Autotune modes

Autotuning can be performed in three different ways depending on the setting of parameter *25.34 Speed controller autotune mode*. The selections *Smooth*, *Normal* and *Tight* define how the drive torque reference should react to a speed reference step after tuning. The selection *Smooth* will produce a slow but robust response; *Tight* will produce a fast response but possibly too high gain values for some applications. The figure below shows speed responses at a speed reference step (typically 1…20%).



A: Undercompensated
B: Normally tuned (autotuning)
C: Normally tuned (manually). Better dynamic performance than with B
D: Overcompensated speed controller

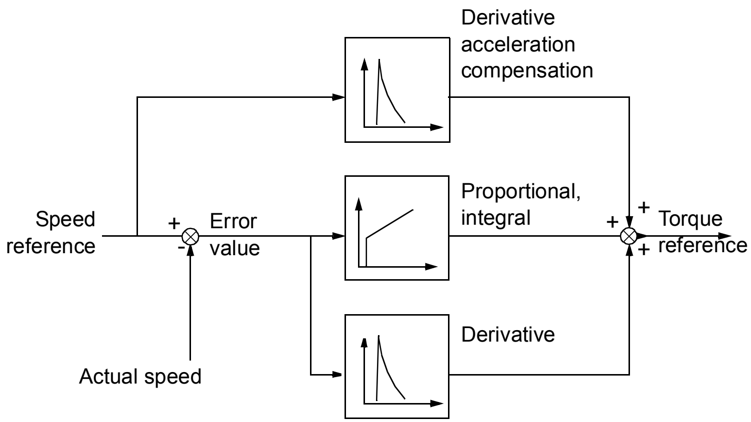
Autotune results

At the end of a successful autotune routine, its results are automatically transferred into parameters

- *25.02 Speed proportional gain* (proportional gain of the speed controller)
- *25.03 Speed integration time* (integration time of the speed controller)
- *25.37 Mechanical time constant*(mechanical time constant of the motor and machine).

Nevertheless, it is still possible to manually adjust the controller gain, integration time and derivation time.

The figure below is a simplified block diagram of the speed controller. The controller output is the reference for the torque controller.



Warning indications

A warning message, *AF90 Speed controller autotuning*, will be generated if the autotune routine does not complete successfully. See chapter *Fault tracing* (page *405*) for further information.

Settings

Parameters *25.33*…*25.40* (page *222*).

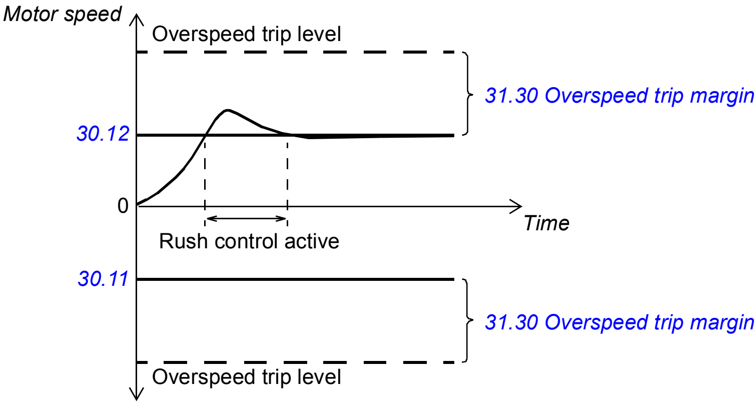
Oscillation damping

The oscillation damping function can be used to cancel out oscillations caused by mechanics or an oscillating DC voltage. The input – a signal reflecting the oscillation – is selected by parameter *26.53 Oscillation compensation input*. The oscillation damping function outputs a sine wave (*26.58 Oscillation damping output*) which can be summed with the torque reference with a suitable gain (*26.57 Oscillation damping gain*) and phase shift (*26.56 Oscillation damping phase*).

The oscillation damping algorithm can be activated without connecting the output to the reference chain, which makes it possible to compare the input and output of the function and make further adjustments before applying the result.

Rush control

In torque control, the motor could potentially rush if the load were suddenly lost. The control program has a rush control function that decreases the torque reference whenever the motor speed exceeds *30.11 Minimum speed* or *30.12 Maximum speed*.



The function is based on a PI controller. The proportional gain and integration time can be defined by parameters. Setting these to zero disables rush control.

Settings

See parameters

- *26.81 Rush control gain*
- *26.82 Rush control integration time*

Encoder support

The control program supports two single-turn or multi turn encoders (or resolvers). The following optional interface modules are available:

- TTL encoder interface FEN-01—two TTL inputs, TTL output (for encoder emulation and echo) and two digital inputs for position latching
- Absolute encoder interface FEN-11—absolute encoder input, TTL input, TTL output (for encoder emulation and echo) and two digital inputs for position latching
- Resolver interface FEN-21—resolver input, TTL input, TTL output (for encoder emulation and echo) and two digital inputs for position latching
- HTL encoder interface FEN-31—HTL encoder input, TTL output (for encoder emulation and echo) and two digital inputs for position latching.
- HTL/TTL encoder interface FSE-31 (for use with an FSO-xx safety functions module): Two HTL/TTL encoder inputs.

The interface module is installed onto any optional slot on the drive control unit. The module (except FSE-31) can also be installed onto an FEA-0x extension adapter.

Encoder echo and emulation

Both encoder echo and emulation are supported by the above-mentioned FEN-xx interfaces.

Encoder echo is available with TTL, TTL+ and HTL encoders. The signal received from the encoder is relayed to the TTL output unchanged. This enables the connection of one encoder to several drives.

Encoder emulation also relays the encoder signal to the output, but the signal is either scaled, or position data converted to pulses. Emulation can be used when absolute encoder or resolver position needs to be converted to TTL pulses, or when the signal must be converted to a different pulse number than the original.

Quick configuration of HTL encoder feedback

1. Specify the type of encoder interface module (parameter *91.11 Module 1 type* = *FEN-31*) and slot in which the module is installed (*91.12 Module 1 location*).
2. Specify the type of encoder (*92.01 Encoder 1 type* = *HTL*). The parameter listing is re-read from the drive after the value is changed.
3. Specify the interface module to which the encoder is connected to (*92.02 Encoder 1 source* = *Module 1*).
4. Set the number of pulses according to encoder nameplate (*92.10 Pulses/revolution*).
5. If the encoder rotates at a different speed to the motor (that is, not mounted directly on the motor shaft), enter the gear ratio in *90.43 Motor gear numerator* and *90.44 Motor gear denominator*.
6. Set parameter *91.10 Encoder parameter refresh* to *Refresh* to apply the new parameter settings. The parameter automatically reverts to *Done*.
7. Check that *91.02 Module 1 status* is showing the correct interface module type (*FEN-31*). Also check the status of the module. Both LEDs should be glowing green.
8. Start the motor with a reference. For example, 400 rpm.
9. Compare the estimated speed (*01.02 Motor speed estimated*) with the measured speed (*01.04 Encoder 1 speed filtered*). If the values are the same, set the encoder as the feedback source (*90.41 Motor feedback selection* = *Encoder 1*).
10. Specify the action taken in case the feedback signal is lost (*90.45 Motor feedback fault*).

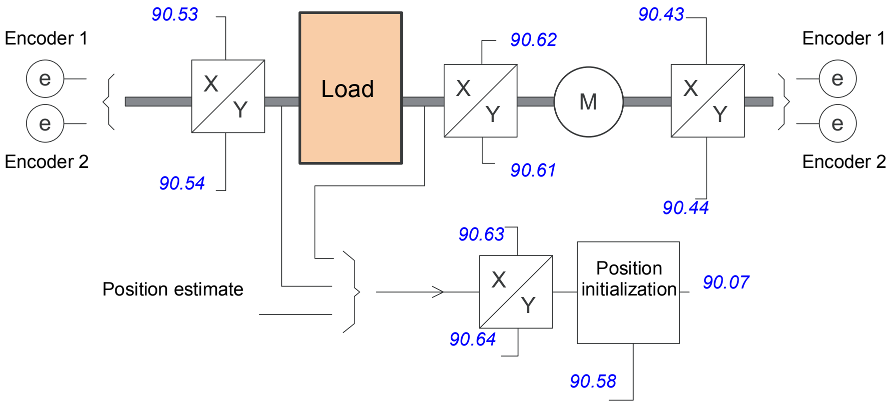
Settings

See parameter groups

- *90 Feedback selection*
- *91 Encoder module settings*
- *92 Encoder 1 configuration*
- *93 Encoder 2 configuration*

Position counter

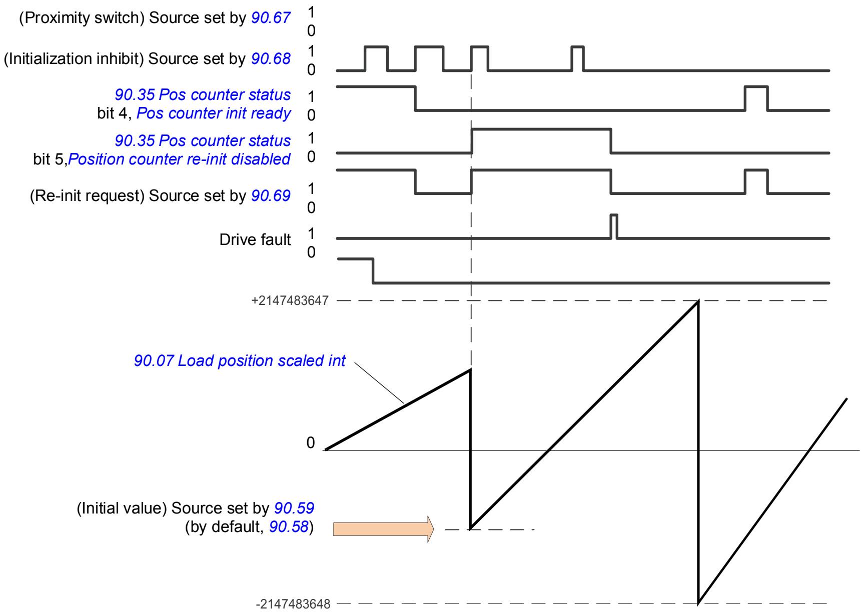
The control program contains a position counter feature that can be used to indicate the position of a load, eg. the position of a conveyor belt or the height of the load on a crane. The output of the counter function, parameter *90.07 Load position scaled int*, indicates the scaled number of revolutions read from an encoder through either encoder interface. A position estimate calculated internally by the motor control can be used instead of encoder feedback. (The estimate is also used until next stop if the selected feedback is lost and its monitoring parameter is set to warning instead of fault.)



The source of the measurement is selected by *90.51 Load feedback selection*. Any gear ratio between the encoder and load is defined by *90.53 Load gear numerator* and *90.54 Load gear denominator*. In case the internal position estimate is chosen as the source, the gear between the motor and load must be defined in *90.61 Gear numerator* and *90.62 Gear denominator*.

The relation between revolutions of the motor shaft and the translatory movement of the load (in any given unit of distance) is defined by parameters *90.63 Feed constant numerator* and *90.64 Feed constant denominator*.

By default, all of the ratios mentioned above are 1:1.



The position counter is initialized by setting a known physical position of the load into the control program. The initial position (for example, the home/zero position, or the distance from it) can be entered manually in a parameter (*90.58 Pos counter init value int*), or taken from another parameter. This position is set as the value of the position counter (*90.07 Load position scaled int*) when the source selected by *90.67 Pos counter init cmd source*, such as a proximity switch connected to a digital input, is activated. A successful initialization is indicated by bit 4 of *90.35 Pos counter status*.

Any subsequent initialization of the counter must first be enabled by *90.69 Reset pos counter init ready*. To define a time window for initializations, *90.68 Disable pos counter initialization* can be used to inhibit the signal from the proximity switch. An active fault in the drive will also prevent counter initialization.

See also the block diagram on page *481*.

Reading/writing position counter values through fieldbus

The parameters of the position counter function, such as *90.07 Load position scaled int* and *90.58 Pos counter init value int*, can be accessed from an upper-level control system in the following formats:

- 16-bit integer (if 16 bits are sufficient for the application)
- 32-bit integer (can be accessed as two consequent 16-bit words)

For example, to read parameter *90.07 Load position scaled int* through fieldbus, set the selection parameter of the desired dataset (in group 52) to *Other* – *90.07*, and select the format. If you select a 32-bit format, the subsequent data word is also automatically reserved.

Example 2: Transmitting a 32-bit integer over fieldbus

Parameters *90.05 Load position scaled* and *90.65 Pos counter init value* are real-type numbers.

In this example, 123456.78 is to be used as the initial value sent from the PLC. To send the number as an integer over the fieldbus, multiply the value by 100 and select it to be transmitted as two data words:

- 12345678 = BC614Eh
- 614Eh = 24910
- BCh = 188
- FBA data out x = 188
- FBA data out (x + 1) = 24910.

The drive will thus receive a 32-bit integer. To restore the original two decimal places, set parameter *90.38 Pos counter decimals* to 2. This will divide the integer by 100 before it is written into *90.65 Pos counter init value*. Parameter *90.05 Load position scaled* will also be scaled, so when read by the PLC, it will still appear as an integer (12345678).

90.38 Pos counter decimals = 2

90.65 Pos counter init value = 123456.78

Example 3: Transmitting a 32-bit floating point number over fieldbus

In this example, 66770.125 is used as the initial value sent from the PLC. To transmit a 32-bit floating-point value, split it into two 16-bit words.

According to IEEE 754, the value 66770.125 converts to 47826910h including the sign, exponent and significand.

High word: 4782h = 18306

Low word: 6910h = 26896

For eg. PROFIBUS, these values can be set as

FBA data out x = 18306

FBA data out (x + 1) = 26896.

For ABB Automation using DDCS communication, the two words can be transmitted as eg. data words 12.1 and 12.2 respectively.

When configuring the data selection parameters, select the 32-bit floating-point number format for parameters *90.65 Pos counter init value* and *90.05 Load position scaled*.

As a result, parameter *90.65 Pos counter init value* will be set to 66770.125.

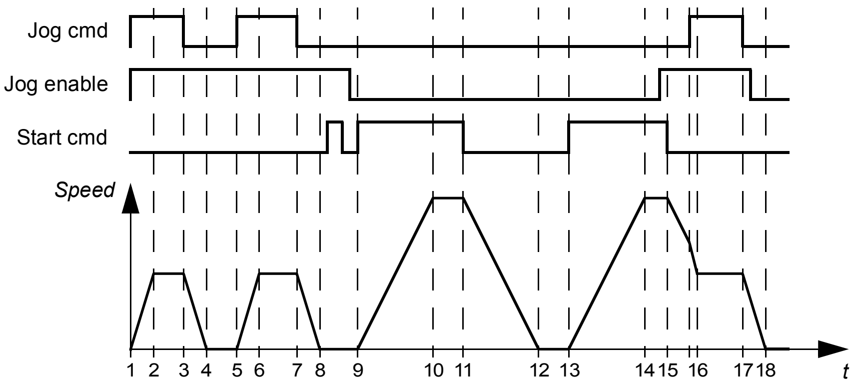
Jogging

The jogging function enables the use of a momentary switch to briefly rotate the motor. The jogging function is typically used during servicing or commissioning to control the machinery locally.

Two jogging functions (1 and 2) are available, each with their own activation sources and references. The signal sources are selected by parameters *20.26 Jogging 1 start source* and *20.27 Jogging 2 start source*. When jogging is activated, the drive starts and accelerates to the defined jogging speed (*22.42 Jogging 1 ref* or *22.43 Jogging 2 ref*) along the defined jogging acceleration ramp (*23.20 Acc time jogging*). After the activation signal switches off, the drive decelerates to a stop along the defined jogging deceleration ramp (*23.21 Dec time jogging*).

The figure and table below provide an example of how the drive operates during jogging. In the example, the ramp stop mode is used (see parameter *21.03 Stop mode*).

Jog cmd = State of source set by *20.26 Jogging 1 start source* or *20.27 Jogging 2 start source*
Jog enable = State of source set by *20.25 Jogging enable*
Start cmd = State of drive start command.



Phase	Jog cmd	Jog enable	Start cmd	Description
1-2	1	1	0	Drive accelerates to the jogging speed along the acceleration ramp of the jogging function.
2-3	1	1	0	Drive follows the jog reference.
3-4	0	1	0	Drive decelerates to zero speed along the deceleration ramp of the jogging function.

Phase	Jog cmd	Jog enable	Start cmd	Description
4-5	0	1	0	Drive is stopped.
5-6	1	1	0	Drive accelerates to the jogging speed along the acceleration ramp of the jogging function.
6-7	1	1	0	Drive follows the jog reference.
7-8	0	1	0	Drive decelerates to zero speed along the deceleration ramp of the jogging function.
8-9	0	1->0	0	Drive is stopped. As long as the jog enable signal is on, start commands are ignored. After jog enable switches off, a fresh start command is required.
9-10	x	0	1	Drive accelerates to the speed reference along the selected acceleration ramp (parameters *23.11*…*23.19*).
10-11	x	0	1	Drive follows the speed reference.
11-12	x	0	0	Drive decelerates to zero speed along the selected deceleration ramp (parameters *23.11*…*23.19*).
12-13	x	0	0	Drive is stopped.
13-14	x	0	1	Drive accelerates to the speed reference along the selected acceleration ramp (parameters *23.11*…*23.19*).
14-15	x	0->1	1	Drive follows the speed reference. As long as the start command is on, the jog enable signal is ignored. If the jog enable signal is on when the start command switches off, jogging is enabled immediately.
15-16	0->1	1	0	Start command switches off. The drive starts to decelerate along the selected deceleration ramp (parameters *23.11*…*23.19*). When the jog command switches on, the decelerating drive adopts the deceleration ramp of the jogging function.
16-17	1	1	0	Drive follows the jog reference.
17-18	0	1->0	0	Drive decelerates to zero speed along the deceleration ramp of the jogging function.

See also the block diagram on page *479*.

Notes:

- Jogging is not available when the drive is in local control.
- Jogging cannot be enabled when the drive start command is on, or the drive started when jogging is enabled. Starting the drive after the jog enable switches off requires a fresh start command.

WARNING! If jogging is enabled and activated while the start command is on, jogging will activate as soon as the start command switches off.

- If both jogging functions are activated, the one that was activated first has priority.
- Jogging uses the speed control mode.
- Ramp shape times (parameters *23.16*…*23.19*) do not apply to jogging acceleration/deceleration ramps.
- The inching functions activated through fieldbus (see *06.01 Main control word*, bits 8…9) use the references and ramp times defined for jogging, but do not require the jog enable signal.

Settings

See parameters below:

20.25 Jogging enable

20.26 Jogging 1 start source

20.27 Jogging 2 start source

22.42 Jogging 1 ref

22.43 Jogging 2 ref

23.20 Acc time jogging and

23.21 Dec time jogging.

Position latching

The FEN-xx encoder interface modules listed above support position latching. Position latching stores the position of the motor or machine at the instant a latch signal, eg. from a limit switch, is received.

Each FEN-xx module has two digital inputs that can be used for latching. Latching can alternatively be triggered by the Z-pulse signal received from the encoder.

The control program has two position latching functions that can be configured separately. The stored positions can be read by a PLC and used for position control when the loop is closed in the PLC. The positions can also be used as initial positions – see section *Position counter* (page *66*).

Scalar motor control

Scalar control is the motor control method used instead of DTC (Direct Torque Control). In scalar control mode, the drive is controlled with a speed or frequency reference. However, the outstanding performance of DTC is not achieved in scalar control.

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

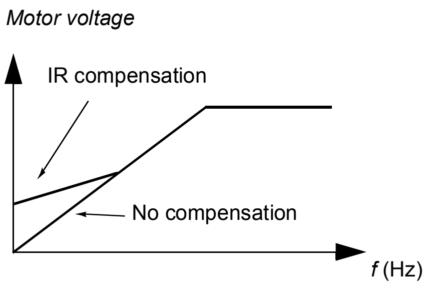
- In multi motor drives:
  - if the load is not equally shared between the motors
  - if the motors are of different sizes or
  - if the motors are changed after motor identification (ID run)
- If the nominal current of the motor is less than 1/6 of the nominal output current of the drive
- If the drive is used without a motor connected (for example, for test purposes)
- If the drive runs a medium-voltage motor through a step-up transformer

In scalar control, some standard features are not available.

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 that require a high break-away torque. In step-up applications, voltage cannot be fed through the transformer at 0 Hz, so an additional breakpoint is available for defining the compensation near zero frequency.

In Direct Torque Control (DTC), no IR compensation is possible or needed as it is applied automatically.



Settings

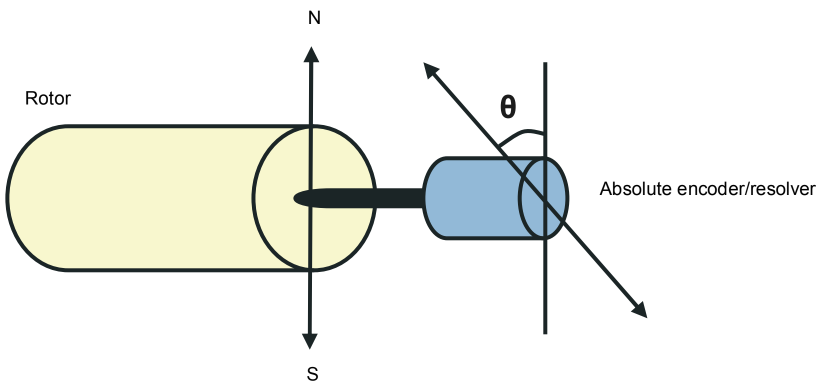
See parameter group *28 Frequency reference chain* (page *226*) and below parameters:

- *19.20 Scalar control reference unit*
- *97.12 IR comp step-up frequency*
- *97.13 IR compensation*
- *99.04 Motor ctrl mode*

Autophasing

Autophasing is an automatic measurement routine to determine the angular position of the magnetic flux of a permanent magnet synchronous motor or the magnetic axis of a synchronous reluctance motor. The motor control requires the absolute position of the rotor flux for accurate control of motor torque.

Sensors like absolute encoders and resolvers indicate the rotor position at all times after the offset between the zero angle of rotor and that of the sensor are established. On the other hand, a standard pulse encoder determines the rotor position when it rotates but the initial position is not known. However, a pulse encoder can be used as an absolute encoder if it is equipped with Hall sensors, albeit with coarse initial position accuracy. The Hall sensors generate commutation pulses that change their state six times during one revolution. It is only known within which 60° sector of a complete revolution the initial position is.



The autophasing routine is performed with permanent magnet synchronous motors and synchronous reluctance motors in the following cases:

1. One-time measurement of the rotor and encoder position difference when an absolute encoder, a resolver, or an encoder with commutation signal is used
2. At every power-up when an incremental encoder is used
3. With open-loop motor control, repetitive measurement of the rotor position at every start
4. When the position of the zero pulse must be measured before the first start after power-up.

Note: In closed-loop control, autophasing is performed automatically after the motor identification run (ID run). Autophasing is also performed automatically before starting when necessary.

Several autophasing modes are available (see parameter *21.13 Autophasing mode*).

The turning mode is recommended especially with case 1 as it is the most robust and accurate method. In turning mode, the motor shaft is turned back and forward (±360/polepairs)° to determine the rotor position. In case 3 (open-loop control), the shaft is turned only in one direction and the angle is smaller.

The standstill modes can be used if the motor cannot be turned (for example, when the load is connected). As the characteristics of motors and loads differ, testing is done to find out the most suitable standstill mode.

A rotor position offset used in motor control can also be given by the user. See parameter *98.15 Position offset user*. Note that the autophasing routine also writes its result into this parameter. The results are updated even if user settings are not enabled by *98.01 User motor model mode*.

The drive is capable of determining the rotor position when started to a running motor in open loop or closed loop modes. In this situation, the setting of *21.13 Autophasing mode* has no effect.

Note: In open-loop control, the motor always turns when it is started as the shaft is turned towards the remanence flux.

Autophasing modes

Several autophasing modes are available (see parameter *21.13 Autophasing mode*).

The turning mode (*Turning*) is recommended especially with case 1 (see the list above) as it is the most robust and accurate method. In turning mode, the motor shaft is turned back and forward (±360/polepairs)° in order to determine the rotor position. In case 3 (open-loop control), the shaft is turned only in one direction and the angle is smaller.

Another turning mode, *Turning with Z-pulse*, can be used if there is difficulty using the normal turning mode, for example, because of significant friction. With this mode, the rotor is turned slowly until a zero pulse is detected from the encoder. When the zero pulse is detected for the first time, its position is stored into parameter *98.15 Position offset user*, which can be edited for fine-tuning. Note that it is not mandatory to use this mode with a zero pulse encoder. In open-loop control, the two turning modes are identical.

The standstill modes (*Standstill 1*, *Standstill 2*) can be used if the motor cannot be turned (for example, when the load is connected). As the characteristics of motors and loads differ, testing must be done to find out the most suitable standstill mode.

The drive is capable of determining the rotor position when started into a running motor in open-loop or closed-loop control. In this situation, the setting of *21.13 Autophasing mode* has no effect.

The autophasing routine can fail and therefore it is recommended to perform the routine several times and check the value of parameter *98.15 Position offset user*.

An autophasing fault (*3385 Autophasing*) can occur with a running motor if the estimated angle of the motor differs too much from the measured angle. This could be caused by, for example, the following:

- The encoder is slipping on the motor shaft
- An incorrect value has been entered into *98.15 Position offset user*
- The motor is already turning before the autophasing routine is started
- *Turning* mode is selected in *21.13 Autophasing mode* but the motor shaft is locked
- *Turning with Z-pulse* mode is selected in *21.13 Autophasing mode* but no zero pulse is detected within a revolution of the motor
- The wrong motor type is selected in *99.03 Motor type*
- Motor ID run has failed.

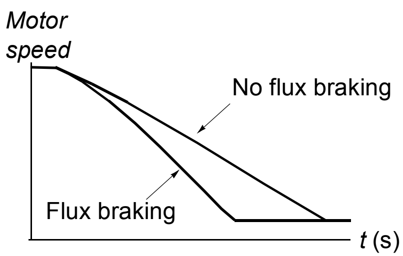
Settings

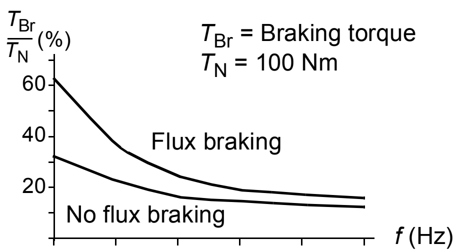
See parameters

- *21.13 Autophasing mode*
- *98.15 Position offset user*
- *99.13 ID run requested*

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.





During flux braking, the drive monitors the motor status continuously. Therefore, flux braking is 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 is 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.

Settings

See parameter *97.05 Flux braking*

DC magnetization

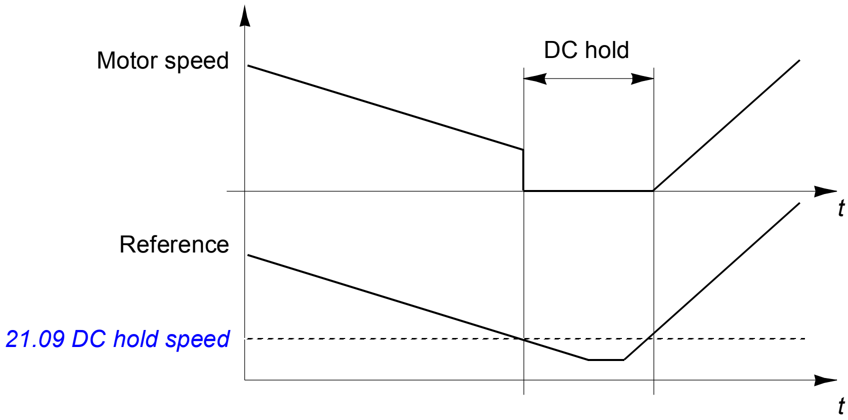
DC magnetization can be applied to the motor to lock the rotor at or near zero speed.

Pre-magnetization

Pre-magnetization refers to DC magnetization of the motor before start. Depending on the selected start mode (*21.01 Start mode*), pre-magnetization is 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.

DC hold

The function makes it possible to lock the rotor at or 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 stops 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.



Note:

- DC hold is only available in speed control.
- The function applies the DC current to one phase only, depending on the position of the rotor. The return current will be shared between the other phases.

Post-magnetization

This feature keeps the motor magnetized for a certain period (parameter *21.11 Post magnetization time*) after stopping to prevent the machinery from moving under load. 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 ramping is the selected stop mode (see parameter *21.03 Stop mode*).

Continuous magnetization

A digital signal, such as a user bit in the fieldbus control word, can be selected to activate continuous magnetization. This can be especially useful in processes requiring motors to be stopped (for example, to stand by until new material is processed), then quickly started without magnetizing them first.

Note: Continuous magnetization is only available in speed control in DTC motor control mode (see page *53*), and only when ramping is the selected stop mode (see parameter *21.03 Stop mode*).

WARNING: The motor must be designed to absorb or dissipate the thermal energy generated by continuous magnetization, for example by forced ventilation.

Settings

Parameters *21.01 Start mode*, *21.02 Magnetization time* and *21.08…21.12* (page *193*).

Application control

See chapter *Default control connections* (page *95*).

Motor potentiometer

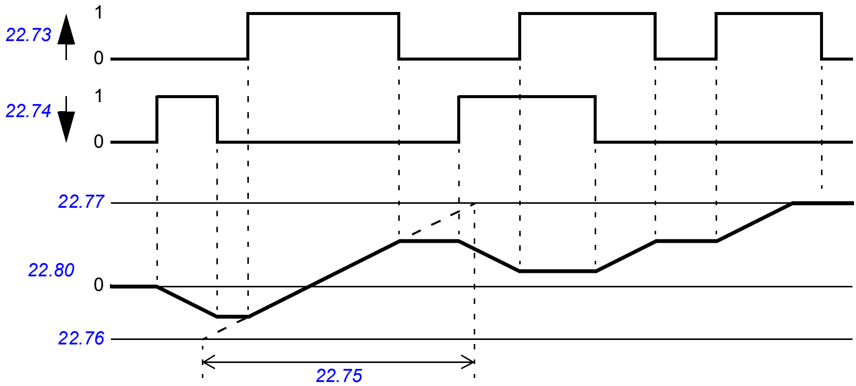
The motor potentiometer is, in effect, a counter whose value can be adjusted up and down using two digital signals selected by parameters *22.73 Motor potentiometer up source* and *22.74 Motor potentiometer down source*. Note that these signals have no effect when the drive is stopped.

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 stop or 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 source of any selector parameter such as *22.11 Speed ref1 source*.

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



Settings

Parameters *22.71*…*22.80* (page *201*).

DC voltage control

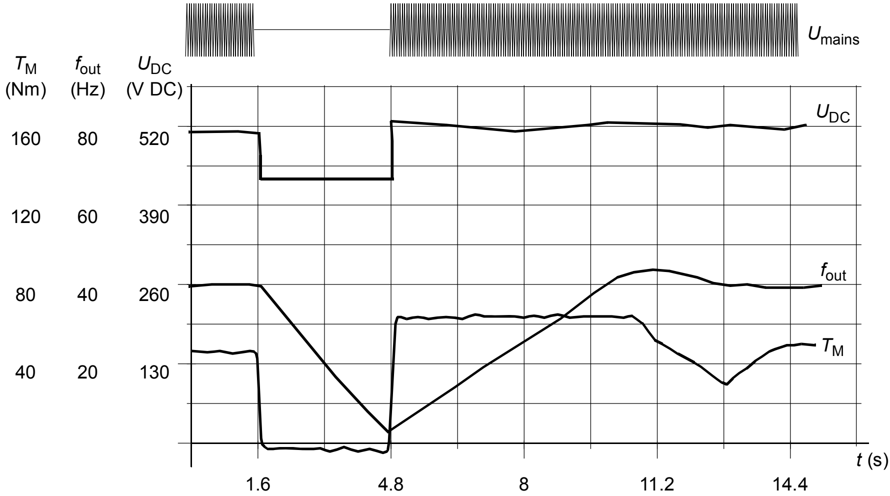
Overvoltage control

Overvoltage control of the intermediate DC link is typically needed when the motor is in generating mode. 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

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 (example 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 mains 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.

Automatic restart

It is possible to restart the drive automatically after a short (maximum 5 seconds) power supply failure by using the Automatic restart function provided that the drive is allowed to run for 5 seconds without the cooling fans operating.

When enabled, the function takes the following actions upon a supply failure to enable 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, *3280 Standby timeout*.

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 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 in volts. All voltages are relative to the supply voltage range selected in parameter *95.01 Supply voltage*.

	Supply voltage range [V] (see *95.01 Supply voltage*)					
Level	**208…240**	**380…415**	**440…480**	**500**	**525…600**	**660…690**
Overvoltage fault limit	489/440*	800	878	880	1113	1218
Overvoltage control limit	389	700	778	810	1013	1118
Internal brake chopper at 100% pulse width	403	697	806	806	1008	1159
Internal brake chopper at 0% pulse width	375	648	749	780	936	1077
Overvoltage warning limit	373	644	745	776	932	1071
DC voltage at upper bound of supply voltage range (U_{DCmax})	324	560	648	675	810	932
DC voltage at lower bound of supply voltage range	281	513	594	675	709	891
Undervoltage control and warning limit	239	436	505	574	602	757
Charging activation/standby limit	225	410	475	540	567	713
Undervoltage fault limit	168	308	356	405	425	535

*489 V with frames R1…R3, 440 V with frames R4…R8.

Settings

See parameters

- *01.11 DC voltage* (page *105*)
- *30.30 Overvoltage control* (page *240*)
- *30.31 Undervoltage control* (page *241*)
- *95.01 Supply voltage* (page *338*) and
- *95.02 Adaptive voltage limits* (page *338*)

Brake chopper

A brake chopper can be used to handle the energy generated by a decelerating motor. When the DC voltage rises high enough, the chopper connects the DC circuit to an external brake resistor. The chopper operates on the pulse width modulation principle.

The internal brake choppers of ACS880 drives start conducting when the DC link voltage reaches 1.156 × U_{DCmax}. 100% pulse width is reached at approximately 1.2 × U_{DCmax}, depending on supply voltage range. See table under *Voltage control and trip limits* (page *81*). (U_{DCmax} is the DC voltage corresponding to the maximum of the AC supply voltage range.)

For information on external brake choppers, refer to their documentation.

Settings

See parameter *01.11 DC voltage* (page *105*) and parameter group *43 Brake chopper* (page *276*).

Safety and protections

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*.

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:

- For SIL 3 / PL e-level emergency stop functions, the drive can be fitted with a TÜV-certified FSO-xx safety options module. The module can then be incorporated into certified safety systems.
- 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 *06.17 Drive status word 2* (page *118*), *06.18 Start inhibit status word* (page *119*), *21.04 Emergency stop mode* (page *191*), *21.05 Emergency stop source* (page *191*), *23.23 Emergency stop time* (page *207*), *25.13 Min torq sp ctrl em stop* (page *219*), *25.14 Max torq sp ctrl em stop* (page *219*), *25.15 Proportional gain em stop* (page *219*), *31.32 Emergency ramp supervision* (page *248*) and *31.33 Emergency ramp supervision delay* (page *248*).

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.

In addition to temperature monitoring, a protection function is available for 'Ex' motors installed in a potentially explosive atmosphere.

Motor thermal protection model

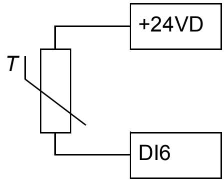
The drive calculates the temperature of the motor on the basis of the following assumptions:

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.

Temperature monitoring using PTC sensors

One PTC sensor can be connected to digital input DI6. FEN-xx encoder interfaces (optional) also have a connection for one PTC sensor.

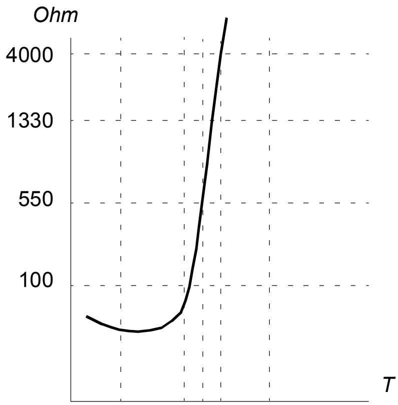


The resistance of the PTC sensor increases when its temperature rises. The increasing resistance of the sensor decreases the voltage at the input, and eventually its state switches from 1 to 0, indicating overtemperature.

1…3 PTC sensors can also be connected in series to an analog input and an analog output. The analog output feeds a constant excitation current of 1.6 mA through the sensor. The sensor resistance increases as the motor temperature rises, as does the voltage over the sensor. The temperature measurement function calculates the resistance of the sensor and generates an indication if overtemperature is detected.

For wiring of the sensor, refer to the Hardware Manual of the drive.

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



In addition to the above, optional FEN-xx encoder interfaces, and FEX-01 and FPTC-01 modules have connections for PTC sensors. Refer to the module-specific documentation for more information.

Temperature monitoring using Pt100 or Pt1000 sensors

1…3 Pt100 or Pt 1000 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 (Pt100) or 1 mA (1000) 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 warning and fault limits can be adjusted by parameters.

For the wiring of the sensor, refer to the *Hardware Manual* of the drive.

Temperature monitoring using KTY84 sensors

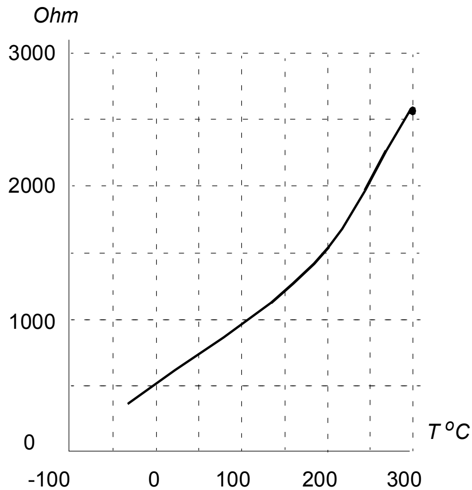
One KTY84 sensor can be connected to an analog input and an analog output on the control unit.

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.

FEN-xx encoder interfaces (optional) also have a connection for one KTY84 sensor.

The figure and table below show typical KTY84 sensor resistance values as a function of the motor operating temperature.

KTY84 scaling
90 °C = 936 ohm
110 °C = 1063 ohm
130 °C = 1197 ohm
150 °C = 1340 ohm



The warning and fault limits can be adjusted by parameters.

For the wiring of the sensor, refer to the *Hardware Manual* of the drive.

Motor fan control logic (parameters *35.100*…*35.106*)

If the motor has an external cooling fan, it is possible to use a drive signal (for example, running/stopped) to control the starter of the fan via a relay or digital output. A digital input can be selected for fan feedback. A loss of the feedback signal will optionally cause a warning or a fault.

Start and stop delays can be defined for the fan. In addition, a feedback delay can be set to define the time within which feedback must be received after the fan starts.

Ex motor support (parameter *95.15*, bit 0)

The control program has a temperature protection function for Ex motors located in a potentially explosive atmosphere. The protection is enabled by setting bit 0 of parameter *95.15 Special HW settings*.

Settings

Parameter groups *35 Motor thermal protection* (page *262*) and *91 Encoder module settings* (page *327*); parameter *95.15 Special HW settings* (page *340*).

Thermal protection of motor cable

The control program contains a thermal protection function for the motor cable. This function should be used, for example, when the nominal current of the drive exceeds the current-carrying capacity of the motor cable.

The program calculates the temperature of the cable on the basis of the following data:

- Measured output current (parameter *01.07 Motor current*)
- Nominal continuous current rating of the cable, specified by *35.61 Cable nominal current*, and
- Thermal time constant of the cable, specified by *35.62 Cable thermal rise time*.

When the calculated temperature of the cable reaches 102% of the rated maximum, a warning (*A480 Motor cable overload*) is given. The drive trips on a fault (*4000 Motor cable overload*) when 106% is reached.

Settings

Parameters *35.60*…*35.62* (page *270*).

Other 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 - Settings** - **Edit texts**.

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*)

The earth fault detection function is based on sum current measurement. 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 the *Hardware manual*.

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. Note that the protection should be disabled in drive/inverter hardware supplied from a common DC bus.

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.

Ramp stop supervision (parameters *31.32*, *31.33*, *31.37* and *31.38*)

The control program has a supervision function for both the normal and emergency stop ramps. The user can either define a maximum time for stopping, or a maximum deviation from the expected deceleration rate. If the drive fails to stop in the expected manner, a fault is generated and the drive coasts to a stop.

Custom motor current fault limit (parameter *31.42*)

The control program sets a motor current limit based on drive hardware. In most cases, the default value is appropriate. However, a lower limit can be manually set by the user, for example, to protect a permanent magnet motor from demagnetization.

Local control loss detection (parameter *49.05*)

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

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

Parameters *31.12*…*31.16* (page *243*).

Diagnostics

Signal supervision

Three 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 contents of the message can be edited on the control panel by selecting **Settings** - **Edit texts**.

The supervised signal is low-pass filtered.

Settings

See parameter group *32 Supervision* (page *251*).

Maintenance timers and counters

The program has six different maintenance timers or counters that can be configured to generate a warning when a pre-defined limit is reached. The contents of the message can be edited on the control panel by selecting **Settings** - **Edit texts**.

The timer/counter can be set to monitor any parameter. This feature is especially useful as a service reminder.

There are three types of counters:

- On time timers. Measures the time a binary source (for example, a bit in a status word) is on.
- Signal edge counters. The counter is incremented whenever the monitored binary source changes state.
- Value counters measures, by integration, the monitored parameter. An warning is given when the calculated area below the signal peak exceeds a user-defined limit.

Settings

See parameter group *33 Generic timer & counter* (page *254*).

Energy savings calculator

This feature consists of the following functionalities:

- An energy optimizer that adjusts the motor flux in such a way that the total 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 *90*).

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

See parameter group *45 Energy efficiency* (page *277*).

Load analyzer

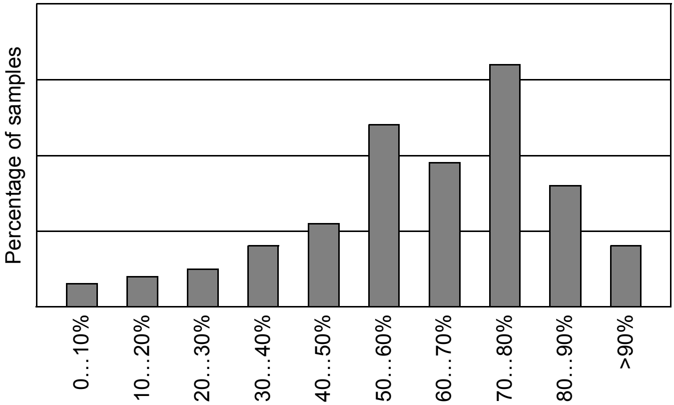
Peak value logger

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.

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 when the drive is running, 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 percentage points wide, and displays the percentage of the collected samples that fall within that range.



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}, as given in the hardware manual). The distribution of samples is shown by parameters *36.20*…*36.29*.

Settings

See parameter group *36 Load analyzer* (page *272*).

Miscellaneous

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.

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 force data*
- I/O extension module settings (groups 14…16)
- data storage parameters (group 47)
- fieldbus adapter-specific settings (groups 51…56 and 58), and
- encoder configuration settings (groups 92…93).

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 be recalled when the motor is switched.

Settings

See parameters *96.10*…*96.13* (page *344*).

Data storage parameters

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

Note that "*Analog src*" type parameters (see page *361*) expect a 32-bit real (floating point) source – in other words, parameters *47.01*…*47.08* can be used as a value source of other parameters while *47.11*…*47.28* cannot.

Settings

See parameter group *47 Data storage* (page *281*).

du/dt filter support

With an external du/dt filter connected to the output of the drive, bit 13 of *95.20 HW options word 1* must be switched on. The setting enables an overtemperature protection for the filter. Note that the setting is not to be activated with inverter modules with internal du/dt filters.

Settings

Parameter *95.20 HW options word 1* (page *341*).

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 *95.15 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.

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

Settings

Parameter *95.15 Special HW settings* (page *340*).

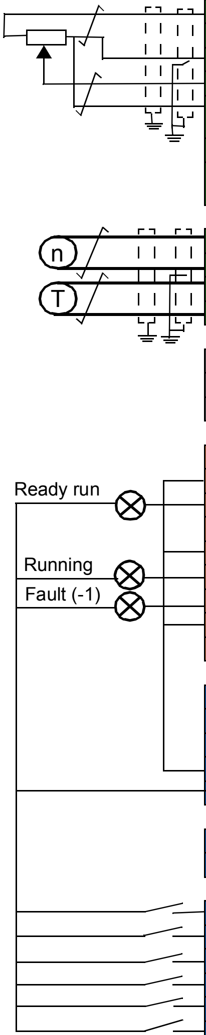
7

Default control connections

Contents of this chapter

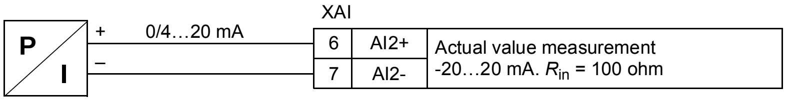
This chapter describes the default control connections of the PCP/ESP control application.

PCP/ESP I/O control connections

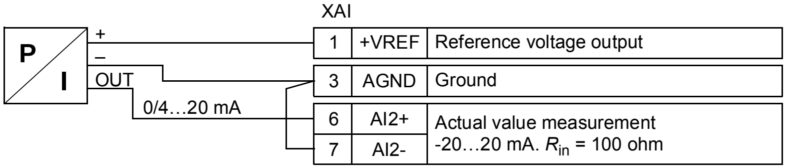


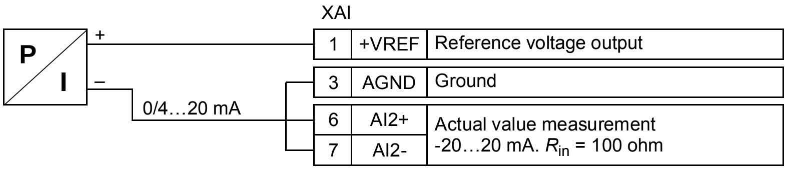
XPOW	External power input	
1	+24VI	24 V DC, 2 A
2	GND	
XAI	Reference voltage and analog inputs	
1	+VREF	10 V DC, R_L 1…10 kohm
2	-VREF	-10 V DC, R_L 1…10 kohm
3	AGND	Ground
4	AI1+	Analog input 1 Speed reference 0(2)...10V, R_{in} > 200 kohm
5	AI1-	
6	AI2+	Analog input 2 0(4)...20 mA, R_{in} > 100 ohm By default, not in use.
7	AI2-	
XAO	Analog outputs	
1	AO1	Motor speed rpm 0...20 mA, R_L < 500 ohm
2	AGND	
3	AO2	Motor current 0...20 mA, R_L < 500 ohm
4	AGND	
XD2D	Drive-to-drive link	
1	B	Drive-to-drive link
2	A	
3	BGND	
XRO1, XRO2, XRO3	Relay outputs	
1	NC	Relay out 1 250 V AC / 30 VDC, 2 A Ready run
2	COM	
3	NO	
1	NC	Relay output 2 250 V AC / 30 VDC, 2 A Running
2	COM	
3	NO	
1	NC	Relay output 3 250 V AC / 30 VDC, 2 A Fault (-1)
2	COM	
3	NO	
XD24	Digital interlock	
1	DIIL	Run enable
2	+24VD	+24 V DC 200 mA
3	DICOM	Digital input ground
4	+24VD	+24 V DC 200 mA
5	DIOGND	Digital input/output ground
XDIO	Digital input/outputs	
1	DIO1	Output: Ready
2	DIO2	Output: Running
XDI	Digital inputs	
1	DI1	Stop (0) / Start (1)
2	DI2	By default, not in use.
3	DI3	By default, not in use.
4	DI4	By default, not in use.
5	DI5	By default, not in use.
6	DI6	By default, not in use.
XSTO	Safe torque off circuits must be closed for the drive to start. See *Hardware manual* of drive.	
X12	Safety options connection	
X13	Control panel connection	
X205	Memory unit connection	

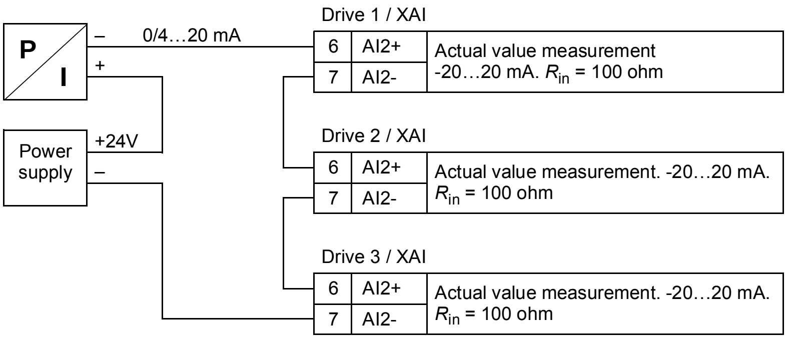
Sensor connection examples



Note: The sensor must be powered externally.







Application control PCP/ESP

This default connection scheme is used for PCP/ESP application. Pump speed reference is constant and selectable through parameter *74.05 Speed ref source*.

The application works through Ext1 and Ext 2 control locations.

The start/stop signal is connected to digital input DI1. The reset is determined by digital input DI2. Klixon temperature sensor is connected to input DI3. Input DI4 is responsible for pressure protection. Pressure limits and temperature limits are set through corresponding parameters, as well as protection modes.

PT100 source feedback goes through input AI1 scaled. AO2 is used for feeding excitation current. Pressure feedback source goes through AI2 scaled as a current signal in the range of 020 mA.

Default parameter settings for the PCP/ESP

Below is a listing of default parameter values that differ from those listed for the factory macro in *Parameter listing* (page *105*).

Parameter		PCP/ESP control default
No.	**Name**	
20.01	*Ext1 commands*	*In1 Start*
20.06	*Ext2 commands*	*Not selected*
74.01	*Pump enable*	*Enable*
74.02	*Run-time hours reset source*	*No*
74.05	*Speed ref source*	*AI1 scaled*
76.01	*Pressure protection function*	*Disable*
76.02	*Pressure protection latching*	*Non latching*
76.03	*Digital feedback source enable*	*FALSE*
76.04	*Digital feedback source*	*FALSE*
76.05	*Analog feedback source enable*	*FALSE*
76.06	*Analog feedback source*	*Zero*
76.07	*Analog feedback limit*	*0.00 kPa or psi*
76.08	*Analog feedback limit delay time*	*0.000 s*
79.01	*Temperature protection function*	*No*
79.02	*Temperature protection device*	*Klixon*
79.03	*Klixon signal source*	*FALSE*
79.04	*PT100 source*	*Zero*
79.05	*PT100 exitation source*	*Zero*
79.06	*PT100 internal selection*	*9.10 mA*
79.07	*Number of PT100 sensors in series*	*1*

Parameter		PCP/ESP control default
No.	**Name**	
79.08	*Warning temperature limit*	*0.00 °C*
79.09	*Fault temperature limit*	*0.00 °C*

8

Parameters

Contents of this chapter

The chapter describes the parameters, including actual signals, of the control program.

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 *Application macros* in See *ACS880 primary control program firmware manual (3AUA0000085967[English])*. **Note:** Certain configurations or optional equipment may require specific default values. These are labeled as follows: (*95.20* bx) = Default changed or write-protected by parameter *95.20*, bit x.
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 *361*).
Other	The value is taken from another parameter. Choosing “Other” displays a parameter list in which the user can specify the source parameter. **Note:** The source parameter must be a 32-bit real (floating point) number. To use a 16-bit integer (for example, received from an external device in data sets) as the source, data storage parameters *47.01*...*47.08* (page *281*) can be used.
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.

Term	Definition
Parameter	Either a user-adjustable operating instruction for the drive, or an *actual signal*.
p.u.	Per unit

Summary of parameter groups

Group	Contents	Page
46 Monitoring/scaling settings	Speed supervision settings; actual signal filtering; general scaling settings.	280
47 Data storage	Data storage parameters that can be written to and read from using other parameters' source and target settings.	281
49 Panel port communication	Communication settings for the control panel port on the drive.	283
50 Fieldbus adapter (FBA)	Fieldbus communication configuration.	284
51 FBA A settings	Fieldbus adapter A configuration.	291
52 FBA A data in	Selection of data to be transferred from drive to fieldbus controller through fieldbus adapter A.	293
53 FBA A data out	Selection of data to be transferred from fieldbus controller to drive through fieldbus adapter A.	293
54 FBA B settings	Fieldbus adapter B configuration.	294
55 FBA B data in	Selection of data to be transferred from drive to fieldbus controller through fieldbus adapter B.	295
56 FBA B data out	Selection of data to be transferred from fieldbus controller to drive through fieldbus adapter B.	296
58 Embedded fieldbus	Configuration of the embedded fieldbus (EFB) interface.	296
74 Pump setup	Basic functions of applications.	303
75 Pump level control	Pump level control function.	307
76 Pump pressure protection	Pump pressure protection function.	310
77 Pump torque protection	Pump torque protection function.	311
78 Pump underload protection	Pump underload protection function.	314
79 Pump temperature protection	Pump temperature protection function.	315
80 Pump backspin control	Basic functions of applications.	316
90 Feedback selection	Motor and load feedback configuration.	318
91 Encoder module settings	Configuration of encoder interface modules.	327
92 Encoder 1 configuration	Settings for encoder 1.	330
93 Encoder 2 configuration	Settings for encoder 2.	336
95 HW configuration	Various hardware-related settings.	338
96 System	Language selection; access levels; macro selection; parameter save and restore; control unit reboot; user parameter sets; unit selection.	342
97 Motor control	Motor model settings.	348
98 User motor parameters	Motor values supplied by the user that are used in the motor model.	351
99 Motor data	Motor configuration settings.	353
200 Safety	FSO-xx settings.	359

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.	
01.01	*Motor speed used*	Measured or estimated motor speed depending on which type of feedback is used (see parameter *90.41 Motor feedback selection*). A filter time constant for this signa46l can be defined by parameter *46.11 Filter time motor speed*.	-
	-30000.00 …30000.00 rpm	Measured or 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 %*	Shows the value of *01.01 Motor speed used* in percent of the synchronous speed of the motor.	10 = 1%
	-1000.00 … 1000.00%	Measured or estimated motor speed.	See par. *46.01*
01.04	*Encoder 1 speed filtered*	Speed of encoder 1 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	Encoder 1 speed.	See par. *46.01*
01.05	*Encoder 2 speed filtered*	Speed of encoder 2 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	Encoder 2 speed.	See par. *46.01*
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*
01.10	*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 out*.	-
	-32768.00 …32767.00 kW or hp	Output power.	1 = 1 unit
01.15	*Output power % of motor nom*	Shows the value of *01.14 Output power* in percent of the nominal power of the motor.	-
	-300.00 … 300.00%	Output power.	1 = 1%
01.17	*Motor shaft power*	Estimated mechanical power at motor shaft. The unit is selected by parameter *96.16 Unit selection*.	-
	-32768.00 … 32767.00 kW or hp	Motor shaft power.	1 = 1 unit
01.18	*Inverter GWh motoring*	Amount of energy that has passed through the drive (towards the motor) in full gigawatt-hours. The minimum value is zero.	-
	0...32767 GWh	Motoring energy in GWh.	1 = 1 GWh
01.19	*Inverter MWh motoring*	Amount of energy that has passed through the drive (towards the motor) in full megawatt-hours. Whenever the counter rolls over, *01.18 Inverter GWh motoring* is incremented.The minimum value is zero.	-
	0...1000 MWh	Motoring energy in MWh.	1 = 1 MWh
01.20	*Inverter kWh motoring*	Amount of energy that has passed through the drive (towards the motor) in full kilowatt-hours. Whenever the counter rolls over, *01.19 Inverter MWh motoring* is incremented.The minimum value is zero.	-
	0...1000 kWh	Motoring energy in kWh.	10 = 1 kWh
01.21	*U-phase current*	Measured U-phase current.	-
	-30000.00 … 30000.00 A	U-phase current.	-
01.22	*V-phase current*	Measured V-phase current.	-
	-30000.00 … 30000.00 A	V-phase current.	-
01.23	*W-phase current*	Measured W-phase current.	-
	-30000.00 … 30000.00 A	W-phase current.	-
01.24	*Flux actual %*	Used flux reference in percent of nominal flux of motor.	-
	0...200%	Flux reference.	1 = 1%
01.29	*Speed change rate*	Rate of actual speed change. Positive values indicate acceleration, negative values indicate deceleration. See also parameters *31.32 Emergency ramp supervision*, *31.33 Emergency ramp supervision delay*, *31.37 Ramp stop supervision* and *31.38 Ramp stop supervision delay*.	-
	-15000...15000 rpm/s	Rate of speed change.	1 = 1 rpm/s

No.	Name/Value	Description	Def/ FbEq16
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 N·m or lb·ft
	0.000...4000000.000 N·m or lb·ft	Nominal torque.	1 = 100 unit
01.31	*Ambient temperature*	Measured temperature of incoming cooling air. The unit is selected by parameter *96.16 Unit selection*.	-
	-40…120 °C or °F	Cooling air temperature.	1 = 1°
01.32	*Inverter GWh regenerating*	Amount of energy that has passed through the drive (towards the supply) in full gigawatt-hours. The minimum value is zero.	-
	0…32767 GWh	Motoring energy in GWh.	1 = 1 GWh
01.33	*Inverter MWh regenerating*	Amount of energy that has passed through the drive (towards the supply) in full megawatt-hours. Whenever the counter rolls over, *01.32 Inverter GWh regenerating* is incremented.The minimum value is zero.	-
	0…1000 MWh	Motoring energy in MWh.	1 = 1 MWh
01.34	*Inverter kWh regenerating*	Amount of energy that has passed through the drive (towards the supply) in full kilowatt-hours. Whenever the counter rolls over, *01.33 Inverter MWh regenerating* is incremented.The minimum value is zero.	-
	0…1000 kWh	Motoring energy in kWh.	10 = 1 kWh
01.35	*Mot - regen energy GWh*	Amount of net energy (motoring energy - regenerating energy) that has passed through the drive in full gigawatt-hours.	-
	-32768…32767 GWh	Motoring energy in GWh.	1 = 1 GWh
01.36	*Mot - regen energy MWh*	Amount of net energy (motoring energy - regenerating energy) that has passed through the drive in full megawatt-hours. Whenever the counter rolls over, *01.35 Mot - regen energy GWh* is incremented or decremented.	-
	-1000…1000 MWh	Motoring energy in MWh.	1 = 1 MWh
01.37	*Mot - regen energy kWh*	Amount of energy (motoring energy - regenerating energy) that has passed through the drive in full kilowatt-hours. Whenever the counter rolls over, *01.36 Mot - regen energy MWh* is incremented or decremented.	-
	-1000…1000 kWh	Motoring energy in kWh.	10 = 1 kWh
01.61	*Abs motor speed used*	Absolute value of *01.01 Motor speed used*.	-
	0.00 … 30000.00 rpm	Measured or estimated motor speed.	See par. *46.01*
01.62	*Abs motor speed %*	Absolute value of *01.03 Motor speed %*.	-
	0.00 … 1000.00%	Measured or estimated motor speed.	See par. *46.01*
01.63	*Abs output frequency*	Absolute value of *01.06 Output frequency*.	-
	0.00 … 500.00 Hz	Estimated output frequency.	See par. *46.02*

No.	Name/Value	Description	Def/ FbEq16
01.64	*Abs motor torque*	Absolute value of *01.10 Motor torque*.	-
	0.0 … 1600.0%	Motor torque.	-
01.65	*Abs output power*	Absolute value of *01.14 Output power*.	-
	0.00 … 32767.00 kW or hp	Output power.	1 = 1 unit
01.66	*Abs output power % motor nom*	Absolute value of *01.15 Output power % of motor nom*.	-
	0.00 … 300.00%	Output power.	1 = 1%
01.68	*Abs motor shaft power*	Absolute value of *01.17 Motor shaft power*.	-
	0.00 … 32767.00 kW or hp	Motor shaft power.	1 = 1 unit

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 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 *461*).	-
	-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
03.07	*FB B reference 1*	Reference 1 received through fieldbus adapter B.	-
	-100000.00 …100000.00	Reference 1 from fieldbus adapter B.	1 = 10
03.08	*FB B reference 2*	Reference 2 received through fieldbus adapter B.	-
	-100000.00 …100000.00	Reference 2 from fieldbus adapter B.	1 = 10
03.09	*EFB reference 1*	Scaled reference 1 received through the embedded fieldbus interface.	1 = 10
	-30000.00 … 30000.00	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	Reference 2 received through the embedded fieldbus interface.	1 = 10

No.	Name/Value	Description	Def/ FbEq16
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
04.04	*Active fault 4*	Code of the 4th active fault.	-
	0000h...FFFFh	4th active fault.	1 = 1
04.05	*Active fault 5*	Code of the 5th active fault.	-
	0000h...FFFFh	5th 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
04.09	*Active warning 4*	Code of the 4th active warning.	-
	0000h...FFFFh	4th active warning.	1 = 1
04.10	*Active warning 5*	Code of the 5th active warning.	-
	0000h...FFFFh	5th 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
04.14	*4th latest fault*	Code of the 4th stored (non-active) fault.	-
	0000h...FFFFh	4th stored fault.	1 = 1
04.15	*5th latest fault*	Code of the 5th stored (non-active) fault.	-
	0000h...FFFFh	5th 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

No.	Name/Value	Description	Def/ FbEq16
04.18	3rd latest warning	Code of the 3rd stored (non-active) warning.	-
	0000h...FFFFh	3rd stored warning.	1 = 1
04.19	4th latest warning	Code of the 4th stored (non-active) warning.	-
	0000h...FFFFh	4th stored warning.	1 = 1
04.20	5th latest warning	Code of the 5th stored (non-active) warning.	-
	0000h...FFFFh	5th stored warning.	1 = 1
04.21	Fault word 1	ACS800-compatible fault word 1. The bit assignments of this word correspond to FAULT WORD 1 in the ACS800. Parameter *04.120 Fault/Warning word compatibility* determines whether the bit assignments are according to the ACS800 Standard or ACS800 System control program. Each bit can indicate several ACS880 events as listed below. This parameter is read-only.	-

Bit	ACS800 fault name (*04.120* = *ACS800 Standard ctrl program*)	ACS800 fault name (*04.120* = *ACS800 System ctrl program*)	ACS880 events indicated by this bit (see *Fault tracing*, page *405*)
0	SHORT CIRC	SHORT CIRC	*2340*
1	OVERCURRENT	OVERCURRENT	*2310*
2	DC OVERVOLT	DC OVERVOLT	*3210*
3	ACS800 TEMP	ACS800 TEMP	*2381*, *4210*,*4290*, *42F1*, *4310*, *4380*
4	EARTH FAULT	EARTH FAULT	*2330*, *2392*, *3181*
5	THERMISTOR	MOTOR TEMP M	*4981*
6	MOTOR TEMP	MOTOR TEMP	*4982*
7	SYSTEM_FAULT	SYSTEM_FAULT	*6481*, *6487*, *64A1*, *64A2*, *64A3*, *64B1*, *64E1*, *6881*, *6882*, *6883*, *6885*
8	UNDERLOAD	UNDERLOAD	-
9	OVERFREQ	OVERFREQ	*7310*
10	Reserved	MPROT SWITCH	*9081*
11	Reserved	CH2 COMM LOSS	-
12	Reserved	SC (INU1)	*2340* (XXYY YY01)
13	Reserved	SC (INU2)	*2340* (XXYY YY02)
14	Reserved	SC (INU3)	*2340* (XXYY YY03)
15	Reserved	SC (INU4)	*2340* (XXYY YY04)

No.	Name/Value	Description	Def/ FbEq16
	0000h…FFFFh	ACS800-compatible fault word 1.	1 = 1

No.	Name/Value	Description	Def/ FbEq16
04.22	*Fault word 2*	ACS800-compatible fault word 2. The bit assignments of this word correspond to FAULT WORD 2 in the ACS800. Parameter *04.120 Fault/Warning word compatibility* determines whether the bit assignments are according to the ACS800 Standard or ACS800 System control program. Each may indicate several ACS880 events as listed below. This parameter is read-only.	-

Bit	ACS800 fault name (*04.120* = *ACS800 Standard ctrl program*)	ACS800 fault name (*04.120* = *ACS800 System ctrl program*)	**ACS880 events indicated by this bit** (see *Fault tracing*, page *405*)
0	SUPPLY PHASE	SUPPLY PHASE	*3130*
1	NO MOT DATA	NO MOTOR DATA	-
2	DC UNDERVOLT	DC UNDERVOLT	*3220*
3	Reserved	CABLE TEMP	*4000*
4	RUN ENABLE	RUN DISABLE	*AFEB*
5	ENCODER ERR	ENCODER ERR	*7301*, *7380*, *7381*, *73A0*, *73A1*
6	I/O COMM	IO COMM ERR	*7080*, *7082*
7	CTRL B TEMP	CTRL B TEMP	-
8	EXTERNAL FLT	SELECTABLE	*9082*
9	OVER SWFREQ	OVER SWFREQ	-
10	AI < MIN FUNC	AI<MIN FUNC	*80A0*
11	PPCC LINK	PPCC LINK	*5681*, *5682*, *5690*, *5691*, *5692*, *5693*, *5694*
12	COMM MODULE	COMM MODULE	*6681*, *7510*, *7520*
13	PANEL LOSS	PANEL LOSS	*7081*
14	MOTOR STALL	MOTOR STALL	*7121*
15	MOTOR PHASE	MOTOR PHASE	*3381*

No.	Name/Value	Description	Def/ FbEq16
	0000h…FFFFh	ACS800-compatible fault word 2.	1 = 1

No.	Name/Value	Description	Def/ FbEq16
04.31	*Warning word 1*	ACS800-compatible warning (alarm) word 1. The bit assignments of this word correspond to ALARM WORD 1 in the ACS800. Parameter *04.120 Fault/Warning word compatibility* determines whether the assignments are according to the ACS800 Standard or ACS800 System control program. Each may indicate several ACS880 warnings as listed below. This parameter is read-only.	-

Bit	ACS800 alarm name (*04.120* = *ACS800 Standard ctrl program*)	ACS800 alarm name (*04.120* = *ACS800 System ctrl program*)	**ACS880 events indicated by this bit** (see *Fault tracing*, page *405*)
0	START INHIBIT	START INHIBI	*B5A0*
1	Reserved	EM STOP	*AFE1*, *AFE2*
2	THERMISTOR	MOTOR TEMP M	*A491*
3	MOTOR TEMP	MOTOR TEMP	*A492*
4	ACS800 TEMP	ACS800 TEMP	*A2BA*, *A4A1*, *A4A9*, *A4B0*, *A4B1*, *A4F6*
5	ENCODER ERR	ENCODER ERR	*A797*, *A7B0*, *A7B1*, *A7E1*
6	T MEAS ALM	T MEAS CIRC	*A490*, *A5EA*, *A782*, *A8A0*
7	Reserved	DIGITAL IO	-
8	Reserved	ANALOG IO	-
9	Reserved	EXT DIGITAL IO	-
10	Reserved	EXT ANALOG IO	*A6E5*, *A7AA*, *A7AB*
11	Reserved	CH2 COMM LOSS	*A7CE*
12	COMM MODULE	MPROT SWITCH	*A981*
13	Reserved	EM STOP DEC	-
14	EARTH FAULT	EARTH FAULT	*A2B3*
15	Reserved	SAFETY SWITC	*A983*

No.	Name/Value	Description	Def/ FbEq16
	0000h…FFFFh	ACS800-compatible warning (alarm) word 1.	1 = 1

No.	Name/Value	Description	Def/ FbEq16
04.32	*Warning word 2*	ACS800-compatible warning (alarm) word 2. The bit assignments of this word correspond to ALARM WORD 2 in the ACS800. Parameter *04.120 Fault/Warning word compatibility* determines whether the bit assignments are according to the ACS800 Standard or ACS800 System control program. Each may indicate several ACS880 warnings as listed below. This parameter is read-only.	-

Bit	ACS800 alarm name (*04.120* = *ACS800 Standard ctrl program*)	 (*04.120* = *ACS800 System ctrl program*)	**ACS880 events indicated by this bit** (see *Fault tracing*, page *405*)
0	Reserved	MOTOR FAN	*A781*
1	UNDERLOAD	UNDERLOAD	-
2	Reserved	INV OVERLOAD	-
3	Reserved	CABLE TEMP	*A480*
4	ENCODER	ENCODER A<>B	-
5	Reserved	FAN OVERTEMP	*A984*
6	Reserved	Reserved	-
7	POWFAIL FILE	POWFAIL FILE	-
8	ALM (OS_17)	POWDOWN FILE	-
9	MOTOR STALL	MOTOR STALL	*A780*
10	AI < MIN FUNC	AI<MIN FUNC	*A8A0*
11	Reserved	COMM MODULE	*A6D1*, *A6D2*, *A7C1*, *A7C2*, *A7CE*
12	Reserved	BATT FAILURE	-
13	PANEL LOSS	PANEL LOSS	*A7EE*
14	Reserved	DC UNDERVOLT	*A3A2*
15	Reserved	RESTARTED	-

No.	Name/Value	Description	Def/ FbEq16
	0000h…FFFFh	ACS800-compatible warning (alarm) word 2.	1 = 1
04.40	*Event word 1*	User-defined event word. This word collects the status of the events (warnings, faults or pure events) selected by parameters *04.41*…*04.72*. For each event, an auxiliary code can optionally be specified for filtering. This parameter is read-only.	-

Bit	Name	Description
0	User bit 0	1 = Event selected by parameters *04.41* (and *04.42*) is active
1	User bit 1	1 = Event selected by parameters *04.43* (and *04.44*) is active
…	…	…
15	User bit 15	1 = Event selected by parameters *04.71* (and *04.72*) is active

No.	Name/Value	Description	Def/ FbEq16
	0000h…FFFFh	User-defined event word.	1 = 1

No.	Name/Value	Description	Def/ FbEq16
04.41	*Event word 1 bit 0 code*	Selects the hexadecimal code of an event (warning, fault or pure event) whose status is shown as bit 0 of *04.40 Event word 1*. The event codes are listed in chapter *Fault tracing* (page *405*).	0000h
	0000h…FFFFh	Code of event.	1 = 1
04.42	*Event word 1 bit 0 aux code*	Specifies an auxiliary code for the event selected by the previous parameter. The selected event is indicated by the event word only if its auxiliary code matches the value of this parameter. With a value of 0000 0000h, the event word will indicate the event regardless of the auxiliary code.	0000 0000h
	0000 0000h … FFFF FFFFh	Code of warning, fault or pure event.	1 = 1
04.43	*Event word 1 bit 1 code*	Selects the hexadecimal code of an event (warning, fault or pure event) whose status is shown as bit 1 of *04.40 Event word 1*. The event codes are listed in chapter *Fault tracing* (page *405*).	0000h
	0000h…FFFFh	Code of event.	1 = 1
04.44	*Event word 1 bit 1 aux code*	Specifies an auxiliary code for the event selected by the previous parameter. The selected event is indicated by the event word only if its auxiliary code matches the value of this parameter. With a value of 0000 0000h, the event word will indicate the event regardless of the auxiliary code.	0000 0000h
	0000 0000h … FFFF FFFFh	Code of warning, fault or pure event.	1 = 1
…	…	…	…
04.71	*Event word 1 bit 15 code*	Selects the hexadecimal code of an event (warning, fault or pure event) whose status is shown as bit 15 of *04.40 Event word 1*. The event codes are listed in chapter *Fault tracing* (page *405*).	0000h
	0000h…FFFFh	Code of event.	1 = 1
04.72	*Event word 1 bit 15 aux code*	Specifies an auxiliary code for the event selected by the previous parameter. The selected event is indicated by the event word only if its auxiliary code matches the value of this parameter. With a value of 0000 0000h, the event word will indicate the event regardless of the auxiliary code.	0000 0000h
	0000 0000h … FFFF FFFFh	Code of warning, fault or pure event.	1 = 1
04.120	*Fault/Warning word compatibility*	Selects whether the bit assignments of parameters *04.21*…*04.32* correspond to the ACS800 Standard control program or the ACS800 System control program.	*FALSE*
	ACS800 Standard ctrl program	The bit assignments of parameters *04.21*…*04.32* correspond to the ACS800 Standard control program as follows: *04.21 Fault word 1*: 03.05 FAULT WORD 1 *04.22 Fault word 2*: 03.06 FAULT WORD 2 *04.31 Warning word 1*: 03.08 ALARM WORD 1 *04.32 Warning word 2*: 03.09 ALARM WORD 2	0

No.	Name/Value	Description	Def/ FbEq16
	ACS800 System ctrl program	The bit assignments of parameters *04.21…04.32* correspond to the ACS800 System control program as follows: *04.21 Fault word 1*: 09.01 FAULT WORD 1 *04.22 Fault word 2*: 09.02 FAULT WORD 2 *04.31 Warning word 1*: 09.04 ALARM WORD 1 *04.32 Warning word 2*: 09.05 ALARM WORD 2	1
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. The counter runs when the inverter modulates.	-
	0...65535 d	Motor run-time counter.	1 = 1 d
05.04	*Fan on-time counter*	Running time of the drive cooling fan. Can be reset from the control panel by keeping Reset depressed for over 3 seconds.	-
	0...65535 d	Cooling fan run-time counter.	1 = 1 d
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%
05.22	*Diagnostic word 3*	Diagnostic word 3.	-

Bit	Name	Value
0…10	Reserved	
11	Fan command	1 = Drive fan is rotating above idle speed
12	Fan service counter	1 = Drive fan service counter has reached its limit
13…15	Reserved	

No.	Name/Value	Description	Def/ FbEq16
	0000h…FFFFh	Diagnostic word 3.	1 = 1
05.41	*Main fan service counter*	Displays the age of the main cooling fan as a percentage of its estimated lifetime. The estimate is based on the duty, operating conditions and other operating parameters of the fan. When the counter reaches 100%, a warning (*A8C0 Fan service counter*) is generated. Can be reset from the control panel by keeping Reset depressed for over 3 seconds.	-

No.	Name/Value	Description	Def/ FbEq16
	0…150%	Main cooling fan age.	1 = 1%
05.42	*Aux. fan service counter*	Displays the age of the auxiliary cooling fan as a percentage of its estimated lifetime. The estimate is based on the duty, operating conditions and other operating parameters of the fan. When the counter reaches 100%, a warning (*A8C0 Fan service counter*) is generated. Can be reset from the control panel by keeping Reset depressed for over 3 seconds.	-
	0…150%	Auxiliary cooling fan age.	1 = 1%
	0000h...FFFFh	Main control word.	1 = 1

06 Control and status words		Drive control and status words.	
06.01	*Main control word*	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). The bit assignments of the word are as described on page *467*. The related status word and state diagram are presented on pages *468* respectively. **Note:** Bits 12…15 can be used to carry additional control data, and used as a signal source by any binary-source selector parameter. This parameter is read-only.	-
	0000h...FFFFh	Main control word.	1 = 1
06.02	*Application control word*	The drive control word received from the application program (if any). The bit assignments are described on page *467*. This parameter is read-only.	-
	0000h...FFFFh	Application program control word.	1 = 1
06.03	*FBA A transparent control word*	The unaltered control word received from the PLC through fieldbus adapter A. This parameter is read-only.	-
	00000000h …FFFFFFFFh	Control word received through fieldbus adapter A.	-
06.04	*FBA B transparent control word*	The unaltered control word received from the PLC through fieldbus adapter B. This parameter is read-only.	-
	00000000h …FFFFFFFFh	Control word received through fieldbus adapter B.	1 = 1
06.05	*EFB transparent control word*	The unaltered control word received from the PLC through the embedded fieldbus interface. This parameter is read-only.	-
	00000000h … FFFFFFFFh	Control word received through the embedded fieldbus interface.	1 = 1

No.	Name/Value	Description	Def/ FbEq16
06.11	*Main status word*	Main status word of the drive. The bit assignments are described on page *468*. The related control word and state diagram are presented on pages *467* and *470* respectively. This parameter is read-only.	-
	0000h...FFFFh	Main status word.	1 = 1
06.16	*Drive status word 1*	Drive status word 1. This parameter is read-only.	-

Bit	Name	Description
0	Enabled	1 = Both run enable (see par. *20.12*) and start enable (*20.19*) signals are present. Note: This bit is not affected by the presence of a fault.
1	Inhibited	1 = Start inhibited. See parameters *06.18* for the source of the inhibiting signal.
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 ctrl	1 = Drive is in *network control* (see page *14*)
10	Ext1 active	1 = Control location EXT1 active
11	Ext2 active	1 = Control location EXT2 active
12	Reserved	
13	Start request	1 = Start requested
14...15	Reserved	

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

No.	Name/Value	Description	Def/ FbEq16
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	Torque control	1 = Torque control mode active
3	Speed control	1 = Speed control mode active
4	Power control	1 = Power control mode active
5	Safe reference active	1 = A “safe” reference is being applied by functions such as parameters *49.05* and *50.02*
6	Last speed active	1 = A “last speed” reference is being 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	Jogging active	1 = Jogging enable signal is on
10	Above limit	1 = Actual speed, frequency or torque equals or exceeds limit (defined by parameters *46.31*…*46.33*). Valid in both directions of rotation.
11	Emergency stop active	1 = An emergency stop command signal is active, or the drive is stopping after receiving an emergency stop command.
12	Reduced run	1 = Reduced run active (see section *See parameter group 47 Data storage (page 281).* on page *92*)
13	Reserved	
14	Stop failed	1 = Stopping failed (see parameter *31.37* and *31.38*.
15	Reserved	

	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.	-

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	Lost start enable	1 = Start enable signal missing
5	Lost run enable	1 = Run enable signal missing
6	FSO inhibit	1 = Operation prevented by FSO-xx safety functions module
7	STO	1 = Safe torque off active
8	Current calibration ended	* 1 = Current calibration routine has finished
9	ID run ended	* 1 = Motor identification run has finished
10	Auto phase ended	* 1 = Autophasing routine has finished
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	Jogging active	1 = The jogging enable signal is inhibiting operation

	0000h…FFFFh	Start inhibit status word.	1 = 1

No.	Name/Value	Description	Def/ FbEq16
06.19	*Speed control status word*	Speed control status word. This parameter is read-only.	-

Bit	Name	Description
0	Zero speed	1 = Drive is running at zero speed
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	Out of window	1 = Speed error window control active (see par. *24.41*)
4	Internal speed feedback	1 = Estimated speed feedback used in motor control, ie. estimated speed is selected by par. *90.41* or *90.46*, or selected encoder has faulted (par. *90.45*) 0 = Encoder 1 or 2 is used for speed feedback.
5	Encoder 1 feedback	1 = Encoder 1 used for speed feedback in motor control 0 = Encoder 1 faulted or not selected as source of speed feedback (see par. *90.41* and *90.46*).
6	Encoder 2 feedback	1 = Encoder 2 used for speed feedback in motor control 0 = Encoder 2 faulted or not selected as source of speed feedback (see par. *90.41* and *90.46*).
7	Any constant speed request	1 = A constant speed or frequency has been selected; see par. *06.20*.
8	Follower speed corr min lim	1 = Minimum limit of speed correction (in a speed-controlled follower) has been reached (see par. *23.39…23.41*).
9	Follower speed corr max lim	1 = Maximum limit of speed correction (in a speed-controlled follower) has been reached (see par. *23.39…23.41*).
10…15	Reserved	

No.	Name/Value	Description	Def/ FbEq16
	0000h…FFFFh	Speed control status word.	1 = 1
06.29	*MSW bit 10 sel*	Selects a binary source whose status is transmitted as bit 10 of *06.11 Main status word*.	*Above limit*
	FALSE	0.	0
	True	1.	1
	Above limit	Bit 10 of *06.17 Drive status word 2* (see page *118*).	2
	Other [bit]	Source selection (see *Terms and abbreviations* on page *101*).	-
06.30	*MSW bit 11 sel*	Selects a binary source whose status is transmitted as bit 11 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 *117*).	2
	Other [bit]	Source selection (see *Terms and abbreviations* on page *101*).	-
06.31	*MSW bit 12 sel*	Selects a binary source whose status is transmitted as bit 12 of *06.11 Main status word*.	*Ext run enable*
	FALSE	0.	0
	True	1.	1

No.	Name/Value	Description	Def/ FbEq16
	Ext run enable	Inverted bit 5 of *06.18 Start inhibit status word* (see page *119*).	2
	Other [bit]	Source selection (see *Terms and abbreviations* on page *101*).	-
06.32	*MSW bit 13 sel*	Selects a binary source whose status is transmitted as bit 13 of *06.11 Main status word*.	*FALSE*
	FALSE	0.	0
	True	1.	1
	Other [bit]	Source selection (see *Terms and abbreviations* on page *101*).	-
06.33	*MSW bit 14 sel*	Selects a binary source whose status is transmitted as bit 14 of *06.11 Main status word*.	*FALSE*
	FALSE	0.	0
	True	1.	1
	Other [bit]	Source selection (see *Terms and abbreviations* on page *101*).	-
06.50	*User status word 1*	User-defined status word. This word shows the status of the binary sources selected by parameters *06.60*…*06.75*. This parameter is read-only.	-

Bit	Name	Description
0	User status bit 0	Status of source selected by parameter *06.60*
1	User status bit 1	Status of source selected by parameter *06.61*
…	…	…
15	User status bit 15	Status of source selected by parameter *06.75*

No.	Name/Value	Description	Def/ FbEq16
	0000h…FFFFh	User-defined status word.	1 = 1
06.60	*User status word 1 bit 0 sel*	Selects a binary source whose status is shown as bit 0 of *06.50 User status word 1*.	*FALSE*
	FALSE	0.	0
	True	1.	1
	Other [bit]	Source selection (see *Terms and abbreviations* on page *101*).	-
06.61	*User status word 1 bit 1 sel*	Selects a binary source whose status is shown as bit 1 of *06.50 User status word 1*.	*Out of window*
	FALSE	0.	0
	True	1.	1
	Out of window	Bit 3 of *06.19 Speed control status word* (see page *120*).	2
	Other [bit]	Source selection (see *Terms and abbreviations* on page *101*).	-
06.62	*User status word 1 bit 2 sel*	Selects a binary source whose status is shown as bit 2 of *06.50 User status word 1*.	*Emergency stop failed*
	FALSE	0.	0
	True	1.	1
	Emergency stop failed	Bit 8 of *06.17 Drive status word 2* (see page *118*).	2

No.	Name/Value	Description	Def/ FbEq16
	Other [bit]	Source selection (see *Terms and abbreviations* on page *101*).	-
06.63	*User status word 1 bit 3 sel*	Selects a binary source whose status is shown as bit 3 of *06.50 User status word 1*.	*Magnetized*
	FALSE	0.	0
	True	1.	1
	Magnetized	Bit 1 of *06.17 Drive status word 2* (see page *118*).	2
	Other [bit]	Source selection (see *Terms and abbreviations* on page *101*).	-
06.64	*User status word 1 bit 4 sel*	Selects a binary source whose status is shown as bit 4 of *06.50 User status word 1*.	*Run disable*
	FALSE	0.	0
	True	1.	1
	Run disable	Bit 5 of *06.18 Start inhibit status word* (see page *119*).	2
	Other [bit]	Source selection (see *Terms and abbreviations* on page *101*).	-
06.65	*User status word 1 bit 5 sel*	Selects a binary source whose status is shown as bit 5 of *06.50 User status word 1*.	*FALSE*
	FALSE	0.	0
	True	1.	1
	Other [bit]	Source selection (see *Terms and abbreviations* on page *101*).	-
06.66	*User status word 1 bit 6 sel*	Selects a binary source whose status is shown as bit 6 of *06.50 User status word 1*.	*FALSE*
	FALSE	0.	0
	True	1.	1
	Other [bit]	Source selection (see *Terms and abbreviations* on page *101*).	-
06.67	*User status word 1 bit 7 sel*	Selects a binary source whose status is shown as bit 7 of *06.50 User status word 1*.	*Identification run done*
	FALSE	0.	0
	True	1.	1
	Identification run done	Bit 0 of *06.17 Drive status word 2* (see page *118*).	2
	Other [bit]	Source selection (see *Terms and abbreviations* on page *101*).	-
06.68	*User status word 1 bit 8 sel*	Selects a binary source whose status is shown as bit 8 of *06.50 User status word 1*.	*Start inhibition*
	FALSE	0.	0
	True	1.	1
	Start inhibition	Bit 7 of *06.18 Start inhibit status word* (see page *119*).	2
	Other [bit]	Source selection (see *Terms and abbreviations* on page *101*).	-

No.	Name/Value	Description	Def/ FbEq16
06.69	*User status word 1 bit 9 sel*	Selects a binary source whose status is shown as bit 9 of *06.50 User status word 1*.	*Limiting*
	FALSE	0.	0
	True	1.	1
	Limiting	Bit 7 of *06.16 Drive status word 1* (see page *117*).	2
	Other [bit]	Source selection (see *Terms and abbreviations* on page *101*).	-
06.70	*User status word 1 bit 10 sel*	Selects a binary source whose status is shown as bit 10 of *06.50 User status word 1*.	*Torque control* Time
	FALSE	0.	0
	True	1.	1
	Torque control	Bit 2 of *06.17 Drive status word 2* (see page *118*).	2
	Other [bit]	Source selection (see *Terms and abbreviations* on page *101*).	-
06.71	*User status word 1 bit 11 sel*	Selects a binary source whose status is shown as bit 11 of *06.50 User status word 1*.	*Zero speed*
	FALSE	0.	0
	True	1.	1
	Zero speed	Bit 0 of *06.19 Speed control status word* (see page *120*).	2
	Other [bit]	Source selection (see *Terms and abbreviations* on page *101*).	-
06.72	*User status word 1 bit 12 sel*	Selects a binary source whose status is shown as bit 12 of *06.50 User status word 1*.	*Internal speed feedback*
	FALSE	0.	0
	True	1.	1
	Internal speed feedback	Bit 4 of *06.19 Speed control status word* (see page *120*).	2
	Other [bit]	Source selection (see *Terms and abbreviations* on page *101*).	-
06.73	*User status word 1 bit 13 sel*	Selects a binary source whose status is shown as bit 13 of *06.50 User status word 1*.	*FALSE*
	FALSE	0.	0
	True	1.	1
	Other [bit]	Source selection (see *Terms and abbreviations* on page *101*).	-
06.74	*User status word 1 bit 14 sel*	Selects a binary source whose status is shown as bit 14 of *06.50 User status word 1*.	*FALSE*
	FALSE	0.	0
	True	1.	1
	Other [bit]	Source selection (see *Terms and abbreviations* on page *101*).	-
06.75	*User status word 1 bit 15 sel*	Selects a binary source whose status is shown as bit 15 of *06.50 User status word 1*.	*False*
	False	0.	0
	True	1.	1

No.	Name/Value	Description	Def/ FbEq16
	Other [bit]	Source selection (see *Terms and abbreviations* on page *101*).	-
06.100	*User control word 1*	User-defined control word 1. This parameter is read-only.	-

Bit	Name	Description
0	User control word 1 bit 0	User-defined bit.
1	User control word 1 bit 1	User-defined bit.
…	…	…
15	User control word 1 bit 15	User-defined bit.

No.	Name/Value	Description	Def/ FbEq16
	0000h…FFFFh	User-defined control word 1.	1 = 1
06.101	*User control word 2*	User-defined control word 2. This parameter is read-only.	-

Bit	Name	Description
0	User control word 2 bit 0	User-defined bit.
1	User control word 2 bit 1	User-defined bit.
…	…	…
15	User control word 2 bit 15	User-defined bit.

No.	Name/Value	Description	Def/ FbEq16
	0000h…FFFFh	User-defined control word 2.	1 = 1

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/inverter unit.	-
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%
07.13	*PU logic version number*	Version number of the power unit logic.	-

No.	Name/Value	Description	Def/ FbEq16
07.21	*Application environment status 1*	Shows which tasks of the application program are running. See the *Drive (IEC 61131-3) application programming manual* (3AUA0000127808 [English]).	-

Bit	Name	Description
0	Pre task	1 = Pre-task running.
1	Appl task1	1 = Task 1 running.
2	Appl task2	1 = Task 2 running.
3	Appl task3	1 = Task 3 running.
4…14	Reserved	
15	Task monitoring	1 = Task monitoring enabled

No.	Name/Value	Description	Def/ FbEq16
	0000h…FFFFh	Application program task status.	1 = 1
07.22	*Application environment status 2*	Shows the status of the openings in the application program. See the *Drive (IEC 61131-3) application programming manual* (3AUA0000127808 [English]).	-

Bit	Name	Description
0	Opening1	Status of opening 1 in the application program.
1	Opening2	Status of opening 2 in the application program.
…	…	…
15	Opening16	Status of opening 16 in the application program.

No.	Name/Value	Description	Def/ FbEq16
	0000h…FFFFh	Application program opening status.	1 = 1
07.23	*Application name*	First five ASCII letters of the name given to the application program in the programming tool. The full name is visible under System info on the control panel or the Drive composer PC tool. _N/A_ = None.	-
07.24	*Application version*	Application program version number given to the application program in the programming tool. Also visible under System info on the control panel or the Drive composer PC tool.	-
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.	-

No.	Name/Value	Description	Def/ FbEq16
09 Pump actuals		Basic signals for monitoring the application. All parameters in this group are read-only unless otherwise noted.	
09.01	*Rod torque*	Estimated pump torque in engineering units.	0.00 N•m or lbft
	-100000.00 ...100000.00	Value range	10 = 1 N•m or lbft

No.	Name/Value	Description	Def/ FbEq16
09.02	*Maximum rod torque*	Maximum allowed pump torque in engineering units.	0.00
	-100000.00 ...100000.00	Value range	10 = 1 N•m or lbft
09.03	*Motor torque*	Actual motor torque in engineering units.	0.00 N•m or lbft
	-100000.00 ...100000.00	Value range	10 = 1 N•m or lbft
09.04	*Maximum motor torque*	Maximum allowed motor torque in engineering units.	0.00 N•m or lbft
	-100000.00 ...100000.00	Value range	10 = 1 N•m or lbft
09.05	*Rod speed*	Pump speed in engineering units.	0.00 Prpm, rpm or Hz
	-100000.00 ...100000.00	Value range	10 = 1 Prpm, rpm or Hz
09.06	*Motor speed reference*	Motor speed reference in engineering units.	0.00 rpm or Hz
	-100000.00 ...100000.00	Value range	10 = 1 rpm or Hz
09.07	*Run-time hours*	Runtime of the pump in hours.	0.00 h
	0.00....100000.00	Value range	10 = 1 h
09.08	*Fluid level*	Measured fluid level in depth units.	0.00 m, ft or Joints
	-100000.00 ...100000.00	Value range	10 = 1 m, ft or Joints
09.09	*Pressure*	Measured pressure in engineering units.	0.00 kPa or psi
	-100000.00 ...100000.00	Value range	10 = 1 kPa or psi
09.10	*Measured temperature*	Measured temperature in engineering units.	0.00 °C
	-100000.00 ...100000.00	Value range	10 = 1 °C
09.11	*Backspin speed reference*	Speed reference for controllable shutdown procedure.	0.00 Prpm, rpm or Hz
	-100000.00 ...100000.00	Value range	10 = 1 Prpm, rpm or Hz
09.12	*Start delay remain*	Remaining start delay time.	0.000s
	0…4294967.295	Value range	10 = 1 s
09.13	*Backspin status word*	Pump backspin status word.	0000h

No.	Name/Value	Description	Def/ FbEq16
		(see bit table below)	
	0000h...FFFFh	Backspin status word	1 = 1
09.14	*Pump status word*	Pump control program status word.	0000h

Bit	Name	Description
0	Backspin enabled	Backspin function is enabled.
1	Backspin operation active	Backspin function is active.
2	Backspin limit active	Backspin limit is reached.
3...9	Reserved	
10	Start delay enabled	Start delay function is enabled.
11	Start delay timer active	Start delay function is active.
12...15	Reserved	

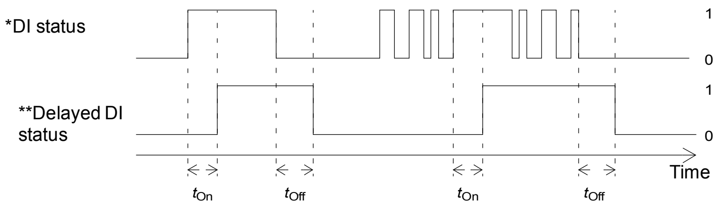
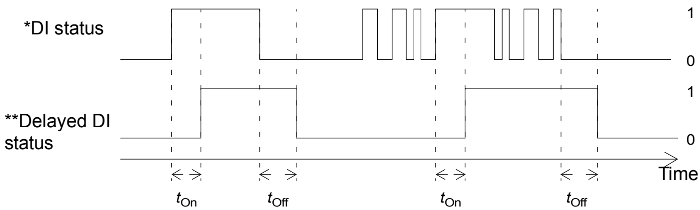
Bit	Name	Description
0	Thermal protection alarm level reached	Alarm due to thermal protection failure.
1	Thermal protection fault level reached	Drive tripped due to thermal protection failure.
2	Thermal protection active	Actual temperature for thermal protection.
3	High pressure presented - digital sensor	High pressure measured by digital sensor.
4	High pressure presented - analogue sensor	High pressure measured by analog sensor.
5	High pressure protection active	Actual value for high pressure protection.
6	Underload protection active	Actual value for underload protection.
7	Rod torque 1 active	Actual rod torque 1.
8	Rod torque 2 active	Actual rod torque 2.
9	Torque protection active	Actual value for torque protection.
10	Sleep mode active	Actual value for sleep mode.
11	Fault delay active	Fault delay is active.
12	Replace battery	Battery from ZCU is needed to replace.
13	Brake confirm active	Brake confirm is active.
14	Starting speed active	Drive is ready for startup ramp.
15	Rod torque 2 speed	Reserved for rod torque 2 speed.

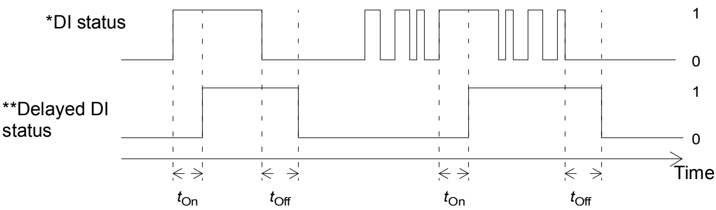
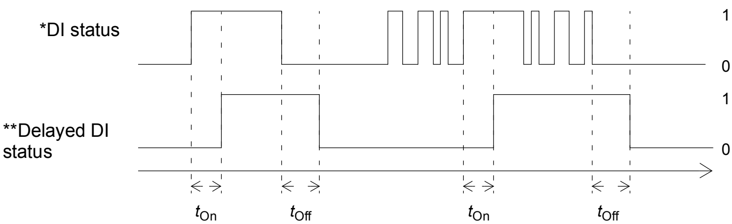
No.	Name/Value	Description	Def/ FbEq16
	0000h…FFFFh	Pump status word.	1 = 1
09.15	*Sleep feedback value*	Integrated value of sleep signal feedback from different sources *75.14 Sleep signal source 1* and *75.15 Sleep signal source 2*.	0.00 SourceUnit
	-100000.00...100000.00	Value range	1 = 1
09.16	*Sleep time*	Period of time when pump is in sleep mode.	0.000 s
	0...100000.000 s	Value range	10 = 1 s

No.	Name/Value	Description	Def/ FbEq16
10 Standard DI, RO		Configuration of digital inputs and relay outputs.	
10.01	DI status	Displays the electrical status of digital inputs DIIL and DI6…DI1. The activation/deactivation delays of the inputs (if any are specified) are ignored. A filtering time can be defined by parameter 10.51 DI filter time. Bits 0…5 reflect the status of DI1…DI6; bit 15 reflects the status of the DIIL input. Example: 1000000000010011b = DIIL, DI5, DI2 and DI1 are on, DI3, DI4 and DI6 are off. This parameter is read-only.	-
	0000h…FFFFh	Status of digital inputs.	1 = 1
10.02	DI delayed status	Displays the status of digital inputs DIIL and DI6…DI1. This word is updated only after activation/deactivation delays (if any are specified). Bits 0…5 reflect the delayed status of DI1…DI6; bit 15 reflects the delayed status of the DIIL input. This parameter is read-only.	-
	0000h…FFFFh	Delayed status of 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 force data is provided for each digital input, and its value is applied whenever the corresponding bit in this parameter is 1.	0000h

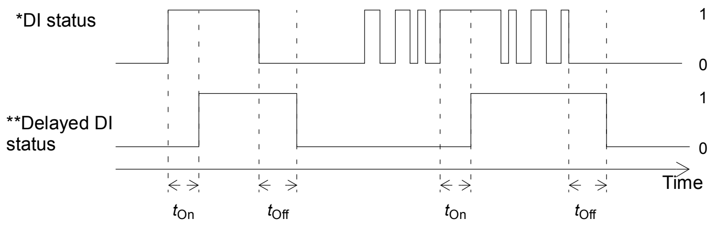
Bit	Value
0	1 = Force DI1 to value of bit 0 of parameter 10.04 DI force data.
1	1 = Force DI2 to value of bit 1 of parameter 10.04 DI force data.
2	1 = Force DI3 to value of bit 2 of parameter 10.04 DI force data.
3	1 = Force DI4 to value of bit 3 of parameter 10.04 DI force data.
4	1 = Force DI5 to value of bit 4 of parameter 10.04 DI force data.
5	1 = Force DI6 to value of bit 5 of parameter 10.04 DI force data.
6…14	Reserved
15	1 = Force DIIL to value of bit 15 of parameter 10.04 DI force data.

No.	Name/Value	Description	Def/ FbEq16
	0000h…FFFFh	Override selection for digital inputs.	1 = 1
10.04	DI force data	Contains the values that the digital inputs are forced to when selected by 10.03 DI force selection. Bit 0 is the forced value for DI1; bit 15 is the forced value for the DIIL input.	0000h
	0000h…FFFFh	Forced values of digital inputs.	1 = 1

No.	Name/Value	Description	Def/ FbEq16
10.05	*DI1 ON delay*	Defines the activation delay for digital input DI1.	0.0 s
		 t_{On} = *10.05 DI1 ON delay* t_{Off} = *10.06 DI1 OFF delay* *Electrical status of digital input. Indicated by *10.01 DI status*. **Indicated by *10.02 DI delayed status*.	
	0.0 … 3000.0 s	Activation delay for DI1.	10 = 1 s
10.06	*DI1 OFF delay*	Defines the deactivation delay for digital input DI1. See parameter *10.05 DI1 ON delay*.	0.0 s
	0.0 … 3000.0 s	Deactivation delay for DI1.	10 = 1 s
10.07	*DI2 ON delay*	Defines the activation delay for digital input DI2.	0.0 s
		 t_{On} = *10.07 DI2 ON delay* t_{Off} = *10.08 DI2 OFF delay* *Electrical status of digital input. Indicated by *10.01 DI status*. **Indicated by *10.02 DI delayed status*.	
	0.0 … 3000.0 s	Activation delay for DI2.	10 = 1 s
10.08	*DI2 OFF delay*	Defines the deactivation delay for digital input DI2. See parameter *10.07 DI2 ON delay*.	0.0 s
	0.0 … 3000.0 s	Deactivation delay for DI2.	10 = 1 s

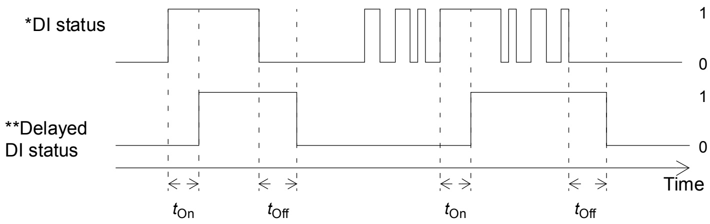
No.	Name/Value	Description	Def/ FbEq16
10.09	*DI3 ON delay*	Defines the activation delay for digital input DI3.	0.0 s
	 t_{On} = *10.09 DI3 ON delay* t_{Off} = *10.10 DI3 OFF delay* *Electrical status of digital input. Indicated by *10.01 DI status*. **Indicated by *10.02 DI delayed status*.		
	0.0 … 3000.0 s	Activation delay for DI3.	10 = 1 s
10.10	*DI3 OFF delay*	Defines the deactivation delay for digital input DI3. See parameter *10.09 DI3 ON delay*.	0.0 s
	0.0 … 3000.0 s	Deactivation delay for DI3.	10 = 1 s
10.11	*DI4 ON delay*	Defines the activation delay for digital input DI4.	0.0 s
	 t_{On} = *10.11 DI4 ON delay* t_{Off} = *10.12 DI4 OFF delay* *Electrical status of digital input. Indicated by *10.01 DI status*. **Indicated by *10.02 DI delayed status*.		
	0.0 … 3000.0 s	Activation delay for DI4.	10 = 1 s
10.12	*DI4 OFF delay*	Defines the deactivation delay for digital input DI4. See parameter *10.11 DI4 ON delay*.	0.0 s
	0.0 … 3000.0 s	Deactivation delay for DI4.	10 = 1 s

No.	Name/Value	Description	Def/ FbEq16
10.13	*DI5 ON delay*	Defines the activation delay for digital input DI5.	0.0 s



t_{On} = *10.13 DI5 ON delay*
t_{Off} = *10.14 DI5 OFF delay*
*Electrical status of digital input. Indicated by *10.01 DI status*.
**Indicated by *10.02 DI delayed status*.

No.	Name/Value	Description	Def/ FbEq16
	0.0 … 3000.0 s	Activation delay for DI5.	10 = 1 s
10.14	*DI5 OFF delay*	Defines the deactivation delay for digital input DI5. See parameter *10.13 DI5 ON delay*.	0.0 s
	0.0 … 3000.0 s	Deactivation delay for DI5.	10 = 1 s
10.15	*DI6 ON delay*	Defines the activation delay for digital input DI6.	0.0 s

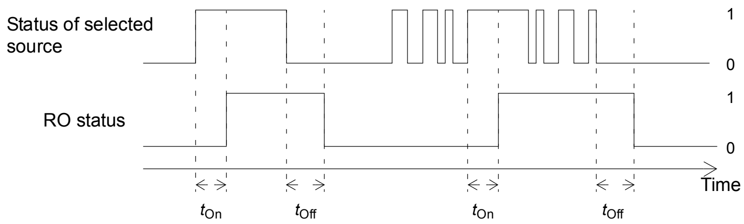


t_{On} = *10.15 DI6 ON delay*
t_{Off} = *10.16 DI6 OFF delay*
*Electrical status of digital input. Indicated by *10.01 DI status*.
**Indicated by *10.02 DI delayed status*.

No.	Name/Value	Description	Def/ FbEq16
	0.0 … 3000.0 s	Activation delay for DI6.	10 = 1 s
10.16	*DI6 OFF delay*	Defines the deactivation delay for digital input DI6. See parameter *10.15 DI6 ON delay*.	0.0 s
	0.0 … 3000.0 s	Deactivation delay for DI6.	10 = 1 s
10.21	*RO status*	Status of relay outputs RO8…RO1. Example: 00000001b = RO1 is energized, RO2…RO8 are de-energized.	-
	0000h…FFFFh	Status of relay outputs.	1 = 1

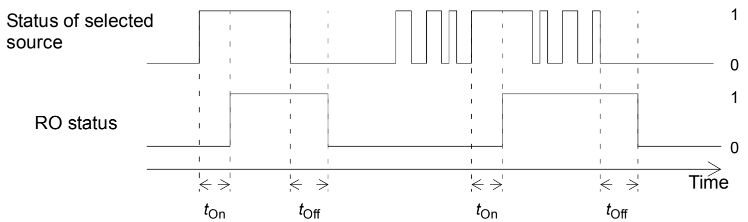
No.	Name/Value	Description	Def/ FbEq16
10.24	RO1 source	Selects a drive signal to be connected to relay output RO1.	Ready run; 10.01 b3 (-1) (95.20 b2); 35.105 b1 (95.20 b6); 06.16 b6 (95.20 b9)
	Not energized	Output is not energized.	0
	Energized	Output is energized.	1
	Ready run	Bit 1 of 06.11 Main status word (see page 117).	2
	Enabled	Bit 0 of 06.16 Drive status word 1 (see page 117).	4
	Started	Bit 5 of 06.16 Drive status word 1 (see page 117).	5
	Magnetized	Bit 1 of 06.17 Drive status word 2 (see page 118).	6
	Running	Bit 6 of 06.16 Drive status word 1 (see page 117).	7
	Ready ref	Bit 2 of 06.11 Main status word (see page 117).	8
	At setpoint	Bit 8 of 06.11 Main status word (see page 117).	9
	Reverse	Bit 2 of 06.19 Speed control status word (see page 120).	10
	Zero speed	Bit 0 of 06.19 Speed control status word (see page 120).	11
	Above limit	Bit 10 of 06.17 Drive status word 2 (see page 118).	12
	Warning	Bit 7 of 06.11 Main status word (see page 117).	13
	Fault	Bit 3 of 06.11 Main status word (see page 117).	14
	Fault (-1)	Inverted bit 3 of 06.11 Main status word (see page 117).	15
	Open brake command	Bit 0 of 44.01 Brake control status.	22
	Ext2 active	Bit 11 of 06.16 Drive status word 1 (see page 117).	23
	Remote control	Bit 9 of 06.11 Main status word (see page 117).	24
	Supervision 1	Bit 0 of 32.01 Supervision status (see page 251).	33
	Supervision 2	Bit 1 of 32.01 Supervision status (see page 251).	34
	Supervision 3	Bit 2 of 32.01 Supervision status (see page 251).	35
	RO/DIO control word bit0	Bit 0 of 10.99 RO/DIO control word (see page 134).	40
	RO/DIO control word bit1	Bit 1 of 10.99 RO/DIO control word (see page 134).	41
	RO/DIO control word bit2	Bit 2 of 10.99 RO/DIO control word (see page 134).	42
	RO/DIO control word bit8	Bit 8 of 10.99 RO/DIO control word (see page 134).	43
	RO/DIO control word bit9	Bit 9 of 10.99 RO/DIO control word (see page 134).	44
	Other [bit]	Source selection (see Terms and abbreviations on page 101).	-

No.	Name/Value	Description	Def/ FbEq16
10.25	*RO1 ON delay*	Defines the activation delay for relay output RO1.	0.0 s



t_{On} = *10.25 RO1 ON delay*
t_{Off} = *10.26 RO1 OFF delay*

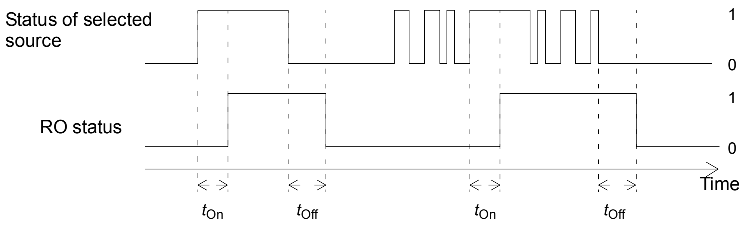
No.	Name/Value	Description	Def/ FbEq16
	0.0 … 3000.0 s	Activation delay for RO1.	10 = 1 s
10.26	*RO1 OFF delay*	Defines the deactivation delay for relay output RO1. See parameter *10.25 RO1 ON delay*.	0.0 s
	0.0 … 3000.0 s	Deactivation delay for RO1.	10 = 1 s
10.27	*RO2 source*	Selects a drive signal to be connected to relay output RO2. For the available selections, see parameter *10.24 RO1 source*.	*Running* (*95.20* b3)
10.28	*RO2 ON delay*	Defines the activation delay for relay output RO2.	0.0 s (*95.20* b3)



t_{On} = *10.28 RO2 ON delay*
t_{Off} = *10.29 RO2 OFF delay*

No.	Name/Value	Description	Def/ FbEq16
	0.0 … 3000.0 s	Activation delay for RO2.	10 = 1 s
10.29	*RO2 OFF delay*	Defines the deactivation delay for relay output RO2. See parameter *10.28 RO2 ON delay*.	0.0 s (*95.20* b3)
	0.0 … 3000.0 s	Deactivation delay for RO2.	10 = 1 s
10.30	*RO3 source*	Selects a drive signal to be connected to relay output RO3. For the available selections, see parameter *10.24 RO1 source*.	*Fault (-1)*

No.	Name/Value	Description	Def/ FbEq16
10.31	*RO3 ON delay*	Defines the activation delay for relay output RO3.	0.0 s



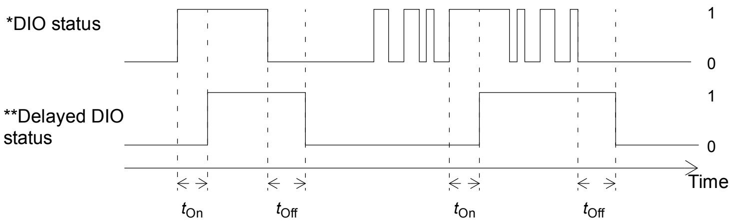
t_{On} = *10.31 RO3 ON delay*
t_{Off} = *10.32 RO3 OFF delay*

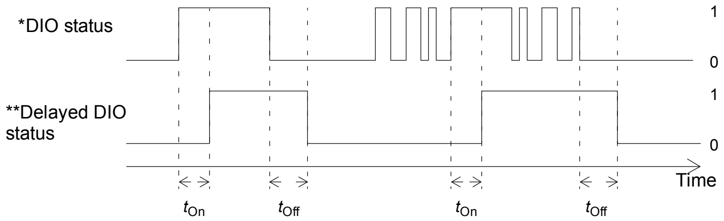
No.	Name/Value	Description	Def/ FbEq16
	0.0 … 3000.0 s	Activation delay for RO3.	10 = 1 s
10.32	*RO3 OFF delay*	Defines the deactivation delay for relay output RO3. See parameter *10.31 RO3 ON delay*.	0.0 s
	0.0 … 3000.0 s	Deactivation delay for RO3.	10 = 1 s
10.51	*DI filter time*	Defines a filtering time for parameter *10.01 DI status*	10.0 ms
	0.3...100.0 ms	Filter time for *10.01 DI status*.	10 = 1 ms
10.99	*RO/DIO control word*	Storage parameter for controlling the relay outputs and digital input/outputs eg. through the embedded fieldbus interface. To control the relay outputs (RO) and the digital input/outputs (DIO) of the drive, send a control word with the bit assignments shown below as Modbus I/O data.	0000h

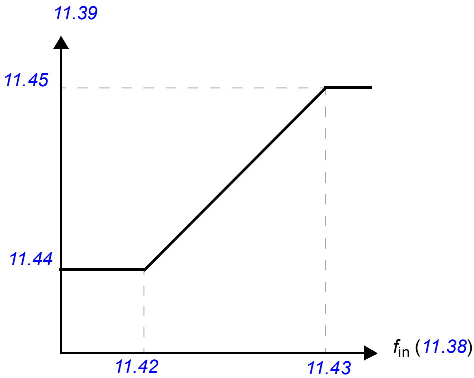
Bit	Name	Description
0	RO1	Source bits for relay outputs RO1…RO3 (see parameters *10.24*, *10.27* and *10.30*).
1	RO2	
2	RO3	
3…7	Reserved	
8	DIO1	Source bits for digital input/outputs DIO1…DIO3 (see parameters *11.06* and *11.10*).
9	DIO2	
10…15	Reserved	

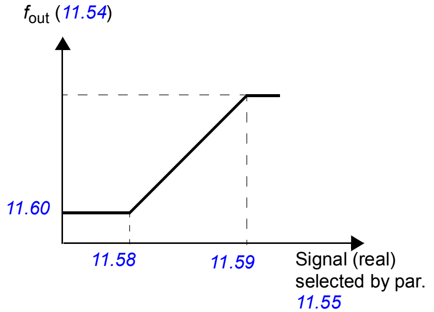
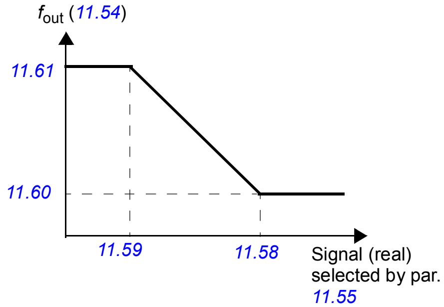
No.	Name/Value	Description	Def/ FbEq16
	0000h…FFFFh	RO/DIO control word.	1 = 1
11 Standard DIO, FI, FO		Configuration of digital input/outputs and frequency inputs/outputs.	
11.01	*DIO status*	Displays the status of digital input/outputs DIO2…DIO1. The activation/deactivation delays (if any are specified) are ignored. A filtering time (for input mode) can be defined by parameter *10.51 DI filter time*. Example: 0010 = DIO2 is on, DIO is off. This parameter is read-only.	-
	0000b…0011b	Status of digital input/outputs.	1 = 1

No.	Name/Value	Description	Def/ FbEq16
11.02	*DIO delayed status*	Displays the delayed status of digital input/outputs DIO2…DIO1. This word is updated only after activation/deactivation delays (if any are specified). Example: 0010 = DIO2 is on, DIO1 is off. This parameter is read-only.	-
	0000b…0011b	Delayed status of digital input/outputs.	1 = 1
11.05	*DIO1 function*	Selects whether DIO1 is used as a digital output or input, or a frequency input.	*Output*
	Output	DIO1 is used as a digital output.	0
	Input	DIO1 is used as a digital input.	1
	Frequency	DIO1 is used as a frequency input.	2
11.06	*DIO1 output source*	Selects a drive signal to be connected to digital input/output DIO1 when parameter *11.05 DIO1 function* is set to *Output*.	*Ready run*
	Not energized	Output is off.	0
	Energized	Output is on.	1
	Ready run	Bit 1 of *06.11 Main status word* (see page *117*).	2
	Enabled	Bit 0 of *06.16 Drive status word 1* (see page *117*).	4
	Started	Bit 5 of *06.16 Drive status word 1* (see page *117*).	5
	Magnetized	Bit 1 of *06.17 Drive status word 2* (see page *118*).	6
	Running	Bit 6 of *06.16 Drive status word 1* (see page *117*).	7
	Ready ref	Bit 2 of *06.11 Main status word* (see page *117*).	8
	At setpoint	Bit 8 of *06.11 Main status word* (see page *117*).	9
	Reverse	Bit 2 of *06.19 Speed control status word* (see page *120*).	10
	Zero speed	Bit 0 of *06.19 Speed control status word* (see page *120*).	11
	Above limit	Bit 10 of *06.17 Drive status word 2* (see page *118*).	12
	Warning	Bit 7 of *06.11 Main status word* (see page *117*).	13
	Fault	Bit 3 of *06.11 Main status word* (see page *117*).	14
	Fault (-1)	Inverted bit 3 of *06.11 Main status word* (see page *117*).	15
	Open brake command	Bit 0 of 44.01 Brake control status. (See *ACS880 primary control program firmware manual (3AUA0000085967[English])*).	22
	Ext2 active	Bit 11 of *06.16 Drive status word 1* (see page *117*).	23
	Remote control	Bit 9 of *06.11 Main status word* (see page *117*).	24
	Supervision 1	Bit 0 of *32.01 Supervision status* (see page *251*).	33
	Supervision 2	Bit 1 of *32.01 Supervision status* (see page *251*).	34
	Supervision 3	Bit 2 of *32.01 Supervision status* (see page *251*).	35
	RO/DIO control word bit0	Bit 0 of *10.99 RO/DIO control word* (see page *134*).	40
	RO/DIO control word bit1	Bit 1 of *10.99 RO/DIO control word* (see page *134*).	41
	RO/DIO control word bit2	Bit 2 of *10.99 RO/DIO control word* (see page *134*).	42

No.	Name/Value	Description	Def/ FbEq16
	RO/DIO control word bit8	Bit 8 of *10.99 RO/DIO control word* (see page *134*).	43
	RO/DIO control word bit9	Bit 9 of *10.99 RO/DIO control word* (see page *134*).	44
	Other [bit]	Source selection (see *Terms and abbreviations* on page *101*).	-
11.07	*DIO1 ON delay*	Defines the activation delay for digital input/output DIO1 (when used as a digital output or digital input).	0.0 s
	 t_{On} = *11.07 DIO1 ON delay* t_{Off} = *11.08 DIO1 OFF delay* *Electrical status of DIO (in input mode) or status of selected source (in output mode). Indicated by *11.01 DIO status*. **Indicated by *11.02 DIO delayed status*.		
	0.0 … 3000.0 s	Activation delay for DIO1.	10 = 1 s
11.08	*DIO1 OFF delay*	Defines the deactivation delay for digital input/output DIO1 (when used as a digital output or digital input). See parameter *11.07 DIO1 ON delay*.	0.0 s
	0.0…3000.0 s	Deactivation delay for DIO1.	10 = 1 s
11.09	*DIO2 function*	Selects whether DIO2 is used as a digital output or input, or a frequency output.	*Output*
	Output	DIO2 is used as a digital output.	0
	Input	DIO2 is used as a digital input.	1
	Frequency	DIO2 is used as a frequency output.	2
11.10	*DIO2 output source*	Selects a drive signal to be connected to digital input/output DIO2 when parameter *11.09 DIO2 function* is set to *Output*. For the available selections, see parameter *11.06 DIO1 output source*.	*Running*

No.	Name/Value	Description	Def/ FbEq16
11.11	*DIO2 ON delay*	Defines the activation delay for digital input/output DIO2 (when used as a digital output or digital input).	0.0 s
	 t_{On} = *11.11 DIO2 ON delay* t_{Off} = *11.12 DIO2 OFF delay* *Electrical status of DIO (in input mode) or status of selected source (in output mode). Indicated by *11.01 DIO status*. **Indicated by *11.02 DIO delayed status*.		
	0.0…3000.0 s	Activation delay for DIO2.	10 = 1 s
11.12	*DIO2 OFF delay*	Defines the deactivation delay for digital input/output DIO2 (when used as a digital output or digital input). See parameter *11.11 DIO2 ON delay*.	0.0 s
	0.0…3000.0 s	Deactivation delay for DIO2.	10 = 1 s
11.38	*Freq in 1 actual value*	Displays the value of frequency input 1 (via DIO1 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*	Displays the value of frequency input 1 (via DIO1 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.	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 (DIO1 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*) by parameters *11.42*…*11.45* as follows:  	0 Hz
	0…16000 Hz	Minimum frequency of frequency input 1 (DIO1).	1 = 1 Hz
11.43	*Freq in 1 max*	Defines the maximum for the frequency actually arriving at frequency input 1 (DIO1 when it is used as a frequency input). See parameter *11.42 Freq in 1 min*.	16000 Hz
	0…16000 Hz	Maximum frequency for frequency input 1 (DIO1).	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
11.54	*Freq out 1 actual value*	Displays the value of frequency output 1 after scaling. See parameter *11.58 Freq out 1 src min*. This parameter is read-only.	-
	0…16000 Hz	Value of frequency output 1.	1 = 1
11.55	*Freq out 1 source*	Selects a signal to be connected to frequency output 1.	*Motor speed used*
	Zero	None.	0
	Motor speed used	*01.01 Motor speed used* (page *105*).	1
	Output frequency	*01.06 Output frequency* (page *105*).	3
	Motor current	*01.07 Motor current* (page *105*).	4
	Motor torque	*01.10 Motor torque* (page *105*).	6

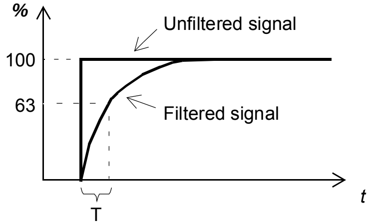
No.	Name/Value	Description	Def/ FbEq16
	DC voltage	*01.11 DC voltage* (page *105*).	7
	Power inu out	*01.14 Output power* (page *106*).	8
	Speed ref ramp in	*23.01 Speed ref ramp input* (page *203*).	10
	Speed ref ramped	*23.02 Speed ref ramp output* (page *204*).	11
	Speed ref used	*24.01 Used speed reference* (page *210*).	12
	Torq ref used	26.02 Torque reference used.	13
	Freq ref used	*28.02 Frequency ref ramp output* (page *226*).	14
	Other	Source selection (see *Terms and abbreviations* on page *101*).	-
11.58	*Freq out 1 src min*	Defines the real value of the signal (selected by parameter *11.55 Freq out 1 source* and shown by parameter *11.54 Freq out 1 actual value*) that corresponds to the minimum value of frequency output 1 (defined by parameter *11.60 Freq out 1 at src min*).  	0.000
	-32768.000 …32767.000	Real signal value corresponding to minimum value of frequency output 1.	1 = 1
11.59	*Freq out 1 src max*	Defines the real value of the signal (selected by parameter *11.55 Freq out 1 source* and shown by parameter *11.54 Freq out 1 actual value*) that corresponds to the maximum value of frequency output 1 (defined by parameter *11.61 Freq out 1 at src max*). See parameter *11.58 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

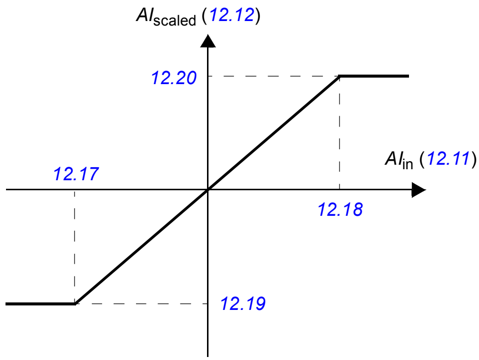
No.	Name/Value	Description	Def/ FbEq16
11.60	*Freq out 1 at src min*	Defines the minimum value of frequency output 1. See diagrams at parameter *11.58 Freq out 1 src min*.	0 Hz
	0…16000 Hz	Minimum value of frequency output 1.	1 = 1 Hz
11.61	*Freq out 1 at src max*	Defines the maximum value of frequency output 1. See diagrams at parameter *11.58 Freq out 1 src min*.	16000 Hz
	0…16000 Hz	Maximum value of frequency output 1.	1 = 1 Hz
11.81	*DIO filter time*	Defines a filtering time for parameter *11.01 DIO status*. The filtering time will only affect the DIOs that are in input mode.	10.0 ms
	0.3...100 ms	Filtering time for *11.01*.	10 = 1 ms
12 Standard AI		Configuration of standard analog inputs.	
12.01	*AI tune*	Triggers the analog input tuning function. Connect the signal to the input and select the appropriate tuning function.	
	No action	AI tune is not activated.	0
	AI1 min tune	Current analog input AI1 signal value is set as minimum value of AI1 into parameter *12.17 AI1 min*. The value reverts back to *No action* automatically.	1
	AI1 max tune	Current analog input AI1 signal value is set as maximum value of AI1 into parameter *12.18 AI1 max*. The value reverts back to *No action* automatically	2
	AI2 min tune	Current analog input AI2 signal value is set as minimum value of AI2 into parameter *12.27 AI2 min*. The value reverts back to *No action* automatically	3
	AI2 max tune	Current analog input AI2 signal value is set as maximum value of AI2 into parameter *12.28 AI2 max*. The value reverts back to *No action* automatically	4
12.03	*AI supervision function*	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*.	*No action*
	No action	No action taken.	0
	Fault	Drive trips on *80A0 AI supervision*.	1
	Warning	Drive generates an *A8A0 AI supervision* warning.	2
	Last speed	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.	3
	Speed ref safe	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.	4

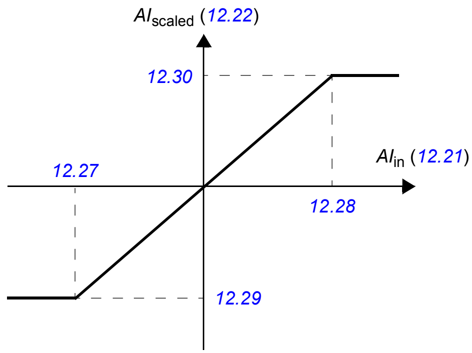
No.	Name/Value	Description	Def/ FbEq16
12.04	*AI supervision selection*	Specifies the analog input limits to be supervised. See parameter *12.03 AI supervision function*.	0000b

Bit	Name	Description
0	AI1 < MIN	1 = Minimum limit supervision of AI1 active.
1	AI1 > MAX	1 = Maximum limit supervision of AI1 active.
2	AI2 < MIN	1 = Minimum limit supervision of AI2 active.
3	AI2 > MAX	1 = Maximum limit supervision of AI2 active.
4…15	Reserved	

No.	Name/Value	Description	Def/ FbEq16
	0000b…1111b	Activation of analog input supervision.	1 = 1
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.	-
	-22.000… 22.000 mA or V	Value of analog input AI1.	1000 = 1 mA or V
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
12.15	*AI1 unit selection*	Selects the unit for readings and settings related to analog input AI1. Note: This setting must match the corresponding hardware setting on the drive control unit (see the hardware manual of the drive). 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.	*V*
	V	Volts.	2
	mA	Milliamperes.	10

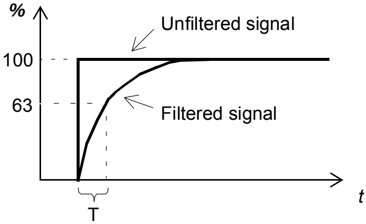
No.	Name/Value	Description	Def/ FbEq16
12.16	AI1 filter time	Defines the filter time constant for analog input AI1.  $O = I \times (1 - e^{-t/T})$ I = filter input (step) O = filter output *t* = time T = filter time constant Note: The signal is also filtered due to the signal interface hardware (approximately 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 12.01 AI tune.	0.000 mA or V
	-22.000 …22.000 mA or V	Minimum value of AI1.	1000 = 1 mA or V
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 12.01 AI tune.	20.000 mA or 10.000 V
	-22.000 …22.000 mA or V	Maximum value of AI1.	1000 = 1 mA or V

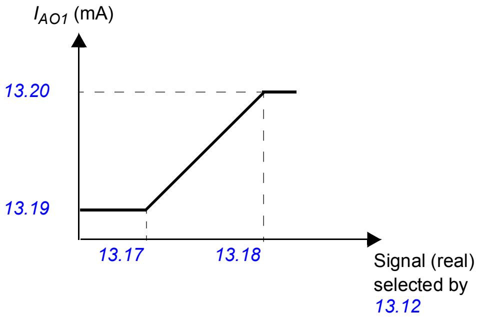
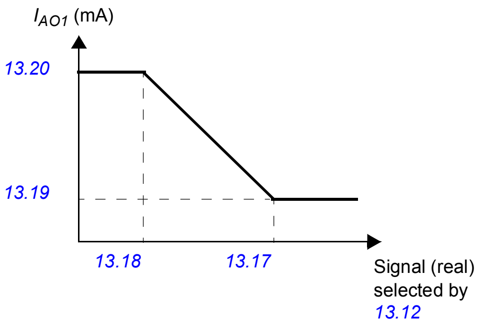
No.	Name/Value	Description	Def/ FbEq16
12.19	*AI1 scaled at AI1 min*	Defines the real internal value that corresponds to the minimum analog input AI1 value defined by parameter *12.17 AI1 min*. (Changing the polarity settings of *12.19* and *12.20* can effectively invert the analog input.) 	0.000
	-32768.000 …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*.	1500.000; 1800.000 (*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.	-
	-22.000 …22.000 mA or V	Value of analog input AI2.	1000 = 1 mA or V
12.22	*AI2 scaled value*	Displays the value of analog input AI2 after scaling. See parameters *12.29 AI2 scaled at AI2 min* and *12.30 AI2 scaled at AI2 max*. This parameter is read-only.	-
	-32768.000 …32767.000	Scaled value of analog input AI2.	1 = 1
12.25	*AI2 unit selection*	Selects the unit for readings and settings related to analog input AI2. Note: This setting must match the corresponding hardware setting on the drive control unit (see the hardware manual of the drive). 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.	*mA*
	V	Volts.	2
	mA	Milliamperes.	10

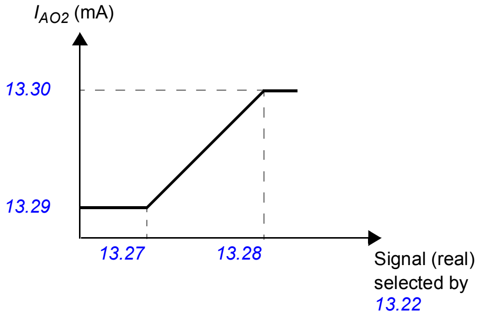
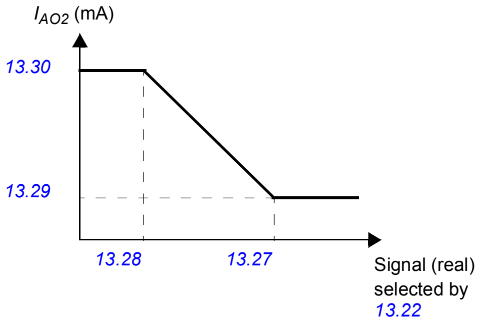
No.	Name/Value	Description	Def/ FbEq16
12.26	*AI2 filter time*	Defines the filter time constant for analog input AI2. See parameter *12.16 AI1 filter time*.	0.100 s
	0.000…30.000 s	Filter time constant.	1000 = 1 s
12.27	*AI2 min*	Defines the minimum site value for analog input AI2. Set the value actually sent to the drive when the analog signal from plant is wound to its minimum setting. See also parameter *12.01 AI tune*.	0.000 mA or V
	-22.000 …22.000 mA or V	Minimum value of AI2.	1000 = 1 mA or V
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. See also parameter *12.01 AI tune*.	20.000 mA or 10.000 V
	-22.000 …22.000 mA or V	Maximum value of AI2.	1000 = 1 mA or V
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 *12.30* 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 maximum analog input AI2 value defined by parameter *12.28 AI2 max*. See the drawing at parameter *12.29 AI2 scaled at AI2 min*.	100.000
	-32768.000 …32767.000	Real value corresponding to maximum AI2 value.	1 = 1

13 Standard AO		Configuration of standard analog outputs.	
13.11	*AO1 actual value*	Displays the value of AO1 in mA. This parameter is read-only.	-
	0.000…22.000 mA	Value of AO1.	1000 = 1 mA

No.	Name/Value	Description	Def/ FbEq16
13.12	*AO1 source*	Selects a signal to be connected to analog output AO1. Alternatively, sets the output to excitation mode to feed a constant current to a temperature sensor.	*Motor speed used*
	Zero	None.	0
	Motor speed used	*01.01 Motor speed used* (page *105*).	1
	Output frequency	*01.06 Output frequency* (page *105*).	3
	Motor current	*01.07 Motor current* (page *105*).	4
	Motor torque	*01.10 Motor torque* (page *105*).	6
	DC voltage	*01.11 DC voltage* (page *105*).	7
	Power inu out	*01.14 Output power* (page *106*).	8
	Speed ref ramp in	*23.01 Speed ref ramp input* (page *203*).	10
	Speed ref ramp out	*23.02 Speed ref ramp output* (page *204*).	11
	Speed ref used	*24.01 Used speed reference* (page *210*).	12
	Torq ref used	*26.02 Torque reference used*	13
	Freq ref used	*28.02 Frequency ref ramp output* (page *226*).	14
	Force Pt100 excitation	The output is used to feed an excitation current to 1…3 Pt100 sensors. See section *Motor thermal protection* (page *83*).	20
	Force KTY84 excitation	The output is used to feed an excitation current to a KTY84 sensor. See section *Motor thermal protection* (page *83*).	21
	Force PTC excitation	The output is used to feed an excitation current to 1…3 PTC sensors. See section *Motor thermal protection* (page *83*).	22
	Force Pt1000 excitation	The output is used to feed an excitation current to 1…3 Pt1000 sensors. See section *Motor thermal protection* (page *83*).	23
	AO1 data storage	*13.91 AO1 data storage* (page *149*).	37
	AO2 data storage	*13.92 AO2 data storage* (page *149*).	38
	Other	Source selection (see *Terms and abbreviations* on page *101*).	-

No.	Name/Value	Description	Def/ FbEq16
13.16	*AO1 filter time*	Defines the filtering time constant for analog output AO1.  $O = I \times (1 - e^{-t/T})$ 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
	-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*.	1500.0; 1800.0 (*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 mA
	0.000…22.000 mA	Minimum AO1 output value.	1000 = 1 mA
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	Maximum AO1 output value.	1000 = 1 mA

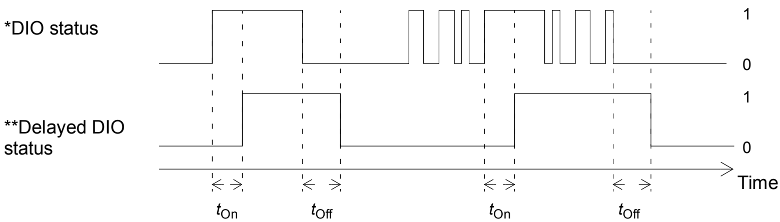
No.	Name/Value	Description	Def/ FbEq16
13.21	*AO2 actual value*	Displays the value of AO2 in mA. This parameter is read-only.	-
	0.000…22.000 mA	Value of AO2.	1000 = 1 mA
13.22	*AO2 source*	Selects a signal to be connected to analog output AO2. Alternatively, sets the output to excitation mode to feed a constant current to a temperature sensor. For the selections, see parameter *13.12 AO1 source*.	*Motor current*
13.26	*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*).  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

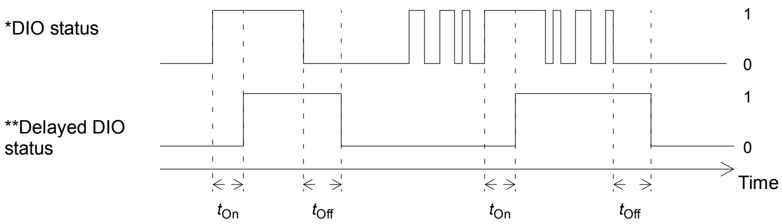
No.	Name/Value	Description	Def/ FbEq16
13.28	*AO2 source max*	Defines the real maximum value of the signal (selected by parameter *13.22 AO2 source*) that corresponds to the maximum required AO2 output value (defined by parameter *13.30 AO2 out at AO2 src max*). See parameter *13.27 AO2 source min*.	100.0
	-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 fieldbus. In *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 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 fieldbus. In *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 to *AO2 data storage*.	0.00
	-327.68 … 327.67	Storage parameter for AO2.	100 = 1

14 I/O extension module 1		Configuration of I/O extension module 1. See also section *Programmable I/O extensions* (page *56*). Note: The contents of the parameter group vary according to the selected I/O extension module type.	
14.01	*Module 1 type*	Activates (and specifies the type of) I/O extension module 1.	*None*
	None	Inactive.	0
	FIO-01	FIO-01.	1
	FIO-11	FIO-11.	2
	FAIO-01	FAIO-01.	4
14.02	*Module 1 location*	Specifies the slot (1…3) on the control unit of the drive into which the I/O extension module is installed. Alternatively, specifies the node ID of the slot on an FEA-0x extension adapter.	*Slot 1*
	Slot 1	Slot 1.	1
	Slot 2	Slot 2.	2
	Slot 3	Slot 3.	3
	4…254	Node ID of the slot on the FEA-0x extension adapter.	1 = 1

No.	Name/Value	Description	Def/ FbEq16
14.03	*Module 1 status*	Displays the status of I/O extension module 1.	*No option*
	No option	No module detected in the specified slot.	0
	No communication	A module has been detected but cannot be communicated with.	1
	Unknown	The module type is unknown.	2
	FIO-01	An FIO-01 module has been detected and is active.	15
	FIO-11	An FIO-11 module has been detected and is active.	20
	FAIO-01	An FAIO-01 module has been detected and is active.	24
14.05	*DIO status*	*(Visible when 14.01 Module 1 type = FIO-01 or FIO-11)* Displays the status of the digital input/outputs on the extension module. The activation/deactivation delays (if any are specified) are ignored. A filtering time (for input mode) can be defined by parameter *10.51 DI filter time*. Bit 0 indicates the status of DIO1. **Note:** The number of active bits in this parameter depends on the number of digital input/outputs on the extension module. **Example:** 1001b = DIO1 and DIO4 are on, remainder are off. This parameter is read-only.	-
	0000b…1111b	Status of digital input/outputs.	1 = 1
14.06	*DIO delayed status*	*(Visible when 14.01 Module 1 type = FIO-01 or FIO-11)* Displays the delayed status of the digital input/outputs on the extension module. This word is updated only after activation/deactivation delays (if any are specified). Bit 0 indicates the status of DIO1. Note: The number of active bits in this parameter depends on the number of digital input/outputs on the extension module. **Example:** 00001001b = DIO1 and DIO4 are on, remainder are off. This parameter is read-only.	-
	0000b…1111b	Delayed status of digital input/outputs.	1 = 1
14.08	*DIO filter time*	(Visible when *14.01 Module 1 type* = *FIO-01 or FIO-11*) Defines a filtering time for parameter 14.05 DIO status. The filtering time will only affect the DIOs that are in input mode.	10.0 ms
	0.8...100.0 ms	Filtering time for *14.05*.	10 = 1 ms
14.09	*DIO1 function*	*(Visible when 14.01 Module 1 type = FIO-01 or FIO-11)* Selects whether DIO1 of the extension module is used as a digital input or output.	*Input*
	Output	DIO1 is used as a digital output.	0
	Input	DIO1 is used as a digital input.	1
14.11	*DIO1 output source*	*(Visible when 14.01 Module 1 type = FIO-01 or FIO-11)* Selects a drive signal to be connected to digital input/output DIO1 of the extension module when parameter *14.09 DIO1 function* is set to *Output*.	*Not energized*
	Not energized	Output is not energized.	0
	Energized	Output is energized.	1

No.	Name/Value	Description	Def/ FbEq16
	Ready run	Bit 1 of *06.11 Main status word* (see page *117*).	2
	Enabled	Bit 0 of *06.16 Drive status word 1* (see page *117*).	4
	Started	Bit 5 of *06.16 Drive status word 1* (see page *117*).	5
	Magnetized	Bit 1 of *06.17 Drive status word 2* (see page *118*).	6
	Running	Bit 6 of *06.16 Drive status word 1* (see page *117*).	7
	Ready ref	Bit 2 of *06.11 Main status word* (see page *117*).	8
	At setpoint	Bit 8 of *06.11 Main status word* (see page *117*).	9
	Reverse	Bit 2 of *06.19 Speed control status word* (see page *120*).	10
	Zero speed	Bit 0 of *06.19 Speed control status word* (see page *120*).	11
	Above limit	Bit 10 of *06.17 Drive status word 2* (see page *118*).	12
	Warning	Bit 7 of *06.11 Main status word* (see page *117*).	13
	Fault	Bit 3 of *06.11 Main status word* (see page *117*).	14
	Fault (-1)	Inverted bit 3 of *06.11 Main status word* (see page *117*).	15
	Open brake command	Bit 0 of *44.01 Brake control status*	22
	Ext2 active	Bit 11 of *06.16 Drive status word 1* (see page *117*).	23
	Remote control	Bit 9 of *06.11 Main status word* (see page *117*).	24
	Supervision 1	Bit 0 of *32.01 Supervision status* (see page *251*).	33
	Supervision 2	Bit 1 of *32.01 Supervision status* (see page *251*).	34
	Supervision 3	Bit 2 of *32.01 Supervision status* (see page *251*).	35
	RO/DIO control word bit0	Bit 0 of *10.99 RO/DIO control word* (see page *134*).	40
	RO/DIO control word bit1	Bit 1 of *10.99 RO/DIO control word* (see page *134*).	41
	RO/DIO control word bit2	Bit 2 of *10.99 RO/DIO control word* (see page *134*).	42
	RO/DIO control word bit8	Bit 8 of *10.99 RO/DIO control word* (see page *134*).	43
	RO/DIO control word bit9	Bit 9 of *10.99 RO/DIO control word* (see page *134*).	44
	Other [bit]	Source selection (see *Terms and abbreviations* on page *101*).	-

No.	Name/Value	Description	Def/ FbEq16
14.12	*DIO1 ON delay*	*(Visible when 14.01 Module 1 type = FIO-01 or FIO-11)* Defines the activation delay for digital input/output DIO1.	0.0 s
		 t_{On} = *14.12 DIO1 ON delay* t_{Off} = *14.13 DIO1 OFF delay* *Electrical status of DIO (in input mode) or status of selected source (in output mode). Indicated by *14.05 DIO status*. **Indicated by *14.06 DIO delayed status*.	
	0.0…3000.0 s	Activation delay for DIO1.	10 = 1 s
14.13	*DIO1 OFF delay*	*(Visible when 14.01 Module 1 type = FIO-01 or FIO-11)* Defines the deactivation delay for digital input/output DIO1. See parameter *14.12 DIO1 ON delay*.	0.0 s
	0.0…3000.0 s	Deactivation delay for DIO1.	10 = 1 s
14.14	*DIO2 function*	*(Visible when 14.01 Module 1 type = FIO-01 or FIO-11)* Selects whether DIO2 of the extension module is used as a digital input or output.	*Input*
	Output	DIO2 is used as a digital output.	0
	Input	DIO2 is used as a digital input.	1
14.15	*DIO2 filter gain*	(Visible when *14.01 Module 1 type* = *FIO-11*) Determines a filtering time for DIO2 when it is used as an input.	*7.5 us*
	7.5 us	7.5 microseconds.	0
	195 us	195 microseconds.	1
	780 us	780 microseconds.	2
	4.680 ms	4.680 milliseconds.	3
14.16	*DIO2 output source*	*(Visible when 14.01 Module 1 type = FIO-01 or FIO-11)* Selects a drive signal to be connected to digital input/output DIO2 when parameter *14.14 DIO2 function* is set to *Output*. For the available selections, see parameter *14.11 DIO1 output source*.	*Not energized*

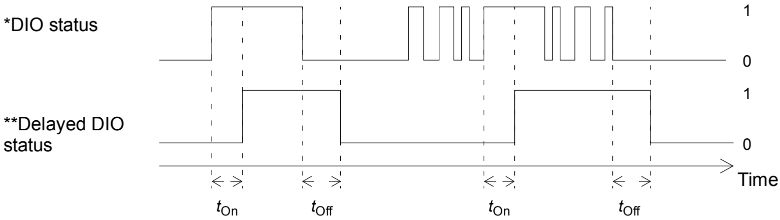
No.	Name/Value	Description	Def/ FbEq16
14.17	*DIO2 ON delay*	*(Visible when 14.01 Module 1 type = FIO-01 or FIO-11)* Defines the activation delay for digital input/output DIO2.	0.0 s
	 t_{On} = *14.17 DIO2 ON delay* t_{Off} = *14.18 DIO2 OFF delay* *Electrical status of DIO (in input mode) or status of selected source (in output mode). Indicated by *14.05 DIO status*. **Indicated by *14.06 DIO delayed status*.		
	0.0…3000.0 s	Activation delay for DIO2.	10 = 1 s
14.18	*DIO2 OFF delay*	*(Visible when 14.01 Module 1 type = FIO-01 or FIO-11)* Defines the deactivation delay for digital input/output DIO2. See parameter *14.17 DIO2 ON delay*.	0.0 s
	0.0…3000.0 s	Deactivation delay for DIO2.	10 = 1 s
14.19	*DIO3 function*	(Visible when *14.01 Module 1 type* = *FIO-01*) Selects whether DIO3 of the extension module is used as a digital input or output.	*Input*
	Output	DIO3 is used as a digital output.	0
	Input	DIO3 is used as a digital input.	1
14.19	*AI supervision function*	*(Visible when 14.01 Module 1 type = FIO-11 or FAIO-01)* 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 *14.20 AI supervision selection*.	*No action*
	No action	No action taken.	0
	Fault	Drive trips on *80A0 AI supervision*.	1
	Warning	Drive generates an *A8A0 AI supervision* warning.	2
	Last speed	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.	3
	Speed ref safe	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.	4

No.	Name/Value	Description	Def/ FbEq16
14.20	*AI supervision selection*	(*Visible when 14.01 Module 1 type = FIO-11 or FAIO-01*) Specifies the analog input limits to be supervised. See parameter *14.19 AI supervision function*. **Note:** The number of active bits in this parameters depends on the number of inputs on the extension module.	0000 0000b

Bit	Name	Description
0	AI1 < MIN	1 = Minimum limit supervision of AI1 active.
1	AI1 > MAX	1 = Maximum limit supervision of AI1 active.
2	AI2 < MIN	1 = Minimum limit supervision of AI2 active.
3	AI2 > MAX	1 = Maximum limit supervision of AI2 active.
4	AI3 < MIN	1 = Minimum limit supervision of AI3 active (FIO-11 only).
5	AI3 > MAX	1 = Maximum limit supervision of AI3 active (FIO-11 only).
6…15	Reserved	

No.	Name/Value	Description	Def/ FbEq16
	0000 0000b…0011 1111b	Activation of analog input supervision.	1 = 1
14.21	*DIO3 output source*	(*Visible when 14.01 Module 1 type = FIO-01*) Selects a drive signal to be connected to digital input/output DIO3 when parameter *14.19 DIO3 function* is set to *Output*. For the available selections, see parameter *14.11 DIO1 output source*.	*Not energized*
14.21	*AI tune*	(*Visible when 14.01 Module 1 type = FIO-01 or FAIO-01*) Triggers the analog input tuning function, which enables the use of actual measurements as the minimum and maximum input values instead of potentially inaccurate estimates. Apply the minimum or maximum signal to the input and select the appropriate tuning function. See also the drawing at parameter *14.35 AI1 scaled at AI1 min*.	*No action*
	No action	Tuning action completed or no action has been requested. The parameter automatically reverts to this value after any tuning action.	0
	AI1 min tune	The measured value of AI1 is set as the minimum value of AI1 into parameter *14.33 AI1 min*.	1
	AI1 max tune	The measured value of AI1 is set as the maximum value of AI1 into parameter *14.34 AI1 max*.	2
	AI2 min tune	The measured value of AI2 is set as the minimum value of AI2 into parameter *14.48 AI2 min*.	3
	AI2 max tune	The measured value of AI2 is set as the maximum value of AI2 into parameter *14.49 AI2 max*.	4
	AI3 min tune	(*Visible when 14.01 Module 1 type = FIO-11*) The measured value of AI3 is set as the minimum value of AI3 into parameter *14.63 AI3 min*.	5
	AI3 max tune	(*Visible when 14.01 Module 1 type = FIO-11*) The measured value of AI3 is set as the maximum value of AI3 into parameter *14.64 AI3 max*.	6

No.	Name/Value	Description	Def/ FbEq16
14.22	*DIO3 ON delay*	*(Visible when 14.01 Module 1 type = FIO-01)* Defines the activation delay for digital input/output DIO3.	0.0 s

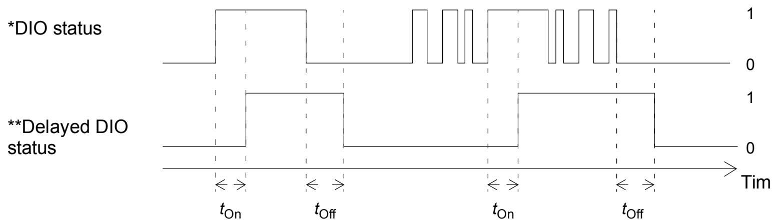


t_{On} = *14.22 DIO3 ON delay*
t_{Off} = *14.23 DIO3 OFF delay*
*Electrical status of DIO (in input mode) or status of selected source (in output mode). Indicated by *14.05 DIO status*.
**Indicated by *14.06 DIO delayed status*.

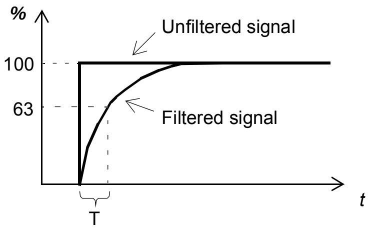
No.	Name/Value	Description	Def/ FbEq16
	0.0…3000.0 s	Activation delay for DIO3.	10 = 1 s
14.22	*AI force selection*	*(Visible when 14.01 Module 1 type = FIO-11 or FAIO-01)* The true readings of the analog inputs can be overridden for eg. testing purposes. A forced value parameter is provided for each analog input, and its value is applied whenever the corresponding bit in this parameter is 1.	0000b

Bit	Value
0	1 = Force AI1 to value of parameter *14.28 AI1 force data*.
1	1 = Force AI2 to value of parameter *14.43 AI2 force data*.
2	1 = Force AI3 to value of parameter *14.58 AI3 force data* (FIO-11 only).
3…15	Reserved.

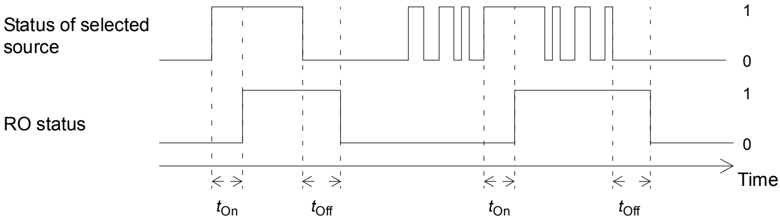
No.	Name/Value	Description	Def/ FbEq16
	0000b …0111b	Forced values selector for analog inputs.	1 = 1
14.23	*DIO3 OFF delay*	*(Visible when 14.01 Module 1 type = FIO-01)* Defines the deactivation delay for digital input/output DIO3. See parameter *14.22 DIO3 ON delay*.	0.0 s
	0.0…3000.0 s	Deactivation delay for DIO3.	10 = 1 s
14.24	*DIO4 function*	(Visible when *14.01 Module 1 type* = *FIO-01*) Selects whether DIO4 of the extension module is used as a digital input or output.	*Input*
	Output	DIO4 is used as a digital output.	0
	Input	DIO4 is used as a digital input.	1
14.26	*DIO4 output source*	*(Visible when 14.01 Module 1 type = FIO-01)* Selects a drive signal to be connected to digital input/output DIO4 when parameter *14.24 DIO4 function* is set to *Output*. For the available selections, see parameter *14.11 DIO1 output source*.	*Not energized*

No.	Name/Value	Description	Def/ FbEq16
14.26	*AI1 actual value*	*(Visible when 14.01 Module 1 type = FIO-11 or FAIO-01)* Displays the value of analog input AI1 in mA or V (depending on whether the input is set to current or voltage). This parameter is read-only.	-
	-22.000 …22.000 mA or V	Value of analog input AI1.	1000 = 1 mA or V
14.27	*DIO4 ON delay*	*(Visible when 14.01 Module 1 type = FIO-01)* Defines the activation delay for digital input/output DIO4.	0.0 s
	 t_{On} = *14.27 DIO4 ON delay* t_{Off} = *14.28 DIO4 OFF delay* *Electrical status of DIO (in input mode) or status of selected source (in output mode). Indicated by *14.05 DIO status*. **Indicated by *14.06 DIO delayed status*.		
	0.0…3000.0 s	Activation delay for DIO4.	10 = 1 s
14.27	*AI1 scaled value*	*(Visible when 14.01 Module 1 type = FIO-11 or FAIO-01)* Displays the value of analog input AI1 after scaling. See parameter *14.35 AI1 scaled at AI1 min*. This parameter is read-only.	-
	-32768.000 …32767.000	Scaled value of analog input AI1.	1 = 1
14.28	*DIO4 OFF delay*	*(Visible when 14.01 Module 1 type = FIO-01)* Defines the deactivation delay for digital input/output DIO4. See parameter *14.27 DIO4 ON delay*.	0.0 s
	0.0…3000.0 s	Deactivation delay for DIO4.	10 = 1 s
14.28	*AI1 force data*	*(Visible when 14.01 Module 1 type = FIO-11 or FAIO-01)* Forced value that can be used instead of the true reading of the input. See parameter *14.22 AI force selection*.	0.000 mA
	-22.000 …22.000 mA or V	Forced value of analog input AI1.	1000 = 1 mA or V
14.29	*AI1 HW switch pos*	*(Visible when 14.01 Module 1 type = FIO-11 or FAIO-01)* Shows the position of the hardware current/voltage selector on the I/O extension module. Note: The setting of the current/voltage selector must match the unit selection made in parameter *14.30 AI1 unit selection*. I/O module reboot either by cycling the power or through parameter *96.08 Control board boot* is required to validate any changes in the hardware settings.	-
	V	Volts.	2
	mA	Milliamperes.	10

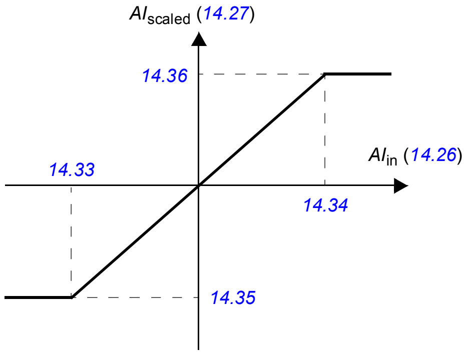
No.	Name/Value	Description	Def/ FbEq16
14.30	*AI1 unit selection*	*(Visible when 14.01 Module 1 type = FIO-11 or FAIO-01)* Selects the unit for readings and settings related to analog input AI1. Note: This setting must match the corresponding hardware setting on the I/O extension module (see the manual of the I/O extension module). The hardware setting is shown by parameter *14.29 AI1 HW switch pos*. I/O module reboot either by cycling the power or through parameter *96.08 Control board boot* is required to validate any changes in the hardware settings.	*mA*
	V	Volts.	2
	mA	Milliamperes.	10
14.31	*RO status*	*(Visible when 14.01 Module 1 type = FIO-01)* Status of relay outputs on the I/O extension module. Example: 00000001b = RO1 is energized, RO2 is de-energized.	-
	0000b…1111b	Status of relay outputs.	1 = 1
14.31	*AI1 filter gain*	(Visible when *14.01 Module 1 type* = *FIO-11* or *FAIO-01*) Selects a hardware filtering time for AI1. See also parameter *14.32 AI1 filter time*.	*1 ms*
	No filtering	No filtering.	0
	125 us	125 microseconds.	1
	250 us	250 microseconds.	2
	500 us	500 microseconds.	3
	1 ms	1 millisecond.	4
	2 ms	2 milliseconds.	5
	4 ms	4 milliseconds.	6
	7.9375 ms	7.9375 milliseconds.	7

No.	Name/Value	Description	Def/ FbEq16
14.32	*AI1 filter time*	(Visible when *14.01 Module 1 type* = *FIO-11* or *FAIO-01*) 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. See parameter *14.31 AI1 filter gain*.	0.100 s
	0.000…30.000 s	Filter time constant.	1000 = 1 s
14.33	*AI1 min*	(Visible when *14.01 Module 1 type* = *FIO-11* or *FAIO-01*) Defines the minimum value for analog input AI1. See also parameter *14.21 AI tune.*	0.000 mA or V
	-22.000…22.000 mA or V	Minimum value of AI1.	1000 = 1 mA or V
14.34	*RO1 source*	*(Visible when 14.01 Module 1 type = FIO-01)* Selects a drive signal to be connected to relay output RO1. For the available selections, see parameter *14.11 DIO1 output source*.	*Not energized*
14.34	*AI1 max*	(Visible when *14.01 Module 1 type* = *FIO-11* or *FAIO-01*) Defines the maximum value for analog input AI1. See also parameter *14.21 AI tune.*	10.000 mA or V
	-22.000…22.000 mA or V	Maximum value of AI1.	1000 = 1 mA or V

No.	Name/Value	Description	Def/ FbEq16
14.35	*RO1 ON delay*	*(Visible when 14.01 Module 1 type = FIO-01)* Defines the activation delay for relay output RO1.	0.0 s

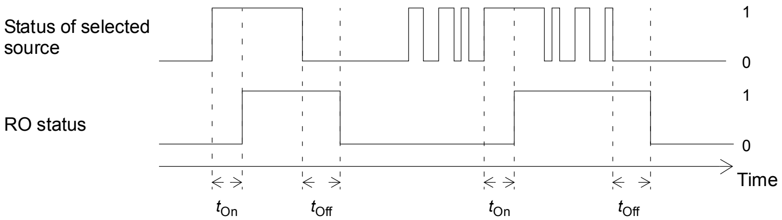


t_{On} = *14.35 RO1 ON delay*
t_{Off} = *14.36 RO1 OFF delay*

No.	Name/Value	Description	Def/ FbEq16
	0.0…3000.0 s	Activation delay for RO1.	10 = 1 s
14.35	*AI1 scaled at AI1 min*	(Visible when *14.01 Module 1 type* = *FIO-11* or *FAIO-01*) Defines the real value that corresponds to the minimum analog input AI1 value defined by parameter *14.33 AI1 min*. 	0.000

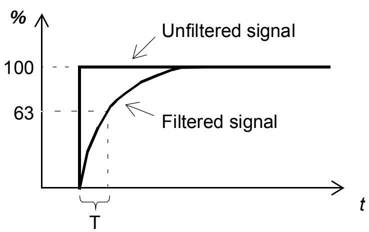
No.	Name/Value	Description	Def/ FbEq16
	-32768.000 …32767.000	Real value corresponding to minimum AI1 value.	1 = 1
14.36	*RO1 OFF delay*	*(Visible when 14.01 Module 1 type = FIO-01)* Defines the deactivation delay for relay output RO1. See parameter *14.35 RO1 ON delay*.	0.0 s
	0.0…3000.0 s	Deactivation delay for RO1.	10 = 1 s
14.36	*AI1 scaled at AI1 max*	(Visible when *14.01 Module 1 type* = *FIO-11* or *FAIO-01*) Defines the real value that corresponds to the maximum analog input AI1 value defined by parameter *14.34 AI1 max*. See the drawing at parameter *14.35 AI1 scaled at AI1 min*.	100.000
	-32768.000 …32767.000	Real value corresponding to maximum AI1 value.	1 = 1

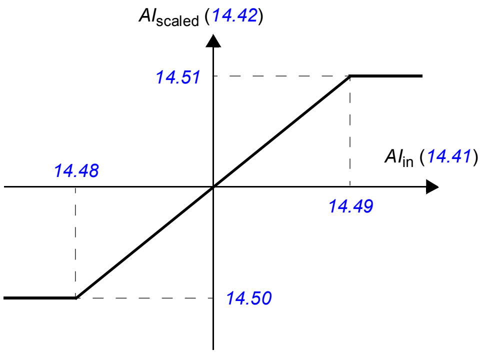
No.	Name/Value	Description	Def/ FbEq16
14.37	*RO2 source*	*(Visible when 14.01 Module 1 type = FIO-01)* Selects a drive signal to be connected to relay output RO2. For the available selections, see parameter *14.11 DIO1 output source*.	*Not energized*
14.38	*RO2 ON delay*	*(Visible when 14.01 Module 1 type = FIO-01)* Defines the activation delay for relay output RO2.	0.0 s



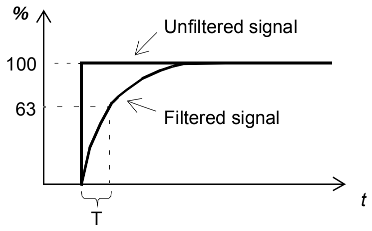
t_{On} = *14.38 RO2 ON delay*
t_{Off} = *14.39 RO2 OFF delay*

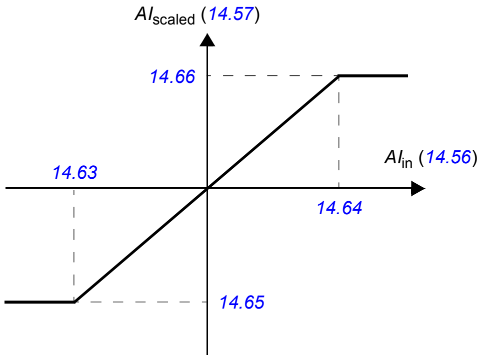
No.	Name/Value	Description	Def/ FbEq16
	0.0…3000.0 s	Activation delay for RO2.	10 = 1 s
14.39	*RO2 OFF delay*	*(Visible when 14.01 Module 1 type = FIO-01)* Defines the deactivation delay for relay output RO2. See parameter *14.38 RO2 ON delay*.	0.0 s
	0.0…3000.0 s	Deactivation delay for RO2.	10 = 1 s
14.41	*AI2 actual value*	*(Visible when 14.01 Module 1 type = FIO-11 or FAIO-01)* Displays the value of analog input AI2 in mA or V (depending on whether the input is set to current or voltage). This parameter is read-only.	-
	-22.000…22.000 mA or V	Value of analog input AI2.	1000 = 1 mA or V
14.42	*AI2 scaled value*	*(Visible when 14.01 Module 1 type = FIO-11 or FAIO-01)* Displays the value of analog input AI2 after scaling. See parameter *14.50 AI2 scaled at AI2 min*. This parameter is read-only.	-
	-32768.000 …32767.000	Scaled value of analog input AI2.	1 = 1
14.43	*AI2 force data*	*(Visible when 14.01 Module 1 type = FIO-11 or FAIO-01)* Forced value that can be used instead of the true reading of the input. See parameter *14.22 AI force selection*.	0.000 mA
	-22.000…22.000 mA or V	Forced value of analog input AI2.	1000 = 1 mA or V
14.44	*AI2 HW switch pos*	*(Visible when 14.01 Module 1 type = FIO-11 or FAIO-01)* Shows the position of the hardware current/voltage selector on the I/O extension module. Note: The setting of the current/voltage selector must match the unit selection made in parameter *14.45 AI2 unit selection*. I/O module reboot either by cycling the power or through parameter *96.08 Control board boot* is required to validate any changes in the hardware settings.	-
	V	Volts.	2

No.	Name/Value	Description	Def/ FbEq16
	mA	Milliamperes.	10
14.45	*AI2 unit selection*	*(Visible when 14.01 Module 1 type = FIO-11 or FAIO-01)* Selects the unit for readings and settings related to analog input AI2. Note: This setting must match the corresponding hardware setting on the I/O extension module (see the manual of the I/O extension module). The hardware setting is shown by parameter *14.44 AI2 HW switch pos*. I/O module reboot either by cycling the power or through parameter *96.08 Control board boot* is required to validate any changes in the hardware settings.	*mA*
	V	Volts.	2
	mA	Milliamperes.	10
14.46	*AI2 filter gain*	(Visible when *14.01 Module 1 type* = *FIO-11* or *FAIO-01*) Selects a hardware filtering time for AI2. See also parameter *14.47 AI2 filter time*.	*1 ms*
	No filtering	No filtering.	0
	125 us	125 microseconds.	1
	250 us	250 microseconds.	2
	500 us	500 microseconds.	3
	1 ms	1 millisecond.	4
	2 ms	2 milliseconds.	5
	4 ms	4 milliseconds.	6
	7.9375 ms	7.9375 milliseconds.	7
14.47	*AI2 filter time*	(Visible when *14.01 Module 1 type* = *FIO-11* or *FAIO-01*) Defines the filter time constant for analog input AI2.  $O = I \times (1 - e^{-t/T})$ 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. See parameter *14.46 AI2 filter gain*.	0.100 s
	0.000…30.000 s	Filter time constant.	1000 = 1 s

No.	Name/Value	Description	Def/ FbEq16
14.48	*AI2 min*	(Visible when *14.01 Module 1 type* = *FIO-11* or *FAIO-01*) Defines the minimum value for analog input AI2. See also parameter *14.21 AI tune*.	0.000 mA or V
	-22.000…22.000 mA or V	Minimum value of AI2.	1000 = 1 mA or V
14.49	*AI2 max*	(Visible when *14.01 Module 1 type* = *FIO-11* or *FAIO-01*) Defines the maximum value for analog input AI2. See also parameter *14.21 AI tune*.	10.000 mA or V
	-22.000…22.000 mA or V	Maximum value of AI2.	1000 = 1 mA or V
14.50	*AI2 scaled at AI2 min*	(Visible when *14.01 Module 1 type* = *FIO-11* or *FAIO-01*) Defines the real value that corresponds to the minimum analog input AI2 value defined by parameter *14.48 AI2 min*. 	0.000
	-32768.000 …32767.000	Real value corresponding to minimum AI2 value.	1 = 1
14.51	*AI2 scaled at AI2 max*	(Visible when *14.01 Module 1 type* = *FIO-11* or *FAIO-01*) Defines the real value that corresponds to the maximum analog input AI2 value defined by parameter *14.49 AI2 max*. See the drawing at parameter *14.50 AI2 scaled at AI2 min*.	100.000
	-32768.000 …32767.000	Real value corresponding to maximum AI2 value.	1 = 1
14.56	*AI3 actual value*	*(Visible when 14.01 Module 1 type = FIO-11)* Displays the value of analog input AI3 in mA or V (depending on whether the input is set to current or voltage). This parameter is read-only.	-
	-22.000…22.000 mA or V	Value of analog input AI3.	1000 = 1 mA or V
14.57	*AI3 scaled value*	*(Visible when 14.01 Module 1 type = FIO-11)* Displays the value of analog input AI3 after scaling. See parameter *14.65 AI3 scaled at AI3 min*. This parameter is read-only.	-
	-32768.000 …32767.000	Scaled value of analog input AI3.	1 = 1

No.	Name/Value	Description	Def/ FbEq16
14.58	*AI3 force data*	*(Visible when 14.01 Module 1 type = FIO-11)* Forced value that can be used instead of the true reading of the input. See parameter *14.22 AI force selection*.	0.000 mA
	-22.000…22.000 mA or V	Forced value of analog input AI3.	1000 = 1 mA or V
14.59	*AI3 HW switch pos*	*(Visible when 14.01 Module 1 type = FIO-11)* Shows the position of the hardware current/voltage selector on the I/O extension module. Note: The setting of the current/voltage selector must match the unit selection made in parameter *14.60 AI3 unit selection*. I/O module reboot either by cycling the power or through parameter *96.08 Control board boot* is required to validate any changes in the hardware settings.	-
	V	Volts.	2
	mA	Milliamperes.	10
14.60	*AI3 unit selection*	*(Visible when 14.01 Module 1 type = FIO-11)* Selects the unit for readings and settings related to analog input AI3. Note: This setting must match the corresponding hardware setting on the I/O extension module (see the manual of the I/O extension module). The hardware setting is shown by parameter *14.59 AI3 HW switch pos*. I/O module reboot either by cycling the power or through parameter *96.08 Control board boot* is required to validate any changes in the hardware settings.	*mA*
	V	Volts.	2
	mA	Milliamperes.	10
14.61	*AI3 filter gain*	(Visible when *14.01 Module 1 type* = *FIO-11*) Selects a hardware filtering time for AI3. See also parameter *14.62 AI3 filter time*.	*1 ms*
	No filtering	No filtering.	0
	125 us	125 microseconds.	1
	250 us	250 microseconds.	2
	500 us	500 microseconds.	3
	1 ms	1 millisecond.	4
	2 ms	2 milliseconds.	5
	4 ms	4 milliseconds.	6
	7.9375 ms	7.9375 milliseconds.	7

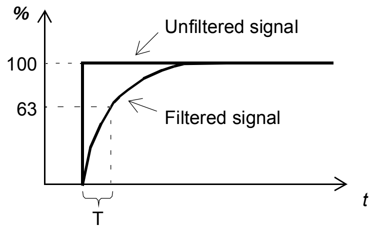
No.	Name/Value	Description	Def/ FbEq16
14.62	*AI3 filter time*	(Visible when *14.01 Module 1 type* = *FIO-11*) Defines the filter time constant for analog input AI3.  $O = I \times (1 - e^{-t/T})$ I = filter input (step) O = filter output *t* = time T = filter time constant Note: The signal is also filtered due to the signal interface hardware. See parameter *14.61 AI3 filter gain*.	0.100 s
	0.000…30.000 s	Filter time constant.	1000 = 1 s
14.63	*AI3 min*	(Visible when *14.01 Module 1 type* = *FIO-11*) Defines the minimum value for analog input AI3. See also parameter *14.21 AI tune.*	0.000 mA or V
	-22.000…22.000 mA or V	Minimum value of AI3.	1000 = 1 mA or V
14.64	*AI3 max*	(Visible when *14.01 Module 1 type* = *FIO-11*) Defines the maximum value for analog input AI3. See also parameter *14.21 AI tune.*	10.000 mA or V
	-22.000…22.000 mA or V	Maximum value of AI3.	1000 = 1 mA or V

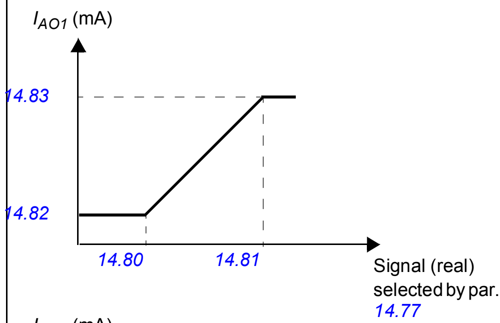
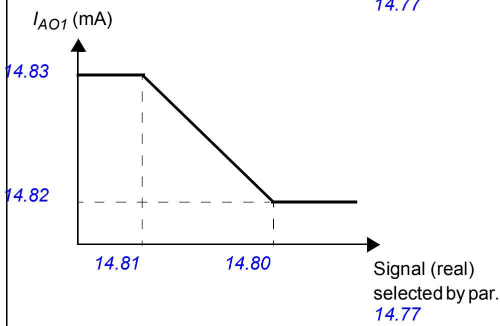
No.	Name/Value	Description	Def/ FbEq16
14.65	*AI3 scaled at AI3 min*	(Visible when *14.01 Module 1 type* = *FIO-11*) Defines the real value that corresponds to the minimum analog input AI3 value defined by parameter *14.63 AI3 min*.  	0.000
	-32768.000 …32767.000	Real value corresponding to minimum AI3 value.	1 = 1
14.66	*AI3 scaled at AI3 max*	(Visible when *14.01 Module 1 type* = *FIO-11*) Defines the real value that corresponds to the maximum analog input AI3 value defined by parameter *14.64 AI3 max*. See the drawing at parameter *14.65 AI3 scaled at AI3 min*.	100.000
	-32768.000 …32767.000	Real value corresponding to maximum AI3 value.	1 = 1
14.71	*AO force selection*	*(Visible when 14.01 Module 1 type = FIO-11 or FAIO-01)* The value of the analog output can be overridden for eg. testing purposes. A forced value parameter (*14.78 AO1 force data*) is provided for the analog output, and its value is applied whenever the corresponding bit in this parameter is 1.	00b

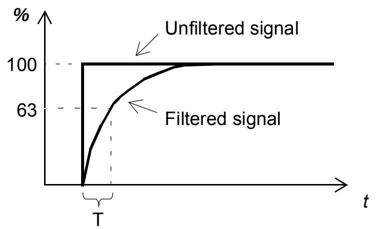
Bit	Value
0	1 = Force AO1 to value of parameter *14.78 AO1 force data*.
1	1 = Force AO2 to value of parameter *14.88 AO2 force data* (FAIO-01 only).
3…15	Reserved.

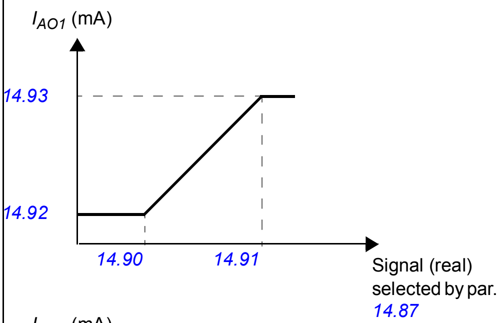
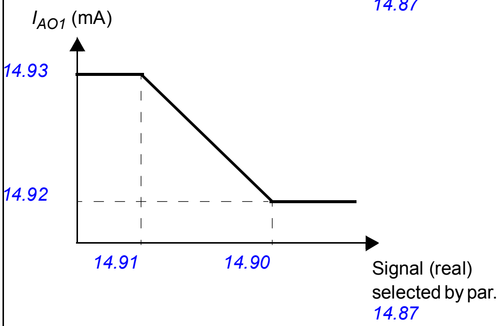
No.	Name/Value	Description	Def/ FbEq16
	00b…11b	Forced values selector for analog outputs.	1 = 1
14.76	*AO1 actual value*	*(Visible when 14.01 Module 1 type = FIO-11 or FAIO-01)* Displays the value of AO1 in mA. This parameter is read-only.	-
	0.000…22.000 mA	Value of AO1.	1000 = 1 mA
14.77	*AO1 source*	*(Visible when 14.01 Module 1 type = FIO-11 or FAIO-01)* Selects a signal to be connected to analog output AO1. Alternatively, sets the output to excitation mode to feed a constant current to a temperature sensor.	*Zero*
	Zero	None.	0

No.	Name/Value	Description	Def/ FbEq16
	Motor speed used	*01.01 Motor speed used* (page 105).	1
	Output frequency	*01.06 Output frequency* (page 105).	3
	Motor current	*01.07 Motor current* (page 105).	4
	Motor torque	*01.10 Motor torque* (page 105).	6
	DC voltage	*01.11 DC voltage* (page 105).	7
	Power inu out	*01.14 Output power* (page 106).	8
	Speed ref ramp in	*23.01 Speed ref ramp input* (page 203).	10
	Speed ref ramp out	*23.02 Speed ref ramp output* (page 204).	11
	Speed ref used	*24.01 Used speed reference* (page 210).	12
	Torq ref used	*26.02 Torque reference used*	13
	Freq ref used	*28.02 Frequency ref ramp output* (page 226).	14
	Force PT100 excitation	The output is used to feed an excitation current to 1…3 Pt100 sensors. See section *Motor thermal protection* (page 83).	20
	Force KTY84 excitation	The output is used to feed an excitation current to a KTY84 sensor. See section *Motor thermal protection* (page 83).	21
	Force PTC excitation	The output is used to feed an excitation current to 1…3 PTC sensors. See section *Motor thermal protection* (page 83).	22
	Force Pt1000 excitation	The output is used to feed an excitation current to 1…3 Pt1000 sensors. See section *Motor thermal protection* (page 83).	23
	AO1 data storage	*13.91 AO1 data storage* (page 149).	37
	AO2 data storage	*13.92 AO2 data storage* (page 149).	38
	Other	Source selection (see *Terms and abbreviations* on page 101).	-
14.78	*AO1 force data*	*(Visible when 14.01 Module 1 type = FIO-11 or FAIO-01)* Forced value that can be used instead of the selected output signal. See parameter *14.71 AO force selection*.	0.000 mA
	0.000…22.000 mA	Forced value of analog output AO1.	1000 = 1 mA

No.	Name/Value	Description	Def/ FbEq16
14.79	*AO1 filter time*	*(Visible when 14.01 Module 1 type* = *FIO-11 or FAIO-01)* Defines the filtering time constant for analog output AO1.  $O = I \times (1 - e^{-t/T})$ 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
14.80	*AO1 source min*	*(Visible when 14.01 Module 1 type = FIO-11 or FAIO-01)* Defines the real value of the signal (selected by parameter *14.77 AO1 source*) that corresponds to the minimum AO1 output value (defined by parameter *14.82 AO1 out at AO1 src min*).  	0.0
	-32768.0…32767.0	Real signal value corresponding to minimum AO1 output value.	1 = 1
14.81	*AO1 source max*	*(Visible when 14.01 Module 1 type = FIO-11 or FAIO-01)* Defines the real value of the signal (selected by parameter *14.77 AO1 source*) that corresponds to the maximum AO1 output value (defined by parameter *14.83 AO1 out at AO1 src max*). See parameter *14.80 AO1 source min*.	100.0
	-32768.0…32767.0	Real signal value corresponding to maximum AO1 output value.	1 = 1
14.82	*AO1 out at AO1 src min*	*(Visible when 14.01 Module 1 type = FIO-11 or FAIO-01)* Defines the minimum output value for analog output AO1. See also drawing at parameter *14.80 AO1 source min*.	0.000 mA
	0.000…22.000 mA	Minimum AO1 output value.	1000 = 1 mA
14.83	*AO1 out at AO1 src max*	*(Visible when 14.01 Module 1 type = FIO-11 or FAIO-01)* Defines the maximum output value for analog output AO1. See also drawing at parameter *14.80 AO1 source min*.	10.000 mA
	0.000…22.000 mA	Maximum AO1 output value.	1000 = 1 mA

No.	Name/Value	Description	Def/ FbEq16
14.86	*AO2 actual value*	*(Visible when 14.01 Module 1 type* = *FAIO-01)* Displays the value of AO2 in mA. This parameter is read-only.	-
	0.000…22.000 mA	Value of AO2.	1000 = 1 mA
14.87	*AO2 source*	*(Visible when 14.01 Module 1 type* = *FAIO-01)* 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 *14.77 AO1 source*.	*Zero*
14.88	*AO2 force data*	*(Visible when 14.01 Module 1 type* = *FAIO-01)* Forced value that can be used instead of the selected output signal. See parameter *14.71 AO force selection*.	0.000 mA
	0.000…22.000 mA	Forced value of analog output AO2.	1000 = 1 mA
14.89	*AO2 filter time*	*(Visible when 14.01 Module 1 type* = *FAIO-01)* Defines the filtering time constant for analog output AO2.  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
14.90	*AO2 source min*	*(Visible when 14.01 Module 1 type = FAIO-01)* Defines the real value of the signal (selected by parameter *14.87 AO2 source*) that corresponds to the minimum AO2 output value (defined by parameter *14.92 AO2 out at AO2 src min*).  	0.0
	-32768.0…32767.0	Real signal value corresponding to minimum AO2 output value.	1 = 1
14.91	*AO2 source max*	*(Visible when 14.01 Module 1 type = k)* Defines the real value of the signal (selected by parameter *14.87 AO2 source*) that corresponds to the maximum AO2 output value (defined by parameter *14.93 AO2 out at AO2 src max*). See parameter *14.90 AO2 source min*.	100.0
	-32768.0…32767.0	Real signal value corresponding to maximum AO2 output value.	1 = 1
14.92	*AO2 out at AO2 src min*	*(Visible when 14.01 Module 1 type = FAIO-01)* Defines the minimum output value for analog output AO2. See also drawing at parameter *14.90 AO2 source min*.	0.000 mA
	0.000…22.000 mA	Minimum AO2 output value.	1000 = 1 mA
14.93	*AO2 out at AO2 src max*	*(Visible when 14.01 Module 1 type = FAIO-01)* Defines the maximum output value for analog output AO2. See also drawing at parameter *14.90 AO2 source min*.	10.000 mA
	0.000…22.000 mA	Maximum AO2 output value.	1000 = 1 mA

No.	Name/Value	Description	Def/ FbEq16
15 I/O extension module 2		Configuration of I/O extension module 2. See also section *Programmable I/O extensions* (page 56). Note: The contents of the parameter group vary according to the selected I/O extension module type.	
15.01	Module 2 type	See parameter *14.01 Module 1 type*.	*None*
15.02	Module 2 location	See parameter *14.02 Module 1 location*.	*Slot 1*
15.03	Module 2 status	See parameter *14.03 Module 1 status*.	*No option*
15.05	DIO status	(Visible when *15.01 Module 2 type* = *FIO-01* or *FIO-11*) See parameter *14.05 DIO status*.	-
15.06	DIO delayed status	(Visible when *15.01 Module 2 type* = *FIO-01* or *FIO-11*) See parameter *14.06 DIO delayed status*.	-
15.08	DIO filter time	(Visible when *15.01 Module 2 type* = *FIO-01* or *FIO-11*) See parameter *14.08 DIO filter time*.	10.0 ms
15.09	DIO1 function	(Visible when *15.01 Module 2 type* = *FIO-01* or *FIO-11*) See parameter *14.09 DIO1 function*.	*Input*
15.11	DIO1 output source	(Visible when *15.01 Module 2 type* = *FIO-01* or *FIO-11*) See parameter *14.11 DIO1 output source*.	*Not energized*
15.12	DIO1 ON delay	(Visible when *15.01 Module 2 type* = *FIO-01* or *FIO-11*) See parameter *14.12 DIO1 ON delay*.	0.0 s
15.13	DIO1 OFF delay	(Visible when *15.01 Module 2 type* = *FIO-01* or *FIO-11*) See parameter *14.13 DIO1 OFF delay*.	0.0 s
15.14	DIO2 function	(Visible when *15.01 Module 2 type* = *FIO-01* or *FIO-11*) See parameter *14.14 DIO2 function*.	*Input*
15.15	DIO2 filter gain	(Visible when *15.01 Module 2 type* = *FIO-11*) See parameter *14.15 DIO2 filter gain*.	*7.5 us*
15.16	DIO2 output source	(Visible when *15.01 Module 2 type* = *FIO-01* or *FIO-11*) See parameter *14.16 DIO2 output source*.	*Not energized*
15.17	DIO2 ON delay	(Visible when *15.01 Module 2 type* = *FIO-01* or *FIO-11*) See parameter *14.17 DIO2 ON delay*.	0.0 s
15.18	DIO2 OFF delay	(Visible when *15.01 Module 2 type* = *FIO-01* or *FIO-11*) See parameter *14.18 DIO2 OFF delay*.	0.0 s
15.19	DIO3 configuration	(Visible when *15.01 Module 2 type* = *FIO-01*) See parameter *14.19 DIO3 function*.	*Input*
15.19	AI supervision function	(Visible when *15.01 Module 2 type* = *FIO-11* or *FAIO-01*) See parameter *14.19 AI supervision function*.	*No action*
15.20	AI supervision selection	(Visible when *15.01 Module 2 type* = *FIO-11* or *FAIO-01*) See parameter *14.20 AI supervision selection*.	0000 0000b
15.21	DIO3 output source	(Visible when *15.01 Module 2 type* = *FIO-01*) See parameter *14.21 DIO3 output source*.	*Not energized*
15.21	AI tune	(Visible when *15.01 Module 2 type* = *FIO-11* or *FAIO-01*) See parameter *14.21 AI tune*.	*No action*
15.22	DIO3 ON delay	(Visible when *15.01 Module 2 type* = *FIO-01*) See parameter *14.22 DIO3 ON delay*.	0.0 s
15.22	AI force selection	(Visible when *15.01 Module 2 type* = *FIO-11* or *FAIO-01*) See parameter *14.22 AI force selection*.	0000b

No.	Name/Value	Description	Def/ FbEq16
15.23	*DIO3 OFF delay*	*(Visible when 15.01 Module 2 type = FIO-01)* See parameter *14.23 DIO3 OFF delay*.	0.0 s
15.24	*DIO4 configuration*	(Visible when *15.01 Module 2 type* = *FIO-01*) See parameter *14.24 DIO4 function*.	*Input*
15.26	*DIO4 output source*	(Visible when *15.01 Module 2 type* = *FIO-01*) See parameter *14.26 DIO4 output source*.	*Not energized*
15.26	*AI1 actual value*	(Visible when *15.01 Module 2 type* = *FIO-11* or *FAIO-01*) See parameter *14.26 AI1 actual value*.	-
15.27	*DIO4 ON delay*	(Visible when *15.01 Module 2 type* = *FIO-01*) See parameter *14.27 DIO4 ON delay*.	0.0 s
15.27	*AI1 scaled value*	(Visible when *15.01 Module 2 type* = *FIO-11* or *FAIO-01*) See parameter *14.27 AI1 scaled value*.	-
15.28	*DIO4 OFF delay*	(Visible when *15.01 Module 2 type* = *FIO-01*) See parameter *14.28 DIO4 OFF delay*.	0.0 s
15.28	*AI1 force data*	(Visible when *15.01 Module 2 type* = *FIO-11* or *FAIO-01*) See parameter *14.28 AI1 force data*.	0.000 mA
15.29	*AI1 HW switch pos*	(Visible when *15.01 Module 2 type* = *FIO-11* or *FAIO-01*) See parameter *14.29 AI1 HW switch pos*.	-
15.30	*AI1 unit selection*	(Visible when *15.01 Module 2 type* = *FIO-11* or *FAIO-01*) See parameter *14.30 AI1 unit selection*.	*mA*
15.31	*RO status*	*(Visible when 15.01 Module 2 type = FIO-01)* See parameter *14.31 RO status*.	-
15.31	*AI1 filter gain*	(Visible when *15.01 Module 2 type* = *FIO-11* or *FAIO-01*) See parameter *14.31 AI1 filter gain*.	*1 ms*
15.32	*AI1 filter time*	(Visible when *15.01 Module 2 type* = *FIO-11* or *FAIO-01*) See parameter *14.32 AI1 filter time*.	0.100 s
15.33	*AI1 min*	(Visible when *15.01 Module 2 type* = *FIO-11* or *FAIO-01*) See parameter *14.33 AI1 min*.	0.000 mA or V
15.34	*RO1 source*	(Visible when *15.01 Module 2 type* = *FIO-01*) See parameter *14.34 RO1 source*.	*Not energized*
15.34	*AI1 max*	(Visible when *15.01 Module 2 type* = *FIO-11* or *FAIO-01*) See parameter *14.34 AI1 max*.	10.000 mA or V
15.35	*RO1 ON delay*	(Visible when *15.01 Module 2 type* = *FIO-01*) See parameter *14.35 RO1 ON delay*.	0.0 s
15.35	*AI1 scaled at AI1 min*	(Visible when *15.01 Module 2 type* = *FIO-11* or *FAIO-01*) See parameter *14.35 AI1 scaled at AI1 min*.	0.000
15.36	*RO1 OFF delay*	(Visible when *15.01 Module 2 type* = *FIO-01*) See parameter *14.36 RO1 OFF delay*.	0.0 s
15.36	*AI1 scaled at AI1 max*	(Visible when *15.01 Module 2 type* = *FIO-11* or *FAIO-01*) See parameter *14.36 AI1 scaled at AI1 max*.	100.000
15.37	*RO2 source*	(Visible when *15.01 Module 2 type* = *FIO-01*) See parameter *14.37 RO2 source*.	*Not energized*
15.38	*RO2 ON delay*	(Visible when *15.01 Module 2 type* = *FIO-01*) See parameter *14.38 RO2 ON delay*.	0.0 s
15.39	*RO2 OFF delay*	(Visible when *15.01 Module 2 type* = *FIO-01*) See parameter *14.39 RO2 OFF delay*.	0.0 s

No.	Name/Value	Description	Def/ FbEq16
15.41	*AI2 actual value*	(Visible when *15.01 Module 2 type* = *FIO-11* or *FAIO-01*) See parameter *14.41 AI2 actual value*.	-
15.42	*AI2 scaled value*	(Visible when *15.01 Module 2 type* = *FIO-11* or *FAIO-01*) See parameter *14.42 AI2 scaled value*.	-
15.43	*AI2 force data*	(Visible when *15.01 Module 2 type* = *FIO-11* or *FAIO-01*) See parameter *14.43 AI2 force data*.	0.000 mA
15.44	*AI2 HW switch position*	(Visible when *15.01 Module 2 type* = *FIO-11* or *FAIO-01*) See parameter *14.44 AI2 HW switch pos*.	-
15.45	*AI2 unit selection*	(Visible when *15.01 Module 2 type* = *FIO-11* or *FAIO-01*) See parameter *14.45 AI2 unit selection*.	*mA*
15.46	*AI2 filter gain*	(Visible when *15.01 Module 2 type* = *FIO-11* or *FAIO-01*) See parameter *14.46 AI2 filter gain*.	*1 ms*
15.47	*AI2 filter time*	(Visible when *15.01 Module 2 type* = *FIO-11* or *FAIO-01*) See parameter *14.47 AI2 filter time*.	0.100 s
15.48	*AI2 min*	(Visible when *15.01 Module 2 type* = *FIO-11* or *FAIO-01*) See parameter *14.48 AI2 min*.	0.000 mA or V
15.49	*AI2 max*	(Visible when *15.01 Module 2 type* = *FIO-11* or *FAIO-01*) See parameter *14.49 AI2 max*.	10.000 mA or V
15.50	*AI2 scaled at AI2 min*	(Visible when *15.01 Module 2 type* = *FIO-11* or *FAIO-01*) See parameter *14.50 AI2 scaled at AI2 min*.	0.000
15.51	*AI2 scaled at AI2 max*	(Visible when *15.01 Module 2 type* = *FIO-11* or *FAIO-01*) See parameter *14.51 AI2 scaled at AI2 max*.	100.000
15.56	*AI3 actual value*	(Visible when *15.01 Module 2 type* = *FIO-11*) See parameter *14.56 AI3 actual value*.	-
15.57	*AI3 scaled value*	(Visible when *15.01 Module 2 type* = *FIO-11*) See parameter *14.57 AI3 scaled value*.	-
15.58	*AI3 force data*	(Visible when *15.01 Module 2 type* = *FIO-11*) See parameter *14.58 AI3 force data*.	0.000 mA
15.59	*AI3 HW switch position*	(Visible when *15.01 Module 2 type* = *FIO-11*) See parameter *14.59 AI3 HW switch pos*.	-
15.60	*AI3 unit selection*	(Visible when *15.01 Module 2 type* = *FIO-11*) See parameter *14.60 AI3 unit selection*.	*mA*
15.61	*AI3 filter gain*	(Visible when *15.01 Module 2 type* = *FIO-11*) See parameter *14.61 AI3 filter gain*.	*1 ms*
15.62	*AI3 filter time*	(Visible when *15.01 Module 2 type* = *FIO-11*) See parameter *14.62 AI3 filter time*.	0.100 s
15.63	*AI3 min*	(Visible when *15.01 Module 2 type* = *FIO-11*) See parameter *14.63 AI3 min*.	0.000 mA or V
15.64	*AI3 max*	(Visible when *15.01 Module 2 type* = *FIO-11*) See parameter *14.64 AI3 max*.	10.000 mA or V
15.65	*AI3 scaled at AI3 min*	(Visible when *15.01 Module 2 type* = *FIO-11*) See parameter *14.65 AI3 scaled at AI3 min*.	0.000
15.66	*AI3 scaled at AI3 max*	(Visible when *15.01 Module 2 type* = *FIO-11*) See parameter *14.66 AI3 scaled at AI3 max*.	100.000
15.71	*AO force selection*	(Visible when *15.01 Module 2 type* = *FIO-11* or *FAIO-01*) See parameter *14.71 AO force selection*.	00b

No.	Name/Value	Description	Def/ FbEq16
15.76	AO1 actual value	(Visible when 15.01 Module 2 type = FIO-11 or FAIO-01) See parameter 14.76 AO1 actual value.	-
15.77	AO1 source	(Visible when 15.01 Module 2 type = FIO-11 or FAIO-01) See parameter 14.77 AO1 source.	Zero
15.78	AO1 force data	(Visible when 15.01 Module 2 type = FIO-11 or FAIO-01) See parameter 14.78 AO1 force data.	0.000 mA
15.79	AO1 filter time	(Visible when 15.01 Module 2 type = FIO-11 or FAIO-01) See parameter 14.79 AO1 filter time.	0.100 s
15.80	AO1 source min	(Visible when 15.01 Module 2 type = FIO-11 or FAIO-01) See parameter 14.80 AO1 source min.	0.0
15.81	AO1 source max	(Visible when 15.01 Module 2 type = FIO-11 or FAIO-01) See parameter 14.81 AO1 source max.	100.0
15.82	AO1 out at AO1 src min	(Visible when 15.01 Module 2 type = FIO-11 or FAIO-01) See parameter 14.82 AO1 out at AO1 src min.	0.000 mA
15.83	AO1 out at AO1 src max	(Visible when 15.01 Module 2 type = FIO-11 or FAIO-01) See parameter 14.83 AO1 out at AO1 src max.	10.000 mA
15.86	AO2 actual value	(Visible when 15.01 Module 2 type = FAIO-01) See parameter 14.86 AO2 actual value.	-
15.87	AO2 source	(Visible when 15.01 Module 2 type = FAIO-01) See parameter 14.87 AO2 source.	Zero
15.88	AO2 force data	(Visible when 15.01 Module 2 type = FAIO-01) See parameter 14.88 AO2 force data.	0.000 mA
15.89	AO2 filter time	(Visible when 15.01 Module 2 type = FAIO-01) See parameter 14.89 AO2 filter time.	0.100 s
15.90	AO2 source min	(Visible when 15.01 Module 2 type = FAIO-01) See parameter 14.90 AO2 source min.	0.0
15.91	AO2 source max	(Visible when 15.01 Module 2 type = FAIO-01) See parameter 14.91 AO2 source max.	100.0
15.92	AO2 out at AO1 src min	(Visible when 15.01 Module 2 type = FAIO-01) See parameter 14.92 AO2 out at AO2 src min.	0.000 mA
15.93	AO2 out at AO1 src max	(Visible when 15.01 Module 2 type = FAIO-01) See parameter 14.93 AO2 out at AO2 src max.	10.000 mA

16 I/O extension module 3		Configuration of I/O extension module 3. See also section Programmable I/O extensions (page 56). Note: The contents of the parameter group vary according to the selected I/O extension module type.	
16.01	Module 3 type	See parameter 14.01 Module 1 type.	None
16.02	Module 3 location	See parameter 14.02 Module 1 location.	Slot 1
16.03	Module 3 status	See parameter 14.03 Module 1 status.	No option
16.05	DIO status	*(Visible when 16.01 Module 3 type = FIO-01 or FIO-11)* See parameter 14.05 DIO status.	-
16.06	DIO delayed status	*(Visible when 16.01 Module 3 type = FIO-01 or FIO-11)* See parameter 14.06 DIO delayed status.	-
16.08	DIO filter time	*(Visible when 16.01 Module 3 type = FIO-01 or FIO-11)* See parameter 14.08 DIO filter time.	10.0 ms

No.	Name/Value	Description	Def/ FbEq16
16.09	*DIO1 function*	*(Visible when 16.01 Module 3 type = FIO-01 or FIO-11)* See parameter *14.09 DIO1 function*.	*Input*
16.11	*DIO1 output source*	*(Visible when 16.01 Module 3 type = FIO-01 or FIO-11)* See parameter *14.11 DIO1 output source*.	*Not energized*
16.12	*DIO1 ON delay*	*(Visible when 16.01 Module 3 type = FIO-01 or FIO-11)* See parameter *14.12 DIO1 ON delay*.	0.0 s
16.13	*DIO1 OFF delay*	*(Visible when 16.01 Module 3 type = FIO-01 or FIO-11)* See parameter *14.13 DIO1 OFF delay*.	0.0 s
16.14	*DIO2 function*	*(Visible when 16.01 Module 3 type = FIO-01 or FIO-11)* See parameter *14.14 DIO2 function*.	*Input*
16.16	*DIO2 output source*	*(Visible when 16.01 Module 3 type = FIO-01 or FIO-11)* See parameter *14.16 DIO2 output source*.	*Not energized*
16.17	*DIO2 ON delay*	*(Visible when 16.01 Module 3 type = FIO-01 or FIO-11)* See parameter *14.17 DIO2 ON delay*.	0.0 s
16.18	*DIO2 OFF delay*	*(Visible when 16.01 Module 3 type = FIO-01 or FIO-11)* See parameter *14.18 DIO2 OFF delay*.	0.0 s
16.19	*DIO3 function*	(Visible when *16.01 Module 3 type* = *FIO-01*) See parameter *14.19 DIO3 function*.	*Input*
16.19	*AI supervision function*	(Visible when *16.01 Module 3 type* = *FIO-11* or *FAIO-01*) See parameter *14.19 AI supervision function*.	*No action*
16.20	*AI supervision selection*	(Visible when *16.01 Module 3 type* = *FIO-11* or *FAIO-01*) See parameter *14.20 AI supervision selection*.	0000 0000b
16.21	*DIO3 output source*	*(Visible when 16.01 Module 3 type = FIO-01)* See parameter *14.21 DIO3 output source*.	*Not energized*
16.21	*AI tune*	*(Visible when 16.01 Module 3 type = FIO-01* or *FAIO-01)* See parameter *14.21 DIO3 output source*.	*No action*
16.22	*DIO3 ON delay*	*(Visible when 16.01 Module 3 type = FIO-01)* See parameter *14.22 DIO3 ON delay*.	0.0 s
16.22	*AI force selection*	(Visible when *16.01 Module 3 type* = *FIO-11* or *FAIO-01*) See parameter *14.22 AI force selection*.	0000b
16.23	*DIO3 OFF delay*	*(Visible when 16.01 Module 3 type = FIO-01)* See parameter *14.23 DIO3 OFF delay*.	0.0 s
16.24	*DIO4 configuration*	(Visible when *16.01 Module 3 type* = *FIO-01*) See parameter *14.24 DIO4 function*.	*Input*
16.26	*DIO4 output source*	(Visible when *16.01 Module 3 type* = *FIO-01*) See parameter *14.26 DIO4 output source*.	*Not energized*
16.26	*AI1 actual value*	(Visible when *16.01 Module 3 type* = *FIO-11* or *FAIO-01*) See parameter *14.26 AI1 actual value*.	-
16.27	*DIO4 ON delay*	(Visible when *16.01 Module 3 type* = *FIO-01*) See parameter *14.27 DIO4 ON delay*.	0.0 s
16.27	*AI1 scaled value*	(Visible when *16.01 Module 3 type* = *FIO-11* or *FAIO-01*) See parameter *14.27 AI1 scaled value*.	-
16.28	*DIO4 OFF delay*	(Visible when *16.01 Module 3 type* = *FIO-01*) See parameter *14.28 DIO4 OFF delay*.	0.0 s
16.28	*AI1 force data*	(Visible when *16.01 Module 3 type* = *FIO-11* or *FAIO-01*) See parameter *14.28 AI1 force data*.	0.000 mA

No.	Name/Value	Description	Def/ FbEq16
16.29	AI1 HW switch position	(Visible when 16.01 Module 3 type = FIO-11 or FAIO-01) See parameter 14.29 AI1 HW switch pos.	-
16.30	AI1 unit selection	(Visible when 16.01 Module 3 type = FIO-11 or FAIO-01) See parameter 14.30 AI1 unit selection.	mA
16.31	RO status	(Visible when 16.01 Module 3 type = FIO-11) See parameter 14.31 RO status.	-
16.31	AI1 filter gain	(Visible when 16.01 Module 3 type = FIO-11 or FAIO-01) See parameter 14.31 AI1 filter gain.	1 ms
16.32	AI1 filter time	(Visible when 16.01 Module 3 type = FIO-11 or FAIO-01) See parameter 14.32 AI1 filter time.	0.100 s
16.33	AI1 min	(Visible when 16.01 Module 3 type = FIO-11 or FAIO-01) See parameter 14.33 AI1 min.	0.000 mA or V
16.34	RO1 source	(Visible when 16.01 Module 3 type = FIO-01) See parameter 14.34 RO1 source.	Not energized
16.34	AI1 max	(Visible when 16.01 Module 3 type = FIO-11 or FAIO-01) See parameter 14.34 AI1 max.	10.000 mA or V
16.35	RO1 ON delay	(Visible when 16.01 Module 3 type = FIO-01) See parameter 14.35 RO1 ON delay.	0.0 s
16.35	AI1 scaled at AI1 min	(Visible when 16.01 Module 3 type = FIO-11 or FAIO-01) See parameter 14.35 AI1 scaled at AI1 min.	0.000
16.36	RO1 OFF delay	(Visible when 16.01 Module 3 type = FIO-01) See parameter 14.36 RO1 OFF delay.	0.0 s
16.36	AI1 scaled at AI1 max	(Visible when 16.01 Module 3 type = FIO-11 or FAIO-01) See parameter 14.36 AI1 scaled at AI1 max.	100.000
16.37	RO2 source	(Visible when 16.01 Module 3 type = FIO-01) See parameter 14.37 RO2 source.	Not energized
16.38	RO2 ON delay	(Visible when 16.01 Module 3 type = FIO-01) See parameter 14.38 RO2 ON delay.	0.0 s
16.39	RO2 OFF delay	(Visible when 16.01 Module 3 type = FIO-01) See parameter 14.39 RO2 OFF delay.	0.0 s
16.41	AI2 actual value	(Visible when 16.01 Module 3 type = FIO-11 or FAIO-01) See parameter 14.41 AI2 actual value.	-
16.42	AI2 scaled value	(Visible when 16.01 Module 3 type = FIO-11 or FAIO-01) See parameter 14.42 AI2 scaled value.	-
16.43	AI2 force data	(Visible when 16.01 Module 3 type = FIO-11 or FAIO-01) See parameter 14.43 AI2 force data.	0.000 mA
16.44	AI2 HW switch pos	(Visible when 16.01 Module 3 type = FIO-11 or FAIO-01) See parameter 14.44 AI2 HW switch pos.	-
16.45	AI2 unit selection	(Visible when 16.01 Module 3 type = FIO-11 or FAIO-01) See parameter 14.45 AI2 unit selection.	mA
16.46	AI2 filter gain	(Visible when 16.01 Module 3 type = FIO-11 or FAIO-01) See parameter 14.46 AI2 filter gain.	1 ms
16.47	AI2 filter time	(Visible when 16.01 Module 3 type = FIO-11 or FAIO-01) See parameter 14.47 AI2 filter time.	0.100 s
16.48	AI2 min	(Visible when 16.01 Module 3 type = FIO-11 or FAIO-01) See parameter 14.48 AI2 min.	0.000 mA or V

No.	Name/Value	Description	Def/ FbEq16
16.49	*AI2 max*	(Visible when *16.01 Module 3 type* = *FIO-11* or *FAIO-01*) See parameter *14.49 AI2 max*.	10.000 mA or V
16.50	*AI2 scaled at AI2 min*	(Visible when *16.01 Module 3 type* = *FIO-11* or *FAIO-01*) See parameter *14.50 AI2 scaled at AI2 min*.	0.000
16.51	*AI2 scaled at AI2 max*	(Visible when *16.01 Module 3 type* = *FIO-11* or *FAIO-01*) See parameter *14.51 AI2 scaled at AI2 max*.	100.000
16.56	*AI3 actual value*	(Visible when *16.01 Module 3 type* = *FIO-11*) See parameter *14.56 AI3 actual value*.	-
16.57	*AI3 scaled value*	(Visible when *16.01 Module 3 type* = *FIO-11*) See parameter *14.57 AI3 scaled value*.	-
16.58	*AI3 force data*	(Visible when *16.01 Module 3 type* = *FIO-11*) See parameter *14.58 AI3 force data*.	0.000 mA
16.59	*AI3 HW switch position*	(Visible when *16.01 Module 3 type* = *FIO-11*) See parameter *14.59 AI3 HW switch pos*.	-
16.60	*AI3 unit selection*	(Visible when *16.01 Module 3 type* = *FIO-11*) See parameter *14.60 AI3 unit selection*.	*mA*
16.61	*AI3 filter gain*	(Visible when *16.01 Module 3 type* = *FIO-11*) See parameter *14.61 AI3 filter gain*.	*1 ms*
16.62	*AI3 filter time*	(Visible when *16.01 Module 3 type* = *FIO-11*) See parameter *14.62 AI3 filter time*.	0.100 s
16.63	*AI3 min*	(Visible when *16.01 Module 3 type* = *FIO-11*) See parameter *14.63 AI3 min*.	0.000 mA or V
16.64	*AI3 max*	(Visible when *16.01 Module 3 type* = *FIO-11*) See parameter *14.64 AI3 max*.	10.000 mA or V
16.65	*AI3 scaled at AI3 min*	(Visible when *16.01 Module 3 type* = *FIO-11*) See parameter *14.65 AI3 scaled at AI3 min*.	0.000
16.66	*AI3 scaled at AI3 max*	(Visible when *16.01 Module 3 type* = *FIO-11*) See parameter *14.66 AI3 scaled at AI3 max*.	100.000
16.71	*AO force selection*	(Visible when *16.01 Module 3 type* = *FIO-11* or *FAIO-01*) See parameter *14.71 AO force selection*.	00b
16.76	*AO1 actual value*	(Visible when *16.01 Module 3 type* = *FIO-11* or *FAIO-01*) See parameter *14.76 AO1 actual value*.	-
16.77	*AO1 source*	(Visible when *16.01 Module 3 type* = *FIO-11* or *FAIO-01*) See parameter *14.77 AO1 source*.	*Zero*
16.78	*AO1 force data*	(Visible when *16.01 Module 3 type* = *FIO-11* or *FAIO-01*) See parameter *14.78 AO1 force data*.	0.000 mA
16.79	*AO1 filter time*	(Visible when *16.01 Module 3 type* = *FIO-11* or *FAIO-01*) See parameter *14.79 AO1 filter time*.	0.100 s
16.80	*AO1 source min*	(Visible when *16.01 Module 3 type* = *FIO-11* or *FAIO-01*) See parameter *14.80 AO1 source min*.	0.0
16.81	*AO1 source max*	(Visible when *16.01 Module 3 type* = *FIO-11* or *FAIO-01*) See parameter *14.81 AO1 source max*.	100.0
16.82	*AO1 out at AO1 src min*	(Visible when *16.01 Module 3 type* = *FIO-11* or *FAIO-01*) See parameter *14.82 AO1 out at AO1 src min*.	0.000 mA
16.83	*AO1 out at AO1 src max*	(Visible when *16.01 Module 3 type* = *FIO-11* or *FAIO-01*) See parameter *14.83 AO1 out at AO1 src max*.	10.000 mA

No.	Name/Value	Description	Def/ FbEq16
16.86	AO2 actual value	(Visible when 16.01 Module 3 type = FAIO-01) See parameter 14.86 AO2 actual value.	-
16.87	AO2 source	(Visible when 16.01 Module 3 type = FAIO-01) See parameter 14.87 AO2 source.	Zero
16.88	AO2 force data	(Visible when 16.01 Module 3 type = FAIO-01) See parameter 14.88 AO2 force data.	0.000 mA
16.89	AO2 filter time	(Visible when 16.01 Module 3 type = FAIO-01) See parameter 14.89 AO2 filter time.	0.100 s
16.90	AO2 source min	(Visible when 16.01 Module 3 type = FAIO-01) See parameter 14.90 AO2 source min.	0.0
16.91	AO2 source max	(Visible when 16.01 Module 3 type = FAIO-01) See parameter 14.91 AO2 source max.	100.0
16.92	AO2 out at AO2 src min	(Visible when 16.01 Module 3 type = FAIO-01) See parameter 14.92 AO2 out at AO2 src min.	0.000 mA
16.93	AO2 out at AO2 src max	(Visible when 16.01 Module 3 type = FAIO-01) See parameter 14.93 AO2 out at AO2 src max.	10.000 mA
19 Operation mode		Selection of local and external control location sources and operating modes. See also section Operating modes of the drive (page 53).	
19.01	Actual operation mode	Displays the operating mode currently used. See parameters 19.11…19.14. This parameter is read-only.	-
	Zero	None.	1
	Speed	Speed control (in DTC motor control mode).	2
	Torque	Torque control (in DTC motor control mode).	3
	Min	The torque selector is comparing the output of the speed controller (25.01 Torque reference speed control) and torque reference (26.74 Torque ref ramp out) and the smaller of the two is used.	4
	Max	The torque selector is comparing the output of the speed controller (25.01 Torque reference speed control) and torque reference (26.74 Torque ref ramp out) and the greater of the two is used.	5
	Add	The speed controller output is added to the torque reference.	6
	Scalar (Hz)	Frequency control in scalar motor control mode.	10
	Scalar (rpm)	Speed control in scalar motor control mode.	11
	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

No.	Name/Value	Description	Def/ FbEq16
	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
	DIO1	Digital input/output DIO1 (*11.02 DIO delayed status*, bit 0).	11
	DIO2	Digital input/output DIO2 (*11.02 DIO delayed status*, bit 1).	12
	EFB MCW bit 11	Control word bit 11 received through the embedded fieldbus interface.	32
	Other [bit]	Source selection (see *Terms and abbreviations* on page *101*).	-
19.12	*Ext1 control mode 1*	Selects the operating mode for external control location EXT1.	*Speed*
	Zero	None.	1
	Speed	Speed control. The torque reference used is *25.01 Torque reference speed control* (output of the speed reference chain).	2
19.14	*Ext2 control mode 1*	Selects the operating mode for external control location EXT2. For the selections, see parameter *19.12 Ext1 control mode 1*.	*Speed*
19.16	*Local control mode*	Selects the operating mode for local control.	*Speed*
	Speed	Speed control. The torque reference used is *25.01 Torque reference speed control* (output of the speed reference chain).	0
	Torque	Torque control. The torque reference used is *26.74 Torque ref ramp out* (output of the torque reference chain).	1
19.17	*Local control disable*	Enables/disables local control (start and stop buttons on the control panel, and the local controls on the PC tool). WARNING! Before disabling local control, ensure that the control panel is not needed for stopping the drive.	*No*
	No	Local control enabled.	0
	Yes	Local control disabled.	1
19.20	*Scalar control reference unit*	Selects the reference type for scalar motor control mode. See also section *Operating modes of the drive* (page *53*), and parameter *99.04 Motor ctrl mode*.	*Rpm*
	Hz	Hz. The reference is taken from parameter *28.02 Frequency ref ramp output* (output of the frequency control chain).	0
	Rpm	Rpm. The reference is taken from parameter *23.02 Speed ref ramp output* (speed reference after ramping and shaping).	1

<table>
<tr><th>No.</th><th>Name/Value</th><th>Description</th><th>Def/
FbEq16</th></tr>
<tr><td colspan="2">20 Start/stop/direction</td><td>Start/stop/direction and run/start/jog enable signal source selection; positive/negative reference enable signal source selection.
For information on control locations, see section Local control vs. external control (page 51).</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…20.05.</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>In1 Start; In2 Dir</td><td>The source selected by 20.03 Ext1 in1 source is the start signal; the source selected by 20.04 Ext1 in2 source determines the direction. The state transitions of the source bits are interpreted as follows:
<table>
<tr><th>State of source 1 (20.03)</th><th>State of source 2 (20.04)</th><th>Command</th></tr>
<tr><td>0</td><td>Any</td><td>Stop</td></tr>
<tr><td rowspan="2">0 -> 1 (20.02 = Edge)
1 (20.02 = Level)</td><td>0</td><td>Start forward</td></tr>
<tr><td>1</td><td>Start reverse</td></tr>
</table></td><td>2</td></tr>
<tr><td></td><td>In1 Start fwd; In2 Start rev</td><td>The source selected by 20.03 Ext1 in1 source is the forward start signal; the source selected by 20.04 Ext1 in2 source is the reverse start signal. The state transitions of the source bits are interpreted as follows:
<table>
<tr><th>State of source 1 (20.03)</th><th>State of source 2 (20.04)</th><th>Command</th></tr>
<tr><td>0</td><td>0</td><td>Stop</td></tr>
<tr><td>0 -> 1 (20.02 = Edge)
1 (20.02 = Level)</td><td>0</td><td>Start forward</td></tr>
<tr><td>0</td><td>0 -> 1 (20.02 = Edge)
1 (20.02 = Level)</td><td>Start reverse</td></tr>
<tr><td>1</td><td>1</td><td>Stop</td></tr>
</table></td><td>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 20.03 Ext1 in1 source and 20.04 Ext1 in2 source. The state transitions of the source bits are interpreted as follows:
<table>
<tr><th>State of source 1 (20.03)</th><th>State of source 2 (20.04)</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:
• The start signal is always edge-triggered with this setting regardless of parameter 20.02 Ext1 start trigger type.</td><td>4</td></tr>
<tr><td></td><td>In1P Start; In2 Stop; In3 Dir</td><td>The sources of the start and stop commands are selected by parameters 20.03 Ext1 in1 source and 20.04 Ext1 in2 source. The source selected by 20.05 Ext1 in3 source determines the direction. The state transitions of the source bits are interpreted as follows:
<table>
<tr><th>State of source 1 (20.03)</th><th>State of source 2 (20.04)</th><th>State of source 3 (20.05)</th><th>Command</th></tr>
<tr><td>0 -> 1</td><td>1</td><td>0</td><td>Start forward</td></tr>
<tr><td>0 -> 1</td><td>1</td><td>1</td><td>Start reverse</td></tr>
<tr><td>Any</td><td>0</td><td>Any</td><td>Stop</td></tr>
</table>
Notes:
• The start signal is always edge-triggered with this setting regardless of parameter 20.02 Ext1 start trigger type.</td><td>5</td></tr>
<tr><td></td><td>In1P Start fwd; In2P Start rev; In3 Stop</td><td>The sources of the start and stop commands are selected by parameters 20.03 Ext1 in1 source, 20.04 Ext1 in2 source and 20.05 Ext1 in3 source. The state transitions of the source bits are interpreted as follows:
<table>
<tr><th>State of source 1 (20.03)</th><th>State of source 2 (20.04)</th><th>State of source 3 (20.05)</th><th>Command</th></tr>
<tr><td>0 -> 1</td><td>Any</td><td>1</td><td>Start forward</td></tr>
<tr><td>Any</td><td>0 -> 1</td><td>1</td><td>Start reverse</td></tr>
<tr><td>Any</td><td>Any</td><td>0</td><td>Stop</td></tr>
</table>
Note: The start signal is always edge-triggered with this setting regardless of parameter 20.02 Ext1 start trigger type.</td><td>6</td></tr>
<tr><td></td><td>Fieldbus A</td><td>The start and stop commands are taken from fieldbus adapter A.
Note: The start signal is always level-triggered with this setting regardless of parameter 20.02 Ext1 start trigger type.</td><td>12</td></tr>
<tr><td></td><td>Embedded fieldbus</td><td>The start and stop commands are taken from the embedded fieldbus interface.
Note: The start signal is always level-triggered with this setting regardless of parameter 20.02 Ext1 start trigger type.</td><td>14</td></tr>
</table>

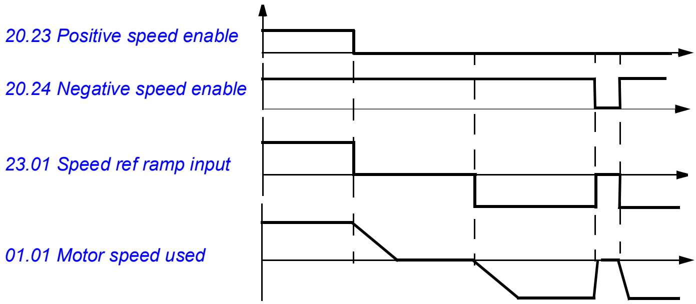
No.	Name/Value	Description	Def/ FbEq16
	Application Program	The start and stop commands are taken from the application program control word (parameter *06.02 Application control word*). **Note**: The start signal is always level-triggered with this setting regardless of parameter *20.02 Ext1 start trigger type*.	21
	ATF	Reserved.	22
20.02	*Ext1 start trigger type*	Defines whether the start signal for external control location EXT1 is edge-triggered or level-triggered. Note: This parameter is only effective when parameter *20.01 Ext1 commands* is set to *In1 Start*, *In1 Start; In2 Dir* or *In1 Start fwd; In2 Start rev*.	*Level*
	Edge	The start signal is edge-triggered.	0
	Level	The start signal is level-triggered.	1
20.03	*Ext1 in1 source*	Selects source 1 for parameter *20.01 Ext1 commands*.	*DI1*
	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
	DI6	Digital input DI6 (*10.02 DI delayed status*, bit 5).	7
	DIO1	Digital input/output DIO1 (*11.02 DIO delayed status*, bit 0).	10
	DIO2	Digital input/output DIO2 (*11.02 DIO delayed status*, bit 1).	11
	Other [bit]	Source selection (see *Terms and abbreviations* on page *101*).	-
20.04	*Ext1 in2 source*	Selects source 2 for parameter *20.01 Ext1 commands*. For the available selections, see parameter *20.03 Ext1 in1 source*.	*Not selected*
20.05	*Ext1 in3 source*	Selects source 3 for parameter *20.01 Ext1 commands*. For the available selections, see parameter *20.03 Ext1 in1 source*.	*Not selected*
20.06	*Ext2 commands*	Selects the source of start, stop and direction commands for external control location 2 (EXT2). See also parameters *20.07*…*20.10*.	*Not selected*
	Not selected	No start or stop command sources selected.	0
	In1 Start	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>	1

<table>
<tr><th>No.</th><th>Name/Value</th><th>Description</th><th>Def/
FbEq16</th></tr>
<tr><td></td><td>In1 Start; In2 Dir</td><td>The source selected by *20.08 Ext2 in1 source* is the start signal; the source selected by *20.09 Ext2 in2 source* determines the direction. 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</td><td>Any</td><td>Stop</td></tr>
<tr><td rowspan="2">0 -> 1 (20.07 = Edge)
1 (20.07 = Level)</td><td>0</td><td>Start forward</td></tr>
<tr><td>1</td><td>Start reverse</td></tr>
</table>
</td><td>2</td></tr>
<tr><td></td><td>In1 Start fwd; In2 Start rev</td><td>The source selected by *20.08 Ext2 in1 source* is the forward start signal; the source selected by *20.09 Ext2 in2 source* is the reverse start signal. 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</td><td>0</td><td>Stop</td></tr>
<tr><td>0 -> 1 (20.07 = Edge)
1 (20.07 = Level)</td><td>0</td><td>Start forward</td></tr>
<tr><td>0</td><td>0 -> 1 (20.07 = Edge)
1 (20.07 = Level)</td><td>Start reverse</td></tr>
<tr><td>1</td><td>1</td><td>Stop</td></tr>
</table>
</td><td>3</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:
• The start signal is always edge-triggered with this setting regardless of parameter *20.07 Ext2 start trigger type*.</td><td>4</td></tr>
<tr><td></td><td>In1P Start; In2 Stop; In3 Dir</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 source selected by *20.10 Ext2 in3 source* determines the direction. 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>State of source 3 (20.10)</th><th>Command</th></tr>
<tr><td>0 -> 1</td><td>1</td><td>0</td><td>Start forward</td></tr>
<tr><td>0 -> 1</td><td>1</td><td>1</td><td>Start reverse</td></tr>
<tr><td>Any</td><td>0</td><td>Any</td><td>Stop</td></tr>
</table>
Notes:
• The start signal is always edge-triggered with this setting regardless of parameter *20.07 Ext2 start trigger type*.</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></td><td>In1P Start fwd; In2P Start rev; In3 Stop</td><td>The sources of the start and stop commands are selected by parameters 20.08 Ext2 in1 source, 20.09 Ext2 in2 source and 20.10 Ext2 in3 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>State of source 3 (20.10)</th><th>Command</th></tr>
<tr><td>0 -> 1</td><td>Any</td><td>1</td><td>Start forward</td></tr>
<tr><td>Any</td><td>0 -> 1</td><td>1</td><td>Start reverse</td></tr>
<tr><td>Any</td><td>Any</td><td>0</td><td>Stop</td></tr>
</table>
Note: The start signal is always edge-triggered with this setting regardless of parameter 20.07 Ext2 start trigger type.</td><td>6</td></tr>
<tr><td></td><td>Fieldbus A</td><td>The start and stop commands are taken from fieldbus adapter A.
Note: The start signal is always level-triggered with this setting regardless of parameter 20.07 Ext2 start trigger type.</td><td>12</td></tr>
<tr><td></td><td>Embedded fieldbus</td><td>The start and stop commands are taken from the embedded fieldbus interface.
Note: The start signal is always level-triggered with this setting regardless of parameter 20.07 Ext2 start trigger type.</td><td>14</td></tr>
<tr><td></td><td>Application Program</td><td>The start and stop commands are taken from the application program control word (parameter 06.02 Application control word).
Note: The start signal is always level-triggered with this setting regardless of parameter 20.07 Ext2 start trigger type.</td><td>21</td></tr>
<tr><td></td><td>ATF</td><td>Reserved.</td><td>22</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 only effective when parameter 20.06 Ext2 commands is set to In1 Start, In1 Start; In2 Dir or In1 Start fwd; In2 Start rev.</td><td>Edge</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>20.08</td><td>Ext2 in1 source</td><td>Selects source 1 for parameter 20.06 Ext2 commands.
For the available selections, see parameter 20.03 Ext1 in1 source.</td><td>Not selected</td></tr>
<tr><td>20.09</td><td>Ext2 in2 source</td><td>Selects source 2 for parameter 20.06 Ext2 commands.
For the available selections, see parameter 20.03 Ext1 in1 source.</td><td>Not selected</td></tr>
<tr><td>20.10</td><td>Ext2 in3 source</td><td>Selects source 3 for parameter 20.06 Ext2 commands.
For the available selections, see parameter 20.03 Ext1 in1 source.</td><td>Not selected</td></tr>
</table>

No.	Name/Value	Description	Def/ FbEq16
20.11	*Run enable stop mode*	Selects the way the motor is stopped when the run enable signal switches off. The source of the run enable signal is selected by parameter *20.12 Run enable 1 source*.	*Coast* (*95.20* b10)
	Coast	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.	0
	Ramp	Stop along the active deceleration ramp. See parameter group *23 Speed reference ramp* on page *203*.	1
	Torque limit	Stop according to torque limits (parameters *30.19* and *30.20*).	2
20.12	*Run enable 1 source*	Selects the source of the external run enable signal. If the run enable signal is switched off, the drive will not start. If already running, the drive will stop according to the setting of parameter *20.11 Run enable stop mode*. 1 = Run enable signal on. **Note**: The warning that indicates a missing signal can be suppressed using parameter *20.30 Enable signals warning function*. See also parameter *20.19 Enable start command*.	*DIIL* (*95.20* b10); *Selected* (*95.20* b5); *DI5* (*95.20* b9);
	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
	DIO1	Digital input/output DIO1 (*11.02 DIO delayed status*, bit 0).	10
	DIO2	Digital input/output DIO2 (*11.02 DIO delayed status*, bit 1).	11
	FBA A MCW bit 3	Control word bit 3 received through fieldbus interface A.	30
	EFB MCW bit 3	Control word bit 3 received through the embedded fieldbus interface.	32
	DIIL	DIIL input (*10.02 DI delayed status*, bit 15).	33
	Active control source MCW bit 3	Control word bit 3 received from the active control source. In case the active source is the control panel, PC tool or drive I/O, the run enable signal is always on. **Note**: If the drive is running, switching bit 3 off effectively removes both the start and run enable signals. In this case, the stop mode is determined by either *20.11 Run enable stop mode* or *21.03 Stop mode*, whichever mode has higher priority. The order of stop modes from highest to lowest priority is *Coast* – *Torque limit* – *Ramp*.	34
	Other [bit]	Source selection (see *Terms and abbreviations* on page *101*).	-

No.	Name/Value	Description	Def/ FbEq16
20.19	*Enable start command*	Selects the source for the start enable signal. 1 = Start enable. With the signal switched off, any drive start command is inhibited. (Switching the signal off while the drive is running will not stop the drive.) **Notes**: • If a level-triggered start command is on when the start enable signal switches on, the drive will start. (An edge-triggered start signal must be cycled for the drive to start.) See parameters *20.02 Ext1 start trigger type* and *20.07 Ext2 start trigger type*. • The warning that indicates a missing signal can be suppressed using parameter *20.30 Enable signals warning function*. See also parameter *20.12 Run enable 1 source*.	*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
	DIO1	Digital input/output DIO1 (*11.02 DIO delayed status*, bit 0).	10
	DIO2	Digital input/output DIO2 (*11.02 DIO delayed status*, bit 1).	11
	DIIL	DIIL input (*10.02 DI delayed status*, bit 15).	30
	Other [bit]	Source selection (see *Terms and abbreviations* on page *101*).	-

No.	Name/Value	Description	Def/ FbEq16
20.23	*Positive speed enable*	Selects the source of the positive speed enable command. 1 = Positive speed enabled. 0 = Positive speed interpreted as zero speed reference. In the figure below, *23.01 Speed ref ramp input* is set to zero after the positive speed enable signal has cleared. Actions in different control modes: **Speed control**: Speed reference is set to zero and the motor is stopped along the currently active deceleration ramp. The rush controller prevents additional torque terms from running the motor in the positive direction. **Torque control**: The rush controller monitors the rotation direction of the motor.  Example: The motor is rotating in the forward direction. To stop the motor, the positive speed enable signal is deactivated by a hardware limit switch (e.g. via digital input). If the positive speed enable signal remains deactivated and the negative speed enable signal is active, only reverse rotation of the motor is allowed.	*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
	DIO1	Digital input/output DIO1 (*11.02 DIO delayed status*, bit 0).	10
	DIO2	Digital input/output DIO2 (*11.02 DIO delayed status*, bit 1).	11
	Other [bit]	Source selection (see *Terms and abbreviations* on page *101*).	-
20.24	*Negative speed enable*	Selects the source of the negative speed reference enable command. See parameter *20.23 Positive speed enable*.	*Selected*

No.	Name/Value	Description	Def/ FbEq16
20.25	*Jogging enable*	Selects the source for a jog enable signal. (The sources for jogging activation signals are selected by parameters *20.26 Jogging 1 start source* and *20.27 Jogging 2 start source*.) 1 = Jogging is enabled. 0 = Jogging is disabled. **Note:** Jogging can be enabled only when no start command from an external control location is active. On the other hand, if jogging is already enabled, the drive cannot be started from an external control location (apart from inching commands through fieldbus). See section *Jogging* (page *69*).	*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
	DIO1	Digital input/output DIO1 (*11.02 DIO delayed status*, bit 0).	10
	DIO2	Digital input/output DIO2 (*11.02 DIO delayed status*, bit 1).	11
	Other [bit]	Source selection (see *Terms and abbreviations* on page *101*).	-
20.26	*Jogging 1 start source*	If enabled by parameter *20.25 Jogging enable*, selects the source for the activation of jogging function 1. (Jogging function 1 can also be activated through fieldbus regardless of parameter *20.25*.) 1 = Jogging 1 active. **Note:** If both jogging 1 and 2 are activated, the one that was activated first has priority.	*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
	DIO1	Digital input/output DIO1 (*11.02 DIO delayed status*, bit 0).	10
	DIO2	Digital input/output DIO2 (*11.02 DIO delayed status*, bit 1).	11
	Other [bit]	Source selection (see *Terms and abbreviations* on page *101*).	-

No.	Name/Value	Description	Def/ FbEq16
20.27	*Jogging 2 start source*	If enabled by parameter *20.25 Jogging enable*, selects the source for the activation of jogging function 2. (Jogging function 2 can also be activated through fieldbus regardless of parameter *20.25*.) 1 = Jogging 2 active. For the selections, see parameter *20.26 Jogging 1 start source*. **Note:** If both jogging 1 and 2 are activated, the one that was activated first has priority.	*Not selected*
20.30	*Enable signals warning function*	Selects enable signal (for example, run enable, start enable) warnings to be suppressed. This parameter can be used to prevent these warnings from flooding the event log. Whenever a bit of this parameter is set to 1, the corresponding warning is suppressed, that is no warning is generated even if the signal is switched off. The bits of this binary number correspond to the following warnings:	00b

Bit	Name	Warning
0	Enable Start	*AFEA Enable start signal missing*
1	Run enable 1	*AFEB Run enable missing*
2…15	Reserved	

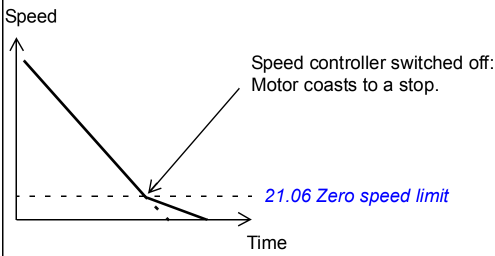
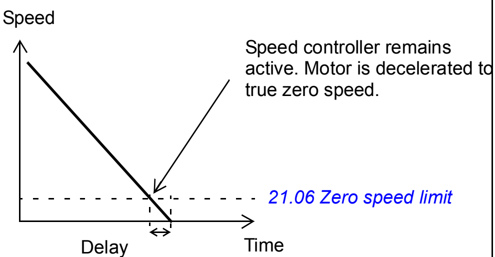
No.	Name/Value	Description	Def/ FbEq16
	00b…11b	Suppression of “enable signal missing” warnings.	1 = 1

21 Start/stop mode		Start and stop modes; emergency stop mode and signal source selection; DC magnetization settings; autophasing mode selection.	
21.01	*Start mode*	Selects the motor start function for the DTC motor control mode, ie. when *99.04 Motor ctrl mode* is set to *DTC*. 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 *Constant time*). • With permanent magnet motors and synchronous reluctance motors, *Automatic* start mode must be used. • This parameter cannot be changed while the drive is running. See also section *DC magnetization* (page *77*).	*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

No.	Name/Value	Description	Def/ FbEq16
	Constant 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. 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
	Automatic	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 (a stopped motor can be restarted immediately without waiting the motor flux to die away). 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.	2
21.02	*Magnetization time*	Defines the pre-magnetization time when • parameter *21.01 Start mode* is set to *Constant time* (in DTC motor control mode), or • parameter *21.19 Scalar start mode* is set to *Const time* (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: **Motor rated power** / **Constant magnetizing time** < 1 kW / ≥ 50 to 100 ms 1 to 10 kW / ≥ 100 to 200 ms 10 to 200 kW / ≥ 200 to 1000 ms 200 to 1000 kW / ≥ 1000 to 2000 ms Note: This parameter cannot be changed while the drive is running.	500 ms
	0…10000 ms	Constant DC magnetizing time.	1 = 1 ms
21.03	*Stop mode*	Selects the way the motor is stopped when a stop command is received. Additional braking is possible by selecting flux braking (see parameter *97.05 Flux braking*).	*Coast*
	Coast	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.	0
	Ramp	Stop along the active deceleration ramp. See parameter group *23 Speed reference ramp* on page *203*.	1
	Torque limit	Stop according to torque limits (parameters *30.19* and *30.20*).	2

Motor rated power	Constant magnetizing time
< 1 kW	≥ 50 to 100 ms
1 to 10 kW	≥ 100 to 200 ms
10 to 200 kW	≥ 200 to 1000 ms
200 to 1000 kW	≥ 1000 to 2000 ms

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)*; *Coast stop (Off2)* (*95.20* b1); *Eme ramp stop (Off3)* (*95.20* b2)
	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 *Reference ramping* [page *58*]). 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)*; *DI4* (*95.20* b1, *95.20* b2)
	Active (false)	0.	0
	Inactive (true)	1.	1
	DIIL	DIIL input (*10.02 DI delayed status*, bit 15).	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

No.	Name/Value	Description	Def/ FbEq16
	DIO1	Digital input/output DIO1 (*11.02 DIO delayed status*, bit 0).	11
	DIO2	Digital input/output DIO2 (*11.02 DIO delayed status*, bit 1).	12
	Other [bit]	Source selection (see *Terms and abbreviations* on page *101*).	-
21.06	*Zero speed limit*	Defines the zero speed limit. The motor is stopped along a speed ramp (when ramped stop is selected) until the defined zero speed limit is reached. After the zero speed delay, the motor coasts to a stop.	30.00 rpm
	0.00…30000.00 rpm	Zero speed limit.	See par. *46.01*
21.07	*Zero speed delay*	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. <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 *21.06 Zero speed limit*, inverter modulation is stopped and the motor coasts to a standstill.  <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 *21.06 Zero speed limit*, 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.  	0 ms
	0…30000 ms	Zero speed delay.	1 = 1 ms

No.	Name/Value	Description	Def/ FbEq16
21.08	*DC current control*	Activates/deactivates the DC hold and post-magnetization functions. See section *DC magnetization* (page *77*). Notes: • These functions are only available in speed control in DTC motor control mode (see page *53*). • 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.	0000b

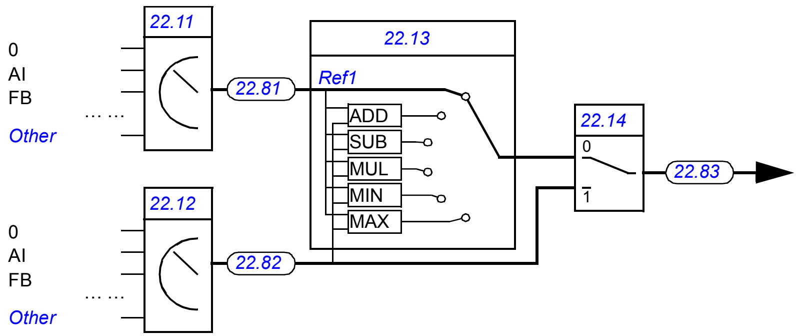
Bit	Value
0	1 = Enable DC hold. See section *DC hold* (page *77*). Note: The DC hold function has no effect if the start signal is switched off.
1	1 = Enable post-magnetization. See section *Post-magnetization* (page *77*). Note: Post-magnetization is only available when ramping is the selected stop mode (see parameter *21.03 Stop mode*).
2…15	Reserved

No.	Name/Value	Description	Def/ FbEq16
	0000b…0011b	DC magnetization selection.	1 = 1
21.09	*DC hold speed*	Defines the DC hold speed. See parameter *21.08 DC current control*, and section *DC hold* (page *77*).	5.00 rpm
	0.00…1000.00 rpm	DC hold speed.	See par. *46.01*
21.10	*DC current reference*	Defines the DC hold current in percent of the motor nominal current. See parameter *21.08 DC current control*, and section *DC magnetization* (page *77*).	30.0%
	0.0…100.0%	DC hold current.	1 = 1%
21.11	*Post magnetization time*	Defines the length of time for which post-magnetization is active after stopping the motor. The magnetization current is defined by parameter *21.10 DC current reference*. See parameter *21.08 DC current control*.	0 s
	0…3000 s	Post-magnetization time.	1 = 1 s

No.	Name/Value	Description	Def/ FbEq16
21.12	*Continuous magnetization command*	Activates/deactivates (or selects a source that activates/deactivates) continuous magnetization. See section *Continuous magnetization* (page *78*). The magnetization current is calculated on the basis of flux reference (see parameter group *97 Motor control*). Notes: • This function is only available when ramping is the selected stop mode (see parameter *21.03 Stop mode*), and only in speed control in DTC motor control mode (see page *53*). • Continuous magnetization causes the motor to heat up. In applications where long magnetization times are required, externally ventilated motors should be used. • Continuous magnetization may not be able to prevent the motor shaft from rotating during a long period if a constant load is applied to the motor. 0 = Normal operation 1 = Magnetization active	*Off*
	Off	0.	0
	On	1.	1
	Other [bit]	Source selection (see *Terms and abbreviations* on page *101*).	-
21.13	*Autophasing mode*	Selects the way autophasing is performed. See section *Autophasing* on page *73*.	*Turning*
	Turning	This mode gives the most accurate autophasing result. This mode can be used, and is recommended, if the motor is allowed to rotate and the start-up is not time-critical. Note: This mode will cause the motor to rotate. The load torque must be less than 5%.	0
	Standstill 1	Faster than the *Turning* mode, but not as accurate. The motor will not rotate.	1
	Standstill 2	An alternative standstill autophasing mode that can be used if the *Turning* mode cannot be used, and the *Standstill 1* mode gives erratic results. However, this mode is considerably slower than *Standstill 1*.	2
	Turning with Z-pulse	This mode should be used if the zero pulse signal of the pulse encoder is to be observed, and other modes do not give a result. The motor will turn until a zero pulse is detected.	3
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 *80*). 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 pre-charging delay. ⚠ **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.	5.0 s
	0.0 s	Automatic restarting disabled.	0

No.	Name/Value	Description	Def/ FbEq16
	0.1…5.0 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 ctrl mode* is set to *Scalar*. Notes: • The start function for the DTC 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 *77*).	*Normal*
	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. 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 starts 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
	Automatic	This setting should be used in applications where flying starts (ie. starting into a rotating motor) are required.	2
22 Speed reference selection		Speed reference selection settings; motor potentiometer settings. See the control chain diagrams on pages *476*…*477*.	
22.01	*Speed ref unlimited*	Displays the output of the speed reference selection block. See the control chain diagram on page *477*. This parameter is read-only.	-
	-30000.00 …30000.00 rpm	Value of the selected speed reference.	See par. *46.01*

No.	Name/Value	Description	Def/ FbEq16
22.11	*Speed ref1 source*	Selects speed reference source 1. Two signal sources can be defined by this parameter and *22.12 Speed ref2 source*. A digital source selected by *22.14 Speed ref1/2 selection* can be used to switch between the two sources, or a mathematical function (*22.13 Speed ref1 function*) applied to the two signals to create the reference.	*AI1 scaled*



No.	Name/Value	Description	Def/ FbEq16
	Zero	None.	0
	AI1 scaled	*12.12 AI1 scaled value* (see page *141*).	1
	AI2 scaled	*12.22 AI2 scaled value* (see page *143*).	2
	FB A ref1	*03.05 FB A reference 1* (see page *108*).	4
	FB A ref2	*03.06 FB A reference 2* (see page *108*).	5
	EFB ref1	*03.09 EFB reference 1* (see page *108*).	8
	EFB ref2	*03.10 EFB reference 2* (see page *108*).	9
	Motor potentiometer	*22.80 Motor potentiometer ref act* (output of the motor potentiometer).	15
	Other	Source selection (see *Terms and abbreviations* on page *101*).	-
22.12	*Speed ref2 source*	Selects speed reference source 2. For the selections, and a diagram of reference source selection, see parameter *22.11 Speed ref1 source*.	*Zero*
22.13	*Speed ref1 function*	Selects a mathematical function between the reference sources selected by parameters *22.11 Speed ref1 source* and *22.12 Speed ref2 source*. See diagram at *22.11 Speed ref1 source*.	*Ref1*
	Ref1	Signal selected by *22.11 Speed ref1 source* is used as speed reference 1 as such (no function applied).	0
	Add (ref1 + ref2)	The sum of the reference sources is used as speed reference 1.	1
	Sub (ref1 - ref2)	The subtraction ([*22.11 Speed ref1 source*] - [*22.12 Speed ref2 source*]) of the reference sources is used as speed reference 1.	2
	Mul (ref1 × ref2)	The multiplication of the reference sources is used as speed reference 1.	3

No.	Name/Value	Description	Def/ FbEq16
	Min (ref1, ref2)	The smaller of the reference sources is used as speed reference 1.	4
	Max (ref1, ref2)	The greater of the reference sources is used as speed reference 1.	5
22.14	*Speed ref1/2 selection*	Configures the selection between speed references 1 and 2. See diagram at *22.11 Speed ref1 source*. 0 = Speed reference 1 1 = Speed reference 2	*Follow Ext1/Ext2 selection*
	Speed reference 1	0.	0
	Speed reference 2	1.	1
	Follow Ext1/Ext2 selection	Speed reference 1 is used when external control location EXT1 is active. Speed reference 2 is used when external control location EXT2 is active. See also parameter *19.11 Ext1/Ext2 selection*.	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
	DIO1	Digital input/output DIO1 (*11.02 DIO delayed status*, bit 0).	11
	DIO2	Digital input/output DIO2 (*11.02 DIO delayed status*, bit 1).	12
	Other [bit]	Source selection (see *Terms and abbreviations* on page *101*).	-
22.15	*Speed additive 1 source*	Defines a reference to be added to the speed reference after reference selection (see page *476*). For the selections, see parameter *22.11 Speed ref1 source*. Note: For safety reasons, the additive is not applied when any of the stop functions are active.	*Zero*
22.16	*Speed share*	Defines a scaling factor for the selected speed reference (speed reference 1 or 2, multiplied by the defined value). Speed reference 1 or 2 is selected by parameter *22.14 Speed ref1/2 selection*.	1.000
	-8.000…8.000	Speed reference scaling factor.	1000 = 1
22.17	*Speed additive 2 source*	Defines a reference to be added to the speed reference after the speed share function (see page *476*). For the selections, see parameter *22.11 Speed ref1 source*. Note: For safety reasons, the additive is not applied when any of the stop functions are active.	*Zero*

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.	0000b

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
	0000b…0011b	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:	*DI5*

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

No.	Name/Value	Description	Def/ FbEq16
	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
	DIO1	Digital input/output DIO1 (*11.02 DIO delayed status*, bit 0).	10
	DIO2	Digital input/output DIO2 (*11.02 DIO delayed status*, bit 1).	11
	Other [bit]	Source selection (see *Terms and abbreviations* on page *101*).	-
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
	-30000.00 … 30000.00 rpm	Constant speed 1.	See par. *46.01*
22.27	*Constant speed 2*	Defines constant speed 2.	0.00 rpm
	-30000.00 … 30000.00 rpm	Constant speed 2.	See par. *46.01*
22.28	*Constant speed 3*	Defines constant speed 3.	0.00 rpm
	-30000.00 … 30000.00 rpm	Constant speed 3.	See par. *46.01*
22.29	*Constant speed 4*	Defines constant speed 4.	0.00 rpm
	-30000.00 … 30000.00 rpm	Constant speed 4.	See par. *46.01*
22.30	*Constant speed 5*	Defines constant speed 5.	0.00 rpm
	-30000.00 … 30000.00 rpm	Constant speed 5.	See par. *46.01*
22.31	*Constant speed 6*	Defines constant speed 6.	0.00 rpm
	-30000.00 … 30000.00 rpm	Constant speed 6.	See par. *46.01*

No.	Name/Value	Description	Def/ FbEq16
22.32	Constant speed 7	Defines constant speed 7.	0.00 rpm
	-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 • 50.32 FBA B comm loss func • 58.14 Communication loss action.	0.00 rpm
	-30000.00 …30000.00 rpm	Safe speed reference.	See par. 46.01
22.42	Jogging 1 ref	Defines the speed reference for jogging function 1.	0.00 rpm
	-30000.00 … 30000.00 rpm	Speed reference for jogging function 1.	See par. 46.01
22.43	Jogging 2 ref	Defines the speed reference for jogging function 2.	0.00 rpm
	-30000.00 … 30000.00 rpm	Speed reference for jogging function 2.	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 59).	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	

No.	Name/Value	Description	Def/ FbEq16
	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

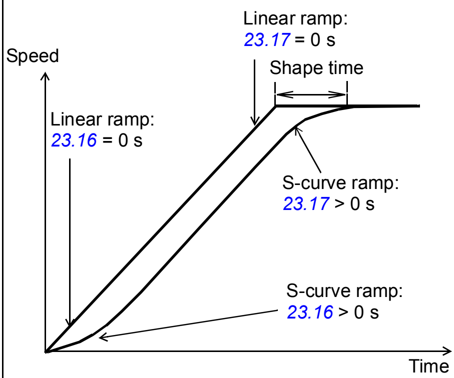
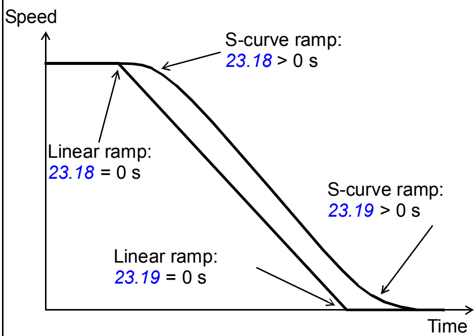
No.	Name/Value	Description	Def/ FbEq16
22.54	*Critical speed 2 low*	Defines the low limit for critical speed range 2. Note: This value must be less than or equal to the value of *22.55 Critical speed 2 high*.	0.00 rpm
	-30000.00 …30000.00 rpm	Low limit for critical speed 2.	See par. *46.01*
22.55	*Critical 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 *Motor potentiometer* (page *78*).	*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*. When the drive is running, the value can 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 stop or a power cycle.	2
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
	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

No.	Name/Value	Description	Def/ FbEq16
	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
	DIO1	Digital input/output DIO1 (*11.02 DIO delayed status*, bit 0).	10
	DIO2	Digital input/output DIO2 (*11.02 DIO delayed status*, bit 1).	11
	Other [bit]	Source selection (see *Terms and abbreviations* on page *101*).	-
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.	60.0 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.	-1500.00
	-32768.00... 32767.00	Motor potentiometer minimum.	1 = 1
22.77	*Motor potentiometer max value*	Defines the maximum value of the motor potentiometer.	1500.00
	-32768.00... 32767.00	Motor potentiometer maximum.	1 = 1
22.80	*Motor potentiometer ref act*	Displays 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
22.81	*Speed reference act 1*	Displays the value of speed reference source 1 (selected by parameter *22.11 Speed ref1 source*). See the control chain diagram on page *476*. This parameter is read-only.	-
	-30000.00 …30000.00 rpm	Value of reference source 1.	See par. *46.01*
22.82	*Speed reference act 2*	Displays the value of speed reference source 2 (selected by parameter *22.12 Speed ref2 source*). See the control chain diagram on page *476*. This parameter is read-only.	-
	-30000.00 …30000.00 rpm	Value of reference source 2.	See par. *46.01*

No.	Name/Value	Description	Def/ FbEq16
22.83	*Speed reference act 3*	Displays the value of speed reference after the mathematical function applied by parameter *22.13 Speed ref1 function* and reference 1/2 selection (*22.14 Speed ref1/2 selection*). See the control chain diagram on page *476*. This parameter is read-only.	-
	-30000.00 …30000.00 rpm	Speed reference after source selection.	See par. *46.01*
22.84	*Speed reference act 4*	Displays the value of speed reference after application of 1st speed additive (*22.15 Speed additive 1 source*). See the control chain diagram on page *476*. This parameter is read-only.	-
	-30000.00 …30000.00 rpm	Speed reference after additive 1.	See par. *46.01*
22.85	*Speed reference act 5*	Displays the value of speed reference after the application of the speed share scaling factor (*22.16 Speed share*). See the control chain diagram on page *476*. This parameter is read-only.	-
	-30000.00 …30000.00 rpm	Speed reference after speed share scaling.	See par. *46.01*
22.86	*Speed reference act 6*	Displays the value of speed reference after application of 2nd speed additive (*22.17 Speed additive 2 source*). See the control chain diagram on page *476*. 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 *477*. The value is received from *22.86 Speed reference act 6* unless overridden by • any constant speed • a jogging reference • *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 *477*.	
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 *477*. This parameter is read-only.	-
	-30000.00 …30000.00 rpm	Speed reference before ramping and shaping.	See par. *46.01*

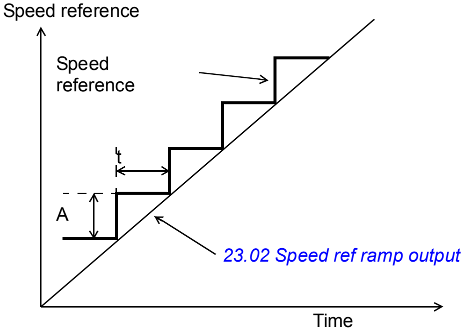
No.	Name/Value	Description	Def/ FbEq16
23.02	*Speed ref ramp output*	Displays the ramped and shaped speed reference in rpm. See the control chain diagram on page *477*. This parameter is read-only.	-
	-30000.00 …30000.00 rpm	Speed reference after ramping and shaping.	See par. *46.01*
23.11	*Ramp set selection*	Selects the source that switches between the two sets of acceleration/deceleration ramp times defined by parameters *23.12*…*23.15*. 0 = Acceleration time 1 and deceleration time 1 are active 1 = Acceleration time 2 and deceleration time 2 are active	*DI4*; *Acc/Dec time 2* (*95.20* b1)
	Acc/Dec time 1	0.	0
	Acc/Dec time 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
	DIO1	Digital input/output DIO1 (*11.02 DIO delayed status*, bit 0).	10
	DIO2	Digital input/output DIO2 (*11.02 DIO delayed status*, bit 1).	11
	Other [bit]	Source selection (see *Terms and abbreviations* on page *101*).	-
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.	20.000 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.	20.000 s
	0.000…1800.000 s	Deceleration time 1.	10 = 1 s
23.14	*Acceleration time 2*	Defines acceleration time 2. See parameter *23.12 Acceleration time 1*.	60.000 s
	0.000…1800.000 s	Acceleration time 2.	10 = 1 s
23.15	*Deceleration time 2*	Defines deceleration time 2. See parameter *23.13 Deceleration time 1*.	60.000 s
	0.000…1800.000 s	Deceleration time 2.	10 = 1 s

No.	Name/Value	Description	Def/ FbEq16
23.16	*Shape time acc 1*	Defines the shape of the acceleration ramp at the beginning of the acceleration. 0.000 s: Linear ramp. Suitable for steady acceleration or deceleration and for slow ramps. 0.001…1000.000 s: S-curve ramp. S-curve ramps are ideal for lifting applications. The S-curve consists of symmetrical curves at both ends of the ramp and a linear part in between. Acceleration:  Deceleration:  	0.000 s
	0.000…1800.000 s	Ramp shape at start of acceleration.	10 = 1 s
23.17	*Shape time acc 2*	Defines the shape of the acceleration ramp at the end of the acceleration. See parameter *23.16 Shape time acc 1*.	0.000 s
	0.000…1800.000 s	Ramp shape at end of acceleration.	10 = 1 s
23.18	*Shape time dec 1*	Defines the shape of the deceleration ramp at the beginning of the deceleration. See parameter *23.16 Shape time acc 1*.	0.000 s
	0.000…1800.000 s	Ramp shape at start of deceleration.	10 = 1 s

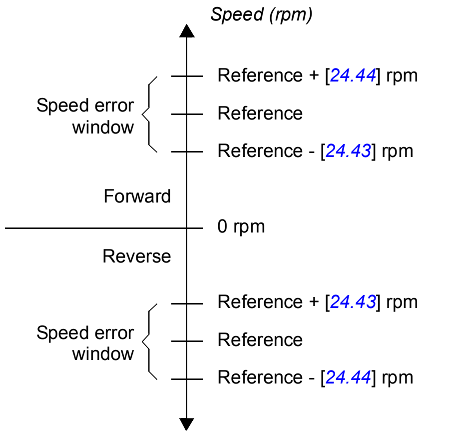
No.	Name/Value	Description	Def/ FbEq16
23.19	*Shape time dec 2*	Defines the shape of the deceleration ramp at the end of the deceleration. See parameter *23.16 Shape time acc 1*.	0.000 s
	0.000…1800.000 s	Ramp shape at end of deceleration.	10 = 1 s
23.20	*Acc time jogging*	Defines the acceleration time for the jogging function i.e. the time required for the speed to change from zero to the speed value defined by parameter *46.01 Speed scaling*.	60.000 s
	0.000 …1800.000 s	Acceleration time for jogging.	10 = 1 s
23.21	*Dec time jogging*	Defines the deceleration time for the jogging function i.e. the time required for the speed to change from the speed value defined by parameter *46.01 Speed scaling* to zero.	60.000 s
	0.000 …1800.000 s	Deceleration time for jogging.	10 = 1 s
23.23	*Emergency stop time*	In speed control mode, this parameter defines the deceleration rate for emergency stop Off3 as the time it would take for the speed to decrease from the value of parameter *46.01 Speed scaling* to zero. This also applies to torque control (if present) because the drive switches to speed control on receiving an emergency stop Off3 command. In frequency control mode, this parameter specifies the time it would take for the frequency to decrease from the value of *46.02 Frequency scaling* to zero. The 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 *23.11*…*23.19* (speed control) or *28.71*…*28.75* (frequency control).	3.000 s
	0.000…1800.000 s	Emergency stop Off3 deceleration time.	10 = 1 s
23.24	*Speed ramp in zero source*	Selects a source that forces the speed reference to zero just before it enters the ramp function. 0 = Force speed reference to zero before the ramp function 1 = Speed reference continues towards the ramp function as normal	*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
	DIO1	Digital input/output DIO1 (*11.02 DIO delayed status*, bit 0).	10
	DIO2	Digital input/output DIO2 (*11.02 DIO delayed status*, bit 1).	11
	Other [bit]	Source selection (see *Terms and abbreviations* on page *101*).	-

No.	Name/Value	Description	Def/ FbEq16
23.26	*Ramp out balancing enable*	Selects the source for enabling/disabling speed reference ramp balancing. This function is used to generate a smooth transfer from a torque- or tension-controlled motor back to being speed-controlled. The balancing output would be tracking the present “line” speed of the application and when transfer is required, the speed reference can then be quickly “seeded” to the correct line speed. Balancing is also possible in the speed controller, see parameter *25.09 Speed ctrl balancing enable*. See also parameter *23.27 Ramp out balancing ref*. 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
	DIO1	Digital input/output DIO1 (*11.02 DIO delayed status*, bit 0).	10
	DIO2	Digital input/output DIO2 (*11.02 DIO delayed status*, bit 1).	11
	Other [bit]	Source selection (see *Terms and abbreviations* on page *101*).	-
23.27	*Ramp out balancing ref*	Defines the reference for speed ramp balancing. The output of the ramp generator is forced to this value when balancing is enabled by parameter *23.26 Ramp out balancing enable*.	0.00 rpm
	-30000.00 …30000.00 rpm	Speed ramp balancing reference.	See par. *46.01*

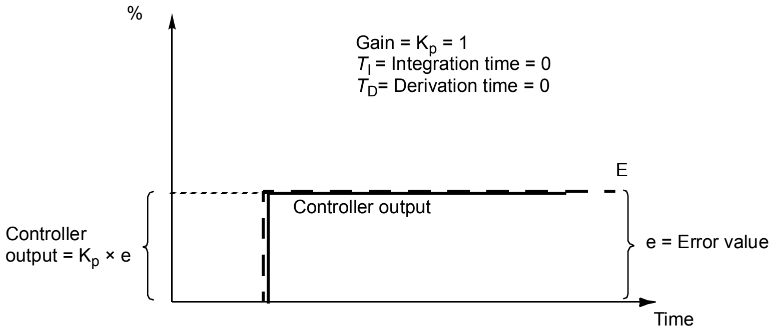
No.	**Name/Value**	**Description**	**Def/ FbEq16**
23.28	*Variable slope enable*	Activates the variable slope function, which controls the slope of the speed ramp during a speed reference change. This allows for a constantly variable ramp rate to be generated, instead of just the standard two ramps normally available. If the update interval of the signal from an external control system and the variable slope rate (*23.29 Variable slope rate*) are equal, the resulting speed reference (*23.02 Speed ref ramp output*) is a straight line.  t = update interval of signal from external control system A = speed reference change during t This function is only active in remote control.	*Off*
	Off	Variable slope disabled.	0
	On	Variable slope enabled (not available in local control).	1
	Other [bit]	Source selection (see *Terms and abbreviations* on page *101*).	-
23.29	*Variable slope rate*	Defines the rate of the speed reference change when variable slope is enabled by parameter *23.28 Variable slope enable*. For the best result, enter the reference update interval into this parameter.	50 ms
	2…30000 ms	Variable slope rate.	1 = 1 ms
23.39	*Follower speed correction out*	Displays the speed correction term for the load share function with a speed-controlled follower drive. See section *Motor control* (page *57*). This parameter is read-only.	-
	-30000.00 …30000.00 rpm	Speed correction term.	See par. *46.01*
23.40	*Follower speed correction enable*	With a speed-controlled follower, selects the source for enabling/disabling the load share function. See section *Motor control* (page *57*). 0 = Disabled 1 = Enabled	*Not selected*
	Not selected	0.	0
	Selected	1.	1

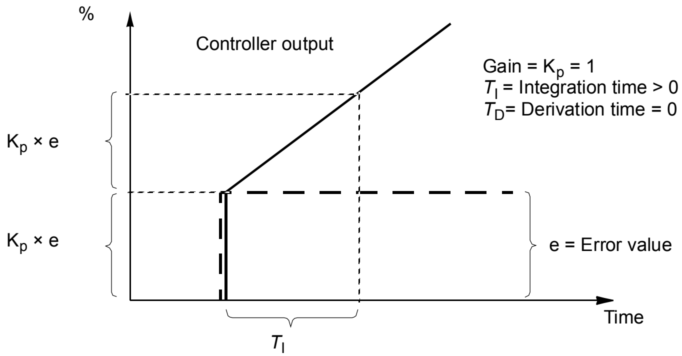
No.	Name/Value	Description	Def/ FbEq16
	DI1	Digital input DI1 (*10.02 DI delayed status*, bit 0).	2
	DI2	Digital input DI2 (*10.02 DI delayed status*, bit 1).	3
	DI3	Digital input DI3 (*10.02 DI delayed status*, bit 2).	4
	DI4	Digital input DI4 (*10.02 DI delayed status*, bit 3).	5
	DI5	Digital input DI5 (*10.02 DI delayed status*, bit 4).	6
	DI6	Digital input DI6 (*10.02 DI delayed status*, bit 5).	7
	DIO1	Digital input/output DIO1 (*11.02 DIO delayed status*, bit 0).	10
	DIO2	Digital input/output DIO2 (*11.02 DIO delayed status*, bit 1).	11
	Other [bit]	Source selection (see *Terms and abbreviations* on page *101*).	-
23.41	*Follower speed correction gain*	Adjusts the gain of the speed correction term in a speed-controlled follower. In effect, defines how accurately the follower follows the master torque. A greater value results in a more accurate performance. See section *Motor control* (page *57*).	1.00%
	0.00…100.00%	Speed correction term adjustment.	1 = 1%
24 Speed reference conditioning		Speed error calculation; speed error window control configuration; speed error step. See the control chain diagrams on pages *481* and *483*.	
24.01	*Used speed reference*	Displays the ramped and corrected speed reference (before speed error calculation). See the control chain diagram on page *481*. 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 *481*. 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 *481*. This parameter is read-only.	-
	-30000.0 …30000.0 rpm	Filtered speed error.	See par. *46.01*
24.04	*Speed error inverted*	Displays the inverted (unfiltered) speed error. See the control chain diagram on page *481*. This parameter is read-only.	-
	-30000.0 …30000.0 rpm	Inverted speed error.	See par. *46.01*

No.	Name/Value	Description	Def/ FbEq16
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. Note: For safety reasons, the correction is not applied when an emergency stop is active. ⚠ WARNING! If the speed reference correction exceeds *21.06 Zero speed limit*, a ramp stop may be impossible. Make sure the correction is reduced or removed when a ramp stop is required. See the control chain diagram on page *481*.	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

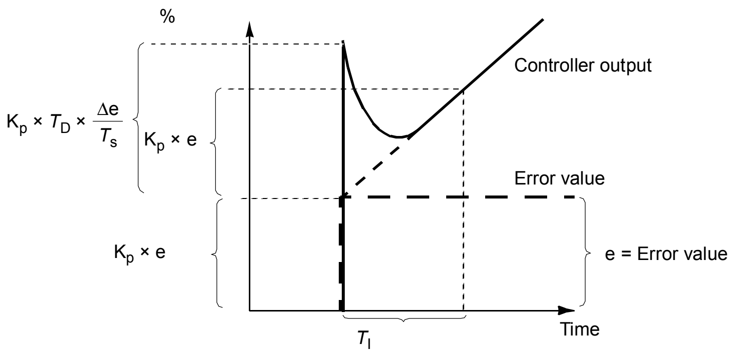
No.	Name/Value	Description	Def/ FbEq16
24.41	*Speed error window control enable*	Enables/disables (or selects a source that enables/disables) speed error window control, sometimes also referred to as deadband control or strip break protection. It forms a speed supervision function for a torque-controlled drive, preventing the motor from running away if the material that is being held under tension breaks. **Note**: Speed error window control is only effective when the operating mode is active (see parameters *19.12* and *19.14*), or when the drive is a speed-controlled follower (see page*57*). If the motor load is lost, then the motor speed rises. The speed error (speed reference - actual speed) increases until it exits the speed error window. When this is detected, the exceeding part of the error value is connected to the speed controller. The speed controller produces a reference term relative to the input and gain (*25.02 Speed proportional gain*). The activation of speed error window control is indicated by bit 3 of *06.19 Speed control status word*. The window boundaries are defined by *24.43 Speed error window high* and *24.44 Speed error window low* as follows:  Note: Parameter *24.44* (rather than *24.43*) defines the overspeed limit in both directions of rotation. This is because the function monitors speed error (which is negative in case of overspeed, positive in case of underspeed). 0 = Speed error window control disabled 1 = Speed error window control enabled	*Disable*
	Disable	0.	0
	Enable	1.	1
	Other [bit]	Source selection (see *Terms and abbreviations* on page *101*).	-

No.	Name/Value	Description	Def/ FbEq16
24.42	*Speed window control mode*	When speed error window control (see parameter *24.41 Speed error window control enable*) is enabled, this parameter determines whether the speed controller only observes the proportional term instead of all three (P, I and D) terms.	*Normal speed control*
	Normal speed control	All these terms (parameters *25.02*, *25.03* and *25.04*) are observed by the speed controller.	0
	P-control	Only the proportional term (*25.02*) is observed by the speed controller. The integral and derivative terms are internally forced to zero.	1
24.43	*Speed error window high*	Defines the upper boundary of the speed error window. See parameter *24.41 Speed error window control enable*.	0.00 rpm
	0.00…3000.00 rpm	Upper boundary of speed error window.	See par. *46.01*
24.44	*Speed error window low*	Defines the lower boundary of the speed error window. See parameter *24.41 Speed error window control enable*.	0.00 rpm
	0.00…3000.00 rpm	Lower boundary of speed error window.	See par. *46.01*
24.46	*Speed error step*	Defines an additional speed error step given to the input of the speed controller (and added to the speed error value). This can be used in large drive systems for dynamic speed normalizing. WARNING! Make sure the error step value is removed when a stop command is given.	0.00 rpm
	-3000.00 …3000.00 rpm	Speed error step.	See par. *46.01*
25 Speed control		Speed controller settings. See the control chain diagrams on pages *481* and *483*.	
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 *483*. This parameter is read-only.	-
	-1600.0…1600.0%	Limited speed controller output torque.	See par. *46.03*

No.	Name/Value	Description	Def/ FbEq16
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. **Note:** This parameter is automatically set by the speed controller autotune function. See section *Speed controller autotune* (page *59*).	10.00
	0.00…250.00	Proportional gain for speed controller.	100 = 1

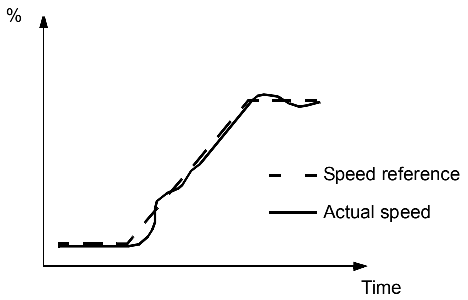
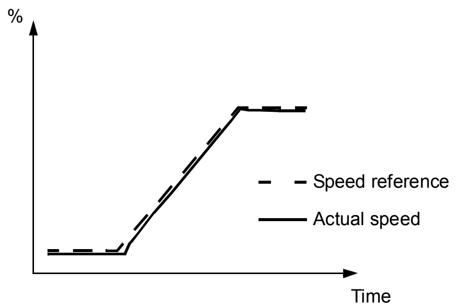
No.	Name/Value	Description	Def/ FbEq16
25.03	*Speed integration time*	Defines the integration time of the speed controller. The integration time defines the rate at which the controller output changes when the error value is constant and the proportional gain of the speed controller is 1. The shorter 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.  **Note:** This parameter is automatically set by the speed controller autotune function. See section *Speed controller autotune* (page *59*)	2.50 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 (especially those without a pulse encoder), 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.	0.000 s



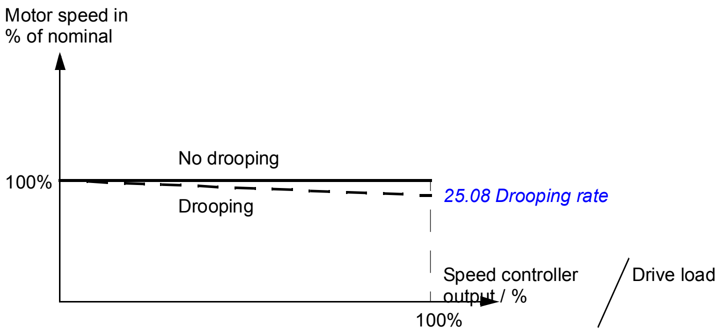
Gain = K_p = 1
T_I = Integration time > 0
T_D= Derivation time > 0
T_s= Sample time period = 250 µs
Δe = Error value change between two samples

	0.000…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

No.	Name/Value	Description	Def/ FbEq16
25.06	*Acc comp derivation time*	Defines the derivation time for acceleration(/deceleration) compensation. In order to compensate for a high inertia load during acceleration, a derivative of the reference is added to the output of the speed controller. The principle of a derivative action is described under parameter *25.04 Speed derivation time*. Note: As a general rule, set this parameter to the value between 50 and 100% of the sum of the mechanical time constants of the motor and the driven machine. The figure below shows the speed responses when a high inertia load is accelerated along a ramp. No acceleration compensation:  Acceleration compensation: 	0.00 s
	0.00…1000.00 s	Acceleration compensation derivation time.	10 = 1 s
25.07	*Acc comp filter time*	Defines the acceleration (or deceleration) compensation filter time constant. See parameters *25.04 Speed derivation time* and *25.06 Acc comp derivation time.*	8.0 ms
	0.0…1000.0 ms	Acceleration/deceleration compensation filter time.	1 = 1 ms

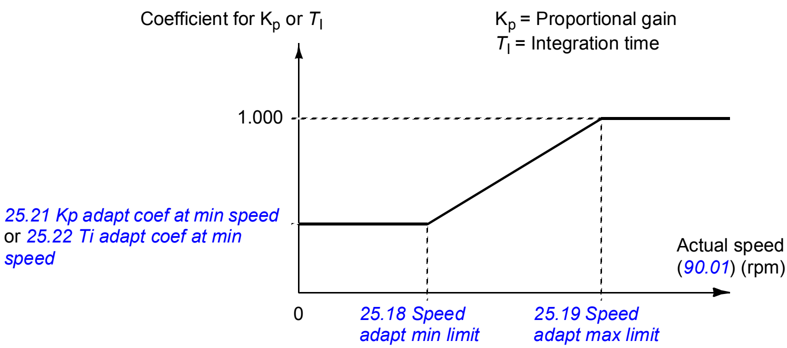
No.	Name/Value	Description	Def/ FbEq16
25.08	*Drooping rate*	Defines the droop rate in percent of the nominal motor speed. Drooping decreases the drive speed slightly as the drive load increases. The actual speed decrease at a certain operating point depends on the droop rate setting and the drive load (= torque reference / speed controller output). At 100% speed controller output, drooping is at its nominal level, that is equal to the value of this parameter. The drooping effect decreases linearly to zero along with the decreasing load. The correct droop rate for a process must be found out case by case in practice.	0.00%

Speed decrease = Speed controller output × Drooping × Nominal speed
Example: Speed controller output is 50%, droop rate is 1%, nominal speed of the drive is 1500 rpm.
Speed decrease = 0.50 × 0.01 × 1500 rpm = 7.5 rpm.

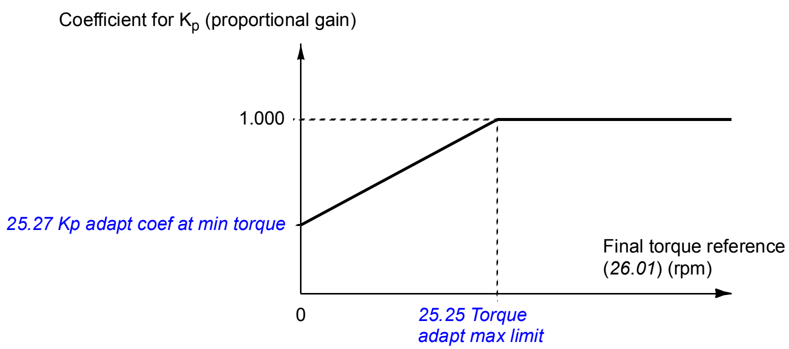


No.	Name/Value	Description	Def/ FbEq16
	0.00…100.00%	Droop rate.	100 = 1%
25.09	*Speed ctrl balancing enable*	Selects the source for enabling/disabling speed controller output balancing. This function is used to generate a smooth transfer from a torque- or tension-controlled motor back to being speed-controlled. When balancing is enabled, the output of the speed controller is forced to the value of *25.10 Speed ctrl balancing ref*. Balancing is also possible in the ramp generator, see parameter *23.26 Ramp out balancing enable*. 0 = Disabled 1 = Enabled	*Not selected*
	Not selected	0.	1
	Selected	1.	2
	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

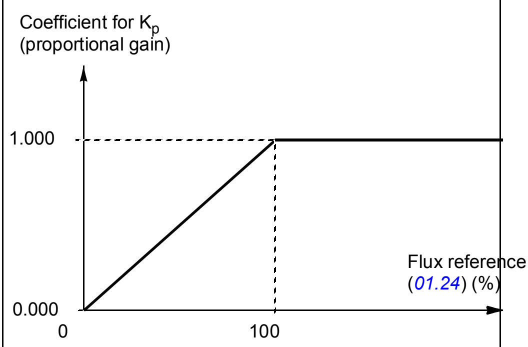
No.	Name/Value	Description	Def/ FbEq16
	DIO1	Digital input/output DIO1 (*11.02 DIO delayed status*, bit 0).	10
	DIO2	Digital input/output DIO2 (*11.02 DIO delayed status*, bit 1).	11
	Other [bit]	Source selection (see *Terms and abbreviations* on page *101*).	-
25.10	*Speed ctrl balancing ref*	Defines the reference used in speed controller output balancing. The output of the speed controller is forced to this value when balancing is enabled by parameter *25.09 Speed ctrl balancing enable*.	0.0%
	-300.0…300.0%	Speed control output balancing reference.	See par. *46.03*
25.11	*Speed control min torque*	Defines the minimum speed controller output torque.	-300.0%
	-1600.0…0.0%	Minimum speed controller output torque.	See par. *46.03*
25.12	*Speed control max torque*	Defines the maximum speed controller output torque.	300.0%
	0.0…1600.0%	Maximum speed controller output torque.	See par. *46.03*
25.13	*Min torq sp ctrl em stop*	Defines the minimum speed controller output torque during a ramped emergency stop (Off1 or Off3).	-400.0%
	-1600.0 … 0.0%	Minimum speed controller output torque for ramped emergency stop.	See par. *46.03*
25.14	*Max torq sp ctrl em stop*	Defines the maximum speed controller output torque during a ramped emergency stop (Off1 or Off3).	400.0%
	0.0…1600.0%	Maximum speed controller output torque for ramped emergency stop.	See par. *46.03*
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

No.	Name/Value	Description	Def/ FbEq16
25.18	*Speed adapt min limit*	Minimum actual speed for speed controller adaptation. Speed controller gain and integration time can be adapted according to actual speed (*90.01 Motor speed for control*). This is done by multiplying the gain (*25.02 Speed proportional gain*) and integration time (*25.03 Speed integration time*) by coefficients at certain speeds. The coefficients are defined individually for both gain and integration time. When actual speed is below or equal to *25.18 Speed adapt min limit*, the gain and integration time are multiplied by *25.21 Kp adapt coef at min speed* and *25.22 Ti adapt coef at min speed* respectively. When actual speed is equal to or above *25.19 Speed adapt max limit*, no adaptation takes place (the coefficient is 1). When actual speed is between *25.18 Speed adapt min limit* and *25.19 Speed adapt max limit*, the coefficients for the gain and integration time are calculated linearly on the basis of the breakpoints. See also the block diagram on page *483*.	0 rpm
			
	0…30000 rpm	Minimum actual speed for speed controller adaptation.	1 = 1 rpm
25.19	*Speed adapt max limit*	Maximum actual speed for speed controller adaptation. See parameter *25.18 Speed adapt min limit*.	0 rpm
	0…30000 rpm	Maximum actual speed for speed controller adaptation.	1 = 1 rpm
25.21	*Kp adapt coef at min speed*	Proportional gain coefficient at minimum actual speed. See parameter *25.18 Speed adapt min limit*.	1.000
	0.000…10.000	Proportional gain coefficient at minimum actual speed.	1000 = 1
25.22	*Ti adapt coef at min speed*	Integration time coefficient at minimum actual speed. See parameter *25.18 Speed adapt min limit*.	1.000
	0.000…10.000	Integration time coefficient at minimum actual speed.	1000 = 1

No.	Name/Value	Description	Def/ FbEq16
25.25	*Torque adapt max limit*	Maximum torque reference for speed controller adaptation. Speed controller gain can be adapted according to the final unlimited torque reference (*26.01 Torque reference to TC*). This can be used to smooth out disturbances caused by a small load and backlashes. The functionality involves multiplying the gain (*25.02 Speed proportional gain*) by a coefficient within a certain torque range. When the torque reference is 0%, the gain is multiplied by the value of parameter *25.27 Kp adapt coef at min torque*. When the torque reference is equal to or above *25.25 Torque adapt max limit*, no adaptation takes place (the coefficient is 1). Between 0% and *25.25 Torque adapt max limit*, the coefficient for the gain is calculated linearly on the basis of the breakpoints. Filtering can be applied on the torque reference using parameter *25.26 Torque adapt filt time*. See also the block diagram on page *483*.	0.0%



No.	Name/Value	Description	Def/ FbEq16
	0.0…1600.0%	Maximum torque reference for speed controller adaptation.	See par. *46.03*
25.26	*Torque adapt filt time*	Defines a filter time constant for the adaptation, in effect adjusting the rate of change of the gain. See parameter *25.25 Torque adapt max limit*.	0.000 s
	0.000…100.000 s	Filter time for adaptation.	100 = 1 s
25.27	*Kp adapt coef at min torque*	Proportional gain coefficient at 0% torque reference. See parameter *25.25 Torque adapt max limit*.	1.000
	0.000…10.000	Proportional gain coefficient at 0% torque reference.	1000 = 1

No.	Name/Value	Description	Def/ FbEq16
25.30	*Flux adaptation enable*	Enables/disables speed controller adaptation based on motor flux reference (*01.24 Flux actual %*). The proportional gain of the speed controller is multiplied by a coefficient of 0…1 between 0…100% flux reference respectively. See also the block diagram on page *483*. 	*Enable*
	Disable	Speed controller adaptation based on flux reference disabled.	0
	Enable	Speed controller adaptation based on flux reference enabled.	1
25.33	*Speed controller autotune*	Activates (or selects a source that activates) the speed controller autotune function. See section *Speed controller autotune* (page *59*). The autotune will automatically set parameters *25.02 Speed proportional gain*, *25.03 Speed integration time* and *25.37 Mechanical time constant*. The prerequisites for performing the autotune routine are: • the motor identification run (ID run) has been successfully completed • the speed and torque limits (parameter group *30 Limits*) have been set • speed feedback filtering (parameter group *90 Feedback selection*), speed error filtering (*24 Speed reference conditioning*) and zero speed (*21 Start/stop mode*) have been set, and • the drive has been started and is running in speed control mode. **WARNING!** The motor and machinery will run against the torque and speed limits during the autotune routine. MAKE SURE IT IS SAFE TO ACTIVATE THE AUTOTUNE FUNCTION! The autotune routine can be aborted by stopping the drive. 0 -> 1 = Activate speed controller autotune **Note:** The value does not revert to 0 automatically.	*Off*
	Off	0.	0
	On	1.	1

No.	Name/Value	Description	Def/ FbEq16
	Other [bit]	Source selection (see *Terms and abbreviations* on page *101*).	-
25.34	*Speed controller autotune mode*	Defines a control preset for the speed controller autotune function. The setting affects the way the torque reference will respond to a speed reference step.	*Normal*
	Smooth	Slow but robust response.	0
	Normal	Medium setting.	1
	Tight	Fast response. May produce too high a gain value for some applications.	2
25.37	*Mechanical time constant*	Mechanical time constant of the drive and the machinery as determined by the speed controller autotune function. The value can be adjusted manually.	-
	0.00 … 1000.00 s	Mechanical time constant.	10 = 1 s
25.38	*Autotune torque step*	Defines an added torque value used by the autotune function. This value is scaled to motor nominal torque. Note that the torque used by the autotune function can also be limited by the torque limits (in parameter group *30 Limits*) and nominal motor torque.	10.00%
	0.00 … 100.00%	Autotune torque step.	100 = 1%
25.39	*Autotune speed step*	Defines a speed value added to the initial speed for the autotune routine. The initial speed (speed used when autotune is activated) plus the value of this parameter is the calculated maximum speed used by the autotune routine. The maximum speed can also be limited by the speed limits (in parameter group *30 Limits*) and nominal motor speed. The value is scaled to motor nominal speed. **Note:** The motor will exceed the calculated maximum speed slightly at the end of each acceleration stage.	10.00%
	0.00 … 100.00%	Autotune speed step.	100 = 1%
25.40	*Autotune repeat times*	Determines how many acceleration/deceleration cycles are performed during the autotune routine. Increasing the value will improve the accuracy of the autotune function, and allow the use of smaller torque or speed step values.	10
	1…10	Number of cycles during autotune routine.	1 = 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 *483*. 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 *483*. This parameter is read-only.	-
	-30000.0…30000.0%	I-part output of speed controller.	See par. *46.03*

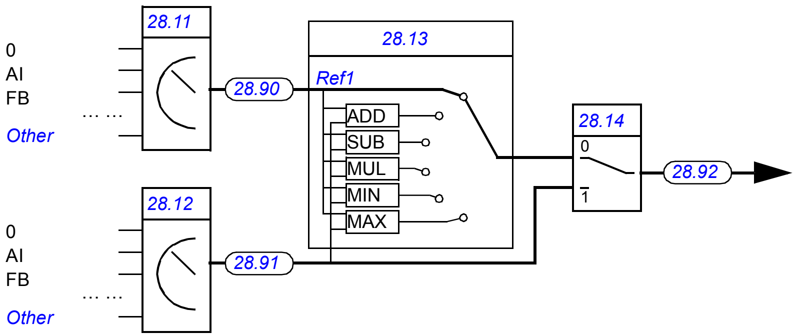
No.	Name/Value	Description	Def/ FbEq16
25.55	*Torque deriv reference*	Displays the output of the derivative (D) part of the speed controller. See the control chain diagram on page *483*. This parameter is read-only.	-
	-30000.0…30000.0%	D-part output of speed controller.	See par. *46.03*
25.56	*Torque acc compensation*	Displays the output of the acceleration compensation function. See the control chain diagram on page *483*. This parameter is read-only.	-
	-30000.0…30000.0%	Output of acceleration compensation function.	See par. *46.03*
25.57	*Torque reference unbalanced*	Displays the acceleration-compensated output of the speed controller. See the control chain diagram on page *483*. This parameter is read-only.	-
	-30000.0…30000.0%	Acceleration-compensated output of speed controller.	See par. *46.03*
26 Torque reference chain		Settings for the torque reference chain.	
26.01	*Torque reference to TC*	Displays the final torque reference given to the torque controller in percent. This reference is then acted upon by various final limiters, like power, torque, load etc. This parameter is read-only.	-
	-1600.0 … 1600.0%	Torque reference for torque control.	-
26.02	*Torque reference used*	Displays the final torque reference (in percent of motor nominal torque) given to the DTC core, and comes after frequency, voltage and torque limitation. This parameter is read-only.	-
	-1600.0 … 1600.0%	Torque reference for torque control.	-
26.51	*Oscillation damping*	Parameters *26.51*…*26.58* configure the oscillation damping function. See section *Oscillation damping* (page *62*). This parameter enables (or selects a source that enables) the oscillation damping algorithm. 1 = Oscillation damping algorithm 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
	DIO1	Digital input/output DIO1 (*11.02 DIO delayed status*, bit 0).	10
	DIO2	Digital input/output DIO2 (*11.02 DIO delayed status*, bit 1).	11
	Other [bit]	Source selection (see *Terms and abbreviations* on page *101*).	-

No.	Name/Value	Description	Def/ FbEq16
26.52	*Oscillation damping out enable*	Determines (or selects a source that determines) whether the output of the oscillation damping function is added to the torque reference or not. **Note:** Before enabling the oscillation damping output, adjust parameters *26.53*…*26.57*. Then monitor the input signal (selected by *26.53*) and the output (*26.58*) to make sure that the correction is safe to apply. 1 = Add oscillation damping output to torque reference	*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
	DIO1	Digital input/output DIO1 (*11.02 DIO delayed status*, bit 0).	10
	DIO2	Digital input/output DIO2 (*11.02 DIO delayed status*, bit 1).	11
	Other [bit]	Source selection (see *Terms and abbreviations* on page *101*).	-
26.53	*Oscillation compensation input*	Selects the input signal for the oscillation damping function. **Note:** Before changing this parameter run-time, disable the oscillation damping output using parameter *26.52*. Monitor the behavior of *26.58* before re-enabling the output.	*Speed error*
	Speed error	-(*24.04 Speed error inverted*), ie. *24.01 Used speed reference* - *24.02 Used speed feedback*. **Note:** This setting is not supported in scalar motor control mode.	0
	DC voltage	*01.11 DC voltage*. (The value is internally filtered.)	1
26.55	*Oscillation damping frequency*	Defines the center frequency of the oscillation damping filter. Set the value according to the number of oscillation peaks in the monitored signal (selected by *26.53*) per second. **Note:** Before changing this parameter run-time, disable the oscillation damping output using parameter *26.52*. Monitor the behavior of *26.58* before re-enabling the output.	31.0 Hz
	0.1 … 60.0 Hz	Center frequency for oscillation damping.	10 = 1 Hz
26.56	*Oscillation damping phase*	Defines a phase shift for the output of the filter. **Note:** Before changing this parameter run-time, disable the oscillation damping output using parameter *26.52*. Monitor the behavior of *26.58* before re-enabling the output.	180 deg
	0…360 deg	Phase shift for oscillation damping function output.	10 = 1 deg

No.	Name/Value	Description	Def/ FbEq16
26.57	*Oscillation damping gain*	Defines a gain for the output of the oscillation damping function, ie. how much the output of the filter is amplified before it is added to the torque reference. Oscillation gain is scaled according to the speed controller gain so that changing the gain will not disturb oscillation damping. **Note:** Before changing this parameter run-time, disable the oscillation damping output using parameter *26.52*. Monitor the behavior of *26.58* before re-enabling the output.	1.0%
	0.0 … 100.0%	Gain setting for oscillation damping output.	10 = 1%
26.58	*Oscillation damping output*	Displays the output of the oscillation damping function. This value is added to the torque reference (as allowed by parameter *26.52 Oscillation damping out enable*). This parameter is read-only.	-
	-1600.000 … 1600.000%	Output of the oscillation damping function.	10 = 1%
26.81	*Rush control gain*	Rush controller gain term. See section *Rush control* (page *62*).	10.0
	0.0 …10000.0	Rush controller gain (0.0 = disabled).	1 = 1
26.82	*Rush control integration time*	Rush controller integration time term.	2.0 s
	0.0 …10.0 s	Rush controller integration time (0.0 = disabled).	1 = 1 s

28 Frequency reference chain		Settings for the frequency reference chain. See the control chain diagrams on pages *484* and *484*.	
28.01	*Frequency ref ramp input*	Displays the used frequency reference before ramping. See the control chain diagram on page *484*. 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 *484*. This parameter is read-only.	-
	-500.00…500.00 Hz	Final frequency reference.	See par. *46.02*

No.	Name/Value	Description	Def/ FbEq16
28.11	Frequency ref1 source	Selects frequency reference source 1. Two signal sources can be defined by this parameter and 28.12 Frequency ref2 source. A digital source selected by 28.14 Frequency ref1/2 selection can be used to switch between the two sources, or a mathematical function (28.13 Frequency ref1 function) applied to the two signals to create the reference.	Zero



No.	Name/Value	Description	Def/ FbEq16
	Zero	None.	0
	AI1 scaled	12.12 AI1 scaled value (see page 141).	1
	AI2 scaled	12.22 AI2 scaled value (see page 143).	2
	FB A ref1	03.05 FB A reference 1 (see page 108).	4
	FB A ref2	03.06 FB A reference 2 (see page 108).	5
	EFB ref1	03.09 EFB reference 1 (see page 108).	8
	EFB ref2	03.10 EFB reference 2 (see page 108).	9
	Motor potentiometer	22.80 Motor potentiometer ref act (output of the motor potentiometer).	15
	Other	Source selection (see Terms and abbreviations on page 101).	-
28.12	Frequency ref2 source	Selects frequency reference source 2. For the selections, and a diagram of reference source selection, see parameter 28.11 Frequency ref1 source.	Zero
28.13	Frequency ref1 function	Selects a mathematical function between the reference sources selected by parameters 28.11 Frequency ref1 source and 28.12 Frequency ref2 source. See diagram at 28.11 Frequency ref1 source.	Ref1
	Ref1	Signal selected by 28.11 Frequency ref1 source is used as frequency reference 1 as such (no function applied).	0
	Add (ref1 + ref2)	The sum of the reference sources is used as frequency reference 1.	1
	Sub (ref1 - ref2)	The subtraction ([28.11 Frequency ref1 source] - [28.12 Frequency ref2 source]) of the reference sources is used as frequency reference 1.	2
	Mul (ref1 × ref2)	The multiplication of the reference sources is used as frequency reference 1.	3

No.	Name/Value	Description	Def/ FbEq16
	Min (ref1, ref2)	The smaller of the reference sources is used as frequency reference 1.	4
	Max (ref1, ref2)	The greater of the reference sources is used as frequency reference 1.	5
28.14	*Frequency ref1/2 selection*	Configures the selection between frequency references 1 and 2. See diagram at *28.11 Frequency ref1 source*. 0 = Frequency reference 1 1 = Frequency reference 2	*Follow Ext1/Ext2 selection*
	Frequency reference 1	0.	0
	Frequency reference 2	1.	1
	Follow Ext1/Ext2 selection	Frequency reference 1 is used when external control location EXT1 is active. Frequency reference 2 is used when external control location EXT2 is active. See also parameter *19.11 Ext1/Ext2 selection*.	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 *101*).	-
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.	0000b

Bit	Name	Information
0	Constant 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 frequency, the sign of the constant frequency setting (parameters *28.26…28.32*) is multiplied by the direction signal (forward: +1, reverse: -1). This effectively allows the drive to have 14 (7 forward, 7 reverse) constant frequencies if all values in *28.26…28.32* are positive. ⚠ **WARNING:** If the direction signal is reverse and the active constant frequency is negative, the drive will run in the forward direction.
		0 = According to Par: The running direction for the constant frequency is determined by the sign of the constant speed setting (parameters *28.26…28.32*).

	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:	*Not selected*

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
	DIO1	Digital input/output DIO1 (*11.02 DIO delayed status*, bit 0).	10
	DIO2	Digital input/output DIO2 (*11.02 DIO delayed status*, bit 1).	11
	Other [bit]	Source selection (see *Terms and abbreviations* on page *101*).	-
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).	0.00 Hz
	-500.00 … 500.00 Hz	Constant frequency 1.	See par. *46.02*
28.27	*Constant frequency 2*	Defines constant frequency 2.	0.00 Hz
	-500.00 … 500.00 Hz	Constant frequency 2.	See par. *46.02*
28.28	*Constant frequency 3*	Defines constant frequency 3.	0.00 Hz
	-500.00 … 500.00 Hz	Constant frequency 3.	See par. *46.02*
28.29	*Constant frequency 4*	Defines constant frequency 4.	0.00 Hz
	-500.00 … 500.00 Hz	Constant frequency 4.	See par. *46.02*
28.30	*Constant frequency 5*	Defines constant frequency 5.	0.00 Hz
	-500.00 … 500.00 Hz	Constant frequency 5.	See par. *46.02*
28.31	*Constant frequency 6*	Defines constant frequency 6.	0.00 Hz
	-500.00 … 500.00 Hz	Constant frequency 6.	See par. *46.02*
28.32	*Constant frequency 7*	Defines constant frequency 7.	0.00 Hz
	-500.00 … 500.00 Hz	Constant frequency 7.	See par. *46.02*
28.41	*Frequency ref safe*	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* • *50.32 FBA B comm loss func* • *58.14 Communication loss action*.	0.00 Hz
	-500.00…500.00 Hz	Safe frequency reference.	See par. *46.02*

No.	Name/Value	Description	Def/ FbEq16
28.51	*Critical frequency function*	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 59).	00b

Bit	Name	Information
0	Enable	1 = Enable: Critical frequencies enabled.
		0 = Disable: Critical frequencies disabled.
1	Sign mode	1 = According to par: The signs of parameters *28.52…28.57* are taken into account.
		0 = Absolute: Parameters *28.52…28.57* are handled as absolute values. Each range is effective in both directions of rotation.

No.	Name/Value	Description	Def/ FbEq16
	0000b…0011b	Critical frequencies configuration word.	1 = 1
28.52	*Critical frequency 1 low*	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*.	0.00 Hz
	-500.00…500.00 Hz	Low limit for critical frequency 1.	See par. *46.02*
28.53	*Critical frequency 1 high*	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*.	0.00 Hz
	-500.00…500.00 Hz	High limit for critical frequency 1.	See par. *46.02*
28.54	*Critical frequency 2 low*	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*.	0.00 Hz
	-500.00…500.00 Hz	Low limit for critical frequency 2.	See par. *46.02*
28.55	*Critical frequency 2 high*	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*.	0.00 Hz
	-500.00…500.00 Hz	High limit for critical frequency 2.	See par. *46.02*
28.56	*Critical frequency 3 low*	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*.	0.00 Hz
	-500.00…500.00 Hz	Low limit for critical frequency 3.	See par. *46.02*
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*

No.	Name/Value	Description	Def/ FbEq16
28.71	*Freq ramp set selection*	Selects a source that switches between the two sets of acceleration/deceleration times defined by parameters *28.72*…*28.75*. 0 = Acceleration time 1 and deceleration time 1 are in force 1 = Acceleration time 2 and deceleration time 2 are in force	*Acc/Dec time 1*
	Acc/Dec time 1	0.	0
	Acc/Dec time 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
	DIO1	Digital input/output DIO1 (*11.02 DIO delayed status*, bit 0).	10
	DIO2	Digital input/output DIO2 (*11.02 DIO delayed status*, bit 1).	11
	Other [bit]	Source selection (see *Terms and abbreviations* on page *101*).	-
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* (not to 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.	20.000 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.	20.000 s
	0.000…1800.000 s	Deceleration time 1.	10 = 1 s
28.74	*Freq acceleration time 2*	Defines acceleration time 2. See parameter *28.72 Freq acceleration time 1*.	60.000 s
	0.000…1800.000 s	Acceleration time 2.	10 = 1 s
28.75	*Freq deceleration time 2*	Defines deceleration time 2. See parameter *28.73 Freq deceleration time 1*.	60.000 s
	0.000…1800.000 s	Deceleration time 2.	10 = 1 s

No.	Name/Value	Description	Def/ FbEq16
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
	DIO1	Digital input/output DIO1 (*11.02 DIO delayed status*, bit 0).	10
	DIO2	Digital input/output DIO2 (*11.02 DIO delayed status*, bit 1).	11
	Other [bit]	Source selection (see *Terms and abbreviations* on page *101*).	-
28.77	*Freq ramp hold*	Selects a source that forces the output of the frequency ramp generator to actual frequency value. 0 = Force ramp output to actual frequency 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
	DIO1	Digital input/output DIO1 (*11.02 DIO delayed status*, bit 0).	10
	DIO2	Digital input/output DIO2 (*11.02 DIO delayed status*, bit 1).	11
	Other [bit]	Source selection (see *Terms and abbreviations* on page *101*).	-
28.78	*Freq ramp output balancing*	Defines a reference for frequency ramp balancing. The output of the ramp generator is forced to this value when balancing is enabled by parameter *28.79 Freq ramp output balancing enable*.	0.00 Hz
	-500.00…500.00 Hz	Frequency ramp balancing reference.	See par. *46.02*
28.79	*Freq ramp output balancing enable*	Selects the source for enabling/disabling speed ramp balancing. See parameter *28.78 Freq ramp output balancing*. 0 = Disabled 1 = Enabled	*Not selected*
	Not selected	0.	
	Selected	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
	DIO1	Digital input/output DIO1 (*11.02 DIO delayed status*, bit 0).	10
	DIO2	Digital input/output DIO2 (*11.02 DIO delayed status*, bit 1).	11
	Other [bit]	Source selection (see *Terms and abbreviations* on page *101*).	-
28.90	*Frequency ref act 1*	Displays the value of frequency reference source 1 (selected by parameter *28.11 Frequency ref1 source*). See the control chain diagram on page *484*. This parameter is read-only.	-
	-500.00…500.00 Hz	Value of frequency reference source 1.	See par. *46.02*
28.91	*Frequency ref act 2*	Displays the value of frequency reference source 2 (selected by parameter *28.12 Frequency ref2 source*). See the control chain diagram on page *484*. This parameter is read-only.	-
	-500.00…500.00 Hz	Value of frequency reference source 2.	See par. *46.02*
28.92	*Frequency ref act 3*	Displays the frequency reference after the function applied by parameter *28.13 Frequency ref1 function* (if any), and after selection (*28.14 Frequency ref1/2 selection*). See the control chain diagram on page *484*. This parameter is read-only.	-
	-500.00…500.00 Hz	Frequency reference after selection.	See par. *46.02*
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 *484*. 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 *484*. This parameter is read-only.	-
	-500.00…500.00 Hz	Frequency reference before ramping and limiting.	See par. *46.02*

No.	Name/Value	Description	Def/ FbEq16
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	Spd ctl tlim min	1 = Speed controller output is being limited by *25.11 Speed control min torque*
2	Spd ctl tlim max	1 = Speed controller output is being limited by *25.12 Speed control max torque*
3	Torq ref max	1 = Torque reference ramp input is being limited by *26.09 Maximum torque ref*, source of *30.25 Minimum torque sel*, *30.26 Power motoring limit* or *30.27 Power generating limit*.
4	Torq ref min	1 = Torque reference ramp input is being limited by 26.08 Minimum torque ref, source of *30.18 Minimum torque sel*, *30.26 Power motoring limit* or *30.27 Power generating limit*.
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	Reserved	
12	Sw freq ref lim	1 = Requested output frequency cannot be reached because of switching frequency limitation (because of output filtering or ATEX-related protections)
13…15	Reserved	

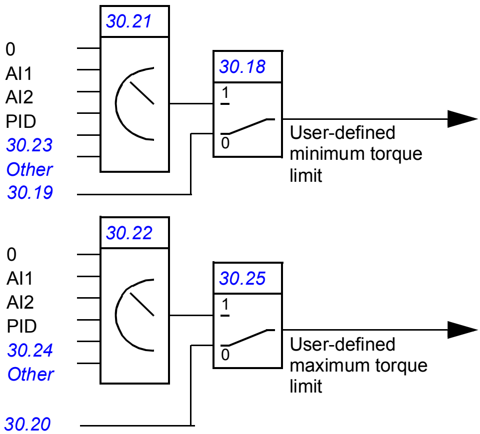
No.	Name/Value	Description	Def/ FbEq16
	0000h…FFFFh	Limit word 1.	1 = 1

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 synchronous reluctance motors only) 1 = Load angle limit is active, ie. the motor cannot produce any more torque
6	Motor pullout	(With asynchronous motors only) 1 = 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	IGBT overtemperature	*1 = Output current is being limited because of estimated IGBT temperature
13	IGBT overload	*1 = Output current is being limited because of IGBT junction to case temperature
14…15	Reserved	
*Only one out of bits 0…3, and one out of bits 9…13 can be on simultaneously. The bit typically indicates the limit that is exceeded first.		

No.	Name/Value	Description	Def/ FbEq16
	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*. In frequency control mode, this limit is not effective. Make sure the frequency limits (*30.13* and *30.14*) are set appropriately if frequency control is used.	-1500.00 rpm; -1800.00 rpm (*95.20* b0)
	-30000.00 …30000.00 rpm	Minimum allowed speed.	See par. *46.01*
30.12	*Maximum speed*	Defines the maximum allowed speed. **WARNING!** This value must not be lower than *30.11 Minimum speed*. **WARNING!** In frequency control mode, this limit is not effective. Make sure the frequency limits (*30.13* and *30.14*) are set appropriately if frequency control is used.	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!** This limit is effective in frequency control mode only.	-50.00 Hz; -60.00 Hz (*95.20* b0)
	-500.00…500.00 Hz	Minimum frequency.	See par. *46.02*
30.14	*Maximum frequency*	Defines the maximum allowed frequency. **WARNING!** This value must not be lower than *30.13 Minimum frequency*. **WARNING!** This limit is effective 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*
30.15	*Maximum start current enable*	A temporary motor current limit specifically for starting can be defined by this parameter and *30.16 Maximum start current*. When this parameter is set to *Enable*, the drive observes the start current limit defined by *30.16 Maximum start current*. The limit is in force for 2 seconds after initial magnetization (of an asynchronous induction motor) or autophasing (of a permanent magnet motor), but not more often than once in every 7 seconds. Otherwise, the limit defined by *30.17 Maximum current* is in force. **Note:** The availability of a start current higher than the general limit depends on drive hardware.	*Disable*
	Disable	Start current limit disabled.	0
	Enable	Start current limit enabled.	1
30.16	*Maximum start current*	Defines the maximum start current when enabled by parameter *30.15 Maximum start current enable*.	-
	0.00...30000.00 A	Maximum motor start current.	1 = 1 A
30.17	*Maximum current*	Defines the maximum allowed motor current.	0.00 A
	0.00…30000.00 A	Maximum motor current.	1 = 1 A

No.	Name/Value	Description	Def/ FbEq16
30.18	*Minimum torque sel*	Selects a source that switches between two different predefined minimum torque limits. 0 = Minimum torque limit defined by *30.19* is active 1 = Minimum torque limit selected by *30.21* is active The user can define two sets of torque limits, and switch between the sets using a binary source such as a digital input. The minimum limit selection (*30.18*) is independent of the maximum limit selection (*30.25*). The first set of limits is defined by parameters *30.19* and *30.20*. The second set has selector parameters for both the minimum (*30.21*) and maximum (*30.22*) limits that allows the use of a selectable analog source (such as an analog input).  **Note:** In addition to the user-defined limits, torque may be limited for other reasons (such as power limitation). Refer to the block diagram on page *484*.	*Minimum torque 1*
	Minimum torque 1	0 (minimum torque limit defined by *30.19* is active).	0
	Minimum torque 2 source	1 (minimum torque limit selected by *30.21* 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
	DIO1	Digital input/output DIO1 (*11.02 DIO delayed status*, bit 0).	10
	DIO2	Digital input/output DIO2 (*11.02 DIO delayed status*, bit 1).	11
	Other [bit]	Source selection (see *Terms and abbreviations* on page *101*).	-

No.	Name/Value	Description	Def/ FbEq16
30.19	*Minimum torque 1*	Defines a minimum torque limit for the drive (in percent of nominal motor torque). See diagram at parameter *30.18 Minimum torque sel*. The limit is effective when • the source selected by *30.18 Minimum torque sel* is 0, or • *30.18* is set to *Minimum torque 1*.	-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). See diagram at parameter *30.18 Minimum torque sel*. The limit is effective when • the source selected by *30.25 Maximum torque sel* is 0, or • *30.25* is set to *Maximum torque 1*.	300.0%
	0.0…1600.0%	Maximum torque 1.	See par. *46.03*
30.21	*Minimum torque 2 source*	Defines the source of the minimum torque limit for the drive (in percent of nominal motor torque) when • the source selected by parameter *30.18 Minimum torque sel* is 1, or • *30.18* is set to *Minimum torque 2 source*. See diagram at *30.18 Minimum torque sel*. **Note**: Any positive values received from the selected source are inverted.	*Minimum torque 2*
	Zero	None.	0
	AI1 scaled	*12.12 AI1 scaled value* (see page *141*).	1
	AI2 scaled	*12.22 AI2 scaled value* (see page *143*).	2
	Minimum torque 2	*30.23 Minimum torque 2*.	6
	Other	Source selection (see *Terms and abbreviations* on page *101*).	-
30.22	*Maximum torque 2 source*	Defines the source of the maximum torque limit for the drive (in percent of nominal motor torque) when • the source selected by parameter *30.25* • is 1, or • *30.25* is set to *Maximum torque 2 source*. See diagram at *30.18 Minimum torque sel*. **Note**: Any negative values received from the selected source are inverted.	*Maximum torque 2*
	Zero	None.	0
	AI1 scaled	*12.12 AI1 scaled value* (see page *141*).	1
	AI2 scaled	*12.22 AI2 scaled value* (see page *143*).	2
	Maximum torque 2	*30.24 Maximum torque 2*.	6
	Other	Source selection (see *Terms and abbreviations* on page *101*).	-

No.	Name/Value	Description	Def/ FbEq16
30.23	*Minimum torque 2*	Defines the minimum torque limit for the drive (in percent of nominal motor torque) when • the source selected by parameter *30.18 Minimum torque sel* is 1, and • *30.21* is set to *Minimum torque 2*. See diagram at *30.18 Minimum torque sel*.	-300.0%
	-1600.0…0.0%	Minimum torque limit 2.	See par. *46.03*
30.24	*Maximum torque 2*	Defines the maximum torque limit for the drive (in percent of nominal motor torque) when • the source selected by parameter *30.25 Maximum torque sel* is 1, and • *30.22* is set to *Maximum torque 2*. See diagram at *30.18 Minimum torque sel*.	300.0%
	0.0…1600.0%	Maximum torque limit 2.	See par. *46.03*
30.25	*Maximum torque sel*	Selects a source that switches between two different maximum torque limits. 0 = Maximum torque limit 1 defined by *30.20* is active 1 = Maximum torque limit selected by *30.22* is active See also parameter *30.18 Minimum torque sel*.	*Maximum torque 1*
	Maximum torque 1	0.	0
	Maximum torque 2 source	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
	DIO1	Digital input/output DIO1 (*11.02 DIO delayed status*, bit 0).	10
	DIO2	Digital input/output DIO2 (*11.02 DIO delayed status*, bit 1).	11
	Other [bit]	Source selection (see *Terms and abbreviations* on page *101*).	-
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.	-300.00%
	-600.00…0.00%	Maximum generating power.	1 = 1%
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

No.	Name/Value	Description	Def/ FbEq16
	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)*; *DI6* (*95.20* b8)
	Active (false)	0.	0
	Inactive (true)	1.	1
	DIIL	DIIL input (*10.02 DI delayed status*, bit 15).	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
	DIO1	Digital input/output DIO1 (*11.02 DIO delayed status*, bit 0).	11
	DIO2	Digital input/output DIO2 (*11.02 DIO delayed status*, bit 1).	12
	Other [bit]	Source selection (see *Terms and abbreviations* on page *101*).	-
31.02	*External event 1 type*	Selects the type of external event 1.	*Fault* (*95.20* b8)
	Fault	The external event generates a fault.	0
	Warning	The external event generates a warning.	1
	Warning/Fault	If the drive is modulating, the external event generates a fault. Otherwise, the event generates a warning.	3
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)*, *DIIL* (*95.20* b8)
31.04	*External event 2 type*	Selects the type of external event 2.	
	Fault	The external event generates a fault.	0
	Warning	The external event generates a warning.	1

No.	Name/Value	Description	Def/ FbEq16
	Warning/Fault	If the drive is modulating, the external event generates a fault. Otherwise, the event generates a warning.	3
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	The external event generates a fault.	0
	Warning	The external event generates a warning.	1
	Warning/Fault	If the drive is modulating, the external event generates a fault. Otherwise, the event generates a warning.	3
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	The external event generates a fault.	0
	Warning	The external event generates a warning.	1
	Warning/Fault	If the drive is modulating, the external event generates a fault. Otherwise, the event generates a warning.	3
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	The external event generates a fault.	0
	Warning	The external event generates a warning.	1
	Warning/Fault	If the drive is modulating, the external event generates a fault. Otherwise, the event generates a warning.	3
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
	DIO1	Digital input/output DIO1 (*11.02 DIO delayed status*, bit 0).	10
	DIO2	Digital input/output DIO2 (*11.02 DIO delayed status*, bit 1).	11
	FBA A MCW bit 7	Control word bit 7 received through fieldbus interface A.	30

No.	Name/Value	Description	Def/ FbEq16
	EFB MCW bit 7	Control word bit 7 received through the embedded fieldbus interface.	32
	Other [bit]	Source selection (see *Terms and abbreviations* on page *101*).	-
31.12	*Autoreset selection*	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. The number and interval of reset attempts are defined by parameters *31.14*…*31.16*. **Note**: The autoreset function is only available in external control; see section *Local control vs. external control* (page *51*). The bits of this binary number correspond to the following faults:	0000h

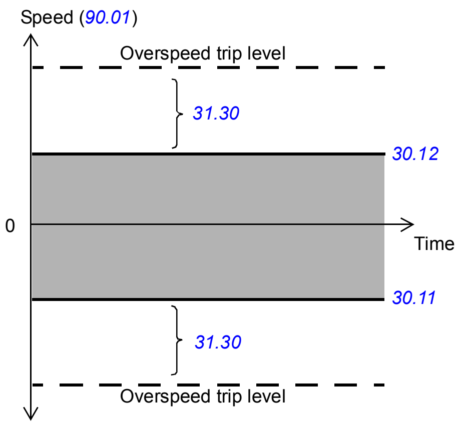
Bit	Fault
0	Overcurrent
1	Overvoltage
2	Undervoltage
3	AI supervision fault
4	Supply unit
5…7	Reserved
8	Application fault 1 (defined in the application program)
9	Application fault 2 (defined in the application program)
10	Selectable fault (see parameter *31.13 User selectable fault*)
11	External fault 1 (from source selected by parameter *31.01 External event 1 source*)
12	External fault 2 (from source selected by parameter *31.03 External event 2 source*)
13	External fault 3 (from source selected by parameter *31.05 External event 3 source*)
14	External fault 4 (from source selected by parameter *31.07 External event 4 source*)
15	External fault 5 (from source selected by parameter *31.09 External event 5 source*)

No.	Name/Value	Description	Def/ FbEq16
	0000h…FFFFh	Automatic reset configuration word.	1 = 1
31.13	*User selectable fault*	Defines the fault that can be automatically reset using parameter *31.12 Autoreset selection*, bit 10. The faults are listed in chapter *Fault tracing* (page *405*).	0000h
	0000h…FFFFh	Fault code.	10 = 1
31.14	*Number of trials*	Defines the maximum number of automatic resets that the drive is allowed to attempt within the time specified by *31.15 Total trials time*. If the fault persists, subsequent reset attempts will be made at intervals defined by *31.16 Delay time*. The faults to be automatically reset are defined by *31.12 Autoreset selection*.	-
	0…5	Number of automatic resets.	

No.	Name/Value	Description	Def/ FbEq16
31.15	*Total trials time*	Defines a time window for automatic fault resets. The maximum number of attempts made during any period of this length is defined by *31.14 Number of trials*. **Note**: If the fault condition remains and cannot be reset, each reset attempt will generate an event and start a new time window. In practice, if the specified number of resets (*31.14*) at specified intervals (*31.16*) take longer than the value of *31.15*, the drive will continue to attempt resetting the fault until the cause is eventually removed.	30.0 s
	1.0…600.0 s	Time for automatic resets.	10 = 1 s
31.16	*Delay time*	Defines the time that the drive will wait after a fault (or a previous reset attempt) before attempting an automatic reset. See parameter *31.12 Autoreset selection*.	0.0 s
	0.0…120.0 s	Autoreset delay.	10 = 1 s
31.19	*Motor phase loss*	Selects how the drive reacts when a motor phase loss is detected.	*Fault*
	No action	No action taken.	0
	Fault	The drive trips on fault *3381 Output phase loss*.	1
31.20	*Earth fault*	Selects how the drive reacts when an earth fault or current unbalance is detected in the motor or the motor cable.	*Fault*
	No action	No action taken.	0
	Warning	The drive generates an *A2B3 Earth leakage* warning.	1
	Fault	The drive trips on fault *2330 Earth leakage*.	2
31.21	*Supply phase loss*	Selects how the drive reacts when a supply phase loss is detected.	*Fault*
	No action	No action taken.	0
	Fault	The drive trips on fault *3130 Input phase loss*.	1

<table>
<tr><th>No.</th><th>Name/Value</th><th>Description</th><th>Def/
FbEq16</th></tr>
<tr><td>*31.22*</td><td>*STO indication run/stop*</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 the *Hardware manual* of the drive.</td><td>*Fault/Fault*</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 *5091 Safe torque off*</td></tr>
<tr><td>0</td><td>1</td><td>Faults *5091 Safe torque off* and *FA81 Safe torque off 1 loss*</td></tr>
<tr><td>1</td><td>0</td><td>Faults *5091 Safe torque off* and *FA82 Safe torque off 2 loss*</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 *5091 Safe torque off*</td><td>Warning *A5A0 Safe torque off*</td></tr>
<tr><td>0</td><td>1</td><td>Faults *5091 Safe torque off* and *FA81 Safe torque off 1 loss*</td><td>Warning *A5A0 Safe torque off* and fault *FA81 Safe torque off 1 loss*</td></tr>
<tr><td>1</td><td>0</td><td>Faults *5091 Safe torque off* and *FA82 Safe torque off 2 loss*</td><td>Warning *A5A0 Safe torque off* and fault *FA82 Safe torque off 2 loss*</td></tr>
<tr><td>1</td><td>1</td><td>(Normal operation)</td><td></td></tr>
</table>
</td><td>1</td></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 *5091 Safe torque off*</td><td>Event *B5A0 Safe torque off*</td></tr>
<tr><td>0</td><td>1</td><td>Faults *5091 Safe torque off* and *FA81 Safe torque off 1 loss*</td><td>Event *B5A0 Safe torque off* and fault *FA81 Safe torque off 1 loss*</td></tr>
<tr><td>1</td><td>0</td><td>Faults *5091 Safe torque off* and *FA82 Safe torque off 2 loss*</td><td>Event *B5A0 Safe torque off* and fault *FA82 Safe torque off 2 loss*</td></tr>
</table>
</td><td>2</td></tr>
</table>

<table>
<tr><th>No.</th><th>Name/Value</th><th>Description</th><th>Def/
FbEq16</th></tr>
<tr><td></td><td>Warning/Warning</td><td><table>
<tr><th colspan="2">Inputs</th><th>Indication (running or stopped)</th></tr>
<tr><th>IN1</th><th>IN2</th><th></th></tr>
<tr><td>0</td><td>0</td><td>Warning A5A0 Safe torque off</td></tr>
<tr><td>0</td><td>1</td><td>Warning A5A0 Safe torque off and fault FA81 Safe torque off 1 loss</td></tr>
<tr><td>1</td><td>0</td><td>Warning A5A0 Safe torque off and fault FA82 Safe torque off 2 loss</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>Indication (running or stopped)</th></tr>
<tr><th>IN1</th><th>IN2</th><th></th></tr>
<tr><td>0</td><td>0</td><td>Event B5A0 Safe torque off</td></tr>
<tr><td>0</td><td>1</td><td>Event B5A0 Safe torque off and fault FA81 Safe torque off 1 loss</td></tr>
<tr><td>1</td><td>0</td><td>Event B5A0 Safe torque off and fault FA82 Safe torque off 2 loss</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>Indication (running or stopped)</th></tr>
<tr><th>IN1</th><th>IN2</th><th></th></tr>
<tr><td>0</td><td>0</td><td>None</td></tr>
<tr><td>0</td><td>1</td><td>Fault FA81 Safe torque off 1 loss</td></tr>
<tr><td>1</td><td>0</td><td>Fault FA82 Safe torque off 2 loss</td></tr>
<tr><td>1</td><td>1</td><td>(Normal operation)</td></tr>
</table></td><td>5</td></tr>
<tr><td>31.23</td><td>Wiring or earth fault</td><td>Selects how the drive reacts to incorrect input power and motor cable connection (i.e. input power cable is connected to drive motor connection).
Note: The protection must be disabled with drive/inverter hardware supplied from a common DC bus.</td><td>Fault</td></tr>
<tr><td></td><td>No action</td><td>No action taken (protection disabled).</td><td>0</td></tr>
<tr><td></td><td>Fault</td><td>The drive trips on fault 3181 Cross connection.</td><td>1</td></tr>
<tr><td>31.24</td><td>Stall function</td><td>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.</td><td>Fault</td></tr>
<tr><td></td><td>No action</td><td>None (stall supervision disabled).</td><td>0</td></tr>
<tr><td></td><td>Warning</td><td>The drive generates an A780 Motor stall warning.</td><td>1</td></tr>
<tr><td></td><td>Fault</td><td>The drive trips on fault 7121 Motor stall.</td><td>2</td></tr>
</table>

No.	Name/Value	Description	Def/ FbEq16
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…500.00 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.	-
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 actual speed (*90.01 Motor speed for control*) 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 DTC 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
	0.00…10000.0 rpm	Overspeed trip margin.	See par. *46.01*

No.	Name/Value	Description	Def/ FbEq16
31.32	*Emergency ramp supervision*	Parameters *31.32 Emergency ramp supervision* and *31.33 Emergency ramp supervision delay*, together with *01.29 Speed change rate*, 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 *23.11*…*23.19* (Off1) or *23.23 Emergency stop time* (Off3). If the actual deceleration rate (*01.29*) 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%
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…32767 s	Maximum ramp-down time, or supervision activation delay.	1 = 1 s
31.35	*Main fan fault function*	Selects how the drive reacts when a main cooling fan fault is detected.	*Fault*
	Fault	The drive trips on fault *5080 Fan*.	0
	Warning	The drive generates an *A581 Fan* warning.	1
	No action	No action taken.	2

No.	Name/Value	Description	Def/ FbEq16
31.36	*Aux fan fault bypass*	(Only visible with a ZCU control unit) 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 sticking or disconnected, the control program first generates a warning (*A582 Auxiliary fan missing*), then 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 suppress the fault. Note: • The parameter must be activated within 2 minutes of control unit reboot (either by cycling the power or by parameter *96.08*). • The parameter only suppresses the fault, not the warning. • 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.	0
	Temporarily bypassed	The auxiliary fan fault indication is temporarily suppressed. The setting will revert automatically to *Off*.	1
31.37	*Ramp stop supervision*	Parameters *31.37 Ramp stop supervision* and *31.38 Ramp stop supervision delay*, together with *01.29 Speed change rate*, provide a supervision function for normal (ie. non-emergency) ramp stopping. 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 *31.38*. Otherwise, *31.37* defines the maximum allowed deviation from the expected deceleration rate, which is calculated from parameters *23.11*…*23.19*. If the actual deceleration rate (*01.29*) deviates too much from the expected rate, the drive trips on *73B1 Stop failed*, sets bit 14 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 ramp stop supervision is disabled.	0%

No.	Name/Value	Description	Def/ FbEq16
	0…300%	Maximum deviation from expected deceleration rate.	1 = 1%
31.38	*Ramp stop supervision delay*	If parameter *31.37 Ramp stop supervision* is set to 0%, this parameter defines the maximum time a ramp stop is allowed to take. If the motor has not stopped when the time elapses, the drive trips on *73B1 Stop failed*, sets bit 14 of *06.17 Drive status word 2*, and coasts to a stop. If *31.37* is set to a value other than 0%, this parameter defines a delay between the receipt of the 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…32767 s	Maximum ramp-down time, or supervision activation delay.	1 = 1 s
31.40	*Disable warnings*	Selects warnings to be suppressed. The parameter is a 16-bit word with each bit corresponding to a warning. Whenever a bit is set to 1, the corresponding warning is suppressed. The bits of this binary number correspond to the following warnings:	0000b

Bit	Fault
0	Overvoltage
1	Reserved
2	Encoder 1
3	Encoder 2
4…15	Reserved

	000b...1101b	Warning suppression word.	1 = 1
31.42	*Overcurrent fault limit*	Sets a custom motor current fault limit. The drive automatically sets an internal motor current limit according to the drive hardware. The internal limit is appropriate in most cases, but this parameter can be used to set a lower current limit, for example, to protect a permanent magnet motor from demagnetization. With this parameter at 0.0 A, only the internal limit is in force.	
	0.00...30000.0 A	Custom motor current fault limit	-

No.	Name/Value	Description	Def/ FbEq16
32 Supervision		Configuration of signal supervision functions 1…3. Three values can be chosen to be monitored; a warning or fault is generated whenever predefined limits are exceeded. See also section *Signal supervision* (page *89*).	
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* and *32.26*.	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…15	Reserved	

No.	Name/Value	Description	Def/ FbEq16
	0000…0111b	Signal supervision status word.	1 = 1
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
32.06	*Supervision 1 action*	Selects the action the drive takes 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 action taken.	0
	Warning	A warning (*A8B0 Signal supervision*) is generated.	1
	Fault	The drive trips on *80B0 Signal supervision*.	2
32.07	*Supervision 1 signal*	Selects the signal to be monitored by signal supervision function 1.	*Zero*
	Zero	None.	0

No.	Name/Value	Description	Def/ FbEq16
	Speed	*01.01 Motor speed used* (page 105).	1
	Frequency	*01.06 Output frequency* (page 105).	3
	Current	*01.07 Motor current* (page 105).	4
	Torque	*01.10 Motor torque* (page 105).	6
	DC voltage	*01.11 DC voltage* (page 105).	7
	Output power	*01.14 Output power* (page 106).	8
	AI1	*12.11 AI1 actual value* (page 141).	9
	AI2	*12.21 AI2 actual value* (page 143).	10
	Speed ref ramp in	*23.01 Speed ref ramp input* (page 203).	18
	Speed ref ramp out	*23.02 Speed ref ramp output* (page 204).	19
	Speed ref used	*24.01 Used speed reference* (page 210).	20
	Torque ref used	*26.02 Torque reference used*	21
	Freq ref used	*28.02 Frequency ref ramp output* (page 226).	22
	Other	Source selection (see *Terms and abbreviations* on page 101).	-
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
	-21474830.00 …21474830.00	Low limit.	-
32.10	*Supervision 1 high*	Defines the upper limit for signal supervision 1.	0.00
	-21474830.00 …21474830.00	Upper limit.	-
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
32.16	*Supervision 2 action*	Selects the action the drive takes 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 action taken.	0
	Warning	A warning (*A8B1 Signal supervision 2*) is generated.	1
	Fault	The drive trips on *80B1 Signal supervision 2*.	2
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*.	*Zero*
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
	-21474830.00 …21474830.00	Low limit.	-
32.20	*Supervision 2 high*	Defines the upper limit for signal supervision 2.	0.00
	-21474830.00 …21474830.00	Upper limit.	-
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
32.26	*Supervision 3 action*	Selects the action the drive takes 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 action taken.	0
	Warning	A warning (*A8B2 Signal supervision 3*) is generated.	1
	Fault	The drive trips on *80B2 Signal supervision 3*.	2

No.	Name/Value	Description	Def/ FbEq16
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*.	*Zero*
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
	-21474830.00 …21474830.00	Low limit.	-
32.30	*Supervision 3 high*	Defines the upper limit for signal supervision 3.	0.00
	-21474830.00 …21474830.00	Upper limit.	-

33 Generic timer & counter		Configuration of maintenance timers/counters. See also section *Maintenance timers and counters* (page *89*).	
33.01	*Counter status*	Displays the maintenance timer/counter status word, indicating which maintenance timers/counters have exceeded their limits. This parameter is read-only.	-

Bit	Name	Description
0	On-time1	1 = On-time timer 1 has reached its preset limit.
1	On-time2	1 = On-time timer 2 has reached its preset limit.
2	Edge 1	1 = Signal edge counter 1 has reached its preset limit.
3	Edge 2	1 = Signal edge counter 2 has reached its preset limit.
4	Value 1	1 = Value counter 1 has reached its preset limit.
5	Value 2	1 = Value counter 2 has reached its preset limit.
6…15	Reserved	

	0000 0000b…0011 1111b	Maintenance time/counter status word.	1 = 1
33.10	*On-time 1 actual*	Displays the actual present value of on-time timer 1. The timer runs whenever the signal selected by parameter *33.13 On-time 1 source* is on. When the timer exceeds the limit set by *33.11 On-time 1 warn limit*, bit 0 of *33.01 Counter status* is set to 1. The warning specified by *33.14 On-time 1 warn message* is also given if enabled by *33.12 On-time 1 function*. The timer can be reset from the Drive composer PC tool, or from the control panel by keeping Reset depressed for over 3 seconds.	-
	0…4294967295 s	Actual present value of on-time timer 1.	-
33.11	*On-time 1 warn limit*	Sets the warning limit for on-time timer 1.	0 s
	0…4294967295 s	Warning limit for on-time timer 1.	-

No.	Name/Value	Description	Def/ FbEq16
33.12	*On-time 1 function*	Configures on-time timer 1.	0000b

Bit	Function
0	Counter mode 0 = Loop: When the limit is reached, the counter is reset. The counter status (bit 0 of *33.01*) switches to 1 for one second. The warning (if enabled) stays active for at least 10 seconds. 1 = Saturate: When the limit is reached, the counter status (bit 0 of *33.01*) switches to 1, and remains so until *33.10* is reset. The warning (if enabled) also stays active until *33.10* is reset.
1	Warning enable 0 = Disable: No warning is given when the limit is reached 1 = Enable: A warning (see *33.14*) is given when the limit is reached
2…15	Reserved

	0000b…0011b	On-time timer 1 configuration word.	1 = 1
33.13	*On-time 1 source*	Selects the signal to be monitored by on-time timer 1.	*False*
	False	Constant 0 (timer disabled).	0
	True	Constant 1.	1
	RO1	Bit 0 of *10.21 RO status* (page *131*).	2
	Other [bit]	Source selection (see *Terms and abbreviations* on page *101*).	-
33.14	*On-time 1 warn message*	Selects the optional warning message for on-time timer 1.	*On-time 1 exceeded*
	On-time 1 exceeded	*A886 On-time 1*. The message text can be edited on the control panel by choosing Menu – Settings – Edit texts.	0
	Clean device	*A88C Device clean*.	6
	Maintain additional cooling fan	*A890 Additional cooling*.	7
	Maintain cabinet fan	*A88E Cabinet fan*.	8
	Maintain DC capacitors	*A88D DC capacitor*.	9
	Maintain motor bearing	*A880 Motor bearing*.	10
33.20	*On-time 2 actual*	Displays the actual present value of on-time timer 2. The timer runs whenever the signal selected by parameter *33.23 On-time 2 source* is on. When the timer exceeds the limit set by *33.21 On-time 2 warn limit*, bit 1 of *33.01 Counter status* is set to 1. The warning specified by *33.24 On-time 2 warn message* is also given if enabled by *33.22 On-time 2 function*. The timer can be reset from the Drive composer PC tool, or from the control panel by keeping Reset depressed for over 3 seconds.	-
	0…4294967295 s	Actual present value of on-time timer 2.	-
33.21	*On-time 2 warn limit*	Sets the warning limit for on-time timer 2.	0 s
	0…4294967295 s	Warning limit for on-time timer 2.	-

No.	Name/Value	Description	Def/ FbEq16
33.22	*On-time 2 function*	Configures on-time timer 2.	0000b

Bit	Function
0	Counter mode 0 = Loop: When the limit is reached, the counter is reset. The counter status (bit 1 of *33.01*) switches to 1 for one second. The warning (if enabled) stays active for at least 10 seconds. 1 = Saturate: When the limit is reached, the counter status (bit 1 of *33.01*) switches to 1, and remains so until *33.20* is reset. The warning (if enabled) also stays active until *33.20* is reset.
1	Warning enable 0 = Disable: No warning is given when the limit is reached 1 = Enable: A warning (see *33.24*) is given when the limit is reached
2…15	Reserved

No.	Name/Value	Description	Def/ FbEq16
	0000b…0011b	On-time timer 2 configuration word.	1 = 1
33.23	*On-time 2 source*	Selects the signal to be monitored by on-time timer 2.	*False*
	False	Constant 0 (timer disabled).	0
	True	Constant 1.	1
	RO1	Bit 0 of *10.21 RO status* (page *131*).	2
	Other [bit]	Source selection (see *Terms and abbreviations* on page *101*).	-
33.24	*On-time 2 warn message*	Selects the optional warning message for on-time timer 2.	*On-time 2 exceeded*
	On-time 2 exceeded	*A887 On-time 2*. The message text can be edited on the control panel by choosing Menu – Settings – Edit texts.	1
	Clean device	*A88C Device clean*.	6
	Maintain additional cool fan	*A890 Additional cooling*.	7
	Maintain cabinet fan	*A88E Cabinet fan*.	8
	Maintain DC capacitors	*A88D DC capacitor*.	9
	Maintain motor bearing	*A880 Motor bearing*.	10
33.30	*Edge counter 1 actual*	Actual present value of signal edge counter 1. The counter is incremented every time the signal selected by parameter *33.33 Edge counter 1 source* switches on or off (or either, depending on the setting of *33.32 Edge counter 1 function*). A divisor may be applied to the count (see *33.34 Edge counter 1 divider*). When the counter exceeds the limit set by *33.31 Edge counter 1 warn limit*, bit 2 of *33.01 Counter status* is set to 1. The warning specified by *33.35 Edge counter 1 warn message* is also given if enabled by *33.32 Edge counter 1 function*. The counter can be reset from the Drive composer PC tool, or from the control panel by keeping Reset depressed for over 3 seconds.	-
	0…4294967295	Actual present value of signal edge counter 1.	-

No.	Name/Value	Description	Def/ FbEq16
33.31	*Edge counter 1 warn limit*	Sets the warning limit for signal edge counter 1.	0
	0…4294967295	Warning limit for signal edge counter 1.	-
33.32	*Edge counter 1 function*	Configures signal edge counter 1.	0000b

Bit	Function
0	Counter mode 0 = Loop: When the limit is reached, the counter is reset. The counter status (bit 2 of *33.01*) switches to 1 and remains so until the counter is again incremented. The warning (if enabled) stays active for at least 10 seconds. 1 = Saturate: When the limit is reached, the counter status (bit 2 of *33.01*) switches to 1, and remains so until *33.30* is reset. The warning (if enabled) also stays active until *33.30* is reset.
1	Warning enable 0 = Disable: No warning is given when the limit is reached 1 = Enable: A warning (see *33.35*) is given when the limit is reached
2	Count rising edges 0 = Disable: Rising edges are not counted 1 = Enable: Rising edges are counted
3	Count falling edges 0 = Disable: Falling edges are not counted 1 = Enable: Falling edges are counted
4…15	Reserved

No.	Name/Value	Description	Def/ FbEq16
	0000b…1111b	Edge counter 1 configuration word.	1 = 1
33.33	*Edge counter 1 source*	Selects the signal to be monitored by signal edge counter 1.	*False*
	False	Constant 0.	0
	True	Constant 1.	1
	RO1	Bit 0 of *10.21 RO status* (page *131*).	2
	Other [bit]	Source selection (see *Terms and abbreviations* on page *101*).	-
33.34	*Edge counter 1 divider*	Defines a divisor for signal edge counter 1. Determines how many signal edges increment the counter by 1.	1
	1…4294967295	Divisor for signal edge counter 1.	-
33.35	*Edge counter 1 warn message*	Selects the optional warning message for signal edge counter 1.	*Edge counter 1 exceeded*
	Edge counter 1 exceeded	*A888 Edge counter 1*. The message text can be edited on the control panel by choosing Menu – Settings – Edit texts.	2
	Counted main contactor	*A884 Main contactor*.	11
	Counted output relay	*A881 Output relay*.	12
	Counted motor starts	*A882 Motor starts*.	13
	Counted power ups	*A883 Power ups*.	14
	Counted DC charges	*A885 DC charge*.	15

No.	Name/Value	Description	Def/ FbEq16
33.40	*Edge counter 2 actual*	Displays the actual present value of signal edge counter 2. The counter is incremented every time the signal selected by parameter *33.43 Edge counter 2 source* switches on or off (or either, depending on the setting of *33.42 Edge counter 2 function*). A divisor may be applied to the count (see *33.44 Edge counter 2 divider*). When the counter exceeds the limit set by *33.41 Edge counter 2 warn limit*, bit 3 of *33.01 Counter status* is set to 1. The warning specified by *33.45 Edge counter 2 warn message* is also given if enabled by *33.42 Edge counter 2 function*. The counter can be reset from the Drive composer PC tool, or from the control panel by keeping Reset depressed for over 3 seconds.	-
	0…4294967295	Actual present value of signal edge counter 2.	-
33.41	*Edge counter 2 warn limit*	Sets the warning limit for signal edge counter 2.	0
	0…4294967295	Warning limit for signal edge counter 2.	-
33.42	*Edge counter 2 function*	Configures signal edge counter 2.	0000b

Bit	Function
0	Counter mode 0 = Loop: When the limit is reached, the counter is reset. The counter status (bit 3 of *33.01*) remains 1 until the counter is again incremented. The warning (if enabled) stays active for at least 10 seconds. 1 = Saturate: After the limit is reached, the counter status (bit 3 of *33.01*) remains 1 until *33.40* is reset. The warning (if enabled) also stays active until *33.40* is reset.
1	Warning enable 0 = Disable: No warning is given when the limit is reached 1 = Enable: A warning (see *33.45*) is given when the limit is reached
2	Count rising edges 0 = Disable: Rising edges are not counted 1 = Enable: Rising edges are counted
3	Count falling edges 0 = Disable: Falling edges are not counted 1 = Enable: Falling edges are counted
4…15	Reserved

No.	Name/Value	Description	Def/ FbEq16
	0000b…1111b	Edge counter 2 configuration word.	1 = 1
33.43	*Edge counter 2 source*	Selects the signal to be monitored by signal edge counter 2.	*False*
	False	0.	0
	True	1.	1
	RO1	Bit 0 of *10.21 RO status* (page *131*).	2
	Other [bit]	Source selection (see *Terms and abbreviations* on page *101*).	-
33.44	*Edge counter 2 divider*	Defines a divisor for signal edge counter 2. Determines how many signal edges increment the counter by 1.	1
	1…4294967295	Divisor for signal edge counter 2.	-

No.	Name/Value	Description	Def/ FbEq16
33.45	*Edge counter 2 warn message*	Selects the optional warning message for signal edge counter 2.	*Edge counter 2 exceeded*
	Edge counter 2 exceeded	*A889 Edge counter 2*. The message text can be edited on the control panel by choosing Menu – Settings – Edit texts.	3
	Counted main contactor	*A884 Main contactor*.	11
	Counted output relay	*A881 Output relay*.	12
	Counted motor starts	*A882 Motor starts*.	13
	Counted power ups	*A883 Power ups*.	14
	Counted DC charges	*A885 DC charge*.	15
33.50	*Value counter 1 actual*	Displays the actual present value of value counter 1. The value of the source selected by parameter *33.53 Value counter 1 source* is read at one-second intervals and added to the counter. A divisor can be applied to the count (see *33.54 Value counter 1 divider*). When the counter exceeds the limit set by *33.51 Value counter 1 warn limit*, bit 4 of *33.01 Counter status* is set to 1. The warning specified by *33.55 Value counter 1 warn message* is also given if enabled by *33.52 Value counter 1 function*. The counter can be reset from the Drive composer PC tool, or from the control panel by keeping Reset depressed for over 3 seconds.	-
	-2147483008 …2147483008	Actual present value of value counter 1.	-
33.51	*Value counter 1 warn limit*	Sets the limit for value counter 1. With a positive limit, bit 4 of *33.01 Counter status* is set to 1 (and a warning optionally generated) when the counter is equal or greater than the limit. With a negative limit, bit 4 of *33.01 Counter status* is set to 1 (and a warning optionally generated) when the counter is equal or smaller than the limit. 0 = Counter disabled.	0
	-2147483008 …2147483008	Limit for value counter 1.	-

No.	Name/Value	Description	Def/ FbEq16
33.52	*Value counter 1 function*	Configures value counter 1.	0000b

Bit	Function
0	Counter mode 0 = Loop: When the limit is reached, the counter is reset. The counter status (bit 4 of *33.01*) switches to 1 for one second. The warning (if enabled) stays active for at least 10 seconds. 1 = Saturate: When the limit is reached, the counter status (bit 4 of *33.01*) switches to 1, and remains so until *33.50* is reset. The warning (if enabled) also stays active until *33.50* is reset.
1	Warning enable 0 = Disable: No warning is given when the limit is reached 1 = Enable: A warning (see *33.55*) is given when the limit is reached
2…15	Reserved

No.	Name/Value	Description	Def/ FbEq16
	0000b…0011b	Value counter 1 configuration word.	1 = 1
33.53	*Value counter 1 source*	Selects the signal to be monitored by value counter 1.	*Not selected*
	Not selected	None (counter disabled).	0
	Motor speed	*01.01 Motor speed used* (see page *105*).	1
	Other	Source selection (see *Terms and abbreviations* on page *101*).	-
33.54	*Value counter 1 divider*	Defines a divisor for value counter 1. The value of the monitored signal is divided by this value before integration.	1.000
	0.001…2147483.000	Divisor for value counter 1.	-
33.55	*Value counter 1 warn message*	Selects the optional warning message for value counter 1.	*Value counter 1 exceeded*
	Value counter 1 exceeded	*A88A Value counter 1*. The message text can be edited on the control panel by choosing Menu – Settings – Edit texts.	4
	Maintain motor bearing	*A880 Motor bearing*.	10
33.60	*Value counter 2 actual*	Displays the actual present value of value counter 2. The value of the source selected by parameter *33.63 Value counter 2 source* is read at one-second intervals and added to the counter. A divisor can be applied to the count (see *33.64 Value counter 2 divider*). When the counter exceeds the limit set by *33.61 Value counter 2 warn limit*, bit 5 of *33.01 Counter status* is set to 1. The warning specified by *33.65 Value counter 2 warn message* is also given if enabled by *33.62 Value counter 2 function*. The counter can be reset from the Drive composer PC tool, or from the control panel by keeping Reset depressed for over 3 seconds.	-
	-2147483008 …2147483008	Actual present value of value counter 2.	-

<table>
<tr><th>No.</th><th>Name/Value</th><th>Description</th><th>Def/
FbEq16</th></tr>
<tr><td>33.61</td><td>Value counter 2 warn limit</td><td>Sets the limit for value counter 2.
With a positive limit, bit 5 of 33.01 Counter status is set to 1 (and a warning optionally generated) when the counter is equal or greater than the limit.
With a negative limit, bit 5 of 33.01 Counter status is set to 1 (and a warning optionally generated) when the counter is equal or smaller than the limit.
0 = Counter disabled.</td><td>0</td></tr>
<tr><td></td><td>-2147483008 …2147483008</td><td>Limit for value counter 2.</td><td>-</td></tr>
<tr><td>33.62</td><td>Value counter 2 function</td><td>Configures value counter 2.</td><td>0000b</td></tr>
<tr><td></td><td colspan="3">
<table>
<tr><th>Bit</th><th>Function</th></tr>
<tr><td>0</td><td>Counter mode
0 = Loop: When the limit is reached, the counter is reset. The counter status (bit 5 of 33.01) switches to 1 for one second. The warning (if enabled) stays active for at least 10 seconds.
1 = Saturate: When the limit is reached, the counter status (bit 5 of 33.01) switches to 1, and remains so until 33.60 is reset. The warning (if enabled) also stays active until 33.60 is reset.</td></tr>
<tr><td>1</td><td>Warning enable
0 = Disable: No warning is given when the limit is reached
1 = Enable: A warning (see 33.65) is given when the limit is reached</td></tr>
<tr><td>2…15</td><td>Reserved</td></tr>
</table>
</td></tr>
<tr><td></td><td>0000b…0011b</td><td>Value counter 2 configuration word.</td><td>1 = 1</td></tr>
<tr><td>33.63</td><td>Value counter 2 source</td><td>Selects the signal to be monitored by value counter 2.</td><td>Not selected</td></tr>
<tr><td></td><td>Not selected</td><td>None (counter disabled).</td><td>0</td></tr>
<tr><td></td><td>Motor speed</td><td>01.01 Motor speed used (see page 105).</td><td>1</td></tr>
<tr><td></td><td>Other</td><td>Source selection (see Terms and abbreviations on page 101).</td><td>-</td></tr>
<tr><td>33.64</td><td>Value counter 2 divider</td><td>Defines a divisor for value counter 2. The value of the monitored signal is divided by this value before integration.</td><td>1.000</td></tr>
<tr><td></td><td>0.001…2147483.000</td><td>Divisor for value counter 2.</td><td>-</td></tr>
<tr><td>33.65</td><td>Value counter 2 warn message</td><td>Selects the optional warning message for value counter 2.</td><td>Value counter 2 exceeded</td></tr>
<tr><td></td><td>Value counter 2 exceeded</td><td>A88B Value counter 2. The message text can be edited on the control panel by choosing Menu – Settings – Edit texts.</td><td>5</td></tr>
<tr><td></td><td>Maintain motor bearing</td><td>A880 Motor bearing.</td><td>10</td></tr>
</table>

No.	Name/Value	Description	Def/ FbEq16
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 83).	
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 °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 unit is ohms. This parameter is read-only.	-
	-60…1000 °C, -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 unit is ohms. This parameter is read-only.	-
	-60…1000 °C, -76…9032 °F, 0 ohm or [*35.22*] ohm	Measured temperature 2.	1 = 1 unit
35.04	*FEX-01/FPTC-01 status word*	Displays the status of optional FEX-01/FPTC-01 modules. The word can be used as the source of eg. external events. The modules are activated by parameter *35.30 FEX-01/FPTC-01 configuration word*. This parameter is read-only.	-

Bit	Name	Description
0	Module found in slot 1	1 = Yes: An FEX-01/FPTC-01 module has been detected in slot 1.
1	Fault active in slot 1	1 = Yes: The module in slot 1 has an active fault.
2	Warning active in slot 1	1 = Yes: The module in slot 1 has an active warning.
3	Module found in slot 2	1 = Yes: An FEX-01/FPTC-01 module has been detected in slot 2.
4	Fault active in slot 2	1 = Yes: The module in slot 2 has an active fault.
5	Warning active in slot 2	1 = Yes: The module in slot 2 has an active warning.
6	Module found in slot 3	1 = Yes: An FEX-01/FPTC-01 module has been detected in slot 3.
7	Fault active in slot 3	1 = Yes: The module in slot 3 has an active fault.
8	Warning active in slot 3	1 = Yes: The module in slot 3 has an active warning.
9…15	Reserved	

No.	Name/Value	Description	Def/ FbEq16
	0000h…FFFFh	FEX-01/FPTC-01 status word.	1 = 1

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.	*Disabled*
	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
	KTY84 analog I/O	KTY84 sensor connected to the analog input selected by parameter *35.14 Temperature 1 AI source* and an analog output. The analog input can be from the standard I/O or from an extension module. 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 unit selection parameter of the input to volt. • Set the source selection parameter of the analog output to "*Force KTY84 excitation*". • Select the analog input in parameter *35.14*. In case the input is located on an I/O extension module, use the selection *Other* to point at the actual input value parameter (for example, *14.26 AI1 actual value*). The analog output feeds a constant current through the sensor. As the resistance of the sensor changes along with its temperature, the voltage over the sensor changes. The voltage is read by the analog input and converted into degrees.	2
	KTY84 encoder module 1	KTY84 sensor connected to encoder interface 1. See also parameters *91.21 Module 1 temp sensor type* and *91.22 Module 1 temp filter time*.	3
	KTY84 encoder module 2	KTY84 sensor connected to encoder interface 2. See also parameters *91.24 Module 2 temp sensor type* and *91.25 Module 2 temp filter time*.	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 input and output can be on the drive control unit or on an extension module. The required settings are the same as with selection *KTY84 analog I/O*, except that the source selection parameter of the analog output must be set to *Force Pt100 excitation*.	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

No.	Name/Value	Description	Def/ FbEq16
	PTC DI6	PTC sensor connected to digital input DI6 (see the connection diagram on page 84). Note: Either 0 ohm (normal temperature) or the value of parameter 35.02 Measured temperature 1 (excessive temperature) is shown.	8
	PTC analog I/O	PTC sensor connected to a standard analog input selected by parameter 35.14 Temperature 1 AI source and an analog output. The input and output can be on the drive control unit or on an extension module. The required settings are the same as with selection KTY84 analog I/O, except that the source selection parameter of the analog output must be set to Force PTC excitation. **Note:** Either 0 ohm (normal temperature) or 4000 ohm (excessive temperature) will be shown by 35.02 Measured temperature 1.	20
	PTC encoder module 1	PTC sensor connected to encoder interface 1. See also parameters 91.21 Module 1 temp sensor type and 91.22 Module 1 temp filter time.	9
	PTC encoder module 2	PTC sensor connected to encoder interface 2. See also parameters 91.24 Module 2 temp sensor type and 91.25 Module 2 temp filter time.	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 in the unit of temperature specified by 96.16 Unit selection.	11
	1 × Pt1000 analog I/O	Pt1000 sensor connected to a standard analog input selected by parameter 35.14 Temperature 1 AI source and an analog output. The input and output can be on the drive control unit or on an extension module. The required settings are the same as with selection KTY84 analog I/O, except that the source selection parameter of the analog output must be set to Force Pt1000 excitation.	13
	2 × Pt1000 analog I/O	As selection 1 × Pt1000 analog I/O, but with two sensors connected in series. Using multiple sensors improves measurement accuracy significantly.	14
	3 × Pt1000 analog I/O	As selection 1 × Pt1000 analog I/O, but with three sensors connected in series. Using multiple sensors improves measurement accuracy significantly.	15
35.12	Temperature 1 fault limit	Defines the fault limit for temperature monitoring function 1. When measured temperature 1 exceeds the limit, the drive trips on fault 4981 External temperature. The unit is selected by parameter 96.16 Unit selection. Note: With a PTC sensor, the unit is ohms.	130 °C or 266 °F
	-60…5000 °C or ohm, or -76…1832 °F	Fault limit for temperature monitoring function 1.	1 = 1 unit

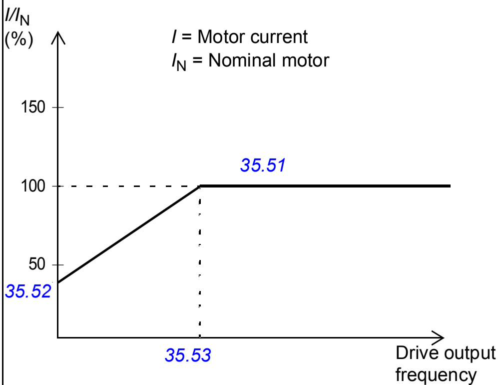
No.	Name/Value	Description	Def/ FbEq16
35.13	*Temperature 1 warning limit*	Defines the warning limit for temperature monitoring function 1. When measured temperature 1 exceeds this limit, a warning (*A491 External temperature*) is generated. The unit is selected by parameter *96.16 Unit selection*. Note: With a PTC sensor, the unit is ohms.	110 °C or 230 °F
	-60…5000 °C or ohm, or -76…9032 °F	Warning limit for temperature monitoring function 1.	1 = 1 unit
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. **Note:** If the input is located on an I/O extension module, use the selection *Other* to point to the AI actual value in group 14, 15 or 16, eg. *14.26 AI1 actual value*.	*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 *101*).	-
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
	KTY84 analog I/O	KTY84 sensor connected to the analog input selected by parameter *35.24 Temperature 2 AI source* and an analog output. The input and output can be on the drive control unit or on an extension module. 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 unit selection parameter of the input to volt. • Set the source selection parameter of the analog output to "*Force KTY84 excitation*". • Select the analog input in parameter *35.24*. In case the input is located on an I/O extension module, use the selection *Other* to point at the actual input value parameter (for example, *14.26 AI1 actual value*). The analog output feeds a constant current through the sensor. As the resistance of the sensor changes along with its temperature, the voltage over the sensor changes. The voltage is read by the analog input and converted into degrees.	2

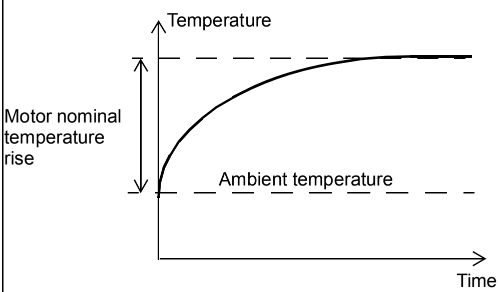
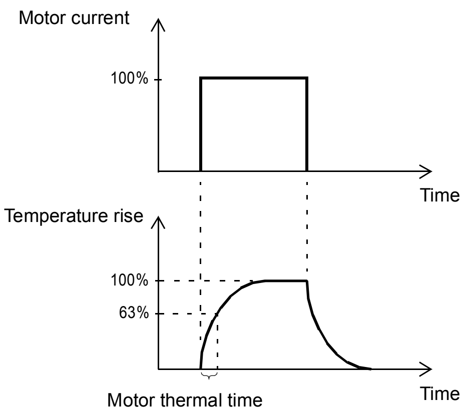
No.	Name/Value	Description	Def/ FbEq16
	KTY84 encoder module 1	KTY84 sensor connected to encoder interface 1. See also parameters *91.21 Module 1 temp sensor type* and *91.22 Module 1 temp filter time*.	3
	KTY84 encoder module 2	KTY84 sensor connected to encoder interface 2. See also parameters *91.24 Module 2 temp sensor type* and *91.25 Module 2 temp filter time*.	4
	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 input and output can be on the drive control unit or on an extension module. The required settings are the same as with selection *KTY84 analog I/O*, except that the source selection parameter of the analog output must be set to *Force Pt100 excitation*.	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 connected to digital input DI6 (see the connection diagram on page *84*). Note: Either 0 ohm (normal temperature) or the value of parameter *35.03 Measured temperature 2* (excessive temperature) is shown.	8
	PTC analog I/O	PTC sensor connected to a standard analog input selected by parameter *35.24 Temperature 2 AI source* and an analog output. The input and output can be on the drive control unit or on an extension module. The required settings are the same as with selection *KTY84 analog I/O*, except that the source selection parameter of the analog output must be set to *Force PTC excitation*. **Note:** Either 0 ohm (normal temperature) or 4000 ohm (excessive temperature) will be shown by *35.03 Measured temperature 2*.	20
	PTC encoder module 1	PTC sensor connected to encoder interface 1. See also parameters *91.21 Module 1 temp sensor type* and *91.22 Module 1 temp filter time*.	9
	PTC encoder module 2	PTC sensor connected to encoder interface 2. See also parameters *91.24 Module 2 temp sensor type* and *91.25 Module 2 temp filter time*.	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 in the unit of temperature specified by *96.16 Unit selection*.	11
	1 × Pt1000 analog I/O	Pt1000 sensor connected to a standard analog input selected by parameter *35.24 Temperature 2 AI source* and an analog output. The input and output can be on the drive control unit or on an extension module. The required settings are the same as with selection *KTY84 analog I/O*, except that the source selection parameter of the analog output must be set to *Force Pt1000 excitation*.	13

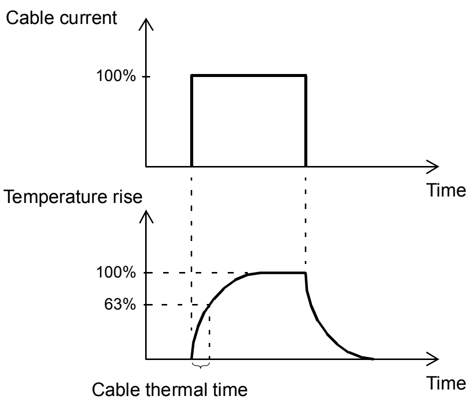
No.	Name/Value	Description	Def/ FbEq16
	2 × Pt1000 analog I/O	As selection *1 × Pt1000 analog I/O*, but with two sensors connected in series. Using multiple sensors improves measurement accuracy significantly.	14
	3 × Pt1000 analog I/O	As selection *1 × Pt1000 analog I/O*, but with three sensors connected in series. Using multiple sensors improves measurement accuracy significantly.	15
35.22	*Temperature 2 fault limit*	Defines the fault limit for temperature monitoring function 2. When measured temperature 2 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, the unit is ohms.	130 °C or 266 °F
	-60…5000 °C or -76…9032 °F	Fault limit for temperature monitoring function 2.	1 = 1 unit
35.23	*Temperature 2 warning limit*	Defines the warning limit for temperature monitoring function 2. When measured temperature 2 exceeds the limit, a warning (*A492 External temperature 2*) is generated. The unit is selected by parameter *96.16 Unit selection*. Note: With a PTC sensor, the unit is ohms.	110 °C or 230 °F
	-60…5000 °C or -76…9032 °F	Warning limit for temperature monitoring function 2.	1 = 1 unit
35.24	*Temperature 2 AI source*	Selects the input for parameter *35.21 Temperature 2 source*, selections *KTY84 analog I/O*, *1 × Pt100 analog I/O*, *2 × Pt100 analog I/O*, *3 × Pt100 analog I/O* and *Direct temperature*.	*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 *101*).	-
35.30	*FEX-01/FPTC-01 configuration word*	Activates FEX-01/FPTC-01 temperature monitoring modules installed on the control unit of the drive. Using this word, it is also possible to suppress the warnings (but not faults) from each module.	0000 0000b

Bit	Name	Description
0	Module in slot 1	1 = Yes: Module installed in slot 1.
1	Disable slot 1 warning	1 = Yes: Warnings from the module in slot 1 suppressed.
2	Module in slot 1	1 = Yes: Module installed in slot 2.
3	Disable slot 1 warning	1 = Yes: Warnings from the module in slot 2 suppressed.
4	Module in slot 1	1 = Yes: Module installed in slot 3.
5	Disable slot 1 warning	1 = Yes: Warnings from the module in slot 3 suppressed.
6…15	Reserved	

	0000 0000b … 0011 1111b	FEX-01/FPTC-01 module configuration word.	1 = 1

No.	Name/Value	Description	Def/ FbEq16
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 -75…212 °F	Ambient temperature.	1 = 1°
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*. 	100%
	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%

No.	Name/Value	Description	Def/ FbEq16
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 i.e. 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*
35.54	*Motor nominal temperature rise*	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*. 	80 °C or 176 °F
	0…300 °C or 32…572 °F	Temperature rise.	1 = 1°
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. 	256 s
	100…10000 s	Motor thermal time constant.	1 = 1 s

No.	Name/Value	Description	Def/ FbEq16
35.60	*Cable temperature*	Shows the calculated temperature of the motor cable. See section *Thermal protection of motor cable* (page *86*). 102% = overtemperature warning (*A480 Motor cable overload*) 106% = overtemperature fault (*4000 Motor cable overload*) This parameter is read-only.	0.0%
	0.0…200.0%	Calculated temperature of motor cable.	1 = 1%
35.61	*Cable nominal current*	Specifies the continuous current of the motor cable for the thermal protection function in the control program. WARNING! The value entered in this parameter must be limited according to all factors affecting the loadability of the cable, such as ambient temperature, cabling arrangement, and shrouding. Refer to the technical data from the cable manufacturer.	10000.00 A
	0.00…10000.00 A	Continuous current-carrying capacity of motor cable.	1 = 1 A
35.62	*Cable thermal rise time*	Specifies the thermal time of the motor cable for the thermal protection function in the control program. This value is defined as the time to reach 63% of the nominal cable temperature when the cable is loaded with nominal current (parameter *35.61 Cable nominal current*). 0 s = Thermal protection of motor cable disabled Refer to the technical data from the cable manufacturer.  	1 s
	0 s	Thermal protection of motor cable disabled.	1 = 1 s
	0…50000 s	Motor cable thermal time constant.	1 = 1 s

No.	Name/Value	Description	Def/ FbEq16
35.100	*DOL starter control source*	Parameters *35.100*…*35.106* configure a monitored start/stop control logic for external equipment such as a contactor-controlled motor cooling fan. This parameter selects the signal that starts and stops the fan. 0 = Stop 1 = Start The output controlling the fan contactor is to be connected to parameter *35.105*, bit 1. On and off delays can be set for the fan by *35.101* and *35.102* respectively. A feedback signal from the fan can be connected to an input selected by *35.103*; the loss of the feedback will optionally trigger a warning or fault (see *35.104* and *35.106*).	*Off*; *06.16* b6 (*95.20* b6)
	Off	0 (function disabled).	0
	On	1.	1
	Running	Bit 6 of *06.16 Drive status word 1* (see page *117*).	2
	Other [bit]	Source selection (see *Terms and abbreviations* on page *101*).	-
35.101	*DOL starter on delay*	Defines a start delay for the motor fan. The delay timer starts when the control source selected by parameter *35.100* switches on. After the delay, bit 1 of *35.105* switches on.	0 s
	0…42949673 s	Motor fan start delay.	1 = 1 s
35.102	*DOL starter off delay*	Defines a stop delay for the motor fan. The delay timer starts when the control source selected by parameter *35.100* switches off. After the delay, bit 1 of *35.105* switches off.	20 min
	0…715828 min	Motor fan stop delay.	1 = 1 min
35.103	*DOL starter feedback source*	Selects the input for motor fan feedback signal. 0 = Stopped 1 = Running After the fan is started (bit 1 of *35.105* switches on), feedback is expected within the time set by *35.104*.	*Not selected*; *DI5* (*95.20* b6)
	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
	DIO1	Digital input/output DIO1 (*11.02 DIO delayed status*, bit 0).	10
	DIO2	Digital input/output DIO2 (*11.02 DIO delayed status*, bit 1).	11
	Other [bit]	Source selection (see *Terms and abbreviations* on page *101*).	-

No.	Name/Value	Description	Def/ FbEq16
35.104	*DOL starter feedback delay*	Defines a feedback delay for the motor fan. The delay timer starts when bit 1 of *35.105* switches on. If no feedback is received from the fan until the delay elapses, the action selected by *35.106* is taken. **Note:** This delay is only applied at start. If the feedback signal is lost during run, the action selected by *35.106* is taken immediately.	0 s; 5s (*95.20* b6)
	0…42949673 s	Motor fan start delay.	1 = 1 s
35.105	*DOL starter status word*	Status of the motor fan control logic. Bit 1 is the control output for the fan, to be selected as the source of, for example, a digital or relay output. The other bits indicate the statuses of the selected control and feedback sources, and the fault status. This parameter is read-only.	-

Bit	Name	Description
0	Start command	Status of fan control source selected by *35.100*. 0 = Stop requested 1 = Start requested
1	Delayed start command	Fan control bit (delays observed). Select this bit as the source of the output controlling the fan. 0 = Stopped 1 = Started
2	DOL feedback	Status of fan feedback (source selected by *35.103*). 0 = Stopped 1 = Running
3	DOL fault (-1)	Fault status. 0 = Fault (fan feedback missing). The action taken is selected by *35.106*. 1 = No fault
4…15	Reserved	

No.	Name/Value	Description	Def/ FbEq16
	0000b…1111b	Status of motor fan control logic.	1 = 1
35.106	*DOL starter event type*	Selects the action taken when missing fan feedback is detected by the motor fan control logic.	*Fault*
	No action	No action taken.	0
	Warning	The drive generates a warning (*A781 Motor fan*).	1
	Fault	Drive trips on *71B1 Motor fan*.	2
36 Load analyzer		Peak value and amplitude logger settings. See also section *Load analyzer* (page *90*).	
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 date and time of the last reset are stored into parameters *36.16* and *36.17* respectively.	*Power inu out*
	Zero	None (peak value logger disabled).	0

No.	Name/Value	Description	Def/ FbEq16
	Motor speed used	*01.01 Motor speed used* (page *105*).	1
	Output frequency	*01.06 Output frequency* (page *105*).	3
	Motor current	*01.07 Motor current* (page *105*).	4
	Motor torque	*01.10 Motor torque* (page *105*).	6
	DC voltage	*01.11 DC voltage* (page *105*).	7
	Power inu out	*01.14 Output power* (page *106*).	8
	Speed ref ramp in	*23.01 Speed ref ramp input* (page *203*).	10
	Speed ref ramped	*23.02 Speed ref ramp output* (page *204*).	11
	Speed ref used	*24.01 Used speed reference* (page *210*).	12
	Torq ref used	26.02 Torque reference used	13
	Freq ref used	*28.02 Frequency ref ramp output* (page *226*).	14
	Other	Source selection (see *Terms and abbreviations* on page *101*).	-
36.02	*PVL filter time*	Defines a filtering time for the peak value logger. 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 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*	Displays the peak value recorded by the peak value logger.	0.00
	-32768.00…32767.00	Peak value.	1 = 1
36.11	*PVL peak date*	Displays the date on which the peak value was recorded.	-
	-	Peak occurrence date.	-
36.12	*PVL peak time*	Displays the time at which the peak value was recorded.	-
	-	Peak occurrence time.	-

No.	Name/Value	Description	Def/ FbEq16
36.13	PVL current at peak	Displays the 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
36.14	PVL DC voltage at peak	Displays the 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	Displays the motor speed at the moment the peak value was recorded.	0.00 rpm
	-32768.00 …32767.00 rpm	Motor speed at peak.	See par. 46.01
36.16	PVL reset date	Displays the date on which the peak value logger was last reset.	-
	-	Last reset date of the peak value logger.	-
36.17	PVL reset time	Displays the time at which the peak value logger was last reset.	-
	-	Last reset time of the peak value logger.	-
36.20	AL1 0 to 10%	Displays the percentage of samples recorded by amplitude logger 1 that fall between 0 and 10%.	0.00%
	0.00…100.00%	Amplitude logger 1 samples between 0 and 10%.	1 = 1%
36.21	AL1 10 to 20%	Displays the 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%	Displays the 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%	Displays the 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%	Displays the 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%	Displays the 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%	Displays the 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%	Displays the 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%	Displays the 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%

No.	Name/Value	Description	Def/ FbEq16
36.29	*AL1 over 90%*	Displays the 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%*	Displays the 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%
36.41	*AL2 10 to 20%*	Displays the 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%*	Displays the 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%*	Displays the 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%*	Displays the 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%*	Displays the 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%*	Displays the 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%*	Displays the 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%*	Displays the 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%*	Displays the 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*	Displays the date on which amplitude logger 2 was last reset.	-
	-	Last reset date of amplitude logger 2.	-
36.51	*AL2 reset time*	Displays the time at which amplitude logger 2 was last reset.	-
	-	Last reset time of amplitude logger 2.	-

No.	Name/Value	Description	Def/ FbEq16
43	**Brake chopper**	Settings for the internal brake chopper.	
43.01	Braking resistor temperature	Displays the estimated temperature of the brake resistor, or how close the brake resistor is to being too hot. The value is given in percent where 100% is the temperature the resistor would reach if the maximum continuous braking power (43.09 Brake resistor Pmax cont) is applied to the resistor for 100% rated time. The thermal time constant (43.08 Brake resistor thermal tc) defines the rated time to achieve 63% temperature. 100% would be reached when 100% time has elapsed. This parameter is read-only.	-
	0.0…120.0%	Estimated brake resistor temperature.	1 = 1%
43.06	Brake chopper enable	Enables brake chopper control. Note: Before enabling brake chopper control, ensure that • a brake resistor is connected, and • the supply voltage range (parameter 95.01 Supply voltage) has been selected correctly.	Disabled
	Disabled	Brake chopper control disabled.	0
	Enabled with thermal model	Brake chopper control enabled with resistor overload protection. Note: Before using this setting, ensure that overvoltage control is switched off (parameter 30.30 Overvoltage control).	1
	Enabled without thermal model	Brake chopper control enabled without resistor overload protection. This setting can be used, for example, if the resistor is equipped with a thermal circuit breaker that is wired to stop the drive if the resistor overheats. Before using this setting, ensure that overvoltage control is switched off (parameter 30.30 Overvoltage control)	2
	Overvoltage peak protection	Brake chopper control enabled in an overvoltage condition. This setting is intended for situations where • the braking chopper is not needed for runtime operation, ie. to dissipate the inertial energy of the motor, • the motor is able to store a considerable amount of magnetic energy in its windings, and • the motor might, deliberately or inadvertently, be stopped by coasting. In such a situation, the motor would potentially discharge enough magnetic energy towards the drive to cause damage. To protect the drive, the brake chopper can be used with a small resistor dimensioned merely to handle the magnetic energy (not the inertial energy) of the motor. With this setting, the brake chopper is activated only whenever the DC voltage exceeds the overvoltage limit. During normal use, the brake chopper is not operating.	3

No.	Name/Value	Description	Def/ FbEq16
43.07	*Brake chopper runtime enable*	Selects the source for quick brake chopper on/off control. 0 = Brake chopper IGBT pulses are cut off 1 = Normal brake chopper IGBT modulation. This parameter can be used to program the chopper control to function only when the supply is missing from a drive with a regenerative supply unit.	*On*
	Off	0.	0
	On	1.	1
	Other [bit]	Source selection (see *Terms and abbreviations* on page *101*).	-
43.08	*Brake resistor thermal tc*	Defines the thermal time constant of the brake resistor for overload protection.	0 s
	0…10000 s	Brake resistor thermal time constant.	1 = 1 s
43.09	*Brake resistor Pmax cont*	Defines the maximum continuous braking power of the resistor (in kW) which will raise the resistor temperature to the maximum allowed value. The value is used in the overload protection.	0.00 kW
	0.00…10000.00 kW	Maximum continuous braking power.	1 = 1 kW
43.10	*Brake resistance*	Defines the resistance value of the brake resistor. The value is used for brake chopper protection.	0.0 ohm
	0.0…1000.0 ohm	Brake resistor resistance value.	1 = 1 ohm
43.11	*Brake resistor fault limit*	Selects the fault limit for the brake resistor temperature protection function. When the limit is exceeded, the drive trips on fault *7183 BR excess temperature*. The value is given in percent of the temperature the resistor reaches when loaded with the power defined by parameter *43.09 Brake resistor Pmax cont*.	105%
	0…150%	Brake resistor temperature fault limit.	1 = 1%
43.12	*Brake resistor warning limit*	Selects the warning limit for the brake resistor temperature protection function. When the limit is exceeded, the drive generates a *A793 BR excess temperature* warning. The value is given in percent of the temperature the resistor reaches when loaded with the power defined by parameter *43.09 Brake resistor Pmax cont*.	95%
	0…150%	Brake resistor temperature warning limit.	1 = 1%

45 Energy efficiency		Settings for the energy saving calculators. See also section *Energy savings calculator* (page *90*).	
45.01	*Saved GW hours*	Displays the 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*	Displays the 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*	Displays the 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
45.05	*Saved money x1000*	Displays the monetary savings in thousands compared to direct-on-line motor connection. This parameter is incremented when *45.06 Saved money* rolls over. The currency is defined by parameter *45.17 Tariff currency unit*. This parameter is read-only (see parameter *45.21 Energy calculations reset*).	-
	0…4294967295 thousands	Monetary savings in thousands of units.	-
45.06	*Saved money*	Displays the 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. The currency is defined by parameter *45.17 Tariff currency unit*. This parameter is read-only (see parameter *45.21 Energy calculations reset*).	-
	0.00…999.99 units	Monetary savings.	1 = 1 unit
45.08	*CO2 reduction in kilotons*	Displays the 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

No.	Name/Value	Description	Def/ FbEq16
45.09	*CO2 reduction in tons*	Displays the 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
45.11	*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 or a synchronous reluctance motor, energy optimization is always enabled regardless of this parameter.	*Disable*
	Disable	Energy optimization disabled.	0
	Enable	Energy optimization enabled.	1
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. The currency is defined by parameter *45.17 Tariff currency unit*. Note: Tariffs are read only at the instant of selection, and are not applied retroactively.	1.000 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*.	2.000 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
	DIO1	Digital input/output DIO1 (*11.02 DIO delayed status*, bit 0).	10
	DIO2	Digital input/output DIO2 (*11.02 DIO delayed status*, bit 1).	11

No.	Name/Value	Description	Def/ FbEq16
	Other [bit]	Source selection (see *Terms and abbreviations* on page *101*).	-
45.17	*Tariff currency unit*	Specifies the currency used for the savings calculations.	*EUR*
	Local currency	Local currency. The name of the currency can be edited by choosing Menu - Settings - Edit texts on the control panel.	100
	EUR	Euro.	101
	USD	US dollar.	102
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
	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.	0.0 kW
	0.0…100000.0 kW	Motor power.	See par. *46.04*
45.21	*Energy calculations reset*	Resets the savings counter parameters *45.01*…*45.09*	*Done*
	Done	Reset not requested (normal operation), or reset complete.	0
	Reset	Reset the savings counter parameters. The value reverts automatically to *Done*.	1

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 fieldbus, master/follower etc. 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 fieldbus, master/follower etc. communication.	50.00 Hz; 60.00 Hz (*95.20* b0)
	0.10…1000.00 Hz	Acceleration/deceleration terminal/initial frequency.	10 = 1 Hz

No.	Name/Value	Description	Def/ FbEq16
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. Integer-type storage parameters cannot be used as the source of other parameters. See also section *Data storage parameters* (page 92).	
47.01	*Data storage 1 real32*	Data storage parameter 1. Parameters *47.01*…*47.08* are real 32-bit numbers that can be used as source values of other parameters. Storage parameters *47.01*…*47.08* can be used as the target of received 16-bit data. The scaling and range are defined by parameters *47.31*…*47.38*.	0.000
	-2147483.000 …2147483.000	32-bit data real (floating point) number.	-
47.02	*Data storage 2 real32*	Data storage parameter 2. See also parameter *47.01 Data storage 1 real32*.	0.000
	-2147483.00 …2147483.000	32-bit data real (floating point) number.	-
47.03	*Data storage 3 real32*	Data storage parameter 3. See also parameter *47.01 Data storage 1 real32*.	0.000
	-2147483.000 …2147483.000	32-bit data real (floating point) number.	-
47.04	*Data storage 4 real32*	Data storage parameter 4. See also parameter *47.01 Data storage 1 real32*.	0.000
	-2147483.000 …2147483.000	32-bit data real (floating point) number.	-
47.05	*Data storage 5 real32*	Data storage parameter 5. See also parameter *47.01 Data storage 1 real32*.	0.000
	-2147483.000 …2147483.000	32-bit data real (floating point) number.	-
47.06	*Data storage 6 real32*	Data storage parameter 6. See also parameter *47.01 Data storage 1 real32*.	0.000
	-2147483.000 …2147483.000	32-bit data real (floating point) number.	-
47.07	*Data storage 7 real32*	Data storage parameter 7. See also parameter *47.01 Data storage 1 real32*.	0.000
	-2147483.000 …2147483.000	32-bit data real (floating point) number.	-
47.08	*Data storage 8 real32*	Data storage parameter 8. See also parameter *47.01 Data storage 1 real32*.	0.000
	-2147483.000 …2147483.000	32-bit data real (floating point) number.	-
47.11	*Data storage 1 int32*	Data storage parameter 9.	0
	-2147483648 …2147483647	32-bit integer.	-

No.	Name/Value	Description	Def/ FbEq16
47.12	*Data storage 2 int32*	Data storage parameter 10.	0
	-2147483648 …2147483647	32-bit integer.	-
47.13	*Data storage 3 int32*	Data storage parameter 11.	0
	-2147483648 …2147483647	32-bit integer.	-
47.14	*Data storage 4 int32*	Data storage parameter 12.	0
	-2147483648 …2147483647	32-bit integer.	-
47.15	*Data storage 5 int32*	Data storage parameter 13.	0
	-2147483648 …2147483647	32-bit integer.	-
47.16	*Data storage 6 int32*	Data storage parameter 14.	0
	-2147483648 …2147483647	32-bit integer.	-
47.17	*Data storage 7 int32*	Data storage parameter 15.	0
	-2147483648 …2147483647	32-bit integer.	-
47.18	*Data storage 8 int32*	Data storage parameter 16.	0
	-2147483648 …2147483647	32-bit integer.	-
47.21	*Data storage 1 int16*	Data storage parameter 17.	0
	-32768…32767	16-bit integer.	1 = 1
47.22	*Data storage 2 int16*	Data storage parameter 18.	0
	-32768…32767	16-bit integer.	1 = 1
47.23	*Data storage 3 int16*	Data storage parameter 19.	0
	-32768…32767	16-bit integer.	1 = 1
47.24	*Data storage 4 int16*	Data storage parameter 20.	0
	-32768…32767	16-bit integer.	1 = 1
47.25	*Data storage 5 int16*	Data storage parameter 21.	0
	-32768…32767	16-bit integer.	1 = 1
47.26	*Data storage 6 int16*	Data storage parameter 22.	0
	-32768...32767	16-bit integer.	1 = 1
47.27	*Data storage 7 int16*	Data storage parameter 23.	0
	-32768…32767	16-bit integer.	1 = 1
47.28	*Data storage 8 int16*	Data storage parameter 24.	0
	-32768…32767	16-bit integer.	1 = 1
47.31	*Data storage 1 real32 type*	Defines the scaling of parameter *47.01 Data storage 1 real32* to and from 16-bit integer format. This scaling is used when the data storage parameter is the target of received 16-bit data. The setting also defines the visible range of the storage parameter.	*Unscaled*
	Unscaled	Data storage only. Range: -2147483.264 … 2147473.264.	0

No.	Name/Value	Description	Def/ FbEq16
	Transparent	Scaling: 1 = 1. Range: -32768 … 32767.	1
	General	Scaling: 1 = 100. Range: -327.68 … 327.67.	2
	Torque	The scaling is defined by parameter 46.03 Torque scaling. Range: -1600.0 … 1600.0.	3
	Speed	The scaling is defined by parameter *46.01 Speed scaling*. Range: -30000.00 … 30000.00.	4
	Frequency	The scaling is defined by parameter *46.02 Frequency scaling*. Range: -500.00 … 500.00.	5
47.32	*Data storage 2 real32 type*	Defines the 16-bit scaling of parameter *47.02 Data storage 2 real32*. See parameter *47.31 Data storage 1 real32 type*.	*Unscaled*
47.33	*Data storage 3 real32 type*	Defines the 16-bit scaling of parameter *47.03 Data storage 3 real32*. See parameter *47.31 Data storage 1 real32 type*.	*Unscaled*
47.34	*Data storage 4 real32 type*	Defines the 16-bit scaling of parameter *47.04 Data storage 4 real32*. See parameter *47.31 Data storage 1 real32 type*.	*Unscaled*
47.35	*Data storage 5 real32 type*	Defines the 16-bit scaling of parameter *47.05 Data storage 5 real32*. See parameter *47.31 Data storage 1 real32 type*.	*Unscaled*
47.36	*Data storage 6 real32 type*	Defines the 16-bit scaling of parameter *47.06 Data storage 6 real32*. See parameter *47.31 Data storage 1 real32 type*.	*Unscaled*
47.37	*Data storage 7 real32 type*	Defines the 16-bit scaling of parameter *47.07 Data storage 7 real32*. See parameter *47.31 Data storage 1 real32 type*.	*Unscaled*
47.38	*Data storage 8 real32 type*	Defines the 16-bit scaling of parameter *47.08 Data storage 8 real32*. See parameter *47.31 Data storage 1 real32 type*.	*Unscaled*

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.	*230.4 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
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

No.	Name/Value	Description	Def/ FbEq16
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 Panel port communication*.	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
	Fault always	Drive trips on *7081 Panel port communication*. This occurs even though no control is expected from the panel (or PC tool).	4
	Warning	Drive generates an *A7EE Panel loss* warning. This occurs even though no control is expected from the panel (or PC tool). WARNING! Make sure that it is safe to continue operation in case of a communication break.	5
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
	Refresh	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 *461*).	
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
	Option slot 1	Communication between drive and fieldbus adapter A enabled. The adapter is in slot 1.	1
	Option slot 2	Communication between drive and fieldbus adapter A enabled. The adapter is in slot 2.	2
	Option slot 3	Communication between drive and fieldbus adapter A enabled. The adapter is in slot 3.	3
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

No.	Name/Value	Description	Def/ FbEq16
	Fault	Communication break detection active. Upon a communication break, the drive trips on a *7510 FBA A communication* fault and coasts to a stop.	1
	Last speed	Communication break detection active. Upon a communication break, the drive generates a warning (*A7C1 FBA A communication*) 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	Communication break detection active. Upon a communication break, the drive generates a warning (*A7C1 FBA A communication*) and sets the speed to the value defined by parameter *22.41 Speed ref safe* (when speed reference is being used) 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
	Fault always	Drive trips on *7510 FBA A communication*. This occurs even though no control is expected from the fieldbus.	4
	Warning	Drive generates an *A7C1 FBA A communication* warning. This occurs even though no control is expected from the fieldbus. WARNING! Make sure that it is safe to continue operation in case of a communication break.	5
50.03	*FBA A comm loss t out*	Defines the time delay before the action defined by parameter *50.02 FBA A comm loss func* is taken. Time count starts when the communication link fails to update the message. As a rule of thumb, this parameter should be set to at least 3 times the transmit interval of the master.	0.3 s
	0.3…6553.5 s	Time delay.	1 = 1 s
50.04	*FBA A ref1 type*	Selects the type and scaling of reference 1 received from fieldbus adapter A. The scaling of the reference is defined by parameters *46.01*…*46.03*, depending on which reference type is selected by this parameter.	*Speed or frequency*
	Speed or frequency	Type and scaling are chosen automatically according to the currently active operation mode as follows:	0

Operation mode (see par. *19.01*)	**Reference type**	**Scaling**
Speed control	*Speed*	*46.01 Speed scaling*
Torque control		
Frequency control	*Frequency*	*46.02 Frequency scaling*

No.	Name/Value	Description	Def/ FbEq16
	Transparent	No scaling is applied.	1
	General	Generic reference with a scaling of 100 = 1 (ie. integer and two decimals).	2
	Torque	The scaling is defined by parameter 46.03 Torque scaling.	3

No.	Name/Value	Description	Def/ FbEq16
	Speed	The scaling is defined by parameter *46.01 Speed scaling*.	4
	Frequency	The scaling is defined by parameter *46.02 Frequency scaling*.	5
50.05	*FBA A ref2 type*	Selects the type and scaling of reference 2 received from fieldbus adapter A. The scaling of the reference is defined by parameters *46.01*…*46.03*, depending on which reference type is selected by this parameter. For the selections, see parameter *50.04 FBA A ref1 type*.	*Speed or frequency*
50.07	*FBA A actual 1 type*	Selects the type/source and scaling of actual value 1 transmitted to the fieldbus network through fieldbus adapter A.	*Speed or frequency*
	Speed or frequency	Type/source and scaling are chosen automatically according to the currently active operation mode as follows:	0

Operation mode (see par. *19.01*)	**Actual 1 type (source)**	**Scaling**
Speed control	*Speed* (*01.01 Motor speed used*)	*46.01 Speed scaling*
Torque control		
Frequency control	*Frequency* (*01.06 Output frequency*)	*46.02 Frequency scaling*

No.	Name/Value	Description	Def/ FbEq16
	Transparent	The value selected by parameter *50.10 FBA A act1 transparent source* is sent as actual value 1. No scaling is applied (the 16-bit scaling is 1 = 1 unit).	1
	General	The value selected by parameter *50.10 FBA A act1 transparent source* is sent as actual value 1 with a 16-bit scaling of 100 = 1 unit (ie. integer and two decimals).	2
	Torque	*01.10 Motor torque* is sent as actual value 1.	3
	Speed	*01.01 Motor speed used* is sent as actual value 1. The scaling is defined by parameter *46.01 Speed scaling*.	4
	Frequency	*01.06 Output frequency* is sent as actual value 1. The scaling is defined by parameter *46.02 Frequency scaling*.	5
	Position	Motor position is sent as actual value 1. See parameter *90.06 Motor position scaled*.	6
50.08	*FBA A actual 2 type*	Selects the type/source and scaling of actual value 2 transmitted to the fieldbus network through fieldbus adapter A. For the selections, see parameter *50.07 FBA A actual 1 type*.	*Speed or frequency*
50.09	*FBA A SW transparent source*	Selects the source of the fieldbus status word when the fieldbus adapter is set to a transparent communication profile eg. by its configuration parameters (group *51 FBA A settings*).	*Not selected*
	Not selected	No source selected.	-
	Other	Source selection (see *Terms and abbreviations* on page *101*).	-

No.	Name/Value	Description	Def/ FbEq16
50.10	*FBA A act1 transparent source*	When parameter *50.07 FBA A actual 1 type* is set to *Transparent* or *General* this parameter selects the source of actual value 1 transmitted to the fieldbus network through fieldbus adapter A.	*Not selected*
	Not selected	No source selected.	-
	Other	Source selection (see *Terms and abbreviations* on page *101*).	-
50.11	*FBA A act2 transparent source*	When parameter *50.08 FBA A actual 2 type* is set to *Transparent* or *General* this parameter selects the source of actual value 2 transmitted to the fieldbus network through fieldbus adapter A.	*Not selected*
	Not selected	No source selected.	-
	Other	Source selection (see *Terms and abbreviations* on page *101*).	-
50.12	*FBA A debug mode*	Enables the display of raw (unmodified) data received from and sent to fieldbus adapter A in parameters *50.13*…*50.18*. This functionality should only be used for debugging.	*Disable*
	Disable	Display of raw data from fieldbus adapter A disabled.	0
	Fast	Display of raw data from fieldbus adapter A enabled.	1
50.13	*FBA A control word*	Displays the raw (unmodified) control word 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.	-
	00000000h …FFFFFFFFh	Control word sent by master to fieldbus adapter A.	-
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.	-

<table>
<tr><th>No.</th><th>Name/Value</th><th>Description</th><th>Def/
FbEq16</th></tr>
<tr><td>50.18</td><td>FBA A actual value 2</td><td>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.</td><td>-</td></tr>
<tr><td></td><td>-2147483648
…2147483647</td><td>Raw ACT2 sent by fieldbus adapter A to master.</td><td>-</td></tr>
<tr><td>50.21</td><td>FBA A timelevel sel</td><td>Selects the communication time levels.
In general, lower time levels of read/write services reduce CPU load. The table below shows the time levels of the read/write services for cyclic high and cyclic low data with each parameter setting.
<table>
<tr><th>Selection</th><th>Cyclic high *</th><th>Cyclic low **</th></tr>
<tr><td>Monitoring</td><td>10 ms</td><td>2 ms</td></tr>
<tr><td>Normal</td><td>2 ms</td><td>10 ms</td></tr>
<tr><td>Fast</td><td>500 µs</td><td>2 ms</td></tr>
<tr><td>Very fast</td><td>250 µs</td><td>2 ms</td></tr>
</table>
* Cyclic high data consists of fieldbus Status word, Act1 and Act2.
** Cyclic low data consists of the parameter data mapped to parameter groups 52 FBA A data in and 53 FBA A data out, and acyclic data.
Control word, Ref1 and Ref2 are handled as interrupts generated on receipt of cyclic high messages.</td><td>Normal</td></tr>
<tr><td></td><td>Normal</td><td>Normal speed.</td><td>0</td></tr>
<tr><td></td><td>Fast</td><td>Fast speed.</td><td>1</td></tr>
<tr><td></td><td>Very fast</td><td>Very fast speed.</td><td>2</td></tr>
<tr><td></td><td>Monitoring</td><td>Low speed. Optimized for PC tool communication and monitoring usage.</td><td>3</td></tr>
<tr><td>50.31</td><td>FBA B enable</td><td>Enables/disables communication between the drive and fieldbus adapter B, and specifies the slot the adapter is installed into.</td><td>Disable</td></tr>
<tr><td></td><td>Disable</td><td>Communication between drive and fieldbus adapter B disabled.</td><td>0</td></tr>
<tr><td></td><td>Option slot 1</td><td>Communication between drive and fieldbus adapter B enabled. The adapter is in slot 1.</td><td>1</td></tr>
<tr><td></td><td>Option slot 2</td><td>Communication between drive and fieldbus adapter B enabled. The adapter is in slot 2.</td><td>2</td></tr>
<tr><td></td><td>Option slot 3</td><td>Communication between drive and fieldbus adapter B enabled. The adapter is in slot 3.</td><td>3</td></tr>
<tr><td>50.32</td><td>FBA B comm loss func</td><td>Selects how the drive reacts upon a fieldbus communication break. The time delay is defined by parameter 50.33 FBA B comm loss timeout.</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>Communication break detection active. Upon a communication break, the drive trips on a 7520 FBA B communication fault and coasts to a stop.</td><td>1</td></tr>
</table>

No.	Name/Value	Description	Def/ FbEq16
	Last speed	Communication break detection active. Upon a communication break, the drive generates a warning (*A7C1 FBA B communication*) 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	Communication break detection active. Upon a communication break, the drive generates a warning (*A7C2 FBA B communication*) and sets the speed to the value 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
	Fault always	Drive trips on *7520 FBA B communication*. This occurs even though no control is expected from the fieldbus.	4
	Warning	Drive generates an *A7C2 FBA B communication* warning. This occurs even though no control is expected from the fieldbus. WARNING! Make sure that it is safe to continue operation in case of a communication break.	5
50.33	*FBA B comm loss timeout*	Defines the time delay before the action defined by parameter *50.32 FBA B comm loss func* is taken. Time count starts when the communication link fails to update the message. As a rule of thumb, this parameter should be set to at least 3 times the transmit interval of the master.	0.3 s
	0.3…6553.5 s	Time delay.	1 = 1 s
50.34	*FBA B ref1 type*	Selects the type and scaling of reference 1 received from fieldbus adapter B. For the selections, see parameter *50.04 FBA A ref1 type*.	*Speed or frequency*
50.35	*FBA B ref2 type*	Selects the type and scaling of reference 2 received from fieldbus adapter B. For the selections, see parameter *50.04 FBA A ref1 type*.	*Speed or frequency*
50.37	*FBA B actual 1 type*	Selects the type/source and scaling of actual value 1 transmitted to the fieldbus network through fieldbus adapter B. For the selections, see parameter *50.07 FBA A actual 1 type*.	*Speed or frequency*
50.38	*FBA B actual 2 type*	Selects the type/source and scaling of actual value 2 transmitted to the fieldbus network through fieldbus adapter B. For the selections, see parameter *50.07 FBA A actual 1 type*.	*Speed or frequency*
50.39	*FBA B SW transparent source*	Selects the source of the fieldbus status word when the fieldbus adapter is set to a transparent communication profile eg. by its configuration parameters (group *54 FBA B settings*).	*Not selected*
	Not selected	No source selected.	-

No.	Name/Value	Description	Def/ FbEq16
	Other	Source selection (see *Terms and abbreviations* on page *101*).	-
50.40	*FBA B act1 transparent source*	When parameter *50.37 FBA B actual 1 type* is set to *Transparent* or *General* this parameter selects the source of actual value 1 transmitted to the fieldbus network through fieldbus adapter B.	*Not selected*
	Not selected	No source selected.	-
	Other	Source selection (see *Terms and abbreviations* on page *101*).	-
50.41	*FBA B act2 transparent source*	When parameter *50.38 FBA B actual 2 type* is set to *Transparent* or *General* this parameter selects the source of actual value 2 transmitted to the fieldbus network through fieldbus adapter B.	*Not selected*
	Not selected	No source selected.	-
	Other	Source selection (see *Terms and abbreviations* on page *101*).	-
50.42	*FBA B debug mode*	Enables the display of raw (unmodified) data received from and sent to fieldbus adapter B in parameters *50.43*…*50.48*. This functionality should only be used for debugging.	*Disable*
	Disable	Display of raw data from fieldbus adapter B disabled.	0
	Fast	Display of raw data from fieldbus adapter B enabled.	1
50.43	*FBA B control word*	Displays the raw (unmodified) control word sent by the master (PLC) to fieldbus adapter B if debugging is enabled by parameter *50.42 FBA B debug mode*. This parameter is read-only.	-
	00000000h …FFFFFFFFh	Control word sent by master to fieldbus adapter B.	-
50.44	*FBA B reference 1*	Displays raw (unmodified) reference REF1 sent by the master (PLC) to fieldbus adapter B if debugging is enabled by parameter *50.42 FBA B debug mode*. This parameter is read-only.	-
	-2147483648 …2147483647	Raw REF1 sent by master to fieldbus adapter B.	-
50.45	*FBA B reference 2*	Displays raw (unmodified) reference REF2 sent by the master (PLC) to fieldbus adapter B if debugging is enabled by parameter *50.42 FBA B debug mode*. This parameter is read-only.	-
	-2147483648 …2147483647	Raw REF2 sent by master to fieldbus adapter B.	-
50.46	*FBA B status word*	Displays the raw (unmodified) status word sent by fieldbus adapter B to the master (PLC) if debugging is enabled by parameter *50.42 FBA B debug mode*. This parameter is read-only.	-
	00000000h …FFFFFFFFh	Status word sent by fieldbus adapter B to master.	-

No.	Name/Value	Description	Def/ FbEq16
50.47	*FBA B actual value 1*	Displays raw (unmodified) actual value ACT1 sent by fieldbus adapter B to the master (PLC) if debugging is enabled by parameter *50.42 FBA B debug mode*. This parameter is read-only.	-
	-2147483648 …2147483647	Raw ACT1 sent by fieldbus adapter B to master.	-
50.48	*FBA B actual value 2*	Displays raw (unmodified) actual value ACT2 sent by fieldbus adapter B to the master (PLC) if debugging is enabled by parameter *50.42 FBA B debug mode*. This parameter is read-only.	-
	-2147483648 …2147483647	Raw ACT2 sent by fieldbus adapter B to master.	-
50.51	*FBA B timelevel sel*	Selects the communication time levels. In general, lower time levels of read/write services reduce CPU load. The table below shows the time levels of the read/write services for cyclic high and cyclic low data with each parameter setting. <table><tr><th>Selection</th><th>Cyclic high *</th><th>Cyclic low **</th></tr><tr><td>*Monitoring*</td><td>10 ms</td><td>2 ms</td></tr><tr><td>*Normal*</td><td>2 ms</td><td>10 ms</td></tr><tr><td>*Fast*</td><td>500 µs</td><td>2 ms</td></tr><tr><td>*Very fast*</td><td>250 µs</td><td>2 ms</td></tr></table>* Cyclic high data consists of fieldbus Status word, Act1 and Act2. ** Cyclic low data consists of the parameter data mapped to parameter groups *55 FBA B data in* and *56 FBA B data out*, and acyclic data. Control word, Ref1 and Ref2 are handled as interrupts generated on receipt of cyclic high messages.	*Normal*
	Normal	Normal speed.	0
	Fast	Fast speed.	1
	Very fast	Very fast speed.	2
	Monitoring	Low speed. Optimized for PC tool communication and monitoring usage.	3
51 FBA A settings		Fieldbus adapter A configuration.	
51.01	*FBA A type*	Displays the type of the connected fieldbus adapter module. 0 = Module is not found or is not properly connected, or is disabled by parameter *50.01 FBA A enable*; 1 = FPBA; 32 = FCAN; 37 = FDNA; 101 = FCNA, 128 = FENA-11/21; 135 = FECA; 136 = FEPL; 485 = FSCA. 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
	Refresh	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	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

No.	Name/Value	Description	Def/ FbEq16
51.32	*FBA A comm SW ver*	Displays the patch and build versions of the adapter module firmware in format xxyy, where xx = patch version number, yy = build version number. Example: C802 = 200.02 (patch version 200, build version 2).	
		Patch and build versions of adapter module firmware.	-
51.33	*FBA A appl SW ver*	Displays the major and minor versions of the adapter module firmware in format xyy, where x = major revision number, yy = minor revision number. Example: 300 = 3.00 (major version 3, minor version 00).	
		Major and minor versions of adapter module firmware.	-

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
	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
	SW2 16bit	Status Word 2 (16 bits)	24
	Other	Source selection (see *Terms and abbreviations* on page *101*).	-
…	…	…	…
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

No.	Name/Value	Description	Def/ FbEq16
	CW 16bit	Control Word (16 bits)	1
	Ref1 16bit	Reference REF1 (16 bits)	2
	Ref2 16bit	Reference REF2 (16 bits)	3
	CW 32bit	Control Word (32 bits)	11
	Ref1 32bit	Reference REF1 (32 bits)	12
	Ref2 32bit	Reference REF2 (32 bits)	13
	CW2 16bit	Control Word 2 (16 bits)	21
	Other	Source selection (see *Terms and abbreviations* on page *101*).	-
…	…	…	…
53.12	*FBA A data out12*	See parameter *53.01 FBA A data out1*.	*None*
54 FBA B settings		Fieldbus adapter B configuration.	
54.01	*FBA B type*	Displays the type of the connected fieldbus adapter module. 0 = Module is not found or is not properly connected, or is disabled by parameter *50.31 FBA B enable*; 1 = FPBA; 32 = FCAN; 37 = FDNA; 101 = FCNA, 128 = FENA-11/21; 135 = FECA; 136 = FEPL; 485 = FSCA. This parameter is read-only.	-
54.02	*FBA B Par2*	Parameters *54.02*…*54.26* 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
…	…	…	…
54.26	*FBA B Par26*	See parameter *54.02 FBA B Par2*.	-
	0…65535	Fieldbus adapter configuration parameter.	1 = 1
54.27	*FBA B 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
	Refresh	Refreshing.	1
54.28	*FBA B 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.	-
54.29	*FBA B 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

No.	Name/Value	Description	Def/ FbEq16
54.30	*FBA B 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
54.31	*D2FBA B comm status*	Displays the status of the fieldbus adapter module communication.	-
	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
54.32	*FBA B comm SW ver*	Displays the patch and build versions of the adapter module firmware in format xxyy, where xx = patch version number, yy = build version number. Example: C802 = 200.02 (patch version 200, build version 2).	
		Patch and build versions of adapter module firmware.	-
54.33	*FBA B appl SW ver*	Displays the major and minor versions of the adapter module firmware in format xyy, where x = major revision number, yy = minor revision number. Example: 300 = 3.00 (major version 3, minor version 00).	
		Major and minor versions of adapter module firmware.	-

55 FBA B data in		Selection of data to be transferred from drive to fieldbus controller through fieldbus adapter B.	
55.01	*FBA B data in1*	Parameters *55.01*…*55.12* select data to be transferred from the drive to the fieldbus controller through fieldbus adapter B.	*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
	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

No.	Name/Value	Description	Def/ FbEq16
	Act1 32bit	Actual value ACT1 (32 bits)	15
	Act2 32bit	Actual value ACT2 (32 bits)	16
	SW2 16bit	Status Word 2 (16 bits)	24
	Other	Source selection (see *Terms and abbreviations* on page *101*).	-
…	…	…	…
55.12	*FBA B data in12*	See parameter *55.01 FBA B data in1*.	*None*

56 FBA B data out		Selection of data to be transferred from fieldbus controller to drive through fieldbus adapter B.	
56.01	*FBA B data out1*	Parameters *56.01*…*56.12* select data to be transferred from the fieldbus controller to the drive through fieldbus adapter B.	*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
	CW 32bit	Control Word (32 bits)	11
	Ref1 32bit	Reference REF1 (32 bits)	12
	Ref2 32bit	Reference REF2 (32 bits)	13
	CW2 16bit	Control Word 2 (16 bits)	21
	Other	Source selection (see *Terms and abbreviations* on page *101*).	-
…	…	…	…
56.12	*FBA B data out12*	See parameter *56.01 FBA B 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 *437*).	
58.01	*Protocol enable*	Enables/disables the embedded fieldbus interface and selects the protocol to use. **Note:** When the embedded fieldbus interface is enabled, the drive-to-drive link functionality is automatically disabled	*None*
	None	None.	0
	Modbus RTU	Embedded fieldbus interface is enabled and uses the Modbus RTU protocol.	1
58.02	*Protocol ID*	Displays the protocol ID and 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. 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*.	1
	0…255	Node address (values 1…247 are allowable).	1 = 1

No.	Name/Value	Description	Def/ FbEq16
58.04	*Baud rate*	Selects the transfer rate of the fieldbus link. Changes to this parameter take effect after the control unit is rebooted or the new settings validated by parameter *58.06 Communication control*.	*19.2 kbps*
	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
58.05	*Parity*	Selects the type of parity bit and the 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*.	*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*	Validates any changes in the EFB settings, or activates silent mode.	*Enabled*
	Enabled	Normal operation.	0
	Refresh settings	Validates any changed EFB configuration settings. 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

No.	Name/Value	Description	Def/ FbEq16
58.07	*Communication diagnostics*	Displays the status of the EFB communication. This parameter is read-only.	-

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	Reserved
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	Not active	Reserved
13	Protocol 1	Reserved
14	Protocol 2	Reserved
15	Internal error	Reserved

No.	Name/Value	Description	Def/ FbEq16
	0000h…FFFFh	EFB communication status.	1 = 1
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 depressed 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 depressed 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 depressed for over 3 seconds.	-
	0…4294967295	Number of all received packets.	1 = 1

No.	Name/Value	Description	Def/ FbEq16
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 depressed 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 depressed 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*. See also parameters *58.15 Communication loss mode* and *58.16 Communication loss time*.	*Fault*
	No	No action taken (monitoring disabled).	0
	Fault	Drive trips on *6681 EFB comm loss*. This only occurs if control is expected from the EFB (EFB selected as source of start/stop in the currently active location).	1
	Last speed	Drive generates an *A7CE EFB comm loss* warning and freezes the speed to the level the drive was operating at. This only occurs if control is expected from the EFB. 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 *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 only occurs if control 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 trips on *6681 EFB comm loss*. This occurs even though no control is expected from the EFB.	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*. 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

No.	Name/Value	Description	Def/ FbEq16
	Cw / Ref1 / Ref2	A write of the control word or a reference from the fieldbus 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*. See also parameter *58.15 Communication loss mode*.	3.0 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*.	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.	-
	0000h…FFFFh	Control word sent by Modbus controller to the drive.	1 = 1
58.19	*EFB status word*	Displays the raw (unmodified) status word sent by the drive to the Modbus controller. For debugging purposes. This parameter is read-only.	-
	0000h…FFFFh	Status word sent by the drive to the Modbus controller.	1 = 1
58.25	*Control profile*	Defines the control profile used by the protocol.	*ABB Drives*
	ABB Drives	ABB Drives profile (with a 16-bit control word) with registers in the classic format for backward compatibility.	0
	Transparent	Transparent profile (16-bit or 32-bit control word) with registers in the classic format.	2
58.26	*EFB ref1 type*	Selects the type and scaling of reference 1 received through the embedded fieldbus interface. The scaled reference is displayed by *03.09 EFB reference 1*.	*Speed or frequency*
	Speed or frequency	Type and scaling is chosen automatically according to the currently active operation mode as follows:	0

Operation mode (see par. *19.01*)	Reference type	Scaling
Speed control	*Speed*	*46.01 Speed scaling*
Torque control		
Frequency control	*Frequency*	*46.02 Frequency scaling*

	Transparent	No scaling is applied.	1
	General	Generic reference with a specific scaling of 100 = 1 ((ie. integer and two decimals).	2
	Torque	The scaling is defined by parameter *46.03 Torque scaling.*	3
	Speed	The scaling is defined by parameter *46.01 Speed scaling*.	4
	Frequency	The scaling is defined by parameter *46.02 Frequency scaling*.	5

No.	Name/Value	Description	Def/ FbEq16
58.27	*EFB ref2 type*	Selects the type and scaling of reference 2 received through the embedded fieldbus interface. The scaled reference is displayed by *03.10 EFB reference 2*. For the selections, see parameter *58.26 EFB ref1 type*.	*Torque*
58.28	*EFB act1 type*	Selects the type of actual value 1.	*Speed or frequency*
	Speed or frequency	Type/source and scaling are chosen automatically according to the currently active operation mode as follows:	0

Operation mode (see par. *19.01*)	**Actual 1 type (source)**	**Scaling**
Speed control	*Speed* (*01.01 Motor speed used*)	*46.01 Speed scaling*
Torque control		
Frequency control	*Frequency* (*01.06 Output frequency*)	*46.02 Frequency scaling*

No.	Name/Value	Description	Def/ FbEq16
	Transparent	The value selected by parameter *58.31 EFB act1 transparent source* is sent as actual value 1. No scaling is applied (the 16-bit scaling is 1 = 1 unit).	1
	General	The value selected by parameter *58.31 EFB act1 transparent source* is sent as actual value 1 with a 16-bit scaling of 100 = 1 unit (ie. integer and two decimals).	2
	Torque	*01.10 Motor torque* is sent as actual value 1. The scaling is defined by parameter 46.03.	3
	Speed	*01.01 Motor speed used* is sent as actual value 1. The scaling is defined by parameter *46.01 Speed scaling*.	4
	Frequency	*01.06 Output frequency* is sent as actual value 1. The scaling is defined by parameter *46.02 Frequency scaling*.	5
	Position	Motor position is sent as actual value 1. See parameter *90.06 Motor position scaled*.	6
58.29	*EFB act2 type*	Selects the type of actual value 2. For the selections, see parameter *58.28 EFB act1 type*.	*Torque*
58.30	*EFB status word transparent source*	Selects the source of the status word when *58.25 Control profile* is set to *Transparent*.	*Not selected*
	Not selected	None.	0
	Other	Source selection (see *Terms and abbreviations* on page *101*).	-
58.31	*EFB act1 transparent source*	Selects the source of actual value 1 when *58.28 EFB act1 type* is set to *Transparent* or *General*.	*Not selected*
	Not selected	None.	0
	Other	Source selection (see *Terms and abbreviations* on page *101*).	-
58.32	*EFB act2 transparent source*	Selects the source of actual value 1 when *58.29 EFB act2 type* is set to *Transparent* or *General*.	*Not selected*
	Not selected	None.	0
	Other	Source selection (see *Terms and abbreviations* on page *101*).	-

No.	Name/Value	Description	Def/ FbEq16
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*.	*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*.	*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 register address 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	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
	CW 32bit	Control Word (32 bits).	11
	Ref1 32bit	Reference REF1 (32 bits).	12
	Ref2 32bit	Reference REF2 (32 bits).	13

No.	Name/Value	Description	Def/ FbEq16
	SW 32bit	Status Word (32 bits).	14
	Act1 32bit	Actual value ACT1 (32 bits).	15
	Act2 32bit	Actual value ACT2 (32 bits).	16
	CW2 16bit	Control Word 2 (16 bits). When a 32-bit control word is used, this setting means the most-significant 16 bits.	21
	SW2 16bit	Status Word 2 (16 bits). When a 32-bit control word is used, this setting means the most-significant 16 bits.	24
	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
	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 *101*).	-
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*
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*
…	…	…	…
58.124	*Data I/O 24*	Parameter selector for Modbus register address 400024. For the selections, see parameter *58.101 Data I/O 1*.	*None*

74 Pump setup		Basic functions of applications.	
74.01	*Pump enable*	Enables the pump functions related to parameters in group 74 to 79.	*Enable*
	Disable	Disables pump function.	0
	Enable	Enables pump function.	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
	DIO1	Digital input/output DIO1 (*11.02 DIO delayed status*, bit 0).	8
	DIO2	Digital input/output DIO2 (*11.02 DIO delayed status*, bit 1).	9
	Other	Source selection (see *Terms and abbreviations* on page *101*).	-
74.02	*Run-time hours reset source*	Defines the command source used to reset the run-time hour counter (*09.07 Run-time hours*) of the pump.	*No*
	No	Run-time hours reset disabled.	0
	Yes	Run-time hours reset enabled.	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
	DIO1	Digital input/output DIO1 (*11.02 DIO delayed status*, bit 0).	8
	DIO2	Digital input/output DIO2 (*11.02 DIO delayed status*, bit 1).	9
	Other	Source selection (see *Terms and abbreviations* on *101*).	-
74.03	*Gear reduction ratio*	Defines the transmission reduction ratio for PCP application. Note: This feature is not available for ESP.	1.000
	1.000...1000.000	Value range.	1000 = 1
74.04	*Speed ref type*	Selects the reference type between motor speed or pump speed. Note: Not applicable for ESP.	*Pump speed*
	Pump speed	Speed reference of the pump.	0
	Motor speed	Speed reference of the motor.	1
74.05	*Speed ref source*	Selects the source for the speed reference.	*AI1 scaled*
	Zero	Source not selected.	0
	AI1 scaled	*12.12 AI1 scaled value* (see page *141*).	1
	AI2 scaled	*12.22 AI2 scaled value* (see page *141*).	2
	FBA1 ref	Fieldbus adapter A reference1.	3
	FBA2 ref	Fieldbus adapter A reference2.	4
	EFB1 ref	Embedded fieldbus reference 1.	
	EFB2 ref	Embedded fieldbus reference 2.	
	Motor potentiometer ref	*22.80 Motor potentiometer ref act* (output of the motor potentiometer)	5

No.	Name/Value	Description	Def/ FbEq16
	Constant ref	Constant speed reference. See par. *74.06*.	6
	Other	Source selection (see *Terms and abbreviations* on *101*).	-
74.06	*Speed ref*	Sets the speed reference for parameter *74.05 Speed ref source*, if set as *Constant ref*.	0.00 Prpm, rpm or Hz
	0.00...30000.00 Prpm	Speed reference.	10 = 1 Prpm, rpm or Hz
74.07	*Minimum rod speed*	Defines the minimum allowed rod/pump speed. ⚠ **WARNING!** This value must not be higher than *74.06 Speed ref* **Note**: Operational units for PCP is Prpm and for ESP is Hz.	0.00 Prpm, rpm or Hz
	-10000.00 ...10000.00 Prpm	Minimum rod speed.	10 = 1 Prpm, rpm or Hz
74.08	*Maximum rod speed*	Defines the maximum allowed rod/pump speed. ⚠ **WARNING!** This value must not be lower than *74.07 Minimum rod speed*. **Note**: Operational unit for PCP and ESP is rpm and Hz respectively.	0.00 Prpm, rpm or Hz
	-10000.00 ...10000.00 Prpm	Maximum rod speed.	10 = 1 Prpm, rpm or Hz
74.10	*Rod acc time*	Defines the acceleration time for the rod/pump: from zero to *74.08 Maximum rod speed*.	20.000 s
	0.000...10000.000 s	Rod acceleration time.	10 = 1 s
74.11	*Rod dec time*	Defines the deceleration time for the rod/pump: from *74.08 Maximum rod speed* to zero speed.	20.000 s
	0.000...10000.000 s	Rod acceleration time.	10 = 1 s
74.12	*Starting speed enable*	Enables the pump starting speed function. See section *Pump starting speed* on page *33*.	Disable
	Disable	Disables pump ramp up.	0
	Enable	Enables pump ramp up.	1
	Other	Source selection (see *Terms and abbreviations* on page *101*).	-
74.13	*Starting speed*	Defines the starting speed. See section *Pump starting speed* on page *33*.	0.00 Prpm, rpm or Hz
	-10000.00... 10000.00 Prpm	Pump starting speed.	10 = 1 Prpm, rpm or Hz
74.14	*Starting speed acc time*	Defines the acceleration time for the Pump starting speed function. See section *Pump starting speed* on page *33*.	0.000 s
	0.0000 ...10000.000 s	Pump starting speed acceleration time.	10 = 1 s
74.15	*Starting speed time delay*	Defines the delay time for the Pump starting speed function. After this delay, start up procedure ends and the function releases control over speed reference.	0.000 s
	0.0000 ...10000.000 s	Starting speed delay time.	10 = 1 s

No.	Name/Value	Description	Def/ FbEq16
74.18	*Minimum rod torq ref*	Defines minimum allowed torque reference for PCP. ⚠ **WARNING!** Default = 0 is recommended for safety purpose to avoid unexpected backward rotation and rod damages. **Note:** Not applicable for ESP.	0.00 N•m or lbft
	-10000.00...0.00 N•m	Minimum rod torque reference.	10 = 1 N•m or lbft
74.19	*Maximum rod torq ref*	Defines maximum allowed torque reference for PCP. **Note:** Not applicable for ESP.	0.00 N•m or lbft
	0.00...10000.00 N•m	Maximum rod torque reference.	10 = 1 N•m or lbft
74.21	*Brake confirmation enable*	Enables the Brake confirmation function or selects the source for the enable signal. See section *Pump backspin control* on page *47*.	Disable
	Disable	Disables brake confirmation function.	0
	Enable	Enables brake confirmation function.	1
	Other	Source selection (see *Terms and abbreviations* on page *101*).	-
74.22	*Brake confirmation source*	Selects the source of the actual signal used in the Brake confirmation function. The analog signal feedback from the brake device is compared to *74.23 Brake confirmation limit*. If the actual value is below the limit longer than *74.25 Brake confirmation time*, the function controls the mechanical brake on. See also section *Pump backspin control* on page *47*.	Disable
	Zero	Source not selected.	0
	AI1 scaled	*12.12 AI1 scaled value* (see page *141*).	1
	AI2 scaled	*12.22 AI2 scaled value* (see page *143*).	2
	Other	Source selection (see *Terms and abbreviations* on page *101*).	-
74.23	*Brake confirmation limit*	Defines the limit in percentage of range selected by analog input source in parameter *74.22 Brake confirmation source*.	0.00%
	0.00...100.00%	Brake confirmation limit.	100 = 1%
74.24	*Brake confirmation speed*	Defines the reference value used in the Brake confirmation function. See parameter *74.22 Brake confirmation source*.	0.00 Prpm, rpm or Hz
	-500.00...0.00 Prpm	Reference speed.	10 = 1 Prpm, rpm or Hz
74.25	*Brake confirmation time*	Defines the time limit for the Brake confirmation function. See parameter *74.22 Brake confirmation source*.	0.000 s
	0.000...30.000 s	Brake confirmation time.	10 = 1 s
74.26	*Pressure unit selection*	Selects the unit to display for pressure related values on the keypad.	kPa
	kPa	kPa	0
	psi	psi	1

No.	Name/Value	Description	Def/ FbEq16
74.27	*Depth unit selection*	Selects the unit to display for depth related values on the keypad.	m
	m	Meters	0
	ft	Feet	1
	Joints	Joints	2
75 Pump level control		Pump level control function.	
75.01	*Level control enable*	Enables Pump level control function. See section *Pump level control* on page *34*.	Disable
	Disable	Disables Pump level control function.	0
	Enable	Enables Pump level control function.	1
	Other	Source selection (see *Terms and abbreviations* on page *101*).	-
75.02	*Fluid level ref*	Defines the fluid level set point for the Pump level control function.	0.00 m, ft or Joints
	0.00...100000.00 m	Reference	10 = 1 m, ft or Joints
75.03	*Fluid level source function*	Selects a mathematical function between the feedback sources selected by parameters *75.04 Fluid level source 1* and *75.05 Fluid level source 2*.	Source1
	Source1	See parameter *75.04*	0
	Source2	See parameter *75.05*	1
	Source1 + Source2	Sum of sources 1 and 2	2
	Source1 - Source2	Source 2 subtracted from source 1	3
	Source1 x Source2	Source 1 multiplied by source 2	4
	Source1/Source2	Source 1 divided by source 2	5
75.04	*Fluid level source 1*	Defines source 1 for parameter *75.03 Fluid level source function*.	Zero
	Zero	Source not selected	0
	AI1 scaled	*12.12 AI1 scaled value* (see page *141*)	1
	AI2 scaled	*12.22 AI2 scaled value* (see page *143*)	2
	FBA1 ref	Fieldbus adapter A reference1	3
	FBA2 ref	Fieldbus adapter A reference2	4
	Other	Source selection (see *Terms and abbreviations* on page *101*)	-
75.05	*Fluid level source 2*	Defines source 2 for parameter *75.03 Fluid level source function*.	Zero
	Zero	Source not selected	0
	AI1 scaled	*12.12 AI1 scaled value* (see page *141*)	1
	AI2 scaled	*12.22 AI2 scaled value* (see page *143*)	2
	FBA1 ref	Fieldbus adapter A reference1	3
	FBA2 ref	Fieldbus adapter A reference2	4
	Other	Source selection (see *Terms and abbreviations* on page *101*)	-

No.	Name/Value	Description	Def/ FbEq16
75.06	*Level meas range*	Defines the measuring range for the Pump level control function.	0.00 m, ft or Joints
	0.00...100000.00 m	Measuring range	10 = 1 m, ft or Joints
75.07	*Fluid level p-gain*	Defines the gain for the Pump level control function. **Note**: This value should be kept low to avoid unwanted oscillation from the drive speed reference causing the pump to cycle up and down in rpm.	0.00
	0.00...5.00	Proportional gain	100 = 1
75.08	*Fluid level i-time*	Defines the integration time for the Pump level control function. **Note**: This value should be kept at a fairly large value to avoid unwanted oscillation from the drive speed reference causing the pump to cycle up and down in rpm.	0.000 s
	0.000...3600.000 s	Integration time	10 = 1 s
75.09	*Level control invert*	Selects the reaction characteristics of the Pump level control function.	Disable
	Disable	When the feedback signal selected by *75.03 Fluid level source 1* is less than *75.02 Fluid level ref*, the PI regulator output increases, causing the speed reference to increase.	0
	Enable	When the feedback signal selected by *75.03 Fluid level source 1* is greater than *75.02 Fluid level ref*, the PI regulator output increases, causing the speed reference to increase.	1
	Other	Source selection (see *Terms and abbreviations* on page *101*).	-
75.10	*Sleep control enable*	Enables the Sleep and wake up function. See section *Sleep and wake up function* on page *35*.	Disable
	Disable	Disables sleep and wake up control function.	0
	Enable	Enables sleep and wake up control function.	1
	Other	Source selection (see *Terms and abbreviations* on page *101*)	-
75.11	*Sleep warning enable*	Enables the warning for the Sleep and wake up function. See section *Sleep and wake up function* on page *35*.	Disable
	Disable	Disables sleep and wake up warning.	0
	Enable	Enables sleep and wake up warning.	1
	Other	Source selection (see *Terms and abbreviations* on page *101*)	-
75.12	*Sleep limit type*	Selects the sleep function type: sleep at low limit or sleep at high limit.	Low limit
	Low limit	If *75.10 Sleep control enable* is enabled and *75.14 Sleep signal source 1* is less than or equal to *75.16 Sleep level* and the condition is true longer than the time*75.08 Fluid level i-time*, the pump will shut down. The Sleep function is active until *75.14 Sleep signal source 1* increases to a level greater than or equal to *75.18 Wakeup level*. See section *Sleep and wake up function* on page *35*.	0

No.	Name/Value	Description	Def/ FbEq16
	High limit	If *75.14 Sleep signal source 1* is greater than or equal to *75.16 Sleep level* and the condition is true longer than time *75.08 Fluid level i-time*, the pump will shut down. The Sleep function is active until *75.14 Sleep signal source 1* increases to a level less than or equal to *75.18 Wakeup level*. See section *Sleep and wake up function* on page *35*.	1
75.13	*Sleep signal source function*	Selects a mathematical function between the feedback sources selected by parameters *75.14 Sleep signal source 1* and *75.15 Sleep signal source 2*.	Source 1
	Source1	See parameter *75.14*.	0
	Source2	See parameter *75.15*.	1
	Source1 + Source2	Sum of sources 1 and 2.	2
	Source1 - Source2	Source 2 subtracted from source 1.	3
	Source1 x Source2	Source 1 multiplied by source 2.	4
	Source1 / Source2	Source 1 divided by source 2.	5
75.14	*Sleep signal source 1*	Defines the source 1 signal monitored for activation of sleep function.	Zero
	Zero	Zero	0
	AI1 scaled	*12.12 AI1 scaled value* (see page *141*)	1
	AI2 scaled	*12.22 AI2 scaled value* (see page *143*)	2
	FBA1 ref	Fieldbus adapter A reference1	3
	FBA2 ref	Fieldbus adapter A reference2	4
	Rod speed	Actual rod speed	5
	Other	Source selection (see *Terms and abbreviations* on page *101*)	-
75.15	*Sleep signal source 2*	Defines the source 2 signal monitored for activation of sleep function.	Zero
	Zero	Zero	0
	AI1 scaled	*12.12 AI1 scaled value* (see page *141*).	1
	AI2 scaled	*12.22 AI2 scaled value* (see page *143*).	2
	FBA1 ref	Fieldbus adapter A reference1	3
	FBA2 ref	Fieldbus adapter A reference2	4
	Rod speed	Actual rod speed	5
	Other [bit]	Source selection (see *Terms and abbreviations* on page *101*).	-
75.16	*Sleep level*	Defines the set point for activation of sleep function. The set point percentage of range selected by analog input source in parameter *75.14 Sleep signal source 1* or *75.15 Sleep signal source 2*. See section *Sleep and wake up function* on page *35*. Note: The Wakeup level has higher priority than the Sleep level.	0.00 SourceUnit
	0.00...100000000.00 SourceUnit	Sleep level.	100 = 1 SourceUnit

No.	Name/Value	Description	Def/ FbEq16
75.17	Sleep delay time	Defines the time period required to verify Sleep condition.	0.000 s
	0.000...10000.000 s	Sleep delay time.	10 = 1 s
75.18	Wakeup level	Defines the set point for the deactivation of sleep function. The set point percentage of range selected by analog input source in parameter 75.14 Sleep signal source 1 or 75.15 Sleep signal source 2. **Note**: The Wakeup level has higher priority than the Sleep level.	0.00 SourceUnit
	0.00...100000000.00 SourceUnit	Wakeup level.	100 = 1 SourceUnit
75.19	Wakeup delay time	Defines the time period required for verifying Wakeup condition.	0.000 s
	0.000...10000.000 s	Wakeup delay time.	10 = 1 s
75.20	Maximum sleep time	Maximum period of time allowed for pump to stay in sleep mode. **Note:** To disable this function set parameter value to 0.000.	0.000 s
	0.000...100000.000 s	Value range	10 = 1 s

76 Pump pressure protection		Pump pressure protection function.	
76.01	Pressure protection function	Enables Pump pressure protection function. See section Pump pressure protection on page 40.	Disable
	Disable	Disables Pump pressure protection function.	0
	Enable	Enables Pump pressure protection function.	1
	Other	Source selection (see Terms and abbreviations on page 101).	-
76.02	Pressure protection latching	Defines the latching type for pump pressure protection.	Non latching
	Non latching	A high pressure or high discharge pressure activates the warning message that is displayed as long as the high pressure condition is active. If the high pressure condition is missing, the pump regains a normal run condition. If the shutdown process finishes and the pump shuts off and the high pressure condition is missing, the pump starts automatically if a valid start command is present.	0
	Latching	The main difference from “Non latching” function is the pump trips on a fault and does not start automatically even if a valid start command is present. A fault reset is required to start the pump.	1
	Latch zero speed	Until the speed is above zero, the pump is in the “Non latching” type and after the speed reaches zero the pump is in the “Latching” type function.	2
76.03	Digital feedback source enable	Enables the source of digital feedback for high pressure protection.	FALSE
	FALSE	Disables digital feedback.	0
	TRUE	Enables digital feedback.	1
	Other	Source selection (see Terms and abbreviations on page 101).	-

No.	Name/Value	Description	Def/ FbEq16
76.04	*Digital feedback source*	Selects the source of digital feedback for high pressure protection.	*FALSE*
	FALSE	High pressure condition detected.	0
	TRUE	No high pressure condition.	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
	DIO1	Digital input/output DIO1(*11.02 DIO delayed status*, bit 0).	8
	DIO2	Digital input/output DIO2 (*11.02 DIO delayed status*, bit 0).	9
	Other	Source selection (see *Terms and abbreviations* on page *101*).	-
76.05	*Analog feedback source enable*	Enables the source of analog feedback for high pressure protection.	*FALSE*
	FALSE	Disables analog feedback.	0
	TRUE	Enables digital feedback.	1
	Other	Source selection (see *Terms and abbreviations* on page *101*).	-
76.06	*Analog feedback source*	Selects the source of analog feedback for high pressure protection.	Zero
	Zero	Zero	0
	AI1 scaled	*12.12 AI1 scaled value* (see page *141*).	1
	AI2 scaled	*12.22 AI2 scaled value* (see page *143*).	2
	Other	Source selection (see *Terms and abbreviations* on page *101*).	-
76.07	*Analog feedback limit*	Defines the analog feedback limit. If the feedback is above this limit, a fault or warning is indicated.	0.00 kPa or psi
	0.00...10000.00 Kpa	Analog feedback limit.	10 = 1 kPa or psi
76.08	*Analog feedback limit delay time*	Defines the time period required to verify the analog feedback limit.	0.000 s
	0.000...3600.000 s	Analog feedback limit delay time.	10 = 1 s
77 Pump torque protection		Pump torque protection function.	
77.01	*Rod torq limit display*	Selects the rod protection measurement as torque or current. See *Pump torque protection*, page *41*.	Torque
	Torque	Rod torque value for rod torque protection. See parameters *77.04 Rod torq1 limit* and *77.09 Rod torq2 limit*.	0
	Current	Motor current value for rod current protection. See parameters *77.04 Rod torq1 limit* and *77.09 Rod torq2 limit*.	1

No.	Name/Value	Description	Def/ FbEq16
77.02	*Rod torq1 function*	Enables the Rod torque 1 function for pump torque protection.	Disable
	Disable	Disables the Rod torque 1 function.	0
	Enable	Enables the Rod torque 1 function.	1
	Other	Source selection (see *Terms and abbreviations* on page *101*).	-
77.03	*Rod torq1 limit type*	Selects the Rod torque 1 limit type of the fault condition in *77.04 Rod torq1 limit*. **Note**: A warning is displayed during the shutdown process.	Low limit
	Low limit	The control program triggers the Torque pressure protection function when *09.01 Rod torque* is less than or equal to *77.04 Rod torq1 limit* and *09.05 Rod speed* is less than or equal to *77.05 Rod torq1 speed* for a period of time greater than *77.06 Rod torq1 delay time*. A hysteresis (of *Rod torque* * 5%) is present in the comparator meaning, once the condition is set, it latches until the *09.01 Rod torque* increases to a value of [*Rod torq1 limit* + (*Rod torque* * 05)].	0
	High limit	The control program triggers the Torque pressure protection function when *09.01 Rod torque* is greater than or equal to *77.04 Rod torq1 limit* and *09.05 Rod speed* is greater than or equal to *77.05 Rod torq1 speed* for a period of time greater than *77.06 Rod torq1 delay time*. A hysteresis (of *Rod torque* * 5%) is present in the comparator meaning, once the condition is set, it latches until the *09.01 Rod torque* decreases to a value of [*Rod torq1 limit* - (*Rod torque* * 05)].	1
77.04	*Rod torq1 limit*	Defines the torque limit for Rod torque 1 function in engineering units.	0.00 N•m. lbft or A
	0.00...10000.00 N•m	Rod torque 1 limit.	10 = 1 N•m, lbft or A
77.05	*Rod torq1 speed*	Defines the speed limit for rod torque 1 functionality in engineering units.	0.00 Prpm, rpm or Hz
	-3600.00 ...3600.00 Prpm	Rod torque 1 speed.	10 = 1 Prpm, rpm or Hz
77.06	*Rod torq1 delay time*	Defines the time period for confirming the high torque 1 condition.	0.000 s
	0.000...10000.000 s	Rod torque 1 delay time.	10 = 1 s
77.07	*Rod torq2 function*	Defines the Rod torque 2 function for pump torque protection.	Disable
	Disable	0	0
	Enable	1	1
	Other	Source selection (see *Terms and abbreviations* on page *101*).	-

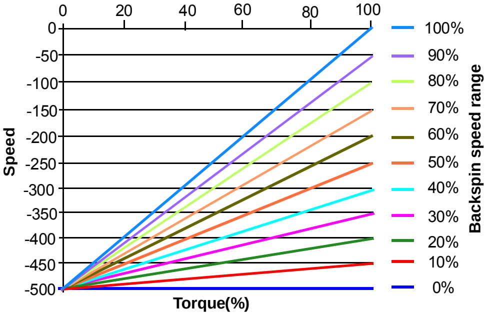
No.	Name/Value	Description	Def/ FbEq16
77.08	Rod torq2 limit type	Selects the Rod torque 2 limit type for the fault condition in 77.09 Rod torq2 limit. Note: A warning is displayed during the shutdown process.	Low limit
	Low limit	The control program triggers the Torque pressure protection function when 09.01 Rod torque is less than or equal to 77.09 Rod torq2 limit for the time period greater than 77.10 Rod torq2 delay time. A hysteresis (of Rod torque * 5%) is present in the comparator meaning, once the condition is set, it latches until the Rod torque increases to a value of [Rod torq2 limit+ (Rod torque * 05)].	0
	High limit	The control program triggers the Torque pressure protection function when 09.01 Rod torque is greater than or equal to 77.09 Rod torq2 limit for a period of time greater than 77.10 Rod torq2 delay time. A hysteresis (of Rod torque * 5%) is present in the comparator meaning, once the condition is set, it latches until the Rod torque decreases to a value of [Rod torq2 limit - (Rod torque * 05)].	1
77.09	Rod torq2 limit	Defines the torque limit for Rod torque 2 limit in engineering units.	0.00 N•m, lbft or A
	0.00...10000.00 N•m	Rod torque 2 limit.	10 = 1 N•m, lbft or A
77.10	Rod torq2 delay time	Defines the time period for confirming high torque 2 condition.	0.000 s
	0.000...10000.000 s	Rod torque 2 delay time.	10 = 1 s
77.11	Rod torq2 additive speed ref	Defines the additional speed reference that adds to the speed reference once the Rod torque 2 limit function is triggered.	0.00 Prmp, rpm or Hz
	-3600.00 ...3600.00 Prpm	Rod torque 2 additive speed reference.	10 = 1 Prpm, rpm or Hz
77.12	Rod torq2 speed delay time	Defines the time period to keep the parameter 77.11 Rod torq2 additive speed ref active even when the required condition is not available.	0.000 s
	0.000...10000.000 s	Rod torque 2 speed delay time.	10 = 1 s
77.13	Rod torq2 limit counter	Counts the number of times the additional speed reference is added to speed reference. Note: One counted cycle is considered as appliance of 77.11 Rod torq2 additive speed ref and returning the previous value.	0
	0...100	Rod torque 2 limit counter.	1 = 1
77.14	Rod torq2 time window	Defines the time period at which 77.13 Rod torq2 limit counter exceeds its limit and triggers a fault condition.	0.000 s
	0.000...7200.000 s	Rod torque 2 time window.	10 = 1 s

No.	Name/Value	Description	Def/ FbEq16
78 Pump underload protection		Pump underload protection function.	
78.01	Underload limit display	Selects the pump underload protection measurement as torque or current. See *Pump underload protection*, page 44.	Torque
	Torque	Rod torque value for rod torque protection. See parameters *78.03 Torque1*, *78.05 Torque2* and *78.07 Torque3*, which are percentage of rod torque limits in parameter *74.19 Maximum rod torq ref*.	0
	Current	Motor current value for pump underload protection. See parameters, *78.03 Torque1*, *78.05 Torque2* and *78.07 Torque3*, which are percentage of motor current limits in parameter *99.06 Motor nominal current*.	1
78.02	Underload function	Selects the Pump underload protection function. See section *Settings* on page 44.	No
	No	No reaction on protection condition.	0
	Warning	Display warning message.	1
	Fault	The control program triggers a fault condition and displays the warning message. Note: The fault is triggered only after the pump stops.	2
78.03	Torque1	Defines the torque 1 value used for the Y position of the first X-Y plot to create the user defined underload curve for the system.	1600.00 T(%) or A(%)
	0.00...10000.00 T (%)	Torque 1	10 = 1 T(%) or A(%)
78.04	Speed1	Defines the Rod speed 1 value used for the X position of the first X-Y plot to create the user defined underload curve for the system.	0.00 Prpm, rpm or Hz
	-3600.00 ...3600.00 Prpm	Speed 1	10 = 1 Prpm, rpm or Hz
78.05	Torque2	Defines the Rod torque 2 value used for the Y position of the second X-Y plot to create the user defined underload curve for the system.	1600.00 T(%) or A(%)
	0.00...10000.00 T(%)	Torque 2	10 = 1 T(%) or A(%)
78.06	Speed2	Defines the Rod speed 2 value used for the X position of the second X-Y plot to create the user defined underload curve for the system.	1000.00 Prpm, rpm or Hz
	-3600.00 ...3600.00 Prpm	Speed 2	10 = 1 Prpm, rpm or Hz
78.07	Torque3	Defines the Rod torque 3 value used for the Y position of the third X-Y plot to create the user defined underload curve for the system.	1600.00 T(%) or A(%)
	0.00...10000.00 T(%)	Torque 3	10 = 1 T(%) or A(%)

No.	Name/Value	Description	Def/ FbEq16
78.08	*Speed3*	Defines the Rod speed 3 value used for the X position of the third X-Y plot to create the user defined underload curve for the system.	1500.00 Prpm, rpm or Hz
	-3600.00 ...3600.00 Prpm	Speed 3	10 = 1 Prpm, rpm or Hz
78.09	*Underload delay time*	Defines the time required to confirm the underload condition.	0.000 s
	0.000...100000.000 s	Underload delay time.	10 = 1 s
79 Pump temperature protection		Pump temperature protection function.	
79.01	*Temperature protection function*	Selects the Pump temperature protection function. See the *Pump pressure protection* on page *40*.	No
	No	No reaction on protection condition. Note: However, the PT100 feedback temperature can still be monitored on the keypad at *09.10 Measured temperature*.	0
	Warning	Displays warning message. Warning is triggered when the *09.10 Measured temperature* is greater than *79.08 Warning temperature limit* for 5 sec or the Klixon digital input is false.	1
	Fault	Protection condition triggers fault condition and displays fault message. Fault is triggered when the *09.10 Measured temperature* is greater than *79.09 Fault temperature limit* for 5 sec or the Klixon digital input is false. Note: Fault condition means, that fault is triggered after pump stops.	2
79.02	*Temperature protection device*	Selects *79.01 Temperature protection function* feedback source.	Klixon
	Klixon	Using digital sensor.	0
	PT-100	Using analog sensor.	1
	Both	Using both sensors simultaneously.	2
79.03	*Klixon signal source*	Digital feedback source for the Klixon device.	*FALSE*
	FALSE	Disables digital feedback functionality.	0
	TRUE	Enables digital feedback functionality.	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
	DIO1	Digital input/output DIO1(*11.02 DIO delayed status*, bit 0).	8
	DIO2	Digital input/output DIO2 (*11.02 DIO delayed status*, bit 0).	9
	Other [bit]	Source selection (see *Terms and abbreviations* on page *101*).	-
79.04	*PT100 source*	Analog feedback source for PT100.	Zero
	Zero	Zero.	0

No.	Name/Value	Description	Def/ FbEq16
	AI1 scaled	*12.12 AI1 scaled value* (see page *141*).	1
	AI2 scaled	*12.22 AI2 scaled value* (see page *143*).	2
	Other [bit]	Source selection (see *Terms and abbreviations* on page *101*).	-
79.05	*PT100 exitation source*	Feeding current for 1…3 PT100 sensors.	Zero
	Zero	Zero.	0
	Internal selection	See par *79.06 PT100 internal selection*.	1
	Other [bit]	Source selection (see *Terms and abbreviations* on page *101*).	-
79.06	*PT100 internal selection*	User defined feeding current.	9.10 mA
	0.00...20.00 mA	PT100 internal selection.	100 = 1 mA
79.07	*Number of PT100 sensors in series*	Number of connected PT100 sensors.	1
	1...3	Number of PT100 sensors connected in series.	1 = 1
79.08	*Warning temperature limit*	Temperature limit for displaying warning message.	0.00 °C
	0.00...200.00 °C	Warning temperature limit.	10 = 1 °C
79.09	*Fault temperature limit*	Temperature limit, that triggers a fault.	0.00 °C
	0.00...200.00 °C	Fault temperature limit.	10 = 1 °C

80 Pump backspin control		Basic functions of applications.	
80.01	*Backspin enable*	Enables the Backspin function. See section *Pump backspin control* on page *47*.	Disable
	Disable	Disable backspin function.	0
	Enable	Enable backspin function.	1
	Other	Source selection (see *Terms and abbreviations* on page *101*).	-
80.02	*Backspin ref limit*	Defines the reference speed/frequency limit for the Backspin function. See section *Pump backspin control* on page *47*. WARNING! If *Backspin ref limit* is set to 0, the *Pump backspin control* procedure is ineffective.	0.00 Prpm, rpm or Hz
	-500.00...0.00	Reference limit	10 = 1 Prpm, rpm or Hz
80.03	*Backspin acc time*	Defines the acceleration time for the Backspin function: from zero speed to *80.02 Backspin ref limit*.	0.000 s
	0.000...10000.000 s	Acceleration time	10 = 1 s
80.04	*Backspin stop torque*	Defines a torque limit for the Backspin function. See section *Pump backspin control* on page *47*. When the actual torque is below the limit, Backspin function is complete and it gives coast to stop command to the drive. **Note:** This setting eliminates excessive shut down times.	0.00 N•m or lbft

No.	Name/Value	Description	Def/ FbEq16
	0.00...10000.00 N•m or lbft	Torque limit	10 = 1 N•m or lbft
80.05	*Backspin speed range trim*	Sets the speed reference regulation range for the Backspin function. The figure below illustrates how the range changes depending on the load and the speed range setting. Note: Default = 0% is recommended because it is the safest range of backspin operation to avoid rod damages and drive overvoltage. 	0.00%
	0.00...100.00%	Speed reference in percent of *80.02 Backspin ref limit*.	100 = 1%
80.11	*Start delay enable*	Enables start delay function. See *Pump backspin control* on page *47*.	Disable
	Disable	Disables start delay function.	0
	Enable	Enables start delay function.	1
	DI1	Digital input DI1.	2
	DI2	Digital input DI2.	3
	DI3	Digital input DI3.	4
	DI4	Digital input DI4.	5
	DI5	Digital input DI5.	6
	DI6	Digital input DI6.	7
	DIO1	Digital input/output DIO1.	8
	DIO2	Digital input/output DIO2.	9
	Other [bit]	Source selection (see *Terms and abbreviations* on page *101*).	-
80.12	*Start delay time*	Defines the time delay from the previous drive stop to the next possible start. During this time drive is not allowed to start.	3600.000s
	0.000...4294967.295s	Start delay time	10 = 1s

No.	Name/Value	Description	Def/ FbEq16
90 Feedback selection		Motor and load feedback configuration. See also sections *Encoder support* (page *63*) and *Position counter* (page *66*), and the diagram on page *480*.	
90.01	*Motor speed for control*	Displays the estimated or measured motor speed that is used for motor control, ie. final motor speed feedback selected by parameter *90.41 Motor feedback selection* and filtered by *90.42 Motor speed filter time*. In case measured feedback is selected, it is also scaled by the motor gear function (*90.43 Motor gear numerator* and *90.44 Motor gear denominator*). This parameter is read-only.	-
	-32768.00 … 32767.00 rpm	Motor speed used for control.	See par. *46.01*
90.02	*Motor position*	Displays the motor position (within one revolution) received from the source selected by parameter *90.41 Motor feedback selection*. In case measured feedback is selected, it is also scaled by the motor gear function (*90.43 Motor gear numerator* and *90.44 Motor gear denominator*). This parameter is read-only.	-
	0.00000000 … 1.00000000 rev	Motor position.	32767 = 1 rev
90.03	*Load speed*	Displays the estimated or measured load speed that is used for motor control, ie. final load speed feedback selected by parameter *90.51 Load feedback selection* and filtered by parameter *90.52 Load speed filter time*. In case measured feedback is selected, it is also scaled by the load gear function (*90.53 Load gear numerator* and *90.54 Load gear denominator*). In case motor feedback or estimated feedback is used, it is inversely scaled by *90.61 Gear numerator* and *90.62 Gear denominator* (ie. *90.62* divided by *90.61*). This parameter is read-only.	-
	-32768.00 …32767.00 rpm	Load speed.	See par. *46.01*
90.04	*Load position*	Displays the load position received from the source selected by parameter *90.51 Load feedback selection*. The value is multiplied as specified by parameter *90.57 Load position resolution*. In case measured feedback is selected, it is also scaled by the load gear function (*90.53 Load gear numerator* and *90.54 Load gear denominator*). In case motor feedback or estimated feedback is used, it is inversely scaled by *90.61 Gear numerator* and *90.62 Gear denominator* (ie. *90.62* divided by *90.61*). An offset can be defined by *90.56 Load position offset*. This parameter is read-only.	-
	-2147483648 …2147483647	Load position.	-

No.	Name/Value	Description	Def/ FbEq16
90.05	*Load position scaled*	Displays the scaled load position in decimal format. The position is relative to the initial position set by parameters *90.65* and *90.66*. The number of decimal places is defined by parameter *90.38 Pos counter decimals*. **Note:** This is a floating point parameter, and the accuracy is compromised near the ends of the range. Consider using parameter *90.07 Load position scaled int* instead of this parameter. This parameter is read-only.	-
	-2147483.648 …2147483.647	Scaled load position in decimal format.	-
90.06	*Motor position scaled*	Displays the calculated motor position. The axis mode (linear or rollover) and resolution are defined by parameters *90.48 Motor position axis mode* and *90.49 Motor position resolution* respectively. **Note:** The position value can be sent on a fast time level to the fieldbus controller by selecting *Position* in either *50.07 FBA A actual 1 type*, *50.08 FBA A actual 2 type*, *50.37 FBA B actual 1 type* or *50.38 FBA B actual 2 type*. This parameter is read-only.	-
	-2147483.648 … 2147483.647	Motor position.	-
90.07	*Load position scaled int*	Displays the output of the position counter function. The position is relative to the initial position set by parameters *90.58* and *90.59*. See section *Position counter* (page *66*), and the block diagram on page *481*. This parameter is read-only.	
	-2147483.648 … 2147483.647	Motor position.	-
90.10	*Encoder 1 speed*	Displays encoder 1 speed in rpm. This parameter is read-only.	-
	-32768.00 …32767.00 rpm	Encoder 1 speed.	See par. *46.01*
90.11	*Encoder 1 position*	Displays the actual position of encoder 1 within one revolution. This parameter is read-only.	-
	0.00000000 …1.00000000 rev	Encoder 1 position within one revolution.	32767 = 1 rev
90.12	*Encoder 1 multiturn revolutions*	Displays the revolutions of (multiturn) encoder 1 within its value range (see parameter *92.14 Revolution data width*). This parameter is read-only.	-
	0…16777215	Encoder 1 revolutions.	-

No.	Name/Value	Description	Def/ FbEq16
90.13	*Encoder 1 revolution extension*	Displays the revolution count extension for encoder 1. With a single-turn encoder, the counter is incremented when encoder position (parameter *90.11*) wraps around in the positive direction, and decremented in the negative direction. With a multiturn encoder, the counter is incremented when the revolutions count (parameter *90.12*) exceeds the value range in the positive direction, and decremented in the negative direction. This parameter is read-only.	-
	-2147483648 …2147483647	Encoder 1 revolution count extension.	-
90.14	*Encoder 1 position raw*	Displays the raw measurement data of encoder 1 position (within one revolution) as a 24-bit unsigned integer received from the encoder interface. This parameter is read-only.	-
	0…16777215	Raw encoder 1 position within one revolution.	-
90.15	*Encoder 1 revolutions raw*	Displays the revolutions of (multiturn) encoder 1 within its value range (see parameter *92.14 Revolution data width*) as a raw measurement. This parameter is read-only.	-
	0…16777215	Raw encoder 1 revolution count.	-
90.20	*Encoder 2 speed*	Displays encoder 2 speed in rpm. This parameter is read-only.	-
	-32768.00 …32767.00 rpm	Encoder 2 speed.	See par. *46.01*
90.21	*Encoder 2 position*	Displays the actual position of encoder 2 within one revolution. This parameter is read-only.	-
	0.00000000 …1.00000000 rev	Encoder 2 position within one revolution.	-
90.22	*Encoder 2 multiturn revolutions*	Displays the revolutions of (multiturn) encoder 2 within its value range (see parameter *93.14 Revolution data width*). This parameter is read-only.	-
	0…16777215	Encoder 2 revolutions.	-
90.23	*Encoder 2 revolution extension*	Displays the revolution count extension for encoder 2. With a single-turn encoder, the counter is incremented when encoder position (parameter *90.21*) wraps around in the positive direction, and decremented in the negative direction. With a multiturn encoder, the counter is incremented when the revolutions count (parameter *90.22*) exceeds the value range in the positive direction, and decremented in the negative direction. This parameter is read-only.	-
	-2147483648 …2147483647	Encoder 2 revolution count extension.	-

No.	Name/Value	Description	Def/ FbEq16
90.24	*Encoder 2 position raw*	Displays the raw measurement data of encoder 2 position (within one revolution) as a 24-bit unsigned integer received from the encoder interface. This parameter is read-only.	-
	0…16777215	Raw encoder 2 position within one revolution.	-
90.25	*Encoder 2 revolutions raw*	Displays the revolutions of (multiturn) encoder 2 within its value range (see parameter *93.14 Revolution data width*) as a raw measurement. This parameter is read-only.	-
	0…16777215	Raw encoder 2 revolution count.	-
90.26	*Motor revolution extension*	Displays the motor revolution count extension. The counter is incremented when the position selected by *90.41 Motor feedback selection* wraps around in the positive direction, and decremented in the negative direction. This parameter is read-only.	-
	-2147483648 …2147483647	Motor revolution count extension.	-
90.27	*Load revolution extension*	Displays the load revolution count extension. The counter is incremented when the position selected by *90.51 Load feedback selection* wraps around in the positive direction, and decremented in the negative direction. This parameter is read-only.	-
	-2147483648 …2147483647	Load revolution count extension.	-
90.35	*Pos counter status*	Status information related to the position counter function. See section *Position counter* (page *66*). This parameter is read-only.	-

Bit	Name	Value
0	Encoder 1 feedback	1 = Encoder 1 selected as load feedback source
1	Encoder 2 feedback	1 = Encoder 2 selected as load feedback source
2	Internal position feedback	1 = Internal load position estimate selected as load feedback source
3	Motor feedback	1 = Motor feedback selected as load feedback source
4	Pos counter init ready	1 = Position counter successfully initialized
5	Position counter re-init disabled	1 = Position counter initialization is being prevented by par. *90.68*
6	Position data inaccurate	1 = Encoder feedback intermittent or lost. (If the drive is running, estimated position is used whenever encoder feedback is unavailable. If the drive is in stopped state, position counting will continue based on encoder data after the connection is restored.)
7…15	Reserved	

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

No.	Name/Value	Description	Def/ FbEq16
90.38	*Pos counter decimals*	Scales the values of parameters *90.05 Load position scaled* and *90.65 Pos counter init value* when written from or read to from an external source (eg. fieldbus). The setting corresponds to the number of decimal places. For example, with the setting of 3, an integer value of 66770 written into *90.65 Pos counter init value* is divided by 1000, so the final value applied will be 66.770. Likewise, the value of *90.05 Load position scaled* is multiplied by 1000 when read.	3
	0…9	Number of position counter decimal places.	1 = 1
90.41	*Motor feedback selection*	Selects the motor speed feedback value used during motor control.	*Estimate*
	Estimate	A calculated speed estimate generated from the DTC core is used.	0
	Encoder 1	Actual speed measured by encoder 1. The encoder is set up by the parameters in group *92 Encoder 1 configuration*.	1
	Encoder 2	Actual speed measured by encoder 2. The encoder is set up by the parameters in group *93 Encoder 2 configuration*.	2
90.42	*Motor speed filter time*	Defines a filter time for motor speed feedback used for control (*90.01 Motor speed for control*).	3 ms
	0 … 10000 ms	Motor speed filter time.	1 = 1 ms
90.43	*Motor gear numerator*	Parameters *90.43* and *90.44* define a gear function between the motor speed feedback and motor control. The gear is used to correct a difference between the motor and encoder speeds for example if the encoder is not mounted directly on the motor shaft. $\frac{\text{90.43 Motor gear numerator}}{\text{90.44 Motor gear denominator}} = \frac{\text{Motor speed}}{\text{Encoder speed}}$	1
	-2147483648 …2147483647	Motor gear numerator.	-
90.44	*Motor gear denominator*	See parameter *90.43 Motor gear numerator*.	1
	-2147483648 …2147483647	Motor gear denominator.	-
90.45	*Motor feedback fault*	Selects how the drive reacts to loss of measured motor feedback.	*Fault*
	Fault	Drive trips on a *7301 Motor speed feedback* or *7381 Encoder 1* fault.	0
	Warning	Drive generates a *A7B0 Motor speed feedback* or *A7E1 Encoder* warning and continues operation using estimated feedbacks. **Note:** Before using this setting, test the stability of the speed control loop with estimated feedback by running the drive on estimated feedback (see *90.41 Motor feedback selection*).	1
90.46	*Force open loop*	Defines the speed feedback used by the DTC motor model.	*No*
	No	The motor model uses the feedback selected by *90.41 Motor feedback selection*.	0

No.	Name/Value	Description	Def/ FbEq16
	Yes	The motor model uses the calculated speed estimate (regardless of the setting of *90.41 Motor feedback selection*, which in this case only selects the source of feedback for the speed controller).	1
90.48	*Motor position axis mode*	Selects the axis type for motor position measurement.	*Rollover*
	Linear	Linear.	0
	Rollover	The value is between 0 and 1 revolutions, and rolls over at 360 degrees.	1
90.49	*Motor position resolution*	Defines how many bits are used for motor position count within one revolution. For example, with the setting of 24, the position value is multiplied by 16777216 for display in parameter *90.06 Motor position scaled* (or for fieldbus).	24
	0…31	Motor position resolution.	-
90.51	*Load feedback selection*	Selects the source of load speed and position feedbacks used in control.	*None*
	None	No load feedback selected.	0
	Encoder 1	Load feedbacks are updated based on the speed and position values read from encoder 1. The values are scaled by the load gear function (*90.53 Load gear numerator* and *90.54 Load gear denominator*). The encoder is set up by the parameters in group *92 Encoder 1 configuration*.	1
	Encoder 2	Load feedbacks are updated based on the speed and position values read from encoder 2. The values are scaled by the load gear function (*90.53 Load gear numerator* and *90.54 Load gear denominator*). The encoder is set up by the parameters in group *93 Encoder 2 configuration*.	2
	Estimate	Calculated speed and position estimates are used. The values are scaled from the motor side to the load side using the inverted ratio between *90.61 Gear numerator* and *90.62 Gear denominator* (ie. *90.62* divided by *90.61*).	3
	Motor feedback	The source selected by parameter *90.41 Motor feedback selection* for motor feedback is also used for load feedback. Any difference between the motor and load speeds (and positions) can be compensated by using the inverted ratio between *90.61 Gear numerator* and *90.62 Gear denominator* (*90.62* divided by *90.61*).	4
90.52	*Load speed filter time*	Defines a filter time for load speed feedback (*90.03 Load speed*).	4 ms
	0…10000 ms	Load speed filter time.	-

No.	Name/Value	Description	Def/ FbEq16
90.53	Load gear numerator	Parameters 90.53 and 90.54 define a gear function between the load (ie. driven equipment) speed and the encoder feedback selected by parameter 90.51 Load feedback selection. The gear can be used to correct a difference between the load and encoder speeds for example if the encoder is not mounted directly on the rotated machinery. $$\frac{\text{90.53 Load gear numerator}}{\text{90.54 Load gear denominator}} = \frac{\text{Load speed}}{\text{Encoder speed}}$$	1
	-2147483648 …2147483647	Load gear numerator.	-
90.54	Load gear denominator	See parameter 90.53 Load gear numerator.	1
	-2147483648 … 2147483647	Load gear denominator.	-
90.55	Load feedback fault	Selects how the drive reacts to loss of load feedback.	Fault
	Fault	Drive trips on a 73A1 Load feedback fault.	0
	Warning	Drive generates a A7B1 Load speed feedback warning and continues operation using estimated feedbacks.	1
90.56	Load position offset	Defines a load-side position offset. The resolution is determined by parameter 90.57 Load position resolution.	0 rev
	-2147483648…2147483647 rev	Load-side position offset.	-
90.57	Load position resolution	Defines how many bits are used for load position count within one revolution. For example, with the setting of 16, the position value is multiplied by 65536 for display in parameter 90.04 Load position.	16
	0…31	Load position resolution.	-
90.58	Pos counter init value int	Defines an initial position (or distance) for the position counter (as an integer value) when parameter 90.59 Pos counter init value int source is set to Pos counter init value int. See also section Position counter (page 66).	0
	-2147483648 … 2147483647	Initial integer value for position counter.	-
90.59	Pos counter init value int source	Selects the source of the initial position integer value. When the source selected by 90.67 Pos counter init cmd source activates, the value selected in this parameter is assumed to be the position of the load.	Pos counter init value int
	Zero	0.	0
	Pos counter init value int	Parameter 90.58 Pos counter init value int.	1
	Other	Source selection (see Terms and abbreviations on page 101).	-

No.	Name/Value	Description	Def/ FbEq16
90.61	*Gear numerator*	Parameters *90.61* and *90.62* define a gear function between the motor and load speeds. $$\frac{\text{90.61 Gear numerator}}{\text{90.62 Gear denominator}} = \frac{\text{Motor speed}}{\text{Load speed}}$$	1
	-2147483648 …2147483647	Gear numerator (motor-side).	-
90.62	*Gear denominator*	See parameter *90.61 Gear numerator*.	1
	-2147483648 …2147483647	Gear denominator (load-side).	-
90.63	*Feed constant numerator*	Parameters *90.63* and *90.64* define the feed constant for the position calculation: $$\frac{\text{90.63 Feed constant numerator}}{\text{90.64 Feed constant denominator}}$$ The feed constant converts rotational motion into translatory motion. The feed constant is the distance the load moves during one turn of the motor shaft. The translatory load position is shown by parameter *90.05 Load position scaled*.	1
	-2147483648 …2147483647	Feed constant numerator.	-
90.64	*Feed constant denominator*	See parameter *90.63 Feed constant numerator*.	1
	-2147483648 …2147483647	Feed constant denominator.	-
90.65	*Pos counter init value*	Defines an initial position (or distance) for the position counter (as a decimal number) when parameter *90.66 Pos counter init value source* is set to *Pos counter init value*. See also section *Position counter* (page *66*). The number of decimal places is defined by parameter *90.38 Pos counter decimals*.	0.000
	-2147483.648 …2147483.647	Initial value for position counter.	-
90.66	*Pos counter init value source*	Selects the source of the initial position value. When the source selected by *90.67 Pos counter init cmd source* activates, the value selected in this parameter is assumed to be the position of the load (in decimal format).	*Pos counter init value*
	Zero	0.	0
	Pos counter init value	Parameter *90.65 Pos counter init value*.	1
	Other	Source selection (see *Terms and abbreviations* on page *101*).	-

No.	Name/Value	Description	Def/ FbEq16
90.67	*Pos counter init cmd source*	Selects a digital source (for example, a limit switch connected to a digital input) that initializes the position counter. When the digital source activates, the value selected by *90.66 Pos counter init value source* is assumed to be the position of the load. Note: Position counter initialization can be prevented by parameter *90.68 Disable pos counter initialization*.	*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
	DIO1	Digital input/output DIO1 (*11.02 DIO delayed status*, bit 0).	10
	DIO2	Digital input/output DIO2 (*11.02 DIO delayed status*, bit 1).	11
	Other [bit]	Source selection (see *Terms and abbreviations* on page *101*).	-
90.68	*Disable pos counter initialization*	Selects a source that prevents the initialization of the position counter.	*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
	DIO1	Digital input/output DIO1 (*11.02 DIO delayed status*, bit 0).	10
	DIO2	Digital input/output DIO2 (*11.02 DIO delayed status*, bit 1).	11
	Other [bit]	Source selection (see *Terms and abbreviations* on page *101*).	-
90.69	*Reset pos counter init ready*	Selects a source that enables a new initialization of the position counter, ie. resets bit 4 of *90.35 Pos counter status*.	*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

No.	Name/Value	Description	Def/ FbEq16
	DIO1	Digital input/output DIO1 (*11.02 DIO delayed status*, bit 0).	10
	DIO2	Digital input/output DIO2 (*11.02 DIO delayed status*, bit 1).	11
	Other [bit]	Source selection (see *Terms and abbreviations* on page *101*).	-
91 Encoder module settings		Configuration of encoder interface modules.	
91.01	*FEN DI status*	Displays the status of the digital inputs of FEN-xx encoder interface modules. This parameter is read-only.	-

Bit	Name	Information
0	DI1 /module 1	DI1 of interface module 1 (see parameters *91.11* and *91.12*)
1	DI2 /module 1	DI2 of interface module 1 (see parameters *91.11* and *91.12*)
2…3	Reserved	
4	DI1 /module 2	DI1 of interface module 2 (see parameters *91.13* and *91.14*)
5	DI2 /module 2	DI2 of interface module 2 (see parameters *91.13* and *91.14*)
6…15	Reserved	

No.	Name/Value	Description	Def/ FbEq16
	0000 0000b … 0011 0011b	Status word of digital inputs on FEN-xx modules.	1 = 1
91.02	*Module 1 status*	Displays the type of the interface module found in the location specified by parameter *91.12 Module 1 location*. This parameter is read-only.	-
	No option	No module detected in the specified slot.	0
	No communication	A module has been detected but cannot be communicated with.	1
	Unknown	The module type is unknown.	2
	FEN-01	An FEN-01 module has been detected and is active.	16
	FEN-11	An FEN-11 module has been detected and is active.	17
	FEN-21	An FEN-21 module has been detected and is active.	18
	FEN-31	An FEN-31 module has been detected and is active.	21
	FSE-31	An FSE-31 module has been detected and is active.	25
91.03	*Module 2 status*	Displays the type of the interface module found in the location specified by parameter *91.14 Module 2 location*. For the indications, see parameter *91.02 Module 1 status*. This parameter is read-only.	-
91.04	*Module 1 temperature*	Displays the temperature measured through the sensor input of interface module 1. The unit is selected by parameter *96.16 Unit selection*. Note: With a PTC sensor, the unit is ohms. This parameter is read-only.	-
	0…1000 °C, °F or ohm	Temperature measured through interface module 1.	-

No.	Name/Value	Description	Def/ FbEq16
91.06	*Module 2 temperature*	Displays the temperature measured through the sensor input of interface module 2. The unit is selected by parameter *96.16 Unit selection*. Note: With a PTC sensor, the unit is ohms. This parameter is read-only.	-
	0…1000 °C, °F or ohm	Temperature measured through interface module 2.	-
91.10	*Encoder parameter refresh*	Validates any changed encoder interface module parameters. This is needed for any parameter changes in groups 90…93 to take effect. After refreshing, the value reverts automatically to *Done*. Note: The parameter cannot be changed while the drive is running.	*Done*
	Done	Refreshing done.	0
	Refresh	Refreshing.	1
91.11	*Module 1 type*	Defines the type of the module used as interface module 1.	*None*
	None	None (communication disabled).	0
	FEN-01	FEN-01.	1
	FEN-11	FEN-11.	2
	FEN-21	FEN-21.	3
	FEN-31	FEN-31.	4
	FSE-31	FSE-31.	5
91.12	*Module 1 location*	Specifies the slot (1…3) on the control unit of the drive into which the interface module is installed. Alternatively, specifies the node ID of the slot on an FEA-0x extension adapter.	*Slot 2*
	Slot 1	Slot 1.	1
	Slot 2	Slot 2.	2
	Slot 3	Slot 3.	3
	4…254	Node ID of the slot on the FEA-0x extension adapter.	1 = 1
91.13	*Module 2 type*	Defines the type of the module used as interface module 2.	*None*
	None	None (communication disabled).	0
	FEN-01	FEN-01.	1
	FEN-11	FEN-11.	2
	FEN-21	FEN-21.	3
	FEN-31	FEN-31.	4
	FSE-31	FSE-31.	5
91.14	*Module 2 location*	Specifies the slot (1…3) on the control unit of the drive into which the interface module is installed. Alternatively, specifies the node ID of the slot on an FEA-0x extension adapter.	*Slot 3*
	Slot 1	Slot 1.	1
	Slot 2	Slot 2.	2
	Slot 3	Slot 3.	3
	4…254	Node ID of the slot on the FEA-0x extension adapter.	1 = 1

No.	Name/Value	Description	Def/ FbEq16
91.21	*Module 1 temp sensor type*	Specifies the type of temperature sensor connected to interface module 1.	*None*
	None	None.	0
	PTC	PTC. (The unit is ohms.)	1
	KTY-84	KTY84. (The unit is selected by parameter *96.16 Unit selection*.)	2
91.22	*Module 1 temp filter time*	Defines a filtering time for the temperature measurement through interface module 1.	1500 ms
	0…10000 ms	Filtering time for temperature measurement.	-
91.24	*Module 2 temp sensor type*	Specifies the type of temperature sensor connected to interface module 2.	*None*
	None	None.	0
	PTC	PTC. (The unit is ohms.)	1
	KTY-84	KTY84. (The unit is selected by parameter *96.16 Unit selection*.)	2
91.25	*Module 2 temp filter time*	Defines a filtering time for the temperature measurement through interface 2.	1500 ms
	0…10000 ms	Filtering time for temperature measurement.	-
91.31	*Module 1 TTL output source*	Selects the encoder input on interface module 1 whose signal is echoed by or emulated to the TTL output. See also section *Encoder support* (page *63*).	*Not selected*
	Not selected	TTL output not in use.	0
	Module input 1	Input 1 is echoed by or emulated to the TTL output.	1
	Module input 2	Input 2 is echoed by or emulated to the TTL output.	2
91.32	*Module 1 emulation pulses/rev*	Defines the number of TTL pulses per revolution for encoder emulation output of interface module 1.	0
	0…65535	Number of TTL pulses for emulation.	1 = 1
91.33	*Module 1 emulated Z-pulse offset*	With interface module 1, defines when zero pulses are emulated in relation to zero position received from the encoder. For example, with a value of 0.50000, a zero pulse is emulated whenever the encoder position passes 0.5 revolutions. With a value of 0.00000, a zero pulse is emulated whenever the encoder position passes zero position.	0.00000
	0.00000 … 1.00000 rev	Position of emulated zero pulses.	32767 = 1 rev
91.41	*Module 2 TTL output source*	Selects the encoder input on interface module 2 whose signal is echoed by or emulated to the TTL output. See also section *Encoder support* (page *63*).	*Not selected*
	Not selected	TTL output not in use.	0
	Module input 1	Input 1 is echoed by or emulated to the TTL output.	1
	Module input 2	Input 2 is echoed by or emulated to the TTL output.	2
91.42	*Module 2 emulation pulses/rev*	Defines the number of TTL pulses per revolution for encoder emulation output of interface module 2.	0
	0…65535	Number of TTL pulses for emulation.	1 = 1

No.	Name/Value	Description	Def/ FbEq16
91.43	*Module 2 emulated Z-pulse offset*	With interface module 2, defines when zero pulses are emulated in relation to zero position received from the encoder. For example, with a value of 0.50000, a zero pulse is emulated whenever the encoder position passes 0.5 revolutions. With a value of 0.00000, a zero pulse is emulated whenever the encoder position passes zero position.	0
	0.00000 … 1.00000 rev	Position of emulated zero pulses.	32767 = 1 rev
92 Encoder 1 configuration		Settings for encoder 1. Notes: • The contents of the parameter group vary according to the selected encoder type. • It is recommended that encoder connection 1 (this group) is used whenever possible since the data received through that interface is fresher than the data received through connection 2 (group *93 Encoder 2 configuration*).	
92.01	*Encoder 1 type*	Selects the type of encoder/resolver 1.	*None configured*
	None configured	None.	0
	TTL	TTL. Module type (input): FEN-01 (X31), FEN-11 (X41) or FEN-21 (X51).	1
	TTL+	TTL+ (with commutation signals). Module type (input): FEN-01 (X32).	2
	Absolute encoder	Absolute encoder. Module type (input): FEN-11 (X42).	3
	Resolver	Resolver. Module type (input): FEN-21 (X52).	4
	HTL	HTL. Module type (input): FEN-31 (X82).	5
	HTL 1	HTL. Module type (input): FSE-31 (X31).	6
	HTL 2	HTL. Module type (input): FSE-31 (X32).	7
	TTL 1	TTL. Module type (input): FSE-31 (X31).	8
	TTL 2	TTL. Module type (input): FSE-31 (X32).	9
92.02	*Encoder 1 source*	Selects the interface module that the encoder is connected to. (The physical locations and types of encoder interface modules are defined in parameter group *91 Encoder module settings*.)	*Module 1*
	Module 1	Interface module 1.	0
	Module 2	Interface module 2.	1
92.10	*Pulses/revolution*	*(Visible when TTL, TTL+ or HTL encoder is selected)* Defines the pulse number per revolution.	2048
	0…65535	Number of pulses.	-
92.10	*Sine/cosine number*	*(Visible when an Absolute encoder is selected)* Defines the number of sine/cosine wave cycles within one revolution. **Note:** This parameter need not be set when an EnDat or SSI encoder is used in continuous mode. See parameter *92.30 Serial link mode*.	0
	0…65535	Number of sine/cosine wave cycles within one revolution.	-

No.	Name/Value	Description	Def/ FbEq16
92.10	*Excitation signal frequency*	*(Visible when a resolver is selected)* Defines the frequency of the excitation signal.	1 kHz
	1…20 kHz	Excitation signal frequency.	1 = 1 kHz
92.11	*Pulse encoder type*	*(Visible when a TTL, TTL+ or HTL encoder is selected)* Selects the type of encoder.	*Quadrature*
	Quadrature	Quadrature encoder (with two channels, A and B)	0
	Single track	Single-track encoder (with one channel, A). Note: With this setting, the measured speed value is always positive regardless of direction of rotation.	1
92.11	*Absolute position source*	*(Visible when absolute encoder is selected)* Selects the source of the absolute position information.	*None*
	None	Not selected.	0
	Commut signals	Commutation signals.	1
	EnDat	Serial interface: EnDat encoder.	2
	Hiperface	Serial interface: HIPERFACE encoder.	3
	SSI	Serial interface: SSI encoder.	4
	Tamagawa	Serial interface: Tamagawa 17/33-bit encoder.	5
92.11	*Excitation signal amplitude*	*(Visible when a resolver is selected)* Defines the amplitude of the excitation signal.	4.0 V
	4.0…12.0 V	Excitation signal amplitude.	10 = 1 V
92.12	*Speed calculation mode*	*(Visible when a TTL, TTL+ or HTL is selected)* Selects the speed calculation mode. *With a single-track encoder (parameter *92.11 Pulse encoder type* is set to *Single track*), the speed is always positive.	*Auto rising*
	A&B all	Channels A and B: Rising and falling edges are used for speed calculation. *Channel B: Defines the direction of rotation. Note: With a single-track encoder (parameter *92.11 Pulse encoder type*), this setting acts like setting *A all*.	0
	A all	Channel A: Rising and falling edges are used for speed calculation. *Channel B: Defines the direction of rotation.	1
	A rising	Channel A: Rising edges are used for speed calculation. *Channel B: Defines the direction of rotation.	2
	A falling	Channel A: Falling edges are used for speed calculation. *Channel B: Defines the direction of rotation.	3
	Auto rising	One of the above modes is selected automatically depending on the pulse frequency as follows: **Pulse frequency of the channel(s)** → **Used mode** < 2442 Hz → *A&B all* 2442…4884 Hz → *A all* > 4884 Hz → *A rising*	4

No.	Name/Value	Description	Def/ FbEq16
	Auto falling	One of the above modes is selected automatically depending on the pulse frequency as follows: <table><tr><th>Pulse frequency of the channel(s)</th><th>Used mode</th></tr><tr><td>< 2442 Hz</td><td>*A&B all*</td></tr><tr><td>2442…4884 Hz</td><td>*A all*</td></tr><tr><td>> 4884 Hz</td><td>*A falling*</td></tr></table>	5
92.12	*Zero pulse enable*	*(Visible when an absolute encoder is selected)* Enables the encoder zero pulse for the absolute encoder input (X42) of the FEN-11 interface module. Note: No zero pulse exists with serial interfaces, ie. when parameter *92.11 Absolute position source* is set to *EnDat*, *Hiperface*, *SSI* or *Tamagawa*.	*Disable*
	Disable	Zero pulse disabled.	0
	Enable	Zero pulse enabled.	1
92.12	*Resolver polepairs*	*(Visible when is resolver is selected)* Defines the number of pole pairs of the resolver.	1
	1…32	Number of resolver pole pairs.	1 = 1
92.13	*Position estimation enable*	*(Visible when TTL, TTL+ or HTL is selected)* Selects whether position estimation is used with encoder 1 to increase position data resolution or not.	*Enable*
	Disable	Measured position used. (The resolution is 4 × pulses per revolution for quadrature encoders, 2 × pulses per revolution for single-track encoders.)	0
	Enable	Estimated position used. (Uses position interpolation; extrapolated at the time of data request.)	1
92.13	*Position data width*	*(Visible when an absolute encoder is selected)* Defines the number of bits used to indicate position within one revolution. For example, a setting of 15 bits corresponds to 32768 positions per revolution. The value is used when parameter *92.11 Absolute position source* is set to *EnDat*, *Hiperface* or *SSI*. When parameter *92.11 Absolute position source* is set to *Tamagawa*, this parameter is internally set to 17.	0
	0…32	Number of bits used in position indication within one revolution.	1 = 1
92.14	*Speed estimation enable*	*(Visible when TTL, TTL+ or HTL is selected)* Selects whether calculated or estimated speed is used. Estimation increases the speed ripple in steady state operation, but improves the dynamics.	*Disable*
	Disable	Last calculated speed used. (The calculation interval is 62.5 microseconds to 4 milliseconds.)	0
	Enable	Estimated speed (estimated at the time of data request) is used.	1

No.	Name/Value	Description	Def/ FbEq16
92.14	*Revolution data width*	*(Visible when an absolute encoder is selected)* Defines the number of bits used in revolution counting with a multiturn encoder. For example, a setting of 12 bits would support counting up to 4096 revolutions. The value is used when parameter *92.11 Absolute position source* is set to *EnDat*, *Hiperface* or *SSI*. When parameter *92.11 Absolute position source* is set to *Tamagawa*, setting this parameter to a non-zero value activates multiturn data requesting.	0
	0…32	Number of bits used in revolution count.	1 = 1
92.15	*Transient filter*	*(Visible when a TTL, TTL+ or HTL is selected)* Activates transient filtering for the encoder (changes in direction of rotation are ignored above the selected pulse frequency).	*4880 Hz*
	4880 Hz	Change in direction of rotation allowed below 4880 Hz.	0
	2440 Hz	Change in direction of rotation allowed below 2440 Hz.	1
	1220 Hz	Change in direction of rotation allowed below 1220 Hz.	2
	Disabled	Change in direction of rotation allowed at any pulse frequency.	3
92.16	*Encoder 1 supply voltage*	*(Visible when parameter 92.01 Encoder 1 type = HTL 1, HTL 2, TTL 1 or TTL 2)* Selects the power supply voltage for encoder 1.	*0V*
	0V	Disabled.	0
	5V	5 V.	1
	24V	24 V.	2
92.17	*Accepted pulse freq of encoder 1*	*(Visible when parameter 92.01 Encoder 1 type = HTL 1, HTL 2, TTL 1 or TTL 2)* Defines the maximum pulse frequency of encoder 1.	0 kHz
	0…300 kHz	Pulse frequency.	1 = 1 kHz
92.21	*Encoder cable fault mode*	*(Visible when a TTL, TTL+ or HTL is selected)* Selects which encoder cable channels and wires are monitored for wiring faults.	*A, B*
	A, B	A and B.	0
	A, B, Z	A, B and Z.	1
	A+, A-, B+, B-	A+, A-, B+ and B-.	2
	A+, A-, B+, B-, Z+, Z-	A+, A-, B+, B-, Z+ and Z-.	3
92.30	*Serial link mode*	*(Visible when an absolute encoder is selected)* Selects the serial link mode with an EnDat or SSI encoder.	*Initial position*
	Initial position	Single position transfer mode (initial position).	0
	Continuous	Continuous position data transfer mode.	1
	Continuous speed and position	Continuous speed and position data transfer mode. This setting is intended for EnDat 2.2 encoders without sin/cos signals. **Note:** This setting requires an FEN-11 interface revision H or later.	2

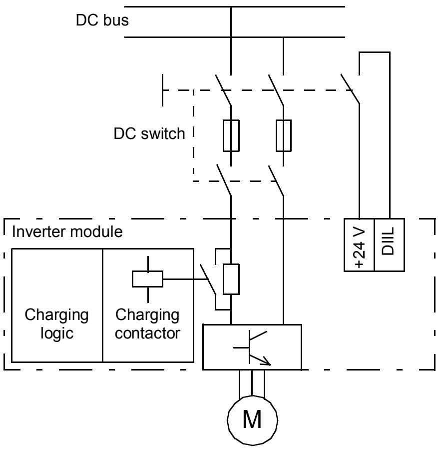
No.	Name/Value	Description	Def/ FbEq16
92.31	*EnDat max calculation time*	*(Visible when an absolute encoder is selected)* Selects the maximum encoder calculation time for an EnDat encoder. Note: This parameter needs to be set only when an EnDat encoder is used in continuous mode, ie. without incremental sin/cos signals (supported only as encoder 1). See also parameter *92.30 Serial link mode*.	*50 ms*
	10 us	10 microseconds.	0
	100 us	100 microseconds.	1
	1 ms	1 millisecond.	2
	50 ms	50 milliseconds.	3
92.32	*SSI cycle time*	*(Visible when an absolute encoder is selected)* Selects the transmission cycle for an SSI encoder. Note: This parameter needs to be set only when an SSI encoder is used in continuous mode, ie. without incremental sin/cos signals (supported only as encoder 1). See also parameter *92.30 Serial link mode*.	*100 us*
	50 us	50 microseconds.	0
	100 us	100 microseconds.	1
	200 us	200 microseconds.	2
	500 us	500 microseconds.	3
	1 ms	1 millisecond.	4
	2 ms	2 milliseconds.	5
92.33	*SSI clock cycles*	*(Visible when an absolute encoder is selected)* Defines the length of an SSI message. The length is defined as the number of clock cycles. The number of cycles can be calculated by adding 1 to the number of bits in an SSI message frame.	2
	2…127	SSI message length.	-
92.34	*SSI position msb*	*(Visible when an absolute encoder is selected)* With an SSI encoder, defines the location of the MSB (most significant bit) of the position data within an SSI message.	1
	1…126	Position data MSB location (bit number).	-
92.35	*SSI revolution msb*	*(Visible when an absolute encoder is selected)* With an SSI encoder, defines the location of the MSB (most significant bit) of the revolution count within an SSI message.	1
	1…126	Revolution count MSB location (bit number).	-
92.36	*SSI data format*	*(Visible when an absolute encoder is selected)* Selects the data format for an SSI encoder.	*Binary*
	Binary	Binary code.	0
	Gray	Gray code.	1
92.37	*SSI baud rate*	*(Visible when an absolute encoder is selected)* Selects the baud rate for an SSI encoder.	*100 kBit/s*
	10 kBit/s	10 kbit/s.	0
	50 kBit/s	50 kbit/s.	1

No.	Name/Value	Description	Def/ FbEq16
	100 kBit/s	100 kbit/s.	2
	200 kBit/s	200 kbit/s.	3
	500 kBit/s	500 kbit/s.	4
	1000 kBit/s	1000 kbit/s.	5
92.40	*SSI zero phase*	*(Visible when an absolute encoder is selected)* Defines the phase angle within one sine/cosine signal period that corresponds to the value of zero on the SSI serial link data. The parameter is used to adjust the synchronization of the SSI position data and the position based on sine/cosine incremental signals. Incorrect synchronization may cause an error of ±1 incremental period. Note: This parameter needs to be set only when an SSI encoder is used in initial position mode (see parameter *92.30 Serial link mode*).	*315-45 deg*
	315-45 deg	315-45 degrees.	0
	45-135 deg	45-135 degrees.	1
	135-225 deg	135-225 degrees.	2
	225-315 deg	225-315 degrees.	3
92.45	*Hiperface parity*	*(Visible when an absolute encoder is selected)* Defines the use of parity and stop bits with a HIPERFACE encoder. Typically this parameter need not be set.	*Odd*
	Odd	Odd parity indication bit, one stop bit.	0
	Even	Even parity indication bit, one stop bit.	1
92.46	*Hiperface baud rate*	*(Visible when an absolute encoder is selected)* Defines the transfer rate of the link with a HIPERFACE encoder. Typically this parameter need not be set.	*4800 bits/s*
	4800 bits/s	4800 bit/s.	0
	9600 bits/s	9600 bit/s.	1
	19200 bits/s	19200 bit/s.	2
	38400 bits/s	38400 bit/s.	3
92.47	*Hiperface node address*	*(Visible when an absolute encoder is selected)* Defines the node address for a HIPERFACE encoder. Typically this parameter need not be set.	64
	0…255	HIPERFACE encoder node address.	-

No.	Name/Value	Description	Def/ FbEq16
93 Encoder 2 configuration		Settings for encoder 2. Note: • The contents of the parameter group vary according to the selected encoder type. • It is recommended that encoder connection 1 (group *92 Encoder 1 configuration*) is used whenever possible since the data received through that interface is fresher than the data received through connection 2 (this group).	
93.01	*Encoder 2 type*	Selects the type of encoder/resolver 2.	*None configured*
	None configured	None.	0
	TTL	TTL. Module type (input): FEN-01 (X31), FEN-11 (X41) or FEN-21 (X51).	1
	TTL+	TTL+ (with commutation signals). Module type (input): FEN-01 (X32).	2
	Abs enc	Absolute encoder. Module type (input): FEN-11 (X42).	3
	Resolver	Resolver. Module type (input): FEN-21 (X52).	4
	HTL	HTL. Module type (input): FEN-31 (X82).	5
	HTL 1	HTL. Module type (input): FSE-31 (X31).	6
	HTL 2	HTL. Module type (input): FSE-31 (X32).	7
	TTL 1	TTL. Module type (input): FSE-31 (X31).	8
	TTL 2	TTL. Module type (input): FSE-31 (X32).	9
93.02	*Encoder 2 source*	Selects the interface module that the encoder is connected to. (The physical locations and types of encoder interface modules are defined in parameter group *91 Encoder module settings*.)	*Module 1*
	Module 1	Interface module 1.	1
	Module 2	Interface module 2.	2
93.10	*Pulses/revolution*	(Visible when TTL, TTL+ or HTL encoder is selected) See parameter *92.10 Pulses/revolution*.	2048
93.10	*Sine/cosine number*	(Visible when an absolute encoder is selected) See parameter *92.10 Sine/cosine number*.	0
93.10	*Excitation signal frequency*	(Visible when a resolver is selected) See parameter *92.10 Excitation signal frequency*.	1 kHz
93.11	*Pulse encoder type*	(Visible when TTL, TTL+ or HTL encoder is selected) See parameter *92.11 Pulse encoder type*.	*Quadrature*
93.11	*Absolute position source*	(Visible when an absolute encoder is selected) See parameter *92.11 Absolute position source*.	*None*
93.11	*Excitation signal amplitude*	(Visible when a resolver is selected) See parameter *92.11 Excitation signal amplitude*.	4.0 V
93.12	*Speed calculation mode*	(Visible when TTL, TTL+ or HTL encoder is selected) See parameter *92.12 Speed calculation mode*.	*Auto rising*
93.12	*Zero pulse enable*	(Visible when an absolute encoder is selected) See parameter *92.12 Zero pulse enable*.	*Disable*

No.	Name/Value	Description	Def/ FbEq16
93.12	*Resolver polepairs*	(Visible when a resolver is selected) See parameter *92.12 Resolver polepairs*.	1
93.13	*Position estimation enable*	(Visible when TTL, TTL+ or HTL encoder is selected) See parameter *92.13 Position estimation enable*.	*Enable*
93.13	*Position data width*	(Visible when an absolute encoder is selected) See parameter *92.13 Position data width*.	0
93.14	*Speed estimation enable*	(Visible when TTL, TTL+ or HTL encoder is selected) See parameter *92.14 Speed estimation enable*.	*Disable*
93.14	*Revolution data width*	(Visible when an absolute encoder is selected) See parameter *92.14 Revolution data width*.	0
93.15	*Transient filter*	(Visible when TTL, TTL+ or HTL encoder is selected) See parameter *92.15 Transient filter*.	*4880 Hz*
93.16	*Encoder 2supply voltage*	*(Visible when parameter 93.01 Encoder 2 type = HTL 1, HTL 2, TTL 1 or TTL 2)* See parameter *92.16 Encoder 1 supply voltage*.	*0V*
93.17	*Accepted pulse freq of encoder 2*	*(Visible when parameter 93.01 Encoder 2 type = HTL 1, HTL 2, TTL 1 or TTL 2)* See parameter *92.17 Accepted pulse freq of encoder 1*.	0 kHz
93.21	*Encoder cable fault mode*	((Visible when TTL, TTL+ or HTL encoder is selected) See parameter *92.21 Encoder cable fault mode*.	*A, B*
93.30	*Serial link mode*	(Visible when an absolute encoder is selected) See parameter *92.30 Serial link mode*.	*Initial position*
93.31	*EnDat calc time*	(Visible when an absolute encoder is selected) See parameter *92.31 EnDat max calculation time*.	*50 ms*
93.32	*SSI cycle time*	(Visible when an absolute encoder is selected) See parameter *92.32 SSI cycle time*.	*100 us*
93.33	*SSI clock cycles*	(Visible when an absolute encoder is selected) See parameter *92.33 SSI clock cycles*.	2
93.34	*SSI position msb*	(Visible when an absolute encoder is selected) See parameter *92.34 SSI position msb*.	1
93.35	*SSI revolution msb*	(Visible when an absolute encoder is selected) See parameter *92.35 SSI revolution msb*.	1
93.36	*SSI data format*	(Visible when an absolute encoder is selected) See parameter *92.36 SSI data format*.	*Binary*
93.37	*SSI baud rate*	(Visible when an absolute encoder is selected) See parameter *92.37 SSI baud rate*.	*100 kBit/s*
93.40	*SSI zero phase*	(Visible when an absolute encoder is selected) See parameter *92.40 SSI zero phase*.	*315-45 deg*
93.45	*Hiperface parity*	(Visible when an absolute encoder is selected) See parameter *92.45 Hiperface parity*.	*Odd*
93.46	*Hiperface baud rate*	(Visible when an absolute encoder is selected) See parameter *92.46 Hiperface baud rate*.	*4800 bits/s*
93.47	*Hiperface node address*	(Visible when an absolute encoder is selected) See parameter *92.47 Hiperface node address*.	64

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.	-
	Not given	No voltage range selected. The drive will not start modulating before a range is selected.	0
	208…240 V	208…240 V	1
	380…415 V	380…415 V	2
	440…480 V	440…480 V	3
	500 V	500 V	4
	525…600 V	525…600 V	5
	660…690 V	660…690 V	6
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.	Disable
	Disable	Adaptive voltage limits disabled.	0
	Enable	Adaptive voltage limits enabled.	1
95.04	Control board supply	Specifies how the control unit of the drive is powered.	Internal 24V; External 24V (95.20 b4)
	Internal 24V	The drive control unit is powered from the drive power unit it is connected to.	0
	External 24V	The drive control unit is powered from an external power supply.	1
	Redundant external 24V	(Type BCU control units only) The drive control unit is powered from two redundant external power supplies. The loss of one of the supplies generates a warning (AFEC External power signal missing).	2

No.	Name/Value	Description	Def/ FbEq16
95.08	*DC switch monitoring*	Enables/disables DC switch monitoring via the DIIL input. This setting is intended for use with inverter modules with an internal charging circuit that are connected to the DC bus through a DC switch. An auxiliary contact of the DC switch must be wired to the DIIL input so that the input switches off when the DC switch is opened.  If the DC switch is opened with the inverter running, the inverter is given a coast-to-stop command, and its charging circuit activated. Starting the inverter is prevented until the DC switch is closed and the DC circuit in the inverter unit recharged. Notes: • By default, DIIL is the input for the Run enable signal. Adjust *20.12 Run enable 1 source* if necessary. • An internal charging circuit is standard on some inverter module types but optional on others; check with your local ABB representative.	*Disable*; *Enable* (*95.20* b5)
	Disable	DC switch monitoring through the DIIL input disabled.	0
	Enable	DC switch monitoring through the DIIL input enabled.	1
95.09	*Fuse switch control*	Activates communication to a xSFC charging controller. This setting is intended for use with inverter modules that are connected to a DC bus through a DC switch/charging circuit controlled by a charging controller. The charging controller monitors the charging of the inverter unit, and sends an enable command when the charging has finished. When the DC switch is opened, the charging controller stops the inverter. For more information, see xSFC documentation.	*Disable*; *Enable* (*95.20* b7)
	Disable	Communication with xSFC disabled.	0
	Enable	Communication with xSFC enabled.	1
	0000h…FFFFh	Inverter modules connected.	1 = 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 = An ‘Ex’ motor is connected to the output of the drive/inverter. To be activated if an ‘Ex’ motor is used, and located in a potentially explosive atmosphere.
1	ABB Sine filter	1 = An ABB sine filter is connected to the output of the drive/inverter.
2	High speed mode	1 = Switching frequency adaptation to output frequency active. This setting improves control performance at high output frequencies (typically above 112 Hz).
3…15	Reserved	

No.	Name/Value	Description	Def/ FbEq16
	0000b…0111b	Hardware options configuration word.	1 = 1

No.	Name/Value	Description	Def/ FbEq16
95.20	*HW options word 1*	Specifies hardware-related options that require differentiated parameter defaults. Activating a bit in this parameter makes the necessary changes in other parameters – for example, activating an emergency stop option reserves a digital input. In most cases, the differentiated parameters will also be write-protected. This parameter, as well as the changes in other parameters implemented by it, are not affected by a parameter restore.	-

Bit	Name	Information
0	Supply frequency 60 Hz	0 = 50 Hz; 1 = 60 Hz. Affects parameters *11.45*, *11.59*, *12.20*, *13.18*, *30.11*, *30.12*, *30.13*, *30.14*, *31.26*, *31.27*, *46.01*, *46.02*.
1	Emergency stop Cat 0	Emergency stop, Category 0, without FSO module. Affects parameters *21.04*, *21.05*, *23.11*.
2	Emergency stop Cat 1	Emergency stop, Category 1, without FSO module. Affects parameters *10.24*, *21.04*, *21.05*, *23.11*.
3	RO2 for -07 cabinet cooling fan	1 = Control of cabinet cooling fan (used only with specific ACS880-07 hardware). Affects parameters *10.27*, *10.28*, *10.29*.
4	Externally powered control unit	1 = Control unit powered externally. Affects parameter *95.04*.
5	DC supply switch	1 = DC switch monitoring active. Affects parameters *20.12*, *31.03*, *95.08*. **Note:** Setting this bit activates the Run enable signal. Recheck *20.12* and adjust if necessary
6	DOL motor switch	1 = Motor fan control active. Affects parameters *10.24*, *35.100*, *35.103*, *35.104*.
7	xSFC-01 fuse switch controller	1 = xSFC charging controller used. Affects parameter *95.09*.
8	Service switch	1 = Service switch connected. Affects parameters *31.01*, *31.02*.
9	Output contactor	1 = Output contactor present. Affects parameters *10.24*, *20.12*.
10	Brake resistor, sine filter, IP54 fan	1 = Status (eg. thermal) switches connected to DIIL input. Affects *20.11*, *20.12*.
11	INU-DSU communication	Supply unit control by inverter unit. 1 = Yes (activates communication through RDCO module CH1)
12	Reserved	
13	Du/dt filter activation	1 = A du/dt filter is connected to the drive/inverter output. **Note:** This bit is to be left at 0 if the drive/inverter module is equipped with internal du/dt filtering (for example, frame R8i inverter modules with option +E205).
14	DOL fan activation	Reserved
15	INU-ISU communication	1 = IGBT supply unit control by inverter unit active.

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

No.	Name/Value	Description	Def/ FbEq16
95.21	*HW options word 2*	Specifies more hardware-related options that require differentiated parameter defaults. See parameter *95.20 HW options word 1*.	-
		<table><tr><th>Bit</th><th>Name</th><th>Information</th></tr><tr><td>0</td><td>Dual use</td><td>1 = Dual use active. For drives with option +N8200. (Allows higher output frequencies and frequency reference limits.)</td></tr><tr><td>1…15</td><td>Reserved</td><td></td></tr></table>	
	0000h…FFFFh	Hardware options configuration word 2.	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. **Note:** • 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.)	-
	Not selected	None.	0
	English	English.	1033
	Deutsch	German.	1031
	Italiano	Italian.	1040
	Español	Spanish.	3082
	Portugues	Portuguese.	2070
	Nederlands	Dutch.	1043
	Français	French.	1036
	Dansk	Danish.	1030
	Suomi	Finnish.	1035
	Svenska	Swedish.	1053
	Russki	Russian.	1049
	Polski	Polish.	1045
	Czech	Czech.	1029
	Chinese (Simplified, PRC)	Simplified Chinese.	2052
	Türkçe	Turkish.	1055
96.02	*Pass code*	Pass codes can be entered into this parameter to activate further access levels, for example additional parameters, parameter lock, etc. See parameter *96.03 Access levels active*. Entering “358” toggles the parameter lock, which prevents the changing of all other parameters through the control panel or the Drive composer PC tool.	0
	0…99999999	Pass code.	-

No.	Name/Value	Description	Def/ FbEq16
96.03	*Access levels active*	Shows which access levels have been activated by pass codes entered into parameter *96.02 Pass code*. This parameter is read-only. **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	0001h
	0000h…FFFFh	Active access levels.	-
96.04	*Macro select*	Selects the application macro. For more information, see *ACS880 primary control program firmware manual (3AUA0000085967[English])*. After a selection is made, the parameter reverts automatically to *Done*.	*Done*
	Done	Macro selection complete; normal operation.	0
	Factory	Factory macro	1
	Hand/Auto	Hand/Auto macro	2
	Sequence control	Sequential control macro	5
	FIELDBUS	Reserved.	6
96.05	*Macro active*	Shows which application macro is currently selected. For more information, see *ACS880 primary control program firmware manual (3AUA0000085967[English])*. To change the macro, use parameter *96.04 Macro select*.	*Factory*
	Factory	Factory macro	1
	Hand/Auto	Hand/Auto macro	2
	Sequence control	Sequential control macro	5
	FIELDBUS	Fieldbus control macro	6
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	All editable parameter values are restored to default values, except • motor data and ID run results • parameter *31.42 Overcurrent fault limit* • control panel/PC communication settings • I/O extension module settings • fieldbus adapter settings • encoder configuration data • application macro selection and the parameter defaults implemented by it • parameter *95.01 Supply voltage* • parameter *95.20 HW options word 1* and the differentiated defaults implemented by it.	8
	Clear all	All editable parameter values are restored to default values, except • control panel/PC communication settings • fieldbus adapter settings • application macro selection and the parameter defaults implemented by it • parameter *95.01 Supply voltage* • parameter *95.20 HW options word 1* and the differentiated defaults implemented by it. PC tool communication is interrupted during the restoring.	62
96.07	*Parameter save manually*	Saves the valid parameter values to permanent memory. This parameter should be used to store values sent from a fieldbus, or when using an external power supply to the control board as the supply might have 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.	0
	0…1	1 = Reboot the control unit.	1 = 1
96.09	*FSO reboot*	Changing the value of (or the source selected by) this parameter to 1 reboots the optional FSO-xx safety functions module. **Note:** The value does not reverts to 0 automatically.	*FALSE*
	FALSE	0.	0
	True	1.	1
	Other [bit]	Source selection (see *Terms and abbreviations* on page *101*).	-
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 *92*).	-
	n/a	No user parameter sets have been saved.	0
	Loading	A user set is being loaded.	1

<table>
<tr><th>No.</th><th>Name/Value</th><th>Description</th><th>Def/
FbEq16</th></tr>
<tr><td></td><td>Saving</td><td>A user set is being saved.</td><td>2</td></tr>
<tr><td></td><td>Faulted</td><td>Invalid or empty parameter set.</td><td>3</td></tr>
<tr><td></td><td>User set 1</td><td>User set 1 has been loaded.</td><td>4</td></tr>
<tr><td></td><td>User set 2</td><td>User set 2 has been loaded.</td><td>5</td></tr>
<tr><td></td><td>User set 3</td><td>User set 3 has been loaded.</td><td>6</td></tr>
<tr><td></td><td>User set 4</td><td>User set 4 has been loaded.</td><td>7</td></tr>
<tr><td>96.11</td><td>User set save/load</td><td>Enables the saving and restoring of up to four custom sets of parameter settings. See section User parameter sets (page 92).
The set that was in use before powering down the drive is in use after the next power-up.
Notes:
• Hardware configuration settings such as I/O extension module, fieldbus and encoder configuration parameters (groups 14…16, 47, 51…56, 58 and 92…93) are forced input/output values (such as 10.03 and 10. 04) 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.</td><td>No action</td></tr>
<tr><td></td><td>No action</td><td>Load or save operation complete; normal operation.</td><td>0</td></tr>
<tr><td></td><td>User set I/O mode</td><td>Load user parameter set using parameters 96.12 User set IO sel in1 and 96.13 User set IO sel in2.</td><td>1</td></tr>
<tr><td></td><td>Load set 1</td><td>Load user parameter set 1.</td><td>2</td></tr>
<tr><td></td><td>Load set 2</td><td>Load user parameter set 2.</td><td>3</td></tr>
<tr><td></td><td>Load set 3</td><td>Load user parameter set 3.</td><td>4</td></tr>
<tr><td></td><td>Load set 4</td><td>Load user parameter set 4.</td><td>5</td></tr>
<tr><td></td><td>Save to set 1</td><td>Save user parameter set 1.</td><td>18</td></tr>
<tr><td></td><td>Save to set 2</td><td>Save user parameter set 2.</td><td>19</td></tr>
<tr><td></td><td>Save to set 3</td><td>Save user parameter set 3.</td><td>20</td></tr>
<tr><td></td><td>Save to set 4</td><td>Save user parameter set 4.</td><td>21</td></tr>
<tr><td>96.12</td><td>User set IO sel in1</td><td>When parameter 96.11 User set save/load is set to User set I/O mode, selects the user parameter set together with parameter 96.13 User set IO sel in2 as follows:
<table><tr><th>Status of source defined by par. 96.12</th><th>Status of source defined by par. 96.13</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>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>
</table>

No.	Name/Value	Description	Def/ FbEq16
	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
	DIO1	Digital input/output DIO1 (*11.02 DIO delayed status*, bit 0).	10
	DIO2	Digital input/output DIO2 (*11.02 DIO delayed status*, bit 1).	11
	Other [bit]	Source selection (see *Terms and abbreviations* on page *101*).	-
96.13	*User set IO sel in2*	See parameter *96.12 User set IO sel in1*.	*Not selected*
96.16	*Unit selection*	Selects the unit of parameters indicating power, temperature and torque.	0000 0000b

Bit	Name	Information
0	Power unit	0 = kW
		1 = hp
1	Reserved	
2	Temperature unit	0 = C (°C)
		1 = F (°F)
3	Reserved	
4	Torque unit	0 = Nm (N·m)
		1 = lbft (lb·ft)
5…15	Reserved	

No.	Name/Value	Description	Def/ FbEq16
	0000 0000b…0001 0101b	Unit selection word.	1 = 1
96.20	*Time sync primary source*	Defines the 1st priority external source for synchronization of the drive’s time and date.	*DDCS Controller*
	Internal	No external source selected.	0
	DDCS Controller	External controller.	1
	Fieldbus A or B	Fieldbus interface A or B.	2
	Fieldbus A	Fieldbus interface A.	3
	Fieldbus B	Fieldbus interface B.	4
	Embedded FB	Reserved.	6
	Embedded Ethernet	Ethernet port on type BCU control unit.	7
	Panel link	Control panel, or Drive composer PC tool connected to the control panel.	8
	Ethernet tool link	Drive composer PC tool through an FENA module.	9
96.24	*Full days since 1st Jan 1980*	Number of full days passed since beginning of the year 1980. This parameter, together with *96.25 Time in minutes within 24 h* and *96.26 Time in ms within one minute* makes it possible to set the date and time in the drive via the parameter interface from a fieldbus or application program. This may be necessary if the fieldbus protocol does not support time synchronization.	-
	1…59999	Days since beginning of 1980.	1 = 1

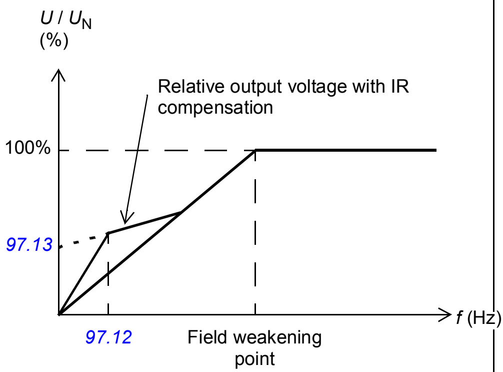
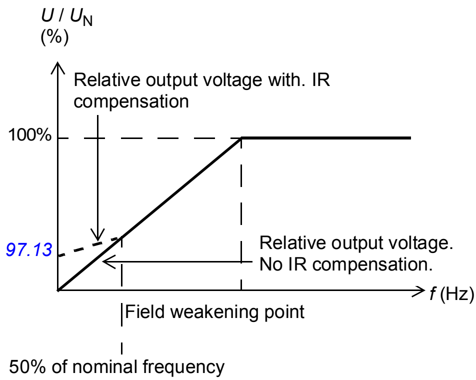
No.	Name/Value	Description	Def/ FbEq16
96.25	*Time in minutes within 24 h*	Number of full minutes passed since midnight. For example, the value 860 corresponds to 2:20 pm. See parameter *96.24 Full days since 1st Jan 1980*.	0 min
	1…1439	Minutes since midnight.	1 = 1
96.26	*Time in ms within one minute*	Number of milliseconds passed since last minute. See parameter *96.24 Full days since 1st Jan 1980*.	0 ms
	0…59999	Number of milliseconds since last minute.	1 = 1
96.29	*Time sync source status*	Time source status word. This parameter is read-only.	-

Bit	Name	Description
0	Time tick received	1 = 1st priority tick received: Tick has been received from 1st priority source.
1	Aux Time tick received	1 = 2nd priority tick received: Tick has been received from 2nd priority source.
2	Tick interval is too long	1 = Yes: Tick interval too long (accuracy compromised).
3	DDCS controller	1 = Tick received: Tick has been received from an external controller.
4	Master/Follower	1 = Tick received: Tick has been received through the master/follower link.
5	Reserved	
6	D2D	1 = Tick received: Tick has been received through the drive-to-drive link.
7	FbusA	1 = Tick received: Tick has been received through fieldbus interface A.
8	FbusB	1 = Tick received: Tick has been received through fieldbus interface B.
9	EFB	1 = Tick received: Tick has been received through the embedded fieldbus interface.
10	Ethernet	1 = Tick received: Tick has been received through the Ethernet port on type BCU control unit.
11	Panel link	1 = Tick received: Tick has been received from the control panel, or Drive composer PC tool connected to the control panel.
12	Ethernet tool link	1 = Tick received: Tick has been received from Drive composer PC tool through an FENA module.
13	Parameter setting	1 = Tick received: Tick has been set by parameters *96.24*…*96.26*.
14	RTC	1 = RTC time in use: Time and date have been read from the real-time clock.
15	Drive On-Time	1 = Drive on-time in use: Time and date are displaying drive on-time.

No.	Name/Value	Description	Def/ FbEq16
	0000h…FFFFh	Time source status word 1.	1 = 1
96.31	*Drive ID number*	Specifies an ID number for the drive. The ID can be read by an external controller through DDCS, for example, for comparison with an ID contained by the controller’s application.	0
	0...32767	Drive ID number	1 = 1

No.	Name/Value	Description	Def/ FbEq16
97 Motor control		Motor model settings.	
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*). See section *Flux braking* (page *75*). 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
	Full	Maximum braking power. Almost all available current is used to convert the mechanical braking energy to thermal energy in the motor.	2
97.06	Flux reference select	Defines the source of flux reference. Note: This is an expert level parameter and should not be adjusted without appropriate skill.	*User flux reference*
	Zero	None.	0
	User flux reference	Parameter *97.07 User flux reference*.	1
	Other	Source selection (see *Terms and abbreviations* on page *101*).	-
97.07	User flux reference	Defines the flux reference when parameter *97.06 Flux reference select* is set to *User flux reference*.	100.00%
	0.00…200.00%	User-defined flux reference.	100 = 1%

No.	Name/Value	Description	Def/ FbEq16
97.09	*Switching freq 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
	Cyclic	Control performance optimized for cyclic load applications. Note: This setting is not suitable for long motor cables.	2
	Custom	This setting is to be used by ABB-authorized service personnel only. **Note:** This setting may require derating. Refer to the rating data in the Hardware manual.	3
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
97.12	*IR comp step-up frequency*	IR compensation (ie. output voltage boost) can be used in step-up applications to compensate for resistive losses in the step-up transformer, cabling and motor. As voltage cannot be fed through a step-up transformer at 0 Hz, a specific type of IR compensation should be used. This parameter adds a frequency breakpoint for parameter *97.13 IR compensation* as shown below.  0.0 Hz = Breakpoint disabled	0.0 Hz
	0.0...50.0 Hz	IR compensation breakpoint for step-up applications.	1 = 1 Hz
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 direct torque control (DTC mode) cannot be applied.  See also section *IR compensation for scalar motor control* on page *72*.	0.00%
	0.00…50.00%	Voltage boost at zero speed in percent of nominal motor voltage.	1 = 1%

No.	Name/Value	Description	Def/ FbEq16
97.15	*Motor model temperature adaptation*	Selects whether the temperature-dependent parameters (such as stator or rotor resistance) of the motor model adapt to actual (measured or estimated) temperature or not. See parameter group *35 Motor thermal protection* for selection of temperature measurement sources.	*Disabled*
	Disabled	Temperature adaptation of motor model disabled.	0
	Estimated temperature	Estimated temperature (*35.01 Motor estimated temperature*) used for adaptation of motor model.	1
	Measured temperature 1	Measured temperature 1 (*35.02 Measured temperature 1*) used for adaptation of motor model.	2
	Measured temperature 2	Measured temperature 2 (*35.03 Measured temperature 2*) used for adaptation of motor model.	3
97.32	*Motor torque unfiltered*	Unfiltered motor torque in percent of the nominal motor torque	
	-1600.0 … 1600.0%	Unfiltered motor torque.	
97.33	*Speed estimate filter time*	Defines a filtering time for estimated speed. See the diagram on page *480*.	5.00 ms
	0.00 … 100.00 ms	Filtering time for estimated speed.	1 = 1 ms

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*…*98.14* and the rotor angle offset parameter *98.15*. 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*…*98.15* 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 datasheet from a motor manufacturer. • This parameter cannot be changed while the drive is running.	*Not selected*
	Not selected	Parameters *98.02*…*98.15* inactive.	0
	Motor parameters	The values of parameters *98.02*…*98.14* are used as the motor model.	1
	Position offset	The value of parameter *98.15* is used as the rotor angle offset. Parameters *98.02*…*98.14* are inactive.	2
	Motor parameters & position offset	The values of parameters *98.02*…*98.14* are used as the motor model, and the value of parameter *98.15* is used as the rotor angle offset.	3

No.	Name/Value	Description	Def/ FbEq16
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.	-
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…100000.01 mH	Main inductance.	1 = 10000 mH

No.	Name/Value	Description	Def/ FbEq16
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…100000.01 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…100000.01 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…100000.01 mH	Quadrature axis inductance.	1 = 10000 mH
98.15	*Position offset user*	Defines an angle offset between the zero position of the synchronous motor and the zero position of the position sensor. This value is initially set by the autophasing routine when parameter *21.13 Autophasing mode* is set to *Turning with Z-pulse*, and can be fine-tuned later on. Notes: • The value is in electrical degrees. The electrical angle equals the mechanical angle multiplied by the number of motor pole pairs. • This parameter is valid only for permanent magnet motors.	0 deg
	0…360 deg	Angle offset.	1 = 1 deg

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.	1
	SynRM	(Only visible with option +N7502) Synchronous reluctance motor. Three-phase AC synchronous motor with salient pole rotor without permanent magnets.	2

No.	Name/Value	Description	Def/ FbEq16
99.04	Motor ctrl mode	Selects the motor control mode.	DTC
	DTC	Direct torque control. This mode is suitable for most applications. Note: Instead of direct torque control, scalar control is also available, and should be used in the following situations: • with multimotor applications 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). See also section *Operating modes of the drive* (page *53*).	0
	Scalar	Scalar control. The outstanding motor control accuracy of DTC cannot be achieved in scalar control. Refer to the *DTC* selection above for a list of applications where scalar control should definitely be used. Note: • Correct motor operation requires that the magnetizing current of the motor does not exceed 90% of the nominal current of the inverter. • Some standard features are disabled in scalar control mode. See also section *Scalar motor control* (page *71*), and section *Operating modes of the drive* (page *53*).	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. For ESP with sine filter and step-up transformer instead of using the motor rating plate data, set the motor nominal current according to the calculated current. See the description of current calculation in section *Faults: D105 Brake confirmation fault* on page *50*. **Note**: • 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 (nominal current) of the drive (0…2 × I_N with scalar control mode).	1 = 1 A

No.	Name/Value	Description	Def/ FbEq16
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. For ESP with sine filter and step-up transformer instead of using the motor rating plate data, set the motor nominal voltage according to the nominal supply voltage of the drive (example: 690 V). For more information, see section *Faults: D105 Brake confirmation fault* on page *50*. **Note**: • 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. Note that the nominal voltage is not equal to the equivalent DC motor voltage (EDCM) specified by some motor manufacturers. The nominal voltage can be calculated by dividing the EDCM voltage by 1.7 (or square root of 3). • 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…800.0 V	Nominal voltage of the motor. The allowable range is 1/6…2 × U_N (nominal voltage) of the drive. U_N equals the upper bound of the supply voltage range selected by parameter *95.01 Supply voltage*.	10 = 1 V
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.	50.00 Hz
	0.00…500.00 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 nominal power is not shown on the rating plate, nominal torque can be entered instead in parameter *99.12*. 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

No.	Name/Value	Description	Def/ FbEq16
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. The setting should match the value on the rating plate of the motor. With a permanent magnet or synchronous reluctance motor, this value is not needed. Note: 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. This value can be given instead of nominal power (*99.10*) if shown on the rating plate of the motor. The unit is selected by parameter *96.16 Unit selection*. Note: • This setting is an alternative to the nominal power value (*99.10*). If both are entered, *99.12* takes priority. • This parameter cannot be changed while the drive is running.	0.000 N·m or lb·ft
	0.000…4000000.000 N·m or lb·ft	Nominal motor torque.	1 = 1 unit
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*. Note: • 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 ctrl mode* = *Scalar*), only the *Current measurement calibration* ID run mode is possible. • 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*, *Advanced Standstill*) has already been performed once.	0

No.	Name/Value	Description	Def/ FbEq16
	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. Note: • 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
	Reduced	Reduced ID run. This mode should be selected instead of the *Normal* or *Advanced* ID Run if • mechanical losses are higher than 20% (i.e. the motor cannot be de-coupled from the driven equipment), or if • flux reduction is not allowed while the motor is running (i.e. 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 or synchronous reluctance motor, the shaft can rotate up to half a revolution. Note: A standstill ID run should be selected only if the *Normal*, *Reduced* or *Advanced* ID run is not possible due to the restrictions caused by the connected mechanics. For example, with lift or crane applications. See also selection *Advanced Standstill*.	3

No.	Name/Value	Description	Def/ FbEq16
	Autophasing	The autophasing routine determines the start angle of a permanent magnet or synchronous reluctance motor (see page 73). Autophasing does not update the other motor model values. Autophasing is automatically performed as part of the *Normal*, *Reduced*, *Standstill*, *Advanced* or *Advanced Standstill* ID runs. Using this setting, it is possible to perform autophasing alone. This is useful after changes in the feedback configuration, such as the replacement or addition of an absolute encoder, resolver, or pulse encoder with commutation signals. Note: • This setting can only be used after a *Normal*, *Reduced*, *Standstill*, *Advanced* or *Advanced Standstill* ID run has already been performed. • Depending on the selected autophasing mode, the shaft can rotate during autophasing. See parameter *21.13 Autophasing mode*.	4
	Current measurement calibration	Requests current measurement calibration, ie. identification of current measurement offset and gain errors. The calibration will be performed at next start.	5
	Advanced	Advanced ID run. Guarantees the best possible control accuracy. The ID run can take a couple of minutes. 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 will run at up to approximately 50…100% of the nominal speed during the ID run. Several accelerations and decelerations are done. ENSURE THAT IT IS SAFE TO RUN THE MOTOR BEFORE PERFORMING THE ID RUN!	6
	Advanced Standstill	Advanced Standstill ID run. This selection is recommended with AC induction motors up to 75 kW instead of the *Standstill* ID run if • the exact nominal ratings of the motor are not known, or • the control performance of the motor is not satisfactory after a *Standstill* ID run. Note: The time it takes for the *Advanced Standstill* ID run to complete varies according to motor size. With a small motor, the ID run typically completes within 5 minutes; with a large motor, the ID run may take up to an hour.	7
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
	Autophasing	*Autophasing*.	4

No.	Name/Value	Description	Def/ FbEq16
	Current measurement calibration	*Current measurement calibration*.	5
	Advanced	*Advanced* ID run.	6
	Advanced Standstill	*Advanced Standstill* ID run.	7
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. • After changing this parameter, the sign of encoder feedback (if any) must be checked. This can be done by setting parameter *90.41 Motor feedback selection* to *Estimate*, and comparing the sign of *90.01 Motor speed for control* to *90.10 Encoder 1 speed* (or *90.20 Encoder 2 speed*). If the sign of the measurement is incorrect, the encoder wiring must be corrected or the sign of *90.43 Motor gear numerator* reversed.	*U V W*
	U V W	Normal.	0
	U W V	Reversed rotation direction.	1

200 Safety	FSO-xx settings.	
This group contains parameters related to the optional FSO-xx safety functions module. For details on the parameters in this group, refer to the documentation of the FSO-xx module.		

9

Additional parameter data

Contents of this chapter

This chapter lists the parameters with some additional data. For parameter descriptions, see chapter *Parameters* (page *101*).

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	The parameter can be set to the value of another parameter by choosing “Other”, and selecting the source parameter from a list. **Note:** The source parameter must be a 32-bit real (floating point) number. To use a 16-bit integer (for example, received in DDCS data sets) as the source, data storage parameters *47.01*...*47.08* (see page *281*) can be used. In addition to the “Other” selection, the parameter may offer other pre-selected settings.
Binary src	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 fieldbus communication when a 32-bit value is selected in parameter group *52 FBA A data in* or *53 FBA A data out*. The corresponding 16-bit scaling are listed in chapter *Parameters* (page *101*).
List	Selection list.
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 %
01.04	Encoder 1 speed filtered	*Real*	-30000.00…30000.00	rpm	100 = 1 rpm
01.05	Encoder 2 speed filtered	*Real*	-30000.00…30000.00	rpm	100 = 1 rpm
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
01.10	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	%	10 = 1 %
01.17	Motor shaft power	*Real*	-32768.00...32767.00	kW or hp	100 = 1 unit
01.18	Inverter GWh motoring	*Real*	0…32767	GWh	1 = 1 GWh
01.19	Inverter MWh motoring	*Real*	0…1000	MWh	1 = 1 MWh
01.20	Inverter kWh motoring	*Real*	0…1000	kWh	1 = 1 kWh
01.21	U-phase current	*Real*	-30000.00 … 30000.00	A	100 = 1 A
01.22	V-phase current	*Real*	-30000.00 … 30000.00	A	100 = 1 A
01.23	W-phase current	*Real*	-30000.00 … 30000.00	A	100 = 1 A
01.24	Flux actual %	*Real*	0…200	%	1 = 1%
01.29	Speed change rate	*Real*	-15000…15000	rpm/s	1 = 1 rpm/s
01.30	Nominal torque scale	*Real*	0.000…4000000.000	N•m or lb.ft	1000 = 1 unit
01.31	Ambient temperature	*Real*	-40…120	°C or °F	10 = 1 °
01.32	Inverter GWh regenerating	*Real*	0…32767	GWh	1 = 1 GWh
01.33	Inverter MWh regenerating	*Real*	0…1000	MWh	1 = 1 MWh
01.34	Inverter kWh regenerating	*Real*	0…1000	kWh	1 = 1 kWh
01.35	Mot - regen energy GWh	*Real*	-32768 … 32767	GWh	1 = 1 GWh
01.36	Mot - regen energy MWh	*Real*	-1000…1000	MWh	1 = 1 MWh
01.37	Mot - regen energy kWh	*Real*	-1000…1000	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 rpm
01.63	Abs output frequency	*Real*	0.00 … 500.00	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 or hp	100 = 1 unit

No.	Name	Type	Range	Unit	FbEq32
01.66	Abs output power % motor nom	*Real*	0.00 … 300.00	%	10 = 1%
01.68	Abs motor shaft power	*Real*	0.00 … 32767.00	kW or hp	100 = 1 unit
03 Input references					
03.01	Panel reference	*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
03.07	FB B reference 1	*Real*	-100000.00…100000.00	-	100 = 1
03.08	FB B 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
04.04	Active fault 4	*Data*	0000h…FFFFh	-	1 = 1
04.05	Active fault 5	*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
04.09	Active warning 4	*Data*	0000h…FFFFh	-	1 = 1
04.10	Active warning 5	*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
04.14	4th latest fault	*Data*	0000h…FFFFh	-	1 = 1
04.15	5th 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
04.19	4th latest warning	*Data*	0000h…FFFFh	-	1 = 1
04.20	5th latest warning	*Data*	0000h…FFFFh	-	1 = 1
04.21	Fault word 1	*PB*	0000h…FFFFh	-	1 = 1
04.22	Fault word 2	*PB*	0000h…FFFFh	-	1 = 1
04.31	Warning word 1	*PB*	0000h…FFFFh	-	1 = 1
04.32	Warning word 2	*PB*	0000h…FFFFh	-	1 = 1
04.40	Event word 1	*PB*	0000h…FFFFh	-	1 = 1
04.41	Event word 1 bit 0 code	*Data*	0000h…FFFFh	-	1 = 1
04.42	Event word 1 bit 0 aux code	*Data*	0000 0000h … FFFF FFFFh	-	1 = 1
04.43	Event word 1 bit 1 code	*Data*	0000h…FFFFh	-	1 = 1

No.	Name	Type	Range	Unit	FbEq32
04.44	Event word 1 bit 1 aux code	*Data*	0000 0000h … FFFF FFFFh	-	1 = 1
…	…	…	…	…	
04.71	Event word 1 bit 15 code	*Data*	0000h…FFFFh	-	1 = 1
04.72	Event word 1 bit 15 aux code	*Data*	0000 0000h … FFFF FFFFh	-	1 = 1
04.120	Fault/Warning word compatibility	*List*	0…1	-	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
05.04	Fan on-time counter	*Real*	0…65535	d	1 = 1 d
05.11	Inverter temperature	*Real*	-40.0…160.0	%	10 = 1%
05.22	Diagnostic word 3	*PB*	0000h…FFFFh	-	1 = 1
05.41	Main fan service counter	*Real*	0…150	%	1 = 1%
05.42	Aux. fan service counter	*Real*	0…150	%	1 = 1%
06 Control and status words					
06.01	Main control word	*PB*	0000h…FFFFh	-	1 = 1
06.02	Application control word	*PB*	0000h…FFFFh	-	1 = 1
06.03	FBA A transparent control word	*PB*	00000000h…FFFFFFFFh	-	1 = 1
06.04	FBA B transparent control word	*PB*	00000000h…FFFFFFFFh	-	1 = 1
06.05	EFB transparent control word	*PB*	00000000h…FFFFFFFFh	-	
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
06.29	MSW bit 10 sel	*Binary src*	-	-	1 = 1
06.30	MSW bit 11 sel	*Binary src*	-	-	1 = 1
06.31	MSW bit 12 sel	*Binary src*	-	-	1 = 1
06.32	MSW bit 13 sel	*Binary src*	-	-	1 = 1
06.33	MSW bit 14 sel	*Binary src*	-	-	1 = 1
06.50	User status word 1	*PB*	0000h...FFFFh	-	1 = 1
06.60	User status word 1 bit 0 sel	*Binary src*	-	-	1 = 1
06.61	User status word 1 bit 1 sel	*Binary src*	-	-	1 = 1

No.	Name	Type	Range	Unit	FbEq32
06.62	User status word 1 bit 2 sel	*Binary src*	-	-	1 = 1
06.63	User status word 1 bit 3 sel	*Binary src*	-	-	1 = 1
06.64	User status word 1 bit 4 sel	*Binary src*	-	-	1 = 1
06.65	User status word 1 bit 5 sel	*Binary src*	-	-	1 = 1
06.66	User status word 1 bit 6 sel	*Binary src*	-	-	1 = 1
06.67	User status word 1 bit 7 sel	*Binary src*	-	-	1 = 1
06.68	User status word 1 bit 8 sel	*Binary src*	-	-	1 = 1
06.69	User status word 1 bit 9 sel	*Binary src*	-	-	1 = 1
06.70	User status word 1 bit 10 sel	*Binary src*	-	-	1 = 1
06.71	User status word 1 bit 11 sel	*Binary src*	-	-	1 = 1
06.72	User status word 1 bit 12 sel	*Binary src*	-	-	1 = 1
06.73	User status word 1 bit 13 sel	*Binary src*	-	-	1 = 1
06.74	User status word 1 bit 14 sel	*Binary src*	-	-	1 = 1
06.75	User status word 1 bit 15 sel	*Binary src*	-	-	1 = 1
06.100	User control word 1	*PB*	0000h…FFFFh	-	1 = 1
06.101	User control word 2	*PB*	0000h…FFFFh	-	1 = 1
07 System info					
07.03	Drive rating id	*List*	-	-	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%
07.13	PU logic version number	*Data*	-	-	1 = 1
07.21	Application environment status 1	*PB*	0000h…FFFFh	-	1 = 1
07.22	Application environment status 2	*PB*	0000h…FFFFh	-	1 = 1
07.23	Application name	*Data*	-	-	1 = 1
07.24	Application version	*Data*	-	-	1 = 1
07.25	Customization package name	*Data*	-	-	1 = 1

No.	Name	Type	Range	Unit	FbEq32
07.26	Customization package version	*Data*	-	-	1 = 1
09 Pump actuals					
09.01	Rod torque	*Real*	-100000.00...100000.00	N•m or lbft	100 = 1 Nm or lbft
09.02	Maximum rod torque	*Real*	-100000.00...100000.00	N•m or lbft	100 = 1 Nm or lbft
09.03	Motor torque	*Real*	-100000.00...100000.00	N•m or lbft	100 = 1 Nm or lbft
09.04	Maximum motor torque	*Real*	-100000.00...100000.00	N•m or lbft	100 = 1 Nm or lbft
09.05	Rod speed	*Real*	-100000.00...100000.00	Prpm, rpm or Hz	100 = 1 Prpm, rpm or Hz
09.06	Motor speed reference	*Real*	-100000.00...100000.00	rpm or Hz	100 = 1 rpm or Hz
09.07	Run-time hours	*Real*	0.00...100000.00	h	100 = 1 h
09.08	Fluid level	*Real*	-100000.00...100000.00	m, ft or Joints	100 = 1 m, ft or Joints
09.09	Pressure	*Real*	-100000.00...100000.00	kPa or psi	100 = 1 kPa or psi
09.10	Measured temperature	*Real*	-100000.00...100000.00	°C	100 = 1 °C
09.11	Backspin speed reference	*Real*	-100000.00...100000.00	Prpm, rpm or Hz	100 = 1 Prpm, rpm or Hz
09.12	Start delay remain	*Real*	0...4294967.295	s	1000 = 1 s
09.13	Backspin status word	*PB*	0000h...FFFFh	-	1 = 1
09.14	Pump status word	*PB*	0000h…FFFFh	-	1 = 1
09.15	Sleep feedback value	*Real*	-100000.00...100000.00	Source Unit	100 = 1 SourceUnit
09.16	Sleep time	*Real*	0.000...10000.000	s	1000 = 1 s

Parameter groups 10…99

No.	Name	Type	Range	Unit	FbEq32
10 Standard DI, RO					
10.01	DI status	*PB*	0000h…FFFFh	-	1 = 1
10.02	DI delayed status	*PB*	0000h…FFFFh	-	1 = 1
10.03	DI force selection	*PB*	0000h…FFFFh	-	1 = 1
10.04	DI force data	*PB*	0000h…FFFFh	-	1 = 1
10.05	DI1 ON delay	*Real*	0.0…3000.0	s	10 = 1 s
10.06	DI1 OFF delay	*Real*	0.0…3000.0	s	10 = 1 s
10.07	DI2 ON delay	*Real*	0.0…3000.0	s	10 = 1 s
10.08	DI2 OFF delay	*Real*	0.0…3000.0	s	10 = 1 s
10.09	DI3 ON delay	*Real*	0.0…3000.0	s	10 = 1 s

No.	Name	Type	Range	Unit	FbEq32
10.10	DI3 OFF delay	*Real*	0.0…3000.0	s	10 = 1 s
10.11	DI4 ON delay	*Real*	0.0…3000.0	s	10 = 1 s
10.12	DI4 OFF delay	*Real*	0.0…3000.0	s	10 = 1 s
10.13	DI5 ON delay	*Real*	0.0…3000.0	s	10 = 1 s
10.14	DI5 OFF delay	*Real*	0.0…3000.0	s	10 = 1 s
10.15	DI6 ON delay	*Real*	0.0…3000.0	s	10 = 1 s
10.16	DI6 OFF delay	*Real*	0.0…3000.0	s	10 = 1 s
10.21	RO status	*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
10.51	DI filter time	*Real*	0.3...100.0	ms	10 = 1 ms
10.99	RO/DIO control word	*PB*	0000h…FFFFh	-	1 = 1
11 Standard DIO, FI, FO					
11.01	DIO status	*PB*	0000b…0011b	-	1 = 1
11.02	DIO delayed status	*PB*	0000b…0011b	-	1 = 1
11.05	DIO1 function	*List*	0…2	-	1 = 1
11.06	DIO1 output source	*Binary src*	-		1 = 1
11.07	DIO1 ON delay	*Real*	0.0…3000.0	s	10 = 1 s
11.08	DIO1 OFF delay	*Real*	0.0…3000.0	s	10 = 1 s
11.09	DIO2 function	*List*	0…2	-	1 = 1
11.10	DIO2 output source	*Binary src*	-		1 = 1
11.11	DIO2 ON delay	*Real*	0.0…3000.0	s	10 = 1 s
11.12	DIO2 OFF delay	*Real*	0.0…3000.0	s	10 = 1 s
11.38	Freq in 1 actual value	*Real*	0…16000	Hz	1 = 1 Hz
11.39	Freq in 1 scaled	*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
11.54	Freq out 1 actual value	*Real*	0…16000	Hz	1 = 1 Hz

No.	Name	Type	Range	Unit	FbEq32
11.55	Freq out 1 source	*Analog src*	-	-	1 = 1
11.58	Freq out 1 src min	*Real*	-32768.000…32767.000	-	1000 = 1
11.59	Freq out 1 src max	*Real*	-32768.000…32767.000	-	1000 = 1
11.60	Freq out 1 at src min	*Real*	0…16000	Hz	1 = 1 Hz
11.61	Freq out 1 at src max	*Real*	0…16000	Hz	1 = 1 Hz
11.81	DIO filter time	*Real*	0.3 … 100.0	ms	10 = 1 ms
12 Standard AI					
12.01	AI tune	enum	0...4	-	
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*	-22.000…22.000	V or mA	1000 = 1 unit
12.12	AI1 scaled value	*Real*	-32768.000…32767.000	-	1000 = 1
12.15	AI1 unit selection	*List*	-	-	1 = 1
12.16	AI1 filter time	*Real*	0.000…30.000	s	1000 = 1 s
12.17	AI1 min	*Real*	-22.000…22.000	mA or V	1000 = 1 mA or V
12.18	AI1 max	*Real*	-22.000…22.000	mA or V	1000 = 1 mA or V
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*	-22.000…22.000	mA or V	1000 = 1 mA or V
12.22	AI2 scaled value	*Real*	-32768.000…32767.000	-	1000 = 1
12.25	AI2 unit selection	*List*	-	-	1 = 1
12.26	AI2 filter time	*Real*	0.000…30.000	s	1000 = 1 s
12.27	AI2 min	*Real*	-22.000…22.000	mA or V	1000 = 1 mA or V
12.28	AI2 max	*Real*	-22.000…22.000	mA or V	1000 = 1 mA or V
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
13 Standard AO					
13.11	AO1 actual value	*Real*	0.000…22.000	mA	1000 = 1 mA
13.12	AO1 source	*Analog src*	-	-	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	mA	1000 = 1 mA
13.20	AO1 out at AO1 src max	*Real*	0.000…22.000	mA	1000 = 1 mA
13.21	AO2 actual value	*Real*	0.000…22.000	mA	1000 = 1 mA

No.	Name	Type	Range	Unit	FbEq32
13.22	AO2 source	*Analog src*	-	-	1 = 1
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
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
14 I/O extension module 1					
14.01	Module 1 type	*List*	-	-	1 = 1
14.02	Module 1 location	*Real*	1…254	-	1 = 1
14.03	Module 1 status	*List*	0…4	-	1 = 1
Common parameters for DIOx (*14.01 Module 1 type* = *FIO-01* or *FIO-11*)					
14.05	DIO status	*PB*	0000b…1111b	-	1 = 1
14.06	DIO delayed status	*PB*	0000b…1111b	-	1 = 1
DIO1/DIO2 (*14.01 Module 1 type* = *FIO-01* or *FIO-11*)					
14.08	DIO filter time	*Real*	0.8...100.0	ms	10 = 1 ms
14.09	DIO1 function	*List*	0…1	-	1 = 1
14.10	DIO1 filter gain (Not visible when *14.01 Module 1 type* = *FIO-01*)	*List*	0…3	-	1 = 1
14.11	DIO1 output source	*Binary src*	-	-	1 = 1
14.12	DIO1 ON delay	*Real*	0.0…3000.0	s	10 = 1 s
14.13	DIO1 OFF delay	*Real*	0.0…3000.0	s	10 = 1 s
14.14	DIO2 function	*List*	0…1	-	1 = 1
14.15	DIO2 filter gain (Not visible when *14.01 Module 1 type* = *FIO-01*)	*List*	0…3	-	1 = 1
14.16	DIO2 output source	*Binary src*	-	-	1 = 1
14.17	DIO2 ON delay	*Real*	0.0…3000.0	s	10 = 1 s
14.18	DIO2 OFF delay	*Real*	0.0…3000.0	s	10 = 1 s
DIO3/DIO4 (14.01 Module 1 type = FIO-01)					
14.19	DIO3 function	*List*	0…1	-	1 = 1
14.21	DIO3 output source	*Binary src*	-	-	1 = 1
14.22	DIO3 ON delay	*Real*	0.0…3000.0	s	10 = 1 s
14.23	DIO3 OFF delay	*Real*	0.0…3000.0	s	10 = 1 s
14.24	DIO4 function	*List*	0…1	-	1 = 1
14.26	DIO4 output source	*Binary src*	-22.000...22.000	mA or V	1 = 1
14.27	DIO4 ON delay	*Real*	-32768.000…32767.000	s	10 = 1 s

No.	Name	Type	Range	Unit	FbEq32
14.28	DIO4 OFF delay	*Real*	0.0…3000.0	s	10 = 1 s
RO1/RO2 (*14.01 Module 1 type* = *FIO-01*)					
14.31	RO status	*PB*	0000h…FFFFh	-	1 = 1
14.34	RO1 source	*Binary src*	-	-	1 = 1
14.35	RO1 ON delay	*Real*	0.0…3000.0	s	10 = 1 s
14.36	RO1 OFF delay	*Real*	0.0…3000.0	s	10 = 1 s
14.37	RO2 source	*Binary src*	-	-	1 = 1
14.38	RO2 ON delay	*Real*	0.0…3000.0	s	10 = 1 s
14.39	RO2 OFF delay	*Real*	0.0…3000.0	s	10 = 1 s
Common parameter for AIx (*14.01 Module 1 type* = *FIO-11* or *FAIO-01*)					
14.19	AI supervision function	*List*	0...4	-	1 = 1
14.20	AI supervision selection	*PB*	0000h...FFFFh	-	1 = 1
14.21	AI tune	*List*	0...6 (*FIO-11* or *FAIO-01*)		1 = 1
14.22	AI force selection	*PB*	0000h...FFFFh	-	1 = 1
AI1/AI2 (*14.01 Module 1 type* = *FIO-11* or *FAIO-01*)					
14.26	AI1 actual value	*Real*	-22.000…22.000	mA or V	1000 = 1 unit
14.27	AI1 scaled value	*Real*	-32768.000…32767.000	-	1000 = 1
14.28	AI1 force data	*Real*	-22.000…22.000	mA or V	1000 = 1 unit
14.29	AI1 HW switch pos	*List*	-	-	1 = 1
14.30	AI1 unit selection	*List*	-	-	1 = 1
14.31	AI1 filter gain	*List*	0…7	-	1 = 1
14.32	AI1 filter time	*Real*	0.000…30.000	s	1000 = 1 s
14.33	AI1 min	*Real*	-22.000…22.000	mA or V	1000 = 1 mA or V
14.34	AI1 max	*Real*	-22.000…22.000	mA or V	1000 = 1 mA or V
14.35	AI1 scaled at AI1 min	*Real*	-32768.000…32767.000	-	1000 = 1
14.36	AI1 scaled at AI1 max	*Real*	-32768.000…32767.000	-	1000 = 1
14.41	AI2 actual value	*Real*	-22.000…22.000	mA or V	1000 = 1 unit
14.42	AI2 scaled value	*Real*	-32768.000…32767.000	-	1000 = 1
14.43	AI2 force data	*Real*	-22.000…22.000	mA or V	1000 = 1 unit
14.44	AI2 HW switch pos	*List*	-	-	1 = 1
14.45	AI2 unit selection	*List*	-	-	1 = 1
14.46	AI2 filter gain	*List*	0…7	-	1 = 1
14.47	AI2 filter time	*Real*	0.000…30.000	s	1000 = 1 s
14.48	AI2 min	*Real*	-22.000…22.000	mA or V	1000 = 1 mA or V
14.49	AI2 max	*Real*	-22.000…22.000	mA or V	1000 = 1 mA or V
14.50	AI2 scaled at AI2 min	*Real*	-32768.000…32767.000	-	1000 = 1
14.51	AI2 scaled at AI2 max	*Real*	-32768.000…32767.000	-	1000 = 1

No.	Name	Type	Range	Unit	FbEq32
AI3 (*14.01 Module 1 type* = *FIO-11*)					
14.56	AI3 actual value	*Real*	-22.000…22.000	mA or V	1000 = 1 unit
14.57	AI3 scaled value	*Real*	-32768.000…32767.000	-	1000 = 1
14.58	AI3 force data	*Real*	-22.000…22.000	mA or V	1000 = 1 unit
14.59	AI3 HW switch pos	*List*	-	-	1 = 1
14.60	AI3 unit selection	*List*	-	-	1 = 1
14.61	AI3 filter gain	*List*	0…7	-	1 = 1
14.62	AI3 filter time	*Real*	0.000…30.000	s	1000 = 1 s
14.63	AI3 min	*Real*	-22.000…22.000	mA or V	1000 = 1 mA or V
14.64	AI3 max	*Real*	-22.000…22.000	mA or V	1000 = 1 mA or V
14.65	AI3 scaled at AI3 min	*Real*	-32768.000…32767.000	-	1000 = 1
14.66	AI3 scaled at AI3 max	*Real*	-32768.000…32767.000	-	1000 = 1
Common parameters for AOx (*14.01 Module 1 type* = *FIO-11* or *FAIO-01*)					
14.71	AO force selection	*PB*	00000000h...FFFFFFFFh	-	1 = 1
AO1 (*14.01 Module 1 type* = *FIO-11* or *FAIO-01*)					
14.76	AO1 actual value	*Real*	0.000…22.000	mA	1000 = 1 mA
14.77	AO1 source	*Analog src*	-	-	1 = 1
14.78	AO1 force data	*Real*	0.000…22.000	mA	1000 = 1 mA
14.79	AO1 filter time	*Real*	0.000…30.000	s	1000 = 1 s
14.80	AO1 source min	*Real*	-32768.0…32767.0	-	10 = 1
14.81	AO1 source max	*Real*	-32768.0…32767.0	-	10 = 1
14.82	AO1 out at AO1 src min	*Real*	0.000…22.000	mA	1000 = 1 mA
14.83	AO1 out at AO1 src max	*Real*	0.000…22.000	mA	1000 = 1 mA
AO2 (*14.01 Module 1 type* = *FAIO-01*)					
14.86	AO2 actual value	*Real*	0.000…22.000	mA	1000 = 1 mA
14.87	AO2 source	*Analog src*	-	-	1 = 1
14.88	AO2 force data	*Real*	0.000…22.000	mA	1000 = 1 mA
14.89	AO2 filter time	*Real*	0.000…30.000	s	1000 = 1 s
14.90	AO2 source min	*Real*	-32768.0…32767.0	-	10 = 1
14.91	AO2 source max	*Real*	-32768.0…32767.0	-	10 = 1
14.92	AO2 out at AO2 src min	*Real*	0.000…22.000	mA	1000 = 1 mA
14.93	AO2 out at AO2 src max	*Real*	0.000…22.000	mA	1000 = 1 mA
15 I/O extension module 2					
15.01	Module 2 type	*List*	-	-	1 = 1
15.02	Module 2 location	*Real*	1…254	-	1 = 1
15.03	Module 2 status	*List*	0…2	-	1 = 1
Common parameters for DIOx (*15.01 Module 2 type* = *FIO-01* or *FIO-11*)					
15.05	DIO status	*PB*	00000000h…FFFFFFFFh	-	1 = 1

No.	Name	Type	Range	Unit	FbEq32
15.06	DIO delayed status	*PB*	00000000h…FFFFFFFFh	-	1 = 1
DIO1/DIO2 (*15.01 Module 2 type* = *FIO-01* or *FIO-11*)					
15.08	DIO filter time	*Real*	0.8...100.0	ms	10 = 1 ms
15.09	DIO1 function	*List*	0…1	-	1 = 1
15.11	DIO1 output source	*Binary src*	-	-	1 = 1
15.12	DIO1 ON delay	*Real*	0.0…3000.0	s	10 = 1 s
15.13	DIO1 OFF delay	*Real*	0.0…3000.0	s	10 = 1 s
15.14	DIO2 function	*List*	0…1	-	1 = 1
15.15	DIO2 filter gain (Not visible when *15.01 Module 2 type* = FIO-01)	*List*	0…3	-	1 = 1
15.16	DIO2 output source	*Binary src*	-	-	1 = 1
15.17	DIO2 ON delay	*Real*	0.0…3000.0	s	10 = 1 s
15.18	DIO2 OFF delay	*Real*	0.0…3000.0	s	10 = 1 s
DIO3/DIO4 (*15.01 Module 2 type* = *FIO-01*)					
15.19	DIO3 configuration	*List*	0…1	-	1 = 1
15.21	DIO3 output source	*Binary src*	-	-	1 = 1
15.22	DIO3 ON delay	*Real*	0.0…3000.0	s	10 = 1 s
15.23	DIO3 OFF delay	*Real*	0.0…3000.0	s	10 = 1 s
15.24	DIO4 configuration	*List*	0…1	-	1 = 1
15.26	DIO4 output source	*Binary src*	-	-	1 = 1
15.27	DIO4 ON delay	*Real*	0.0…3000.0	s	10 = 1 s
15.28	DIO4 OFF delay	*Real*	0.0…3000.0	s	10 = 1 s
RO1/RO2 (*15.01 Module 2 type* = *FIO-01*)					
15.31	RO status	*PB*	0000h…FFFFh	-	1 = 1
15.34	RO1 source	*Binary src*	-	-	1 = 1
15.35	RO1 ON delay	*Real*	0.0…3000.0	s	10 = 1 s
15.36	RO1 OFF delay	*Real*	0.0…3000.0	s	10 = 1 s
15.37	RO2 source	*Binary src*	-	-	1 = 1
15.38	RO2 ON delay	*Real*	0.0…3000.0	s	10 = 1 s
15.39	RO2 OFF delay	*Real*	0.0…3000.0	s	10 = 1 s
Common parameters for AIx (*15.01 Module 2 type* = *FIO-11* or *FAIO-01*)					
15.19	AI supervision function	*List*	0…4	-	1 = 1
15.20	AI supervision selection	*PB*	0000h...FFFFh	-	1 = 1
15.21	AI tune	*List*	0.6...(*FIO-11*) 0.4...(*FAIO-01*)	-	1 = 1
15.22	AI force selection	*PB*	00000000h…FFFFFFFFh	-	1 = 1
AI1/AI2 (*15.01 Module 2 type* = *FIO-11* or *FAIO-01*)					

No.	Name	Type	Range	Unit	FbEq32
15.26	AI1 actual value	Real	-22.000…22.000	mA or V	1000 = 1 unit
15.27	AI1 scaled value	Real	-32768.000…32767.000	-	1000 = 1
15.28	AI1 force data	Real	-22.000…22.000	mA or V	1000 = 1 unit
15.29	AI1 HW switch pos	List	-	-	1 = 1
15.30	AI1 unit selection	List	-	-	1 = 1
15.31	AI1 filter gain	List	0…7	-	1 = 1
15.32	AI1 filter time	Real	0.000…30.000	s	1000 = 1 s
15.33	AI1 min	Real	-22.000…22.000	mA or V	1000 = 1 mA or V
15.34	AI1 max	Real	-22.000…22.000	mA or V	1000 = 1 mA or V
15.35	AI1 scaled at AI1 min	Real	-32768.000…32767.000	-	1000 = 1
15.36	AI1 scaled at AI1 max	Real	-32768.000…32767.000	-	1000 = 1
15.41	AI2 actual value	Real	-22.000…22.000	mA or V	1000 = 1 unit
15.42	AI2 scaled value	Real	-32768.000…32767.000	-	1000 = 1
15.43	AI2 force data	Real	-22.000…22.000	mA or V	1000 = 1 unit
15.44	AI2 HW switch position	List	-	-	1 = 1
15.45	AI2 unit selection	List	-	-	1 = 1
15.46	AI2 filter gain	List	0…7	-	1 = 1
15.47	AI2 filter time	Real	0.000…30.000	s	1000 = 1 s
15.48	AI2 min	Real	-22.000…22.000	mA or V	1000 = 1 mA or V
15.49	AI2 max	Real	-22.000…22.000	mA or V	1000 = 1 mA or V
15.50	AI2 scaled at AI2 min	Real	-32768.000…32767.000	-	1000 = 1
15.51	AI2 scaled at AI2 max	Real	-32768.000…32767.000	-	1000 = 1
AI3 (*15.01 Module 2 type* = *FIO-11* or *FAIO-01*)					
15.56	AI3 actual value	Real	-22.000…22.000	mA or V	1000 = 1 unit
15.57	AI3 scaled value	Real	-32768.000…32767.000	-	1000 = 1
15.58	AI3 force data	Real	-22.000…22.000	mA or V	1000 = 1 unit
15.59	AI3 HW switch position	List	-	-	1 = 1
15.60	AI3 unit selection	List	-	-	1 = 1
15.61	AI3 filter gain	List	0…7	-	1 = 1
15.62	AI3 filter time	Real	0.000…30.000	s	1000 = 1 s
15.63	AI3 min	Real	-22.000…22.000	mA or V	1000 = 1 mA or V
15.64	AI3 max	Real	-22.000…22.000	mA or V	1000 = 1 mA or V
15.65	AI3 scaled at AI3 min	Real	-32768.000…32767.000	-	1000 = 1
15.66	AI3 scaled at AI3 max	Real	-32768.000…32767.000	-	1000 = 1
Common parameters for AOx (*15.01 Module 2 type* = *FIO-11* or *FAIO-01*)					
15.71	AO force selection	PB	00000000h…FFFFFFFFh	-	1 = 1
AO1 (*15.01 Module 2 type* = *FIO-11* or *FAIO-01*)					

No.	Name	Type	Range	Unit	FbEq32
15.76	AO1 actual value	*Real*	0.000…22.000	mA	1000 = 1 mA
15.77	AO1 source	*Analog src*	-	-	1 = 1
15.78	AO1 force data	*Real*	0.000…22.000	mA	1000 = 1 mA
15.79	AO1 filter time	*Real*	0.000…30.000	s	1000 = 1 s
15.80	AO1 source min	*Real*	-32768.0…32767.0	-	10 = 1
15.81	AO1 source max	*Real*	-32768.0…32767.0	-	10 = 1
15.82	AO1 out at AO1 src min	*Real*	0.000…22.000	mA	1000 = 1 mA
15.83	AO1 out at AO1 src max	*Real*	0.000…22.000	mA	1000 = 1 mA
AO2 (*15.01 Module 2 type* = *FIO-11* or *FAIO-01*)					
15.86	AO2 actual value	*Real*	0.000…22.000	mA	1000 = 1 mA
15.87	AO2 source	*Analog src*	-	-	1 = 1
15.88	AO2 force data	*Real*	0.000…22.000	mA	1000 = 1 mA
15.89	AO2 filter time	*Real*	0.000…30.000	s	1000 = 1 s
15.90	AO2 source min	*Real*	-32768.0…32767.0	-	10 = 1
15.91	AO2 source max	*Real*	-32768.0…32767.0	-	10 = 1
15.92	AO2 out at AO1 src min	*Real*	0.000…22.000	mA	1000 = 1 mA
15.93	AO2 out at AO1 src max	*Real*	0.000…22.000	mA	1000 = 1 mA
16 I/O extension module 3					
16.01	Module 3 type	*List*	-	-	1 = 1
16.02	Module 3 location	*Real*	1…254	-	1 = 1
16.03	Module 3 status	*List*	0…2	-	1 = 1
Common parameters for DIOx (*16.01 Module 3 type* = *FIO-01* or *FIO-11*)					
16.05	DIO status	*PB*	00000000h…FFFFFFFFh	-	1 = 1
16.06	DIO delayed status	*PB*	00000000h…FFFFFFFFh	-	1 = 1
DIO1/DIO2 (*16.01 Module 3 type* = *FIO-01* or *FIO-11*)					
16.08	DIO filter time	*Real*	0.8...100.0	ms	10 = 1 ms
16.09	DIO1 function	*List*	0…1	-	1 = 1
16.11	DIO1 output source	*Binary src*	-	-	1 = 1
16.12	DIO1 ON delay	*Real*	0.0 … 3000.0	s	10 = 1 s
16.13	DIO1 OFF delay	*Real*	0.0 … 3000.0	s	10 = 1 s
16.14	DIO2 function	*List*	0…1	-	1 = 1
16.16	DIO2 output source	*Binary src*	-	-	1 = 1
16.17	DIO2 ON delay	*Real*	0.0 … 3000.0	s	10 = 1 s
16.18	DIO2 OFF delay	*Real*	0.0 … 3000.0	s	10 = 1 s
DIO3/DIO4 (*16.01 Module 3 type* = *FIO-01*)					
16.19	DIO3 function	*List*	0…1	-	1 = 1
16.21	DIO3 output source	*Binary src*	-	-	1 = 1

No.	Name	Type	Range	Unit	FbEq32
16.22	DIO3 ON delay	*Real*	0.0…3000.0	s	10 = 1 s
16.23	DIO3 OFF delay	*Real*	0.0…3000.0	s	10 = 1 s
16.24	DIO4 configuration	*List*	0…1	-	1 = 1
16.26	DIO4 output source	*Binary src*	-	-	1 = 1
16.27	DIO4 ON delay	*Real*	0.0…3000.0	s	10 = 1 s
16.28	DIO4 OFF delay	*Real*	0.0…3000.0	s	10 = 1 s
RIO1/RO2 (*16.01 Module 3 type* = *FIO-01*)					
16.31	RO status	*PB*	0000h…FFFFh	-	1 = 1
16.34	RO1 source	*Binary src*	-	-	1 = 1
16.35	RO1 ON delay	*Real*	0.0…3000.0	s	10 = 1 s
16.36	RO1 OFF delay	*Real*	0.0…3000.0	s	10 = 1 s
16.37	RO2 source	*Binary src*	-	-	1 = 1
16.38	RO2 ON delay	*Real*	0.0…3000.0	s	10 = 1 s
16.39	RO2 OFF delay	*Real*	0.0…3000.0	s	10 = 1 s
Common parameters for AIx (*16.01 Module 3 type* = *FIO-11* or *FAIO-01*)					
16.19	AI supervision function	*List*	0...4	-	1 = 1
16.20	AI supervision selection	*PB*	0000h...FFFFh	-	1 = 1
16.21	AI tune	*List*	0.6...(*FIO-11*) 0.4... (*FAIO-01*)	-	1 = 1
16.22	AI force selection	*PB*	00000000h…FFFFFFFFh	-	1 = 1
AI1/AI2 (*16.01 Module 3 type* = *FIO-11* or *FAIO-01*)					
16.26	AI1 actual value	*Real*	-22.000…22.000	mA or V	1000 = 1 unit
16.27	AI1 scaled value	*Real*	-32768.000…32767.000	-	1000 = 1
16.28	AI1 force data	*Real*	-22.000…22.000	mA or V	1000 = 1 unit
16.29	AI1 HW switch position	*List*	-	-	1 = 1
16.30	AI1 unit selection	*List*	-	-	1 = 1
16.31	AI1 filter gain	*List*	0…7	-	1 = 1
16.32	AI1 filter time	*Real*	0.000…30.000	s	1000 = 1 s
16.33	AI1 min	*Real*	-22.000…22.000	mA or V	1000 = 1 mA or V
16.34	AI1 max	*Real*	-22.000…22.000	mA or V	1000 = 1 mA or V
16.35	AI1 scaled at AI1 min	*Real*	-32768.000…32767.000	-	1000 = 1
16.36	AI1 scaled at AI1 max	*Real*	-32768.000…32767.000	-	1000 = 1
16.41	AI2 actual value	*Real*	-22.000…22.000	mA or V	1000 = 1 unit
16.42	AI2 scaled value	*Real*	-32768.000…32767.000	-	1000 = 1
16.43	AI2 force data	*Real*	-22.000…22.000	mA or V	1000 = 1 unit
16.44	AI2 HW switch pos	*List*	-	-	1 = 1
16.45	AI2 unit selection	*List*	-	-	1 = 1
16.46	AI2 filter gain	*List*	0…7	-	1 = 1

No.	Name	Type	Range	Unit	FbEq32
16.47	AI2 filter time	*Real*	0.000…30.000	s	1000 = 1 s
16.48	AI2 min	*Real*	-22.000…22.000	mA or V	1000 = 1 mA or V
16.49	AI2 max	*Real*	-22.000…22.000	mA or V	1000 = 1 mA or V
16.50	AI2 scaled at AI2 min	*Real*	-32768.000…32767.000	-	1000 = 1
16.51	AI2 scaled at AI2 max	*Real*	-32768.000…32767.000	-	1000 = 1
AI13 (*16.01 Module 3 type* = *FIO-11*)					
16.56	AI3 actual value	*Real*	-22.000…22.000	mA or V	1000 = 1 unit
16.57	AI3 scaled value	*Real*	-32768.000…32767.000	-	1000 = 1
16.58	AI3 force data	*Real*	-22.000…22.000	mA or V	1000 = 1 unit
16.59	AI3 HW switch position	*List*	-	-	1 = 1
16.60	AI3 unit selection	*List*	-	-	1 = 1
16.61	AI3 filter gain	*List*	0…7	-	1 = 1
16.62	AI3 filter time	*Real*	0.000…30.000	s	1000 = 1 s
16.63	AI3 min	*Real*	-22.000…22.000	mA or V	1000 = 1 mA or V
16.64	AI3 max	*Real*	-22.000…22.000	mA or V	1000 = 1 mA or V
16.65	AI3 scaled at AI3 min	*Real*	-32768.000…32767.000	-	1000 = 1
16.66	AI3 scaled at AI3 max	*Real*	-32768.000…32767.000	-	1000 = 1
Common parameters for AOx (*16.01 Module 3 type* = *FIO-11* or *FAIO-01*)					
16.71	AO force selection	*PB*	00000000h…FFFFFFFFh	-	1 = 1
AO1 (*16.01 Module 3 type* = *FIO-11* or *FAIO-01*)					
16.76	AO1 actual value	*Real*	0.000…22.000	mA	1000 = 1 mA
16.77	AO1 source	*Analog src*	-	-	1 = 1
16.78	AO1 force data	*Real*	0.000…22.000	mA	1000 = 1 mA
16.79	AO1 filter time	*Real*	0.000…30.000	s	1000 = 1 s
16.80	AO1 source min	*Real*	-32768.0…32767.0	-	10 = 1
16.81	AO1 source max	*Real*	-32768.0…32767.0	-	10 = 1
16.82	AO1 out at AO1 src min	*Real*	0.000…22.000	mA	1000 = 1 mA
16.83	AO1 out at AO1 src max	*Real*	0.000…22.000	mA	1000 = 1 mA
AO2 (*16.01 Module 3 type* = *FAIO-01*)					
16.86	AO2 actual value	*Real*	0.000 … 22.000	mA	1000 = 1 mA
16.87	AO2 source	*Analog src*	-	-	1 = 1
16.88	AO2 force data	*Real*	0.000 … 22.000	mA	1000 = 1 mA
16.89	AO2 filter time	*Real*	0.000 … 30.000	s	1000 = 1 s
16.90	AO2 source min	*Real*	-32768.0 … 32767.0	-	10 = 1
16.91	AO2 source max	*Real*	-32768.0 … 32767.0	-	10 = 1
16.92	AO2 out at AO2 src min	*Real*	0.000 … 22.000	mA	1000 = 1 mA
16.93	AO2 out at AO2 src max	*Real*	0.000 … 22.000	mA	1000 = 1 mA

No.	Name	Type	Range	Unit	FbEq32
19 Operation mode					
19.01	Actual operation mode	*List*	-	-	1 = 1
19.11	Ext1/Ext2 selection	*Binary src*	-	-	1 = 1
19.12	Ext1 control mode 1	*List*	1…6	-	1 = 1
19.14	Ext2 control mode 1	*List*	1…6	-	1 = 1
19.16	Local control mode	*List*	0…1	-	1 = 1
19.17	Local control disable	*List*	0…1	-	1 = 1
19.20	Scalar control reference unit	*List*	0…1	-	1 = 1
20 Start/stop/direction					
20.01	Ext1 commands	*List*	-	-	1 = 1
20.02	Ext1 start trigger type	*List*	0…1	-	1 = 1
20.03	Ext1 in1 source	*Binary src*	-	-	1 = 1
20.04	Ext1 in2 source	*Binary src*	-	-	1 = 1
20.05	Ext1 in3 source	*Binary src*	-	-	1 = 1
20.06	Ext2 commands	*List*	-	-	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
20.10	Ext2 in3 source	*Binary src*	-	-	1 = 1
20.11	Run enable stop mode	*List*	0…2	-	1 = 1
20.12	Run enable 1 source	*Binary src*	-	-	1 = 1
20.19	Enable start command	*Binary src*	-	-	1 = 1
20.23	Positive speed enable	*Binary src*	-	-	1 = 1
20.24	Negative speed enable	*Binary src*	-	-	1 = 1
20.25	Jogging enable	*Binary src*	-	-	1 = 1
20.26	Jogging 1 start source	*Binary src*	-	-	1 = 1
20.27	Jogging 2 start source	*Binary src*	-	-	1 = 1
20.30	Enable signals warning function	*PB*	00b…11b	-	1 = 1
21 Start/stop mode					
21.01	Start mode	*List*	0…2	-	1 = 1

No.	Name	Type	Range	Unit	FbEq32
21.02	Magnetization time	*Real*	0…10000	ms	1 = 1 ms
21.03	Stop mode	*List*	0…1	-	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…30000	ms	1 = 1 ms
21.12	Continuous magnetization command			-	
21.13	Autophasing mode	*List*	0…2	-	1 = 1
21.18	Auto restart time	*Real*	0.0, 0.1…5.0	s	10 = 1 s
21.19	Scalar start mode	*List*	0…2	-	1 = 1
22 Speed reference selection					
22.01	Speed ref unlimited	*Real*	-30000.00…30000.00	rpm	100 = 1 rpm
22.11	Speed ref1 source	*Analog src*	-	-	1 = 1
22.12	Speed ref2 source	*Analog src*	-	-	1 = 1
22.13	Speed ref1 function	*List*	0…5	-	1 = 1
22.14	Speed ref1/2 selection	*Binary src*	-	-	1 = 1
22.15	Speed additive 1 source	*Analog src*	-	-	1 = 1
22.16	Speed share	*Real*	-8.000…8.000	-	1000 = 1
22.17	Speed additive 2 source	*Analog src*	-	-	1 = 1
22.21	Constant speed function	*PB*	0000b…0011b	-	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

No.	Name	Type	Range	Unit	FbEq32
22.41	Speed ref safe	*Real*	-30000.00…30000.00	rpm	100 = 1 rpm
22.42	Jogging 1 ref	*Real*	-30000.00 … 30000.00	rpm	100 = 1 rpm
22.43	Jogging 2 ref	*Real*	-30000.00 … 30000.00	rpm	100 = 1 rpm
22.51	Critical speed function	*PB*	0000b…0011b	-	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…2	-	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
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
22.81	Speed reference act 1	*Real*	-30000.00…30000.00	rpm	100 = 1 rpm
22.82	Speed reference act 2	*Real*	-30000.00…30000.00	rpm	100 = 1 rpm
22.83	Speed reference act 3	*Real*	-30000.00…30000.00	rpm	100 = 1 rpm
22.84	Speed reference act 4	*Real*	-30000.00…30000.00	rpm	100 = 1 rpm
22.85	Speed reference act 5	*Real*	-30000.00…30000.00	rpm	100 = 1 rpm
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
23.11	Ramp set selection	*Binary src*	-	-	1 = 1
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
23.14	Acceleration time 2	*Real*	0.000 …1800.000	s	1000 = 1 s
23.15	Deceleration time 2	*Real*	0.000 …1800.000	s	1000 = 1 s
23.16	Shape time acc 1	*Real*	0.000 …1800.000	s	1000 = 1 s
23.17	Shape time acc 2	*Real*	0.000 …1800.000	s	1000 = 1 s
23.18	Shape time dec 1	*Real*	0.000 …1800.000	s	1000 = 1 s
23.19	Shape time dec 2	*Real*	0.000 …1800.000	s	1000 = 1 s

No.	Name	Type	Range	Unit	FbEq32
23.20	Acc time jogging	*Real*	0.000 …1800.000	s	1000 = 1 s
23.21	Dec time jogging	*Real*	0.000 …1800.000	s	1000 = 1 s
23.23	Emergency stop time	*Real*	0.000 …1800.000	s	1000 = 1 s
23.24	Speed ramp in zero source	*Binary src*	-	-	1 = 1
23.26	Ramp out balancing enable	*Binary src*	-	-	1 = 1
23.27	Ramp out balancing ref	*Real*	-30000.00…30000.00	rpm	100 = 1 rpm
23.28	Variable slope enable	*List*	0…1	-	1 = 1
23.29	Variable slope rate	*Real*	2…30000	ms	1 = 1 ms
23.39	Follower speed correction out	*Real*	-30000.00...30000.00	rpm	100 = 1 rpm
23.40	Follower speed correction enable	*Binary src*	-	-	1 = 1
23.41	Follower speed correction gain	*Real*	0.00...100.00	%	100 = 1%
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*	-30000.00…30000.00	rpm	100 = 1 rpm
24.04	Speed error inverted	*Real*	-30000.00…30000.00	rpm	100 = 1 rpm
24.11	Speed correction	*Real*	-10000.00…10000.00	-	100 = 1
24.12	Speed error filter time	*Real*	0…10000	ms	1 = 1 ms
24.41	Speed error window control enable	*List*	0…1	-	1 = 1
24.42	Speed window control mode	*List*	0…1	-	1 = 1
24.43	Speed error window high	*Real*	0.00…3000.00	rpm	100 = 1 rpm
24.44	Speed error window low	*Real*	0.00…3000.00	rpm	100 = 1 rpm
24.46	Speed error step	*Real*	-3000.00…3000.00	rpm	100 = 1 rpm
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…10000.000	s	1000 = 1 s
25.05	Derivation filter time	*Real*	0…10000	ms	1 = 1 ms
25.06	Acc comp derivation time	*Real*	0.00…1000.00	s	100 = 1 s
25.07	Acc comp filter time	*Real*	0.0…1000.0	ms	10 = 1 ms
25.08	Drooping rate	*Real*	0.00…100.00	%	100 = 1%
25.09	Speed ctrl balancing enable	*Binary src*	-	-	1 = 1
25.10	Speed ctrl balancing ref	*Real*	-300.0…300.0	%	10 = 1%
25.11	Speed control min torque	*Real*	-1600.0…0.0	%	10 = 1%
25.12	Speed control max torque	*Real*	0.0…1600.0	%	10 = 1%
25.13	Min torq sp ctrl em stop	*Real*	-1600…0	%	10 = 1%

No.	Name	Type	Range	Unit	FbEq32
25.14	Max torq sp ctrl em stop	*Real*	0…1600	%	10 = 1%
25.15	Proportional gain em stop	*Real*	1.00…250.00	-	100 = 1
25.18	Speed adapt min limit	*Real*	0...30000	rpm	1 = 1 rpm
25.19	Speed adapt max limit	*Real*	0...30000	rpm	1 = 1 rpm
25.21	Kp adapt coef at min speed	*Real*	0.000...10.000	-	1000 = 1
25.22	Ti adapt coef at min speed	*Real*	0.000...10.000	-	1000 = 1
25.25	Torque adapt max limit	*Real*	0.0...1600.0	%	10 = 1%
25.26	Torque adapt filt time	*Real*	0.000...100.000	s	1000 = 1 s
25.27	Kp adapt coef at min torque	*Real*	0.000...10.000	-	1000 = 1
25.30	Flux adaptation enable	*List*	0...1	-	1 = 1
25.33	Speed controller autotune	*Binary src*	-	-	1 = 1
25.34	Speed controller autotune mode	*List*	0...2	-	1 = 1
25.37	Mechanical time constant	*Real*	0.00...1000.00	s	100 = 1 s
25.38	Autotune torque step	*Real*	0.00...100.00	%	100 = 1 %
25.39	Autotune speed step	*Real*	0.00...100.00	%	100 = 1 %
25.40	Autotune repeat times	*Real*	1...10	-	1 = 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%
25.56	Torque acc compensation	*Real*	-30000.0… 30000.0	%	10 = 1%
25.57	Torque reference unbalanced	*Real*	-30000.0… 30000.0	%	10 = 1%
26 Torque reference chain					
26.01	Torque reference to TC	*Real*	-1600.0 … 1600.0	%	10 = 1%
26.02	Torque reference used	*Real*	-1600.0 … 1600.0	%	10 = 1%
26.51	Oscillation damping	*Binary src*	-	-	1 = 1
26.52	Oscillation damping out enable	*Binary src*	-	-	1 = 1
26.53	Oscillation compensation input	*List*	0…1	-	1 = 1
26.55	Oscillation damping frequency	*Real*	0.1 … 60.0	Hz	10 = 1 Hz
26.56	Oscillation damping phase	*Real*	0…360	deg	1 = 1 deg
26.57	Oscillation damping gain	*Real*	0.0 … 100.0	%	10 = 1%
26.58	Oscillation damping output	*Real*	-1600.000 … 1600.000	%	1000 = 1%
26.81	Rush control gain	*Real*	0.0 … 10000.0	-	10 = 1
26.82	Rush control integration time	*Real*	0.0 … 10.0	s	10 = 1 s
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	Frequency ref1 source	*Analog src*	-	-	1 = 1

No.	Name	Type	Range	Unit	FbEq32
28.12	Frequency ref2 source	*Analog src*	-	-	1 = 1
28.13	Frequency ref1 function	*List*	0…5	-	1 = 1
28.14	Frequency ref1/2 selection	*Binary src*	-	-	1 = 1
28.21	Constant frequency function	*PB*	0000b…0011b	-	1 = 1
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*	0000b…0011b	-	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
28.71	Freq ramp set selection	*Binary src*	-	-	1 = 1
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
28.74	Freq acceleration time 2	*Real*	0.000 …1800.000	s	1000 = 1 s
28.75	Freq deceleration time 2	*Real*	0.000 …1800.000	s	1000 = 1 s
28.76	Freq ramp in zero source	*Binary src*	-	-	1 = 1
28.77	Freq ramp hold	*Binary src*	-	-	1 = 1
28.78	Freq ramp output balancing	*Real*	-500.00…500.00	Hz	100 = 1 Hz
28.79	Freq ramp output balancing enable	*Binary src*	-	-	1 = 1
28.90	Frequency ref act 1	*Real*	-500.00…500.00	Hz	100 = 1 Hz
28.91	Frequency ref act 2	*Real*	-500.00…500.00	Hz	100 = 1 Hz
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

No.	Name	Type	Range	Unit	FbEq32
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
30.15	Maximum start current enable	*List*	0...1	-	1 = 1
30.16	Maximum start current	*Real*	0.00...30000.00	A	100 = 1 A
30.17	Maximum current	*Real*	0.00…30000.00	A	100 = 1 A
30.18	Minimum torque sel	*Binary src*	-	-	1 = 1
30.19	Minimum torque 1	*Real*	-1600.0…0.0	%	10 = 1%
30.20	Maximum torque 1	*Real*	0.0…1600.0	%	10 = 1%
30.21	Minimum torque 2 source	*Analog src*	-	-	1 = 1
30.22	Maximum torque 2 source	*Analog src*	-	-	1 = 1
30.23	Minimum torque 2	*Real*	-1600.0...0.0	%	10 = 1%
30.24	Maximum torque 2	*Real*	0.0...1600.0	%	10 = 1%
30.25	Maximum torque sel	*Binary src*	-	-	1 = 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
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

No.	Name	Type	Range	Unit	FbEq32
31.11	Fault reset selection	*Binary src*	-	-	1 = 1
31.12	Autoreset selection	*PB*	0000h…FFFFh	-	1 = 1
31.13	User 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…5	-	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*	0.0…10000.0	rpm	100 = 1 rpm
31.27	Stall frequency limit	*Real*	0.00…500.00	Hz	100 = 1 Hz
31.28	Stall time	*Real*	0…3600	s	1 = 1 s
31.30	Overspeed trip margin	*Real*	0…10000	rpm	100 = 1 rpm
31.32	Emergency ramp supervision	*Real*	0…300	%	1 = 1%
31.33	Emergency ramp supervision delay	*Real*	0…32767	s	1 = 1 s
31.35	Main fan fault function	*List*	0…2	-	1 = 1
31.36	Aux fan fault bypass	*List*	0…1	-	1 = 1
31.37	Ramp stop supervision	*Real*	0…300	%	1 = 1%
31.38	Ramp stop supervision delay	*Real*	0…32767	s	1 = 1 s
31.40	Disable warnings	*PB*	0000h…FFFFh	-	1 = 1
31.42	Overcurrent fault limit	*Real*	0.00...30000.00	A	100 = 1 A
32 Supervision					
32.01	Supervision status	*PB*	0000…0111b	-	1 = 1
32.05	Supervision 1 function	*List*	0…6	-	1 = 1
32.06	Supervision 1 action	*List*	0…2	-	1 = 1
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*	-21474830.00 …21474830.00	-	100 = 1
32.10	Supervision 1 high	*Real*	-21474830.00 …21474830.00	-	100 = 1
32.15	Supervision 2 function	*List*	0…6	-	1 = 1
32.16	Supervision 2 action	*List*	0…2	-	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

No.	Name	Type	Range	Unit	FbEq32
32.19	Supervision 2 low	*Real*	-21474830.00 …21474830.00	-	100 = 1
32.20	Supervision 2 high	*Real*	-21474830.00 …21474830.00	-	100 = 1
32.25	Supervision 3 function	*List*	0…6	-	1 = 1
32.26	Supervision 3 action	*List*	0…2	-	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*	-21474830.00 …21474830.00	-	100 = 1
32.30	Supervision 3 high	*Real*	-21474830.00 …21474830.00	-	100 = 1
33 Generic timer & counter					
33.01	Counter status	*PB*	0000 0000b…0011 1111b	-	1 = 1
33.10	On-time 1 actual	*Real*	0…4294967295	s	1 = 1 s
33.11	On-time 1 warn limit	*Real*	0…4294967295	s	1 = 1 s
33.12	On-time 1 function	*PB*	0000b…0011b	-	1 = 1
33.13	On-time 1 source	*Binary src*	-	-	1 = 1
33.14	On-time 1 warn message	*List*	-	-	1 = 1
33.20	On-time 2 actual	*Real*	0…4294967295	s	1 = 1 s
33.21	On-time 2 warn limit	*Real*	0…4294967295	s	1 = 1 s
33.22	On-time 2 function	*PB*	0000b…0011b	-	1 = 1
33.23	On-time 2 source	*Binary src*	-	-	1 = 1
33.24	On-time 2 warn message	*List*	-	-	1 = 1
33.30	Edge counter 1 actual	*Real*	0…4294967295	-	1 = 1
33.31	Edge counter 1 warn limit	*Real*	0…4294967295	-	1 = 1
33.32	Edge counter 1 function	*PB*	0000b…1111b	-	1 = 1
33.33	Edge counter 1 source	*Binary src*	-	-	1 = 1
33.34	Edge counter 1 divider	*Real*	1…4294967295	-	1 = 1
33.35	Edge counter 1 warn message	*List*	-	-	1 = 1
33.40	Edge counter 2 actual	*Real*	0…4294967295	-	1 = 1
33.41	Edge counter 2 warn limit	*Real*	0…4294967295	-	1 = 1
33.42	Edge counter 2 function	*PB*	0000b…1111b	-	1 = 1
33.43	Edge counter 2 source	*Binary src*	-	-	1 = 1
33.44	Edge counter 2 divider	*Real*	1…4294967295	-	1 = 1
33.45	Edge counter 2 warn message	*List*	-	-	1 = 1
33.50	Value counter 1 actual	*Real*	-2147483008 …2147483008	-	1 = 1

No.	Name	Type	Range	Unit	FbEq32
33.51	Value counter 1 warn limit	*Real*	-2147483008 …2147483008	-	1 = 1
33.52	Value counter 1 function	*PB*	0000b…0011b	-	1 = 1
33.53	Value counter 1 source	*Analog src*	-	-	1 = 1
33.54	Value counter 1 divider	*Real*	0.001…2147483.000	-	1000 = 1
33.55	Value counter 1 warn message	*List*	-	-	1 = 1
33.60	Value counter 2 actual	*Real*	-2147483008 …2147483008	-	1 = 1
33.61	Value counter 2 warn limit	*Real*	-2147483008 …2147483008	-	1 = 1
33.62	Value counter 2 function	*PB*	0000b…0011b	-	1 = 1
33.63	Value counter 2 source	*Analog src*	-	-	1 = 1
33.64	Value counter 2 divider	*Real*	0.001…2147483.000	-	1000 = 1
33.65	Value counter 2 warn message	*List*	-	-	1 = 1
35 Motor thermal protection					
35.01	Motor estimated temperature	*Real*	-60…1000	°C	1 = 1 °C
35.02	Measured temperature 1	*Real*	-60 … 5000 °C, -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, -76 … 9032 °F, 0 ohm or [*35.22*] ohm	°C, °F or ohm	1 = 1 unit
35.04	FEX-01/FPTC-01 status word	*PB*	0000h…FFFFh	-	1 = 1
35.11	Temperature 1 source	*List*	0…11	-	1 = 1
35.12	Temperature 1 fault limit	*Real*	-60 … 5000 °C or ohm, or -76 … 9032 °F	°C, °F or ohm	1 = 1 unit
35.13	Temperature 1 warning limit	*Real*	-60 … 5000 °C or ohm, 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…11	-	1 = 1
35.22	Temperature 2 fault limit	*Real*	-60 … 5000 °C or ohm, or -76 … 9032 °F	°C, °F or ohm	1 = 1 unit
35.23	Temperature 2 warning limit	*Real*	-60 … 5000 °C or ohm, or -76 … 9032 °F	°C, °F or ohm	1 = 1 unit
35.24	Temperature 2 AI source	*Analog src*	-	-	1 = 1
35.30	FEX-01/FPTC-01 configuration word	*PB*	0000h…FFFFh	-	1 = 1
35.50	Motor ambient temperature	*Real*	-60 … 100 °C or -76 … 212 °F	°C or °F	1 = 1 °
35.51	Motor load curve	*Real*	50…150	%	1 = 1%
35.52	Zero speed load	*Real*	50…150	%	1 = 1%

No.	Name	Type	Range	Unit	FbEq32
35.53	Break point	*Real*	1.00…500.00	Hz	100 = 1 Hz
35.54	Motor nominal temperature rise	*Real*	0…300	°C	1 = 1 °C
35.55	Motor thermal time constant	*Real*	100…10000	s	1 = 1 s
35.60	Cable temperature	*Real*	00...200.0	%	10 = 1%
35.61	Cable nominal current	*Real*	0.00...10000.0	A	100 = 1 A
35.62	Cable thermal rise time	*Real*	0...50000	s	1 = 1 s
35.100	DOL starter control source	*Binary src*	-	-	1 = 1
35.101	DOL starter on delay	*Real*	0...42949673	s	1 = 1 s
35.102	DOL starter off delay	*Real*	0...715828	min	1 = 1 min
35.103	DOL starter feedback source	*Binary src*	-	-	1 = 1
35.104	DOL starter feedback delay	*Real*	0...42949673	s	1 = 1 s
35.105	DOL starter status word	*PB*	0000b...1111b	-	1 = 1
35.106	DOL starter event type	*List*	0...2	-	1 = 1
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
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*	-32768.00…32767.00	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%

No.	Name	Type	Range	Unit	FbEq32
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
43 Brake chopper					
43.01	Braking resistor temperature	*Real*	0.0…120.0	%	10 = 1%
43.06	Brake chopper enable	*List*	0…2	-	1 = 1
43.07	Brake chopper runtime enable	*Binary src*	-	-	1 = 1
43.08	Brake resistor thermal tc	*Real*	0…10000	s	1 = 1 s
43.09	Brake resistor Pmax cont	*Real*	0.00…10000.00	kW	100 = 1 kW
43.10	Brake resistance	*Real*	0…1000	ohm	10 = 1 ohm
43.11	Brake resistor fault limit	*Real*	0…150	%	1 = 1%
43.12	Brake resistor warning limit	*Real*	0…150	%	1 = 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
45.05	Saved money x1000	*Real*	0…4294967295	thousand	1 = 1 thousand
45.06	Saved money	*Real*	0.00…999.99	(selectabl e)	100 = 1 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
45.11	Energy optimizer	*List*	0…1	-	1 = 1
45.12	Energy tariff 1	*Real*	0.000 …4294966.296	(selectabl e)	1000 = 1 unit
45.13	Energy tariff 2	*Real*	0.000…4294966.296	(selectabl e)	1000 = 1 unit
45.14	Tariff selection	*Binary src*	-	-	1 = 1
45.17	Tariff currency unit	*List*	100…102	-	1 = 1

No.	Name	Type	Range	Unit	FbEq32
45.18	CO2 conversion factor	*Real*	0.000…65.535	metricton/ MWh	1000 = 1 metric ton/MWh
45.19	Comparison power	*Real*	0.0…100000.0	kW	10 = 1 kW
45.21	Energy calculations reset	*List*	0…1	-	1 = 1
46 Monitoring/scaling settings					
46.01	Speed scaling	*Real*	0.10…30000.00	rpm	100 = 1 rpm
46.02	Frequency scaling	*Real*	0.10…1000.00	Hz	100 = 1 Hz
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
47.05	Data storage 5 real32	*Real*	-2147483.000 …2147483.000	-	1000 = 1
47.06	Data storage 6 real32	*Real*	-2147483.000 …2147483.000	-	1000 = 1
47.07	Data storage 7 real32	*Real*	-2147483.000 …2147483.000	-	1000 = 1
47.08	Data storage 8 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
47.15	Data storage 5 int32	*Real*	-2147483648 …2147483647	-	1 = 1
47.16	Data storage 6 int32	*Real*	-2147483648 …2147483647	-	1 = 1
47.17	Data storage 7 int32	*Real*	-2147483648 …2147483647	-	1 = 1
47.18	Data storage 8 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
47.25	Data storage 5 int16	*Real*	-32768…32767	-	1 = 1
47.26	Data storage 6 int16	*Real*	-32768…32767	-	1 = 1

No.	Name	Type	Range	Unit	FbEq32
47.27	Data storage 7 int16	*Real*	-32768…32767	-	1 = 1
47.28	Data storage 8 int16	*Real*	-32768…32767	-	1 = 1
47.31	Data storage 1 real32 type	*List*	0…5	-	1 = 1
47.32	Data storage 2 real32 type	*List*	0…5	-	1 = 1
47.33	Data storage 3 real32 type	*List*	0…5	-	1 = 1
47.34	Data storage 4 real32 type	*List*	0…5	-	1 = 1
47.35	Data storage 5 real32 type	*List*	0…5	-	1 = 1
47.36	Data storage 6 real32 type	*List*	0…5	-	1 = 1
47.37	Data storage 7 real32 type	*List*	0…5	-	1 = 1
47.38	Data storage 8 real32 type	*List*	0…5	-	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*	0.1…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…3	-	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…10	-	1 = 1
50.05	FBA A ref2 type	*List*	0…10	-	1 = 1
50.07	FBA A actual 1 type	*List*	0…6	-	1 = 1
50.08	FBA A actual 2 type	*List*	0…6	-	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
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
50.21	FBA A timelevel sel	*List*	0…3	-	1 = 1
50.31	FBA B enable	*List*	0…1	-	1 = 1

No.	Name	Type	Range	Unit	FbEq32
50.32	FBA B comm loss func	*List*	0…3	-	1 = 1
50.33	FBA B comm loss timeout	*Real*	0.3…6553.5	s	10 = 1 s
50.34	FBA B ref1 type	*List*	0…10	-	1 = 1
50.35	FBA B ref2 type	*List*	0…10	-	1 = 1
50.37	FBA B actual 1 type	*List*	0…6	-	1 = 1
50.38	FBA B actual 2 type	*List*	0…6	-	1 = 1
50.39	FBA B SW transparent source	*Analog src*	-	-	1 = 1
50.40	FBA B act1 transparent source	*Analog src*	-	-	1 = 1
50.41	FBA B act2 transparent source	*Analog src*	-	-	1 = 1
50.42	FBA B debug mode	*List*	0…1	-	1 = 1
50.43	FBA B control word	*Data*	00000000h…FFFFFFFFh	-	1 = 1
50.44	FBA B reference 1	*Real*	-2147483648 …2147483647	-	1 = 1
50.45	FBA B reference 2	*Real*	-2147483648 …2147483647	-	1 = 1
50.46	FBA B status word	*Data*	00000000h…FFFFFFFFh	-	1 = 1
50.47	FBA B actual value 1	*Real*	-2147483648 …2147483647	-	1 = 1
50.48	FBA B actual value 2	*Real*	-2147483648 … 2147483647	-	1 = 1
50.51	FBA B timelevel sel	*List*	0…3	-	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

No.	Name	Type	Range	Unit	FbEq32
53 FBA A data out					
53.01	FBA A data out1	*List*	-	-	1 = 1
…	…	…	…	…	
53.12	FBA A data out12	*List*	-	-	1 = 1
54 FBA B settings					
54.01	FBA B type				
54.02	FBA B Par2	UINT16	0...65535	-	
...	...	...	...	...	
54.26	FBA B Par26	UINT16	0...65535	-	
54.27	FBA B par refresh	*List*	0...1	-	
54.28	FBA B par table ver	UINT16	-	-	
54.29	FBA B drive type code	UINT16	0...65535	-	
54.30	FBA B mapping file ver	UINT16	0...65535	-	
54.31	D2FBA B comm status	*List*	0...6	-	
54.32	FBA B comm SW ver	UINT16	-	-	
54.33	FBA B appl SW ver	UINT16	-	-	
55 FBA B data in					
55.01	FBA B data in1	*List*	-	-	1 = 1
...	...	...	...		
55.12	FBA B data in12	*List*	-	-	1 = 1
56 FBA B data out					
56.01	FBA B data out1	*List*	-	-	1 = 1
...	...	...	...		
56.12	FBA B data out12	*List*	-	-	1 = 1
58 Embedded fieldbus					
58.01	Protocol enable	*List*	-	-	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*	2…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
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

No.	Name	Type	Range	Unit	FbEq32
58.18	EFB control word	*PB*	0000h…FFFFh	-	1 = 1
58.19	EFB status word	*PB*	0000h…FFFFh	-	1 = 1
58.25	Control profile	*List*	0, 2	-	1 = 1
58.26	EFB ref1 type	*List*	0…5	-	1 = 1
58.27	EFB ref2 type	*List*	0…5	-	1 = 1
58.28	EFB act1 type	*List*	0…6	-	1 = 1
58.29	EFB act2 type	*List*	0…6	-	1 = 1
58.30	EFB status word transparent source	*Analog src*	-	-	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
…	…	…	…	…	
58.124	Data I/O 24	*Analog src*	-	-	1 = 1
74 Pump setup					
74.01	Pump enable	*Binary src*	-	-	1 = 1
74.02	Run-time hours reset source	*Binary src*	-	-	1 = 1
74.03	Gear reduction ratio	*Real*	1.00...1000.00	-	1000 = 1
74.04	Speed ref type	*List*	-	-	1 = 1
74.05	Speed ref source	*Analog src*	-	Prpm, rpm or Hz	1 = 1
74.06	Speed ref	*Real*	0.00...30000.00	Prpm, rpm or Hz	100 = 1 Prpm, rpm or Hz
74.07	Minimum rod speed	*Real*	-10000.00...10000.00	Prpm, rpm or Hz	100 = 1 Prpm, rpm or Hz

No.	Name	Type	Range	Unit	FbEq32
74.08	Maximum rod speed	*Real*	-10000.00...10000.00	Prpm, rpm or Hz	100 = 1 Prpm, rpm or Hz
74.10	Rod acc time	*Real*	0.000...10000.000	s	1000 = 1 s
74.11	Rod dec time	*Real*	0.000...10000.000	s	1000 = 1 s
74.12	Starting speed enable	*Binary src*	-	-	1 = 1
74.13	Starting speed	*Real*	-10000.00...10000.00	Prpm, rpm or Hz	100 = 1 Prpm, rpm or Hz
74.14	Starting speed acc time	*Real*	0.000...10000.000	s	1000 = 1 s
74.15	Starting speed time delay	*Real*	0.000...10000.000	s	1000 = 1 s
74.18	Minimum rod torq ref	*Real*	-10000.00...0.00	N•m or ibft	100 = 1 N•m or lbft
74.19	Maximum rod torq ref	*Real*	0.00...10000.00	N•m or lbft	100 = 1 N•m or lbft
74.21	Brake confirmation enable	*Binary src*	-	-	1 = 1
74.22	Brake confirmation source	*Analog src*	-	-	1 = 1
74.23	Brake confirmation limit	*Real*	0.00...100.00	%	100 = 1%
74.24	Brake confirmation speed	*Real*	-500.00...0.00	Prpm, rpm or Hz	100 = 1 Prpm, rpm or Hz
74.25	Brake confirmation time	*Real*	1.000...30.000	s	1000 = 1 s
74.26	Pressure unit selection	*List*	-	-	1 = 1
74.27	Depth unit selection	*List*	-	-	1 = 1
75 Pump level control					
75.01	Level control enable	-	-	-	1 = 1
75.02	Fluid level ref	*Real*	0.00…100000.00	m, ft or Joints	100 = 1 m, ft or Joints
75.03	Fluid level source function	*List*	0...5	m	1 = 1
75.04	Fluid level source 1	*Analog src*	-	m	1 = 1
75.05	Fluid level source 2	*Analog src*	-	m	1 = 1
75.06	Level meas range	*Real*	0.00...100000.00	m, ft or Joints	100 = 1 m, ft or Joints
75.07	Fluid level p-gain	*Real*	0.00...5.00	-	100 = 1
75.08	Fluid level i-time	*Real*	1.000...3600.000	s	1000 = 1 s
75.09	Level control invert	-	-	-	1 = 1
75.10	Sleep control enable	*Binary src*	-	-	1 = 1
75.11	Sleep warning enable	*Binary src*	-	-	1 = 1
75.12	Sleep limit type	*List*	-	-	1 = 1
75.13	Sleep signal source function	*List*	0...5	-	1 = 1

No.	Name	Type	Range	Unit	FbEq32
75.14	Sleep signal source 1	*Analog src*	-	-	1 = 1
75.15	Sleep signal source 2	*Analog src*	-	-	1 = 1
75.16	Sleep level	*Real*	0.00...100000000.00	%	100 = 1%
75.17	Sleep delay time	*Real*	0.000...10000.000	s	1000 = 1 s
75.18	Wakeup level	*Real*	0.00...100000000.00	%	100 = 1%
75.19	Wakeup delay time	*Real*	0.000...10000.000	s	1000 = 1 s
75.20	Maximum sleep time	*Real*	0.000...100000.000	s	1000 = 1 s
76 Pump pressure protection					
76.01	Pressure protection function	*List*	-	-	1 = 1
76.02	Pressure protection latching	*List*	0...2	-	1 = 1
76.03	Digital feedback source enable	*Binary src*	-	-	1 = 1
76.04	Digital feedback source	*Binary src*	-	-	1 = 1
76.05	Analog feedback source enable	*Binary src*	-	-	1 = 1
76.06	Analog feedback source	*Analog src*	-	-	1 = 1
76.07	Analog feedback limit	*Real*	0.00...10000.00	kPa or psi	100 = 1 kPa or psi
76.08	Analog feedback limit delay time	*Real*	0.000...3600.000	s	1000 = 1 s
77 Pump torque protection					
77.01	Rod torq limit display	*List*	-	-	1 = 1
77.02	Rod torq1 function	*Binary src*	-	-	1 = 1
77.03	Rod torq1 limit type	*List*	-	-	1 = 1
77.04	Rod torq1 limit	*Real*	0.00...10000.00	N•m, lbft or A	100 = 1 N•m, lbft or A
77.05	Rod torq1 speed	*Real*	-3600.00...3600.00	Prpm, rpm or Hz	100 = 1 Prpm, rpm or Hz
77.06	Rod torq1 delay time	*Real*	0.000...10000.000	s	1000 = 1 s
77.07	Rod torq2 function	*Binary src*	-	-	1 = 1
77.08	Rod torq2 limit type	*List*	-	-	1 = 1
77.09	Rod torq2 limit	*Real*	0.00...10000.00	N•m, lbft or A	100 = 1 N•m, lbft or A
77.10	Rod torq2 delay time	*Real*	0.000...10000.000	s	100 = 1 s
77.11	Rod torq2 additive speed ref	*Real*	-3600.00...3600.00	Prpm, rpm or Hz	100 = 1 Prpm, rpm or Hz
77.12	Rod torq2 speed delay time	*Real*	0.000...100000.000	s	1000 = 1 s
77.13	Rod torq2 limit counter	*Real*	0...100	-	1 = 1
77.14	Rod torq2 time window	*Real*	0.000...7200.000	s	1000 = 1 s

No.	Name	Type	Range	Unit	FbEq32
78 Pump underload protection					
78.01	Underload limit display	*List*	-	-	1 = 1
78.02	Underload function	*Binary src*	-	-	1 = 1
78.03	Torque1	*Real*	0.00...10000.00	T(%) or A(%)	100 = 1 T(%) or A(%)
78.04	Speed1	*Real*	-3600.00...3600.00	Prpm, rpm or Hz	100 = 1 Prpm, rpm or Hz
78.05	Torque2	*Real*	0.00...10000.00	T(%) or A(%)	100 = 1 T(%) or A(%)
78.06	Speed2	*Real*	-3600.00...3600.00	rpm or Hz	100 = 1 Prpm, rpm, Hz
78.07	Torque3	*Real*	0.00...10000.00	T(%) or A(%)	100 = 1 T(%) or A(%)
78.08	Speed3	*Real*	-3600.00...3600.00	Prpm, rpm or Hz	100 = 1 Prpm, rpm or Hz
78.09	Underload delay time	*Real*	0.000...100000.000	s	1000 = 1 s
79 Pump temperature protection					
79.01	Temperature protection function	*Binary src*	-	-	1 = 1
79.02	Temperature protection device	*List*	0...2	-	1 = 1
79.03	Klixon signal source	*Binary src*	-	-	1 = 1
79.04	PT100 source	*Analog src*	-	F,C	1 = 1
79.05	PT100 exitation source	*Analog src*	-	mA	1 = 1
79.06	PT100 internal selection	*List*	0.00...20.00	mA	100 = 1 mA
79.07	Number of PT100 sensors in series	*List*	1...3	-	1 = 1
79.08	Warning temperature limit	*Real*	0.00...200.00	°C or °F	100 = 1 °
79.09	Fault temperature limit	*Real*	0.00...200.00	°C or °F	100 = 1 °
80 Pump backspin control					
80.01	Backspin enable	*Binary src*	-	-	1 = 1
80.02	Backspin ref limit	*Real*	-500.00...0.00	Prpm	1 = 1
80.03	Backspin acc time	*Real*	0.000...10000.000	s	1 = 1
80.04	Backspin stop torque	*Real*	0.00...10000.00	Nm	1 = 1
80.05	Backspin speed range trim	*Real*	0.00...100.00	%	1 = 1
80.11	Start delay enable	*Binary src*	-	-	1 = 1 mA
80.12	Start delay time	*Real*	0 … 4294967.295	s	1000 = 1 s
90 Feedback selection					
90.01	Motor speed for control	*Real*	-32768.00…32767.00	rpm	100 = 1 rpm
90.02	Motor position	*Real*	0.00000000…1.00000000	rev	100000000 = 1 rev

No.	Name	Type	Range	Unit	FbEq32
90.03	Load speed	*Real*	-32768.00…32767.00	rpm	100 = 1 rpm
90.04	Load position	*Real*	-2147483648 ...2147483647	rev	1 = 1
90.05	Load position scaled	*Real*	-2147483.250 ...2147483.250	-	100000 = 1
90.06	Motor position scaled	*Real*	-2147483.648 ...2147483.647	-	1000 = 1
90.07	Load position scaled int	*Real*	-2147483648 … 2147483647	-	1 = 1
90.10	Encoder 1 speed	*Real*	-32768.00…32767.00	rpm	100 = 1 rpm
90.11	Encoder 1 position	*Real*	0.00000000…1.00000000	rev	100000000 = 1 rev
90.12	Encoder 1 multiturn revolutions	*Real*	0…16777215	-	1 = 1
90.13	Encoder 1 revolution extension	*Real*	-2147483648 ...2147483647	-	1 = 1
90.14	Encoder 1 position raw	*Real*	0…16777215	-	1 = 1
90.15	Encoder 1 revolutions raw	*Real*	0…16777215	-	1 = 1
90.20	Encoder 2 speed	*Real*	-32768.00…32767.00	rpm	100 = 1 rpm
90.21	Encoder 2 position	*Real*	0.00000000…1.00000000	rev	100000000 = 1 rev
90.22	Encoder 2 multiturn revolutions	*Real*	0…16777215	-	1 = 1
90.23	Encoder 2 revolution extension	*Real*	-2147483648 ...2147483647	-	1 = 1
90.24	Encoder 2 position raw	*Real*	0…16777215	-	1 = 1
90.25	Encoder 2 revolutions raw	*Real*	0…16777215	-	1 = 1
90.26	Motor revolution extension	*Real*	-2147483648 ...2147483647	-	1 = 1
90.27	Load revolution extension	*Real*	-2147483648 ...2147483647	-	1 = 1
90.35	Pos counter status	*PB*	000000b…111111b	-	1 = 1
90.38	Pos counter decimals	*List*	0…9	-	1 = 1
90.41	Motor feedback selection	*List*	0…2	-	1 = 1
90.42	Motor speed filter time	*Real*	0…10000	ms	1 = 1 ms
90.43	Motor gear numerator	*Real*	-2147483648… 2147483647	-	1 = 1
90.44	Motor gear denominator	*Real*	-2147483648… 2147483647	-	1 = 1
90.45	Motor feedback fault	*List*	0…1	-	1 = 1
90.46	Force open loop	*List*	0…1	-	1 = 1
90.48	Motor position axis mode	*List*	0…1	-	1 = 1
90.49	Motor position resolution	*Real*	0…31	-	1 = 1
90.51	Load feedback selection	*List*	0…4	-	1 = 1

No.	Name	Type	Range	Unit	FbEq32
90.52	Load speed filter time	*Real*	0…10000	ms	1 = 1 ms
90.53	Load gear numerator	*Real*	-2147483648 …2147483647	-	1 = 1
90.54	Load gear denominator	*Real*	-2147483648 …2147483647	-	1 = 1
90.55	Load feedback fault	*List*	0…1	-	1 = 1
90.56	Load position offset	*Real*	-2147483648 … 2147483647	rev	1 = 1 rev
90.57	Load position resolution	*Real*	0…31	-	1 = 1
90.58	Pos counter init value int	*Real*	-2147483648 …2147483647	-	1 = 1
90.59	Pos counter init value int source	*Binary src*	-	-	1 = 1
90.61	Gear numerator	*Real*	-2147483648 …2147483647	-	1 = 1
90.62	Gear denominator	*Real*	-2147483648 …2147483647	-	1 = 1
90.63	Feed constant numerator	*Real*	-2147483648 …2147483647	-	1 = 1
90.64	Feed constant denominator	*Real*	-2147483648 …2147483647	-	1 = 1
90.65	Pos counter init value	*Real*	-2147483.648 …2147483.647	-	1 = 1
90.66	Pos counter init value source	*Binary src*	-	-	1 = 1
90.67	Pos counter init cmd source	*Binary src*	-	-	1 = 1
90.68	Disable pos counter initialization	*Binary src*	-	-	1 = 1
90.69	Reset pos counter init ready	*Binary src*	-	-	1 = 1
91 Encoder module settings					
91.01	FEN DI status	*PB*	0000 0000b …0011 0011b	-	1 = 1
91.02	Module 1 status	*List*	-	-	1 = 1
91.03	Module 2 status	*List*	-	-	1 = 1
91.04	Module 1 temperature	*Real*	0…1000	°C	1 = 1 °C
91.06	Module 2 temperature	*Real*	0…1000	°C	1 = 1 °C
91.10	Encoder parameter refresh	*List*	0…1	-	1 = 1
91.11	Module 1 type	*List*	0…4	-	1 = 1
91.12	Module 1 location	*Real*	4…254	-	1 = 1
91.13	Module 2 type	*List*	0…4	-	1 = 1
91.14	Module 2 location	*Real*	4…254	-	1 = 1
91.21	Module 1 temp sensor type	*List*	0…2	-	1 = 1
91.22	Module 1 temp filter time	*Real*	0…10000	ms	1 = 1 ms
91.24	Module 2 temp sensor type	*List*	0…2	-	1 = 1

No.	Name	Type	Range	Unit	FbEq32
91.25	Module 2 temp filter time	*Real*	0…10000	ms	1 = 1 ms
91.31	Module 1 TTL output source	*List*	0…2	-	1 = 1
91.32	Module 1 emulation pulses/rev	*Real*	0…65535	-	1 = 1
91.33	Module 1 emulated Z-pulse offset	*Real*	0.00000 … 1.00000	rev	100000 = 1 rev
91.41	Module 2 TTL output source	*List*	0…2	-	1 = 1
91.42	Module 2 emulation pulses/rev	*Real*	0…65535	-	1 = 1
91.43	Module 2 emulated Z-pulse offset	*Real*	0.00000 … 1.00000	rev	100000 = 1 rev
92 Encoder 1 configuration					
92.01	Encoder 1 type	*List*	0.9	-	1 = 1
92.02	Encoder 1 source	*List*	1…2	-	1 = 1
Other parameters in this group when parameter *92.01 Encoder 1 type* = *TTL*, *TTL+* or *HTL*					
92.10	Pulses/revolution	*Real*	0…65535	-	1 = 1
92.11	Pulse encoder type	*List*	0…1	-	1 = 1
92.12	Speed calculation mode	*List*	0…5	-	1 = 1
92.13	Position estimation enable	*List*	0…1	-	1 = 1
92.14	Speed estimation enable	*List*	0…1	-	1 = 1
92.15	Transient filter	*List*	0…3	-	1 = 1
92.16	Encoder 1 supply voltage	*List*	0…2	-	1 = 1
92.17	Accepted pulse freq of encoder 1	*Real*	0...300	kHz	1 = 1 kHz
92.21	Encoder cable fault mode	*List*	0…3	-	1 = 1
Other parameters in this group when parameter *92.01 Encoder 1 type* = *Absolute encoder*					
92.10	Sine/cosine number	*Real*	0…65535	-	1 = 1
92.11	Absolute position source	*List*	0…5	-	1 = 1
92.12	Zero pulse enable	*List*	0…1	-	1 = 1
92.13	Position data width	*Real*	0…32	-	1 = 1
92.14	Revolution data width	*Real*	0…32	-	1 = 1
92.30	Serial link mode	*List*	0…2	-	1 = 1
92.31	EnDat max calculation time	*List*	0…3	-	1 = 1
92.32	SSI cycle time	*List*	0…5	-	1 = 1
92.33	SSI clock cycles	*Real*	2…127	-	1 = 1
92.34	SSI position msb	*Real*	1…126	-	1 = 1
92.35	SSI revolution msb	*Real*	1…126	-	1 = 1
92.36	SSI data format	*List*	0…1	-	1 = 1
92.37	SSI baud rate	*List*	0…5	-	1 = 1
92.40	SSI zero phase	*List*	0…3	-	1 = 1
92.45	Hiperface parity	*List*	0…1	-	1 = 1
92.46	Hiperface baud rate	*List*	0…3	-	1 = 1
92.47	Hiperface node address	*Real*	0…255	-	1 = 1

No.	Name	Type	Range	Unit	FbEq32
Other parameters in this group when parameter *92.01 Encoder 1 type* = *Resolver*					
92.10	Excitation signal frequency	*Real*	1…20	kHz	1 = 1 kHz
92.11	Excitation signal amplitude	*Real*	4.0…12.0	V	10 = 1 V
92.12	Resolver polepairs	*List*	1…32	-	1 = 1
93 Encoder 2 configuration					
93.01	Encoder 2 type	*List*	0.9	-	1 = 1
93.02	Encoder 2 source	*List*	1…2	-	1 = 1
Other parameters in this group when parameter *93.01 Encoder 2 type* = *TTL*, *TTL+* or *HTL*					
93.10	Pulses/revolution	*Real*	0…65535	-	1 = 1
93.11	Pulse encoder type	*List*	0…1	-	1 = 1
93.12	Speed calculation mode	*List*	0…5	-	1 = 1
93.13	Position estimation enable	*List*	0…1	-	1 = 1
93.14	Speed estimation enable	*List*	0…1	-	1 = 1
93.15	Transient filter	*List*	0…3	-	1 = 1
93.16	Encoder 2supply voltage	*List*	0…2	-	1 = 1
93.17	Accepted pulse freq of encoder 2	*Real*	0...300	kHz	1 = 1 kHz
93.21	Encoder cable fault mode	*List*	0…3	-	1 = 1
Other parameters in this group when parameter *93.01 Encoder 2 type* = *Abs enc*					
93.10	Sine/cosine number	*Real*	0…65535	-	1 = 1
93.11	Absolute position source	*List*	0…5	-	1 = 1
93.12	Zero pulse enable	*List*	0…1	-	1 = 1
93.13	Position data width	*Real*	0…32	-	1 = 1
93.14	Revolution data width	*Real*	0…32	-	1 = 1
93.30	Serial link mode	*List*	0…2	-	1 = 1
93.31	EnDat calc time	*List*	0…3	-	1 = 1
93.32	SSI cycle time	*List*	0…5	-	1 = 1
93.33	SSI clock cycles	*Real*	2…127	-	1 = 1
93.34	SSI position msb	*Real*	1…126	-	1 = 1
93.35	SSI revolution msb	*Real*	1…126	-	1 = 1
93.36	SSI data format	*List*	0…1	-	1 = 1
93.37	SSI baud rate	*List*	0…5	-	1 = 1
93.40	SSI zero phase	*List*	0…3	-	1 = 1
93.45	Hiperface parity	*List*	0…1	-	1 = 1
93.46	Hiperface baud rate	*List*	0…3	-	1 = 1
93.47	Hiperface node address	*Real*	0…255	-	1 = 1
Other parameters in this group when parameter *93.01 Encoder 2 type* = *Resolver*					
93.10	Excitation signal frequency	*Real*	1…20	kHz	1 = 1 kHz
93.11	Excitation signal amplitude	*Real*	4.0…12.0	V	10 = 1 V
93.12	Resolver polepairs	*List*	1…32	-	1 = 1

No.	Name	Type	Range	Unit	FbEq32
95 HW configuration					
95.01	Supply voltage	*List*	0…6	-	1 = 1
95.02	Adaptive voltage limits	*List*	0…1	-	1 = 1
95.04	Control board supply	*List*	0…2	-	1 = 1
95.08	DC switch monitoring	*List*	0…1	-	1 = 1
95.09	Fuse switch control	*List*	0…1	-	1 = 1
95.15	Special HW settings	*PB*	0000b…0111b	-	1 = 1
95.20	HW options word 1	*PB*	0000h...FFFFh	-	1 = 1
95.21	HW options word 2	*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 levels active	*PB*	0000h...FFFFh	-	1 = 1
96.04	Macro select	*List*	0…6	-	1 = 1
96.05	Macro active	*List*	1…6	-	1 = 1
96.06	Parameter restore	*List*	-	-	1 = 1
96.07	Parameter save manually	*List*	0…1	-	1 = 1
96.08	Control board boot	*Real*	0…1	-	1 = 1
96.09	FSO reboot	*Binary src*	-	-	-
96.10	User set status	*List*	-	-	-
96.11	User set save/load	*List*	-	-	-
96.12	User set IO sel in1	*Binary src*	-	-	-
96.13	User set IO sel in2	*Binary src*	-	-	
96.16	Unit selection	*PB*	0000 0000b…0001 0101b	-	1 = 1
96.20	Time sync primary source	*List*	0...9	-	1 = 1
96.24	Full days since 1st Jan 1980	*Real*	1...59999	-	1 = 1
96.25	Time in minutes within 24 h	*Real*	0...1439	-	1 = 1
96.26	Time in ms within one minute	*Real*	0...59999	-	1 = 1
96.29	Time sync source status	*PB*	0000h...FFFFh	-	1 = 1
96.31	Drive ID number	*Real*	0...32767	-	1 = 1
97 Motor control					
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
97.06	Flux reference select	*Binary src*	-	-	1 = 1
97.07	User flux reference	*Real*	0…200	%	100 = 1%
97.09	Switching freq mode	*List*	0…3	-	1 = 1
97.10	Signal injection	*List*	0…4	-	1 = 1

No.	Name	Type	Range	Unit	FbEq32
97.11	TR tuning	*Real*	25…400	%	1 = 1%
97.12	IR comp step-up frequency	*Real*	0.0...50.0	Hz	10 = 1 Hz
97.13	IR compensation	*Real*	0.00…50.00	%	100 = 1%
97.15	Motor model temperature adaptation	*List*	0…1	-	1 = 1
97.32	Motor torque unfiltered	*Real*	-1600.0...1600.0	%	10 = 1%
97.33	Speed estimate filter time	*Real*	0.00...100.00	ms	100 = 1 ms
98 User motor parameters					
98.01	User motor model mode	*List*	0…3	-	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.
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…100000.01	mH	100 = 1 mH
98.12	SigmaL user SI	*Real*	0.00…100000.01	mH	100 = 1 mH
98.13	Ld user SI	*Real*	0.00…100000.01	mH	100 = 1 mH
98.14	Lq user SI	*Real*	0.00…100000.01	mH	100 = 1 mH
98.15	Position offset user	*Real*	0…360	° electrical	1 = 1° electrical
99 Motor data					
99.03	Motor type	*List*	0…1	-	1 = 1
99.04	Motor ctrl 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…800.0	V	10 = 1 V
99.08	Motor nominal frequency	*Real*	0.00…500.00	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 lb.ft	1000 = 1 unit

No.	Name	Type	Range	Unit	FbEq32
99.13	ID run requested	*List*	0…7	-	1 = 1
99.14	Last ID run performed	*List*	0…7	-	1 = 1
99.15	Motor polepairs calculated	*Real*	0…1000	-	1 = 1
99.16	Motor phase order	*List*	0…1	-	1 = 1
200 Safety					
This group contains parameters related to the optional FSO-xx safety functions module. For details on the parameters in this group, refer to the documentation of the FSO-xx module.					

10

Fault tracing

Contents of this chapter

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, an ABB service representative should be contacted.

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 *Safety instructions* on the first pages of the Hardware manual before working on the drive.

Indications

Warnings and faults indicate an abnormal drive status. The codes and names of active warnings/faults are displayed on the control panel of the drive as well as the Drive composer PC tool. Only the codes of warnings/faults are available over fieldbus.

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.

For some warnings and faults, the message text are edited and instructions and contact information added. To edit these messages, choose **Settings - Edit texts** on the control panel.

How to reset faults

After the cause of a fault has been corrected, the fault can be reset from a selectable source (see parameter *31.11 Fault reset selection*) such as the control panel, Drive composer PC tool, the digital inputs of the drive, or fieldbus. After the fault is removed, the drive can be restarted.

Warning/fault history

Event logs

When a warning or fault is detected, it is stored in the event log with a time stamp and other information. The event log can be accessed from the main Menu on the control panel. It can also be accessed (and reset) using the Drive composer PC tool.

One of the logs contains faults and fault resets. The other log lists warnings and pure events, as well as clearing entries. Both logs contain 32 most recent events.

Auxiliary codes

Some events generate an auxiliary code that often helps in pinpointing the problem.The auxiliary code is displayed on the control panel together with the message. It is also stored in the event log details. In the Drive composer PC tool, the auxiliary code (if any) is shown in the event listing.

Parameters warning/fault information

The codes of active warnings and faults (maximum five each), and five previously occurred warnings and faults are stored in the parameters of group *04 Warnings and faults* (page *109*).

Event word (parameters 04.40...04.72)

Parameter *04.40 Event word 1* can be configured by the user to indicate the status of 16 selectable events (ie. faults, warnings or pure events). It is possible to specify an auxiliary code for each event to filter out other auxiliary codes.

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.

The QR code can be generated by choosing **Menu** - **Assistants** - **QR code** on the control panel.

Warning messages

Note: The list also contains events that only appear in the Event log.

Code (hex)	Warning	Cause	What to do
A2A1	Current calibration	Current measurement calibration will occur at next start.	Informative warning.
A2B1	Overcurrent	Output current has exceeded internal fault limit.	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 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 encoder cable (including phasing).
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. If no earth fault can be detected, contact your local ABB representative.
A2B4	Short circuit	Short-circuit in motor cable(s) or motor.	Check motor and motor cable. 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.
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 the overloading of the brake chopper or 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.	

Code (hex)	Warning	Cause	What to do
A3C1	DC voltage difference	Difference in DC voltages between parallel-connected inverter modules.	Contact your local ABB representative.
A480	Motor cable overload	Calculated motor cable temperature has exceeded warning limit.	Check the settings of parameters *35.61* and *35.62*. Check the dimensioning of the motor cable in regard to required load.
A490	Incorrect temperature sensor setup	Sensor type mismatch or	Check the settings of supervision source parameters *35.11* and *35.21* against *91.21* and *91.24*.
		Faulty wiring between an encoder interface module and the temperature sensor.	Check the wiring of the sensor. The auxiliary code identifies the interface module. (0 = Module 1, 1 = Module 2).
A491	External temperature (Editable message text)	Measured temperature 1 or 2 has exceeded warning limit.	Check the values of parameters *35.02 Measured temperature 1* and *35.03 Measured temperature 2*. Check the cooling of the motor (or other equipment whose temperature is being measured). Check the warning limits for measured temperatures 1 and 2 in parameter group *35 Motor thermal protection*.
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 unit temperature is excessive.	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 unit replacement.
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), ensure that load current does not exceed derated load capacity of drive. See appropriate *Hardware Manual*. 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.

Code (hex)	Warning	Cause	What to do
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).
A4B2	PCB space cooling	Temperature difference between ambient and drive module PCB space is excessive.	Check the cooling fan inside the PCB space. Check the auxiliary code.
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.
A580	PU communication	Communication errors detected between the drive control unit and the power unit.	Check the connections between the drive control unit and the power unit.
A581	Fan	Cooling fan stuck or disconnected.	Check fan operation and connection. Replace fan if faulty.
A582	Auxiliary fan missing	An auxiliary cooling fan (connected to the fan connectors on the control unit) is stuck or disconnected.	Check auxiliary fan(s) and connection(s). Replace faulty fan. Make sure the front cover of the drive module 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 *424*).
A5A0	Safe torque off Programmable warning: *31.22 STO indication run/stop*	Safe torque off function is active, i.e. safety circuit signal(s) connected to connector XSTO is lost.	Check safety circuit connections. For more information, see appropriate drive hardware manual and description of parameter *31.22 STO indication run/stop* (page *245*).
A5EA	Measurement circuit temperature	Problem with internal temperature measurement of the drive.	Check the auxiliary code.
A5EB	PU board powerfail	Power unit power supply failure.	Contact your local ABB representative.
A5EC	PU communication internal	Communication errors detected between the drive control unit and the power unit.	Check the connections between the drive control unit and the power unit.
A5ED	Measurement circuit ADC	Measurement circuit fault.	Contact your local ABB representative.
A5EE	Measurement circuit DFF	Measurement circuit fault.	Contact your local ABB representative.

Code (hex)	Warning	Cause	What to do
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.
A683	Data saving to power unit	An error in saving data to the power unit.	Check the auxiliary code. See actions for each code below.
	0	An error is preventing saving from initializing.	Cycle the power to the drive. If the control unit is externally powered, also reboot the control unit (using parameter *96.08 Control board boot*) or by cycling its power. If the problem persists, contact your local ABB representative.
	1		
	2	Write error.	
A684	SD card	Error related to SD card used to store data (BCU control unit only).	Check the auxiliary code. See actions for each code below.
	1	No SD card	Insert a compatible, writable SD card into the SD CARD slot of the BCU control unit.
	2	SD card write-protected	
	3	SD card unreadable	
A685	Power fail saving	Power fail saving is requested too frequently due to oscillating power supply to the control unit. Some of the requests may have been discarded, potentially causing data loss.	Check the power supply of the control unit. If powered internally from the drive, check the supply voltage of the drive.
A6A4	Motor nominal value	The motor parameters are set incorrectly.	Check the settings of the motor configuration parameters in group 99.
		The drive is not dimensioned correctly.	Check that the drive is sized correctly for the motor.
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 until the motor data is entered.
A6A6	Voltage category unselected	The supply voltage range has not been defined.	Define supply voltage range (parameter *95.01 Supply voltage*).
A6D1	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*.
A6D2	FBA B 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)* and *54 FBA B settings*.

Code (hex)	Warning	Cause	What to do
A6E5	AI parametrization	The current/voltage jumper setting of an analog input does not correspond to parameter settings.	Check the auxiliary code. The code identifies the analog input whose settings are in conflict. Adjust either the jumper 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 jumper settings.
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.
A781	Motor fan Programmable warning: *35.106 DOL starter event type*	No feedback received from external fan.	Check external fan (or other equipment controlled) by the logic. Check settings of parameters *35.100*…*35.106*.
A782	FEN temperature	Error in temperature measurement when temperature sensor (KTY or PTC) connected to encoder interface FEN-xx is used.	Check that parameter *35.11 Temperature 1 source* / *35.21 Temperature 2 source* setting corresponds to actual encoder interface installation.
		Error in temperature measurement when KTY sensor connected to encoder interface FEN-01 is used.	FEN-01 does not support temperature measurement with KTY sensor. Use PTC sensor or other encoder interface module.
A791	Brake resistor	Brake resistor broken or not connected.	Check that a brake resistor has been connected. Check the condition of the brake resistor.
A793	BR excess temperature	Brake resistor temperature has exceeded warning limit defined by parameter *43.12 Brake resistor warning limit*.	Stop drive. Let resistor cool down. Check resistor overload protection function settings (parameter group *43 Brake chopper*). Check warning limit setting, parameter *43.12 Brake resistor warning limit*. Check that braking cycle meets allowed limits.
A794	BR data	Brake resistor data has not been given.	Check the resistor data settings (parameters *43.08*…*43.10*). The parameter is specified by the auxiliary code.
	0000 0001	Resistance value too low.	Check value of *43.10*.
	0000 0002	Thermal time constant not given.	Check value of *43.08*.
	0000 0003	Maximum continuous power not given.	Check value of *43.09*.

Code (hex)	Warning	Cause	What to do
A797	Speed feedback configuration	Speed feedback configuration has changed.	Use parameter *91.10 Encoder parameter refresh*) to validate any changes in the settings.
	0001	Adapter not found in specified slot.	Check module location (*91.12* or *91.14*).
	0002	Detected type of interface module does not match parameter setting.	Check the module type (*91.11* or *91.13*) against status (*91.02* or *91.03*).
	0003	Logic version too old.	Contact your local ABB representative.
	0004	Software version too old.	Contact your local ABB representative.
	0006	Encoder type incompatible with interface module type.	Check module type (*91.11* or *91.13*) against encoder type (*92.01* or *93.01*).
	0007	Adapter not configured.	Check module location (*91.12* or *91.14*).
	0008	Speed feedback configuration has changed.	Use parameter *91.10 Encoder parameter refresh*) to validate any changes in the settings.
	0009	No encoders configured to encoder module	Configure the encoder in group *92 Encoder 1 configuration* or *93 Encoder 2 configuration*.
	000A	Non-existing emulation input.	Check input selection (*91.31* or *91.41*).
	000B	Echo not supported by selected input (for example, resolver or absolute encoder).	Check input selection (*91.31* or *91.41*), interface module type, and encoder type.
	000C	Emulation in continuous mode not supported.	Check input selection (*91.31* or *91.41*) and serial link mode (*92.30* or *93.30*) settings.
A79B	BC short circuit	Short circuit in brake chopper IGBT	Replace brake chopper. Ensure brake resistor is connected and not damaged.
A79C	BC IGBT excess temperature	Brake chopper IGBT temperature has exceeded internal warning limit.	Let chopper cool down. Check for excessive ambient temperature. Check for cooling fan failure. Check for obstructions in the air flow. Check the dimensioning and cooling of the cabinet. Check resistor overload protection function settings (parameters *43.06*…*43.10*). Check that braking cycle meets allowed limits. Check that drive supply AC voltage is not excessive.

Code (hex)	Warning	Cause	What to do
A7AA	FIO-11 AI parametrization	The hardware current/voltage setting of an analog input (on an FIO-11 I/O extension module) does not correspond to parameter settings.	Adjust either the setting on the FIO-11 module or parameter *14.30*/*15.30*/*16.30*. (The hardware switch settings detected by the control program are shown in parameters *14.29*, *15.29* and *16.29*.) **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 jumper settings.
A7AB	Extension I/O configuration failure	The I/O extension module types and locations specified by parameters do not match the detected configuration.	Check the auxiliary code. The code indicates which I/O extension module is affected. Check the type and location settings of the modules (parameters *14.01*, *14.02*, *15.01*, *15.02*, *16.01* and *16.02*). Check that the modules are properly installed.
A7B0	Motor speed feedback Programmable warning: *90.45 Motor feedback fault*	No motor speed feedback is received.	Check the auxiliary code (format XXYY ZZZZ). "XX" specifies the number of the encoder interface module (**01**: *91.11*/*91.12*, **02**: *91.13*/*91.14*), "YY" specifies the encoder (**01:** *92 Encoder 1 configuration*, **02:** *93 Encoder 2 configuration*). "ZZZZ" indicates the problem (see actions for each code below).
	0001	Motor gear definition invalid or outside limits.	Check motor gear settings (*90.43* and *90.44*).
	0002	Encoder not configured.	Check encoder settings (*92 Encoder 1 configuration* or *93 Encoder 2 configuration*). Use parameter *91.10 Encoder parameter refresh*) to validate any changes in the settings.
	0003	Encoder stopped working.	Check encoder status.
	0004	Encoder drift detected.	Check for slippage between encoder and motor.
A7B1	Load speed feedback Programmable warning: *90.55 Load feedback fault*	No load speed feedback is received.	Check the auxiliary code (format XXYY ZZZZ). "XX" specifies the number of the encoder interface module (**01**: *91.11*/*91.12*, **02**: *91.13*/*91.14*), "YY" specifies the encoder (**01:** *92 Encoder 1 configuration*, **02:** *93 Encoder 2 configuration*). "ZZZZ" indicates the problem (see actions for each code below).
	0001	Load gear definition invalid or outside limits.	Check load gear settings (*90.53* and *90.54*).
	0002	Feed constant definition invalid or outside limits.	Check feed constant settings (*90.63* and *90.64*).
	0003	Encoder stopped working.	Check encoder status.

Code (hex)	Warning	Cause	What to do
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.
A7C2	FBA B communication Programmable warning: *50.32 FBA B comm loss func*	Cyclical communication between drive and fieldbus adapter module B or between PLC and fieldbus adapter module B is lost.	Check status of fieldbus communication. See user documentation of fieldbus interface. Check settings of parameter group *50 Fieldbus adapter (FBA)*. 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 XD2D connector on the control unit.
A7E1	Encoder Programmable warning: *90.45 Motor feedback fault*	Encoder 1 error.	Check that the parameter settings in groups *92 Encoder 1 configuration* are correct. **Note:** New settings will only take effect after parameter *91.10 Encoder parameter refresh* is used or after the drive control unit is powered up the next time. Check the auxiliary code. See appropriate actions for each code below.
	Aux code: 1020	Overspeed	Contact your local ABB representative.
	Aux code: 1021	Pulse overfrequency	
	Aux code: 1022	Cable fault	Check the wiring of the encoder. See also parameter *92.21 Encoder cable fault mode*.
	Aux code: 1023	Resolver ID run fault	Contact your local ABB representative.
	Aux code: 1024	Encoder fault	Refer to encoder documentation.
	Aux code: 1025	Encoder warning	
	Aux code: 1026	Unsupported cable fault detection mode.	Try a different setting in *92.21 Encoder cable fault mode*.
	Aux code: 1027	Resolver SW version	Contact your local ABB representative.
	Aux code: 1028	Resolver speed scale	

Code (hex)	Warning	Cause	What to do
A7E2	Encoder 2	Encoder 2 error.	Check that the parameter settings in groups *93 Encoder 2 configuration* are correct. **Note:** New settings will only take effect after parameter *91.10 Encoder parameter refresh* is used or after the drive control unit is powered up the next time. Check the auxiliary code. See appropriate actions for each code below.
	Aux code: 1030	Overspeed	Contact your local ABB representative.
	Aux code: 1031	Pulse overfrequency	
	Aux code: 1032	Cable fault	Check the wiring of the encoder. See also parameters *93.31 Encoder cable fault mode*.
	Aux code: 1033	Resolver ID run fault	Contact your local ABB representative.
	Aux code: 1034	Encoder fault	Refer to encoder documentation.
	Aux code: 1035	Encoder warning	
	Aux code: 1036	Unsupported cable fault detection mode.	Try a different setting in *93.31 Encoder cable fault mode*.
	Aux code: 1037	Resolver SW version	Contact your local ABB representative.
	Aux code: 1038	Resolver speed scale	
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. Disconnect and reconnect the control panel.
A880	Motor bearing Programmable warnings: *33.14 On-time 1 warn message* *33.24 On-time 2 warn message* *33.55 Value counter 1 warn message* *33.65 Value counter 2 warn message*	Warning generated by an on-time timer or a value counter.	Check the auxiliary code. Check the source of the warning corresponding to the code: 0: *33.13 On-time 1 source* 1: *33.23 On-time 2 source* 4: *33.53 Value counter 1 source* 5: *33.63 Value counter 2 source*.
A881	Output relay	Warning generated by an edge counter. Programmable warnings: *33.35 Edge counter 1 warn message* *33.45 Edge counter 2 warn message*	Check the auxiliary code. Check the source of the warning corresponding to the code: 2: *33.33 Edge counter 1 source* 3: *33.43 Edge counter 2 source*.
A882	Motor starts		
A883	Power ups		
A884	Main contactor		
A885	DC charge		
A886	On-time 1 (Editable message text) Programmable warning: *33.14 On-time 1 warn message*	Warning generated by on-time timer 1.	Check the source of the warning (parameter *33.13 On-time 1 source*).
A887	On-time 2 (Editable message text) Programmable warning: *33.24 On-time 2 warn message*	Warning generated by on-time timer 2.	Check the source of the warning (parameter *33.23 On-time 2 source*).

Code (hex)	Warning	Cause	What to do
A888	Edge counter 1 (Editable message text) Programmable warning: *33.35 Edge counter 1 warn message*	Warning generated by edge counter 1.	Check the source of the warning (parameter *33.33 Edge counter 1 source*).
A889	Edge counter 2 (Editable message text) Programmable warning: *33.45 Edge counter 2 warn message*	Warning generated by edge counter 2.	Check the source of the warning (parameter *33.43 Edge counter 2 source*).
A88A	Value counter 1 (Editable message text) Programmable warning: *33.55 Value counter 1 warn message*	Warning generated by value counter 1.	Check the source of the warning (parameter *33.53 Value counter 1 source*).
A88B	Value counter 2 (Editable message text) Programmable warning: *33.65 Value counter 2 warn message*	Warning generated by value counter 2.	Check the source of the warning (parameter *33.63 Value counter 2 source*).
A88C	Device clean	Warning generated by an on-time timer. Programmable warnings: *33.14 On-time 1 warn message* *33.24 On-time 2 warn message*	Check the auxiliary code. Check the source of the warning corresponding to the code: 0: *33.13 On-time 1 source* 1: *33.23 On-time 2 source* 10: *05.04 Fan on-time counter*.
A88D	DC capacitor		
A88E	Cabinet fan		
A88F	Cooling fan		
A890	Additional cooling		
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*.
A8B0	Signal supervision (Editable message text) Programmable warning: *32.06 Supervision 1 action*	Warning generated by a signal supervision function.	Check the source of the warning (parameter *32.07*, *32.17* or *32.28*).
A8B1	Signal supervision 2 (Editable message text) Programmable warning: *32.16 Supervision 2 action*	Warning generated by the signal supervision 2 function.	Check the source of the warning (parameter *32.17 Supervision 2 signal*).
A8B2	Signal supervision 3 (Editable message text) Programmable warning: *32.26 Supervision 3 action*	Warning generated by the signal supervision 3 function.	Check the source of the warning (parameter *32.27 Supervision 3 signal*).
A8C0	Fan service counter	A cooling fan has reached the end of its estimated lifetime. See parameters *05.41* and *05.42*.	Check the auxiliary code. The code indicates which fan is to be replaced. 0: Main cooling fan 1: Auxiliary cooling fan 2: Auxiliary cooling fan 2 3: Cabinet cooling fan 4: PCB compartment fan Refer to the hardware manual of the drive for fan replacement instructions.

Code (hex)	Warning	Cause	What to do
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*.
AF90	Speed controller autotuning	The speed controller autotune routine did not complete successfully.	Check the auxiliary code (format XXXX YYYY). “YYYY” indicates the problem (see actions for each code below).
	0000	The drive was stopped before the autotune routine finished.	Repeat autotune until successful.
	0001	The drive was started but was not ready to follow the autotune command.	Make sure the prerequisites of the autotune run are fulfilled. See section *Before activating the autotune routine* (page *60*).
	0002	Required torque reference could not be reached before the drive reached maximum speed.	Decrease torque step (parameter *25.38*) or increase speed step (*25.39*).
	0003	Motor could not accelerate/decelerate to maximum/minimum speed.	Increase torque step (parameter *25.38*) or decrease speed step (*25.39*).
	0005	Motor could not decelerate with full autotune torque.	Decrease torque step (parameter *25.38*) or speed step (*25.39*).
AFAA	Autoreset	A fault is about to be autoreset.	Informative warning. See the settings in parameter group *31 Fault functions*.

Code (hex)	Warning	Cause	What to do
AFE1	Emergency stop (off2)	Drive has received an emergency stop (mode selection off2) command.	Check that it is safe to continue operation. Return emergency stop push button to normal position. Restart drive.
AFE2	Emergency stop (off1 or off3)	Drive has received an emergency stop (mode selection off1 or off3) command.	
AFEA	Enable start signal missing (Editable message text)	No enable start signal received.	Check the setting of (and the source selected by) parameter *20.19 Enable start command*.
AFEB	Run enable missing	No run enable signal is received.	Check setting of parameter *20.12 Run enable 1 source*. Switch signal on (e.g. in the fieldbus Control Word) or check wiring of selected source.
AFEC	External power signal missing	*95.04 Control board supply* is set to *External 24V* but no voltage is connected to the XPOW connector of the control unit.	Check the external 24 V DC power supply to the control unit, or change the setting of parameter *95.04*.
AFF6	Identification run	Motor ID run will occur at next start.	Informative warning.
AFF7	Autophasing	Autophasing will occur at next start.	Informative warning.
B5A0	STO event Programmable event: *31.22 STO indication run/stop*	Safe torque off function is active, i.e. safety circuit signal(s) connected to connector XSTO is lost.	Check safety circuit connections. For more information, see appropriate drive hardware manual and description of parameter *31.22 STO indication run/stop* (page *245*).
D200	Overtemperature	*09.10 Measured temperature* exceeded *79.07 Warning temperature limit* for 5 sec or the Klixon digital input is false.	Check for problem in measurement device. Check for problem in temperature measurement circuit. Check well and discharge pressures (excessive pressure can cause heating). Check warning function setting in parameters.
D201	Pressure	*09.09 Pressure* exceeded *76.07 Analog feedback limit* for *76.08 Analog feedback limit delay time* or *76.04 Digital feedback source* is set as false.	Check for problem in measurement device. Check for high gas content. Check warning function setting in parameters.
D202	Underload	*78.02 Underload function* is set to warning when *09.01 Rod torque* and *09.05 Rod speed* actual values are lower than user defined curve (parameters *78.03* - *78.08*) for *78.09 Underload delay time*.	Check parameter settings. Check setting of *78.02 Underload function*.

Code (hex)	Warning	Cause	What to do
D203	Check curve	There are identical torque values in parameters *78.03* - *78.08*.	Check parameter settings and set values as required.
D204	Rod torque 1 limit	Actual *09.01 Rod torque* is beyond the limits. Warning condition has been fulfilled. Shut-down procedure is active.	See parameters *77.02* - *77.06*. Check warning function setting in parameters and set values as required.
D205	Rod torque 2 speed	Actual speed reference has been modified by *77.07 Rod torq2 function* on *77.11 Rod torq2 additive speed ref* value.	Check parameter settings and set values as required.
D206	Rod torque 2 limit	*77.11 Rod torq2 additive speed ref* has been triggered more than *77.13 Rod torq2 limit counter* times during *77.14 Rod torq2 time window*. Shut-down procedure is active.	Check parameter settings and set values as required.
D207	Sleep mode	Sleep condition has been fulfilled.	See parameters *75.12* - *75.19*. Or set *75.11 Sleep warning enable* as disabled.
D208	Backspin limit	Actual *09.05 Rod speed* is faster than *09.11 Backspin speed reference*.	Check parameter settings and set values as required.
D209	Backspin active	*Pump backspin control* procedure is in process.	See parameters *80.01* - *80.05*. Wait till procedure is completed.
D20A	Brake confirmation active	*74.21 Brake confirmation enable* is active and p9ocedure is in process.	Wait till procedure is completed.
D20B	Fault delay active	Fault is triggered and tripping is delayed till the drive is stopped.	Wait till drive is tripped.
D20C	Start delay active	Start delay procedure is in progress. It is not allowed to start the drive.	Wait till procedure is completed in time *09.12 Start delay remain*.
D20D	Replace ZCU battery	ZCU board battery is empty.	Replace ZCU board battery.

Fault messages

Code (hex)	Fault	Cause	What to do
2281	Calibration	Measured offset of output phase current measurement or difference between output phase U2 and W2 current measurement is too great (the values are updated during current calibration).	Try performing the current calibration again (select *Current measurement calibration* at parameter *99.13*). If the fault persists, contact your local ABB representative.
2310	Overcurrent	Output current has exceeded internal fault limit.	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* and *46.02 Frequency scaling*. Check motor and motor cable (including phasing and delta/star connection). Check that the start-up data in parameter group *99 Motor data* (page *353*) corresponds to the motor rating plate. Check that there are no power factor correction capacitors or surge absorbers in motor cable. Check encoder cable (including phasing).
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 that there is no earth fault in motor or motor cables: Measure insulation resistances of motor and motor cable. If no earth fault can be detected, contact your local ABB representative.
2340	Short circuit	Short-circuit in motor cable(s) or motor	Check motor and motor cable. Check there are no power factor correction capacitors or surge absorbers in motor cable.
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.
2392	BU earth leakage	Total earth leakage of inverter modules is excessive.	Check there are no power factor correction capacitors or surge absorbers in motor cable. Measure insulation resistances of motor cables and motor. Contact your local ABB representative.

Code (hex)	Fault	Cause	What to do
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 input power supply imbalance.
3180	Charge relay lost	No acknowledgement received from charge relay.	Contact your local ABB representative.
3181	Cross connection Programmable fault: *31.23 Wiring or earth fault*	Incorrect input power and motor cable connection (i.e. 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 brake chopper and resistor (if present). Check deceleration time. Use coast-to-stop function (if applicable). Retrofit drive with brake chopper and brake resistor.
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.
3280	Standby timeout	Automatic restart failed (see section *Automatic restart* on page *80*).	Check the condition of the supply (voltage, cabling, fuses, switchgear).
3291	DC voltage difference	Difference in DC voltages between parallel-connected inverter modules.	Contact your local ABB representative.
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.

Code (hex)	Fault	Cause	What to do
3385	Autophasing	Autophasing routine (see section *Autophasing* on page *73*) has failed.	Try other autophasing modes (see parameter *21.13 Autophasing mode*) if possible. If the *Turning with Z-pulse* mode is selected, check the zero pulse given by the encoder. Check that the motor ID run has been successfully completed. Clear parameter *98.15 Position offset user*. Check that the encoder is not slipping on the motor shaft. Check that the motor is not already turning when the autophasing routine starts. Check the setting of parameter *99.03 Motor type*.
4000	Motor cable overload	Calculated motor cable temperature has exceeded warning limit.	Check the settings of parameters *35.61* and *35.62*. Check the dimensioning of the motor cable in regard to required load.
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.
4290	Cooling	Drive module temperature is excessive.	Check ambient temperature. If it exceeds 40 °C (104 °F), ensure that load current does not exceed derated load capacity of drive. See appropriate *Hardware Manual.* 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).

Code (hex)	Fault	Cause	What to do
4981	External temperature (Editable message text)	Measured temperature 1 or 2 has exceeded fault limit.	Check the values of parameters *35.02 Measured temperature 1* and *35.03 Measured temperature 2*. Check the cooling of the motor (or other equipment whose temperature is being measured). Check the fault limits for measured temperatures 1 and 2 in parameter group *35 Motor thermal protection*.
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). Check the value of parameter *35.22 Temperature 2 fault limit*.
4990	FEX-01/FPTC-01 not found	A temperature monitoring module has been activated by parameter *35.30* but cannot be detected.	Power down the control unit and check that the module is properly inserted in the correct slot. The last digit of the auxiliary code identifies the slot.
4991	Safe motor temperature 1 (Editable message text)	The temperature monitoring module installed in slot 1 indicates overtemperature.	Check the cooling of the motor. Check the motor load and drive ratings. Check the wiring of the temperature sensor. Repair wiring if faulty. Measure the resistance of the sensor. Replace sensor if faulty.
4992	Safe motor temperature 2 (Editable message text)	The temperature monitoring module installed in slot 2 indicates overtemperature.	
4993	Safe motor temperature 3 (Editable message text)	The temperature monitoring module installed in slot 3 indicates overtemperature.	
5080	Fan	Cooling fan stuck or disconnected.	Check fan operation and connection. Replace fan if faulty.
5081	Auxiliary fan broken	An auxiliary cooling fan (connected to the fan connectors on the control unit) is stuck or disconnected.	Check auxiliary fan(s) and connection(s). Replace faulty fan. Make sure the front cover of the drive module is in place and tightened. If the commissioning of the drive requires that the cover is off, activate parameter *31.36 Aux fan fault bypass* within 2 minutes from control unit reboot to temporarily suppress the fault. The auxiliary code identifies the fan (**1:** Main fan 1, **2:** Main fan 2, **3:** Main fan 3, **4:** Auxiliary fan 1, **5:** Auxiliary fan 2, **6:** Auxiliary fan 3, **7:** Filter fan 1, **8:** Filter fan 2, **9:** Filter fan 3).

Code (hex)	Fault	Cause	What to do
5090	STO hardware failure	Safe torque off hardware failure.	Contact your local ABB representative. The code contains location information, especially with parallel-connected inverter modules. When converted into a 32-bit binary number, the bits of the code indicate the following: 31…28: Number of faulty inverter module (0…11 decimal). 1111: STO_ACT states of control unit and inverter modules in conflict 27: STO_ACT state of inverter modules 26: STO_ACT state of control unit 25: STO1 of control unit 24: STO2 of control unit 23…12: STO1 of inverter modules 12…1 (Bits of non-existing modules set to 1) 11…0: STO2 of inverter modules 12…1 (Bits of non-existing modules set to 1)
5091	Safe torque off Programmable fault: *31.22 STO indication run/stop*	Safe torque off function is active, i.e. safety circuit signal(s) connected to connector XSTO is broken during start or run.	Check safe torque off circuit connections. For more information, see appropriate drive hardware manual and description of parameter *31.22 STO indication run/stop* (page *245*).
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 unit. This may occur eg. after a firmware update or memory unit replacement.	Cycle the power to the drive. Check the auxiliary code. The auxiliary code categories are as follows: 1 = PU and CU ratings not the same. Rating ID has changed. 2 = Parallel connection rating ID has changed. 3 = PU types not the same in all power units. 4 = Parallel connection rating ID is active in a single power unit setup. 5 = It is not possible to implement the selected rating with the current PUs. 6 = PU rating ID is 0. 7 = Reading PU rating ID or PU type failed on PU connection. With parallel connection faults, the format of the auxiliary code is 0X0Y. “Y” indicates the auxiliary code category, “X” indicates the first faulty PU channel in hexadecimal (1…C).

Code (hex)	Fault	Cause	What to do
5094	Measurement circuit temperature	Problem with internal temperature measurement of the drive.	See *A5EA Measurement circuit temperature* (page *410*).
5681	PU communication	Communication errors detected between the drive control unit and the power unit.	Check the connection between the drive control unit and the power unit.
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.
5690	PU communication internal	Internal communication error.	Contact your local ABB representative.
5691	Measurement circuit ADC	Measurement circuit fault.	Contact your local ABB representative, quoting the auxiliary code.
5692	PU board powerfail	Power unit power supply failure.	Check the auxiliary code.
5693	Measurement circuit DFF	Measurement circuit fault.	Contact your local ABB representative, quoting the auxiliary code.
5694	PU communication configuration	Version check cannot find a matching power unit FPGA logic.	Update the FPGA logic of the power unit. Contact your local ABB representative.
5696	PU state feedback	State feedback from output phases does not match control signals.	Contact your local ABB representative, quoting the auxiliary code.
5697	Charging feedback	Charging feedback signal missing.	Check the feedback signal coming from the charging system.
5698	Unknown power unit fault	Unidentified power unit logic fault.	Check power unit logic and firmware compatibility. Contact your local ABB representative.
6180	Internal SW error	Internal error.	Contact your local ABB representative. Quote the auxiliary code (check the event details in the event log).
6181	FPGA version incompatible	Firmware and FPGA versions are incompatible.	Update power unit FPGA logic or firmware (whichever is older). Contact your local ABB representative.
6306	FBA A mapping file	Fieldbus adapter A mapping file read error.	Contact your local ABB representative.
6481	Task overload	Internal fault. **Note:** This fault cannot be reset.	Contact your local ABB representative.
6487	Stack overflow	Internal fault. **Note:** This fault cannot be reset.	Contact your local ABB representative.

Code (hex)	Fault	Cause	What to do
64A1	Internal file load	File read error. **Note:** This fault cannot be reset.	Contact your local ABB representative.
64A2	Internal record load	Internal record load error.	Contact your local ABB representative.
64A3	Application loading	Application file incompatible or corrupted. **Note:** This fault cannot be reset.	Contact your local ABB representative.
64A5	Licensing fault	Running the control program is prevented either because a restrictive license exists, or because a required license is missing.	Record the auxiliary codes of all active licensing faults and contact your product vendor for further instructions.
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.
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.
64E1	Kernel overload	Operating system error. **Note:** This fault cannot be reset.	Contact your local ABB representative.
6581	Parameter system	Parameter load or save failed.	Try forcing a save using parameter *96.07 Parameter save manually*. Retry.
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	Communication break in embedded fieldbus (EFB) communication.	Check the status of the fieldbus master (online/offline/error etc.). Check cable connections to the XD2D connector 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.

Code (hex)	Fault	Cause	What to do
		Version mismatch between EFB protocol firmware and drive firmware.	
6881	Text data overflow	Internal fault.	Reset the fault. Contact your local ABB representative if the fault persists.
6882	Text 32-bit table overflow	Internal fault.	Reset the fault. Contact your local ABB representative if the fault persists.
6883	Text 64-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.
7080	Option module comm loss	Communication between drive and option module (FEN-xx and/or FIO-xx) is lost.	Check that the option modules are properly seated in their slots. Check that the option modules or slot connectors are not damaged. To pinpoint the problem, try installing the modules into different slots.
7081	Panel port communication 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. Check the auxiliary code.
7082	Extension I/O type mismatch	The I/O extension module types specified by parameters do not match the detected configuration.	Check the auxiliary code. The code indicates which I/O extension module is affected. Check the type and location settings of the modules (parameters *14.01*, *14.02*, *15.01*, *15.02*, *16.01* and *16.02*). Check that the modules are properly installed.
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.
7181	Brake resistor	Brake resistor broken or not connected.	Check that a brake resistor has been connected. Check the condition of the brake resistor. Check the dimensioning of the brake resistor.

Code (hex)	**Fault**	**Cause**	**What to do**
7183	BR excess temperature	Brake resistor temperature has exceeded fault limit defined by parameter *43.11 Brake resistor fault limit*.	Stop drive. Let resistor cool down. Check resistor overload protection function settings (parameter group *43 Brake chopper*). Check fault limit setting, parameter *43.11 Brake resistor fault limit*. Check that braking cycle meets allowed limits.
7184	Brake resistor wiring	Brake resistor short circuit or brake chopper control fault.	Check brake chopper and brake resistor connection. Ensure brake resistor is not damaged.
7191	BC short circuit	Short circuit in brake chopper IGBT.	Ensure brake resistor is connected and not damaged. Check the electrical specifications of the brake resistor against the *Hardware manual*. Replace brake chopper (if replaceable).
7192	BC IGBT excess temperature	Brake chopper IGBT temperature has exceeded internal fault limit.	Let chopper cool down. Check for excessive ambient temperature. Check for cooling fan failure. Check for obstructions in the air flow. Check the dimensioning and cooling of the cabinet. Check resistor overload protection function settings (parameter group *43 Brake chopper*). Check that braking cycle meets allowed limits. Check that drive supply AC voltage is not excessive.
71B1	Motor fan Programmable fault: *35.106 DOL starter event type*	No feedback received from external fan.	Check external fan (or other equipment controlled) by the logic. Check settings of parameters *35.100*…*35.106*.
7301	Motor speed feedback Programmable fault: *90.45 Motor feedback fault*	No motor speed feedback received.	Check the event log for an auxiliary code. See appropriate actions for each code at *A7B0 Motor speed feedback* (page *414*).
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 need for brake chopper and resistor(s).

Code (hex)	Fault	Cause	What to do
7358	Line side converter faulted	The supply unit has tripped on a fault.	If using a control panel or the Drive composer tool, connect to the supply unit to read the fault code. Refer to the firmware manual of the supply unit for instructions related to the code.
7380	Encoder internal	Internal fault.	Contact your local ABB representative.
7381	Encoder 1 Programmable fault: *90.45 Motor feedback fault*	Encoder 1 feedback fault.	If fault appears during first start-up before encoder feedback is used: - Check cable between encoder and encoder interface module (FEN-xx) and order of connector signal wires at both ends of cable. If absolute encoder, EnDat/Hiperface/SSI, with incremental sin/cos pulses is used, incorrect wiring can be located as follows: Disable serial link (zero position) by setting parameter 91.02 to 0 and test encoder operation: - If encoder fault is not activated, check serial link data wiring. Note that zero position is not taken into account when serial link is disabled. - If encoder fault is activated, check serial link and sin/cos signal wiring. **Note:** Because only zero position is requested through serial link and during, position is updated according to sin/cos pulses. - Check encoder parameter settings. If fault appears after encoder feedback has already been used or during drive: - Check that encoder connection wiring or encoder is not damaged. - Check that encoder interface module (FEN-xx) connection or module is not damaged. - Check earthings (when disturbances are detected in communication between encoder interface module and encoder). For more information on encoders, see parameter groups *90 Feedback selection*, *91 Encoder module settings*, *92 Encoder 1 configuration* and *93 Encoder 2 configuration*. Check the event log for an auxiliary code. See appropriate actions for each code at *A7E1 Encoder* or *A7E2 Encoder 2* (page *415*).
7391	Encoder 2	Encoder 2 feedback fault.	

Code (hex)	Fault	Cause	What to do
		EnDat or SSI encoder is used in continuous mode as encoder 2. (I.e. *90.02 Encoder 2 sel* = *FEN-11 ABS* and 91.02 ABS ENC INTERF = EnDat [or 91.02 ABS ENC INTERF = SSI] and 91.30 ENDAT MODE = CONTINUOUS [or 91.25 SSI MODE = CONTINUOUS].)	If possible, use single position transfer instead of continuous position transfer (i.e. if encoder has incremental sin/cos signals): - Change parameter 91.25 SSI MODE / 91.30 ENDAT MODE to value INITIAL POS. Otherwise use Endat/SSI encoder as encoder 1: - Change parameter *90.01 Encoder 1 sel* to value *FEN-11 ABS* and parameter *90.02 Encoder 2 sel* to value *None*. **Note:** The new setting will only take effect after parameter *91.10 Encoder parameter refresh* is used or after the JCU Control Unit is powered up the next time.
73A0	Speed feedback configuration	Speed feedback configuration incorrect.	Check the feedback source selection parameters in group *90 Feedback selection*. In case the source is an encoder interface, check parameter settings in groups *91 Encoder module settings*, *92 Encoder 1 configuration* and *93 Encoder 2 configuration*. Check the event log for an auxiliary code. See appropriate actions for each code below.
	Aux code: 1000	Interface module location settings in conflict.	Check the module location settings (*91.12 Module 1 location* and *91.14 Module 2 location*).
	Aux code: 1001	Detected type of interface module 1 does not match setting.	Check setting of *91.11 Module 1 type* against *91.02 Module 1 status*. Check setting of *91.12 Module 1 location*.
	Aux code: 1002	Detected type of interface module 2 does not match setting.	Check setting of *91.13 Module 2 type* against *91.03 Module 2 status*. Check setting of *91.14 Module 2 location*.
	Aux code: 1003	Interface module 1 type does not match encoder type.	Check settings of *91.11 Module 1 type* and *92.01 Encoder 1 type*.
	Aux code: 1004	Interface module 2 type does not match encoder type.	Check settings of *91.13 Module 2 type* and *93.01 Encoder 2 type*.
	Aux code: 1005	Speed feedback configuration has changed.	Use parameter *91.10 Encoder parameter refresh*) to validate any changes in the settings.
73A1	Load feedback	No load feedback received.	Check the auxiliary code. See appropriate actions for each code below.

Code (hex)	Fault	Cause	What to do
	Aux code: 1015	Load feedback configuration error (for example, a nonexistent encoder has been selected as feedback source).	Check the settings of parameter *90.51*…*90.57*, and the status of the source selected in *90.51*. In case the source is an encoder interface, check parameter settings in groups *91 Encoder module settings*, *92 Encoder 1 configuration* and *93 Encoder 2 configuration*.
	Aux code: 1016	Unexpected load feedback.	Check the settings of parameter *90.51*…*90.57*, and the status of the source selected in *90.51*. In case the source is an encoder interface, check parameter settings in groups *91 Encoder module settings*, *92 Encoder 1 configuration* and *93 Encoder 2 configuration*. Check that the encoder is mounted so that no slippage is possible.
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 (*23.11*…*23.19* for mode Off1, *23.23* for mode Off3).
73B1	Stop failed	Ramp stop did not finish within expected time.	Check the settings of parameters *31.37 Ramp stop supervision* and *31.38 Ramp stop supervision delay*. Check the predefined ramp times in parameter group *23 Speed reference ramp*.
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.
7520	FBA B communication Programmable fault: *50.32 FBA B comm loss func*	Cyclical communication between drive and fieldbus adapter module B or between PLC and fieldbus adapter module B is lost.	Check status of fieldbus communication. See user documentation of fieldbus interface. Check settings of parameter group *50 Fieldbus adapter (FBA)*. Check cable connections. Check if communication master is able to communicate.
7583	Line side unit faulted	The supply unit (or other converter) connected to the inverter unit has generated a fault.	Check fault status of supply unit (or other converter). Refer to the firmware manual of the supply unit.

Code (hex)	Fault	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 wiring connected to the input. Check the minimum and maximum limits of the input in parameter group *12 Standard AI*. Check the auxiliary code.
80B0	Signal supervision (Editable message text) Programmable fault: *32.06 Supervision 1 action*	Fault generated by a signal supervision function.	Check the source of the fault (parameter *32.07*, *32.17* or *32.28*).
80B1	Signal supervision 2 (Editable message text) Programmable fault: *32.16 Supervision 2 action*	Fault generated by the signal supervision 2 function.	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 3 function.	Check the source of the fault (parameter *32.27 Supervision 3 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*.
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 loss	Safe torque off function is active, ie. STO circuit 1 is broken.	Check safety circuit connections. For more information, see appropriate drive hardware manual and description of parameter *31.22 STO indication run/stop* (page *245*). Check the auxiliary code, The code contains location information, especially with parallel-connected inverter modules
FA82	Safe torque off 2 loss	Safe torque off function is active, ie. STO circuit 2 is broken.	

Code (hex)	Fault	Cause	What to do
FB11	Memory unit missing	No memory unit is attached to the control unit.	Power down the control unit. Check that the memory unit is properly inserted into the control unit.
		The memory unit attached to the control unit is empty.	Power down the control unit. Attach a memory unit (with the appropriate firmware) to the control unit.
FB12	Memory unit incompatible	The memory unit attached to the control unit is incompatible.	Power down the control unit. Attach a compatible memory unit.
FB13	Memory unit FW incompatible	The firmware on the attached memory unit is incompatible with the drive.	Power down the control unit. Attach a memory unit with compatible firmware.
FB14	Memory unit FW load failed	The firmware on the attached memory unit could not be loaded to the drive.	Power down the control unit. Check that the memory unit is properly inserted into the control unit. If the problem persists, replace the memory unit.
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.
FF81	FB A force trip	A fault trip command has been received through fieldbus adapter A.	Check the fault information provided by the PLC.
FF82	FB B force trip	A fault trip command has been received through fieldbus adapter B.	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 Modbus controller.
D100	Overtemperature fault	*09.10 Measured temperature* exceeded *79.08 Fault temperature limit* for 3 sec or the Klixon digital input is false.	Check for problem in measurement device. Check for problem in temperature measurement circuit. Check well and discharge pressures (excessive pressure can cause heating). Check warning function setting in parameters.

Code (hex)	**Fault**	**Cause**	**What to do**
D101	Pressure fault	Measured *09.09 Pressure* is over than defined limits. Fault condition has been fulfilled.	Check for problem in measurement device. Check for high gas content. Check warning function setting in parameters. See *76.02 Pressure protection latching*.
D102	Underload fault	*78.02 Underload function* is set to fault. Point of actual *09.01 Rod torque* / *09.05 Rod speed* values falls below user defined curve (parameters *78.03* - *78.08*) for a time period defined by parameter *78.08 Underload delay time*.	Check parameter settings. Check setting of *78.02 Underload function*. Check mechanical condition of the pump. Check fluid condition.
D103	Rod torque 1 limit fault	*09.01 Rod torque* is lower or higher than *77.04 Rod torq1 limit* and *09.05 Rod speed* is lower that *77.05 Rod torq1 speed* for a period of time defined by parameter *77.06 Rod torq1 delay time*.	See parameters *77.02* - *77.06*. Check warning function setting in parameters and set values as required. Check mechanical condition of the pump.
D104	Rod torque 2 limit fault	*77.07 Rod torq2 function* has been triggered more than *77.13 Rod torq2 limit counter* times during *77.14 Rod torq2 time window*.	Check parameter settings and set values as required.
D105	Brake confirmation fault	Mechanical brake (if present) did not pass *Pump backspin control* procedure.	Check operational condition of mechanical brake (if present). Check parameters *74.21*...*74.25*.

11

Fieldbus control through the embedded fieldbus interface (EFB)

What this chapter contains

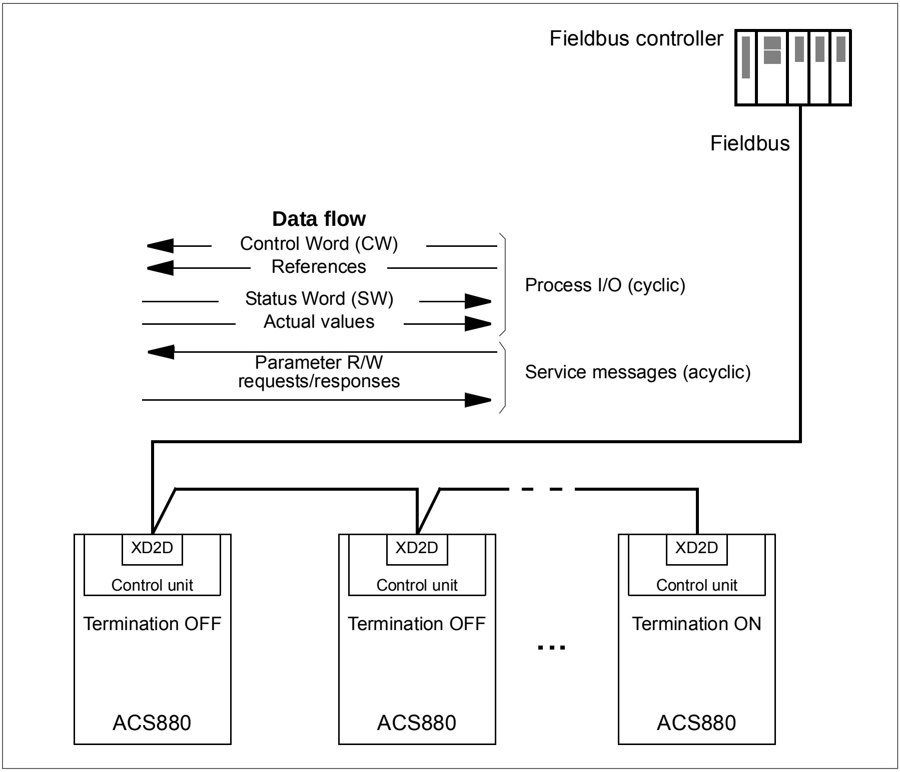
The chapter describes how the drive can be controlled by external devices over a communication network (fieldbus) using the embedded fieldbus interface.

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.



Connecting the fieldbus to the drive

Connect the fieldbus to terminal XD2D on the control unit of the drive. See the appropriate *Hardware Manual* for more information on the connection, chaining and termination of the link.

Note: If the XD2D connector is reserved by the embedded fieldbus interface (parameter *58.01 Protocol enable* is set to *Modbus RTU*), the drive-to-drive link functionality is automatically disabled.

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. Drive-to-drive link operation is automatically disabled.
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), *Transparent*	Selects the control profile used by the drive. See section *Basics of the embedded fieldbus interface* (page *442*).
58.26 … *58.29*	*EFB ref1 type* … *EFB act2 type*	*Speed or frequency*, *Transparent*, *General*, *Torque*, *Speed*, *Frequency*	Selects the reference and actual value types. With the *Speed or frequency* setting, the type is selected automatically according to the currently active drive control mode.
58.30	*EFB status word transparent source*	*Other*	Defines the source of status word when *58.25 Control profile* = *Transparent*.
58.31	*EFB act1 transparent source*	*Other*	Defines the source of actual value 1 when *58.28 EFB act1 type* = *Transparent* or *General*.
58.32	*EFB act2 transparent source*	*Other*	Defines the source of actual value 2 when *58.29 EFB act2 type* = *Transparent* or *General*.

Parameter	Setting for fieldbus control	Function/Information
58.33 Addressing mode	*Mode 1* (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 Data I/O 1 … *58.124 Data I/O 24*	For example, the default settings (I/Os 1…6 contain the control word, the status word, two references and two actual values)	Define 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*.
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*.

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.

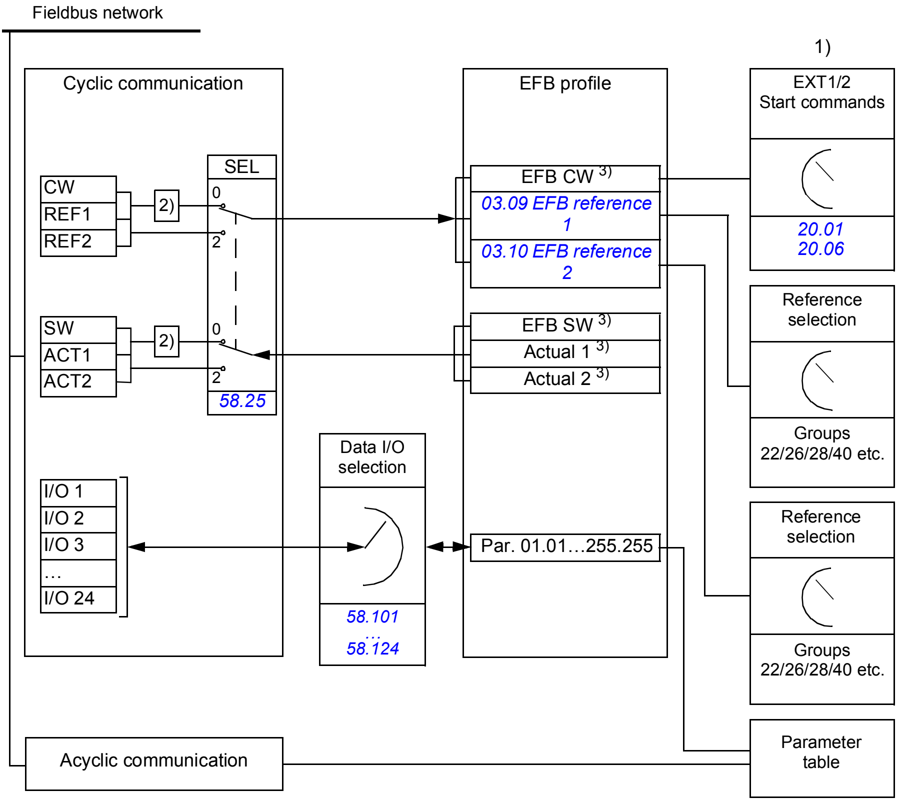
Parameter	Setting for fieldbus control	Function/Information
CONTROL COMMAND SOURCE SELECTION		
20.01 Ext1 commands	*Embedded fieldbus*	Selects fieldbus as the source for the start and stop commands when EXT1 is selected as the active control location.
20.02 Ext2 commands	*Embedded fieldbus*	Selects fieldbus as the source for the start and stop commands when EXT2 is selected as the active control location.
SPEED REFERENCE SELECTION		
22.11 Speed ref1 source	*EFB ref1* or *EFB ref2*	Selects a reference received through the embedded fieldbus interface as speed reference 1.

Parameter	Setting for fieldbus control	Function/Information
22.12 Speed ref2 source	*EFB ref1* or *EFB ref2*	Selects a reference received through the embedded fieldbus interface as speed reference 2.
FREQUENCY REFERENCE SELECTION		
28.11 Frequency ref1 source	*EFB ref1* or *EFB ref2*	Selects a reference received through the embedded fieldbus interface as frequency reference 1.
28.12 Frequency ref2 source	*EFB ref1* or *EFB ref2*	Selects a reference received through the embedded fieldbus interface as frequency reference 2.
PCP/ESP REFERENCE SELECTION		
74.05 Speedrefsource	*EFB1 ref* or *EFB2 ref*	Selects a reference received through the embedded fieldbus interface as speed reference 1 or 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*.		
CONTROL OF RELAY OUTPUTS, ANALOG OUTPUTS AND DIGITAL INPUT/OUTPUTS		
10.24 RO1 source	*RO/DIO control word bit0*	Connects bit 0 of storage parameter *10.99 RO/DIO control word* to relay output RO1.
10.27 RO2 source	*RO/DIO control word bit1*	Connects bit 1 of storage parameter *10.99 RO/DIO control word* to relay output RO2.
10.30 RO3 source	*RO/DIO control word bit2*	Connects bit 2 of storage parameter *10.99 RO/DIO control word* to relay output RO3.
11.05 DIO1 function *11.09 DIO2 function*	*Output* (default)	Sets the digital input/output to output mode.
11.06 DIO1 output source	*RO/DIO control word bit8*	Connects bit 8 of storage parameter *10.99 RO/DIO control word* to digital input/output DIO1.
11.10 DIO2 output source	*RO/DIO control word bit9*	Connects bit 9 of storage parameter *10.99 RO/DIO control word* to digital input/output DIO2.
13.12 AO1 source	*AO1 data storage*	Connects storage parameter *13.91 AO1 data storage* to analog output AO1.
13.22 AO2 source	*AO2 data storage*	Connects storage parameter *13.92 AO2 data storage* to analog output AO2.
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 the transparent control profiles).

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 *446*).
3. If parameter *58.25 Control profile* is set to *Transparent*,

- the sources of the status word and actual values are selected by parameters *58.30*…*58.32* (otherwise, actual values 1 and 2 are automatically selected according to reference type), and the control word is displayed by *06.05 EFB transparent control word*.

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. By 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 (see parameter *06.05 EFB transparent control word*)or the data is converted. See section *About the control profiles* (page *446*).

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 *446*).

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, torque 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 *446*).

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 *446*).

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* … *58.124 Data I/O 24* define the addresses from which the master either reads data (input) or to which it writes data (output).

Control of drive outputs through EFB

The address selection parameters of the data input/outputs have a setting with which the data can be written into a storage parameter in the drive. These storage parameters are readily selectable as signal sources of the drive outputs.

The desired values of the relay outputs (RO) and digital input/outputs (DIO) can be written in a 16-bit word into *10.99 RO/DIO control word*, which is then selected as the source of those outputs. Each of the analog outputs (AO) of the drive have a dedicated storage parameter (*13.91 AO1 data storage* and *13.92 AO2 data storage*), which are available in the source selection parameters *13.12 AO1 source* and *13.22 AO2 source*.

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 to 465536 are inaccessible to these masters.

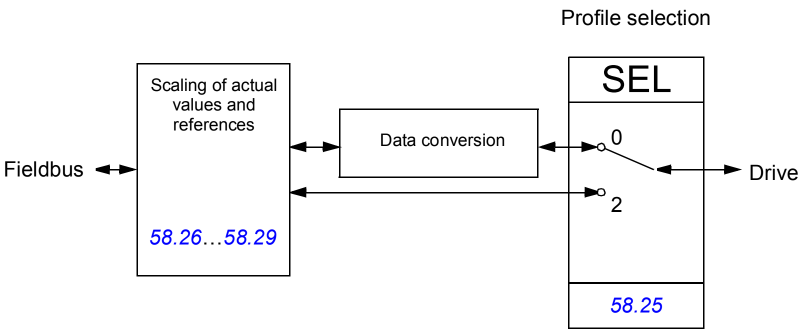
Note: Register addresses of 32-bit parameters cannot be accessed by using 5-digit register numbers.

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
- how drive register addresses are mapped for the fieldbus master.

You can configure the drive to receive and send messages according to the ABB Drives profile or the Transparent profile. With the ABB Drives profile, the embedded fieldbus interface of the drive converts the control word and status word to and from the native data used in the drive. The Transparent profile involves no data conversion. The figure below illustrates the effect of the profile selection.



Control profile selection with parameter *58.25 Control profile*:
- (0) *ABB Drives*
- (2) *Transparent*

Note that scaling of references and actual values can be selected independent of the profile selection by parameters *58.26*…*58.29*.

The ABB Drives profile

Control Word

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* on page *450*.

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 ENABLED**. **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 ENABLED**.
		0	Force Ramp Function Generator output to zero. Drive ramps to stop (current and DC voltage limits in force).
5	RAMP_HOLD	1	Enable ramp function. Proceed to **RAMP FUNCTION GENERATOR: ACCELERATOR ENABLED**.
		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	JOGGING_1	1	Accelerate to jogging 1 reference. **Notes:** • Bits 4…6 must be 0. • See also section *Jogging* (page *69*).
		0	Jogging 1 disabled.
9	JOGGING_2	1	Accelerate to jogging 2 reference. See notes at bit 8.
		0	Jogging 2 disabled.
10	REMOTE_ CMD	1	Fieldbus control enabled.
		0	Control Word <> 0 or Reference <> 0: Retain last Control Word and Reference. Control Word = 0 and Reference = 0: Fieldbus control enabled. 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…15	Reserved		

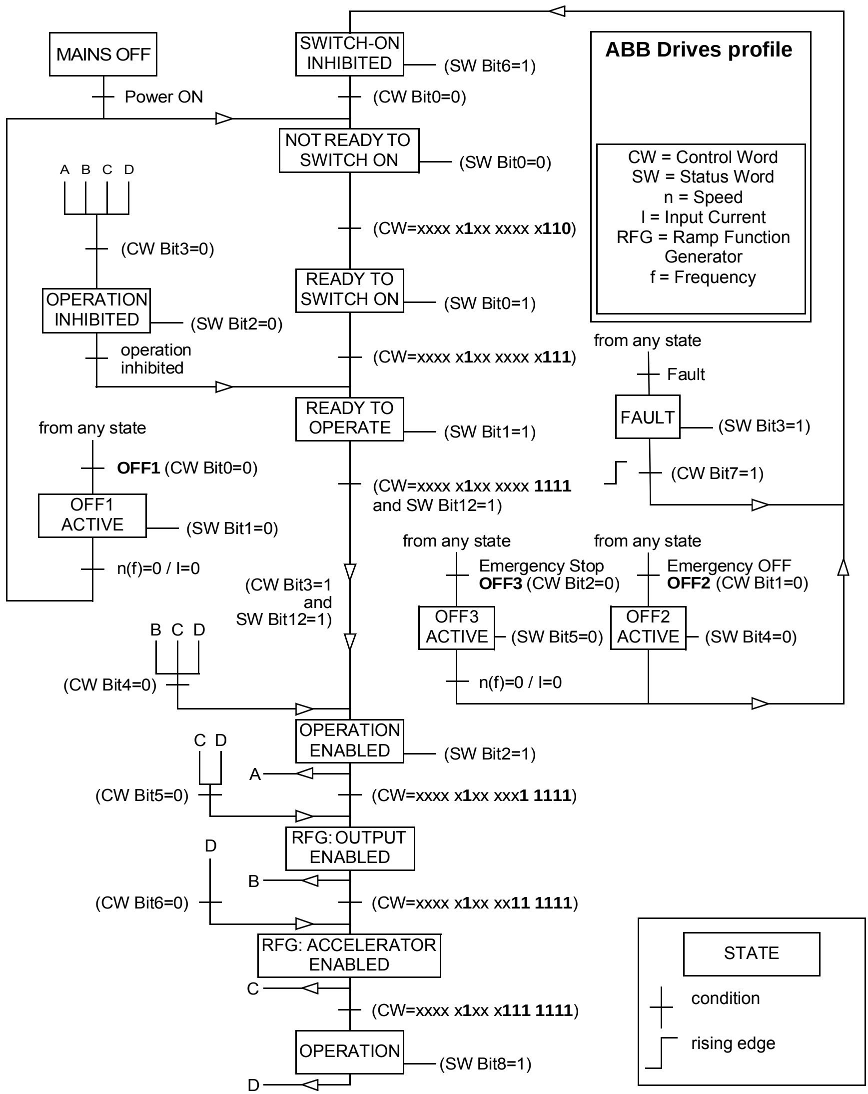
Status Word

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* on page *450*.

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 ENABLED.
		0	OPERATION INHIBITED.
3	TRIPPED	1	FAULT.
		0	No fault.
4	OFF_2_STA	1	OFF2 inactive.
		0	OFF2 ACTIVE.
5	OFF_3_STA	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, i.e. 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		S
12	EXT_RUN_ ENABLE	1	External Run enable signal received.
		0	No external Run enable signal received.
13…15	Reserved		

State transition diagram

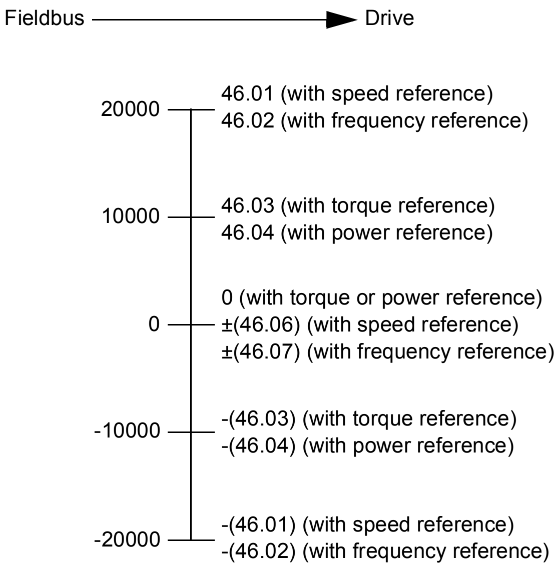
The diagram below shows the state transitions in the drive when the drive is using the ABB Drives profile, and configured to follow the commands of the control word from the embedded fieldbus interface. The upper case texts refer to the states which are used in the tables representing the fieldbus Control and Status words. See sections *Control Word* on page *447* and *Status Word* on page *449*.



References

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…* 46.07; which scaling is in use depends on the setting of *58.26 EFB ref1 type* and *58.27 EFB ref2 type* (see page *301*).

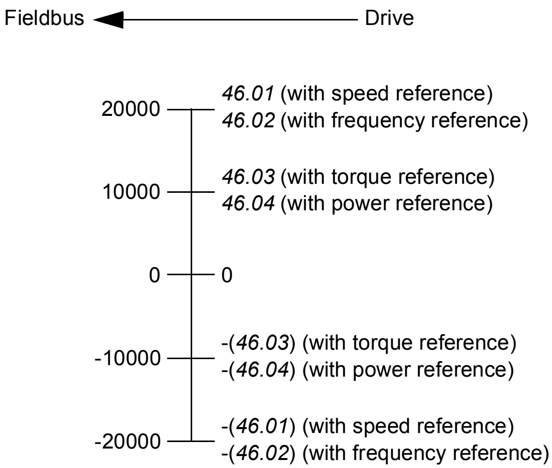


The scaled references are shown by parameters *03.09 EFB reference 1* and *03.10 EFB reference 2*.

Actual values

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 *301*).



Modbus holding register addresses

The table below shows the default Modbus holding register addresses for drive data. This profile provides a converted 16-bit access to the data.

Register address	Register data (16-bit words)
400001	Control word. See section *Control Word* (page *447*). The selection can be changed using parameter *58.101 Data I/O 1*.
400002	Reference 1 (REF1). The selection can be changed using parameter *58.102 Data I/O 2*.
400003	Reference 2 (REF2). The selection can be changed using parameter *58.103 Data I/O 3*.
400004	Status Word (SW). See section *Status Word* (page *449*). The selection can be changed using parameter *58.104 Data I/O 4*.
400005	Actual value 1 (ACT1). The selection can be changed using parameter *58.105 Data I/O 5*.
400006	Actual value 2 (ACT2). The selection can be changed using parameter *58.106 Data I/O 6*.
400007…400024	Data in/out 7…24. Selected by parameters *58.107 Data I/O 7* … *58.124 Data I/O 24*.
400025...400089	Unused
400090...400100	Error code access. See section *Error code registers (holding registers 400090…400100)* (page *460*).
400101...465536	Parameter read/write. Parameters are mapped to register addresses according to parameter *58.33 Addressing mode*.

The Transparent profile

The Transparent profile enables a customizable access to the drive.

The contents of the control word are user-definable. The control word received from the fieldbus is visible in parameter *06.05 EFB transparent control word*, and can be used to control the drive using pointer parameters and/or application programming.

The status word to be sent to the fieldbus controller is selected by parameter *58.30 EFB status word transparent source*. This can be, for example, the user-configurable status word in *06.50 User status word 1*.

The Transparent profile involves no data conversion of the control or status word. Whether references or actual values are scaled depends on the setting of parameters *58.26*…*58.29*. The references received from the fieldbus are visible in parameters *03.09 EFB reference 1* and *03.10 EFB reference 2*.

The Modbus holding register addresses for the Transparent profile are as with the ABB Drives profile (see page *453*).

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, “AINFX”) • 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 (for example, “ACS880”)

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 DATA ADDRESS	The data address received in the query is not an allowable address for the server.
03h	ILLEGAL DATA VALUE	The requested Quantity of Registers is larger than the drive can handle. **Note:** This error does not mean that a value written to a drive parameter is outside the valid range.
04h	SLAVE DEVICE FAILURE	The value written to a drive parameter is outside the valid range. See section *Error code registers (holding registers 400090…400100)* on page *460*.
06h	SLAVE DEVICE BUSY	The server is engaged in processing a long-duration program command.

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).

Reference	ABB drives profile	Transparent profile
00001	OFF1_CONTROL	Control Word bit 0
00002	OFF2_CONTROL	Control Word bit 1
00003	OFF3_CONTROL	Control Word bit 2
00004	INHIBIT_OPERATION	Control Word bit 3
00005	RAMP_OUT_ZERO	Control Word bit 4
00006	RAMP_HOLD	Control Word bit 5
00007	RAMP_IN_ZERO	Control Word bit 6
00008	RESET	Control Word bit 7
00009	JOGGING_1	Control Word bit 8
00010	JOGGING_2	Control Word bit 9
00011	REMOTE_CMD	Control Word bit 10
00012	EXT_CTRL_LOC	Control Word bit 11
00013	User-defined (0)	Control Word bit 12
00014	User-defined (1)	Control Word bit 13
00015	User-defined (2)	Control Word bit 14
00016	User-defined (3)	Control Word bit 15
00017	Reserved	Control Word bit 16
00018	Reserved	Control Word bit 17
00019	Reserved	Control Word bit 18
00020	Reserved	Control Word bit 19
00021	Reserved	Control Word bit 20
00022	Reserved	Control Word bit 21
00023	Reserved	Control Word bit 22
00024	Reserved	Control Word bit 23
00025	Reserved	Control Word bit 24
00026	Reserved	Control Word bit 25
00027	Reserved	Control Word bit 26
00028	Reserved	Control Word bit 27
00029	Reserved	Control Word bit 28
00030	Reserved	Control Word bit 29
00031	Reserved	Control Word bit 30
00032	Reserved	Control Word bit 31
00033	Reserved	*10.99 RO/DIO control word*, bit 0
00034	Reserved	*10.99 RO/DIO control word*, bit 1

Reference	ABB drives profile	Transparent profile
00035	Reserved	*10.99 RO/DIO control word*, bit 2
00036	Reserved	*10.99 RO/DIO control word*, bit 3
00037	Reserved	*10.99 RO/DIO control word*, bit 4
00038	Reserved	*10.99 RO/DIO control word*, bit 5
00039	Reserved	*10.99 RO/DIO control word*, bit 6
00040	Reserved	*10.99 RO/DIO control word*, bit 7
00041	Reserved	*10.99 RO/DIO control word*, bit 8
00042	Reserved	*10.99 RO/DIO control word*, bit 9

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).

Reference	ABB drives profile	Transparent profile
10001	RDY_ON	Status Word bit 0
10002	RDY_RUN	Status Word bit 1
10003	RDY_REF	Status Word bit 2
10004	TRIPPED	Status Word bit 3
10005	OFF_2_STA	Status Word bit 4
10006	OFF_3_STA	Status Word bit 5
10007	SWC_ON_INHIB	Status Word bit 6
10008	ALARM	Status Word bit 7
10009	AT_SETPOINT	Status Word bit 8
10010	REMOTE	Status Word bit 9
10011	ABOVE_LIMIT	Status Word bit 10
10012	User-defined (0)	Status Word bit 11
10013	User-defined (1)	Status Word bit 12
10014	User-defined (2)	Status Word bit 13
10015	User-defined (3)	Status Word bit 14
10016	Reserved	Status Word bit 15
10017	Reserved	Status Word bit 16
10018	Reserved	Status Word bit 17
10019	Reserved	Status Word bit 18
10020	Reserved	Status Word bit 19
10021	Reserved	Status Word bit 20
10022	Reserved	Status Word bit 21
10023	Reserved	Status Word bit 22
10024	Reserved	Status Word bit 23

Reference	ABB drives profile	Transparent profile
10025	Reserved	Status Word bit 24
10026	Reserved	Status Word bit 25
10027	Reserved	Status Word bit 26
10028	Reserved	Status Word bit 27
10029	Reserved	Status Word bit 28
10030	Reserved	Status Word bit 29
10031	Reserved	Status Word bit 30
10032	Reserved	Status Word bit 31
10033	Reserved	*10.02 DI delayed status*, bit 0
10034	Reserved	*10.02 DI delayed status*, bit 1
10035	Reserved	*10.02 DI delayed status*, bit 2
10036	Reserved	*10.02 DI delayed status*, bit 3
10037	Reserved	*10.02 DI delayed status*, bit 4
10038	Reserved	*10.02 DI delayed status*, bit 5
10039	Reserved	*10.02 DI delayed status*, bit 6
10040	Reserved	*10.02 DI delayed status*, bit 7
10041	Reserved	*10.02 DI delayed status*, bit 8
10042	Reserved	*10.02 DI delayed status*, bit 9
10043	Reserved	*10.02 DI delayed status*, bit 10
10044	Reserved	*10.02 DI delayed status*, bit 11
10045	Reserved	*10.02 DI delayed status*, bit 12
10046	Reserved	*10.02 DI delayed status*, bit 13
10047	Reserved	*10.02 DI delayed status*, bit 14
10048	Reserved	*10.02 DI delayed status*, bit 15

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
89	Reset Error Registers	1 = Reset internal error registers (91…95).
90	Error Function Code	Function code of the failed query.
91	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
92	Failed Register	The last register (discrete input, coil, or holding register) that failed to be read or written.
93	Last Register Written Successfully	The last register that was written successfully.
94	Last Register Read Successfully	The last register that was read successfully.

12

Fieldbus control through a fieldbus adapter

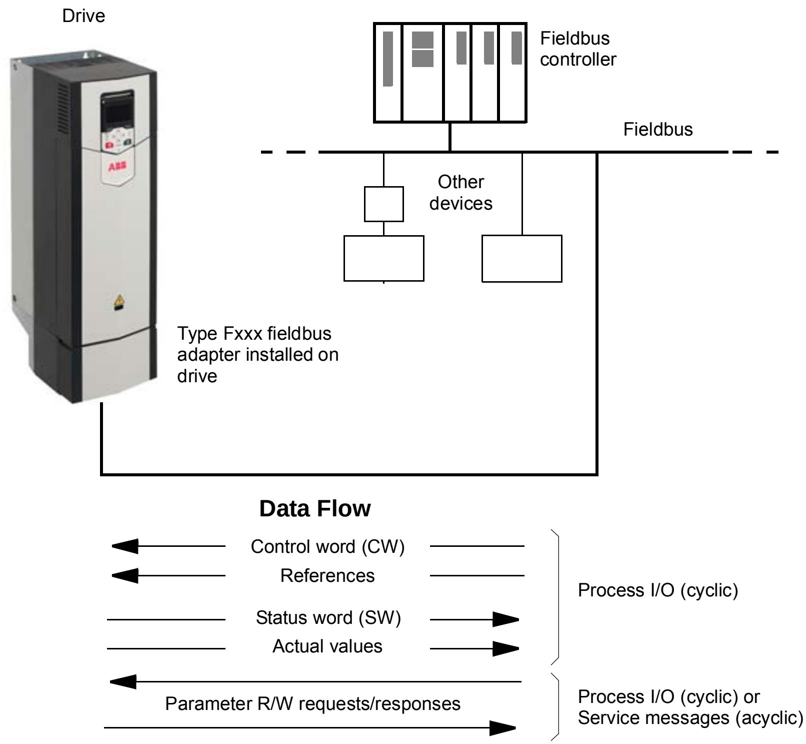
Contents of this chapter

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 a serial communication link using a fieldbus adapter. The fieldbus adapter can be installed into any free drive slot.



The drive can be set 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.

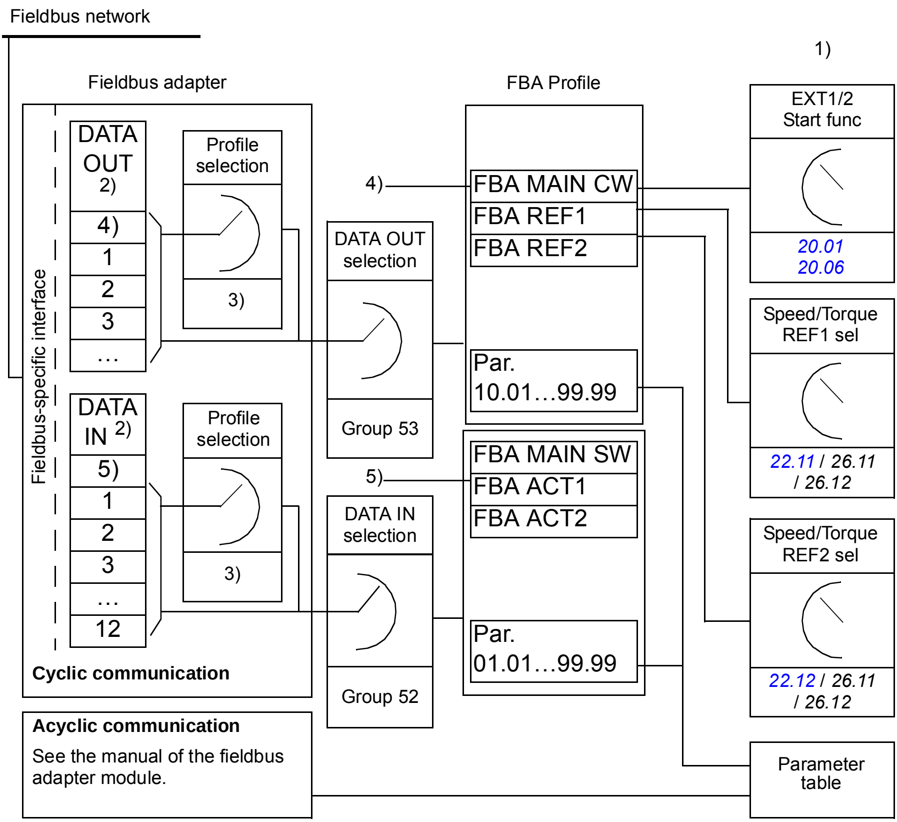
Fieldbus adapters are available for various serial communication systems and protocols, for example

- CANopen (FCAN-01 adapter)
- ControlNet (FCNA-01 adapter)
- DeviceNet (FDNA-01 adapter)
- EtherCAT® (FECA-01 adapter)
- EtherNet/IP™ (FENA-11 or FENA-21 adapter)
- Modbus/RTU (FSCA-01 adapter)
- Modbus/TCP (FENA-11 or FENA-21 adapter)
- POWERLINK (FEPL-02 adapter)
- PROFIBUS DP (FPBA-01 adapter)
- PROFINET IO (FENA-11 or FENA-21 adapter).

Basics of fieldbus control interface

The cyclic communication between a fieldbus system and the drive consists of 16 and 32-bit input and output data words. The drive supports the use of maximum 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 used data words 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.

Control word and Status word

The Control word is used 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 on 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 *467* and *468* respectively. The drive states are presented in the state diagram (page *470*).

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*.

References

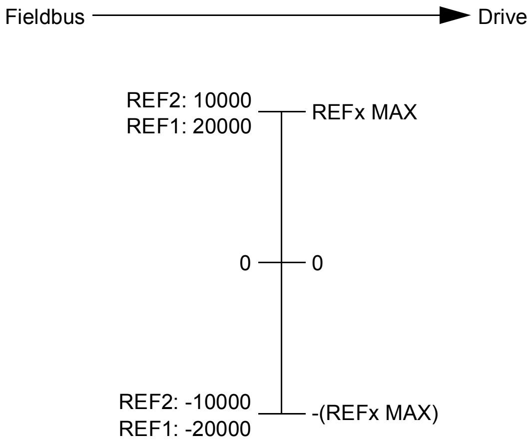
References are 16-bit words containing a sign bit and a 15-bit integer. A negative reference (indicating reversed direction of rotation) is formed by calculating the two's complement from the corresponding positive reference.

ABB drives can receive control information from multiple sources including analog and digital inputs, the drive control panel and a fieldbus adapter module. To control the drive through the fieldbus, the module must be defined as the source for control information, example, Reference.

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 shown below. The values REFx MIN and REFx MAX are set by parameters 46.01...46.07 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*.

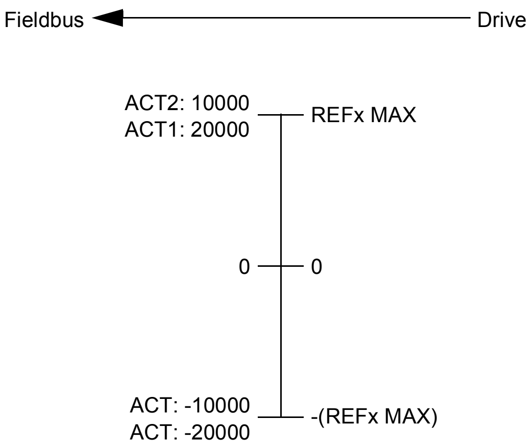
Actual values

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*.

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 shown below. The values REFx MIN and REFx MAX are set by parameters *46.01*...*46.04* which scaling is in use depends on the setting of parameters *50.04* and *50.05*.



Contents of fieldbus Control word

The upper case boldface text refers to the states shown in the state diagram (page *470*).

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 ENABLED**. **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**.

Bit	Name	Value	STATE/Description
4	Ramp out zero	1	Normal operation. Proceed to **RAMP FUNCTION GENERATOR: OUTPUT ENABLED**.
		0	Force Ramp function generator output to zero. The drive immediately decelerates to zero speed (observing the torque limits).
5	Ramp hold	1	Enable ramp function. Proceed to **RAMP FUNCTION GENERATOR: ACCELERATOR ENABLED**.
		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	Inching 1	1	Accelerate to inching (jogging) setpoint 1. **Notes:** Bits 4…6 must be 0. See also section *Scalar motor control* (page *71*).
		0	Inching (jogging) 1 disabled.
9	Inching 2	1	Accelerate to inching (jogging) setpoint 2. See notes at bit 8.
		0	Inching (jogging) 2 disabled.
10	Remote cmd	1	Fieldbus control enabled.
		0	Control word and reference not getting through to the drive, except for bits OFF1, OFF2 and OFF3.
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...15	Reserved.		

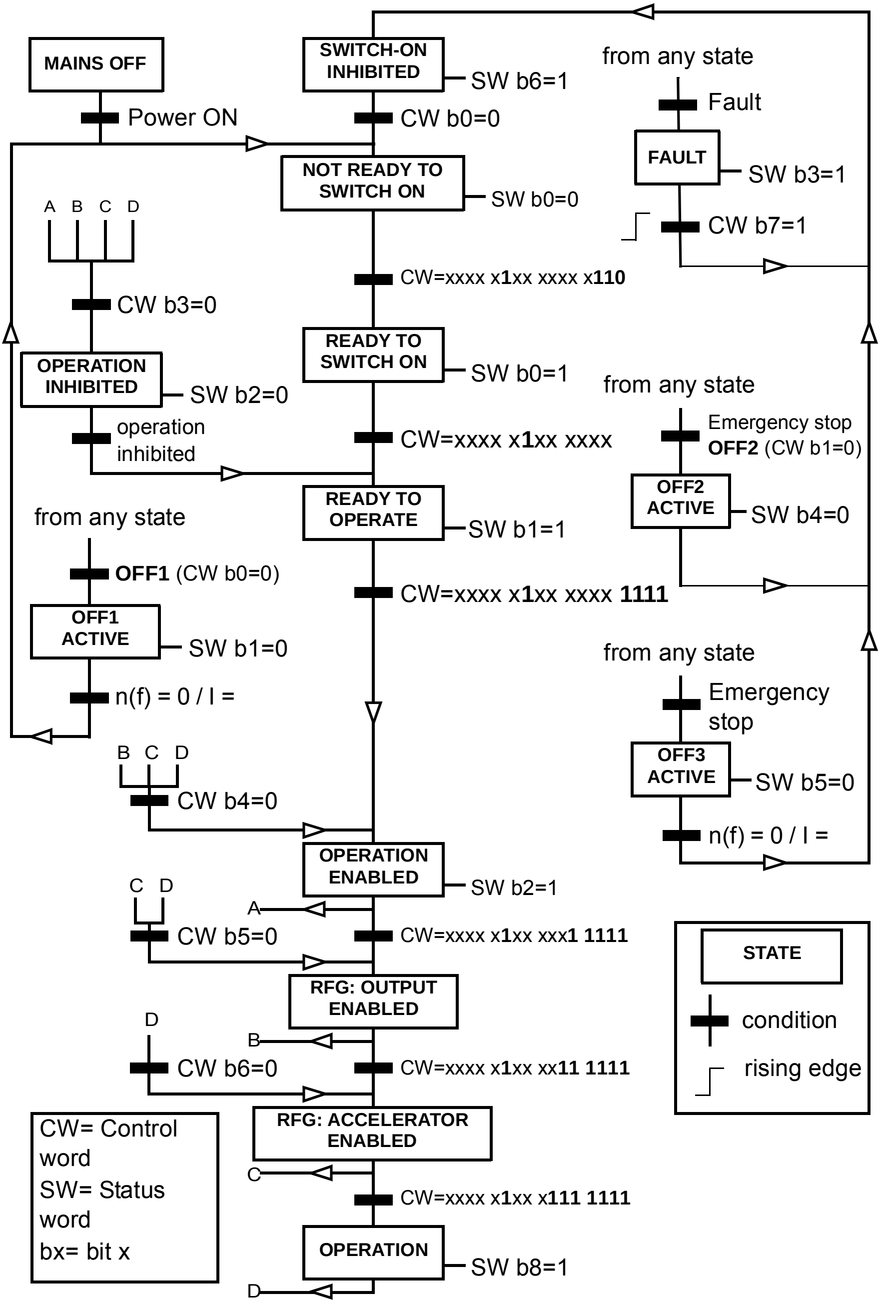
Contents of the fieldbus Status word

The upper case boldface text refers to the states shown in the state diagram (page *470*).

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 ENABLED**.
		0	**OPERATION INHIBITED**.
3	Tripped	1	**FAULT**.
		0	No fault.

Bit	Name	Value	STATE/Description
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, i.e. 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 speed, frequency or torque equals or exceeds supervision limit. Valid in both directions of rotation. The supervision limits are defined by parameters *46.31*...*46.33*.
		0	Actual speed, frequency or torque within supervision limit.
11	User bit 0	-	See parameter *06.30 MSW bit 11 sel*.
12	User bit 1	-	See parameter *06.31 MSW bit 12 sel*.
13	User bit 2	-	See parameter *06.32 MSW bit 13 sel*.
14	User bit 3	-	See parameter *06.33 MSW bit 14 sel*.
15	Reserved		

The state diagram



Setting up the drive for fieldbus control

Before configuring the drive for fieldbus control, install the adapter module mechanically and electrically according to the instructions given in the *User's manual* of the appropriate fieldbus adapter module.

1. Power up the drive.
2. Enable the communication between the drive and the fieldbus adapter module by setting parameter *50.01 FBA A enable* to Enable.
3. 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.
4. With *50.03 FBA A comm loss t out*, define the time between communication break detection and the selected action.
5. 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.
6. Set the fieldbus adapter module configuration parameters in group *51 FBA A settings*. At the minimum, set the required node address and the communication profile.
7. 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: The adapter module sets the Status word and Control word automatically into parameters *52.01* and *53.01* respectively.
8. Save the valid parameter values to permanent memory by setting parameter *96.07 Parameter save manually* to *Save*.
9. Validate the settings made in parameter groups 51, 52 and 53 by setting parameter *51.27 FBA A par refresh* to *Refresh*.
10. Set the relevant drive control parameters to control the drive according to the application. 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 value ±16384 (4000h) corresponds to parameter *46.01 Speed scaling* in the forward and reverse directions.

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 ACS880 drives	Description
50.01 FBA A enable	**1** = Enable	Enables 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** = Auto	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** = PPO1[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
53.05 FBA data out5	23.13[2)]	Deceleration time 1
51.27 FBA A par refresh	**1** = Refresh	Validates the configuration parameter settings.
19.12 Ext1 control mode 1	**2** = Speed	Selects speed control as the control mode 1 for external control location EXT1.
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 Speed ref1 source	**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:

- 47Eh (1150 decimal) –> READY TO SWITCH ON
- 47Fh (1151 decimal) –> OPERATING (Speed mode)

Parameter setting example: Using PCP/ESP application through FPBA

This example shows how to configure a PCP/ESP application for Profibus communication using ABB Drives profile with PPO Type 8 telegram type. The start/stop commands are according to the Main control word (*06.01 Main control word*). Reference is according to application reference (*74.05 Speed ref source*).

Example: Assume that pump maximum speed is 80 Prpm and required speed is 60 Prpm. For ABB Drive profile fieldbus speed reference value 20000 corresponds to maximum motor speed. For gear reduction ratio value 10 (*74.03 Gear reduction ratio*) maximum pump speed 80 Prpm corresponds to fieldbus reference value 2000. Fieldbus reference for 60 Prpm can be calculated as: 60 * 2000/ 80 = 1500.

Speed ref 1 in PZD 2 OUT should be equal to 1500.

If actual value 1 in PZD 2 IN equals 50, then pump speed is 50 Prpm.

The table below gives the recommended drive parameter settings.

Direction	PZD1	PZD2	PZD3	PZD4
Out	Main control word	Speed ref1		
In	Drive status word	Rod speed		Rod torque

Direction	PZD5	PZD6	PZD7	PZD8
Out				
In		Output frequency		Pump status word

The table below gives the recommended drive parameter settings.

Drive parameter	Setting for ACS880 drive	Description
20.01 Ext1 commands	Fieldbus A	Selects the source of start command.
50.01 FBA A enable	Option slot 3	Enables communication between the drive and the fieldbus adapter module. Fieldbus adapter module must be attached to slot 3.
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.
51.05 Profile	ABB Drives[2)]	Selects the Control word according to the ABB Drives profile.
51.27 FBA A par refresh	Refresh	Validates the configuration parameter settings.

Drive parameter	**Setting for ACS880 drive**	**Description**
52.01 FBA data in1	SW 16bit[2)]	Status word of the drive is sent to the master (PLC).
52.02 FBA data in2	9.6 Rod speed[2)]	Rod speed
53.04 FBA data in4	9.1 Rod torque[2)]	Rod torque
52.06 FBA data in6	1.6 Output frequency[2)]	Output frequency of the drive
52.08 FBA data in8	9.14 Pump status word[2)]	Pump status word (16 bit)
53.01 FBA data out1	CW 16bit[2)]	Command word from master to the drive.
53.02 FBA data out2	Ref1 16bit[2)]	Speed reference from master to the drive.
74.01 Pump enable	**Enable**	Enables the pump related application features.
74.03 Gear reduction ratio	10[2)]	Set 10 as transmission reduction ratio for ESP application.
74.05 Speed ref source	FBA1 ref	Set FBA Ref1 as a source for application speed reference.
74.07 Minimum rod speed	-10[2)]	Minimum allowed rod speed.
74.08 Maximum rod speed	80[2)]	Maximum allowed rod speed.
74.19 Maximum rod torq ref	12[2)]	Maximum allowed torque reference for ESP.
74.10 Rod acc time	20[2)]	Time period that is required to accelerate from zero to 46.01 Speed scaling.
74.11 Rod dec time	20[2)]	Time period that is required to decelerate from 46.01 Speed scaling to zero speed.

[1)] Read-only or automatically detected/set
[2)] Example

The start sequence for the parameter example above is given below.Application command word (*06.02 Application control word*):

- 47Eh (1150 decimal) –> READY TO SWITCH ON
- 47Fh (1151 decimal) –> OPERATING (Speed mode)
- 477h (1143 decimal) –> STOP (Coast)

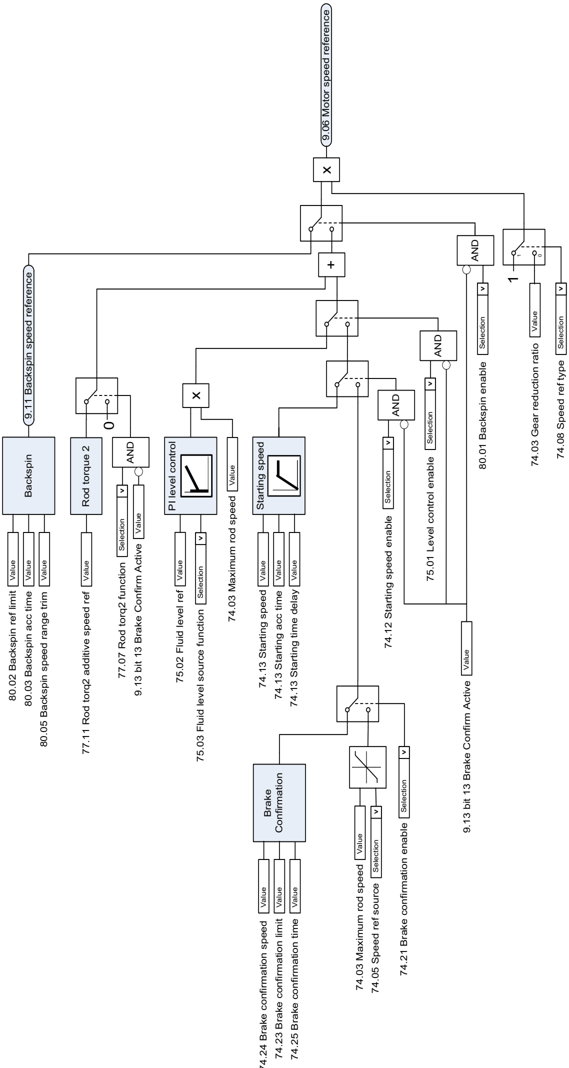
13

Control chain diagrams

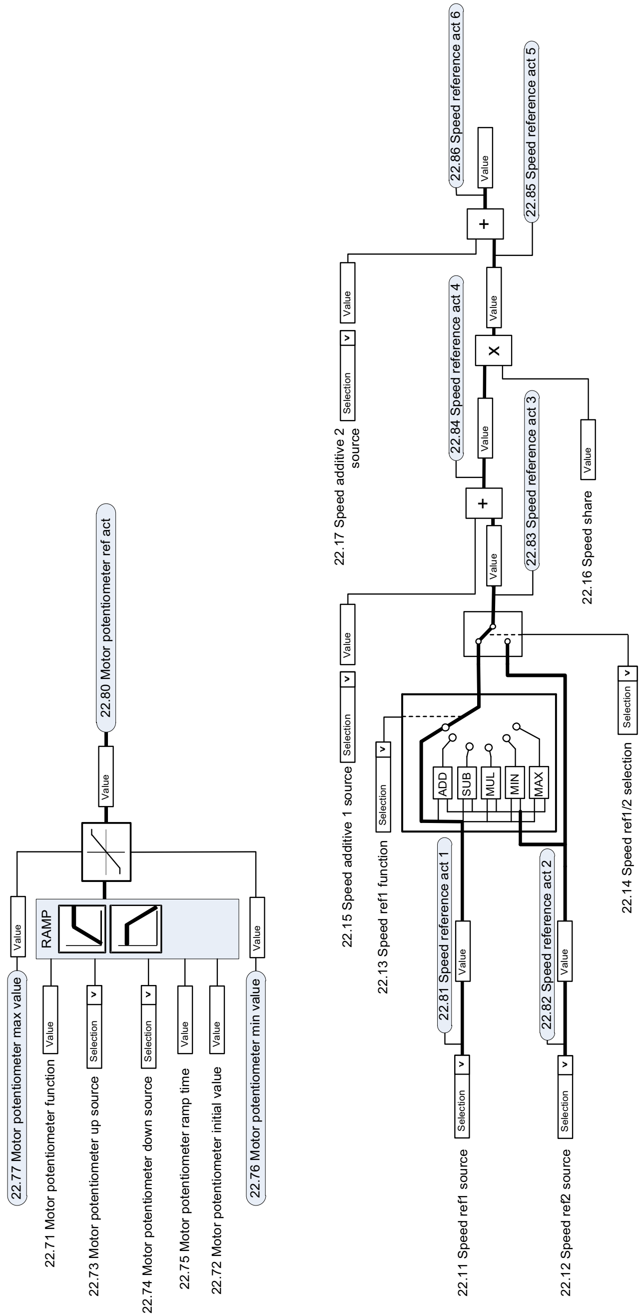
Contents of this chapter

The chapter presents the reference chains of the drive. For a general diagram, see section *Operating modes of the drive* (page *53*).

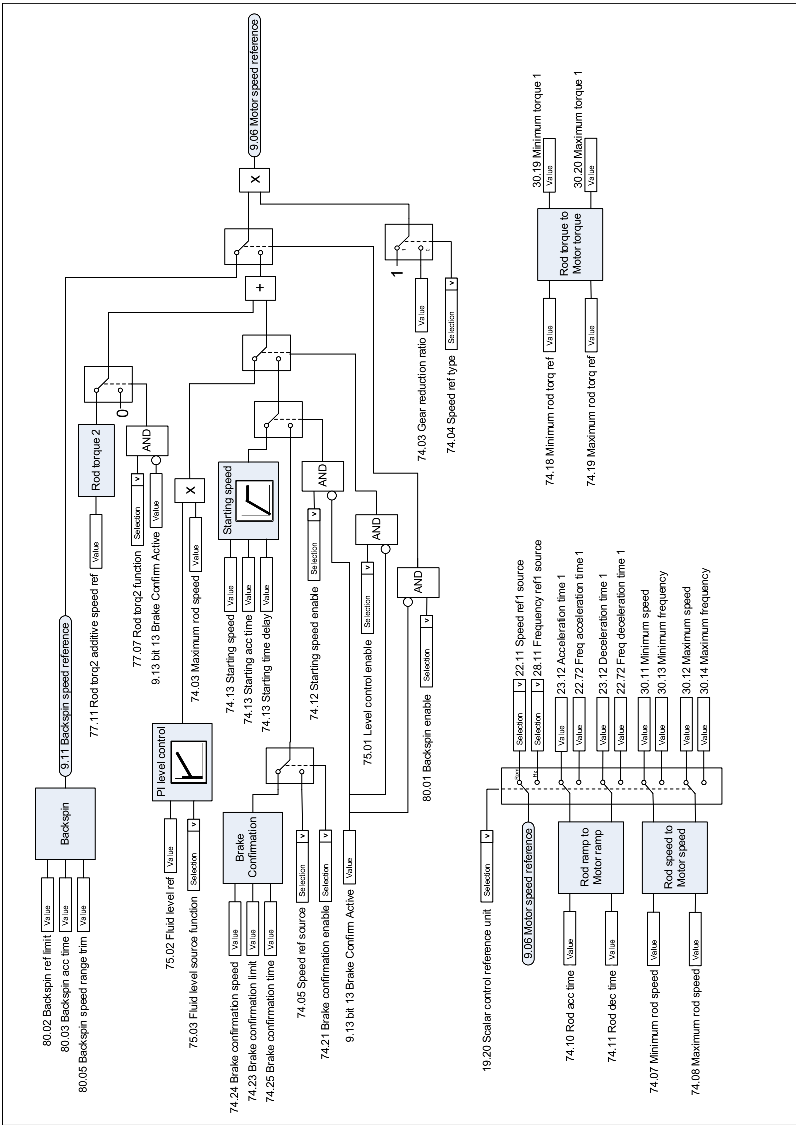
Speed reference source selection for application



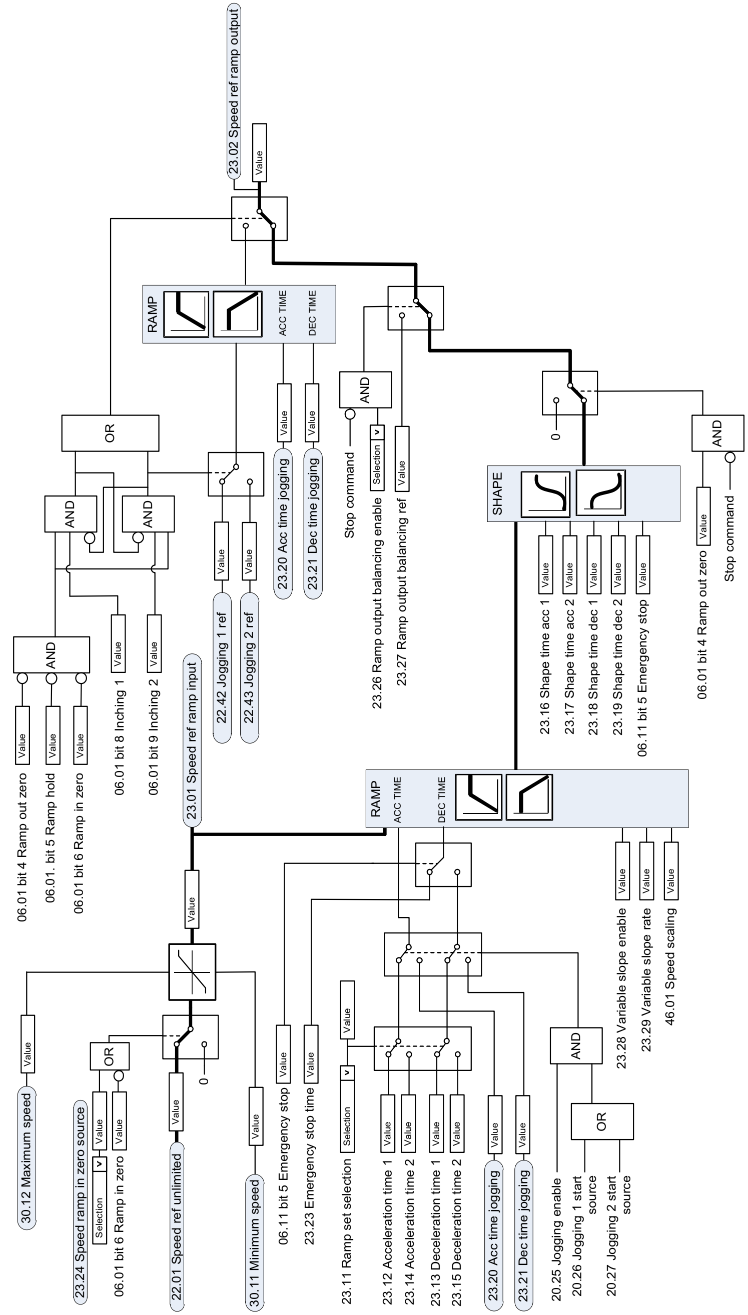
Speed reference source selection I



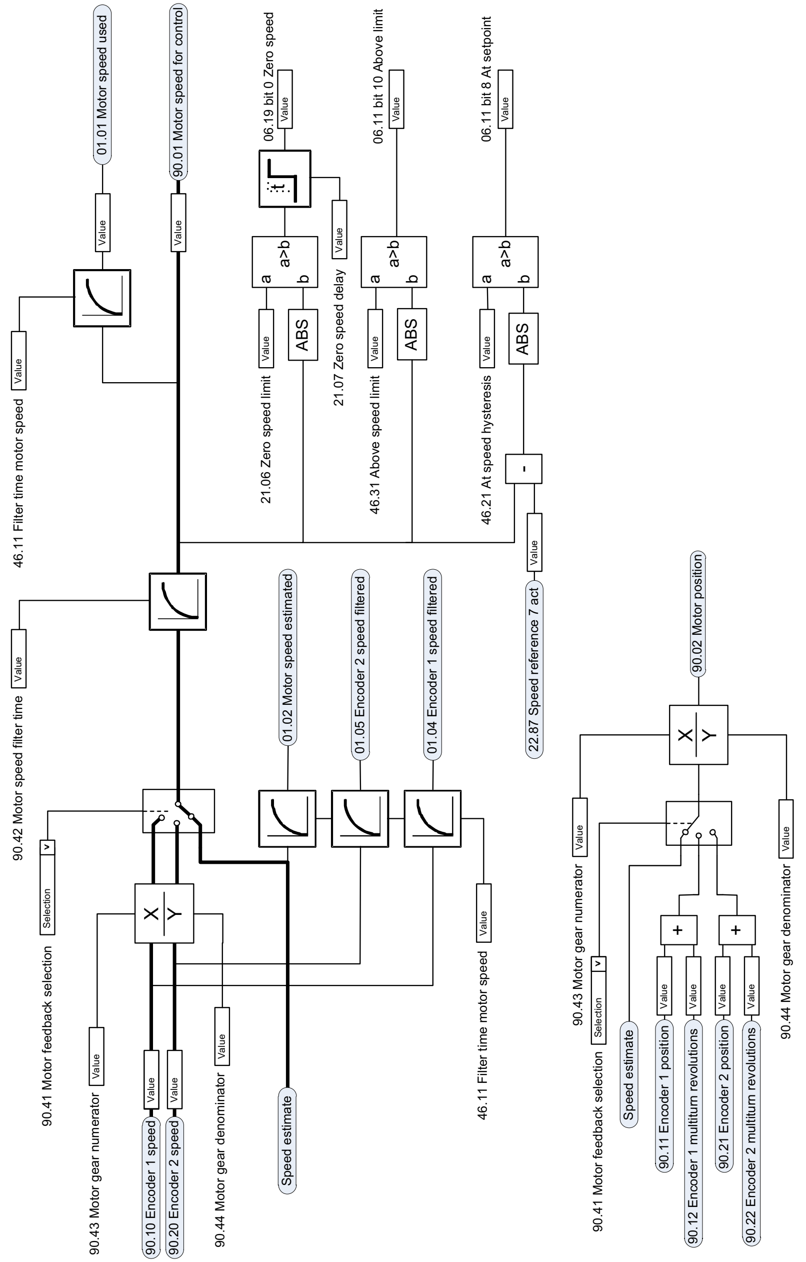
Speed reference source selection II



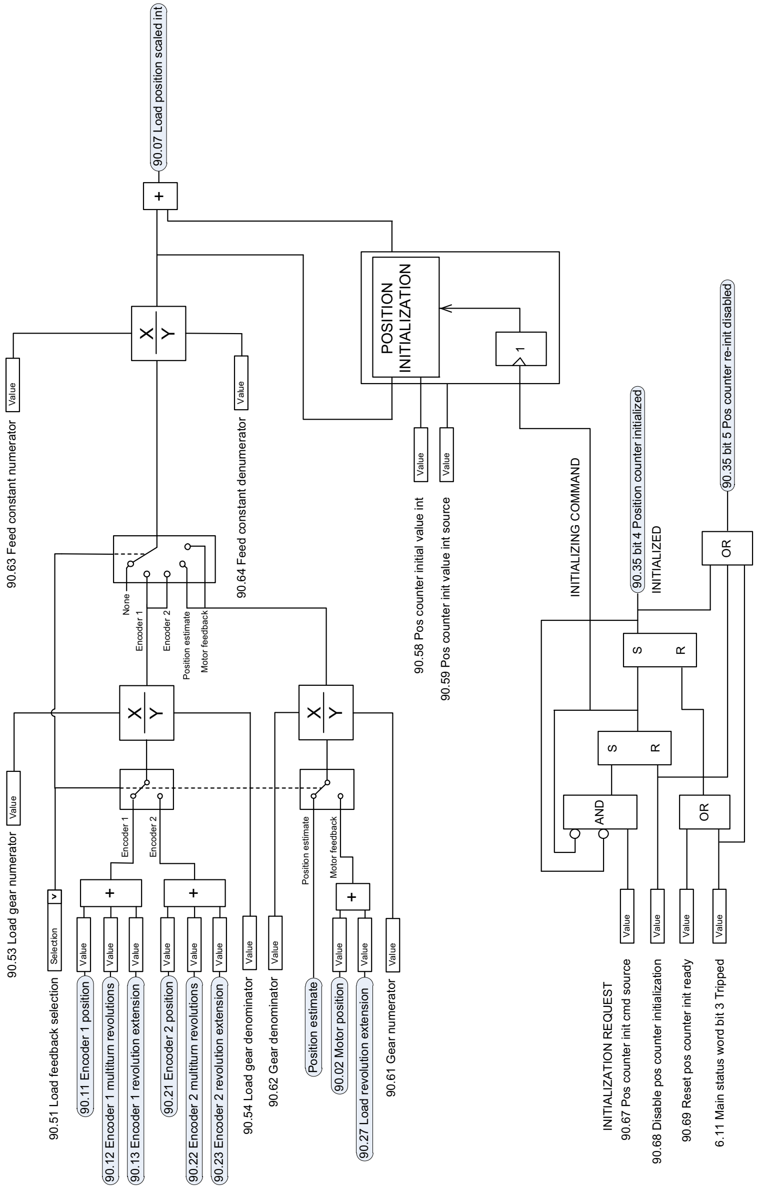
Speed reference ramping and shaping



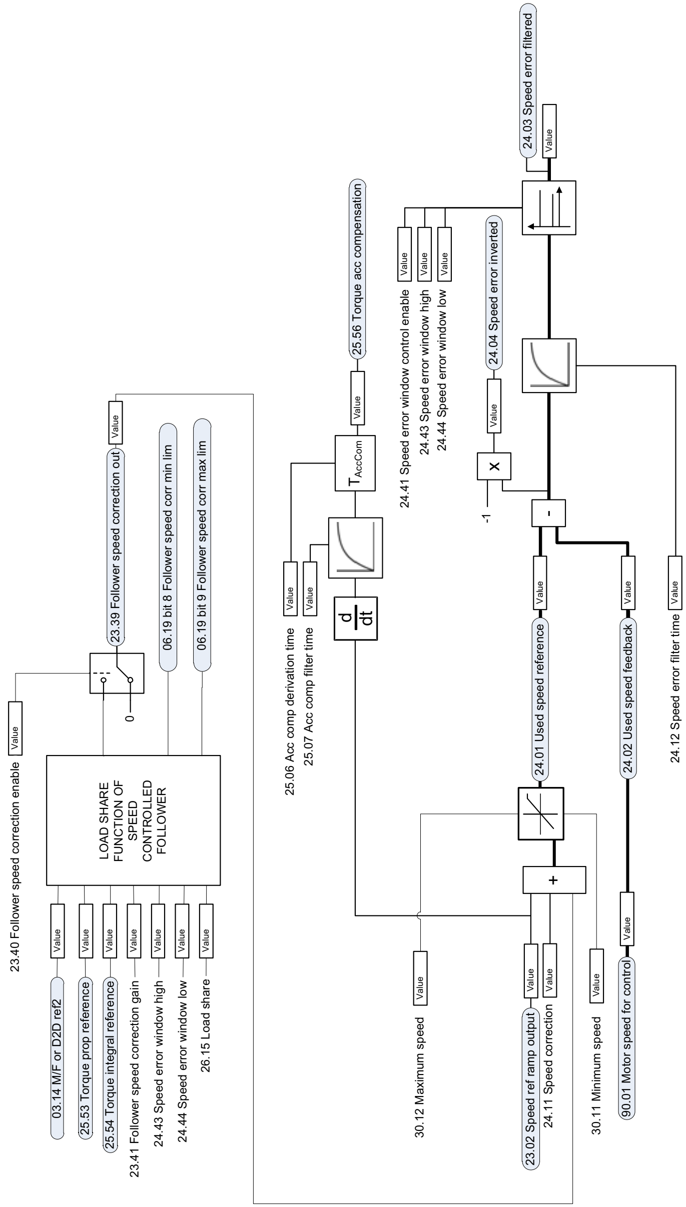
Motor feedback configuration



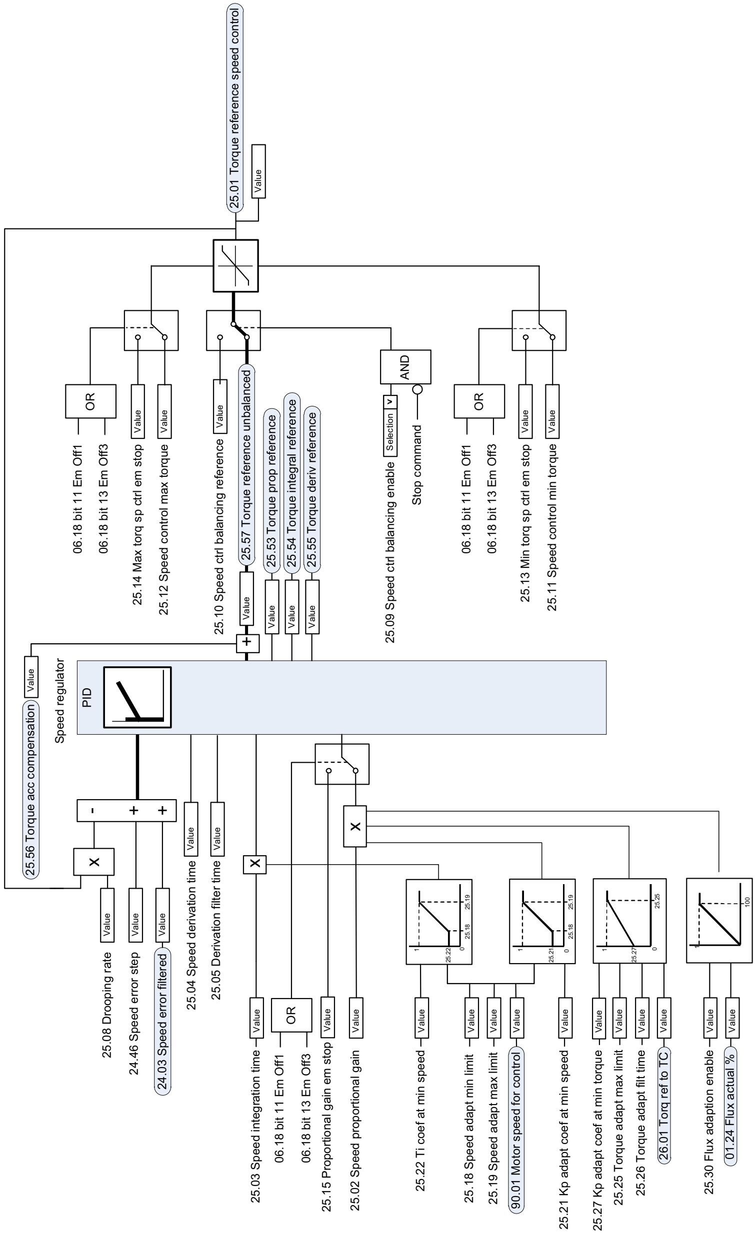
Load feedback and position counter configuration



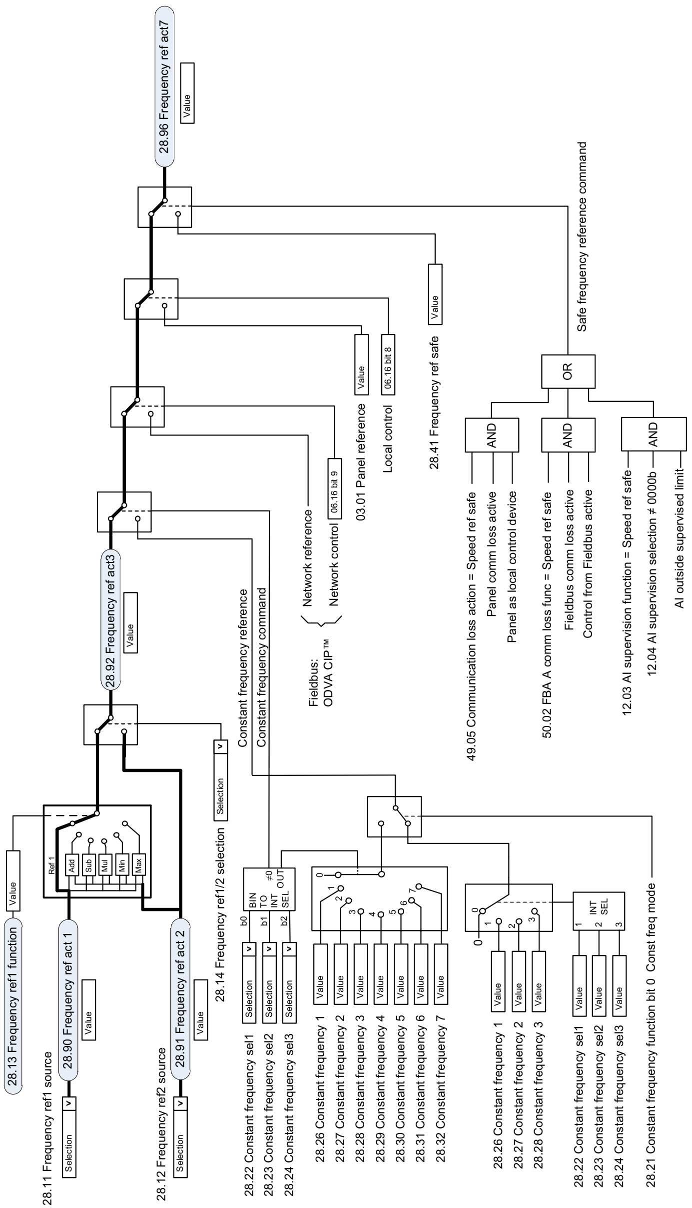
Speed error calculation



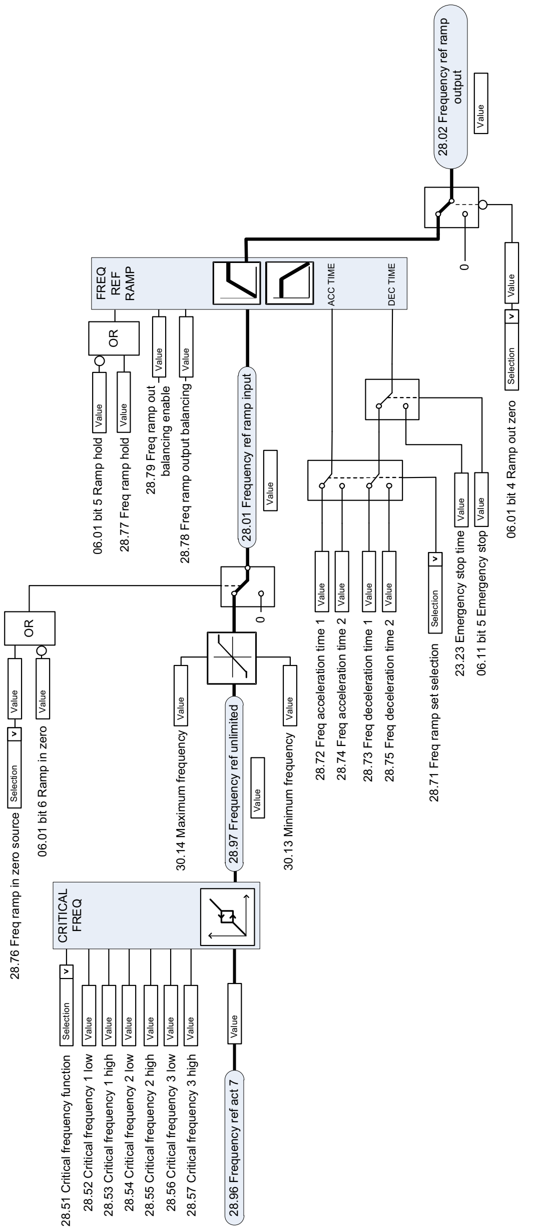
Speed controller



Frequency reference selection



Frequency reference modification



14

Appendix: ESP with step-up transformer and sine filter

Contents of this chapter

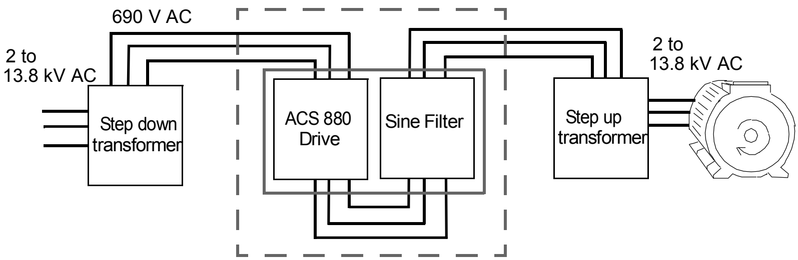
This chapter provides an overview of ESP with step-up transformer and sine filter.

ESP with step-up transformer and sine filter

Sine filters are used to suppress the high frequency components of the drive output. The step up transformer enables the use of a medium-voltage motor with a low-voltage drive.

Block digram

The following block diagram represents the ACS880 drive connected to motor with a step-up transformer and sine filter.



Current calculation

For ESP with sine filter and step-up transformer instead of using the motor rating plate data, set parameter *99.07 Motor nominal voltage* according to the nominal supply voltage of the drive (example: 690 V). Also set the parameter *99.06 Motor nominal current* to

$$\frac{U_2}{U_1} \cdot I_n$$

Where U_1 and U_2 are the primary and secondary voltages of the step-up transformer respectively.

Primary and secondary voltage calculation

Required data:

Motor: $U_n, I_n, \cos(\varphi_n), f_n$

Cable: $R_c, L_c, length$

If the cable characteristics are not known, typical values can be used:

$$R_c = 0.27\frac{\Omega}{km}$$

$$L_c = 0.33\frac{mH}{km}$$

Motor data:

Nominal impedance,

$$Z_m = \frac{U_n}{I_n \cdot \sqrt{3}}$$

Resistive component,

$$R_m = Z_m \cdot \cos(\varphi_n)$$

Reactive component,

$$X_m = Z_m \cdot \sqrt{1 - \cos^2(\varphi_n)}$$

Cable reactance at frequency *f*,

$$X_c = 2\pi f L_c$$

Primary side:

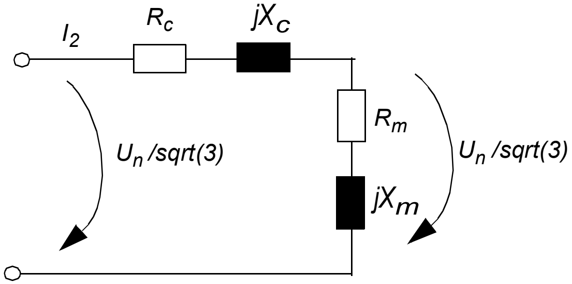
The primary voltage can be assumed to be 10% lower than the supply voltage of the drive because of the voltage drop in the sine filter and the drive.

The primary voltage *U*1 is

- 0.85 X 400 V = 340 V (for 400 V drives)
- 0.87 X 500 V = 435 V (for 500 V drives)
- 0.9 X 690 V = 620 V (for 690 V drives)

Secondary side:

The following diagram represents the secondary side of a step-up system.



The impedance of the secondary side is

$$Z_1 = \sqrt{(R_C + R_m)^2 + (X_C + X_m)^2}$$

The system is dimensioned using the nominal current of the motor:

$$I_2 = I_n$$

The minimum voltage for the transformer secondary is

$$U_2 = \sqrt{3} \cdot I_2 \cdot Z_1$$

Example

The nominal voltage of the drive in this calculation is 690 V.

Motor

$$U_n = 3300V$$

$$I_n = 106A$$

$$f_n = 50Hz$$

$$\cos(\varphi_n) = 0.82$$

$$Z_m = \frac{3300}{106\sqrt{3}}\Omega \approx 17.97\Omega \Rightarrow R_m = 17.97 \cdot 0.82\Omega \approx 14.74\Omega$$

$$X_m = 17.97 \cdot \sqrt{1 - 0.82^2}\Omega \approx 10.29\Omega$$

Cable

$$Length = 5km$$

$$R_c = 0.27\frac{\Omega}{km} \Rightarrow R_c = 5 \cdot 0.27\Omega \approx 1.35\Omega$$

$$L_c = 0.33\frac{mH}{km} \Rightarrow L_c = 5 \cdot 0.33mH \approx 1.65mH$$

$$X_c = 2\pi fL_c \Rightarrow X_c = 2 \cdot \pi \cdot 50 \cdot 1.65 \cdot 10^{-3} \approx 0.52\Omega$$

Secondary side

$$Z_1 = \sqrt{(1.53 + 14.74)^2 + (0.52 + 10.29)^2}\Omega \approx 10.38\Omega$$

Secondary side current,

$$I_2 = I_n = 106A$$

The minimum voltage for secondary side,

$$U_s = \sqrt{3} \cdot 106A \cdot 19.38\Omega \approx 3558V$$

The secondary voltage of the transformer is chosen as,

$$U_{N2} = 3560V$$

Primary side

The primary voltage of the transformer is,

$$U_{N1} = 0.9 \cdot 690V \approx 620V$$

Calculated current,

$$\frac{U_{N2}}{U_{N1}} \cdot I_n = \frac{3560}{620} \cdot 106 \approx 608.6A$$

Set par. *99.06 Motor nominal current* to 608.6 A

For more information, see the *Sine Filters User's Manual* (3AFE68389178 [English]).

Further information

Product and service inquiries

Address any inquiries about the product to your local ABB representative, quoting the type designation and serial number of the unit in question. A listing of ABB sales, support and service contacts can be found by navigating to www.abb.com/searchchannels.

Product training

For information on ABB product training, navigate to new.abb.com/service/training.

Providing feedback on ABB Drives manuals

Your comments on our manuals are welcome. Navigate to new.abb.com/drives/manuals-feedback-form.

Document library on the Internet

You can find manuals and other product documents in PDF format on the Internet at www.abb.com/drives/documents.

Contact us

www.abb.com/drives
www.abb.com/drivespartners

3AXD50000016186 Rev B (EN) 2015-10-27

Power and productivity
for a better world™