ABB INDUSTRIAL DRIVES

ACS880 PCP control program (option +N5200) for ZCU or BCU control unit (AOAL)

Firmware manual

ACS880 PCP control program (option +N5200) for ZCU or BCU control unit (AOAL)

Firmware manual

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Introduction

Contents of this chapter

This chapter describes the contents of the manual. It also contains information on the compatibility, safety and intended audience.

Applicability

This manual applies to the ACS880 PCP control program (option +N5200) for ZCU and BCU control program (AOALC). You can see the firmware and loading package names and versions in parameters as shown in below table:

Parameter	Name/version
07.04 Firmware name	AINFC
07.05 Firmware version	3.46.11.3
07.06 Loading package name	AOALC
07.07 Loading package version	1.65.0.0
07.24 Application version	1.31.0.34

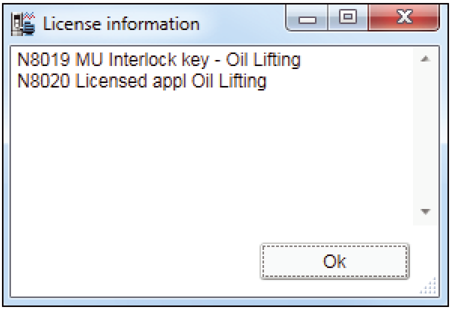
This PCP application program is based on IEC standard 61131-3. It is an in-house application, therefore the application code is locked and cannot be modified by the user.

Licensing

The PCP control program (+N5200) comes with a license key on the ZMU-02 memory unit. The program activates only after recognizing the key and correspondingly registers itself with the PCP software.

Device	License key
ZMU-02 memory unit license key	N8019 MU Interlock key - Oil Lifting
PCP software (loading package)	N8020 Licensed appl Oil Lifting

You can see the license information in the Drive Composer PC tool or in the ACS-APx control panel from **System info** -> **Licenses**.



If the program was loaded to a ZMU-02 memory unit without the license key, then the drive indicates a fault 64A5 Licensing fault. See the auxiliary fault code in the Event logger to know the plus code of the missing license, in this case N8019. For further assistance, contact your local ABB representative.

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.

Related manuals

A quick start-up sequence for a speed control application is provided by *ACS880 drives with primary control program, Quick start-up guide* (3AUA0000098062).

Name	Code
Lists of hyperlinks to product manuals [1]	
ACS880-01 drives	9AKK105408A7004
ACS880-04 drive modules (200 to 710 kW, 300 to 700 hp)	9AKK105713A4819
ACS880-07 drives (45 to 710 kW, 50 to 700 hp)	9AKK105408A8149
ACS880-07 drives (560 to 2800 kW)	9AKK105713A6663
ACS880-17 drives (45 to 400 kW, 60 to 450 hp)	9AKK106930A3466
ACS880-17 drives (160 to 3200 kW)	9AKK106354A1499
ACS880-37 drives (160 to 3200 kW)	9AKK106354A1500
Other drive hardware manuals	
ACS880-04XT drive module packages (500 to 1200 kW) hardware manual	3AXD50000025169
ACS880-04 single drive module packages hardware manual	3AUA0000138495
ACS880-07CLC drives hardware manual	3AXD50000131457
ACS880-14 and -34 single drive packages hardware manual	3AXD50000022021
ACS880-104 inverter modules hardware manual	3AUA0000104271
ACS880-104LC inverter modules hardware manual	3AXD50000045610
ACS880-107 inverter units hardware manual	3AUA0000102519
Drive firmware manuals and guides	
ACS880 primary control program firmware manual (AINLX)	3AUA0000085967
ACS880 drives with primary control program, quick startup guide	3AUA0000098062
ACS880 PCP control program firmware manual	3AXD50000016186
Adaptive programming application guide	3AXD50000028574
Drive application programming manual (IEC 61131-3)	3AUA0000127808
Option manuals and guides	
ACS-AP-I, -S, -W and ACH-AP-H, -W 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.	

[1] Available in the Document library.

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.

Terms and abbreviations

Term	Description
BCU	Type of control unit
Drive	Frequency converter for controlling AC motors
EMC	Electromagnetic compatibility
EMI	Electromagnetic interference
FEN-01	Optional TTL incremental encoder interface module
FEN-11	Optional absolute encoder interface module
FEN-21	Optional resolver interface module
FEN-31	Optional HTL incremental encoder interface module
FIO-11	Optional analog I/O extension module
FPTC-01	Optional thermistor protection module
FPTC-02	Optional ATEX-certified thermistor protection module for potentially explosive atmospheres
Frame, frame size	Physical size of the drive or power module
FSO-12, FSO-21	Optional functional safety modules
IGBT	Insulated gate bipolar transistor
Inverter unit	Inverter module(s) under control of one control unit, and related components. One inverter unit typically controls one motor.
Power module	Common term for drive module, inverter module, supply module, brake chopper module etc.
RFI	Radio-frequency interference
STO	Safe torque off (IEC/EN 61800-5-2)
Supply unit	Supply module(s) under control of one control unit, and related components.

Cyber security disclaimer

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

ABB and its affiliates are not liable for damages and/or losses related to such security breaches, any unauthorized access, interference, intrusion, leakage and/or theft of data or information.

See also section User lock (page 121).

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Quick start-up guide for ACS880 drives

Contents of this chapter

The chapter contains the basic start-up sequence of the drive and additional alternative checklists for starting up the drive with the control program. It also contains configuration setups for specific control program features.

See following sections:

- Start-up (page 22)
- PCP control start-up (page 32)

Note: In the start-up instructions, the drive is set up using the ACS-AP-I, -S, -W and ACH-AP-H, -W Assistant control panels. You can also set up the start-up sequence using the Drive composer PC tool.

Before you start

Make sure that the drive is mechanically and electrically installed as described in the appropriate Quick installation guide and/or Hardware manual.

Safety

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

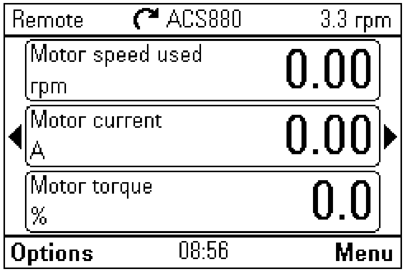
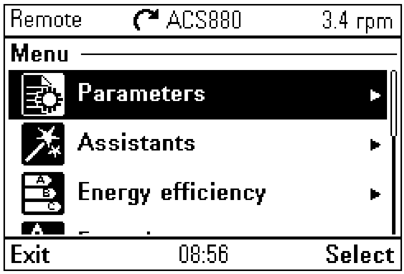
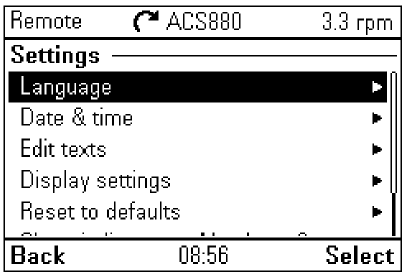
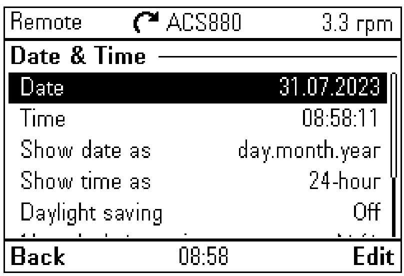
Never work on the drive, the brake chopper circuit, the motor cable or the motor when power is applied to the drive. Always make sure by measuring that no voltage is actually present.

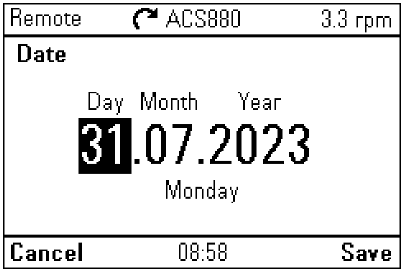
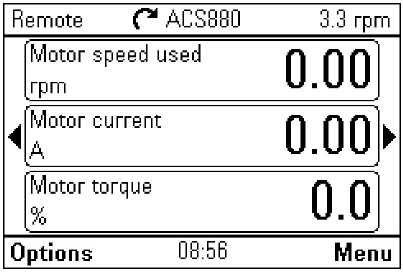
WARNING! Make sure that the machinery into which the drive with brake control function is integrated fulfills the personnel safety regulations. Note that the frequency converter (a Complete Drive Module or a Basic Drive Module, as defined in IEC 61800-2), is not considered as a safety device mentioned in the European Machinery Directive and related harmonized standards. Thus, the personnel safety of the complete machinery must not be based on a specific frequency converter feature (such as the brake control function), but it has to be implemented as defined in the application specific regulations.

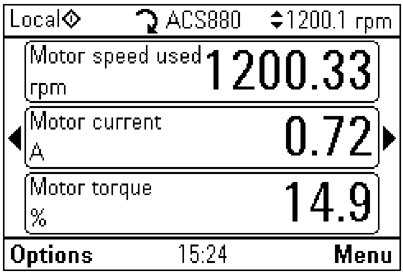
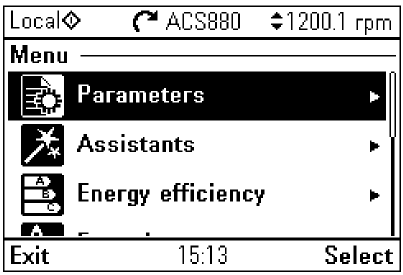
Start-up

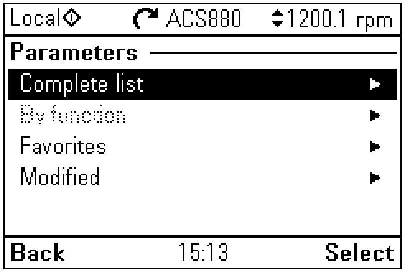
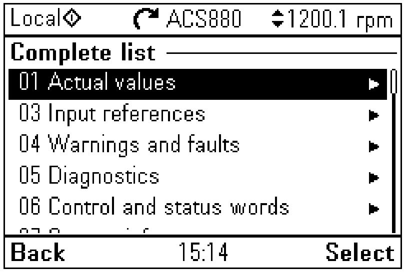
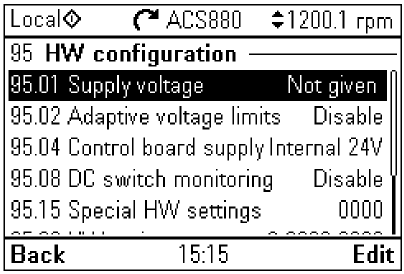
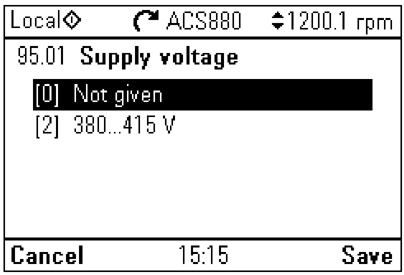
Safety	
WARNING! The start-up may only be carried out by a qualified electrician. The safety instructions must be followed during the start-up procedure. See the safety instructions on the first pages of the appropriate *Hardware manual*.	
☐	Check the installation. See the installation checklist in the 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.

<table>
<tr><th colspan="3">1 – Power-up, date and time settings</th></tr>
<tr><td>☐</td><td>Power up the drive.

Note: It is normal that warning messages appear at various points along the start-up process. To hide a message and to resume the start-up process, press .
Hide any warnings now to enter the Home view (shown on the right).
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.</td><td>
</td></tr>
<tr><td>☐</td><td>In the Home view, press (Menu).
The main Menu (right) appears.</td><td>
</td></tr>
<tr><td>☐</td><td>Highlight Settings on the menu using and press (Select).</td><td>
</td></tr>
<tr><td>☐</td><td>In the Settings menu, highlight Date & time (if not already highlighted) and press (Select).</td><td>
</td></tr>
</table>

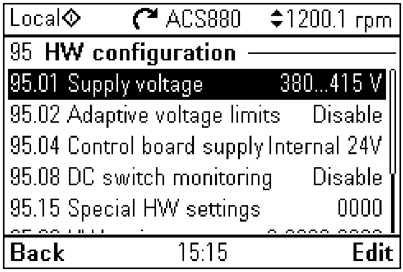
1 – Power-up, date and time settings		
☐	In the **Date & time** menu, highlight **Date** (if not already highlighted) and press (**Edit**).	
☐	Set the correct date: • Use and to move the cursor left and right. • Use and to change the value. • Press (**Save**) to accept the new setting. Check/adjust all the remaining settings in the **Date & time** menu. The **Show clock** setting determines whether the time is shown at all times in the bottom pane of the display. After you have made the settings, press (**Back or Exit**) repeatedly until the **Home** view (right) reappears.	

2 – Supply voltage and motor data settings		
☐	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.	
☐	Open the main **Menu** by pressing (**Menu**).	

2 – Supply voltage and motor data settings		
☐	Highlight **Parameters** and press (**Select**).	
☐	Highlight **Complete list** using ▲ and ▼ and press (**Select**). A listing of parameter groups is displayed.	
☐	Highlight parameter group and press (**Select**). Note that the list wraps around in either direction between groups 99 and 01. In this case, it is quicker to use ▲ to locate group 95 on the list. After selecting a group, a listing of parameters within the group is displayed.	
☐	Highlight parameter **95.01 Supply voltage** (if not already highlighted) and press (**Edit**). The available parameter settings are listed.	

2 – Supply voltage and motor data settings

Highlight the correct setting on the list and press (**Save**).



Press (**Back**) to display the list of parameter groups again. Select parameter group **99 Motor data**, and set parameter **99.03 Motor type**.

Set parameter **99.04 Motor control mode**.

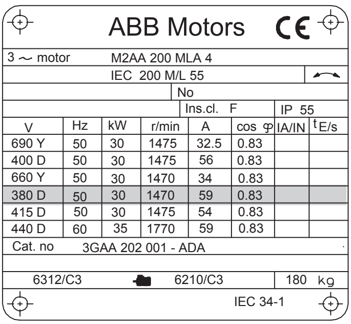
DTC = Direct torque control; **Scalar**

DTC 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.

Refer to the motor nameplate for the following parameter settings. Whenever possible, enter the values exactly as shown on the motor nameplate.

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



Example of a nameplate of a permanent magnet motor:

99.06 Motor nominal current

The allowable range is

- in DTC mode: $1/6 \times I_{Hd} \ldots 2 \times I_{Hd}$ of the drive
- in Scalar mode: $0 \ldots 2 \times I_{Hd}$

Note: With numerical parameter values:

- Use ▲ and ▼ to change the value of a digit.
- Use ◄ and ► to move the cursor left and right.
- Press (**Save**) to enter the value.

2 – Supply voltage and motor data settings	
Make the following parameter settings in the same manner.	
☐	**99.07 Motor nominal voltage** The allowable range is 1/6 × U_N … 2 × U_N of the drive. 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).
☐	**99.08 Motor nominal frequency** 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.
☐	**99.09 Motor nominal speed**
☐	**99.10 Motor nominal power**
☐	**99.11 Motor nominal cos ϕ** **99.12 Motor nominal torque** These values are not required, but can be entered to improve control accuracy. If not known, leave at 0.

<table>
<tr><th colspan="3">2 – Supply voltage and motor data settings</th></tr>
<tr><td>☐</td><td colspan="2">99.13 ID run requested

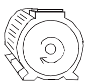
This parameter selects the mode of the identification run (DTC motor control mode only).

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 decoupled 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.

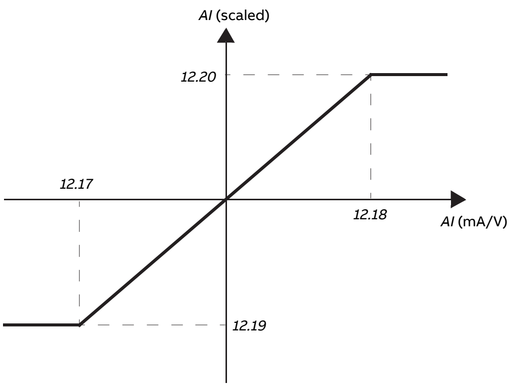
*Reduced mode should be selected if the mechanical losses are higher than 20%, ie. the load cannot be de-coupled, or full flux is required to keep the motor brake open (eg. with conical motors).

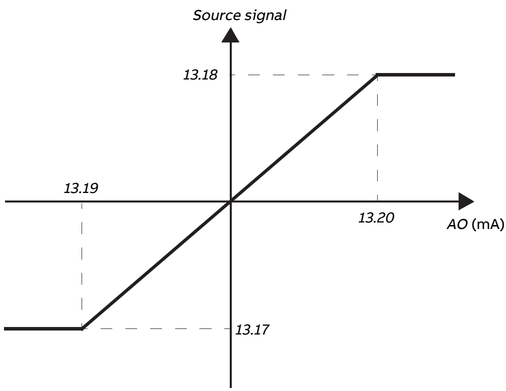
The Standstill mode should be selected if neither the *Normal or *Reduced mode can be used.

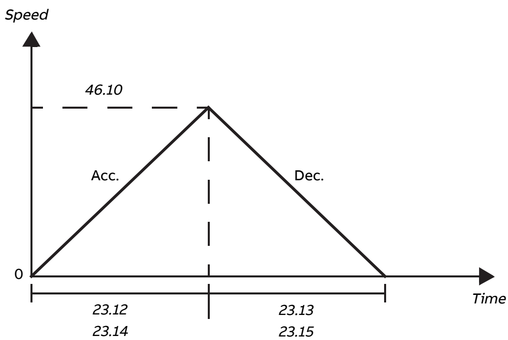
Note:
• This mode cannot be used with a permanent magnet motor if the load torque is higher than 20% of nominal.
• Mechanical brake is not opened by the logic for the identification run.</td></tr>
<tr><td>☐</td><td colspan="2">Ensure that the Safe torque off and emergency stop circuits (if present) are closed.</td></tr>
<tr><td>☐</td><td>Start the identification run by pressing the (Start) button.</td><td>A warning will indicate that the identification run is in progress.</td></tr>
<tr><td>☐</td><td colspan="2">Check that the motor runs in the correct direction (forward direction shown below).

The identification run has completed when the drive stops and the value of parameter 99.13 reverts to “No”.

If the motor ran in the wrong direction, correct the motor cabling or adjust parameter 99.16 Motor phase order.</td></tr>
</table>

<table>
<tr><th colspan="2">3 – Control signal settings</th></tr>
<tr><td>☐</td><td>Check the positions of jumpers J1 and J2 on the control unit of the drive. These jumpers determine whether analog inputs AI1 and AI2 are current or voltage.</td></tr>
<tr><td colspan="2">Check/adjust the following parameters.</td></tr>
</table>

3 – Control signal settings	
☐	**20.01 Ext1 commands** By default, the drive starts/stops according to the status of digital input DI1 (0 = Stop, 1 = Start). DI2 determines the direction of rotation (0 = Forward, 1 = Reverse). If other sources are required, change the value accordingly. The sources **In1**…**In3** are defined by parameters **20.03**…**20.05**.
☐	**12.15 AI1 unit selection** Set this to either **mA** or **V** corresponding to the setting of jumper J1.
☐	**12.17 AI1 min** **12.18 AI1 max** **12.19 AI1 scaled at AI1 min** **12.20 AI1 scaled at AI1 max** The default input for speed reference is analog input AI1. (This is controlled by the parameters in group 22.) Parameters **12.17** and **12.18** set the low and high limits of the analog input signal. Scaling parameters **12.19** and **12.20** define the internal signal levels that correspond to these limits as follows:  The corresponding parameters for analog input AI2 are **12.27**…**12.30**.

	3 – Control signal settings
☐	**13.12 AO1 source** **13.17 AO1 source min** **13.18 AO1 source max** **13.19 AO1 out at AI1 src min** **13.20 AO1 out at AI1 src max** Parameter **13.12** selects the source for analog output AO1 (by default, motor speed in rpm). Parameters **13.17** and **13.18** set low and high source signal values that correspond to the actual analog output values defined by parameters **13.19** and **13.20**. 

	3 – Control signal settings
☐	**46.10 Speed scaling** **23.11 Ramp set selection** **23.12 Acceleration time 1** **23.13 Deceleration time 1** **23.14 Acceleration time 2** **23.15 Deceleration time 2** You can define two different sets of acceleration/deceleration ramps. The source that switches between the two sets is selected by parameter **23.11**. Each acceleration/deceleration time set in parameters **23.12**…**23.15** refers to the time it takes for the drive to accelerate or decelerate between 0 and scaling speed (parameter **46.10**). 
☐	**30.11 Minimum speed** **30.12 Maximum speed** **30.17 Maximum current** **30.19 Minimum torque** **30.20 Maximum torque** Check, and set if necessary, the limits for motor speed, current and torque.
☐	Start the drive with a positive (forward) speed reference: • From control panel (Local control): In the Home view, press ▭ (**Options**), select Reference, adjust the reference using the ◄, ►, ▲, ▼ and keys, press **Save**, and press the Start button. • From I/O: In Remote control, adjust analog input AI1 (reference), switch digital input DI2 to 0 (forward), and switch digital input DI1 to 1 (start).

PCP 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 control start up is given below:

	I/O wiring
☐	Connect the digital and analog I/Os according to the wiring diagram shown in page 126.

	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: Gear reduction ratio = (pump sheave diameter * gear box ratio) / (motor sheave diameter) Maximum rod torque in lbft or Nm.	
☐	Enable the pump functions.	74.01 Pump enable

Basic pump set up		
☐	Define the transmission reduction ratio.	74.03 Gear reduction ratio
☐	Select the reference type between motor speed or pump speed.	74.04 Reference 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 Speed ref constant (Prpm, rpm or Hz).	74.06 Speed ref constant
☐	Define the minimum allowed rod/pump speed. ⚠ **WARNING!** This value must not be higher than 74.06 Speed ref constant (Prpm, rpm or Hz).	74.07 Minimum speed
☐	Define the maximum allowed rod/pump speed. ⚠ **WARNING!** This value must not be lower than 74.07 Minimum speed(Prpm, rpm or Hz).	74.08 Maximum speed
☐	Define maximum allowed torque reference (Nm or lbft).	74.19 Maximum torque
☐	Define the acceleration time for rod/pump: from zero to 74.08 Maximum speed (s).	74.10 Acc time
☐	Define the deceleration time for rod/pump: from 74.08 Maximum speed to zero speed.	74.11 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

Basic pump set up		
☐	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

Optional speed reduction at maximum torque		
☐	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

3

Using the control panel

Refer to *ACS-AP-I, -S, -W and ACH-AP-H, -W Assistant control panels user’s manual* (3AUA0000085685 [English]).

4

PCP program features

Contents of this chapter

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

WARNING!
Make sure that the machinery into which the drive is integrated fulfills the personnel safety regulations. Note that the frequency converter (a Complete Drive Module or a Basic Drive Module, as defined in IEC 61800-2), is not considered as a safety device mentioned in the European Machinery Directive and related harmonized standards. Thus, the personnel safety of the complete machinery must not be based on a specific frequency converter feature, but it has to be implemented as defined in the application specific regulations.

Overview of PCP control program

The Progressive cavity pumping (PCP) 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.

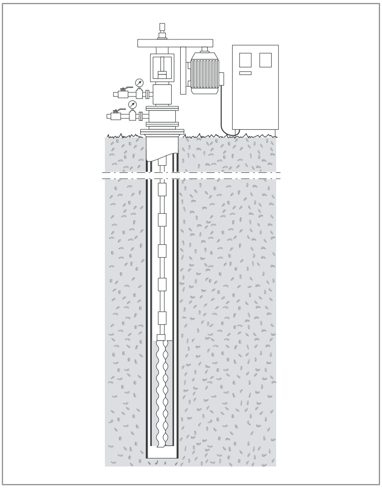
The PCP control program also features an automatic backspin control feature that prevents the unit from uncontrolled reverse rotation caused by back flow of fluid.

See section Pump backspin control (page 54).

Construction of PCP system

ABB industrial drive modules with the pump control program can be used to control PCP pump.

Progressive cavity pump (PCP)



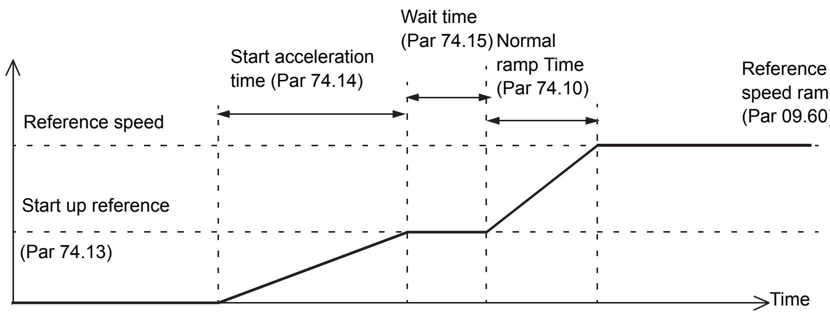
The PCP system consists of a surface drive, a drive string and a down hole PC pump. The PC pump comprises of a single helical-shaped rotor that turns inside a double helical elastomer-lined stator. The stator is attached to the production tubing string and remains stationary during pumping.

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

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 and diagnostics

Parameters: 74.12 Starting speed enable (page 418), 74.13 Starting speed (page 418), 74.14 Starting speed acc time (page 418) and 74.15 Starting speed time delay (page 418).

Signals: 09.06 Motor speed reference (page 173) and 09.14 Pump status word (page 174) (Bit 14).

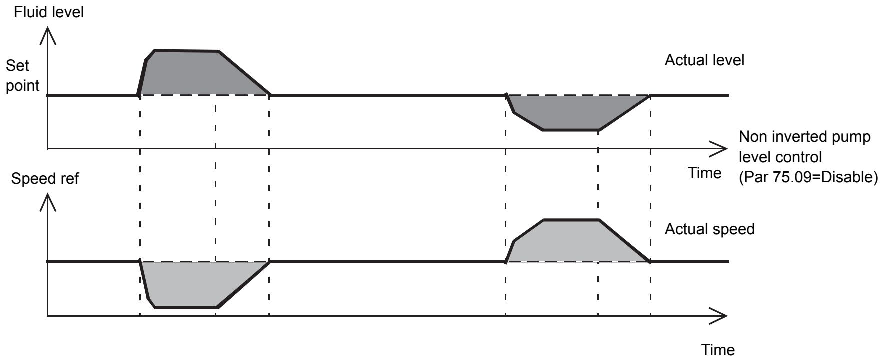
Pump level control

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

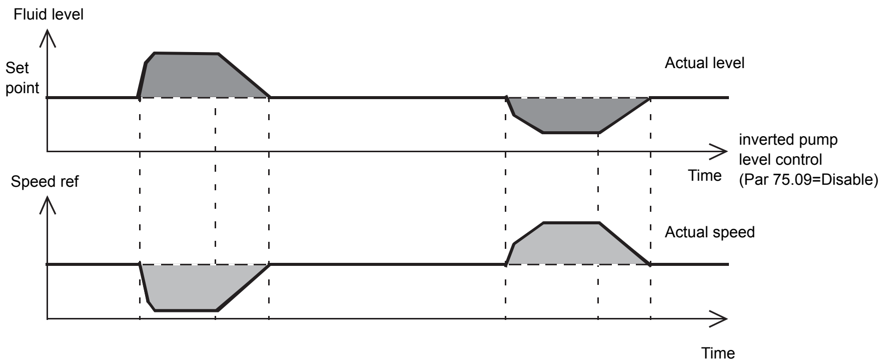
Non-inverted level control



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 and diagnostics

Parameters: 75.01 Level control enable (page 422) to 75.09 Level control invert (page 423).

Signals: 09.08 Fluid level (page 173).

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. See Pump backspin control (page 54). 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 75.40. Wake up function generates start command if parameter 09.16 Sleep time exceeds maximum sleep time. To skip this function, set value of parameter 75.40 to 0.

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

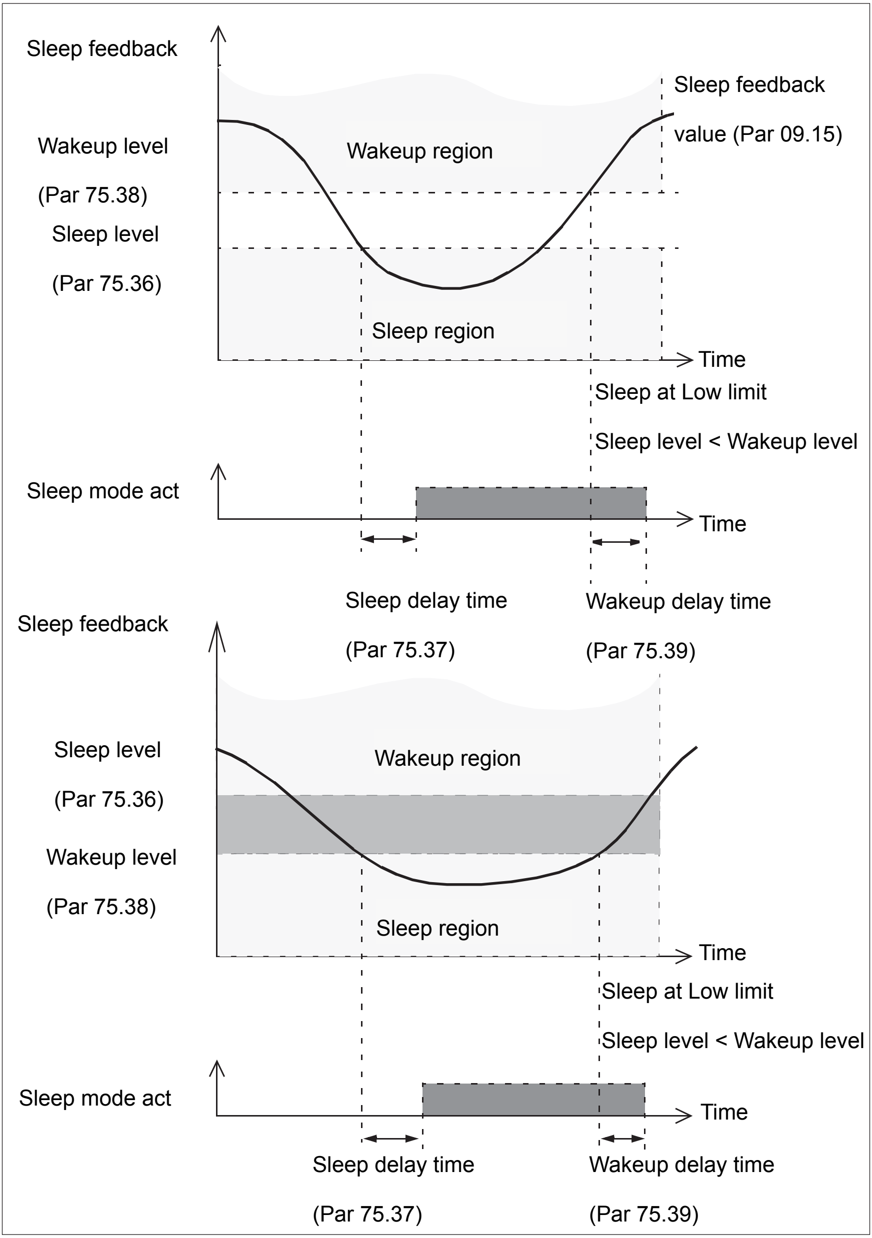
The user can enable this function in the parameter 75.30. The user can also define the sleep level and delay time parameters according to process requirements. The user also defines the sleep limit type (parameter 75.32): whether sleep starts after 09.15 goes below the sleep limit (Low limit) or exceeds 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.

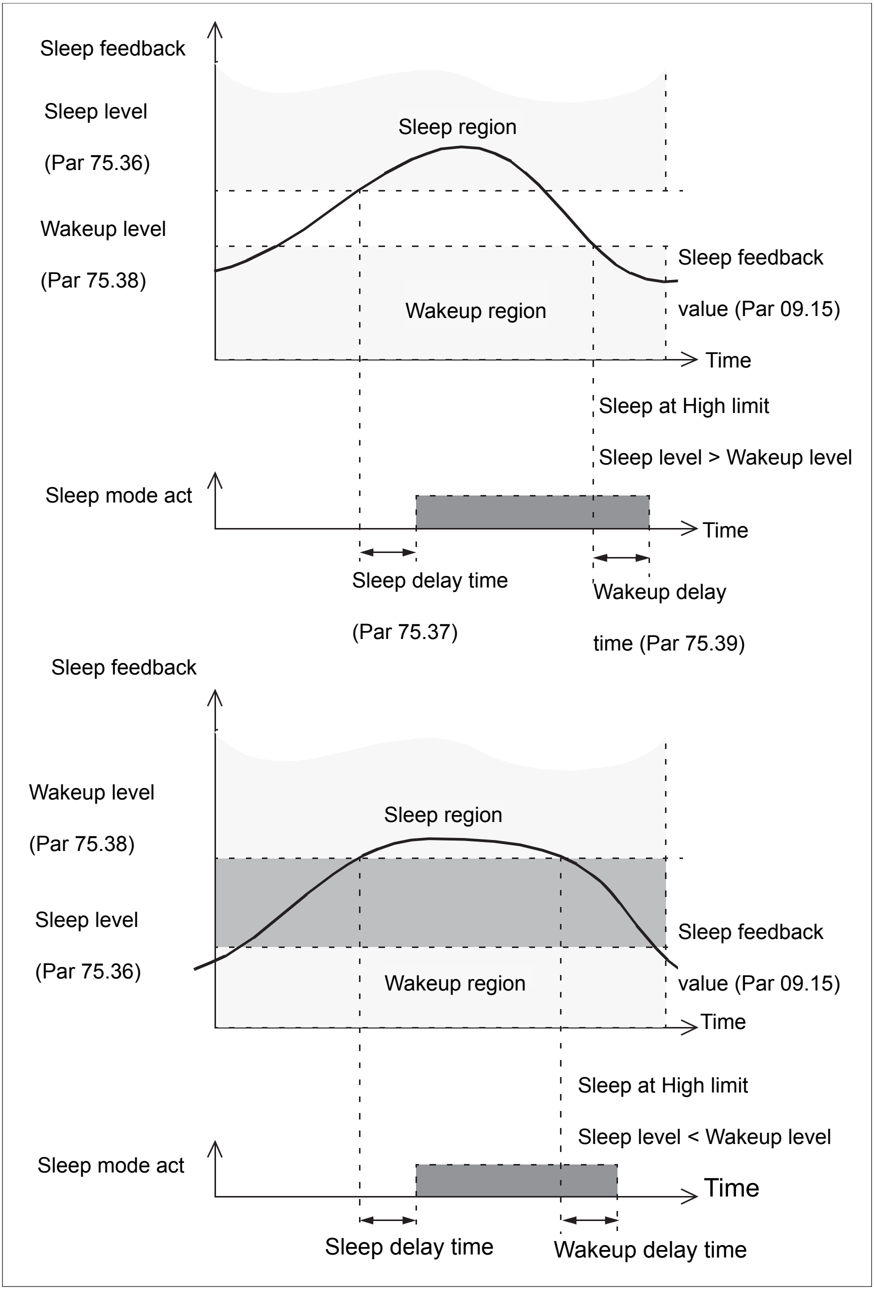
Timing diagram 1

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
Sleep feedback
value (Par 09.15)
Wakeup level
(Par 75.38)
Wakeup region
Sleep level
(Par 75.36)
Sleep region
Time
Sleep at Low limit
Sleep level < Wakeup level
Sleep mode act
Time
Sleep delay time
(Par 75.37)
Wakeup delay time
(Par 75.39)
Sleep feedback
Sleep level
(Par 75.36)
Wakeup region
Wakeup level
(Par 75.38)
Sleep region
Time
Sleep at Low limit
Sleep level < Wakeup level
Sleep mode act
Time
Sleep delay time
(Par 75.37)
Wakeup delay time
(Par 75.39)

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 level
(Par 75.36)
Sleep region
Wakeup level
(Par 75.38)
Sleep feedback
value (Par 09.15)
Wakeup region
Time
Sleep at High limit
Sleep level > Wakeup level
Sleep mode act
Time
Sleep delay time
(Par 75.37)
Wakeup delay
time (Par 75.39)
Sleep feedback
Wakeup level
(Par 75.38)
Sleep region
Sleep level
(Par 75.36)
Sleep feedback
value (Par 09.15)
Wakeup region
Time
Sleep at High limit
Sleep level < Wakeup level
Sleep mode act
Time
Sleep delay time
Wakeup delay time

Settings and diagnostics

Parameters: 75.30 Sleep control enable (page 423) to 75.40 Maximum sleep time (page 425).

Signals: 09.14 Pump status word (page 174) (Bit 10), 09.15 Sleep feedback value (page 175) and 09.16 Sleep time (page 175).

Warnings: D207 Wrong start sequence (page 561).

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 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.

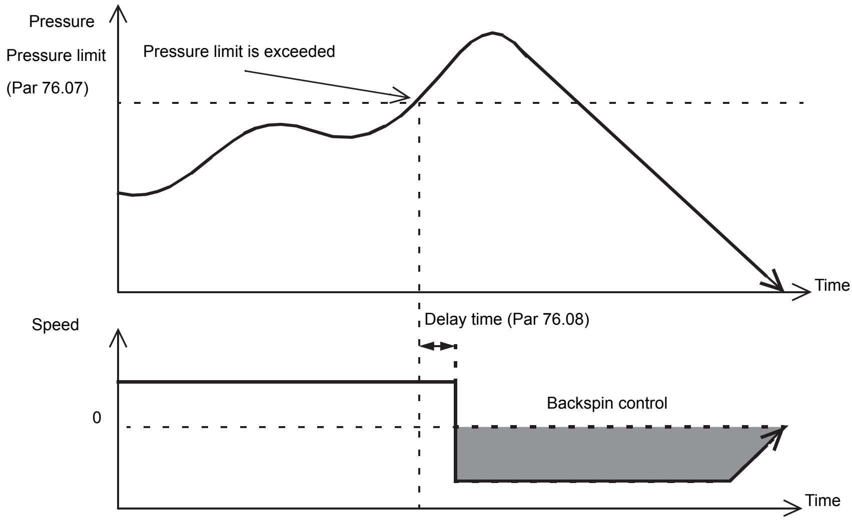
As soon as the safe condition is stabilized, the drive ramps up again or remains stopped according to the selected option: Non latching type (pump starts automatically after clearing the high pressure condition), Latching type (pump trips instead of auto restarting), Latch zero speed (enables Non latching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

Parameter group: 76 Pump pressure protection (page 426).

Signals: 09.09 Pressure (page 173) and 09.14 Pump status word (page 174) (Bits 3, 4 and 5).

Warnings: D201 Pressure (page 560).

Faults: D101 Pressure fault (page 559).

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.

- 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.

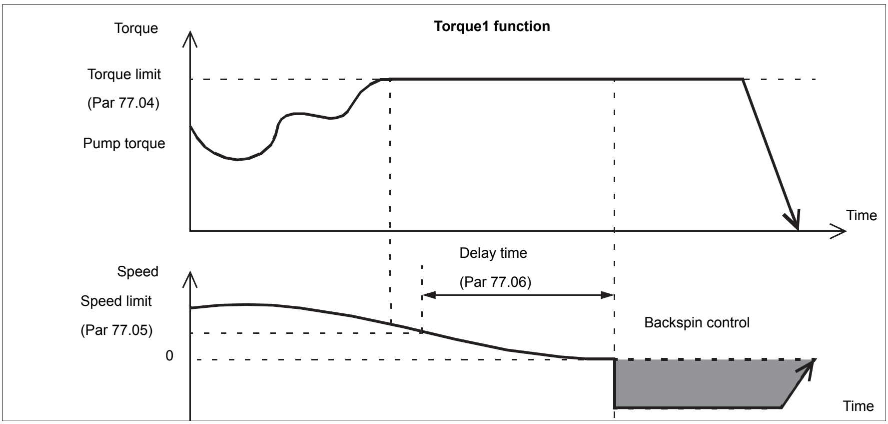
- For limit type low, a hysteresis (of Rod torque * 5%) is present in the comparator meaning, once the condition is set, it latches until the Rod torque increases to a value of [Rod torq1 limit + (Rod torque * 0.05)].
- For limit type high, a hysteresis (of Rod torque * 5%) is present in the comparator 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 Rod torque 1 limit). The user can enable this function in the parameter 77.02. For under load protection, user can define the limit as low or high in parameter 77.03.

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 and diagnostics

Parameters: 77.02 Rod torq1 function (page 428), 77.03 Rod torq1 limit type (page 428), 77.04 Rod torq1 limit (page 428), 77.05 Rod torq1 speed (page 428) and 77.06 Rod torq1 delay time (page 429).

Signals: 09.01 Rod torque (page 173), 09.02 Maximum rod torque (page 173), 09.05 Rod speed (page 173) and 09.14 Pump status word (page 174) (Bit 7).

Warnings:D204 Rod torque 1 limit (page 560).

Faults: D103 Rod torque 1 limit fault (page 559).

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 (parameter 77.11) before the drive shifts to backspin control after delay time has elapsed. The user can enable this function in the parameter 77.07. For torque protection, user can define the limit as low or high in parameter 77.08.

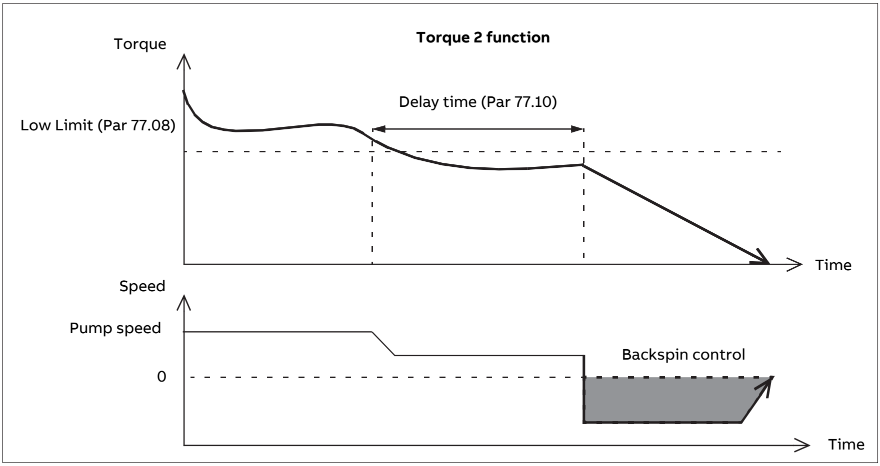
- **Low limit**: The control program triggers the Torque pressure protection function when measured torque and speed are less than or equal to defined Torque2 limits for a period of time greater than the Rod torque2 delay time.
- **High limit**: The control program triggers the Torque pressure protection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

A tracking mode can be used with Rod torque 2 function, to modify speed reference when a torque limit is reached. The tracking option allows to modify the speed reference by adding parameter 77.11 as many times as needed to remove torque protection conditions.

- **Low limit tracking**: The control program triggers the torque pressure protection function when the measured torque and speed are less than or equal to the defined Torque2 limits for a period longer than the Rod torque2 delay time. Low limit tracking function is same as the low limit, but the function triggers multiple times.
- **High limit tracking**: The control program triggers the torque pressure protection function when the measured torque and speed are greater than or equal to the defined Torque2 limits for a period longer than the Rod torque2 delay time. High limit tracking function is same as the high limit, but the function triggers multiple times.

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. After the delay time is passed, the drive shifts to backspin control.



Settings and diagnostics

Parameters: 77.07 Rod torq2 function (page 429), 77.08 Rod torq2 limit type (page 429), 77.09 Rod torq2 limit (page 430), 77.10 Rod torq2 delay time (page 430), 77.11 Rod torq2 additive speed ref (page 430), 77.12 Rod torq2 speed delay time (page 430), 77.13 Rod torq2 limit counter (page 430) and 77.14 Rod torq2 time window (page 430).

Signals: 09.01 Rod torque (page 173), 09.02 Maximum rod torque (page 173), 09.05 Rod speed (page 173) and 09.14 Pump status word (page 174) (Bits 8 and 15).

Warnings: D205 Rod torque 2 speed (page 560) and D206 Rod torque 2 limit (page 560).

Faults: D104 Rod torque 2 limit fault (page 559).

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.

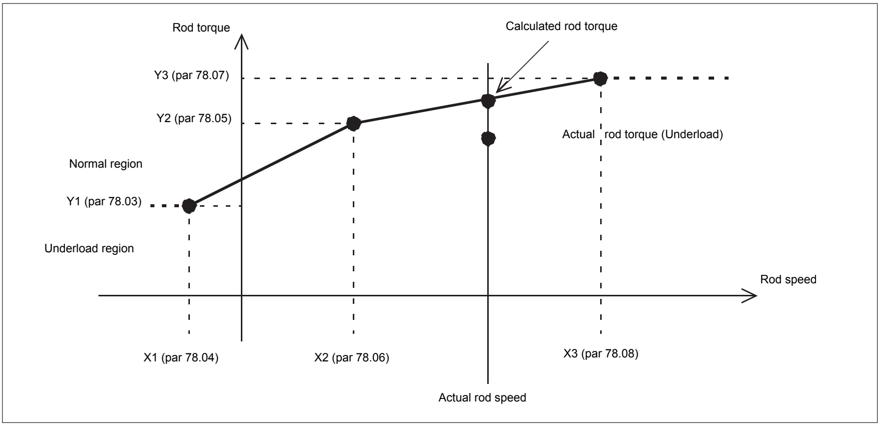
The pump underload protection is based on the measurement of rod torque value. This function also enables pump protection with motor current. The user can select this option in parameter 78.01 Underload limit display.

- 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 and diagnostics

Parameter group: 78 Pump underload protection (page 432).

Signals: 09.01 Rod torque (page 173), 09.05 Rod speed (page 173) and 09.14 Pump status word (page 174) (Bit 6).

Warnings: D202 Underload (page 560).

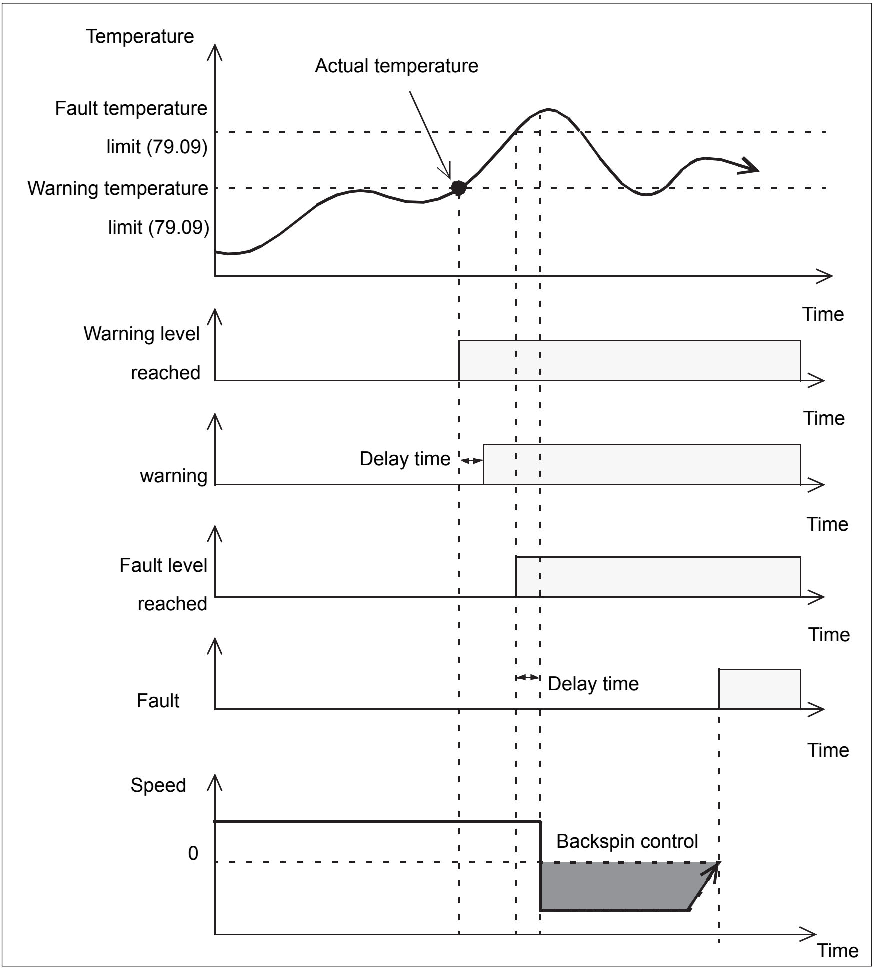
Faults:D102 Underload fault (page 559).

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 and diagnostics

Parameter group: 79 Pump temperature protection (page 434).

Signals: 09.10 Measured temperature (page 173) and 09.14 Pump status word (page 174) (Bits 0, 1 and 2).

Warnings: D200 Overtemperature (page 560).

Faults: D100 Overtemperature fault (page 559).

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.

When zero speed is reached, the drive begins ramping to the backspin speed reference with an acceleration time in parameter 80.03. 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.

Backspin Speed ref = Back spin Limit - (Actual Torque Filtered/Max Torque) * Back spin Limit * Back spin Speed Range

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

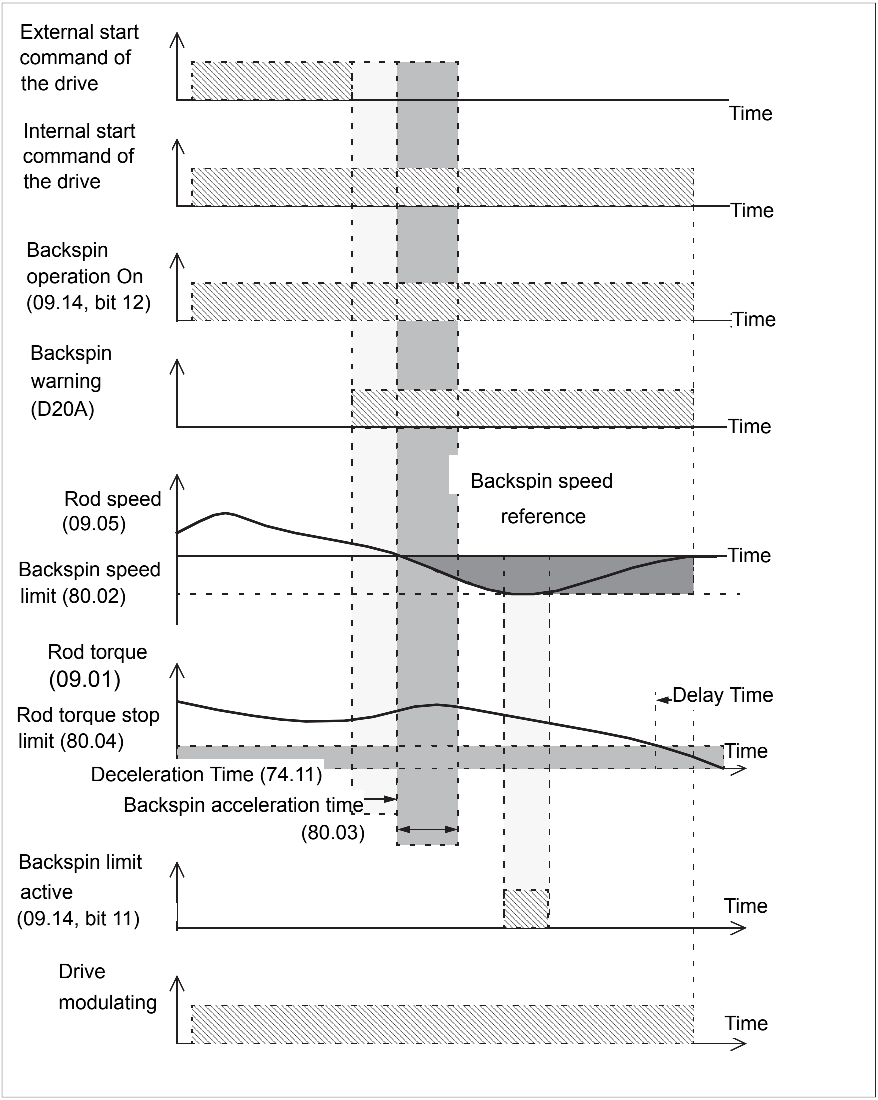
The following procedure and time scheme describes the operation of backspin

function:

1. The Drive receives an external stop command and starts to decelerate the pump down along the defined ramp (74.11 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).
4. The Backspin function keeps the reverse speed under the Backspin speed limit (80.05) until the back flow starts running out and the torque starts decreasing.
5. When the actual torque goes below the limit (80.04), the function does not stop and initiates the Coast to stop command to the drive.
6. If the actual torque stays below the limit (80.04) longer than the time set in parameter (80.06) then the controlled backspin function is complete.

Timing diagram



Settings and diagnostics

Parameters: 80.01 Backspin enable (page 436), 80.02 Backspin ref limit (page 436), 80.03 Backspin acc time (page 436), 80.04 Backspin stop torque (page 436), 80.05 Backspin speed range trim (page 437) and 80.06 Backspin stop delay (page 437).

Signals: 09.11 Backspin speed reference (page 173) and 09.13 Backspin status word (page 174) (bits 0, 1 and 2).

Warnings: D208 Backspin limit (page 561) and D209 Backspin active (page 561).

Start delay

Start delay function blocks any start command after stop command is given. User can enable this function using parameter 80.11 Restart delay enable. Pump cannot start during defined time period 80.12 Restart delay time. This delay time has to be equal or longer than time period needed to complete the shutdown process.

If the Backspin control function is active when the drive is supposed to do a restart (after the delay), drive does not start but it decelerates to zero speed first. The Backspin deceleration time 80.21 Backspin dec time defines the deceleration ramp. When the speed is zero, the drive starts and accelerates to the speed reference with the normal acceleration ramp (74.10 Acc time).

Note: If the deceleration time 80.21 Backspin dec time for the Backspin control is zero, drive uses the normal deceleration ramp 74.11 Dec time to reach the zero peed before the restart.

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 and diagnostics

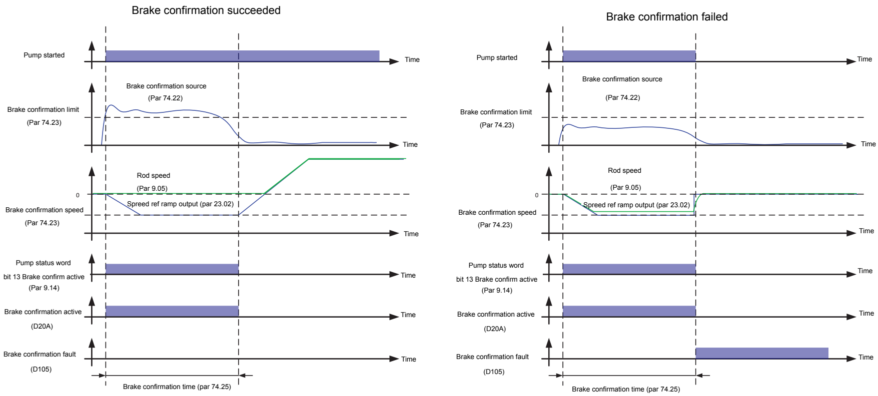
Parameters: 80.11 Restart delay enable (page 437), 80.12 Restart delay time (page 438) and 80.21 Backspin dec time (page 438).

Signals: 09.12 Start delay remain (page 173) and 09.13 Backspin status word (page 174) (bits 10 and 11).

Warnings: D20C Start delay active (page 561).

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 and diagnostics

Parameters: 74.21 Brake confirmation enable (page 419), 74.22 Brake confirmation source (page 419), 74.23 Brake confirmation limit (page 419), 74.24 Brake confirmation speed (page 419) and 74.25 Brake confirmation time (page 419).

Signals: 09.14 Pump status word (page 174) (Bit 13).

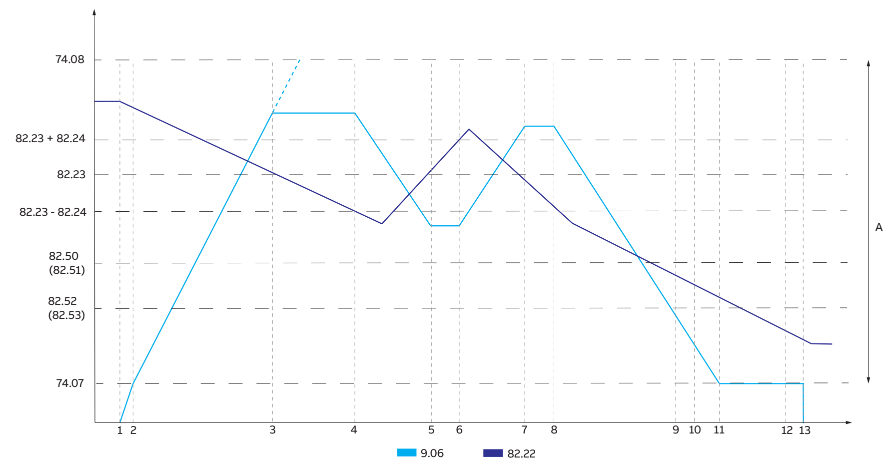
Warnings: D20A Brake confirmation active (page 561).

Faults: D105 Brake confirmation fault (page 559).

Well control

The well control function adjusts the motor speed using the real-time pressure level feedback. The function can maintain stable well pressure to prevent fluctuations and make sure optimal performance and reliability to increase the equipment's lifespan.

The function can be enabled with parameter 82.11.



A	The operating range for the well control function.
1-2	Pump accelerates or decelerates to a minimum rod speed (74.07) by ramping the acceleration time (74.10) or deceleration time (74.11).
2-3	Pump uses well control ramp times depending on the selections (82.31, 82.33 to 82.38).
3	The actual well pressure feedback signal (82.22) touches optimal well pressure (82.23).
3-4	Speed reference is maintained at a constant value when the actual well pressure feedback signal (82.22) is within the optimal well pressure (82.23) +/- hysteresis well pressure (82.24).
4-5	Speed reference is adjusted by well control ramp times when the actual well pressure feedback signal (82.22) is below the optimal well pressure (82.23) +/- hysteresis well pressure (82.24).
5	The actual well pressure feedback signal (82.22) touches optimal well pressure (82.23).

5-6	Speed reference is maintained at a constant value when the actual well pressure feedback signal (82.22) is within the optimal well pressure (82.23) +/- hysteresis well pressure (82.24).
6-7	Speed reference is adjusted by well control ramp times when the actual well pressure feedback signal (82.22) is above optimal well pressure (82.23) +/- hysteresis well pressure (82.24).
7	The actual well pressure feedback signal (82.22) touches optimal well pressure (82.23).
7-8	Speed reference is maintained at a constant value when the actual well pressure feedback signal (82.22) is within the optimal well pressure (82.23) +/- hysteresis well pressure (82.24).
8-11	Speed reference is adjusted by well control ramp times when the actual well pressure feedback signal (82.22) is below the optimal well pressure (82.23) +/- hysteresis well pressure (82.24).
11-13	Speed reference is limited by minimum rod speed (74.07).
9	The actual well pressure feedback signal (82.22) is above the well pressure warning level (82.50).
9-10	Well pressure warning delay (82.51).
10	Well pressure warning message is generated.
12	The actual well pressure feedback signal (82.22) is above the well pressure fault level (82.52).
12-13	Well pressure fault delay (82.53).
13	Drive trips to a fault due to low well pressure.

Settings and diagnostics

Parameters: 74.07 Minimum speed (page 417), 74.08 Maximum speed (page 418), 74.10 Acc time (page 418), 74.11 Dec time (page 418), 82.11 Well control enable (page 440), 82.22 Well pressure actual (page 441), 82.23 Well pressure optimal (page 441), 82.24 Well pressure hysteresis (page 441), 82.31 Cycle time (page 442), 82.33 Acceleration time 1 (page 442), 82.38 Deceleration time 2 (page 442), 82.50 Well pressure warning level (page 444), 82.51 Well pressure warning delay (page 444), 82.52 Well pressure fault level (page 444) and 82.53 Well pressure fault delay (page 444).

Well control logic

The well control function selects the system response based on the changes in the pressure signal with two different modes:

Direct reaction

The control logic maintains an optimal pressure by adjusting the pump speed reference. If the actual pressure feedback value is below 82.23 - 82.24, the control logic increases the pump speed reference. If the actual pressure feedback value is above 82.23 + 82.24, the control logic decreases the pump speed reference. If the pressure feedback value is above the optimal well pressure (82.23), the control logic maintains the pump speed reference at the same speed.

Inverted reaction

The control logic maintains optimal pressure by adjusting the pump speed reference. If the actual pressure feedback value is below the 82.23 - 82.24, the control logic decreases the pump speed reference. If the actual pressure feedback value is above 82.23 + 82.24, the control logic increases the pump speed reference. If the pressure feedback value is above the optimal well pressure (82.23), the control logic maintains the pump speed reference at the same speed.

Settings and diagnostics

Parameters: 82.23 Well pressure optimal, 82.24 Well pressure hysteresis and 82.25 Well control inverted logic.

Advanced options

Maintenance mode

The maintenance mode can be used to switch specific maintenance ramp times (82.41 to 82.42).

The maintenance mode can be enabled with parameter 82.40.

Process recovery

The process recovery function can be enabled by setting parameter 82.30 to Ramp set 2 at recovery mode. The function also sets a recovery period after a stop.

Selecting a new start command before the process recovery trigger time (82.46) has elapsed does not activate the command until the well pressure is inside the optimal well pressure range. The well control function uses Acceleration time 2 (82.37) or Deceleration time 2 (82.38) to bring the system to the optimal well pressure range. The new start command can be activated when the well pressure is within the optimal range.

Note: The recovery mode remains active if the speed reference limit is reached. The recovery mode disables automatically once the actual pressure feedback value is above the optimal well pressure value (82.23).

Settings and diagnostics

Parameters: 82.23 Well pressure optimal, 82.30 Ramp set selection, 82.37 Acceleration time 2, 82.38 Deceleration time 2, 82.40 Maintenance mode, 82.41 Maintenance acceleration, 82.42 Maintenance deceleration and 82.46 Process recovery trigger time.

Monitoring well pressure feedback

Well pressure warning and fault levels

Warning and fault levels can be set for the pressure feedback signals based on level and time delay conditions. The supervision is inactive when the drive is not modulating or stopped.

Note: Well pressure supervision is automatically disabled when the well pressure feedback lost condition is met (when the signal is not reliable).

Well pressure feedback lost

The well pressure feedback signal lost condition is determined with parameter 82.61.

A direct digital signal or a signal generated by a special function which can be configured to monitor specific conditions that indicate the loss of the well pressure feedback signal (82.61). See parameters 82.22 to 82.88.

Note: When the well pressure feedback signal is lost (82.61), the well control reference freezes (default selection by parameter 82.61).

Note: The well pressure warning and fault level supervision function deactivates if the well pressure feedback condition is lost.

Settings and diagnostics

Parameters: 77.11 Rod torq2 additive speed ref (page 430), 82.61 Well pressure feedback lost (page 444) and 82.80 Well pressure supervision status word (page 445).

Belt slip detection

The belt slip detection function is an optional feature that monitors a belt slip while the motor is running. The belt slip limit (84.22) can be set as a reference to identify the slip. When the speed difference (84.03) is equal to or above the belt slip limit (84.22) for a duration longer than the belt slip limit delay (84.23), the program identifies a belt slip. The response actions can be configured with parameter 84.21.

Note: The function can be disabled with parameter 84.21.

Settings and diagnostics

Parameter group: 84 Belt slip detection (page 447).

Parameters: 84.03 Speed difference (page 447), 84.21 Belt slip detection action (page 447), 84.22 Belt slip limit (page 447) and 84.23 Belt slip limit delay (page 447).

Events: D210 Belt slipping and D110 Belt slipping.

5

Control locations and Operating modes

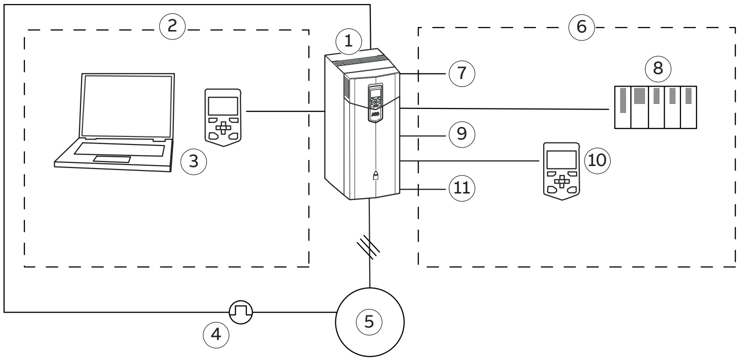
What this chapter contains

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

WARNING! WARNING!
Make sure that the machinery into which the drive is integrated fulfills the personnel safety regulations. Note that the frequency converter (a Complete Drive Module or a Basic Drive Module, as defined in IEC 61800-2), is not considered as a safety device mentioned in the European Machinery Directive and related harmonized standards. Thus, the personnel safety of the complete machinery must not be based on a specific frequency converter feature, but it has to be implemented as defined in the application specific regulations.

Local control vs. external control

The ACS880 has two main control locations: external and local. The control location is selected with the Loc/Rem key on the control panel or in the PC tool.



1) ACS880[1]	
2) Local control	7) I/O[2]
3) Control panel or Drive Composer PC tool (optional)	8) PLC
4) Encoder	9) Fieldbus adapter (Fxxx) or DDCS communication module
5) M 3~	10) Control panel
6) External control	11) Embedded fieldbus interface (EFB) or master/follower link

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

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

Local control

The control commands are given from the control panel keypad or from a PC equipped with Drive Composer when the drive is set to local control. Speed and torque control modes are available for local control; frequency mode is available when scalar motor control mode is used (see parameter 19.16).

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.

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

External control

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

- the I/O terminals (digital and analog inputs), or optional I/O extension modules
- the embedded fieldbus interface or an optional fieldbus adapter module
- the external (DDCS) controller interface
- the master/follower link, and/or
- the control panel.

Two external control locations, EXT1 and EXT2, are available. The user can select the sources of the start and stop commands separately for each location by parameters 20.01…20.10. The operating mode can be selected separately for each location (in parameter group 19) which enables quick switching between different operating modes, for example speed and torque control. Selection between EXT1 and EXT2 is done via any binary source such as a digital input or fieldbus control word (see parameter 19.11). The source of reference is selectable for each operating mode separately.

The control location selection is checked on a 2 ms time level.

Using the control panel as an external control source

The control panel can also be used as a source of start/stop commands and/or reference in external control. Selections for the control panel are available in the start/stop command source and reference source selection parameters.

Reference source selection parameters (except PID setpoint selectors) have two selections for the control panel. The difference between the two selections is in the initial reference value after the reference source switches to the control panel.

Operating modes of the drive

The drive can operate in several operating modes with different types of reference. The mode is selectable for each control location (Local, EXT1 and EXT2) in parameter group 19.

For detailed diagrams, see chapter Control chain diagrams.

Speed control mode

The motor follows a speed reference given to the drive. This mode can be used either with estimated speed 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 in scalar motor control mode.

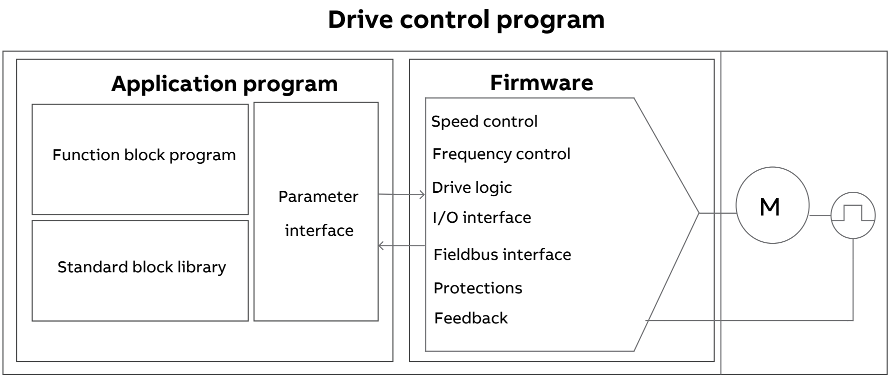
6

Standard program features

Drive configuration and programming

The drive control program is divided into two parts:

- firmware program
- application program



The firmware program performs the main control functions, including speed and torque 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 via parameters

Parameters configure all of the 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 start-up and maintenance PC tool 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 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.

Adaptive programming

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

The Drive Composer PC tool has an Adaptive programming feature with a graphical user interface for building the custom program. The function blocks include the usual arithmetic and logical functions, as well as eg. selection, comparison and timer blocks. The program can contain a maximum of 20 blocks. The adaptive program is executed on a 10 ms time level.

For selecting input to the program, the user interface has pre-selections for the physical inputs, common actual values, and other status information of the drive. Parameter values as well as constants can also be defined as inputs. The output of the program can be used eg. as a start signal, external event or reference, or connected to the drive outputs. Note that connecting the output of the adaptive program to a selection parameter will write-protect the parameter.

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

Please note that sequential programming is not supported.

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

Settings and diagnostics

Parameters: 07.30 Adaptive program status (page 171) and 96.70 Disable adaptive program (page 496).

Events: 64A6 Adaptive program (page 531).

Application programming

The functions of the firmware program can be extended with application programming. Application programmability is available as option +N8010.

Application programs can be built out of 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 analog inputs on the control unit are read on a 0.5 ms time level.

The number of analog inputs can be increased by installing FIO-11 or FAIO-01 I/O extensions (see Programmable I/O extensions below). The analog inputs on extension modules are read on a 2 ms time level.

The drive can be set to perform an action (for example, to generate a warning or fault) if the value of an analog input moves out of a predefined range.

Settings and diagnostics

Parameter group: 12 Standard AI (page 194).

Events: 80A0 AI Supervision (page 538) and A8A0 AI Supervised Warning (page 555).

Programmable analog outputs

The control unit has two current (0…20 mA) analog outputs. Each output can be filtered, inverted and scaled.

The analog outputs on the control unit are updated on a 0.5 ms time level.

The number of analog outputs can be increased by installing FIO-11 or FAIO-01 I/O extensions (see Programmable I/O extensions below). The analog outputs on extension modules are updated on a 2 ms time level.

The number of analog outputs can be increased by installing FIO-11 or FAIO-01 I/O extensions (see Programmable I/O extensions below). The analog outputs on extension modules are updated on a 2 ms time level.

Settings and diagnostics

Parameter group: 13 Standard AO (page 200).

Programmable digital inputs and outputs

The control unit has six digital inputs, a digital start interlock input, and two digital input/outputs (I/O that can be set as either an input or an output). The digital inputs on the control unit are read on a 0.5 ms time level.

One digital input (DI6) doubles as a PTC thermistor input. See section Motor thermal protection (page 106).

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

The number of digital inputs/outputs can be increased by installing FIO-01, FIO-11 or FDIO-01 I/O extensions (see Programmable I/O extensions below). The digital inputs on extension modules are read on a 2 ms time level.

Settings and diagnostics

Parameter groups: 10 Standard DI, RO (page 178) and 11 Standard DIO, FI, FO (page 187).

Programmable relay outputs

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

The relay outputs on the control unit are updated on a 0.5 ms time level.

Relay outputs can be added by installing FIO-01 or FDIO-01 I/O extensions. The relay outputs on extension modules are updated on a 2 ms time level.

Settings and diagnostics

Parameter groups: 10 Standard DI, RO (page 178).

Programmable I/O extensions

Inputs and outputs can be added by using I/O extension modules. One to three modules can be mounted on the slots of the control unit. Slots can be added by connecting an FEA-03 I/O extension adapter.

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

Location	Digital inputs (DI)	Digital I/Os (DIO)	Analog inputs (AI)	Analog outputs (AO)	Relay outputs (RO)
Control unit	6 + DIIL	2	2	2	3
FIO-01	-	4	-	-	2
FIO-11	-	2	3	1	-
FAIO-01	-	-	2	2	-
FDIO-01	3	-	-	-	2

Three I/O extension modules can be 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 and diagnostics

Parameter groups: 14 I/O extension module 1 (page 206), 15 I/O extension module 2 (page 233) and 16 I/O extension module 3 (page 233).

Events: 7082 Ext I/O comm loss (page 534) and A799 ExtIO comm loss (page 549).

Fieldbus control

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

Settings and diagnostics

Parameter groups: 50 Fieldbus adapter (FBA) (page 388), 51 FBA A settings (page 398), 52 FBA A data in (page 400), 53 FBA A data out (page 401), 54 FBA B settings (page 402), 55 FBA B data in (page 404), 56 FBA B data out (page 405) and 58 Embedded fieldbus (page 406).

Events: 7510 FBA A communication (page 537), 7520 FBA B communication (page 537), A7C1 FBA A communication (page 552), A7C2 FBA B communication (page 552) and A7CE EFB comm loss (page 552).

Motor control

Direct torque control (DTC)

The motor control of the ACS880 is based on direct torque control (DTC), the ABB premium motor control platform. The switching of the output semiconductors is controlled to achieve the required stator flux and motor torque. The reference value for the torque controller comes from the speed controller , DC voltage controller or directly from an external torque reference source.

Motor control requires measurement of the 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 the motor control.

The main difference between traditional control and DTC is that torque control operates on the same time level as the power switch control. There is no separate voltage and frequency controlled PWM modulator; the output stage switching is wholly 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 92).

Settings and diagnostics

Parameters: 99.04 Motor control mode (page 507) and 99.13 ID run requested (page 510).

Reference ramping

Acceleration and deceleration ramping times can be set individually for speed, frequency and torque 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 or 46.02. The user can switch between two preset ramp sets using a binary source such as a digital input. For speed reference, also the shape of the ramp can be controlled.

With a torque reference, the ramps are defined as the time it takes for the reference to change between zero and nominal motor torque (parameter 01.30).

Special acceleration/deceleration ramps

The acceleration/deceleration times for the jogging function can be defined separately; see section Jogging (page 89).

The change rate of the motor potentiometer function (page 101) is adjustable. The same rate applies in both directions.

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

Settings and diagnostics

Parameters:

- Speed reference ramping: 23.11 Ramp set selection…23.19 Shape time dec 2 and 46.01 Speed scaling (page 375).
- Frequency reference ramping: 28.71 Freq ramp set selection…28.75 Freq deceleration time 2 and 46.02 Frequency scaling (page 375).
- Jogging: 23.20 Acc time jogging (page 270) and 23.21 Dec time jogging (page 270).
- Motor potentiometer: 22.75 Motor potentiometer ramp time (page 264).
- Emergency stop (“Off3” mode): 23.23 Emergency stop time (page 270).

Constant speeds/frequencies

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

WARNING!
Constant speeds and frequencies override the normal reference irrespective of where the reference is coming from.

The constant speeds/frequencies function operates on a 2 ms time level.

Settings and diagnostics

Parameter groups: 22 Speed reference selection (page 259) and 28 Frequency reference chain (page 297).

Critical speeds/frequencies

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

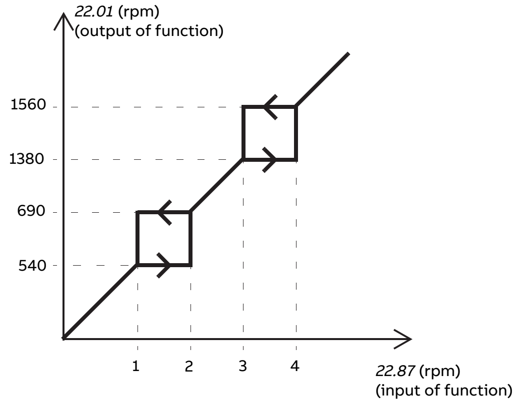
The critical speeds function prevents the reference from dwelling within a critical band for extended times. When a changing reference (22.87) enters a critical range, the output of the function (22.01) freezes until the reference exits the range. Any instant change in the output is smoothed out by the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

The function is also available for scalar motor control with a frequency reference. The input of the function is shown by parameter 28.96 Frequency ref act 7, the output by parameter 28.97 Frequency ref unlimited.

Example

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

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



1	Parameter 22.52 = 540 rpm
2	Parameter 22.53 = 690 rpm
3	Parameter 22.54 = 1380 rpm
4	Parameter 22.55 = 1560 rpm

Settings and diagnostics

Parameters:

- Critical speeds: 22.51 Critical speed function…22.57 Critical speed 3 high (page 263)
- Critical frequencies: 28.51 Critical frequency function…28.57 Critical frequency 3 high.

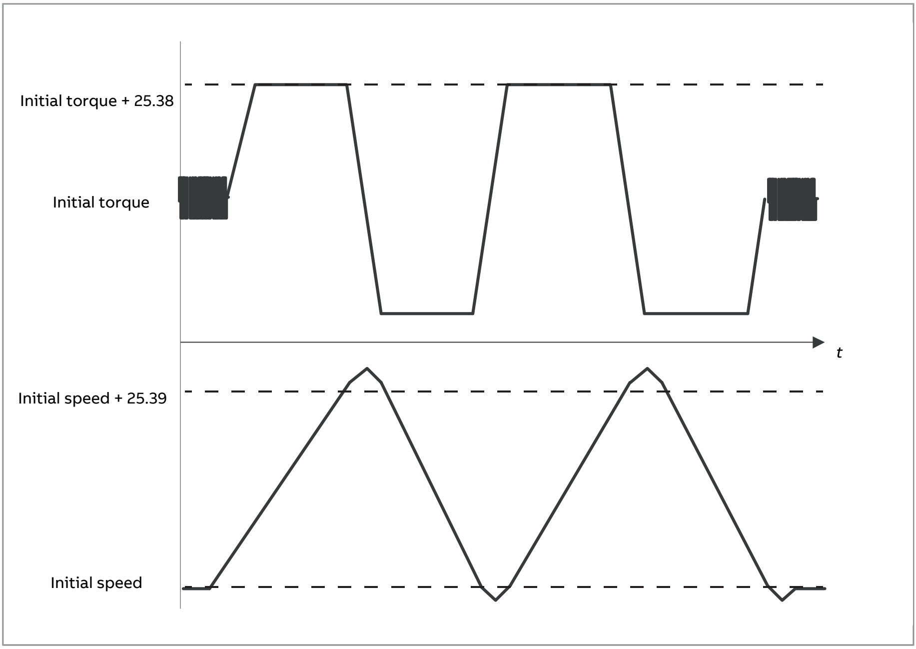
Speed controller autotune

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. 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, unless limited by the maximum torque limit (parameter group 30 Limits) or the nominal motor torque (parameter group 99 Motor data). The calculated maximum speed during the routine is the initial speed (ie. speed when the routine is activated) + 25.39, unless limited by parameter 30.12 or 99.09.

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



Note:

- 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:

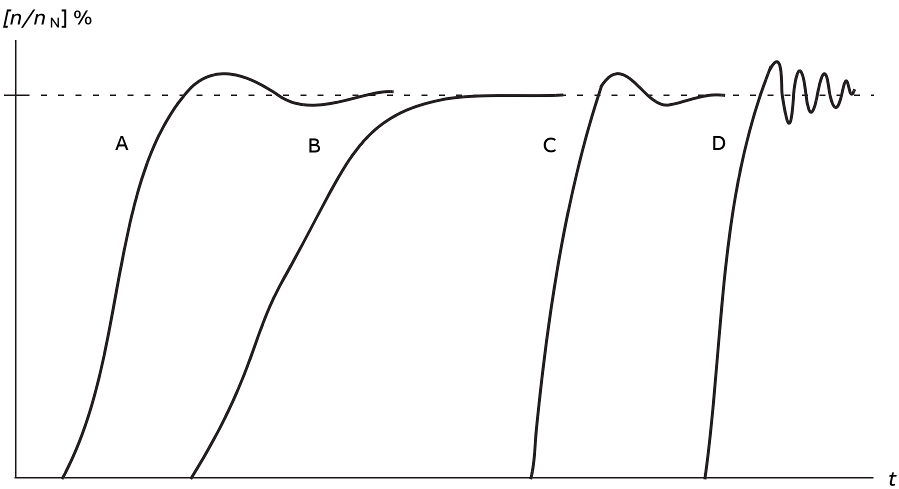
- The motor identification run (ID run) has been successfully completed
- Speed and torque limits (parameter group 30 Limits) have been set
- The speed feedback has been monitored for noise, vibrations and other disturbances caused by the mechanics of the system, and
  - speed feedback filtering (parameter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

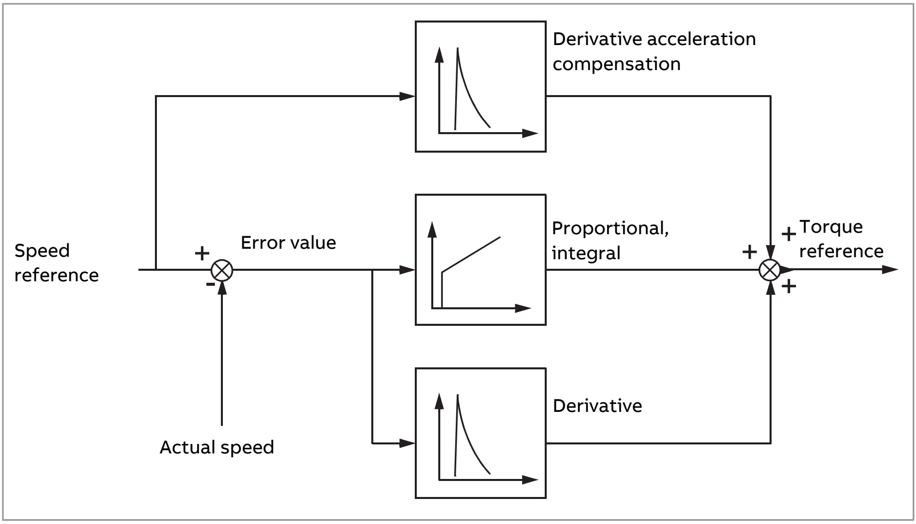
At the end of a successful autotune routine, its results are automatically transferred into parameters

- 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 will be generated if the autotune routine does not complete successfully.

For further information, see chapter Fault tracing.

Settings and diagnostics

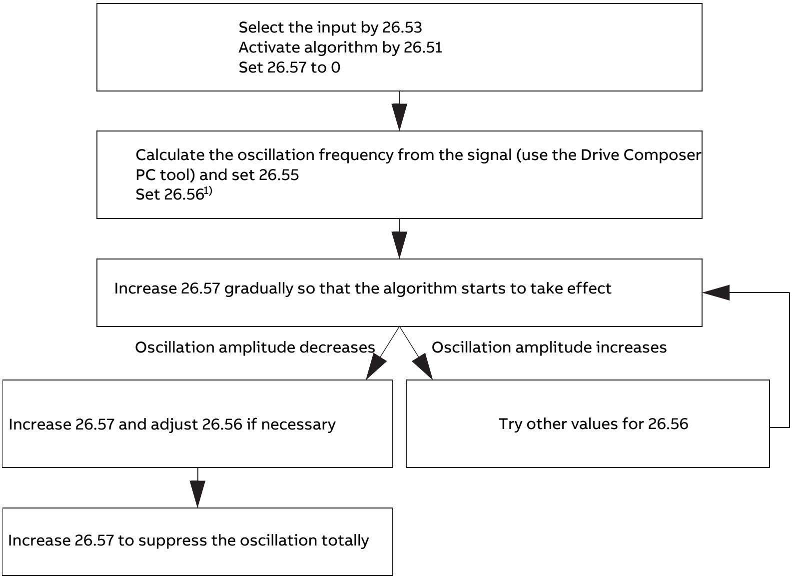
Parameters: 25.33 Speed controller autotune (page 289)…25.40 Autotune repeat times (page 290).

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.

Tuning procedure for oscillation damping



[1)]If the phasing of a DC oscillation cannot be determined by measuring, the value of 0 degrees is usually a suitable initial value.

Note: Changing the speed error low-pass filter time constant or the integration time of the speed controller can affect the tuning of the oscillation damping algorithm. It is recommended to tune the speed controller before the oscillation damping algorithm. (The speed controller gain can be adjusted after the tuning of this algorithm.)

Settings and diagnostics

Parameters: 26.51 Oscillation damping (page 294)…26.58 Oscillation damping output (page 296).

Resonance frequency elimination

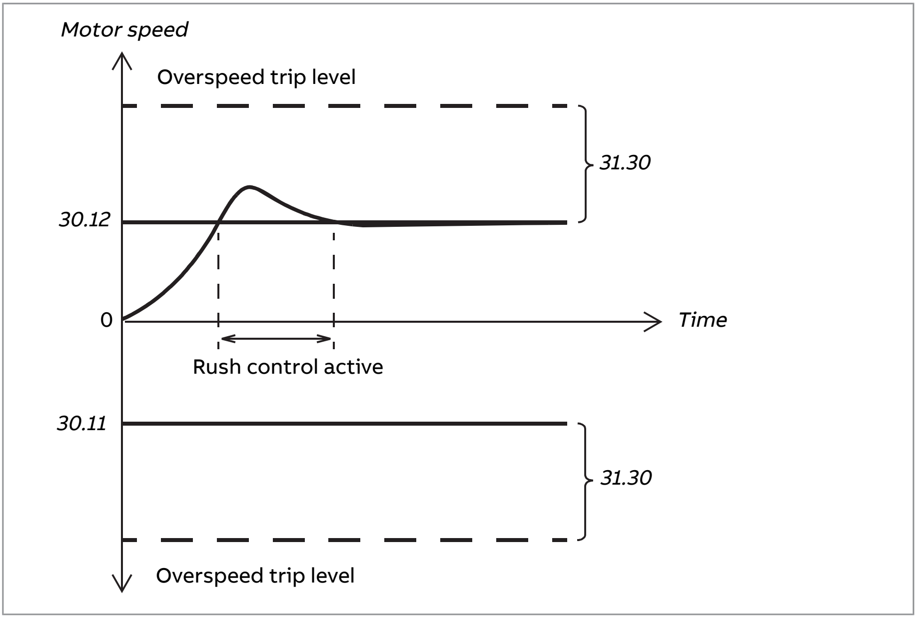
The control program contains a notch filter function for removing the resonance frequencies from the speed error signal.

Settings and diagnostics

Parameters: 24.13 RFE speed filter (page 275)…24.17 Damping of pole (page 277).

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 (90.01) exceeds parameter 30.11 or 30.12.



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 and diagnostics

Parameter groups: 30 Limits (page 307), 31 Fault functions (page 316) and 90 Feedback selection (page 450).

Parameters: 26.81 Rush control gain (page 296) and 26.82 Rush control integration time (page 296).

Encoder support

The program supports two single-turn or multiturn 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

- Absolute encoder interface FEN-11: absolute encoder input, TTL input, TTL output (for encoder emulation and echo) and two digital inputs
- Resolver interface FEN-21: resolver input, TTL input, TTL output (for encoder emulation and echo) and two digital inputs
- HTL encoder interface FEN-31: HTL encoder input, TTL output (for encoder emulation and echo) and two digital inputs
- HTL/TTL encoder interface FSE-31 (for use with an FSO-xx safety functions module): Two HTL/TTL encoder inputs (one HTL input supported at the time of publication).

The interface module is to be installed onto one of the option slots on the drive control unit. The module (except the FSE-31) can also be installed onto an FEA-03 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.

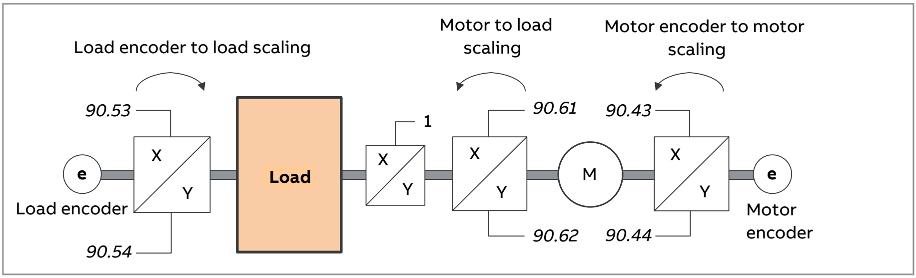
Encoder emulation also relays the encoder signal to the output, but the signal is either scaled, or position data converted to pulses. Emulation can be used when absolute encoder or resolver position needs to be converted to TTL pulses, or when the signal must be converted to a different pulse number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

Load and motor feedback

Three different sources can be used as speed and position feedback: encoder 1, encoder 2, or motor position estimate. Any of these can be used for load position calculation or motor control. The load position calculation makes it possible, for example, to determine the position of a conveyor belt or the height of the load on a crane. The feedback sources are selected by parameters 90.41 and 90.51.

For detailed parameter connections of the motor and load feedback functions, see the block diagrams on pages 618 and 619. For more information on load position calculation, see section Position counter (page 84).

Any mechanical gear ratios between the components (motor, motor encoder, load, load encoder) are specified using the gear parameters shown in the diagram below.



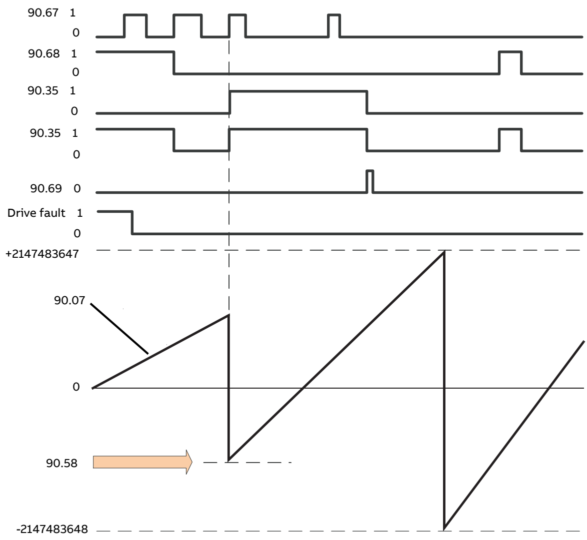
Any gear ratio between the load encoder and the load is defined by 90.53 and 90.54. Similarly, any gear ratio between the motor encoder and the motor is defined by 90.43 and 90.44. In case the internal estimated position is chosen as load feedback, the gear ratio between the motor and load can be defined by 90.61 and 90.62. By default, all of the ratios mentioned above are 1:1. The ratios can only be changed with the drive stopped; new settings require validation by 91.10.

Position counter

The control program contains a position counter feature that can be used to indicate the position of the load. The output of the counter function, parameter 90.07, indicates the scaled number of revolutions read from the selected source (see section Load and motor feedback (page 83)).

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 and 90.64. This gear function can be changed without the need of a parameter refresh or position counter reinitialization – however, the counter output is only updated after new position input data is received.

For detailed parameter connections of the load feedback function, see the block diagram on page 619.



90.67	(Proximity switch) Source set by 90.67
90.68	(Initialization inhibit) Source set by 90.68
90.35	90.35 bit 4, Pos counter init ready
90.35	90.35 bit 5, Position counter re-init disabled
90.69	(Re-init request), Source set by 90.69
90.59	(Initial value) Source set by 90.59. (by default, 90.58)

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), or taken from another parameter. This position is set as the value of the position counter (90.07) when the source selected by 90.67, such as a proximity switch connected to a digital input, is activated. A successful initialization is indicated by bit 4 of 90.35.

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

Encoder error handling

When an encoder is used for load feedback, the action taken in case of an encoder error is specified by 90.55. If the parameter is set to Warning, the calculation will continue smoothly using estimated motor position. If the encoder recovers from the error, the calculation will smoothly switch back to encoder feedback. The load position signals (90.04, 90.05 and 90.07) will continue to be updated all the time, but bit 6 of 90.35 will be set to indicate potentially inaccurate position data. In addition, bit 4 of 90.35 will be cleared upon the next stop as a recommendation to reinitialize the position counter.

Parameter 90.60 defines whether position calculation resumes from the previous value over an encoder error or control unit reboot. By default, bit 4 of 90.35 is cleared after an error, indicating that reinitialization is needed. With 90.60 set to Continue from previous value, the position values are retained over an error or reboot; bit 6 of 90.35 is set however to indicate that an error occurred.

Note: With a multiturn absolute encoder, bit 6 of 90.35 is cleared at the next stop of the drive if the encoder has recovered from the error; bit 4 is not cleared. The status of the position counter is retained over a control unit reboot, after which position calculation resumes from the absolute position given by the encoder, taking into account the initial position specified by 90.58.

WARNING!
If the drive is in stopped state when an encoder error occurs, or if the drive is not powered, parameters 90.04, 90.05, 90.07 and 90.35 are not updated because no movement of the load can be detected. When using previous position values (90.60 is set to Continue from previous value), be aware that the position data is unreliable if the load is able to move.

Reading/writing position counter values through fieldbus

The parameters of the position counter function, such as 90.07 and 90.58, 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 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.

Configuration of HTL encoder motor feedback

1. Specify the type of the encoder interface module (parameter 91.11 = FEN-31) and the slot the module is installed into (91.12).
2. Specify the type of the encoder (92.01 = HTL). The parameter listing will be re-read from the drive after the value is changed.
3. Specify the interface module that the encoder is connected to (92.02 = Module 1).
4. Set the number of pulses according to encoder nameplate (92.10).

5. If the encoder rotates at a different speed to the motor (ie. is not mounted directly on the motor shaft), enter the gear ratio in 90.43 and 90.44.
6. Set parameter 91.10 to Refresh to apply the new parameter settings. The parameter will automatically revert to Done.
7. Check that 91.02 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 of eg. 400 rpm.
9. Compare the estimated speed (01.02) with the measured speed (01.04). If the values are the same, set the encoder as the feedback source (90.41 = Encoder 1).
10. Specify the action taken in case the feedback signal is lost (90.45).

Example 1: Using the same encoder for both load and motor feedback

The drive controls a motor used for lifting a load in a crane. An encoder attached to the motor shaft is used as feedback for motor control. The same encoder is also used for calculating the height of the load in the desired unit. A gear exists between the motor shaft and the cable drum. The encoder is configured as Encoder 1 as shown in Configuration of HTL encoder motor feedback above. In addition, the following settings are made:

- 90.43 = 1
- 90.44 = 1
  (No gear is needed as the encoder is mounted directly on the motor shaft.)
- 90.51 = Encoder 1
- 90.53 = 1
- 90.54 = 50
  The cable drum turns one revolution per 50 revolutions of the motor shaft.
- 90.61 = 1
- 90.62 = 1
  (These parameters need not be changed as position estimate is not being used for feedback.)
- 90.63 = 7
- 90.64 = 10
  The load moves 70 centimeters, ie. 7/10 of a meter, per one revolution of the cable drum.

The load height in meters can be read from 90.07, while 90.03 displays the rotational speed of the cable drum.

Example 2: Using two encoders

One encoder (encoder 1) is used for motor feedback. The encoder is connected to the motor shaft through a gear. Another encoder (encoder 2) measures the line speed elsewhere in the machine. Each encoder is configured as shown in Configuration of HTL encoder motor feedback above. In addition, the following settings are made:

- 90.41 = Encoder 1
- 90.43 = 1
- 90.44 = 3
  The encoder turns three revolutions per one revolution of the motor shaft.
- 90.51 = Encoder 2

The line speed measured by encoder 2 can be read from 90.03. This value is given in rpm which can be converted into another unit by using 90.53 and 90.54. Note that the feed constant gear cannot be used in this conversion because it does not affect 90.03.

Example 3: ACS 600 / ACS800 compatibility

With ACS 600 and ACS800 drives, both the rising and falling edges from encoder channels A and B are typically counted to achieve best possible accuracy. Thus the received pulse number per revolution equals four times the nominal pulse number of the encoder.

In this example, an HTL-type 2048-pulse encoder is fitted directly on the motor shaft. The desired initial position to correspond the proximity switch is 66770.

In the ACS880, the following settings are made:

- 92.01 = HTL
- 92.02 = Module 1
- 92.10 = 2048
- 92.13 = Enable
- 90.51 = Encoder 1
- 90.63 = 8192 (ie. 4 × value of 92.10, as the received number of pulses is 4 times nominal. See also parameter 92.12)
- The desired “data out” parameter is set to Other – 90.58 (32-bit format). Only the high word needs to be specified – the subsequent data word is reserved for the low word automatically.
- The desired sources (such as digital inputs or user bits of the control word) are selected in 90.67 and 90.69.

In the PLC, if the initial value is set in 32-bit format using low and high words (corresponding to ACS800 parameters POS COUNT INIT LO and POS COUNT INIT HI), enter the value 66770 into these words as follows:

- **Eg. PROFIBUS:**
  - FBA data out x = POS COUNT INIT HI = 1 (as bit 16 equals 65536)
  - FBA data out (x + 1) = POS COUNT INIT LO = 1234.
- ABB Automation using DDCS communication, eg.:
  - Data set 12.1 = POS COUNT INIT HI
  - Data set 12.2 = POS COUNT INIT LO

To test the configuration of the PLC, initialize the position counter with the encoder connected. The initial value sent from the PLC should immediately be reflected by 90.07 in the drive. The same value should then appear in the PLC after having been read from the drive.

Settings and diagnostics

Parameter groups 90 Feedback selection (page 450), 91 Encoder module settings (page 462), 92 Encoder 1 configuration (page 466) and 93 Encoder 2 configuration (page 474).

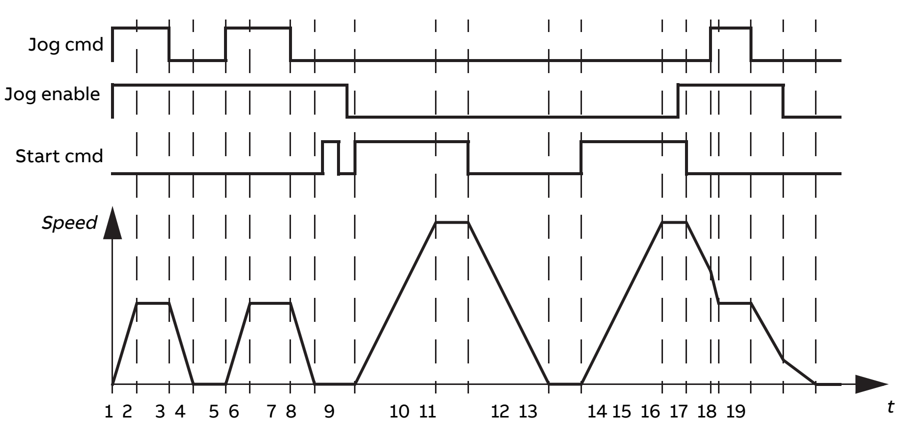
Jogging

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 and 20.27. When jogging is activated, the drive starts and accelerates to the defined jogging speed (22.42 or 22.43) along the defined jogging acceleration ramp (23.20). After the activation signal switches off, the drive decelerates to a stop along the defined jogging deceleration ramp (23.21).

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).

- Jog cmd = State of source set by parameter 20.26 or 20.27
- Jog enable = State of source set by parameter 20.25
- Start cmd = State of drive start command.



Phase	Jog cmd	Jog en-able	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.
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 along the deceleration ramp of the jogging function.
18-19	0	0	0	Drive decelerates to zero speed along the selected deceleration ramp (parameters 23.11

See also the block diagram on page 617.

The jogging function operates on a 2 ms time level.

Note:

- 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 parameter 06.01, bits 8…9) use the references and ramp times defined for jogging, but do not require the jog enable signal.

Settings and diagnostics

Parameters: 20.25 Jogging enable (page 247), 20.26 Jogging 1 start source (page 247), 20.27 Jogging 2 start source (page 248), 22.42 Jogging 1 ref (page 262), 22.43 Jogging

2 ref (page 262), 23.20 Acc time jogging (page 270) and 23.21 Dec time jogging (page 270).

Scalar motor control

It is possible to select scalar control as the motor control method 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

- 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, or
- in multimotor drives, if
  - the load is not equally shared between the motors,
  - the motors are of different sizes, or
  - the motors are going to be changed after motor identification (ID run)

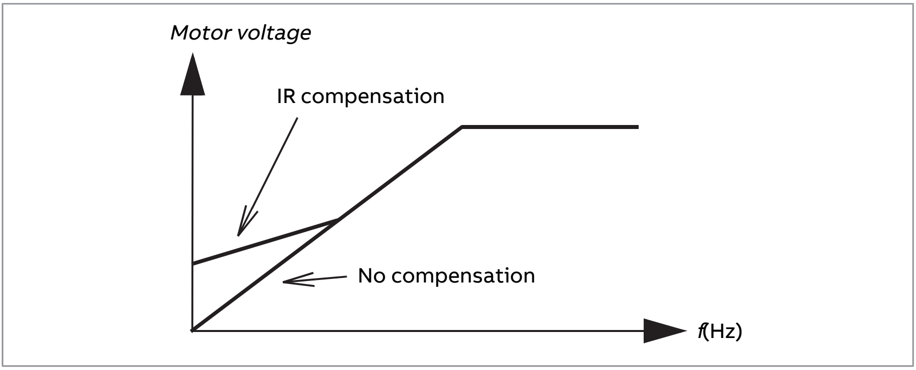
In scalar control, some standard features are not available.

See also section Operating modes of the drive (page 67).

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 breakaway 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 and diagnostics

Parameters: 19.20 Scalar control reference unit (page 235), 97.12 IR comp step-up frequency (page 501), 97.13 IR compensation (page 502) and 99.04 Motor control mode (page 507).

Parameter group: 28 Frequency reference chain (page 297).

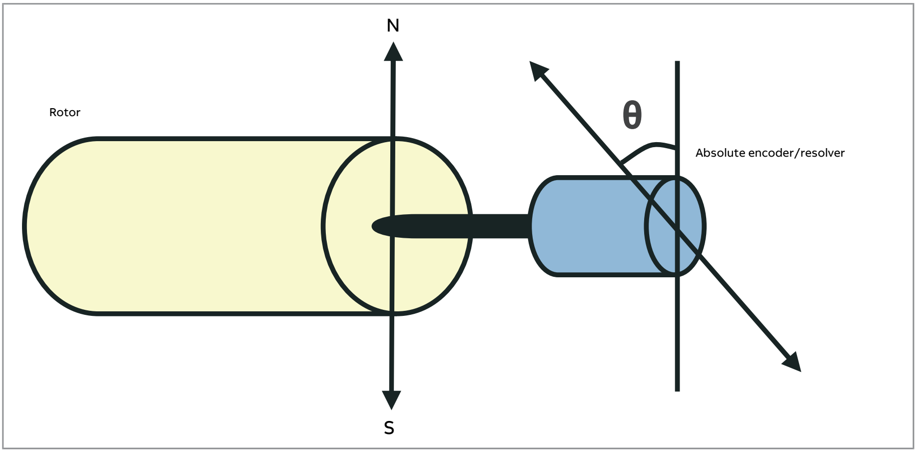
Autophasing

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 in order to control motor torque accurately.

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 has been 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. Hall sensors generate so-called commutation pulses that change their state six times during one revolution, so it is only known within which 60° sector of a complete revolution the initial position is.

Many encoders give a zero pulse (also called Z-pulse) once during each rotation. The position of the zero pulse is fixed. If this position is known with respect to zero position used by motor control, the rotor position at the instant of the zero pulse is also known.

Using the zero pulse improves the robustness of the rotor position measurement. The rotor position must be determined during starting because the initial value given by the encoder is zero. The autophasing routine determines the position, but there is a risk of some position error. If the zero pulse position is known in advance, the position found by autophasing can be corrected as soon as the zero pulse is detected for the first time after starting.



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 signals 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.

In open-loop control, the zero angle of the rotor is determined before starting. In closed-loop control, the actual angle of the rotor is determined with autophasing when the sensor indicates zero angle. The offset of the angle must be determined because the actual zero angles of the sensor and the rotor do not usually match. The autophasing mode determines how this operation is done both in open-loop and closed-loop control.

The rotor position offset used in motor control can also be given by the user – see parameter 98.15. 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.

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

Bit 4 of 06.21 indicates if the rotor position has already been determined

Autophasing modes

Several autophasing modes are available (see parameter 21.13).

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, 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 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.

An autophasing fault (3385) 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
- The motor is already turning before the autophasing routine is started
- Turning mode is selected in 21.13 but the motor shaft is locked
- Turning with Z-pulse mode is selected in 21.13 but no zero pulse is detected within a revolution of the motor
- The wrong motor type is selected in 99.03
- Motor ID run has failed.

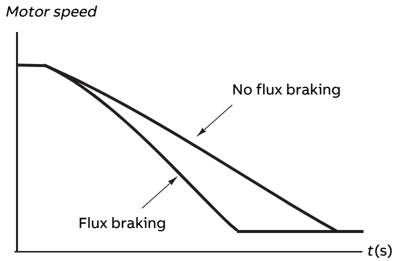
Settings and diagnostics

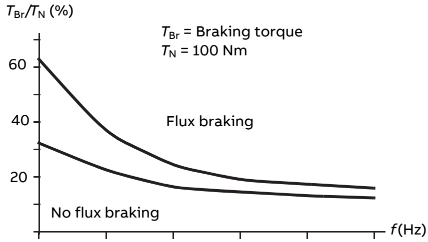
Parameters: 06.21 Drive status word 3 (page 162), 21.13 Autophasing mode (page 255), 98.15 Position offset user (page 506) and 99.13 ID run requested (page 510).

Flux braking

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

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





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

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

Two braking power levels are available:

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

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

Settings and diagnostics

Parameter: 97.05 Flux braking (page 499).

DC magnetization

DC magnetization can be applied to the motor to

- heat the motor to remove or prevent condensation, or
- to lock the rotor at, or near, zero speed.

Pre-heating

A motor pre-heating function is available to prevent condensation in a stopped motor, or to remove condensation from the motor before start. Pre-heating involves feeding a DC current into the motor to heat up the windings.

Pre-heating is deactivated at start, or when one of the other DC magnetization functions is activated. With the drive stopped, pre-heating is disabled by the safe torque off function, a drive fault state, or the process PID sleep function. Pre-heating can only start after one minute has elapsed from stopping the drive.

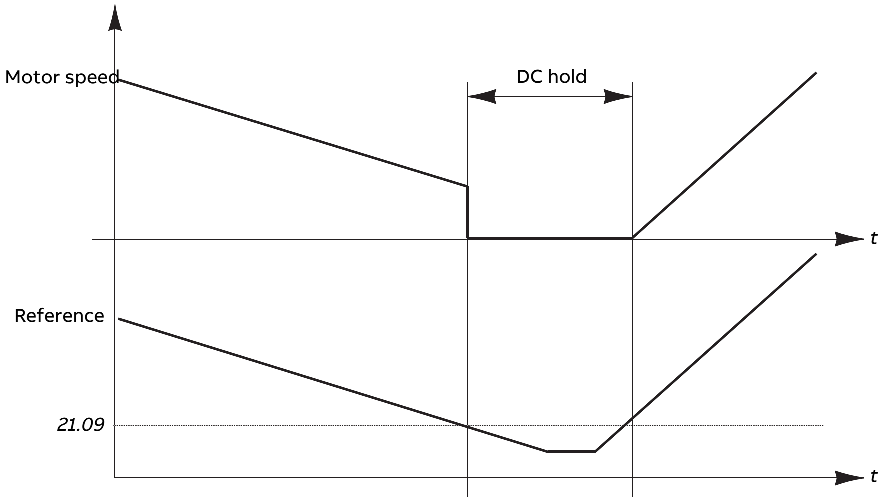
A digital source to control pre-heating is selected by parameter 21.14. The heating current is set by 21.16.

Pre-magnetization

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

DC hold

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



Note:

- DC hold is only available in speed control in DTC motor control mode (see page 67).
- 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) after stopping. This is to prevent the machinery from moving under load, for example before a mechanical brake can be applied. Postmagnetization is activated by parameter 21.08. The magnetization current and time are set by parameters 21.10 and 21.11.

Note: Post-magnetization is only available in speed control in DTC motor control mode (see page 67), and only when ramping is the selected stop mode (see parameter 21.03).

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 56), 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 and diagnostics

Parameters: 06.21 Drive status word 3 (page 162), 21.01 Start mode (page 249), 21.02 Magnetization time (page 250), 21.08 DC current control…21.12 Continuous magnetization command (page 255), 21.14 Pre-heating input source (page 256) and 21.16 Pre-heating current (page 256).

Motor temperature estimation

The Motor temperature estimation function identifies the stator resistance and estimates the initial temperature of the motor. The estimated temperature of the motor can be used when the ambient temperature drops below zero celsius.

The temperature is estimated by feeding a DC current (25% of the motor nominal current) into the motor for a time period of 4 seconds (default). The function uses the resistance value at room temperature obtained during an ID run.

The function can be activated with parameter 21.37. The estimation time can be defined with parameter 21.38. The function can be activated using either of the two ways: With Drive start command or at Drive power-up (after control board boot).

Settings and diagnostics

Parameters: 21.37 Motor temperature estimation (page 258) and 21.38 Motor temperature estimation time (page 258).

Hexagonal motor flux pattern

Note: This feature is only available in scalar motor control mode (see page 67).

Typically, the drive controls the motor flux so that the rotating flux vector follows a circular pattern. This is ideal for most applications. However, when operating above the field weakening point (FWP), it is not possible to reach 100% of the output voltage. This reduces the peak load capacity of the drive.

Using a hexagonal motor flux vector pattern, the maximum output voltage can be reached above the field weakening point. This increases the peak load capacity compared to the circular pattern, but the continuous load capacity in the range of FWP … 1.6 × FWP is reduced because of increasing losses. With hexagonal motor flux active, the pattern changes from circular to hexagonal gradually as the frequency rises from 100% to 120% of the FWP.

Settings and diagnostics

Parameters: 97.18 Hexagonal field weakening (page 502) and 97.19 Hexagonal field weakening point (page 503).

Application control

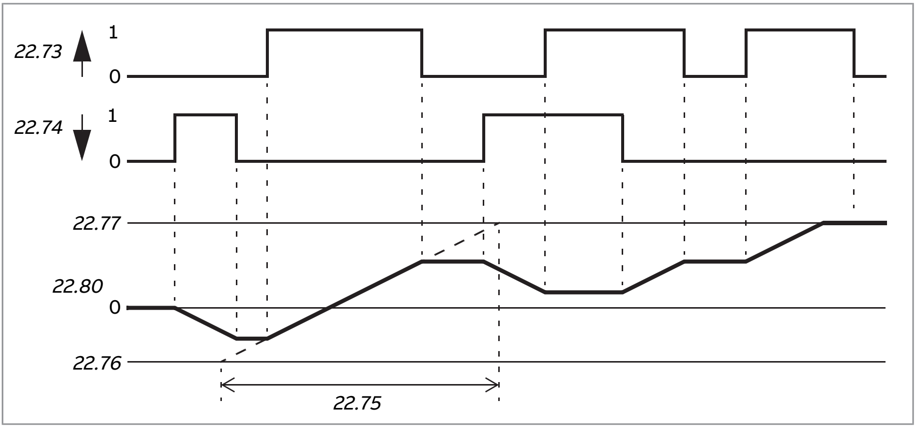
Motor potentiometer

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 and 22.74. Note that these signals have no effect when the drive is stopped.

When enabled by 22.71, the motor potentiometer assumes the value set by 22.72. 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 as the time it would take for the value to change from the minimum (22.76) to the maximum (22.77) or vice versa. If the up and down signals are simultaneously on, the motor potentiometer value does not change.

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



Settings and diagnostics

Parameters 22.71 Motor potentiometer function (page 263)…22.80 Motor potentiometer ref act (page 265).

DC voltage control

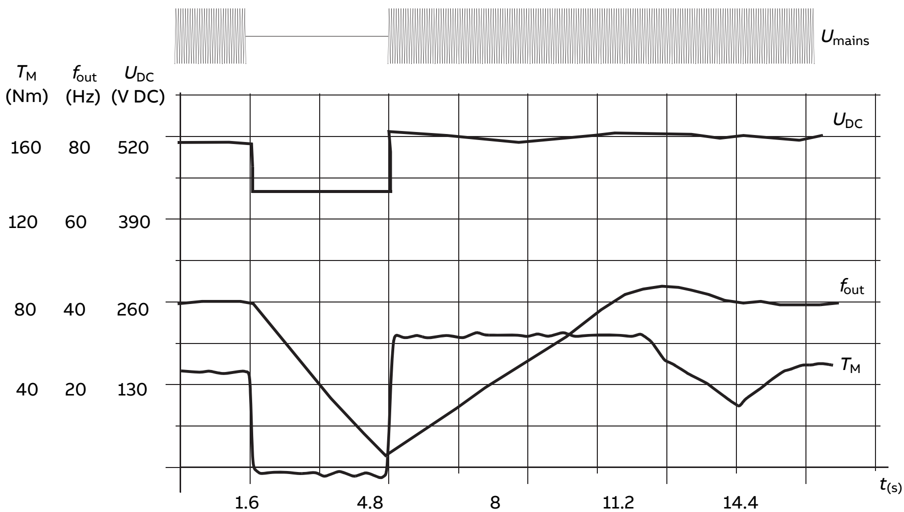
Overvoltage control

Overvoltage control of the intermediate DC link is typically needed when the motor is in generating mode. The motor can generate when it decelerates or when the load overhauls the motor shaft, causing the shaft to turn faster than the applied speed or frequency. To prevent the DC voltage from exceeding the overvoltage control limit, the overvoltage controller automatically decreases the generating torque when the limit is reached. The overvoltage controller also increases any programmed deceleration times if the limit is reached; to achieve shorter deceleration times, a brake chopper and resistor may be required.

Undervoltage control (power loss ride-through)

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

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



U_{DC}= intermediate circuit voltage of the drive, f_{out} = output frequency of the drive, T_M = motor torque Loss of supply voltage at nominal load (f_{out} = 40 Hz). The intermediate circuit DC voltage drops to the minimum limit. The controller keeps the voltage steady as long as the 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

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.

It is possible to restart the drive automatically after a short power supply failure by using the Automatic restart function provided that the drive is allowed to run for a time defined by parameter 21.18 to restart time 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 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.

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.

All levels are relative to the supply voltage range selected in parameter 95.01. The following table shows the values of selected DC voltage levels in volts and in percent of U_{DCmax} (the DC voltage at the upper bound of the supply voltage range).

	Supply voltage range [V AC] (see 95.01)					
Level [V DC (% of U_{DCmax})]	**208…240**	**380…415**	**440…480**	**500**	**525…600**	**660…690**
Overvoltage fault limit	489/440[1]	800	878	880	1113	1218
Overvoltage control limit	405 (125)	700 (125)	810 (125)	810 (120)	1013 (125)	1167 (125)
Internal brake chopper at 100% pulse width	403 (124)	697 (124)	806 (124)	806 (119)	1008 (124)	1159 (124)
Internal brake chopper at 0% pulse width	375 (116)	648 (116)	749 (116)	780 (116)	936 (116)	1077 (116)
Overvoltage warning limit	373 (115)	644 (115)	745 (115)	776 (115)	932 (115)	1071 (115)
U_{DCmax} = DC voltage at upper bound of supply voltage range	324 (100)	560 (100)	648 (100)	675 (100)	810 (100)	932 (100)
DC voltage at lower bound of supply voltage range	281	513	594	675	709	891
Undervoltage control and warning limit	239 (85)	436 (85)	505 (85)	574 (85)	602 (85)	757 (85)
Charging activation/standby limit	225 (80)	410 (80)	475 (80)	540 (80)	567 (80)	713 (80)
Undervoltage fault limit	168 (60)	308 (60)	356 (60)	405 (60)	425 (60)	535 (60)

[1] 489 V with frames R1…R3, 440 V with frames R4…R8.

Settings and diagnostics

Parameters: 01.11 DC voltage (page 137), 30.30 Overvoltage control (page 315), 30.31 Undervoltage control (page 315), 95.01 Supply voltage (page 477), and 95.02 Adaptive voltage limits (page 477).

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.

Some ACS880 drives have an internal brake chopper as standard, some have a brake chopper available as an internal or external option. See the appropriate hardware manual or sales catalog.

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 above. (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.

Note: For runtime braking, overvoltage control (parameter 30.30) needs to be disabled for the chopper to operate.

Settings and diagnostics

Parameters: 01.11 DC voltage (page 137) and 30.30 Overvoltage control (page 315).

Parameter group: 43 Brake chopper (page 368).

Safety and protections

Emergency stop

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

The mode of the emergency stop is selected by parameter 21.04. 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.

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

Note:

- 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 and diagnostics

Parameters: 06.17 Drive status word 2 (page 159), 06.18 Start inhibit status word (page 160), 21.04 Emergency stop mode (page 250), 21.05 Emergency stop source (page 251), 23.23 Emergency stop time (page 270), 25.13 Min torq sp ctrl em stop (page 286), 25.14 Max torq sp ctrl em stop (page 286), 25.15 Proportional gain em stop (page 286), 31.32 Emergency ramp supervision (page 325) and 31.33 Emergency ramp supervision delay (page 325).

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 connected through optional modules that provide reinforced/double insulation.

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). 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.

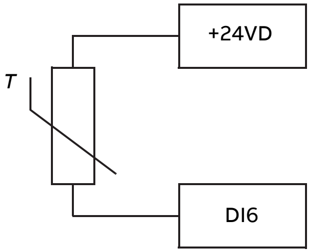
The motor thermal protection model fulfills standard IEC/EN 61800-5-1 ed. 2.1 requirements for thermal memory retention and speed sensitivity. The estimated temperature is retained over power down. Speed dependency is set by parameters 35.51, 35.52 and 35.53.

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

Temperature monitoring using PTC sensors

WARNING!
Double or reinforced insulation is required between the live parts of the motor and the drive control unit. Sensors without reinforced or double insulation must be connected to option module FPTC-xx or FAIO-01. With basic-insulated motor temperature sensors, FAIO-01 forms double insulation. FPTC-xx forms itself a double insulation. See the hardware manual for more information.

One PTC sensor can be connected to digital input DI6.

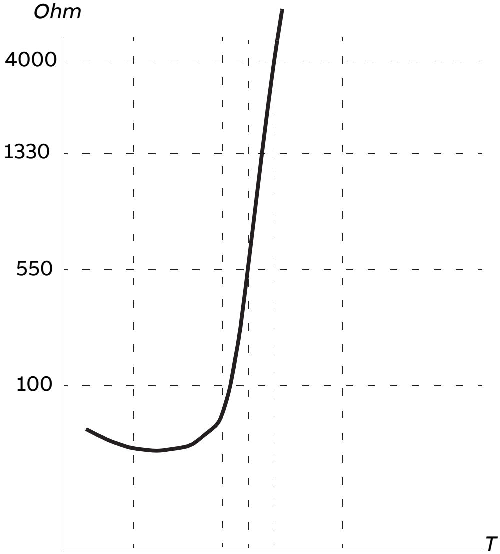


The resistance of the PTC sensor increases when its temperature rises. The increasing resistance of the sensor decreases the voltage at the input, and eventually its state switches from 1 to 0, indicating overtemperature.

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 FPTC-xx modules have connections for PTC sensors. Refer to the module-specific documentation for more information.

Temperature monitoring using Pt100 or Pt1000 sensors

WARNING!
Double or reinforced insulation is required between the live parts of the motor and the drive control unit. Sensors without reinforced or double insulation must be connected to option module FAIO-01. With basic-insulated motor temperature sensors, FAIO-01 forms double insulation. See the hardware manual for more information.

1…3 Pt100 or Pt1000 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 (Pt1000) 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.

Note: If excitation current is too high for the sensor, use some other means to measure the temperature.

Temperature monitoring using KTY84 sensors

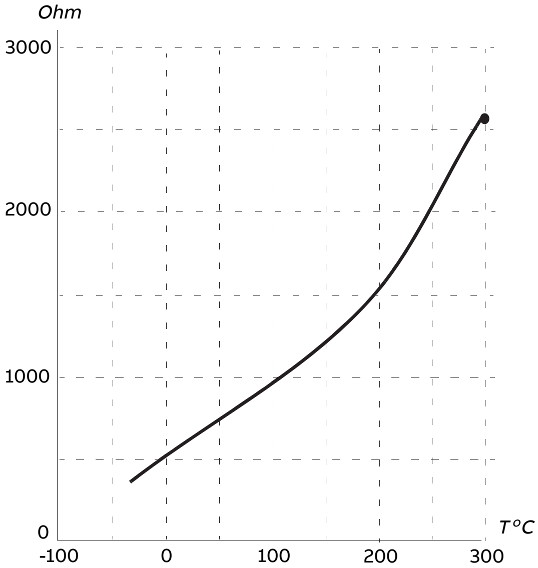
WARNING!
Double or reinforced insulation is required between the live parts of the motor and the drive control unit. Sensors without reinforced or double insulation must be connected to option module FAIO-01. With basic-insulated motor temperature sensors, FAIO-01 forms double insulation. See the hardware manual for more information.

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.

Settings and diagnostics

Parameter groups: 35 Motor thermal protection (page 344) and 91 Encoder module settings (page 462).

Parameters: 95.15 Special HW settings (page 481) and 95.20 HW options word 1 (page 483).

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)
- Nominal continuous current rating of the cable, specified by 35.61, and
- Thermal time constant of the cable, specified by 35.62.

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

Settings and diagnostics

Parameters: 35.60 Cable temperature...35.62 Cable thermal rise time (page 356).

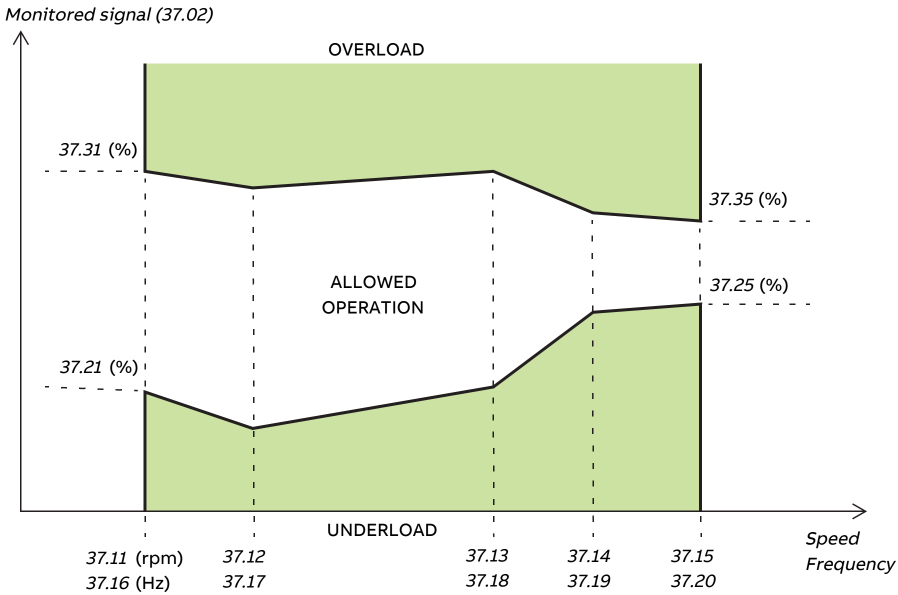
Events: A480 Motor cable overload (page 540) and 4000 Motor cable overload (page 525).

User load curve

The user load curve provides a function that monitors an input signal (eg. motor torque or motor current) as a function of drive output speed or frequency. The function includes both high limit (overload) and low limit (underload) monitoring. Overload monitoring can, for example, be used to detect a pump becoming clogged or a saw blade hitting a knot. Underload monitoring can detect the load being lost, for example because of the snapping of a transmission belt.

The monitoring is effective within a motor speed and/or frequency range. The frequency range is used with a frequency reference in scalar motor control mode; otherwise, the speed range is used. The range is defined by five speed (parameters 37.11…37.15) or frequency (37.16…37.20) values. The values are positive, but the monitoring is symmetrically active in the negative direction as the sign of the monitored signal is ignored. Outside the speed/frequency range, the monitoring is disabled.

An underload (37.21…37.25) and overload (37.31…37.35) limit is set for each of the five speed or frequency points. Between these points, the limits are interpolated linearly to form overload and underload curves.



The action (none, warning or fault) taken when the signal exits the allowed operation area can be selected separately for overload and underload conditions (parameters 37.03 and 37.04 respectively). Each condition also has an optional timer to delay the selected action (37.41 and 37.42).

Settings and diagnostics

Parameter group: 37 User load curve (page 364).

Events: A6E6 ULC configuration (page 547), A8BE ULC overload (page 555), A8BF ULC underload (page 555), 8001 ULC underload (page 537) and 8002 ULC overload (page 538).

Automatic fault resets

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.

The drive can automatically reset itself after overcurrent, overvoltage, undervoltage and external faults. The user can also specify a fault (excluding Safe torque off related faults) to be reset automatically.

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

Settings and diagnostics

Parameters: 31.12 Autoreset selection…31.16 Delay time (page 319).

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
- 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.

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.

Main cooling fan supervision (parameter *31.35*)

The parameter selects how the drive reacts to a loss of the main cooling fan.

With an inverter unit consisting of frame R8i inverter modules, it may be possible to continue operation even if a cooling fan of an inverter module stops. See the description of the parameter.

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.

Diagnostics

Fault and warning messages, data logging

See chapter Fault tracing.

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 is activated, and a warning or fault generated. The contents of the message can be edited on the control panel by selecting **Menu** - **Settings** - **Edit texts**.

The supervised signal is low-pass filtered. The supervision operates on a 2 ms time level. The configuration parameters are scanned for changes on a 10 ms time level.

Settings and diagnostics

Parameter group: 32 Supervision (page 331).

Events: A8B0 Signal supervision (page 555), A8B1 Signal supervision 2 (page 555), A8B2 Signal supervision 3 (page 555), 80B0 Signal supervision (page 538), 80B1 Signal supervision 2 (page 538) and 80B2 Signal supervision 3 (page 538).

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 **Menu** - **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. The counter measures, by integration, the monitored parameter. A warning is given when the calculated area below the signal peak exceeds a user-defined limit.

Settings and diagnostics

Parameter group: 33 Generic timer & counter (page 335).

Energy saving calculators

This feature consists of the following functionalities:

- An energy optimizer that adjusts the motor flux in such a way that the total system efficiency is maximized
- A counter that monitors used and saved energy by the motor and displays them in kWh, currency or volume of CO_2 emissions, and
- A load analyzer showing the load profile of the drive (see separate section on page 117.

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 and diagnostics

Parameter group: 45 Energy efficiency (page 371).

Load analyzer

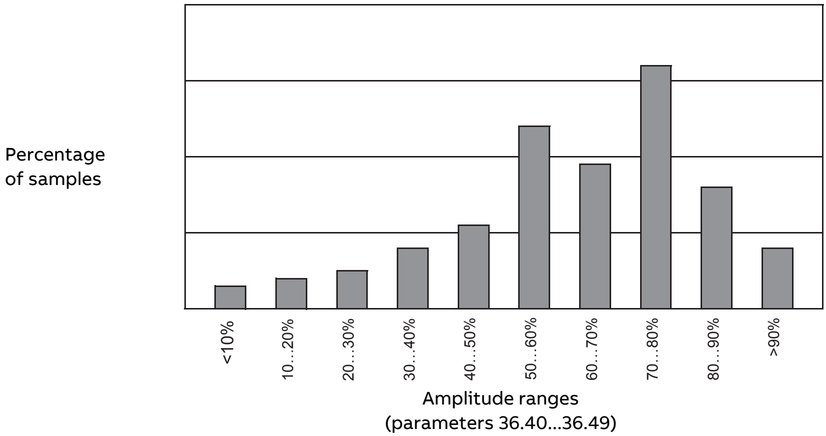
Peak value logger

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

Amplitude loggers

The control program has two amplitude loggers. Depending on the setting of parameter 36.08, the loggers are active continuously or only when the drive is modulating.

For amplitude logger 2, the user can select a signal to be sampled at 200 ms intervals, and specify a value that corresponds to 100%. The collected samples are sorted into 10 read-only parameters according to their amplitude. Each parameter represents an amplitude range 10 percentage points wide, and displays the percentage of the collected samples that have fallen within that range. Note that the lowest range also contains the negative values (if any), while the highest range also contains the values above 100%.



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 collected samples is shown by parameters 36.20…36.29.

Settings and diagnostics

Parameter group: 36 Load analyzer (page 359).

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 and 10.04
- I/O extension module settings (groups 14…16)
- fieldbus communication enable parameters (50.01 and 50.31)
- other fieldbus communication settings (groups 51…56 and 58)
- encoder configuration settings (groups 92…93),
- some hardware settings in parameter group 95, and
- user set selection parameters 96.11…96.13

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

If no parameter sets have been saved, attempting to load a set will create all sets from the currently active parameter settings.

Switching between user parameter sets is only possible with the drive stopped.

Settings and diagnostics

Parameters: 10.03 DI force selection (page 178), 10.04 DI force data (page 178), 50.01 FBA A enable (page 388), 50.31 FBA B enable (page 393), and 96.10 User set status (page 490)…96.13 User set I/O mode in2 (page 491).

Parameter group: 95 HW configuration (page 477).

Events: 64B2 User set fault (page 532).

Parameter checksum calculation

A parameter checksum can be calculated from a user-definable set of parameters to monitor changes in the drive configuration. The calculated checksum is compared to 1…4 reference checksums; in case of a mismatch, an event (a pure event, warning or fault) is generated.

By default, the set of parameters included in the calculation contain most parameters with the exception of

- actual signals
- parameter group 47
- parameters that are activated to validate new settings (such as 51.27 and 96.07)
- parameters that are not saved to the flash memory (such as 96.24…96.26)
- parameters that are internally calculated from others (such as 98.09…98.14).
- dynamic parameters (eg. parameters that vary according to hardware), and
- application program parameters.

The default set can be edited using the Drive customizer PC tool.

Settings and diagnostics

Parameters: 96.53 Actual checksum (page 494)…96.59 Approved checksum 4 (page 495).

Events: 6200 Checksum mismatch (page 530) and A686 Checksum mismatch (page 545).

User lock

WARNING!
ABB will not be liable for damages or losses caused by the failure to activate the user lock using a new pass code. See Cyber security disclaimer (page 19).

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

With several drives, set a unique pass code for each drive.

To activate the user lock for the first time,

- Enter the default pass code, 10000000, into 96.02. This will make parameters 96.100…96.102 visible.
- Enter a new pass code into 96.100. Always use eight digits; if using Drive Composer, finish with Enter.
- Confirm the new pass code in 96.101.

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

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

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

Settings and diagnostics

Parameters: 96.02 Pass code (page 487) and 96.100 Change user pass code…96.102 User lock functionality (page 496).

Events: A6B0 User lock open (page 546).

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 only 32-bit floating point (type *real32*) parameters can be selected as the source of another parameter value. In other words, parameters 47.01…47.08 can be used as value sources of other parameters while 47.11…47.28 cannot.

To use a 16-bit integer (received in DDCS data sets) as the source of another parameter, write the value into one of the *real32* type storage parameters (47.01…47.08). Select the storage parameter as the source, and define a suitable scaling method between the 16-bit and 32-bit values in parameters 47.31…47.38.

Settings and diagnostics

Parameter group: 47 Data storage (page 381).

Reduced run function

A "reduced run" function is available for inverter units consisting of parallel-connected inverter modules. The function makes it possible to continue operation with limited current even if one (or more) module is out of service, for example, because of maintenance work. In principle, reduced run is possible with only one module, but the physical requirements of operating the motor still apply; for example, the modules remaining in use must be able to provide the motor with enough magnetizing current.

Activation of the reduced run function

Note: For cabinet-built drives, the wiring accessories and the air baffle needed during the procedure are available from ABB, and are included in the delivery.

WARNING!
Follow the safety instructions provided for the drive or inverter unit in question.

---

1. Disconnect the supply voltage and all auxiliary voltages from the drive/inverter unit.
2. If the inverter control unit is powered from the faulty module, install an extension to the wiring and connect it to one of the remaining modules.
3. Remove the module to be serviced from its bay. See the appropriate hardware manual for instructions.
4. If the Safe torque off (STO) function is in use, install jumpering in the STO wiring in place of the missing module (unless the module was the last on the chain).
5. Install an air baffle to the top module guide to block the airflow through the empty module bay.
6. In case the inverter unit has a DC switch with a charging circuit, disable the appropriate channel on the xSFC-xx charging controller.
7. Switch on the power to the drive/inverter unit.
8. Enter the number of inverter modules present into parameter 95.13.
9. Reset all faults and start the drive/inverter unit. The maximum current is now automatically limited according to the new inverter configuration. A mismatch between the number of detected modules (95.14) and the value set in 95.13 will generate a fault.

After all modules have been reinstalled, parameter 95.13 must be reset to 0 to disable the reduced run function. In case the inverter is equipped with a charging circuit, the charging monitoring must be reactivated for all modules. If the Safe torque off (STO)function is in use, an acceptance test must be performed (see the hardware manual of the drive/inverter unit for instructions).

Settings and diagnostics

Parameters: 06.17 Drive status word 2 (page 159) and 95.13 Reduced run mode…95.14 Connected modules (page 480).

Events: 5695 Reduced run (page 529).

du/dt filter support

With an external du/dt filter connected to the output of the drive, bit 13 of 95.20 must be switched on. The setting limits the output switching frequency. With frame size R5i…R7i inverter modules, the setting also forces the drive/inverter module fan to full speed. Note that the setting is not to be activated with inverter modules with internal du/dt filters.

Settings and diagnostics

Parameter: 95.20 HW options word 1 (page 483).

Sine filter support

The control program has a setting that enables the use of sine filters (available separately from ABB and others).

With an ABB sine filter connected to the output of the drive, bit 1 of 95.15 must be switched on. The setting limits the switching and output frequencies to

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

With a custom sine filter, bit 3 of 95.15 must be switched on. (The setting does not limit the output frequency.) Additional parameters must be set according to the properties of the filter as listed below.

Settings and diagnostics

Parameters: 95.15 Special HW settings (page 481), 97.01 Switching frequency reference (page 498), 97.02 Minimum switching frequency (page 498), 99.18 Sine filter inductance (page 514) and 99.19 Sine filter capacitance (page 515).

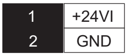
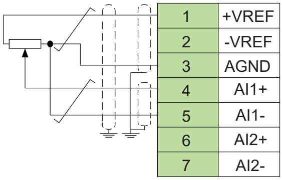
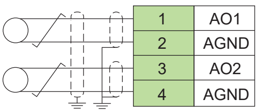
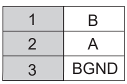
7

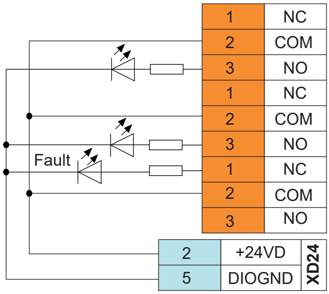
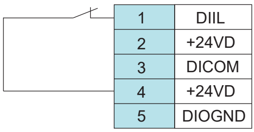
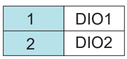
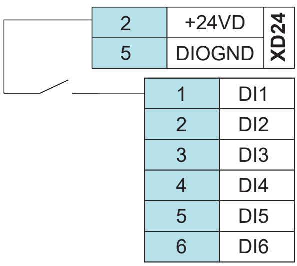
Default control connections

Contents of this chapter

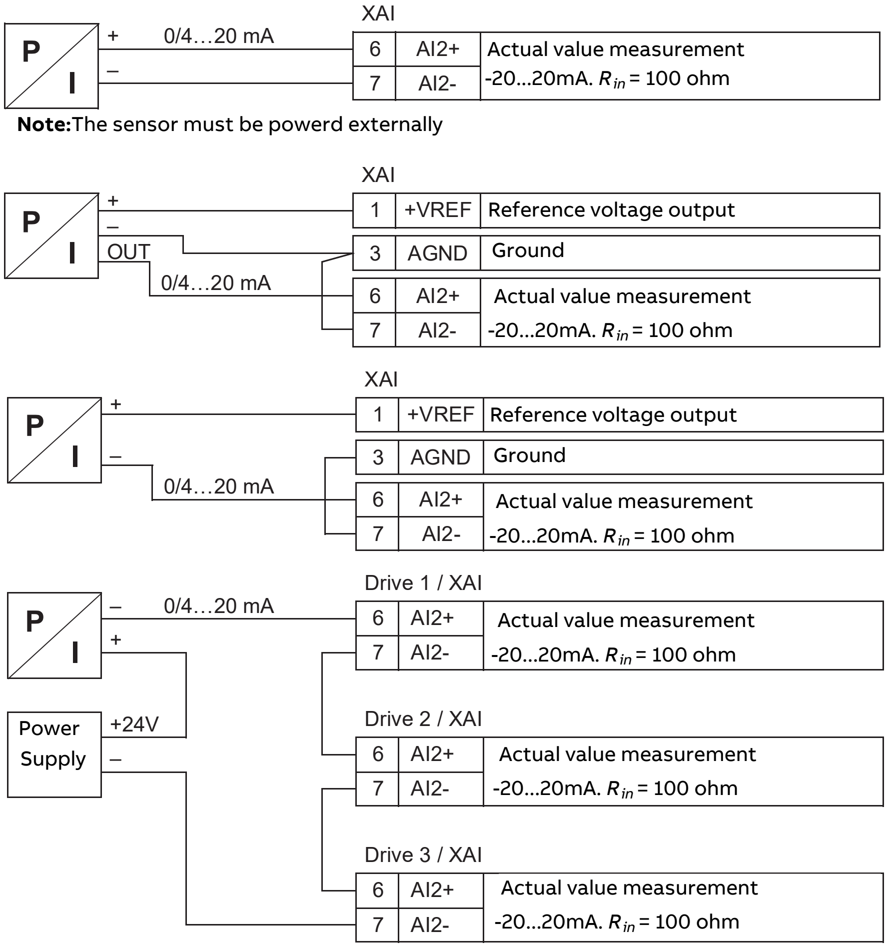
This chapter describes the default control connections of the PCP control application.

PCP I/O control connections

Connection	Term	Description
XPOW External power input		
	+24VI GND	24 V DC, 2 A
XAI Reference voltage and analog inputs		
	+VREF	10 V DC, R_L 1…10 kohm
	-VREF	-10 V DC, R_L 1…10 kohm
	AGND	Ground
	AI1+ AI1-	**Analog input 1** **Speed reference** 0(2)…10 V, R_{in} > 200 kohm
	AI2+ AI2-	Analog input 2 0(4)…20 mA, R_{in} = 100 ohm By default not in use.
XAO Analog outputs		
	AO1 AGND	**Motor speed rpm** 0…20 mA, R_L < 500 ohm
	AO2 AGND	**Motor current** 0…20 mA, R_L < 500 ohm
XD2D Drive-to-drive link		
	B A BGND	drive-to-drive link
XRO1, XRO2, XRO3 Relay outputs		

Connection	Term	Description
	NC	Relay output 1
	COM	250 V AC / 30 V DC, 2 A
	NO	Ready run
	NC	Relay output 2
	COM	250 V AC / 30 V DC, 2 A
	NO	Running
	NC	Relay output 3
	COM	250 V AC / 30 V DC, 2 A
	NO	Fault (-1)
XD24 Digital interlock		
	DIIL	Run enable
	+24VD	+24 V DC 200 mA
	DICOM	Digital input ground
	+24VD	+24 V DC 200 mA
	DIOGND	Digital input/output ground
XDIO Digital input/outputs		
	DIO1	Output: Ready run
	DIO2	Output: Running
XDI Digital inputs		
	DI1	Stop (0) / Start (1)
	DI2	By default, not in use.
	DI3	By default, not in use.
	DI4	By default, not in use.
	DI5	By default, not in use.
	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



Application control PCP

This default connection scheme is used for PCP 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

Below is a listing of default parameter values that differ from those listed for the factory macro in Parameter listing (page 136).

Parameter Name	PCP control default
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	Nonlatching
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 PT-100 source	Zero
79.05 PT-100 exitation source	Zero
79.06 Pt100 internal selection	9.10 mA
79.07 Number of PT-100 sensors in series	1
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. **Note:** Certain configurations or optional equipment may require specific default values. These are labelled as follows: (95.20 bx) = Default changed or write-protected by parameter 95.20, bit x.
FbEq 16b / 32b	(In the following table, shown on the same row as the parameter range, or for each selection) The scaling between the integer used in communication and the value shown on the panel when a 16-bit value is selected for transmission to an external system. The scaling is indicated for both 16-bit and 32-bit values.
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 of the real32 (32-bit floating point) type. 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 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.
Parameter	Either a user-adjustable operating instruction for the drive, or an actual signal.
p.u.	Per unit
[parameter number in square brackets]	The value of the parameter.

Parameter group summary

Parameter listing

No.	Name / Range / Selection	Description	Def / Type FbEq 16b / 32b
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 signal can be defined by parameter 46.11 Filter time motor speed.	- / real32
	-30000.00 … 30000.00 rpm	Measured or estimated motor speed. For 16-bit scaling, see parameter 46.01.	- / 100 = 1 rpm
01.02	Motor speed estimated	Estimated motor speed in rpm. A filter time constant for signal can be defined by parameter 46.11 Filter time motor speed.	- / real32
	-30000.00 … 30000.00 rpm	Estimated motor speed. For 16-bit scaling, see parameter 46.01.	- / 100 = 1 rpm
01.03	Motor speed %	Shows the value of 01.01 Motor speed used in percent of the synchronous speed of the motor.	- / real32
	-1000.00 … 1000.00 %	Measured or estimated motor speed. For 16-bit scaling, see parameter 46.01.	- / 100 = 1 %
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.	- / real32
	-30000.00 … 30000.00 rpm	Encoder 1 speed. For 16-bit scaling, see parameter 46.01.	- / 100 = 1 rpm
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.	- / real32
	-30000.00 … 30000.00 rpm	Encoder 2 speed. For 16-bit scaling, see parameter 46.01.	- / 100 = 1 rpm
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.	- / real32
	-600.00 … 600.00 Hz	Estimated output frequency. For 16-bit scaling, see parameter 46.02.	- / 100 = 1 Hz
01.07	Motor current	Measured (absolute) motor current in A.	- / real32
	0.00 … 30000.00 A	Motor current. For 16-bit scaling, see parameter 46.05.	- / 100 = 1 A
01.08	Motor current % of motor nom	Motor current (drive output current) in percent of the nominal motor current.	- / real32
	0.0 … 1000.0 %	Motor current.	1 = 1 % / 10 = 1 %
01.10	Motor torque	Motor torque in percent of the nominal motor torque. See also parameter 01.30 Nominal torque scale. A filter time constant for this signal can be defined by parameter 46.13 Filter time motor torque.	- / real32

No.	Name / Range / Selection	Description	Def / Type FbEq 16b / 32b
	-1600.0 ... 1600.0 %	Motor torque. For 16-bit scaling, see parameter 46.03.	- / 10 = 1 %
01.11	DC voltage	Measured DC link voltage.	- / real32
	0.00 ... 2000.00 V	DC link voltage.	10 = 1 V / 100 = 1 V
01.13	Output voltage	Calculated motor voltage in V AC.	- / real32
	0...2000 V	Motor voltage.	1 = 1 V / 1 = 1 V
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.	- / real32
	-32768.00 ... 32767.00 kW	Output power. For 16-bit scaling, see parameter 46.04.	- / 100 = 1 kW
01.15	Output power % of motor nom	Shows the value of 01.14 Output power in percent of the nominal power of the motor.	- / real32
	-300.00 ... 300.00 %	Output power.	10 = 1 % / 100 = 1 %
01.17	Motor shaft power	Estimated mechanical power at motor shaft. 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.	- / real32
	-32768.00 ... 32767.00 kW or hp	Motor shaft power.	1 = 1 kW or hp / 100 = 1 kW or hp
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.	- / int16
	0...32767 GWh	Motoring energy in GWh.	1 = 1 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.	- / int16
	0...1000 MWh	Motoring energy in MWh.	1 = 1 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.	- / real32
	0...1000 kWh	Motoring energy in kWh.	10 = 1 kWh / 1 = 1 kWh
01.21	U-phase current	Measured U-phase current.	- / real32
	-30000.00 ... 30000.00 A	U-phase current. For 16-bit scaling, see parameter 46.05.	- / 100 = 1 A
01.22	V-phase current	Measured V-phase current.	- / real32
	-30000.00 ... 30000.00 A	V-phase current. For 16-bit scaling, see parameter 46.05.	- / 100 = 1 A
01.23	W-phase current	Measured W-phase current.	- / real32

No.	Name / Range / Selection	Description	Def / Type FbEq 16b / 32b
	-30000.00 … 30000.00 A	W-phase current. For 16-bit scaling, see parameter 46.05.	- / 100 = 1 A
01.24	Flux actual %	Used flux reference in percent of nominal flux of motor.	- / real32
	0…200 %	Flux reference.	1 = 1 % / 1 = 1 %
01.25	INU momentary cos φ	Momentary cosphi of the drive.	0.00 NoUnit / real32
	-1.00 … 1.00	Cosphi.	100 = 1 / 100 = 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.	- / real32
	-15000…15000 rpm/s	Rate of speed change.	1 = 1 rpm/s / 1 = 1 rpm/s
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 Nm or lb·ft / uint32
	0.000 … 4000000.000 Nm or lb·ft	Nominal torque.	1 = 1 Nm or lb·ft / 1000 = 1 Nm or lb·ft
01.31	Ambient temperature	Measured temperature of incoming cooling air. The unit (°C or °F) is selected by parameter 96.16 Unit selection.	- / real32
	-40.0 … 200.0 °	Cooling air temperature.	1 = 1 ° / 10 = 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.	- / int16
	0…32767 GWh	Regenerative energy in GWh.	1 = 1 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.	- / int16
	0…1000 MWh	Regenerative energy in MWh.	1 = 1 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.	- / real32
	0…1000 kWh	Regenerative energy in kWh.	10 = 1 kWh / 1 = 1 kWh

No.	Name / Range / Selection	Description	Def / Type FbEq 16b / 32b
01.35	Mot - regen energy GWh (resettable)	Amount of net energy (motoring energy - regenerating energy) that has passed through the drive in full gigawatt hours. You can reset the value by setting it to zero. Resetting any of the parameters 01.35 to 01.37 resets all.	0 GWh / int16
	-32768...32767 GWh	Energy balance in GWh.	1 = 1 GWh / 1 = 1 GWh
01.36	Mot - regen energy MWh (resettable)	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 (resettable) is incremented or decremented. You can reset the value by setting it to zero. Resetting any of the parameters 01.35 to 01.37 resets all.	0 MWh / int16
	-1000...1000 MWh	Energy balance in MWh.	1 = 1 MWh / 1 = 1 MWh
01.37	Mot - regen energy kWh (resettable)	Amount of energy (motoring energy - regenerating energy) that has passed through the drive in full kilo-watt-hours. Whenever the counter rolls over, 01.36 Mot - regen energy MWh (resettable) is incremented or decremented. You can reset the value by setting it to zero. Resetting any of the parameters 01.35 to 01.37 resets all.	0 kWh / real32
	-1000...1000 kWh	Energy balance in kWh.	10 = 1 kWh / 1 = 1 kWh
01.61	Abs motor speed used	Absolute value of 01.01 Motor speed used.	- / real32
	0.00 ... 30000.00 rpm	Measured or estimated motor speed. For 16-bit scaling, see parameter 46.01.	- / 100 = 1 rpm
01.62	Abs motor speed %	Absolute value of 01.03 Motor speed %.	- / real32
	0.00 ... 1000.00 %	Measured or estimated motor speed.	10 = 1 % / 100 = 1 %
01.63	Abs output frequency	Absolute value of 01.06 Output frequency.	- / real32
	0.00 ... 600.00 Hz	Estimated output frequency. For 16-bit scaling, see parameter 46.02.	- / 100 = 1 Hz
01.64	Abs motor torque	Absolute value of 01.10 Motor torque.	- / real32
	0.0 ... 1600.0 %	Motor torque. For 16-bit scaling, see parameter 46.03.	- / 10 = 1 %
01.65	Abs output power	Absolute value of 01.14 Output power.	- / real32
	0.00 ... 32767.00 kW or hp	Output power.	1 = 1 kW or hp / 100 = 1 kW or hp
01.66	Abs output power % motor nom	Absolute value of 01.15 Output power % of motor nom.	- / real32
	0.00 ... 300.00 %	Output power.	10 = 1 % / 100 = 1 %
01.68	Abs motor shaft power	Absolute value of 01.17 Motor shaft power.	- / real32

No.	Name / Range / Selection	Description	Def / Type FbEq 16b / 32b
	0.00 … 32767.00 kW or hp	Motor shaft power.	1 = 1 kW or hp / 100 = 1 kW or hp
01.70	Ambient temperature %	Measured temperature of incoming cooling air. The amplitude range of 0…100 % corresponds to 0…60 °C or 32…140 °F. See also 01.31 Ambient temperature.	0.00 percent / real32
	-200.00 … 200.00 %	Cooling air temperature.	1 = 1 % / 100 = 1 %
01.71	Step-up motor current	Estimated motor current in A when a step-up transformer is in use. The value is calculated from parameter 01.07 using the step-up transformer ratio (95.40) and sine filter values 99.18 and 99.19.	- / real32
	0.00 … 30000.00 A	Estimated motor current. For 16-bit scaling, see parameter 46.05.	- / 100 = 1 A
01.72	U-phase RMS current	U-phase rms current.	- / real32
	0.00 … 30000.00 A	U-phase rms current. For 16-bit scaling, see parameter 46.05.	- / 100 = 1 A
01.73	V-phase RMS current	V-phase rms current.	- / real32
	0.00 … 30000.00 A	V-phase rms current. For 16-bit scaling, see parameter 46.05.	- / 100 = 1 A
01.74	W-phase RMS current	W-phase rms current.	- / real32
	0.00 … 30000.00 A	W-phase rms current. For 16-bit scaling, see parameter 46.05.	- / 100 = 1 A

No.	Name / Range / Selection	Description	Def / Type FbEq 16b / 32b
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	Local reference given from the control panel or PC tool.	0.00 NoUnit / real32
	-100000.00 ... 100000.00	Local control panel or PC tool reference.	10 = 1 / 100 = 1
03.02	Panel reference 2	Remote reference given from the control panel or PC tool.	- / real32
	-30000.00 ... 30000.00	Remote control panel or PC tool reference.	10 = 1 / 100 = 1
03.05	FB A reference 1	Reference 1 received through fieldbus adapter A. See also chapter Fieldbus control through a fieldbus adapter.	0.00 NoUnit / real32
	-100000.00 ... 100000.00	Reference 1 from fieldbus adapter A.	10 = 1 / 100 = 1
03.06	FB A reference 2	Reference 2 received through fieldbus adapter A.	0.00 NoUnit / real32
	-100000.00 ... 100000.00	Reference 2 from fieldbus adapter A.	10 = 1 / 100 = 1
03.07	FB B reference 1	Reference 1 received through fieldbus adapter B.	0.00 NoUnit / real32
	-100000.00 ... 100000.00	Reference 1 from fieldbus adapter B.	10 = 1 / 100 = 1
03.08	FB B reference 2	Reference 2 received through fieldbus adapter B.	0.00 NoUnit / real32
	-100000.00 ... 100000.00	Reference 2 from fieldbus adapter B.	10 = 1 / 100 = 1
03.09	EFB reference 1	Scaled reference 1 received through the embedded fieldbus interface. The scaling is defined by 58.26 EFB ref1 type.	- / real32
	-30000.00 ... 30000.00	Reference 1 received through the embedded fieldbus interface.	10 = 1 / 100 = 1
03.10	EFB reference 2	Scaled reference 2 received through the embedded fieldbus interface. The scaling is defined by 58.27 EFB ref2 type.	- / real32
	-30000.00 ... 30000.00	Reference 2 received through the embedded fieldbus interface.	10 = 1 / 100 = 1
03.30	FB A reference 1 int32	Reference 1 received through fieldbus adapter A as a 32-bit integer.	- / int32
		Reference 1 from fieldbus adapter A.	- / -
03.31	FB A reference 2 int32	Reference 2 received through fieldbus adapter A as a 32-bit integer.	- / int32
		Reference 2 from fieldbus adapter A.	- / -
03.51	IEC application panel reference	Panel reference defined in the application program.	0 NoUnit / real32

No.	Name / Range / Selection	Description	Def / Type FbEq 16b / 32b
	-100000...100000	Panel reference in the application program.	1 = 1 / 1 = 1

No.	Name / Range / Selection	Description	Def / Type FbEq 16b / 32b
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).	0 / uint16
	0000…FFFFh	1st active fault.	1 = 1
04.02	Active fault 2	Code of the 2nd active fault.	0 / uint16
	0000…FFFFh	2nd active fault.	1 = 1
04.03	Active fault 3	Code of the 3rd active fault.	0 / uint16
	0000…FFFFh	3rd active fault.	1 = 1
04.04	Active fault 4	Code of the 4th active fault.	0 / uint16
	0000…FFFFh	4th active fault.	1 = 1
04.05	Active fault 5	Code of the 5th active fault.	0 / uint16
	0000…FFFFh	5th active fault.	1 = 1
04.06	Active warning 1	Code of the 1st active warning.	0 / uint16
	0000…FFFFh	1st active warning.	1 = 1
04.07	Active warning 2	Code of the 2nd active warning.	0 / uint16
	0000…FFFFh	2nd active warning.	1 = 1
04.08	Active warning 3	Code of the 3rd active warning.	0 / uint16
	0000…FFFFh	3rd active warning.	1 = 1
04.09	Active warning 4	Code of the 4th active warning.	0 / uint16
	0000…FFFFh	4th active warning.	1 = 1
04.10	Active warning 5	Code of the 5th active warning.	0 / uint16
	0000…FFFFh	5th active warning.	1 = 1
04.11	Latest fault	Code of the 1st stored (non-active) fault.	0 / uint16
	0000…FFFFh	1st stored fault.	1 = 1
04.12	2nd latest fault	Code of the 2nd stored (non-active) fault.	0 / uint16
	0000…FFFFh	2nd stored fault.	1 = 1
04.13	3rd latest fault	Code of the 3rd stored (non-active) fault.	0 / uint16
	0000…FFFFh	3rd stored fault.	1 = 1
04.14	4th latest fault	Code of the 4th stored (non-active) fault.	0 / uint16
	0000…FFFFh	4th stored fault.	1 = 1
04.15	5th latest fault	Code of the 5th stored (non-active) fault.	0 / uint16

No.	Name / Range / Selection	Description	Def / Type FbEq 16b / 32b
	0000…FFFFh	5th stored fault.	1 = 1
04.16	Latest warning	Code of the 1st stored (non-active) warning.	0 / uint16
	0000…FFFFh	1st stored warning.	1 = 1
04.17	2nd latest warning	Code of the 2nd stored (non-active) warning.	0 / uint16
	0000…FFFFh	2nd stored warning.	1 = 1
04.18	3rd latest warning	Code of the 3rd stored (non-active) warning.	0 / uint16
	0000…FFFFh	3rd stored warning.	1 = 1
04.19	4th latest warning	Code of the 4th stored (non-active) warning.	0 / uint16
	0000…FFFFh	4th stored warning.	1 = 1
04.20	5th latest warning	Code of the 5th stored (non-active) warning.	0 / uint16
	0000…FFFFh	5th stored warning.	1 = 1

No.	Name / Range / Selection	Description	Def / Type FbEq 16b / 32b
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.	- / uint16

No.	Name / Range / Selection	Description	Def / Type FbEq 16b / 32b
		<table><tr><td rowspan="2">Bit</td><td colspan="2">ACS800 fault name</td><td rowspan="2">ACS880 events indicated by this bit see Fault tracing.</td></tr><tr><td>(04.120 = ACS800 Standard ctrl program)</td><td>(04.120 = ACS800 System ctrl program)</td></tr><tr><td>0</td><td>SHORT CIRC</td><td>SHORT CIRC</td><td>2340</td></tr><tr><td>1</td><td>OVERCURRENT</td><td>OVERCURRENT</td><td>2310</td></tr><tr><td>2</td><td>DC OVERVOLT</td><td>DC OVERVOLT</td><td>3210</td></tr><tr><td>3</td><td>ACS800 TEMP</td><td>ACS800 TEMP</td><td>2381, 4210, 4290, 42F1, 4310, 4380</td></tr><tr><td>4</td><td>EARTH FAULT</td><td>EARTH FAULT</td><td>2330, 2392, 3181</td></tr><tr><td>5</td><td>THERMISTOR</td><td>MOTOR TEMP M</td><td>4981, 4991, 4992, 4993</td></tr><tr><td>6</td><td>MOTOR TEMP</td><td>MOTOR TEMP</td><td>4982</td></tr><tr><td>7</td><td>SYSTEM_FAULT</td><td>SYSTEM_FAULT</td><td>6481, 6487, 64A1, 64A2, 64A3, 64B1, 64E1, 6881, 6882, 6883, 6885</td></tr><tr><td>8</td><td>UNDERLOAD</td><td>UNDERLOAD</td><td>-</td></tr><tr><td>9</td><td>OVERFREQ</td><td>OVERFREQ</td><td>7310</td></tr><tr><td>10</td><td>Reserved</td><td>MPROT SWITCH</td><td>9081</td></tr><tr><td>12</td><td>Reserved</td><td>SC (INU1)</td><td>2340 (XXYY YY01)</td></tr><tr><td>13</td><td>Reserved</td><td>SC (INU2)</td><td>2340 (XXYY YY02)</td></tr><tr><td>14</td><td>Reserved</td><td>SC (INU3)</td><td>2340 (XXYY YY03)</td></tr><tr><td>15</td><td>Reserved</td><td>SC (INU4)</td><td>2340 (XXYY YY04)</td></tr></table>	

No.	Name / Range / Selection	Description	Def / Type FbEq 16b / 32b
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 bit can indicate several ACS880 events as listed below. This parameter is read-only.	- / uint16

No.	Name / Range / Selection	Description	Def / Type FbEq 16b / 32b

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.
0	SUPPLY PHASE	SUPPLY PHASE	3130
1	NO MOT DATA	NO MOTOR DATA	-
2	DC UNDER-VOLT	DC UNDER-VOLT	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, 5695
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 / Range / Selection	Description	Def / Type FbEq 16b / 32b
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.	- / uint16

No.	Name / Range / Selection	Description	Def / Type FbEq 16b / 32b
		<table><tr><td rowspan="2">Bit</td><td colspan="2">ACS800 alarm name</td><td rowspan="2">ACS880 events indicated by this bit see Fault tracing.</td></tr><tr><td>(04.120 = ACS800 Standard ctrl program)</td><td>(04.120 = ACS800 System ctrl program)</td></tr><tr><td>0</td><td>START INHIBIT</td><td>START INHIBIT</td><td>A5A0</td></tr><tr><td>1</td><td>Reserved</td><td>EM STOP</td><td>AFE1, AFE2</td></tr><tr><td>2</td><td>THERMISTOR</td><td>MOTOR TEMP M</td><td>A491, A497, A498, A499</td></tr><tr><td>3</td><td>MOTOR TEMP</td><td>MOTOR TEMP</td><td>A492</td></tr><tr><td>4</td><td>ACS800 TEMP</td><td>ACS800 TEMP</td><td>A2BA, A4A9, A4B0, A4B1, A4F6</td></tr><tr><td>5</td><td>ENCODER ERR</td><td>ENCODER ERR</td><td>A797, A7B0, A7B1, A7E1</td></tr><tr><td>6</td><td>T MEAS ALM</td><td>T MEAS CIRC</td><td>A490, A5EA, A782, A8A0</td></tr><tr><td>7</td><td>Reserved</td><td>DIGITAL IO</td><td>-</td></tr><tr><td>8</td><td>Reserved</td><td>ANALOG IO</td><td>-</td></tr><tr><td>9</td><td>Reserved</td><td>EXT DIGITAL IO</td><td>-</td></tr><tr><td>10</td><td>Reserved</td><td>EXT ANALOG IO</td><td>A6E5, A7AA, A7AB</td></tr><tr><td>11</td><td>Reserved</td><td>CH2 COMM LOSS</td><td>A7CE</td></tr><tr><td>12</td><td>COMM MODULE</td><td>MPROT SWITCH</td><td>A981</td></tr><tr><td>13</td><td>Reserved</td><td>EM STOP DEC</td><td>-</td></tr><tr><td>14</td><td>EARTH FAULT</td><td>EARTH FAULT</td><td>A2B3</td></tr><tr><td>15</td><td>Reserved</td><td>SAFETY SWITC</td><td>A983</td></tr></table>	
	0000h…FFFFh		1 = 1 / 1 = 1

No.	Name / Range / Selection	Description	Def / Type FbEq 16b / 32b
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.	- / uint16

No.	Name / Range / Selection	Description	Def / Type FbEq 16b / 32b

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.
0	Reserved	MOTOR FAN	A781
1	UNDER-LOAD	UNDER-LOAD	-
2	Reserved	INV OVER-LOAD	-
3	Reserved	CABLE TEMP	A480
4	ENCODER	ENCODER A<>B	-
5	Reserved	FAN OVER-TEMP	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 FAIL-URE	-
13	PANEL LOSS	PANEL LOSS	A7EE
14	Reserved	DC UNDER-VOLT	A3A2
15	Reserved	RESTARTED	-

No.	Name / Range / Selection	Description	Def / Type FbEq 16b / 32b
	0000h…FFFFh		1 = 1 / 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.	- / uint16

No.	Name / Range / Selection	Description	Def / Type FbEq 16b / 32b
b0	User bit 0	1 = Event selected by parameters 04.41 Event word 1 bit 0 code (and 04.42 Event word 1 bit 0 aux code) is active is active	
b1	User bit 1	1 = Event selected by parameters 04.43 Event word 1 bit 1 code (and 04.44 Event word 1 bit 1 aux code) is active	
b15	User bit 15	1 = Event selected by parameters 04.71 (and 04.72) is active	
	0000h…FFFFh		1 = 1 / 1 = 1
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.	0 / uint16
	0000…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 / uint32
	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.	0000h / uint16
	0000…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 / uint32
	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.	0000h / uint16
	0000…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 / uint32

No.	Name / Range / Selection	Description	Def / Type FbEq 16b / 32b
	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.	ACS800 Standard ctrl program / uint16
	ACS800 Standard ctrl program	The bit assignments of parameters 04.21…04.32 correspond to the ACS800 Standard control program as follows: • 04.21: 03.05 FAULT WORD 1 • 04.22: 03.06 FAULT WORD 2 • 04.31: 03.08 ALARM WORD 1 • 04.32: 03.09 ALARM WORD 2	0
	ACS800 System ctrl program	The bit assignments of parameters 04.21…04.32 correspond to the ACS800 System control program as follows: • 04.21: 09.01 FAULT WORD 1 • 04.22: 09.02 FAULT WORD 2 • 04.31: 09.04 ALARM WORD 1 • 04.32: 09.04 ALARM WORD 2	1

No.	Name / Range / Selection	Description	Def / Type FbEq 16b / 32b
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 d / uint16
	0...65535 d	On-time counter.	1 = 1 d / 1 = 1 d
05.02	Run-time counter	Motor run-time counter. The counter runs when the inverter modulates.	0 d / uint16
	0...65535 d	Motor run-time counter.	1 = 1 d / 1 = 1 d
05.04	Main 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 d / uint16
	0...65535 d	Cooling fan run-time counter.	1 = 1 d / 1 = 1 d
05.09	Time from power-up	500-microsecond ticks elapsed since the last boot of the control unit.	- / uint32
	0...4294967295	500-microsecond ticks since last boot.	1 = 1 / 1 = 1
05.11	Inverter temperature	Estimated drive temperature in percent of fault limit. The actual trip temperature varies according to the type of the drive. 0.0 % = 0 °C (32 °F) 94 % approx. = Warning limit 100.0 % = Fault limit	- / real32
	-40.0 ... 160.0 %	Drive temperature in percent.	1 = 1 % / 10 = 1 %
05.22	Diagnostic word 3	Diagnostic word 3.	- / uint16
b0…10	Reserved		
b11	Fan command	1 = Drive fan is rotating above idle speed	
b12	Fan service counter	1 = Drive fan service counter has reached its limit	
b13…15	Reserved		
	0000h…FFFFh		1 = 1 / 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.	0 percent / real32
	0...150 %	Main cooling fan age.	1 = 1 % / 1 = 1 %

No.	Name / Range / Selection	Description	Def / Type FbEq 16b / 32b
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 percent / real32
	0…150 %	Auxiliary cooling fan age.	1 = 1 % / 1 = 1 %
05.111	Line converter temperature	*(Only visible when IGBT supply unit control activated by 95.20)* Estimated supply unit temperature in percent of fault limit. 0.0 % = 0 °C (32 °F) 94 % approx. = Warning limit 100.0 % = Fault limit	- / real32
	-40.0 … 160.0 %	Supply unit temperature in percent.	1 = 1 % / 10 = 1 %

No.	Name / Range / Selection	Description	Def / Type FbEq 16b / 32b
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 604. The related status word and state diagram are presented on pages 606 and 607 respectively. **Note:** This parameter is read-only. • Bits 12…15 can be used to carry additional control data, and used as a signal source by any binary-source selector parameter. Bit 10 must be active for bits 12…15 to update. • In fieldbus control, this parameter value is not exactly the same as the control word that the drive receives from the PLC. See parameter 50.12 FBA A debug mode.	- / uint16
06.02	Application control word	The drive control word received from the application program (if any). The bit assignments are described on page 604. This parameter is read-only.	- / uint16
06.03	FBA A transparent control word	Displays the unaltered control word received from the PLC through fieldbus adapter A when a transparent communication profile is selected eg. by parameter group 51 FBA A settings. See section Control word and Status word (page 601). This parameter is read-only.	0 / uint32
	00000000…FFFFFFFFh	Control word received through fieldbus adapter A.	1 = 1
06.04	FBA B transparent control word	Displays the unaltered control word received from the PLC through fieldbus adapter B when a transparent communication profile is selected eg. by parameter group 54 FBA B settings. See section Control word and Status word (page 601). This parameter is read-only.	0 / uint32
	00000000…FFFFFFFFh	Control word received through fieldbus adapter B.	1 = 1
06.05	EFB transparent control word	Displays the unaltered control word received from the PLC through the embedded fieldbus interface when a transparent communication profile is selected in parameter 58.25 Control profile. See section The Transparent profile (page 589). This parameter is read-only.	0 / uint32
	00000000…FFFFFFFFh	Control word received through the embedded fieldbus interface.	1 = 1

No.	Name / Range / Selection	Description	Def / Type FbEq 16b / 32b
06.11	Main status word	Main status word of the drive. The bit assignments are described on page 606. The related control word and state diagram are presented on pages 604 and 607. **Note:** In fieldbus control, this parameter value is not exactly the same as the status word that the drive sends to the PLC. See parameter 50.12 FBA A debug mode. This parameter is read-only.	- / uint16
06.16	Drive status word 1	Drive status word 1. This parameter is read-only.	- / uint16
b0	Enabled	1 = Both run enable (see par. 20.12) and start enable (20.19) signals are present, and Safe torque off has not been activated. **Note:** • In I/O or local control, clearing this bit makes the drive enter the SWITCH-ON INHIBITED state. For further information, see 606. • This bit is not affected by the presence of a fault.	
b1	Inhibited	1 = Start inhibited. See parameters 06.18 and 06.25 for the source of the inhibiting signal.	
b2	DC charged	1 = DC circuit has been charged. If present, the DC switch is closed, and charging switch is open. 0 = Charging not complete. If the inverter unit is not equipped with a DC switch (option +F286), check setting of 95.09.	
b3	Ready to start	1 = Drive is ready to receive a start command	
b4	Following reference	1 = Drive is ready to follow given reference	
b5	Started	1 = Drive has been started	
b6	Modulating	1 = Drive is modulating (output stage is being controlled)	
b7	Limiting	1 = Any operating limit (speed, torque, etc.) is active	
b8	Local control	1 = Drive is in local control	
b9	Network control	1 = Drive is in network control. See Terms and abbreviations (page 19).	
b10	Ext1 active	1 = Control location EXT1 active	
b11	Ext2 active	1 = Control location EXT2 active	
b12	Reserved		
b13	Start request	1 = Start requested **Note:** At the time of publishing, a start request from the control panel does not activate this bit if any start-inhibiting condition (see bit 1) is present.	

No.	Name / Range / Selection	Description	Def / Type FbEq 16b / 32b
b14…15	Reserved		
	0000h…FFFFh		1 = 1 / 1 = 1
06.17	Drive status word 2	Drive status word 2. This parameter is read-only.	- / uint16
b0	Identification run done	1 = Motor identification (ID) run has been performed	
b1	Magnetized	1 = The motor has been magnetized	
b2	Torque control	1 = Torque control mode active	
b3	Speed control	1 = Speed control mode active	
b4	Voltage control	Reserved	
b5	Safe reference active	1 = A “safe” reference is being applied by functions such as parameters 49.05 and 50.02.	
b6	Last speed active	1 = A “last speed” reference is being applied by functions such as parameters 49.05 and 50.02.	
b7	Loss of reference	1 = Reference signal lost	
b8	Emergency stop failed	1 = Emergency stop failed (see parameters 31.32 and 31.33).	
b9	Jogging active	1 = Jogging enable signal is on	
b10	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.	
b11	Emergency stop active	1 = An emergency stop command signal is active, or the drive is stopping after receiving an emergency stop command.	
b12	Reduced run	1 = Reduced run active (see section Reduced run function (page 122)).	
b13	Reserved		
b14	Stop failed	1 = Stopping failed (see parameters 31.37 and 31.38)	
b15	Reserved		
	0000h…FFFFh		1 = 1 / 1 = 1

No.	Name / Range / Selection	Description	Def / Type FbEq 16b / 32b
06.18	Start inhibit status word	Start inhibit status word. This word specifies the source of the inhibiting condition that is preventing the drive from starting. After the condition is removed, the start command must be cycled. See bit-specific notes. See also parameter 06.25 Drive inhibit status word 2, and 06.16 Drive status word 1, bit 1. This parameter is read-only. **Note:** • If bit 1 of 06.16 Drive status word 1 is still set after the removal of the inhibiting condition, and edge triggering is selected for the active external control location, a fresh rising-edge start signal is required. See parameters 20.02, 20.07 and 20.19. • If bit 1 of 06.16 Drive status word 1 is still set after the removal of the inhibiting condition, a fresh rising-edge start signal is required. • Informative bit. The inhibiting condition need not be removed by the user.	- / uint16
b0	Not ready run	1 = DC voltage is missing or drive has not been parametrized correctly. Check the parameters in groups 95 and 99.	
b1	Ctrl location changed	1 = Control location has changed	
b2	SSW inhibit	1 = Control program is keeping itself in inhibited state	
b3	Fault	1 = A fault is active	
b4	Lost start enable	1 = Start enable signal missing	
b5	Lost run enable	1 = Run enable signal missing	
b6	FSO inhibit	1 = Operation prevented by FSO-xx safety functions module	
b7	STO	1 = Safe torque off active	
b8	Current calibration ended	1 = Current calibration routine has finished	
b9	ID run ended	1 = Motor identification run has finished	
b10	Auto phase ended	1 = Autophasing routine has finished	
b11	Off1	1 = Emergency stop signal (mode Off1)	
b12	Em Off2	1 = Emergency stop signal (mode Off2)	
b13	Em Off3	1 = Emergency stop signal (mode Off3)	
b14	Auto reset inhibit	1 = The autoreset function is inhibiting operation	
b15	Jogging active	1 = The jogging enable signal is inhibiting operation	
	0000h…FFFFh		1 = 1 / 1 = 1

No.	Name / Range / Selection	Description	Def / Type FbEq 16b / 32b
06.19	Speed control status word	Speed control status word. This parameter is read-only.	- / uint16
b0	Zero speed	1 = Drive is running at zero speed, ie. the absolute value of par. 90.01 Motor speed for control has remained below 21.06 Zero speed limit for longer than 21.07 Zero speed delay.	
b1	Forward	1 = Drive is running in forward direction above zero speed limit, ie. [90.01] > +[21.06].	
b2	Reverse	1 = Drive is running in reverse direction above zero speed limit, ie. [90.01] < -[21.06].	
b3	Out of window	1 = Speed error window control active (see par. 24.41)	
b4	Internal speed feed-back	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 used for speed feedback	
b5	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)	
b6	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)	
b7	Constant speed req	1 = A constant speed or frequency has been selected; see par. 06.20.	
b8	MF speed corr min	1 = Minimum limit of speed correction (in a speed-controlled follower) has been reached (see par. 23.39…23.41).	
b9	MF speed corr max	1 = Maximum limit of speed correction (in a speed-controlled follower) has been reached (see par. 23.39…23.41).	
b10…15	Reserved		
	0000h…FFFFh		1 = 1 / 1 = 1
06.20	Constant speed status word	Constant speed/frequency status word. Indicates which constant speed or frequency is active (if any). See also parameter 06.19 Speed control status word, bit 7, and section Constant speeds/frequencies. This parameter is read-only.	- / uint16
b0	Constant speed 1	1 = Constant speed or frequency 1 selected	
b1	Constant speed 2	1 = Constant speed or frequency 2 selected	
b2	Constant speed 3	1 = Constant speed or frequency 3 selected	
b3	Constant speed 4	1 = Constant speed or frequency 4 selected	

No.	Name / Range / Selection	Description	Def / Type FbEq 16b / 32b
b4	Constant speed 5	1 = Constant speed or frequency 5 selected	
b5	Constant speed 6	1 = Constant speed or frequency 6 selected	
b6	Constant speed 7	1 = Constant speed or frequency 7 selected	
b7…15	Reserved		
	0000h…FFFFh		1 = 1 / 1 = 1
06.21	Drive status word 3	Drive status word 3. This parameter is read-only.	- / uint16
b0	DC hold active	1 = DC hold is active (see par. 21.08)	
b1	Post-magnetizing active	1 = Post-magnetizing is active (see par. 21.08)	
b2	Motor pre-heating active	1 = Motor pre-heating is active (see par. 21.14)	
b3	Smooth start active	Reserved	
b4	Rotor position known	1 = Rotor position has been determined (autophasing not needed). See section Autophasing (page 93).	
b5	Brake chopper active	Brake chopper active. See section Brake chopper (page 105).	
b6	Motor temperature estimation active	1 = Motor temperature estimation.	
b7	FSO speed estimate reversed	FSO speed estimate has been reversed.	
b8…15	Reserved		
	0000h…FFFFh		1 = 1 / 1 = 1
06.25	Drive inhibit status word 2	Drive inhibit status word 2. This word specifies the source of the inhibiting condition that is preventing the drive from starting. After the condition is removed, the start command must be cycled. See bit-specific notes. See also parameter 06.18 Start inhibit status word, and 06.16 Drive status word 1, bit 1. This parameter is read-only. **Note:** • If bit 1 of 06.16 Drive status word 1 is still set after the removal of the inhibiting condition, and edge triggering is selected for the active external control location, a fresh rising-edge start signal is required. See parameters 20.02, 20.07 and 20.19. • If bit 1 of 06.16 Drive status word 1 is still set after the removal of the inhibiting condition, a fresh rising-edge start signal is required.	- / uint16
b0	Follower drive	1 = A follower is preventing the master from starting.	
b1	Application	1 = The application program is preventing the drive from starting.	

No.	Name / Range / Selection	Description	Def / Type FbEq 16b / 32b
b2	Reserved		
b3	Encoder feedback	1 = The encoder feedback configuration is preventing the drive from starting.	
b4	Ref source parametrization	1 = A reference source parametrization conflict is preventing the drive from starting. See warning A6DA Reference source parametrization.	
b5…15	Reserved		
	0000h…FFFFh		1 = 1 / 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 / uint32
	False	0	0
	True	1	1
	Above limit	Bit 10 of 06.17 Drive status word 2 (page 159).	2
	Other [bit]	See Terms and abbreviations (page 132).	-
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 / uint32
	False	0	0
	True	1	1
	Ext ctrl loc	Bit 11 of 06.01 Main control word (page 157).	2
	Other [bit]	See Terms and abbreviations (page 132).	-
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 / uint32
	False	0	0
	True	1	1
	Ext run enable	Inverted bit 5 of 06.18 Start inhibit status word (page 160).	2
	Other [bit]	See Terms and abbreviations (page 132).	-
06.32	MSW bit 13 sel	Selects a binary source whose status is transmitted as bit 13 of 06.11 Main status word.	False / uint32
	False	0	0
	True	1	1
	Other [bit]	See Terms and abbreviations (page 132).	-
06.33	MSW bit 14 sel	Selects a binary source whose status is transmitted as bit 14 of 06.11 Main status word.	False / uint32
	False	0	0
	True	1	1
	Other [bit]	See Terms and abbreviations (page 132).	-

No.	Name / Range / Selection	Description	Def / Type FbEq 16b / 32b
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.	- / uint16
b0	User status bit 0	Status of source selected by parameter 06.60.	
b1	User status bit 1	Status of source selected by parameter 06.61.	
b2	User status bit 2	Status of source selected by parameter 06.62.	
b3	User status bit 3	Status of source selected by parameter 06.63.	
b4	User status bit 4	Status of source selected by parameter 06.64.	
b5	User status bit 5	Status of source selected by parameter 06.65.	
b6	User status bit 6	Status of source selected by parameter 06.66.	
b7	User status bit 7	Status of source selected by parameter 06.67.	
b8	User status bit 8	Status of source selected by parameter 06.68.	
b9	User status bit 9	Status of source selected by parameter 06.69.	
b10	User status bit 10	Status of source selected by parameter 06.70.	
b11	User status bit 11	Status of source selected by parameter 06.71.	
b12	User status bit 12	Status of source selected by parameter 06.72.	
b13	User status bit 13	Status of source selected by parameter 06.73.	
b14	User status bit 14	Status of source selected by parameter 06.74.	
b15	User status bit 15	Status of source selected by parameter 06.75.	
	0000h…FFFFh		1 = 1 / 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 / uint32
	FALSE	0	0
	TRUE	1	1
	Other [bit]	See Terms and abbreviations (page 132).	-
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 / uint32
	False	0	0
	True	1	1
	Out of window	Bit 3 of 06.19 Speed control status word (page 161).	2
	Other [bit]	See Terms and abbreviations (page 132).	-
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 / uint32
	False	0	0
	True	1	1

No.	Name / Range / Selection	Description	Def / Type FbEq 16b / 32b
	Emergency stop failed	Bit 8 of 06.17 Drive status word 2 (page 159).	2
	Other [bit]	See Terms and abbreviations (page 132).	-
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 / uint32
	False	0	0
	True	1	1
	Magnetized	Bit 1 of 06.17 Drive status word 2 (page 159).	2
	Other [bit]	See Terms and abbreviations (page 132).	-
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 / uint32
	False	0	0
	True	1	1
	Run disable	Bit 5 of 06.18 Start inhibit status word.	2
	Other [bit]	See Terms and abbreviations (page 132).	-
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 / uint32
	FALSE	0	0
	TRUE	1	1
	Other [bit]	See Terms and abbreviations (page 132).	-
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 / uint32
	FALSE	0	0
	TRUE	1	1
	Other [bit]	See Terms and abbreviations (page 132).	-
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 / uint32
	False	0	0
	True	1	1
	Identification run done	Bit 0 of 06.17 Drive status word 2 (page 159).	2
	Other [bit]	See Terms and abbreviations (page 132).	-
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 / uint32
	False	0	0
	True	1.	1
	Start inhibition	Bit 7 of 06.18 Start inhibit status word (page 160).	2
	Other [bit]	See Terms and abbreviations (page 132).	-
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 / uint32

No.	Name / Range / Selection	Description	Def / Type FbEq 16b / 32b
	False	0	0
	True	1	1
	Limiting	Bit 7 of 06.16 Drive status word 1 (page 158).	2
	Other [bit]	See Terms and abbreviations (page 132).	-
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 / uint32
	False	0	0
	True	1	1
	Torque control	Bit 2 of 06.17 Drive status word 2 (page 159).	2
	Other [bit]	See Terms and abbreviations (page 132).	-
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 / uint32
	False	0	0
	True	1	1
	Zero speed	Bit 0 of 06.19 Speed control status word (page 161).	2
	Other [bit]	See Terms and abbreviations (page 132).	-
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 / uint32
	False	0	0
	True	1	1
	Internal speed feedback	Bit 4 of 06.19 Speed control status word (page 161).	2
	Other [bit]	See Terms and abbreviations (page 132).	-
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 / uint32
	FALSE	0	0
	TRUE	1	1
	Other [bit]	See Terms and abbreviations (page 132).	-
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 / uint32
	FALSE	0	0
	TRUE	1	1
	Other [bit]	See Terms and abbreviations (page 132).	-
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 / uint32
	FALSE	0	0
	TRUE	1	1
	Other [bit]	See Terms and abbreviations (page 132).	-
06.100	User control word 1	User-defined control word 1.	0000h / uint16

No.	Name / Range / Selection	Description	Def / Type FbEq 16b / 32b
b0	User control word 1 bit 0 sel	User-defined bit.	
b1	User control word 1 bit 1 sel	User-defined bit.	
b2	User control word 1 bit 2 sel	User-defined bit.	
b3	User control word 1 bit 3 sel	User-defined bit.	
b4	User control word 1 bit 4 sel	User-defined bit.	
b5	User control word 1 bit 5 sel	User-defined bit.	
b6	User control word 1 bit 6 sel	User-defined bit.	
b7	User control word 1 bit 7 sel	User-defined bit.	
b8	User control word 1 bit 8 sel	User-defined bit.	
b9	User control word 1 bit 9 sel	User-defined bit.	
b10	User control word 1 bit 10 sel	User-defined bit.	
b11	User control word 1 bit 11 sel	User-defined bit.	
b12	User control word 1 bit 12 sel	User-defined bit.	
b13	User control word 1 bit 13 sel	User-defined bit.	
b14	User control word 1 bit 14 sel	User-defined bit.	
b15	User control word 1 bit 15 sel	User-defined bit.	
	0000h…FFFFh		1 = 1 / 1 = 1
06.101	User control word 2	User-defined control word 2.	0000h / uint16
b0	User control word 2 bit 0 sel	User-defined bit.	
b1	User control word 2 bit 1 sel	User-defined bit.	
b2	User control word 2 bit 2 sel	User-defined bit.	
b3	User control word 2 bit 3 sel	User-defined bit.	
b4	User control word 2 bit 4 sel	User-defined bit.	

No.	Name / Range / Selection	Description	Def / Type FbEq 16b / 32b
b5	User control word 2 bit 5 sel	User-defined bit.	
b6	User control word 2 bit 6 sel	User-defined bit.	
b7	User control word 2 bit 7 sel	User-defined bit.	
b8	User control word 2 bit 8 sel	User-defined bit.	
b9	User control word 2 bit 9 sel	User-defined bit.	
b10	User control word 2 bit 10 sel	User-defined bit.	
b11	User control word 2 bit 11 sel	User-defined bit.	
b12	User control word 2 bit 12 sel	User-defined bit.	
b13	User control word 2 bit 13 sel	User-defined bit.	
b14	User control word 2 bit 14 sel	User-defined bit.	
b15	User control word 2 bit 15 sel	User-defined bit.	
	0000h…FFFFh		1 = 1 / 1 = 1

No.	Name / Range / Selection	Description	Def / Type FbEq 16b / 32b
07	System info	Information on drive hardware, firmware and application program. All parameters in this group are read-only.	
07.03	Drive rating id	Type of the drive/inverter unit.	- / uint16
07.04	Firmware name	Firmware identification. The format is AINFX, where X denotes the control unit type (2 or B = BCU-x2, 6 or C = ZCU-12/14).	- / uint32
07.05	Firmware version	Version number of the firmware. The format is A.BB.C.D, where A = major version, B = minor version, C = patch (ie. firmware variant code), D = 0.	- / uint32
07.06	Loading package name	Name of the firmware loading package. The format is AINLX, where X denotes the control unit type (2 or B = BCU-x2, 6 or C = ZCU-12/14).	- / uint32
07.07	Loading package version	Version number of the firmware loading package. See parameter 07.05.	- / uint32
07.08	Bootloader version	Version number of the firmware bootloader.	- / uint32
07.11	Cpu usage	Shows microprocessor load in percent.	- / uint32
	0…100 %	Microprocessor load.	1 = 1 % / 1 = 1 %
07.13	PU logic version number	Version number of the power unit logic. The value of FFFF indicates that the version numbers of parallel-connected power units are different. See the drive information on the control panel.	- / uint16
07.14	FPGA logic version name	Version name of the FPGA logic of the control unit.	- / uint32
07.15	FPGA logic version number	Version number of the FPGA logic of the control unit.	- / uint16
07.21	Application environment status 1	*(Only visible with option +N8010 [application programmability])* Shows which tasks of the application program are running. See the *Drive (IEC 61131-3) application programming manual* (3AUA0000127808 [English]).	- / uint16
b0	Pre task	1 = Pre-task running.	
b1	Appl task1	1 = Task 1 running.	
b2	Appl task2	1 = Task 2 running.	
b3	Appl task3	1 = Task 3 running.	
b4…14	Reserved		
b15	Task monitoring	1 = Task monitoring enabled.	
	0000h…FFFFh		1 = 1 / 1 = 1

No.	Name / Range / Selection	Description	Def / Type FbEq 16b / 32b
07.22	Application environment status 2	*(Only visible with option +N8010 [application programmability])* Shows the status of the openings in the application program. See the *Drive (IEC 61131-3) application programming manual* (3AUA0000127808 [English]).	- / uint16
b0	Opening1	Status of opening 1 in the application program.	
b1	Opening2	Status of opening 2 in the application program.	
b2	Opening3	Status of opening 3 in the application program.	
b3	Opening4	Status of opening 4 in the application program.	
b4	Opening5	Status of opening 5 in the application program.	
b5	Opening6	Status of opening 6 in the application program.	
b6	Opening7	Status of opening 7 in the application program.	
b7	Opening8	Status of opening 8 in the application program.	
b8	Opening9	Status of opening 9 in the application program.	
b9	Opening10	Status of opening 10 in the application program.	
b10	Opening11	Status of opening 11 in the application program.	
b11	Opening12	Status of opening 12 in the application program.	
b12	Opening13	Status of opening 13 in the application program.	
b13	Opening14	Status of opening 14 in the application program.	
b14	Opening15	Status of opening 15 in the application program.	
b15	Opening16	Status of opening 16 in the application program.	
	0000h…FFFFh		1 = 1 / 1 = 1
07.23	Application name	*(Only visible with option +N8010 [application programmability])* 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.	- / uint32
07.24	Application version	*(Only visible with option +N8010 [application programmability])* 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.	- / uint32
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.	- / uint32

No.	Name / Range / Selection	Description	Def / Type FbEq 16b / 32b
07.26	Customization package version	Customization package version number. Also visible under System info on the control panel or the Drive Composer PC tool.	- / uint32
07.30	Adaptive program status	Shows the status of the adaptive program. See section Adaptive programming (page 71).	0000h / uint16
b0	Initialized	1 = Adaptive program initialized	
b1	Editing	1 = Adaptive program is being edited	
b2	Edit done	1 = Editing of adaptive program finished	
b3	Running	1 = Adaptive program running	
b4…13	Reserved		
b14	State changing	Reserved	
b15	Faulted	1 = Error in adaptive program	
	0000h…FFFFh		1 = 1 / 1 = 1
07.40	IEC application Cpu usage peak	*(Only visible with option +N8010 [application programmability])* Displays the peak loading of the microprocessor caused by the application program. This parameter can, for example, be used to check the effect of a given application program functionality on the CPU load. The value is in percent of an internal quota. Can be reset from the control panel by keeping Reset depressed for over 3 seconds.	- / real32
	0.0 ... 100.0 %	Peak microprocessor loading caused by application program.	10 = 1 % / 10 = 1 %
07.41	IEC application Cpu load average	*(Only visible with option +N8010 [application programmability])* Displays the average loading of the microprocessor caused by the application program. The value is in percent of an internal quota.	- / real32
	0.0 ... 100.0 %	Average microprocessor loading caused by application program.	10 = 1 % / 10 = 1 %
07.51	Slot 1 option module	Displays the type of module detected in slot 1 of the drive control unit.	- / uint16
07.52	Slot 2 option module	Displays the type of module detected in slot 2 of the drive control unit.	- / uint16
07.53	Slot 3 option module	Displays the type of module detected in slot 3 of the drive control unit.	- / uint16
07.54	Slot 1 module logic version	Displays the FPGA logic version of module detected in slot 1 of the drive control unit. The logic version is detected for DDCS option modules, for example, FEN encoder modules (FEN-01, FEN-11, FEN-21, FEN-31) and I/O modules (FIO-11, FDIO-01, FAIO-01).	0 / uint16

No.	Name / Range / Selection	Description	Def / Type FbEq 16b / 32b
	0000…FFFFh	Logic version of module detected in slot 1.	1 = 1
07.55	Slot 1 module software version	Displays the software version of module detected in slot 1 of the drive control unit.	- / uint16
07.56	Slot 2 module logic version	Displays the FPGA logic version of module detected in slot 2 of the drive control unit. The logic version is detected for DDCS option modules, for example, FEN encoder modules (FEN-01, FEN-11, FEN-21, FEN-31) and I/O modules (FIO-11, FDIO-01, FAIO-01).	0 / uint16
	0000…FFFFh	Logic version of module detected in slot 2.	1 = 1
07.57	Slot 2 module software version	Displays the software version of module detected in slot 2 of the drive control unit.	- / uint16
07.58	Slot 3 module logic version	Displays the FPGA logic version of module detected in slot 3 of the drive control unit. The logic version is detected for DDCS option modules, for example, FEN encoder modules (FEN-01, FEN-11, FEN-21, FEN-31) and I/O modules (FIO-11, FDIO-01, FAIO-01).	0 / uint16
	0000…FFFFh	Logic version of module detected in slot 3.	1 = 1
07.59	Slot 3 module software version	Displays the software version of module detected in slot 3 of the drive control unit.	- / uint16

No.	Name / Range / Selection	Description	Def / Type FbEq 16b / 32b
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 Nm / real32
	-100000.00 … 100000.00 Nm	Value range. For 16-bit scaling, see parameter 46.200 Rod torque scaler.	10 = 1 Nm / 1 = 1 Nm
09.02	Maximum rod torque	Maximum allowed pump torque in engineering units.	0.00 Nm / real32
	-100000.00 … 100000.00 Nm	Value range. For 16-bit scaling, see parameter 46.200 Rod torque scaler.	10 = 1 Nm / 1 = 1 Nm
09.03	Motor torque	Actual motor torque in engineering units.	0.00 Nm / real32
	-100000.00 … 100000.00 Nm	Value range. For 16-bit scaling, see parameter 46.200 Rod torque scaler.	10 = 1 Nm / 1 = 1 Nm
09.04	Maximum motor torque	Maximum allowed motor torque in engineering units.	0.00 Nm / real32
	-100000.00 … 100000.00 Nm	Value range. For 16-bit scaling, see parameter 46.200 Rod torque scaler.	10 = 1 Nm / 1 = 1 Nm
09.05	Rod speed	Pump speed in engineering units.	0.00 Prpm / real32
	-100000.00 … 100000.00 Prpm	Value range. For 16-bit scaling, see parameter 46.201.	10 = 1 Prpm / 1 = 1 Prpm
09.06	Motor speed reference	Motor speed reference in engineering units.	0.00 rpm / real32
	-100000.00 … 100000.00 rpm	Value range. For 16-bit scaling, see parameter 46.203.	1 = 1 rpm / 1 = 1 rpm
09.07	Run-time hours	Runtime of the pump in hours.	0.00 h / real32
	0.00 … 100000.00 h	Value range.	10 = 1 h / 1 = 1 h
09.08	Fluid level	Measured fluid level in depth units.	0.00 m / real32
	-100000.00 … 100000.00 m	Value range.	100 = 1 m / 1 = 1 m
09.09	Pressure	Measured pressure in engineering units.	0.00 kPa / real32
	-100000.00 … 100000.00 kPa	Value range.	100 = 1 kPa / 1 = 1 kPa
09.10	Measured temperature	Measured temperature in engineering units.	0.00 C / real32
	-100000.00 … 100000.00 C	Value range.	10 = 1 C / 1 = 1 C
09.11	Backspin speed reference	Speed reference for controllable shutdown procedure.	0.00 Prpm / real32
	-100000.00 … 100000.00 Prpm	Value range.	10 = 1 Prpm / 1 = 1 Prpm
09.12	Start delay remain	Remaining start delay time.	0.000 s / uint32

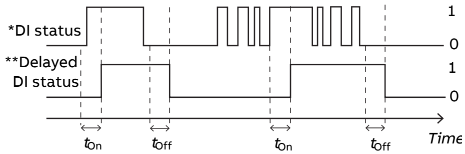
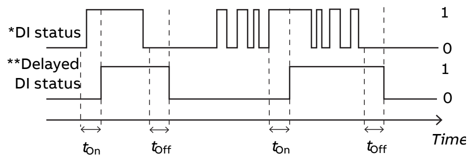
No.	Name / Range / Selection	Description	Def / Type FbEq 16b / 32b
	0.000 … 4294967295.000 s	Value range.	10 = 1 s / 1 = 1 s
09.13	Backspin status word	Pump backspin status word.	0000 0000 0000 0000 / uint16
b0	Backspin enabled	Backspin function is enabled.	
b1	Backspin operation active	Backspin function is active.	
b2	Backspin limit active	Backspin limit is reached.	
b3…9	Reserved		
b10	Start delay enabled	Start delay function is enabled.	
b11	Start delay timer active	Start delay function is active.	
b12…15	Reserved		
	0000h…FFFFh		1 / 1
09.14	Pump status word	Pump control program status word.	0000 0000 0000 0000 / uint16
b0	Thermal protection alarm level reached	Alarm due to thermal protection failure.	
b1	Thermal protection fault level reached	Drive tripped due to thermal protection failure.	
b2	Thermal protection active	Actual temperature for thermal protection.	
b3	High pressure presented - digital sensor	High pressure measured by digital sensor.	
b4	High pressure presented - analogue sensor	Start delay function is active.	
b5	High pressure protection active	Actual value for high pressure protection.	
b6	Underload protection active	Actual value for underload protection.	
b7	Rod torque 1 active	Actual rod torque 1.	
b8	Rod torque 2 active	Actual rod torque 2.	
b9	Torque protection active	Actual value for torque protection.	
b10	Sleep mode active	Actual value for sleep mode.	
b11	Fault delay active	Fault delay is active.	
b12	Replace battery	Battery from ZCU is needed to replace.	
b13	Brake confirm active	Brake confirm is active.	

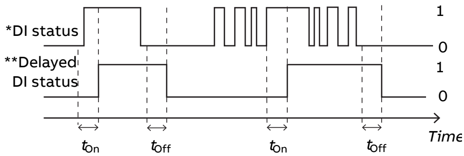
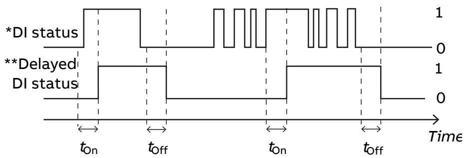
No.	Name / Range / Selection	Description	Def / Type FbEq 16b / 32b
b14	Starting speed active	Drive is ready for startup ramp.	
b15	Rod torque 2 speed	Pump status word.	
	0000h…FFFFh		1 / 1
09.15	Sleep feedback value	Integrated value of sleep signal feedback from different sources 75.34 Sleep signal source 1 and 75.35 Sleep signal source 2.	0.00 SourceUnit / real32
	-100000.00 ... 100000.00 SourceUnit	Value range.	1 = 1 SourceUnit / 1 = 1 SourceUnit
09.16	Sleep time	Period of time when pump is in sleep mode.	0.000 s / uint32
	0.000 ... 100000000.000 s	Value range.	10 = 1 s / 1 = 1 s
09.17	Backspin operation	Shows actual state of backspin.	Not active / uint32
	Not active	Backspin operation is not active.	0
	Active	Backspin operation is active.	1
09.18	Fault word 1	The bit assignments of this word correspond to a FAULT.	0000 0000 0000 0000 / uint16
b0	Short circuit	See event 2340 (page 522).	
b1	Overcurrent	See event 2310 (page 521).	
b2	DC overvoltage	See event 3210 (page 523).	
b3	ACS880 Temp	See events 2381 (page 522), 4210 (page 525), 4290 (page 525), 42F1 (page 526), 4310 (page 526), 4380 (page 526).	
b4	Earth fault	See event 2330 (page 521), 2392 (page 523), 3181 (page 523).	
b5	Thermistor	See event 4981 (page 526).	
b6	Motor temperature	See event 4982 (page 526).	
b7	System fault	See events 6481 (page 531), 6487 (page 531), 64A1 (page 531), 64A2 (page 531), 64A3 (page 531), 64B1 (page 532), 64E1 (page 532), 6881 (page 533), 6882 (page 533), 6883 (page 533), 6885 (page 533).	
b8	Unverload	See event D101 (page 559), D202 (page 560).	
b9	Overfreq	See event 7310 (page 535).	
b10	Line converter	Reserved	
b11…15	Reserved		
	0000h…FFFFh		1 / 1
09.19	Fault word 2	The bit assignments of this word correspond to a FAULT.	0000 0000 0000 0000 / uint16
b0	Supply phase	See event 3130 (page 523).	

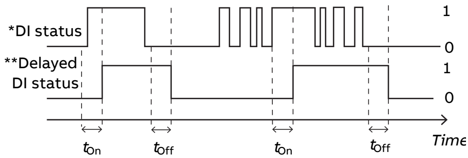
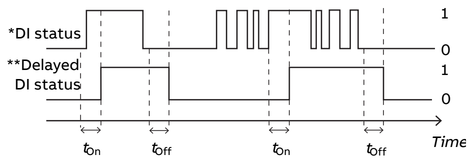
No.	Name / Range / Selection	Description	Def / Type FbEq 16b / 32b
b1	No motor data	See event A6A5 (page 546).	
b2	DC unvdervolt	See event 3220 (page 524).	
b3	External fault	See events 9081 (page 538), 9082 (page 538), 9083 (page 538), 9084 (page 538), 9085 (page 539).	
b4	Run disable	See event AFEB (page 558).	
b5	Encoder fault	See event 7301 (page 535), 7380 (page 536), 7381 (page 536), 73A0 (page 536), 73A1 (page 536).	
b6	IO fault	See event 7080 (page 533), 7082 (page 534).	
b7	Reserved		
b8	AI<Min	See event 80A0 (page 538).	
b9…10	Reserved		
b11	PPCC link fault	See events 5681 (page 528), 5682 (page 528), 5690 (page 529), 5691 (page 529), 5692 (page 529), 5693 (page 529), 5694 (page 529).	
b12	Comm module	See event 6881 (page 533), 7510 (page 537), 7520 (page 537).	
b13	Panel loss	See event 7081 (page 533).	
b14	Motor stall	See event 7121 (page 534).	
b15	Motor phase fault	See event 3381 (page 524).	
	0000h…FFFFh		1 / 1
09.20	Application status word	Application status word.	0000 0000 0000 0000 / uint16
b0	High pressure	Pressure protection digital sensor is active.	
b1	High discharge pressure	Pressure protection analog sensor is active.	
b2	Rod torque 1 limit	Rod torque 1 protection is active.	
b3	Rod torque 2 limit	Rod torque 2 protection is active.	
b4	Rod torque 2 speed act	Rod torque 2 speed act.	
b5	Backspin limit	Backspin limit is reached.	
b6	Underload	Underload protection is active.	
b7	High pump temp	Thermal protection is active.	
b8	Reserved		
b9	Motor stall warning	Motor stall warning is active. See parameter 31.24.	
b10	External fault	External fault is active. See parameters 31.01...31.10.	
b11	AI<Min	An analog signal is outside the limits specified for the analog input.	
b12	Panel loss	Control panel connection loss.	

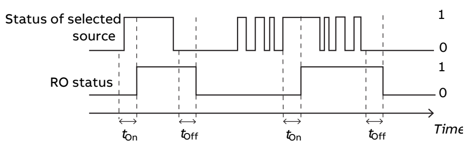
No.	Name / Range / Selection	Description	Def / Type FbEq 16b / 32b
b13	Relay out 1 status	Status of relay 1.	
b14	Relay out 2 status	Status of relay 2.	
b15	Relay out 3 status	Status of relay 3.	
	0000h…FFFFh		1 / 1
09.70	Inverter kWh motoring	Amount of energy that has passed through the drive (towards the motor) in full kilowatt-hours. Whenever the counter rolls over, parameter 01.19 Inverter MWh motoring (page 137) is incremented. The minimum value is zero.	0 kWh / real32
	0...1000 kWh	Amount of energy in kilowatt-hour.	1 = 1 kWh / 1 = 1 kWh

No.	Name / Range / Selection	Description	Def / Type FbEq 16b / 32b
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.	- / uint16
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). A filtering time can be defined by parameter 10.51 DI filter time. 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.	- / uint16
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 / uint16
b0	DI1	1 = Force DI1 to value of bit 0 of parameter 10.04 DI force data.	
b1	DI2	1 = Force DI2 to value of bit 1 of parameter 10.04 DI force data.	
b2	DI3	1 = Force DI3 to value of bit 2 of parameter 10.04 DI force data.	
b3	DI4	1 = Force DI4 to value of bit 3 of parameter 10.04 DI force data.	
b4	DI5	1 = Force DI5 to value of bit 4 of parameter 10.04 DI force data.	
b5	DI6	1 = Force DI6 to value of bit 5 of parameter 10.04 DI force data.	
b6…14	Reserved		
b15	DIIL	1 = Force DIIL to value of bit 15 of parameter 10.04 DI force data.	
	0000h…FFFFh		1 = 1 / 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.	- / uint16

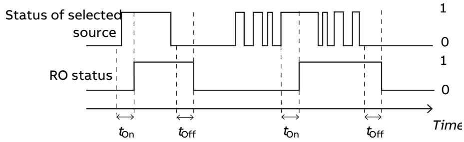
No.	Name / Range / Selection	Description	Def / Type FbEq 16b / 32b
10.05	DI1 ON delay	Defines the activation delay for digital input DI1.  t_{On} = 10.05 DI1 ON delay t_{Off} = 10.06 DI1 OFF delay *Electrical status of digital input. Indicated by 10.01 DI status. **Indicated by 10.02 DI delayed status.	0.0 s / uint32
	0.0 … 3000.0 s	Activation delay for DI1.	10 = 1 s / 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 / uint32
	0.0 … 3000.0 s	Deactivation delay for DI1.	10 = 1 s / 10 = 1 s
10.07	DI2 ON delay	Defines the activation delay for digital input DI2.  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 s / uint32
	0.0 … 3000.0 s	Activation delay for DI2.	10 = 1 s / 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 / uint32
	0.0 … 3000.0 s	Deactivation delay for DI2.	10 = 1 s / 10 = 1 s

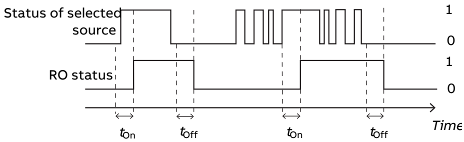
No.	Name / Range / Selection	Description	Def / Type FbEq 16b / 32b
10.09	DI3 ON delay	Defines the activation delay for digital input DI3.  t_{On} = 10.09 DI3 ON delay t_{Off} = 10.10 DI3 OFF delay *Electrical status of digital input. Indicated by 10.01 DI status. **Indicated by 10.02 DI delayed status.	0.0 s / uint32
	0.0 ... 3000.0 s	Activation delay for DI3.	10 = 1 s / 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 / uint32
	0.0 ... 3000.0 s	Deactivation delay for DI3.	10 = 1 s / 10 = 1 s
10.11	DI4 ON delay	Defines the activation delay for digital input DI4.  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 s / uint32
	0.0 ... 3000.0 s	Activation delay for DI4.	10 = 1 s / 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 / uint32
	0.0 ... 3000.0 s	Deactivation delay for DI4.	10 = 1 s / 10 = 1 s

No.	Name / Range / Selection	Description	Def / Type FbEq 16b / 32b
10.13	DI5 ON delay	Defines the activation delay for digital input DI5.  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.	0.0 s / uint32
	0.0 ... 3000.0 s	Activation delay for DI5.	10 = 1 s / 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 / uint32
	0.0 ... 3000.0 s	Deactivation delay for DI5.	10 = 1 s / 10 = 1 s
10.15	DI6 ON delay	Defines the activation delay for digital input DI6.  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.	0.0 s / uint32
	0.0 ... 3000.0 s	Activation delay for DI6.	10 = 1 s / 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 / uint32
	0.0 ... 3000.0 s	Deactivation delay for DI6.	10 = 1 s / 10 = 1 s
10.21	RO status	Status of relay outputs RO8…RO1. **Example:** 00000001b = RO1 is energized, RO2…RO8 are de-energized.	- / uint16
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) / uint32
	Not energized	Output is not energized.	0
	Energized	Output is energized.	1
	Ready run	Bit 1 of 06.11 Main status word (page 158).	2

No.	Name / Range / Selection	Description	Def / Type FbEq 16b / 32b
	Enabled	Bit 0 of 06.16 Drive status word 1 (page 158).	4
	Started	Bit 5 of 06.16 Drive status word 1 (page 158).	5
	Magnetized	Bit 1 of 06.17 Drive status word 2 (page 159).	6
	Running	Bit 6 of 06.16 Drive status word 1 (page 158).	7
	Ready ref	Bit 2 of 06.11 Main status word (page 158).	8
	At setpoint	Bit 8 of 06.11 Main status word (page 158).	9
	Reverse	Bit 2 of 06.19 Speed control status word (page 161).	10
	Zero speed	Bit 0 of 06.19 Speed control status word (page 161).	11
	Above limit	Bit 10 of 06.17 Drive status word 2 (page 159).	12
	Warning	Bit 7 of 06.11 Main status word (page 158).	13
	Fault	Bit 3 of 06.11 Main status word (page 158).	14
	Fault (-1)	Inverted bit 3 of 06.11 Main status word (page 158).	15
	Start request	Bit 13 of 06.16 Drive status word 1 (page 158).	16
	Open brake command	Bit 0 of 44.01 Brake control status.	22
	Ext2 active	Bit 11 of 06.16 Drive status word 1 (page 158).	23
	Remote control	Bit 9 of 06.11 Main status word (page 158).	24
	Supervision 1	Bit 0 of 32.01 Supervision status (page 331).	33
	Supervision 2	Bit 1 of 32.01 Supervision status (page 331).	34
	Supervision 3	Bit 2 of 32.01 Supervision status (page 331).	35
	RO/DIO control word bit0	Bit 0 of 10.99 RO/DIO control word (page 185).	40
	RO/DIO control word bit1	Bit 1 of 10.99 RO/DIO control word (page 185).	41
	RO/DIO control word bit2	Bit 2 of 10.99 RO/DIO control word (page 185).	42
	RO/DIO control word bit8	Bit 8 of 10.99 RO/DIO control word (page 185).	43
	RO/DIO control word bit9	Bit 9 of 10.99 RO/DIO control word (page 185).	44
	Other [bit]	See Terms and abbreviations (page 132).	-
10.25	RO1 ON delay	Defines the activation delay for relay output RO1.  t_{On} = 10.25 RO1 ON delay t_{Off} = 10.26 RO1 OFF delay	0.0 s / uint32
	0.0 … 3000.0 s	Activation delay for RO1.	10 = 1 s / 10 = 1 s

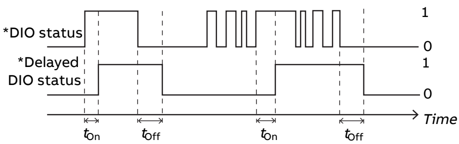
No.	Name / Range / Selection	Description	Def / Type FbEq 16b / 32b
10.26	RO1 OFF delay	Defines the deactivation delay for relay output RO1. See parameter 10.25 RO1 ON delay.	0.0 s / uint32
	0.0 … 3000.0 s	Deactivation delay for RO1.	10 = 1 s / 10 = 1 s
10.27	RO2 source	Selects a drive signal to be connected to relay output RO2.	Running (95.20 b3) / uint32
	Not energized	Output is not energized.	0
	Energized	Output is energized.	1
	Ready run	Bit 1 of 06.11 Main status word (page 158).	2
	Enabled	Bit 0 of 06.16 Drive status word 1 (page 158).	4
	Started	Bit 5 of 06.16 Drive status word 1 (page 158).	5
	Magnetized	Bit 1 of 06.17 Drive status word 2 (page 159).	6
	Running	Bit 6 of 06.16 Drive status word 1 (page 158).	7
	Ready ref	Bit 2 of 06.11 Main status word (page 158).	8
	At setpoint	Bit 8 of 06.11 Main status word (page 158).	9
	Reverse	Bit 2 of 06.19 Speed control status word (page 161).	10
	Zero speed	Bit 0 of 06.19 Speed control status word (page 161).	11
	Above limit	Bit 10 of 06.17 Drive status word 2 (page 159).	12
	Warning	Bit 7 of 06.11 Main status word (page 158).	13
	Fault	Bit 3 of 06.11 Main status word (page 158).	14
	Fault (-1)	Inverted bit 3 of 06.11 Main status word (page 158).	15
	Start request	Bit 13 of 06.16 Drive status word 1 (page 158).	16
	Open brake command	Bit 0 of 44.01 Brake control status.	22
	Ext2 active	Bit 11 of 06.16 Drive status word 1 (page 158).	23
	Remote control	Bit 9 of 06.11 Main status word (page 158).	24
	Supervision 1	Bit 0 of 32.01 Supervision status (page 331).	33
	Supervision 2	Bit 1 of 32.01 Supervision status (page 331).	34
	Supervision 3	Bit 2 of 32.01 Supervision status (page 331).	35
	RO/DIO control word bit0	Bit 0 of 10.99 RO/DIO control word (page 185).	40
	RO/DIO control word bit1	Bit 1 of 10.99 RO/DIO control word (page 185).	41
	RO/DIO control word bit2	Bit 2 of 10.99 RO/DIO control word (page 185).	42
	RO/DIO control word bit8	Bit 8 of 10.99 RO/DIO control word (page 185).	43
	RO/DIO control word bit9	Bit 9 of 10.99 RO/DIO control word (page 185).	44
	Other [bit]	See Terms and abbreviations (page 132).	-

No.	Name / Range / Selection	Description	Def / Type FbEq 16b / 32b
10.28	RO2 ON delay	Defines the activation delay for relay output RO2.  t_{On} = 10.28 RO2 ON delay t_{Off} = 10.29 RO2 OFF delay	0.0 (95.20 b3) s / uint32
	0.0 … 3000.0 s	Activation delay for RO2.	10 = 1 s / 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 (95.20 b3) s / uint32
	0.0 … 3000.0 s	Deactivation delay for RO2.	10 = 1 s / 10 = 1 s
10.30	RO3 source	Selects a drive signal to be connected to relay output RO3.	Fault (-1) / uint32
	Not energized	Output is not energized.	0
	Energized	Output is energized.	1
	Ready run	Bit 1 of 06.11 Main status word (page 158).	2
	Enabled	Bit 0 of 06.16 Drive status word 1 (page 158).	4
	Started	Bit 5 of 06.16 Drive status word 1 (page 158).	5
	Magnetized	Bit 1 of 06.17 Drive status word 2 (page 159).	6
	Running	Bit 6 of 06.16 Drive status word 1 (page 158).	7
	Ready ref	Bit 2 of 06.11 Main status word (page 158).	8
	At setpoint	Bit 8 of 06.11 Main status word (page 158).	9
	Reverse	Bit 2 of 06.19 Speed control status word (page 161).	10
	Zero speed	Bit 0 of 06.19 Speed control status word (page 161).	11
	Above limit	Bit 10 of 06.17 Drive status word 2 (page 159).	12
	Warning	Bit 7 of 06.11 Main status word (page 158).	13
	Fault	Bit 3 of 06.11 Main status word (page 158).	14
	Fault (-1)	Inverted bit 3 of 06.11 Main status word (page 158).	15
	Start request	Bit 13 of 06.16 Drive status word 1 (page 158).	16
	Open brake command	Bit 0 of 44.01 Brake control status.	22
	Ext2 active	Bit 11 of 06.16 Drive status word 1 (page 158).	23
	Remote control	Bit 9 of 06.11 Main status word (page 158).	24
	Supervision 1	Bit 0 of 32.01 Supervision status (page 331).	33
	Supervision 2	Bit 1 of 32.01 Supervision status (page 331).	34
	Supervision 3	Bit 2 of 32.01 Supervision status (page 331).	35
	RO/DIO control word bit0	Bit 0 of 10.99 RO/DIO control word (page 185).	40

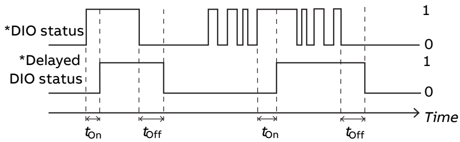
No.	Name / Range / Selection	Description	Def / Type FbEq 16b / 32b
	RO/DIO control word bit1	Bit 1 of 10.99 RO/DIO control word (page 185).	41
	RO/DIO control word bit2	Bit 2 of 10.99 RO/DIO control word (page 185).	42
	RO/DIO control word bit8	Bit 8 of 10.99 RO/DIO control word (page 185).	43
	RO/DIO control word bit9	Bit 9 of 10.99 RO/DIO control word (page 185).	44
	Other [bit]	See Terms and abbreviations (page 132).	-
10.31	RO3 ON delay	Defines the activation delay for relay output RO3.  t_{On} = 10.31 RO3 ON delay t_{Off} = 10.32 RO3 OFF delay	0.0 s / uint32
	0.0 … 3000.0 s	Activation delay for RO3.	10 = 1 s / 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 / uint32
	0.0 … 3000.0 s	Deactivation delay for RO3.	10 = 1 s / 10 = 1 s
10.51	DI filter time	Defines a filtering time for parameters 10.01 DI status and 10.02 DI delayed status. Note that this parameter has no effect on forced DI values defined by parameters 10.03 and 10.04.	10.0 ms / uint32
	0.3 … 100.0 ms	Filtering time for 10.01 and 10.02.	10 = 1 ms / 10 = 1 ms
10.90	IO time level selection	Selects the standard I/O communication time level.	Fast / uint16
	Fast	Standard I/O time level 500 us.	500
	Normal	Standard I/O time level 2 ms.	2000
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. Set the target selection parameter of that particular data (58.101…58.124) to RO/DIO control word. In the source selection parameter of the desired output, select the appropriate bit of this word.	- / uint16
b0	RO1	Source bit for relay output RO1. See parameter 10.24.	
b1	RO2	Source bit for relay output RO2. See parameter 10.27.	
b2	RO3	Source bit for relay output RO3. See parameter 10.30.	

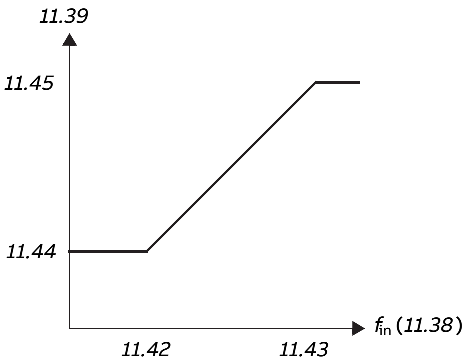
No.	Name / Range / Selection	Description	Def / Type FbEq 16b / 32b
b3…7	Reserved		
b8	DIO1	Source bit for digital input/output DIO1 (see parameter 11.06.	
b9	DIO2	Source bit for digital input/output DIO2 (see parameter 11.10.	
b10…15	Reserved		
	0000h…FFFFh		1 = 1 / 1 = 1

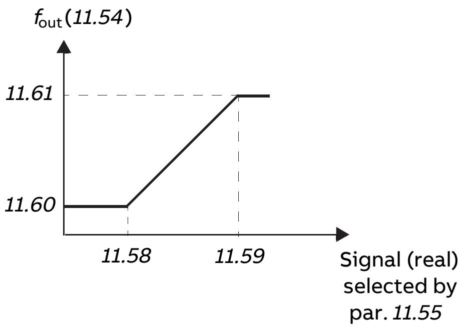
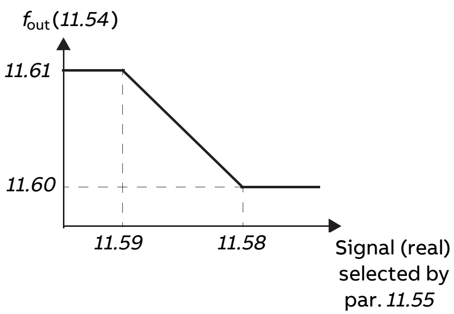
No.	Name / Range / Selection	Description	Def / Type FbEq 16b / 32b
11	Standard DIO, FI, FO	Configuration of digital input/outputs and frequency inputs/outputs.	
11.01	DIO status	Displays the status of digital input/outputs DIO2 and DIO1. The activation/deactivation delays (if any are specified) are ignored. A filtering time (for input mode) can be defined by parameter 11.81 DIO filter time. **Example:** 0010 = DIO2 is on, DIO1 is off. This parameter is read-only.	- / uint16
11.02	DIO delayed status	Displays the delayed status of digital input/outputs DIO2 and DIO1. This word is updated only after activation/deactivation delays (if any are specified). A filtering time (for input mode) can be defined by parameter 11.81 DIO filter time. **Example:** 0010 = DIO2 is on, DIO1 is off. This parameter is read-only.	- / uint16
11.05	DIO1 function	Selects whether DIO1 is used as a digital output or input, or a frequency input.	Output / uint16
	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 / uint32
	Not energized	Output is not energized.	0
	Energized	Output is energized.	1
	Ready run	Bit 1 of 06.11 Main status word (page 158).	2
	Enabled	Bit 0 of 06.16 Drive status word 1 (page 158).	4
	Started	Bit 5 of 06.16 Drive status word 1 (page 158).	5
	Magnetized	Bit 1 of 06.17 Drive status word 2 (page 159).	6
	Running	Bit 6 of 06.16 Drive status word 1 (page 158).	7
	Ready ref	Bit 2 of 06.11 Main status word (page 158).	8
	At setpoint	Bit 8 of 06.11 Main status word (page 158).	9
	Reverse	Bit 2 of 06.19 Speed control status word (page 161).	10
	Zero speed	Bit 0 of 06.19 Speed control status word (page 161).	11
	Above limit	Bit 10 of 06.17 Drive status word 2 (page 159).	12
	Warning	Bit 7 of 06.11 Main status word (page 158).	13
	Fault	Bit 3 of 06.11 Main status word (page 158).	14
	Fault (-1)	Inverted bit 3 of 06.11 Main status word (page 158).	15
	Start request	Bit 13 of 06.16 Drive status word 1 (page 158).	16

No.	Name / Range / Selection	Description	Def / Type FbEq 16b / 32b
	Open brake command	Bit 0 of 44.1 Brake control status. (See ACS880 primary control program firmware manual (3AUA0000085967[English])).	22
	Ext2 active	Bit 11 of 06.16 Drive status word 1 (page 158).	23
	Remote control	Bit 9 of 06.11 Main status word (page 158).	24
	Supervision 1	Bit 0 of 32.01 Supervision status (page 331).	33
	Supervision 2	Bit 1 of 32.01 Supervision status (page 331).	34
	Supervision 3	Bit 2 of 32.01 Supervision status (page 331).	35
	RO/DIO control word bit0	Bit 0 of 10.99 RO/DIO control word (page 185).	40
	RO/DIO control word bit1	Bit 1 of 10.99 RO/DIO control word (page 185).	41
	RO/DIO control word bit2	Bit 2 of 10.99 RO/DIO control word (page 185).	42
	RO/DIO control word bit8	Bit 8 of 10.99 RO/DIO control word (page 185).	43
	RO/DIO control word bit9	Bit 9 of 10.99 RO/DIO control word (page 185).	44
	Other [bit]	See Terms and abbreviations (page 132).	-
11.07	DIO1 ON delay	Defines the activation delay for digital input/output DIO1 (when used as a digital output or digital input).  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 s / uint32
	0.0 ... 3000.0 s	Activation delay for DIO1.	10 = 1 s / 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 / uint32
	0.0 ... 3000.0 s	Deactivation delay for DIO1.	10 = 1 s / 10 = 1 s
11.09	DIO2 function	Selects whether DIO2 is used as a digital output or input, or a frequency output.	Output / uint16
	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

No.	Name / Range / Selection	Description	Def / Type FbEq 16b / 32b
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.	Running / uint32
	Not energized	Output is not energized.	0
	Energized	Output is energized.	1
	Ready run	Bit 1 of 06.11 Main status word (page 158).	2
	Enabled	Bit 0 of 06.16 Drive status word 1 (page 158).	4
	Started	Bit 5 of 06.16 Drive status word 1 (page 158).	5
	Magnetized	Bit 1 of 06.17 Drive status word 2 (page 159).	6
	Running	Bit 6 of 06.16 Drive status word 1 (page 158).	7
	Ready ref	Bit 2 of 06.11 Main status word (page 158).	8
	At setpoint	Bit 8 of 06.11 Main status word (page 158).	9
	Reverse	Bit 2 of 06.19 Speed control status word (page 161).	10
	Zero speed	Bit 0 of 06.19 Speed control status word (page 161).	11
	Above limit	Bit 10 of 06.17 Drive status word 2 (page 159).	12
	Warning	Bit 7 of 06.11 Main status word (page 158).	13
	Fault	Bit 3 of 06.11 Main status word (page 158).	14
	Fault (-1)	Inverted bit 3 of 06.11 Main status word (page 158).	15
	Start request	Bit 13 of 06.16 Drive status word 1 (page 158).	16
	Open brake command	Bit 0 of 44.01 Brake control status.	22
	Ext2 active	Bit 11 of 06.16 Drive status word 1 (page 158).	23
	Remote control	Bit 9 of 06.11 Main status word (page 158).	24
	Supervision 1	Bit 0 of 32.01 Supervision status (page 331).	33
	Supervision 2	Bit 1 of 32.01 Supervision status (page 331).	34
	Supervision 3	Bit 2 of 32.01 Supervision status (page 331).	35
	RO/DIO control word bit0	Bit 0 of 10.99 RO/DIO control word (page 185).	40
	RO/DIO control word bit1	Bit 1 of 10.99 RO/DIO control word (page 185).	41
	RO/DIO control word bit2	Bit 2 of 10.99 RO/DIO control word (page 185).	42
	RO/DIO control word bit8	Bit 8 of 10.99 RO/DIO control word (page 185).	43
	RO/DIO control word bit9	Bit 9 of 10.99 RO/DIO control word (page 185).	44
	Other [bit]	See Terms and abbreviations (page 132).	-

No.	Name / Range / Selection	Description	Def / Type FbEq 16b / 32b
11.11	DIO2 ON delay	Defines the activation delay for digital input/output DIO2 (when used as a digital output or digital input).  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 s / uint32
	0.0 ... 3000.0 s	Activation delay for DIO2.	10 = 1 s / 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 / uint32
	0.0 ... 3000.0 s	Deactivation delay for DIO2.	10 = 1 s / 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.	- / real32
	0...16000 Hz	Unscaled value of frequency input 1.	1 = 1 Hz / 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.	- / real32
	-32768.000 ... 32767.000	Scaled value of frequency input 1.	1 = 1 / 1000 = 1

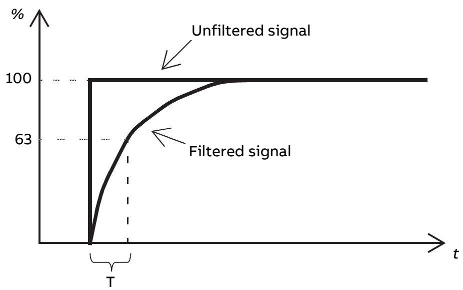
No.	Name / Range / Selection	Description	Def / Type FbEq 16b / 32b
11.42	Freq in 1 min	Defines the minimum for the frequency actually arriving at frequency input 1 (DIO1 when it is used as a frequency input). The incoming frequency signal (11.38 Freq in 1 actual value) is scaled into an internal signal (11.39 Freq in 1 scaled) by parameters 11.42…11.45 as follows: 	0 Hz / real32
	0…16000 Hz	Minimum frequency of frequency input 1 (DIO1).	1 = 1 Hz / 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 / real32
	0…16000 Hz	Maximum frequency for frequency input 1 (DIO1).	1 = 1 Hz / 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 NoUnit / real32
	-32768.000 … 32767.000	Value corresponding to minimum of frequency input 1.	1 = 1 / 1000 = 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) NoUnit / real32
	-32768.000 … 32767.000	Value corresponding to maximum of frequency input 1.	1 = 1 / 1000 = 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.	- / real32
	0…16000 Hz	Value of frequency output 1.	1 = 1 Hz / 1 = 1 Hz
11.55	Freq out 1 source	Selects a signal to be connected to frequency output 1.	Motor speed used / uint32
	Zero	None	0

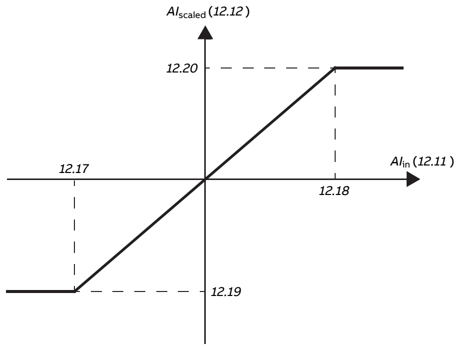
No.	Name / Range / Selection	Description	Def / Type FbEq 16b / 32b
	Motor speed used	01.01 Motor speed used (page 136).	1
	Output frequency	01.06 Output frequency (page 136).	3
	Motor current	01.07 Motor current (page 136).	4
	Motor torque	01.10 Motor torque (page 136).	6
	DC voltage	01.11 DC voltage (page 137).	7
	Power inu out	01.14 Output power (page 137).	8
	Speed ref ramp in	23.01 Speed ref ramp input (page 267).	10
	Speed ref ramp out	23.02 Speed ref ramp output (page 267).	11
	Speed ref used	24.01 Used speed reference (page 274).	12
	Torq ref used	26.02 Torque reference used (page 293).	13
	Other [bit]	Source selection. See Terms and abbreviations (page 132).	-
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 NoUnit / real32
	-32768.000 … 32767.000	Real signal value corresponding to minimum value of frequency output 1.	1 = 1 / 1000 = 1

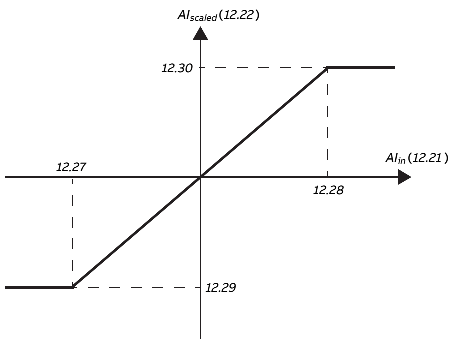
No.	Name / Range / Selection	Description	Def / Type FbEq 16b / 32b
11.59	Freq out 1 src max	Defines the real value of the signal (selected by parameter 11.55 Freq out 1 source and shown by parameter 11.54 Freq out 1 actual value) that corresponds to the maximum value of frequency output 1 (defined by 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) NoUnit / real32
	-32768.000 … 32767.000	Real signal value corresponding to maximum value of frequency output 1.	1 = 1 / 1000 = 1
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 / real32
	0…16000 Hz	Minimum value of frequency output 1.	1 = 1 Hz / 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 / real32
	0…16000 Hz	Maximum value of frequency output 1.	1 = 1 Hz / 1 = 1 Hz
11.81	DIO filter time	Defines a filtering time for parameter 11.01 DIO status and 11.02 DIO delayed status. The filtering time will only affect the DIOs that are in input mode.	10.0 ms / uint32
	0.3 … 100.0 ms	Filtering time for 11.01.	10 = 1 ms / 10 = 1 ms

No.	Name / Range / Selection	Description	Def / Type FbEq 16b / 32b
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 / uint16
	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 supervision applies a margin of 0.5 V or 1.0 mA to the limits. For example, if the maximum limit for the input is 7.000 V, the maximum limit supervision activates at 7.500 V. The inputs and the limits to be observed are selected by parameter 12.04 AI supervision selection. **Note:** Analog input signal supervision is only active when • supervision is forced using parameter 12.05 AI supervision force.	No action / uint16
	No action	No action taken.	0
	Fault	Drive trips on 80A0 AI Supervision.	1
	Warning	Drive generates an A8A0 AI Supervised Warning warning.	2
	Last speed	Drive generates a warning (A8A0 AI Supervised Warning) 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

No.	Name / Range / Selection	Description	Def / Type FbEq 16b / 32b
	Speed ref safe	Drive generates a warning (A8A0 AI Supervised 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.	4
12.04	AI supervision selection	Specifies the analog input limits to be supervised. See parameter 12.03 AI supervision function.	- / uint16
b0	AI1 < MIN	1 = Minimum limit supervision of AI1 active.	
b1	AI1 > MAX	1 = Maximum limit supervision of AI1 active.	
b2	AI2 < MIN	1 = Minimum limit supervision of AI2 active.	
b3	AI2 > MAX	1 = Maximum limit supervision of AI2 active.	
b4…15	Reserved		
	0000h…FFFFh		1 = 1 / 1 = 1
12.05	AI supervision force	Activates analog input supervision separately for each control location (see section Local control vs. external control (page 66)). The parameter is primarily intended for analog input supervision when the input is connected to the application program and not selected as a control source by drive parameters.	0000 0000b / uint16
b0	AI1 Ext 1	1 = AI1 supervision active when EXT1 is being used.	
b1	AI1 Ext 2	1 = AI1 supervision active when EXT2 is being used.	
b2	AI1 Local	1 = AI1 supervision active when local control is being used.	
b3	Reserved		
b4	AI2 Ext 1	1 = AI2 supervision active when EXT1 is being used.	
b5	AI2 Ext 2	1 = AI2 supervision active when EXT2 is being used.	
b6	AI2 Local	1 = AI2 supervision active when local control is being used.	
b7…15	Reserved		
	0000 0000b…0111 0111b		1 = 1 / 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.	- / real32
	-22.000 ... 22.000 mA or V	Value of analog input AI1.	1000 = 1 mA or V / 1000 = 1 mA or V

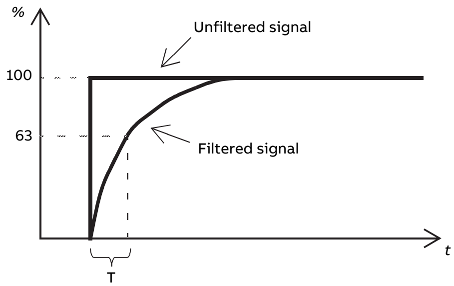
No.	Name / Range / Selection	Description	Def / Type FbEq 16b / 32b
12.12	AI1 scaled value	Displays the value of analog input AI1 after scaling. See parameters 12.19 AI1 scaled at AI1 min and 12.20 AI1 scaled at AI1 max. This parameter is read-only.	- / real32
	-32768.000 ... 32767.000	Scaled value of analog input AI1.	1 = 1 / 1000 = 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 / uint16
	V	Volts.	2
	mA	Milliamperes.	10
12.16	AI1 filter time	Defines the filter time constant for analog input AI1.  O = I × (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 / real32
	0.000 ... 30.000 s	Filter time constant.	1000 = 1 s / 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 / real32

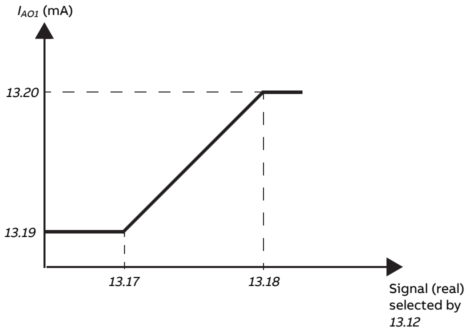
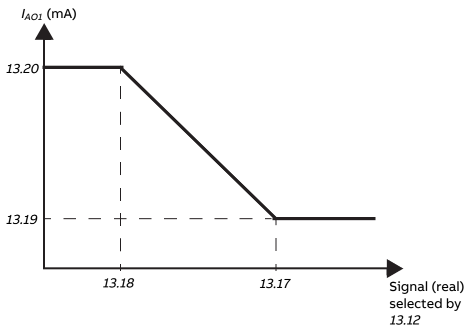
No.	Name / Range / Selection	Description	Def / Type FbEq 16b / 32b
	-22.000 ... 22.000 mA or V	Minimum value of AI1.	1000 = 1 mA or V / 1000 = 1 mA or V
12.18	AI1 max	Defines the maximum site value for analog input AI1. Set the value actually sent to the drive when the analog signal from plant is wound to its maximum setting. See also parameter 12.01 AI tune.	10.000 mA or V / real32
	-22.000 ... 22.000 mA or V	Maximum value of AI1.	1000 = 1 mA or V / 1000 = 1 mA or V
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 NoUnit / real32
	-32768.000 ... 32767.000	Real value corresponding to minimum AI1 value.	1 = 1 / 1000 = 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) NoUnit / real32
	-32768.000 ... 32767.000	Real value corresponding to maximum AI1 value.	1 = 1 / 1000 = 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	- / real32
	-22.000 ... 22.000 mA or V	Value of analog input AI2.	1000 = 1 mA or V / 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.	- / real32
	-32768.000 ... 32767.000	Scaled value of analog input AI2.	1 = 1 / 1000 = 1

No.	Name / Range / Selection	Description	Def / Type FbEq 16b / 32b
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 / uint16
	V	Volts.	2
	mA	Milliamperes.	10
12.26	AI2 filter time	Defines the filter time constant for analog input AI2. See parameter 12.16 AI1 filter time.	0.100 s / real32
	0.000 … 30.000 s	Filter time constant.	1000 = 1 s / 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 / real32
	-22.000 … 22.000 mA or V	Minimum value of AI2.	1000 = 1 mA or V / 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 V / real32
	-22.000 … 22.000 mA or V	Maximum value of AI2.	1000 = 1 mA or V / 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 NoUnit / real32
	-32768.000 … 32767.000	Real value corresponding to minimum AI2 value.	1 = 1 / 1000 = 1

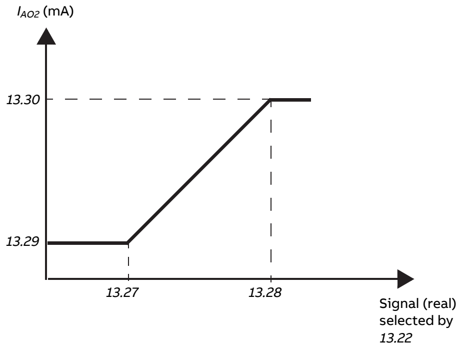
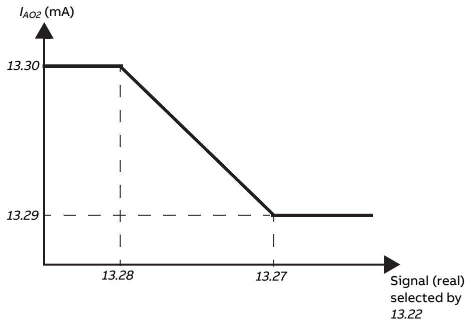
No.	Name / Range / Selection	Description	Def / Type FbEq 16b / 32b
12.30	AI2 scaled at AI2 max	Defines the real value that corresponds to the maximum analog input AI2 value defined by parameter 12.28 AI2 max. See the drawing at parameter 12.29 AI2 scaled at AI2 min.	100.000 NoUnit / real32
	-32768.000 ... 32767.000	Real value corresponding to maximum AI2 value.	1 = 1 / 1000 = 1

No.	Name / Range / Selection	Description	Def / Type FbEq 16b / 32b
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.	- / real32
	0.000 ... 22.000 mA	Value of AO1.	1000 = 1 mA / 1000 = 1 mA
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 / uint32
	Zero	None	0
	Motor speed used	01.01 Motor speed used (page 136).	1
	Output frequency	01.06 Output frequency (page 136).	3
	Motor current	01.07 Motor current (page 136).	4
	Motor torque	01.10 Motor torque (page 136).	6
	DC voltage	01.11 DC voltage (page 137).	7
	Power inu out	01.14 Output power (page 137).	8
	Speed ref ramp in	23.01 Speed ref ramp input (page 267).	10
	Speed ref ramp out	23.02 Speed ref ramp output (page 267).	11
	Speed ref used	24.01 Used speed reference (page 274).	12
	Torq ref used	26.02 Torque reference used (page 293).	13
	Other [bit]	Source selection. See Terms and abbreviations (page 132).	-
	Force Pt100 excitation	The output is used to feed an excitation current to 1…3 Pt100 sensors. See section Motor thermal protection (page 106).	20
	Force KTY84 excitation	The output is used to feed an excitation current to a KTY84 sensor. See section Motor thermal protection (page 106).	21
	Force PTC excitation	The output is used to feed an excitation current to 1…3 PTC sensors. See section Motor thermal protection (page 106).	22
	Force Pt1000 excitation	The output is used to feed an excitation current to 1…3 Pt1000 sensors. See section Motor thermal protection (page 106).	23
	AO1 data storage	13.91 AO1 data storage (page 205).	37
	AO2 data storage	13.92 AO2 data storage (page 205).	38

No.	Name / Range / Selection	Description	Def / Type FbEq 16b / 32b
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 / real32
	0.000 … 30.000 s	Filter time constant.	1000 = 1 s / 1000 = 1 s

No.	Name / Range / Selection	Description	Def / Type FbEq 16b / 32b
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 NoUnit / real32
	-32768.0 … 32767.0	Real signal value corresponding to minimum AO1 output value.	1 = 1 / 10 = 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.	1500.000; 1800.000 (95.20 b0) NoUnit / real32
	-32768.0 … 32767.0	Real signal value corresponding to maximum AO1 output value.	1 = 1 / 10 = 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 / real32
	0.000 … 22.000 mA	Minimum AO1 output value.	1000 = 1 mA / 1000 = 1 mA

No.	Name / Range / Selection	Description	Def / Type FbEq 16b / 32b
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 / real32
	0.000 … 22.000 mA	Maximum AO1 output value.	1000 = 1 mA / 1000 = 1 mA
13.21	AO2 actual value	Displays the value of AO2 in mA. This parameter is read-only.	- / real32
	0.000 … 22.000 mA	Value of AO2.	1000 = 1 mA / 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 / uint32
13.26	AO2 filter time	Defines the filtering time constant for analog output AO2. See parameter 13.16 AO1 filter time.	0.100 s / real32
	0.000 … 30.000 s	Filter time constant.	1000 = 1 s / 1000 = 1 s

No.	Name / Range / Selection	Description	Def / Type FbEq 16b / 32b
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 NoUnit / real32
	-32768.0 … 32767.0	Real signal value corresponding to minimum AO2 output value.	1 = 1 / 10 = 1
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 NoUnit / real32
	-32768.0 … 32767.0	Real signal value corresponding to maximum AO2 output value.	1 = 1 / 10 = 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 / real32
	0.000 … 22.000 mA	Minimum AO2 output value.	1000 = 1 mA / 1000 = 1 mA

No.	Name / Range / Selection	Description	Def / Type FbEq 16b / 32b
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 / real32
	0.000 ... 22.000 mA	Maximum AO2 output value.	1000 = 1 mA / 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 (58.101…58.124) to AO1 data storage.	0.00 NoUnit / real32
	-327.68 ... 327.67	Storage parameter for AO1.	100 = 1 / 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 (58.101…58.124) to AO2 data storage.	0.00 NoUnit / real32
	-327.68 ... 327.67	Storage parameter for AO2.	100 = 1 / 100 = 1

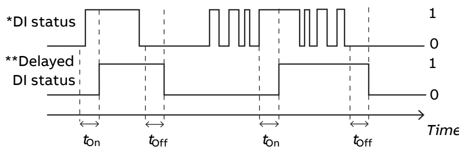
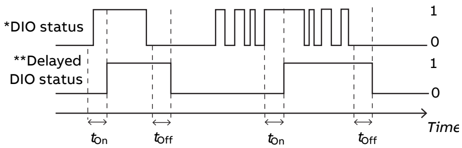
No.	Name / Range / Selection	Description	Def / Type FbEq 16b / 32b
14	I/O extension module 1	Configuration of I/O extension module 1. See also section Programmable I/O extensions (page 73). **Note:** The contents of the parameter group vary according to the selected I/O extension module type.	
14.01	Module 1 type	Activates (and specifies the type of) I/O extension module 1. **Note:** This parameter cannot be changed while the drive is running.	None / uint16
	None	Inactive.	0
	FIO-01	FIO-01.	1
	FIO-11	FIO-11.	2
	FAIO-01	FAIO-01.	4
	FDIO-01	FDIO-01.	3
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-03 extension adapter. **Note:** This parameter cannot be changed while the drive is running.	1 NoUnit / uint16
	1...254	Slot 1 = 1; Slot 2 = 2; Slot 3 = 3. 4…254: Node ID of the slot on the FEA-03 extension adapter.	1 = 1 / 1 = 1
14.03	Module 1 status	Displays the status of I/O extension module 1.	No option / uint16
	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

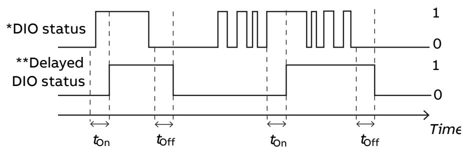
No.	Name / Range / Selection	Description	Def / Type FbEq 16b / 32b
14.05	DI status	(Visible when 14.01 Module 1 type = FAIO-01) Displays the status of the digital inputs on the extension module. The activation/deactivation delays (if any are specified) are ignored. A filtering time (for input mode) can be defined by parameter 14.08 DI filter time. Bit 0 indicates the status of DI1. **Note:** The number of active bits in this parameter depends on the number of digital input/outputs on the extension module. **Example:** 0101b = DI1 and DI3 are on, remainder are off. This parameter is read-only.	- / uint16
14.05	DIO status	(Visible when 14.01 Module 1 type = 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 14.08 DIO 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.	- / uint16
14.05	DIO status	(Visible when 14.01 Module 1 type = FIO-01) 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 14.08 DIO 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.	- / uint16

No.	Name / Range / Selection	Description	Def / Type FbEq 16b / 32b
14.06	DI delayed status	(Visible when 14.01 Module 1 type = FAIO-01) Displays the delayed status of the digital inputs on the extension module. The word is updated only after activation/deactivation delays (if any are specified). Bit 0 indicates the status of DI1. **Note:** The number of active bits in this parameter depends on the number of digital inputs on the extension module. **Example:** 0101b = DI1 and DI3 are on, remainder are off. This parameter is read-only.	- / uint16
14.06	DIO delayed status	(Visible when 14.01 Module 1 type = 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:** 1001b = DIO1 and DIO4 are on, remainder are off. This parameter is read-only.	- / uint16
14.06	DIO delayed status	(Visible when 14.01 Module 1 type = FIO-01) 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:** 1001b = DIO1 and DIO4 are on, remainder are off. This parameter is read-only.	- / uint16
14.08	DI filter time	(Visible when 14.01 Module 1 type = FAIO-01) Defines a filtering time for parameters 14.05 DI status and 14.06 DI delayed status.	10.0 ms / real32
	0.8 ... 100.0 ms	Filtering time for DI status parameters.	10 = 1 ms / 10 = 1 ms
14.08	DIO filter time	(Visible when 14.01 Module 1 type = FIO-11) Defines a filtering time for parameters 14.05 DIO status and 14.06 DIO delayed status. The filtering time will only affect the DIOs that are in input mode.	10.0 ms / real32
	0.8 ... 100.0 ms	Filtering time for DIO status parameters.	10 = 1 ms / 10 = 1 ms

No.	Name / Range / Selection	Description	Def / Type FbEq 16b / 32b
14.08	DIO filter time	(Visible when 14.01 Module 1 type = FIO-01) Defines a filtering time for parameters 14.05 DIO status and 14.06 DIO delayed status. The filtering time will only affect the DIOs that are in input mode.	10.0 ms / real32
	0.8 ... 100.0 ms	Filtering time for DIO status parameters.	10 = 1 ms / 10 = 1 ms
14.09	DIO1 function	(Visible when 14.01 Module 1 type = FIO-11) Selects whether DIO1 of the extension module is used as a digital input or output.	Input / uint16
	Output	DIO1 is used as a digital output.	0
	Input	DIO1 is used as a digital input.	1
14.09	DIO1 function	(Visible when 14.01 Module 1 type = FIO-01) Selects whether DIO1 of the extension module is used as a digital input or output.	Input / uint16
	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-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 / uint32
	Not energized	Output is not energized.	0
	Energized	Output is energized.	1
	Ready run	Bit 1 of 06.11 Main status word (page 158).	2
	Enabled	Bit 0 of 06.16 Drive status word 1 (page 158).	4
	Started	Bit 5 of 06.16 Drive status word 1 (page 158).	5
	Magnetized	Bit 1 of 06.17 Drive status word 2 (page 159).	6
	Running	Bit 6 of 06.16 Drive status word 1 (page 158).	7
	Ready ref	Bit 2 of 06.11 Main status word (page 158).	8
	At setpoint	Bit 8 of 06.11 Main status word (page 158).	9
	Reverse	Bit 2 of 06.19 Speed control status word (page 161).	10
	Zero speed	Bit 0 of 06.19 Speed control status word (page 161).	11
	Above limit	Bit 10 of 06.17 Drive status word 2 (page 159).	12
	Warning	Bit 7 of 06.11 Main status word (page 158).	13
	Fault	Bit 3 of 06.11 Main status word (page 158).	14
	Fault (-1)	Inverted bit 3 of 06.11 Main status word (page 158).	15
	Start request	Bit 13 of 06.16 Drive status word 1 (page 158).	16
	Open brake command	Bit 0 of 44.01 Brake control status.	22
	Ext2 active	Bit 11 of 06.16 Drive status word 1 (page 158).	23
	Remote control	Bit 9 of 06.11 Main status word (page 158).	24
	Supervision 1	Bit 0 of 32.01 Supervision status (page 331).	33
	Supervision 2	Bit 1 of 32.01 Supervision status (page 331).	34

No.	Name / Range / Selection	Description	Def / Type FbEq 16b / 32b
	Supervision 3	Bit 2 of 32.01 Supervision status (page 331).	35
	RO/DIO control word bit0	Bit 0 of 10.99 RO/DIO control word (page 185).	40
	RO/DIO control word bit1	Bit 1 of 10.99 RO/DIO control word (page 185).	41
	RO/DIO control word bit2	Bit 2 of 10.99 RO/DIO control word (page 185).	42
	RO/DIO control word bit8	Bit 8 of 10.99 RO/DIO control word (page 185).	43
	RO/DIO control word bit9	Bit 9 of 10.99 RO/DIO control word (page 185).	44
	Other [bit]	See Terms and abbreviations (page 132).	-
14.11	DIO1 output source	(Visible when 14.01 Module 1 type = FIO-01) 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 / uint32
	Not energized	Output is not energized.	0
	Energized	Output is energized.	1
	Ready run	Bit 1 of 06.11 Main status word (page 158).	2
	Enabled	Bit 0 of 06.16 Drive status word 1 (page 158).	4
	Started	Bit 5 of 06.16 Drive status word 1 (page 158).	5
	Magnetized	Bit 1 of 06.17 Drive status word 2 (page 159).	6
	Running	Bit 6 of 06.16 Drive status word 1 (page 158).	7
	Ready ref	Bit 2 of 06.11 Main status word (page 158).	8
	At setpoint	Bit 8 of 06.11 Main status word (page 158).	9
	Reverse	Bit 2 of 06.19 Speed control status word (page 161).	10
	Zero speed	Bit 0 of 06.19 Speed control status word (page 161).	11
	Above limit	Bit 10 of 06.17 Drive status word 2 (page 159).	12
	Warning	Bit 7 of 06.11 Main status word (page 158).	13
	Fault	Bit 3 of 06.11 Main status word (page 158).	14
	Fault (-1)	Inverted bit 3 of 06.11 Main status word (page 158).	15
	Start request	Bit 13 of 06.16 Drive status word 1 (page 158).	16
	Open brake command	Bit 0 of 44.01 Brake control status.	22
	Ext2 active	Bit 11 of 06.16 Drive status word 1 (page 158).	23
	Remote control	Bit 9 of 06.11 Main status word (page 158).	24
	Supervision 1	Bit 0 of 32.01 Supervision status (page 331).	33
	Supervision 2	Bit 1 of 32.01 Supervision status (page 331).	34
	Supervision 3	Bit 2 of 32.01 Supervision status (page 331).	35

No.	Name / Range / Selection	Description	Def / Type FbEq 16b / 32b
	RO/DIO control word bit0	Bit 0 of 10.99 RO/DIO control word (page 185).	40
	RO/DIO control word bit1	Bit 1 of 10.99 RO/DIO control word (page 185).	41
	RO/DIO control word bit2	Bit 2 of 10.99 RO/DIO control word (page 185).	42
	RO/DIO control word bit8	Bit 8 of 10.99 RO/DIO control word (page 185).	43
	RO/DIO control word bit9	Bit 9 of 10.99 RO/DIO control word (page 185).	44
	Other [bit]	See Terms and abbreviations (page 132).	-
14.12	DI1 ON delay	(Visible when 14.01 Module 1 type = FAIO-01) Defines the activation delay for digital input DI1.  t_{On} = 14.12 DI1 ON delay t_{Off} = 14.13 DI1 OFF delay *Electrical status of DI or status of selected source (in output mode). Indicated by 14.05 DI status. **Indicated by 14.06 DI delayed status.	0.00 s / real32
	0.00 ... 3000.00 s	Activation delay for DI1.	10 = 1 s / 100 = 1 s
14.12	DIO1 ON delay	(Visible when 14.01 Module 1 type = FIO-11) Defines the activation delay for digital input/output DIO1.  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.	0.00 s / real32
	0.00 ... 3000.00 s	Activation delay for DIO1.	10 = 1 s / 100 = 1 s

No.	Name / Range / Selection	Description	Def / Type FbEq 16b / 32b
14.12	DIO1 ON delay	(Visible when 14.01 Module 1 type = FIO-01) Defines the activation delay for digital input/output DIO1.  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.	0.00 s / real32
	0.00 … 3000.00 s	Activation delay for DIO1.	10 = 1 s / 100 = 1 s
14.13	DI1 OFF delay	(Visible when 14.01 Module 1 type = FAIO-01) Defines the deactivation delay for digital input DI1. See parameter 14.12 DI1 ON delay.	0.00 s / real32
	0.00 … 3000.00 s	Deactivation delay for DI1.	10 = 1 s / 100 = 1 s
14.13	DIO1 OFF delay	(Visible when 14.01 Module 1 type = FIO-11) Defines the deactivation delay for digital input/output DIO1. See parameter 14.12 DIO1 ON delay.	0.00 s / real32
	0.00 … 3000.00 s	Deactivation delay for DIO1.	10 = 1 s / 100 = 1 s
14.13	DIO1 OFF delay	(Visible when 14.01 Module 1 type = FIO-01) Defines the deactivation delay for digital input/output DIO1. See parameter 14.12 DIO1 ON delay.	0.00 s / real32
	0.00 … 3000.00 s	Deactivation delay for DIO1.	10 = 1 s / 100 = 1 s
14.14	DIO2 function	(Visible when 14.01 Module 1 type = FIO-11) Selects whether DIO2 of the extension module is used as a digital input or output.	Input / uint16
	Output	DIO2 is used as a digital output.	0
	Input	DIO2 is used as a digital input.	1
14.14	DIO2 function	(Visible when 14.01 Module 1 type = FIO-01) Selects whether DIO2 of the extension module is used as a digital input or output.	Input / uint16
	Output	DIO2 is used as a digital output.	0
	Input	DIO2 is used as a digital input.	1

No.	Name / Range / Selection	Description	Def / Type FbEq 16b / 32b
14.16	DIO2 output source	(Visible when 14.01 Module 1 type = 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 / uint32
14.16	DIO2 output source	(Visible when 14.01 Module 1 type = FIO-01) 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 / uint32
14.17	DI2 ON delay	(Visible when 14.01 Module 1 type = FAIO-01) Defines the activation delay for digital input DI2. See parameter 14.12 DI1 ON delay.	0.00 s / real32
	0.00 … 3000.00 s	Activation delay for DI2.	10 = 1 s / 100 = 1 s
14.17	DIO2 ON delay	(Visible when 14.01 Module 1 type = FIO-11) Defines the activation delay for digital input/output DIO2. See parameter 14.12 DIO1 ON delay.	0.00 s / real32
	0.00 … 3000.00 s	Activation delay for DIO2.	10 = 1 s / 100 = 1 s
14.17	DIO2 ON delay	(Visible when 14.01 Module 1 type = FIO-01) Defines the activation delay for digital input/output DIO2. See parameter 14.12 DIO1 ON delay.	0.00 s / real32
	0.00 … 3000.00 s	Activation delay for DIO2.	10 = 1 s / 100 = 1 s
14.18	DI2 OFF delay	(Visible when 14.01 Module 1 type = FAIO-01) Defines the deactivation delay for digital input DI2. See parameter 14.12 DI1 ON delay.	0.00 s / real32
	0.00 … 3000.00 s	Deactivation delay for DI2.	10 = 1 s / 100 = 1 s
14.18	DIO2 OFF delay	(Visible when 14.01 Module 1 type = FIO-11) Defines the deactivation delay for digital input/output DIO2. See parameter 14.12 DIO1 ON delay.	0.00 s / real32
	0.00 … 3000.00 s	Deactivation delay for DIO2.	10 = 1 s / 100 = 1 s
14.18	DIO2 OFF delay	(Visible when 14.01 Module 1 type = FIO-01) Defines the deactivation delay for digital input/output DIO2. See parameter 14.12 DIO1 ON delay.	0.00 s / real32
	0.00 … 3000.00 s	Deactivation delay for DIO2.	10 = 1 s / 100 = 1 s
14.19	AI supervision function	(Visible when 14.01 Module 1 type = FDIO-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 / uint16
	No action	No action taken.	0

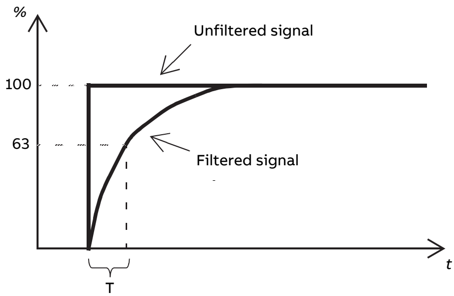
No.	Name / Range / Selection	Description	Def / Type FbEq 16b / 32b
	Fault	Drive trips on 80A0 AI Supervision.	1
	Warning	Drive generates an A8A0 AI Supervised Warning warning.	2
	Last speed	Drive generates a warning (A8A0 AI Supervised Warning) and freezes the speed (or frequency) to the level the drive 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 Supervised 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.	4
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 / uint16
	Output	DIO3 is used as a digital output.	0
	Input	DIO3 is used as a digital input.	1
14.20	AI supervision selection	(Visible when 14.01 Module 1 type = FDIO-01) Specifies the analog input limits to be supervised. See parameter 14.19 AI supervision function. **Note:** The number of active bits in this parameter depends on the number of inputs on the extension module.	- / uint16
b0	AI1 < MIN	1 = Minimum limit supervision of AI1 active.	
b1	AI1 > MAX	1 = Maximum limit supervision of AI1 active.	
b2	AI2 < MIN	1 = Minimum limit supervision of AI2 active.	
b3	AI2 > MAX	1 = Maximum limit supervision of AI2 active.	
b4…15	Reserved		
	0000h…FFFFh		1 = 1 / 1 = 1
14.20	AI supervision selection	(Visible when 14.01 Module 1 type = FIO-11) Specifies the analog input limits to be supervised. See parameter 14.19 AI supervision function.	- / uint16
b0	AI1 < MIN	1 = Minimum limit supervision of AI1 active.	
b1	AI1 > MAX	1 = Maximum limit supervision of AI1 active.	
b2	AI2 < MIN	1 = Minimum limit supervision of AI2 active.	
b3	AI2 > MAX	1 = Maximum limit supervision of AI2 active.	

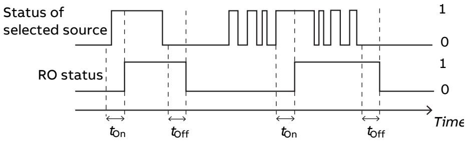
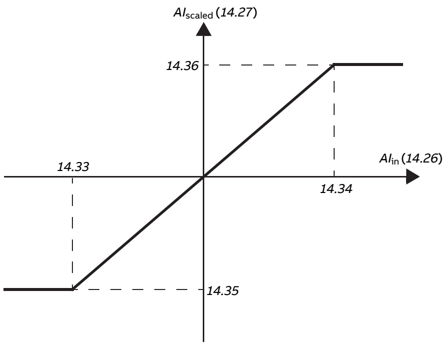
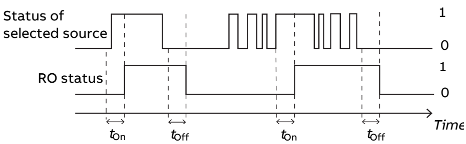
No.	Name / Range / Selection	Description	Def / Type FbEq 16b / 32b
b4	AI3 < MIN	1 = Minimum limit supervision of AI3 active.	
b5	AI3 > MAX	1 = Maximum limit supervision of AI3 active.	
b6…15	Reserved		
	0000h…FFFFh		1 = 1 / 1 = 1
14.21	AI tune	(Visible when 14.01 Module 1 type = FDIO-01) Triggers the 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 / uint16
	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
14.21	AI tune	(Visible when 14.01 Module 1 type = FIO-11) 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 / uint16
	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

No.	Name / Range / Selection	Description	Def / Type FbEq 16b / 32b
	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	The measured value of AI3 is set as the minimum value of AI3 into parameter 14.63 AI3 min.	5
	AI3 max tune	The measured value of AI3 is set as the maximum value of AI3 into parameter 14.64 AI3 max.	6
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 / uint32
14.22	AI force selection	(Visible when 14.01 Module 1 type = FDIO-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.	- / uint16
b0	AI1	1 = Force mode: Force AI1 to value of parameter 14.28 AI1 force data.	
b1	AI2	1 = Force mode: Force AI2 to value of parameter 14.43 AI2 force data.	
b2…15	Reserved		
	0000h…FFFFh		1 = 1 / 1 = 1
14.22	DI3 ON delay	(Visible when 14.01 Module 1 type = FAIO-01) Defines the activation delay for digital input DI3. See parameter 14.12 DI1 ON delay.	0.00 s / real32
	0.00 ... 3000.00 s	Activation delay for DI3.	10 = 1 s / 100 = 1 s
14.22	AI force selection	(Visible when 14.01 Module 1 type = FIO-11) 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.	- / uint16
b0	AI1	1 = Force mode: Force AI1 to value of parameter 14.28 AI1 force data.	
b1	AI2	1 = Force mode: Force AI2 to value of parameter 14.43 AI2 force data.	
b2	AI3	1 = Force mode: Force AI3 to value of parameter 14.58 AI3 force data (FIO-11 only).	
b3…15	Reserved		
	0000h…FFFFh		1 = 1 / 1 = 1
14.22	DIO3 ON delay	(Visible when 14.01 Module 1 type = FIO-01) Defines the activation delay for digital input/output DIO3. See parameter 14.12 DIO1 ON delay.	0.00 s / real32

No.	Name / Range / Selection	Description	Def / Type FbEq 16b / 32b
	0.00 … 3000.00 s	Activation delay for DIO3.	10 = 1 s / 100 = 1 s
14.23	DI3 OFF delay	(Visible when 14.01 Module 1 type = FAIO-01) Defines the deactivation delay for digital input DI3. See parameter 14.12 DI1 ON delay.	0.00 s / real32
	0.00 … 3000.00 s	Deactivation delay for DI3.	10 = 1 s / 100 = 1 s
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 14.12 DIO1 ON delay.	0.00 s / real32
	0.00 … 3000.00 s	Deactivation delay for DIO3.	10 = 1 s / 100 = 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 / uint16
	Output	DIO4 is used as a digital output.	0
	Input	DIO4 is used as a digital input.	1
14.26	AI1 actual value	(Visible when 14.01 Module 1 type = FDIO-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.	- / real32
	-22.000 … 22.000 mA or V	Value of analog input AI1.	1000 = 1 mA or V / 1000 = 1 mA or V
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 / uint32
14.27	AI1 scaled value	(Visible when 14.01 Module 1 type = FDIO-01) Displays the value of analog input AI1 after scaling. See parameter 14.35 AI1 scaled at AI1 min. This parameter is read-only.	- / real32
	-32768.000 … 32767.000	Scaled value of analog input AI1.	1 = 1 / 1000 = 1
14.27	DIO4 ON delay	(Visible when 14.01 Module 1 type = FIO-01) Defines the activation delay for digital input/output DIO4. See parameter 14.12 DIO1 ON delay.	0.00 s / real32
	0.00 … 3000.00 s	Activation delay for DIO4.	10 = 1 s / 100 = 1 s
14.28	AI1 force data	(Visible when 14.01 Module 1 type = FDIO-01) Forced value that can be used instead of the true reading of the input. See parameter 14.22 AI force selection.	- / real32
	-22.000 … 22.000 mA or V	Forced value of analog input AI1.	1000 = 1 mA or V / 1000 = 1 mA or V

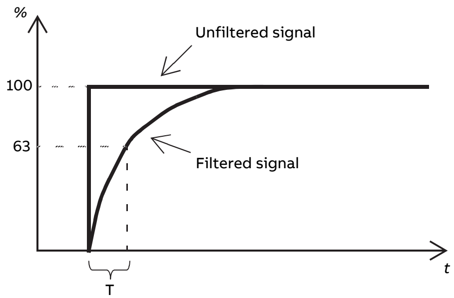
No.	Name / Range / Selection	Description	Def / Type FbEq 16b / 32b
14.28	DIO4 OFF delay	(Visible when 14.01 Module 1 type = FIO-01) Defines the deactivation delay for digital input/output DIO4. See parameter 14.12 DIO1 ON delay.	0.00 s / real32
	0.00 ... 3000.00 s	Deactivation delay for DIO4.	10 = 1 s / 100 = 1 s
14.29	AI1 HW switch position	(Visible when 14.01 Module 1 type = FDIO-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.	mA / uint16
	mA	Milliamperes.	10
	V	Volts.	2
14.30	AI1 unit selection	(Visible when 14.01 Module 1 type = FDIO-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 position. 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 / uint16
	mA	Milliamperes.	10
	V	Volts.	2
14.31	RO status	(Visible when 14.01 Module 1 type = FAIO-01) Status of relay outputs on the I/O extension module. **Example:** 0001b = RO1 is energized, RO2 is de-energized.	- / uint16
	0000h…FFFFh		1 = 1 / 1 = 1
14.31	AI1 filter gain	(Visible when 14.01 Module 1 type = FDIO-01) Selects a hardware filtering time for AI1. See also parameter 14.32 AI1 filter time.	1 ms / uint16
	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

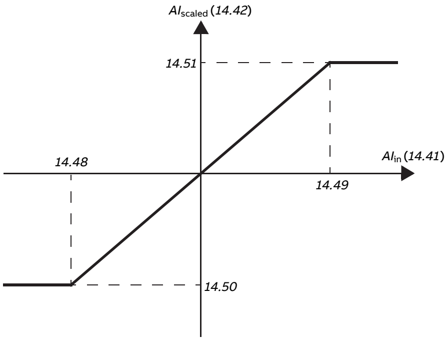
No.	Name / Range / Selection	Description	Def / Type FbEq 16b / 32b
14.31	RO status	(Visible when 14.01 Module 1 type = FIO-01) Status of relay outputs on the I/O extension module. **Example:** 0001b = RO1 is energized, RO2 is de-energized.	- / uint16
	0000h…FFFFh		1 = 1 / 1 = 1
14.32	AI1 filter time	(Visible when 14.01 Module 1 type = FDIO-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 / real32
	0.000 … 30.000 s	Filter time constant.	1000 = 1 s / 1000 = 1 s
14.33	AI1 min	(Visible when 14.01 Module 1 type = FDIO-01) Defines the minimum value for analog input AI1. See also parameter 14.21 AI tune.	0.000 mA or V / real32
	-22.000 … 22.000 mA or V	Minimum value of AI1.	1000 = 1 mA or V / 1000 = 1 mA or V
14.34	RO1 source	(Visible when 14.01 Module 1 type = FAIO-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 / uint32
14.34	AI1 max	(Visible when 14.01 Module 1 type = FDIO-01) Defines the maximum value for analog input AI1. See also parameter 14.21 AI tune.	10.000 mA or V / real32
	-22.000 … 22.000 mA or V	Maximum value of AI1.	1000 = 1 mA or V / 1000 = 1 mA or V

No.	Name / Range / Selection	Description	Def / Type FbEq 16b / 32b
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 / uint32
14.35	RO1 ON delay	(Visible when 14.01 Module 1 type = FAIO-01) Defines the activation delay for relay output RO1.  t_{On} = 14.35 RO1 ON delay t_{Off} = 14.36 RO1 OFF delay	0.00 s / real32
	0.00 … 3000.00 s	Activation delay for RO1.	10 = 1 s / 100 = 1 s
14.35	AI1 scaled at AI1 min	(Visible when 14.01 Module 1 type = FDIO-01) Defines the real value that corresponds to the minimum analog input AI1 value defined by parameter 14.33 AI1 min.  	0.000 NoUnit / real32
	-32768.000 … 32767.000	Real value corresponding to minimum AI1 value.	1 = 1 / 1000 = 1
14.35	RO1 ON delay	(Visible when 14.01 Module 1 type = FIO-01) Defines the activation delay for relay output RO1.  t_{On} = 14.35 RO1 ON delay t_{Off} = 14.36 RO1 OFF delay	0.00 s / real32
	0.00 … 3000.00 s	Activation delay for RO1.	10 = 1 s / 100 = 1 s

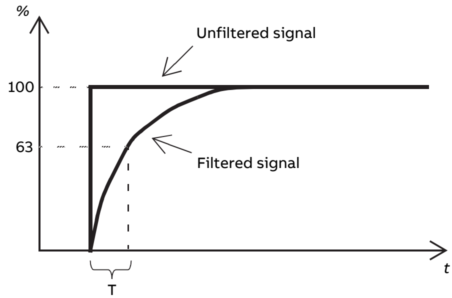
No.	Name / Range / Selection	Description	Def / Type FbEq 16b / 32b
14.36	RO1 OFF delay	(Visible when 14.01 Module 1 type = FAIO-01) Defines the deactivation delay for relay output RO1. See parameter 14.35 RO1 ON delay.	0.00 s / real32
	0.00 … 3000.00 s	Deactivation delay for RO1.	10 = 1 s / 100 = 1 s
14.36	AI1 scaled at AI1 max	(Visible when 14.01 Module 1 type = FDIO-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 NoUnit / real32
	-32768.000 … 32767.000	Real value corresponding to maximum AI1 value.	1 = 1 / 1000 = 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.	0.00 s / real32
	0.00 … 3000.00 s	Deactivation delay for RO1.	10 = 1 s / 100 = 1 s
14.37	RO2 source	(Visible when 14.01 Module 1 type = FAIO-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 / uint32
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 / uint32
14.38	RO2 ON delay	(Visible when 14.01 Module 1 type = FAIO-01) Defines the activation delay for relay output RO2. See parameter 14.35 RO1 ON delay.	0.00 s / real32
	0.00 … 3000.00 s	Activation delay for RO2.	10 = 1 s / 100 = 1 s
14.38	RO2 ON delay	(Visible when 14.01 Module 1 type = FIO-01) Defines the activation delay for relay output RO2. See parameter 14.35 RO1 ON delay.	0.00 s / real32
	0.00 … 3000.00 s	Activation delay for RO2.	10 = 1 s / 100 = 1 s
14.39	RO2 OFF delay	(Visible when 14.01 Module 1 type = FAIO-01) Defines the deactivation delay for relay output RO2. See parameter 14.35 RO1 ON delay.	0.00 s / real32
	0.00 … 3000.00 s	Deactivation delay for RO2.	10 = 1 s / 100 = 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 14.35 RO1 ON delay.	0.00 s / real32
	0.00 … 3000.00 s	Deactivation delay for RO2.	10 = 1 s / 100 = 1 s

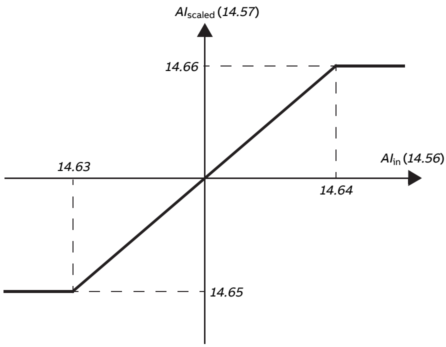
No.	Name / Range / Selection	Description	Def / Type FbEq 16b / 32b
14.41	AI2 actual value	(Visible when 14.01 Module 1 type = FDIO-01) Displays the value of analog input AI2 in mA or V (depending on whether the input is set to current or voltage). This parameter is read-only.	- / real32
	-22.000 … 22.000 mA or V	Value of analog input AI2.	1000 = 1 mA or V / 1000 = 1 mA or V
14.42	AI2 scaled value	(Visible when 14.01 Module 1 type = FDIO-01) Displays the value of analog input AI2 after scaling. See parameter 14.50 AI2 scaled at AI2 min. This parameter is read-only.	- / real32
	-32768.000 … 32767.000 mA or V	Scaled value of analog input AI2.	1 = 1 mA or V / 1000 = 1 mA or V
14.43	AI2 force data	(Visible when 14.01 Module 1 type = FDIO-01) Forced value that can be used instead of the true reading of the input. See parameter 14.22 AI force selection.	- / real32
	-22.000 … 22.000 mA or V	Forced value of analog input AI2.	1000 = 1 mA or V / 1000 = 1 mA or V
14.44	AI2 HW switch position	(Visible when 14.01 Module 1 type = FDIO-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.	mA / uint16
	mA	Milliamperes.	10
	V	Volts.	2
14.45	AI2 unit selection	(Visible when 14.01 Module 1 type = FDIO-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 position. 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 / uint16
	mA	Milliamperes.	10
	V	Volts.	2
14.46	AI2 filter gain	(Visible when 14.01 Module 1 type = FDIO-01) Selects a hardware filtering time for AI2. See also parameter 14.47 AI2 filter time.	1 ms / uint16
	No filtering	No filtering.	0

No.	Name / Range / Selection	Description	Def / Type FbEq 16b / 32b
	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 = FDIO-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 / real32
	0.000 … 30.000 s	Filter time constant.	1000 = 1 s / 1000 = 1 s
14.48	AI2 min	(Visible when 14.01 Module 1 type = FDIO-01) Defines the minimum value for analog input AI2. See also parameter 14.21 AI tune.	0.000 mA or V / real32
	-22.000 … 22.000 mA or V	Minimum value of AI2.	1000 = 1 mA or V / 1000 = 1 mA or V
14.49	AI2 max	(Visible when 14.01 Module 1 type = FDIO-01) Defines the maximum value for analog input AI2. See also parameter 14.21 AI tune.	10.000 mA or V / real32
	-22.000 … 22.000 mA or V	Maximum value of AI2.	1000 = 1 mA or V / 1000 = 1 mA or V

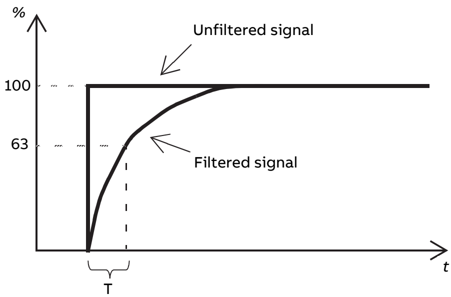
No.	Name / Range / Selection	Description	Def / Type FbEq 16b / 32b
14.50	AI2 scaled at AI2 min	(Visible when 14.01 Module 1 type = FDIO-01) Defines the real value that corresponds to the minimum analog input AI2 value defined by parameter 14.48 AI2 min.  	0.000 NoUnit / real32
	-32768.000 ... 32767.000	Real value corresponding to minimum AI2 value.	1 = 1 / 1000 = 1
14.51	AI2 scaled at AI2 max	(Visible when 14.01 Module 1 type = FDIO-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 NoUnit / real32
	-32768.000 ... 32767.000	Real value corresponding to maximum AI2 value.	1 = 1 / 1000 = 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.	- / real32
	-22.000 ... 22.000 mA or V	Value of analog input AI3.	1000 = 1 mA or V / 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.	- / real32
	-32768.000 ... 32767.000	Scaled value of analog input AI3.	1 = 1 / 1000 = 1
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.	- / real32
	-22.000 ... 22.000 mA or V	Forced value of analog input AI3.	1000 = 1 mA or V / 1000 = 1 mA or V

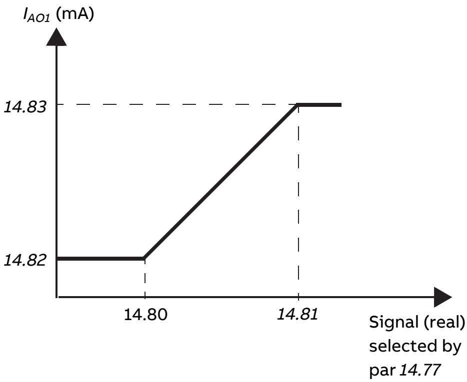
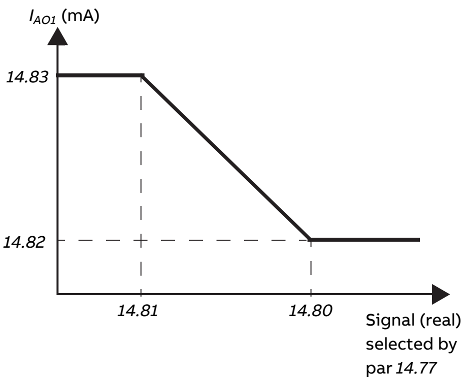
No.	Name / Range / Selection	Description	Def / Type FbEq 16b / 32b
14.59	AI3 HW switch position	(Visible when 14.01 Module 1 type = FIO-11) Shows the position of the hardware current/voltage selector on the I/O extension module. **Note:** The setting of the current/voltage selector must match the unit 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.	mA / uint16
	mA	Milliamperes.	10
	V	Volts.	2
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 position. 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 / uint16
	mA	Milliamperes.	10
	V	Volts.	2
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 / uint16
	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 / Range / Selection	Description	Def / Type FbEq 16b / 32b
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 × (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 / real32
	0.000 … 30.000 s	Filter time constant.	1000 = 1 s / 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 / real32
	-22.000 … 22.000 mA or V	Minimum value of AI3.	1000 = 1 mA or V / 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 / real32
	-22.000 … 22.000 mA or V	Maximum value of AI3.	1000 = 1 mA or V / 1000 = 1 mA or V

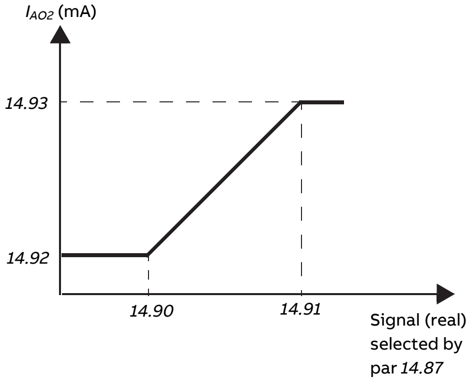
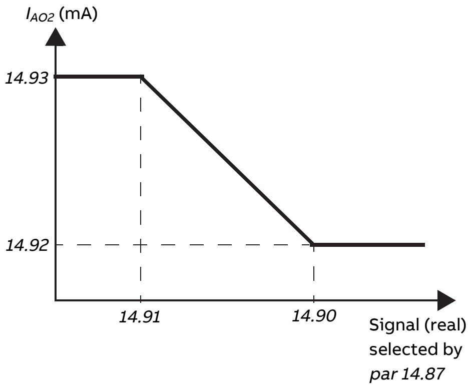
No.	Name / Range / Selection	Description	Def / Type FbEq 16b / 32b
14.65	AI3 scaled at AI3 min	(Visible when 14.01 Module 1 type = FIO-11) Defines the real value that corresponds to the minimum analog input AI3 value defined by parameter 14.63 AI3 min.  	0.000 NoUnit / real32
	-32768.000 … 32767.000	Real value corresponding to minimum AI3 value.	1 = 1 / 1000 = 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 NoUnit / real32
	-32768.000 … 32767.000	Real value corresponding to maximum AI3 value.	1 = 1 / 1000 = 1
14.71	AO force selection	(Visible when 14.01 Module 1 type = FDIO-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.	- / uint16
b0	AO1	1 = Force mode: Force AO1 to value of parameter 14.78 AO1 force data.	
b1	AO2	1 = Force mode: Force AO2 to value of parameter 14.88 AO2 force data (FAIO-01 only).	
b2…15	Reserved		
	0000h…FFFFh		1 = 1 / 1 = 1
14.71	AO force selection	(Visible when 14.01 Module 1 type = FIO-11) 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.	- / uint16
b0	AO1	1 = Force mode: Force AO1 to value of parameter 14.78 AO1 force data.	

No.	Name / Range / Selection	Description	Def / Type FbEq 16b / 32b
b1…15	Reserved		
	0000h…FFFFh		1 = 1 / 1 = 1
14.76	AO1 actual value	(Visible when 14.01 Module 1 type = FDIO-01) Displays the value of AO1 in mA. This parameter is read-only.	- / real32
	0.000 ... 22.000 mA	Value of AO1.	1000 = 1 mA / 1000 = 1 mA
14.77	AO1 source	(Visible when 14.01 Module 1 type = FDIO-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 / uint32
	Zero	None	0
	Motor speed used	01.01 Motor speed used (page 136).	1
	Output frequency	01.06 Output frequency (page 136).	3
	Motor current	01.07 Motor current (page 136).	4
	Motor torque	01.10 Motor torque (page 136).	6
	DC voltage	01.11 DC voltage (page 137).	7
	Power inu out	01.14 Output power (page 137).	8
	Speed ref ramp in	23.01 Speed ref ramp input (page 267).	10
	Speed ref ramp out	23.02 Speed ref ramp output (page 267).	11
	Speed ref used	24.01 Used speed reference (page 274).	12
	Torq ref used	26.02 Torque reference used (page 293).	13
	Other [bit]	Source selection. See Terms and abbreviations (page 132).	-
	Force Pt100 excitation	The output is used to feed an excitation current to 1…3 Pt100 sensors. See section Motor thermal protection (page 106).	20
	Force KTY84 excitation	The output is used to feed an excitation current to a KTY84 sensor. See section Motor thermal protection (page 106).	21
	Force PTC excitation	The output is used to feed an excitation current to 1…3 PTC sensors. See section Motor thermal protection (page 106).	22
	Force Pt1000 excitation	The output is used to feed an excitation current to 1…3 Pt1000 sensors. See section Motor thermal protection (page 106).	23
	AO1 data storage	13.91 AO1 data storage.	37
	AO2 data storage	13.92 AO2 data storage.	38
14.78	AO1 force data	(Visible when 14.01 Module 1 type = FIO-11) Forced value that can be used instead of the selected output signal. See parameter 14.71 AO force selection.	- / real32

No.	Name / Range / Selection	Description	Def / Type FbEq 16b / 32b
	0.000 … 22.000 mA	Forced value of analog output AO1.	1000 = 1 mA / 1000 = 1 mA
14.78	AO1 force data	(Visible when 14.01 Module 1 type = FDIO-01) Forced value that can be used instead of the selected output signal. See parameter 14.71 AO force selection.	0.000 mA / real32
	0.000 … 20.000 mA	Forced value of analog output AO1.	1000 = 1 mA / 1000 = 1 mA
14.79	AO1 filter time	(Visible when 14.01 Module 1 type = FDIO-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 / real32
	0.000 … 30.000 s	Filter time constant.	1000 = 1 s / 1000 = 1 s

No.	Name / Range / Selection	Description	Def / Type FbEq 16b / 32b
14.80	AO1 source min	(Visible when 14.01 Module 1 type = FDIO-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 NoUnit / real32
	-32768.0 … 32767.0	Real signal value corresponding to minimum AO1 output value.	1 = 1 / 10 = 1
14.81	AO1 source max	(Visible when 14.01 Module 1 type = FDIO-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 NoUnit / real32
	-32768.0 … 32767.0	Real signal value corresponding to maximum AO1 output value.	1 = 1 / 10 = 1
14.82	AO1 out at AO1 src min	(Visible when 14.01 Module 1 type = FIO-11) Defines the minimum output value for analog output AO1. See also drawing at parameter 14.80 AO1 source min.	0.000 mA / real32

No.	Name / Range / Selection	Description	Def / Type FbEq 16b / 32b
	0.000 … 22.000 mA	Minimum AO1 output value.	1000 = 1 mA / 1000 = 1 mA
14.82	AO1 out at AO1 src min	(Visible when 14.01 Module 1 type = FDIO-01) Defines the minimum output value for analog output AO1. See also drawing at parameter 14.80 AO1 source min.	0.000 mA / real32
	0.000 … 20.000 mA	Minimum AO1 output value.	1000 = 1 mA / 1000 = 1 mA
14.83	AO1 out at AO1 src max	(Visible when 14.01 Module 1 type = FIO-11) Defines the maximum output value for analog output AO1. See also drawing at parameter 14.80 AO1 source min.	10.000 mA / real32
	0.000 … 22.000 mA	Maximum AO1 output value.	1000 = 1 mA / 1000 = 1 mA
14.83	AO1 out at AO1 src max	(Visible when 14.01 Module 1 type = FDIO-01) Defines the maximum output value for analog output AO1. See also drawing at parameter 14.80 AO1 source min.	10.000 mA / real32
	0.000 … 20.000 mA	Maximum AO1 output value.	1000 = 1 mA / 1000 = 1 mA
14.86	AO2 actual value	(Visible when 14.01 Module 1 type = FDIO-01) Displays the value of AO2 in mA. This parameter is read-only.	- / real32
	0.000 … 22.000 mA	Value of AO2.	1000 = 1 mA / 1000 = 1 mA
14.87	AO2 source	(Visible when 14.01 Module 1 type = FDIO-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 / uint32
14.88	AO2 force data	(Visible when 14.01 Module 1 type = FDIO-01) Forced value that can be used instead of the selected output signal. See parameter 14.71 AO force selection.	0.000 mA / real32
	0.000 … 20.000 mA	Forced value of analog output AO2.	1000 = 1 mA / 1000 = 1 mA
14.89	AO2 filter time	(Visible when 14.01 Module 1 type = FDIO-01) Defines the filtering time constant for analog output AO2. See parameter 14.79 AO1 filter time.	0.100 s / real32
	0.000 … 30.000 s	Filter time constant.	1000 = 1 s / 1000 = 1 s

No.	Name / Range / Selection	Description	Def / Type FbEq 16b / 32b
14.90	AO2 source min	(Visible when 14.01 Module 1 type = FDIO-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 NoUnit / real32
	-32768.0 … 32767.0	Real signal value corresponding to minimum AO2 output value.	1 = 1 / 10 = 1
14.91	AO2 source max	(Visible when 14.01 Module 1 type = FDIO-01) 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 NoUnit / real32
	-32768.0 … 32767.0	Real signal value corresponding to maximum AO2 output value.	1 = 1 / 10 = 1
14.92	AO2 out at AO2 src min	(Visible when 14.01 Module 1 type = FDIO-01) Defines the minimum output value for analog output AO2. See also drawing at parameter 14.90 AO2 source min.	0.000 mA / real32

No.	Name / Range / Selection	Description	Def / Type FbEq 16b / 32b
	0.000 … 20.000 mA	Minimum AO2 output value.	1000 = 1 mA / 1000 = 1 mA
14.93	AO2 out at AO2 src max	(Visible when 14.01 Module 1 type = FDIO-01) Defines the maximum output value for analog output AO2. See also drawing at parameter 14.90 AO2 source min.	10.000 mA / real32
	0.000 … 20.000 mA	Maximum AO2 output value.	1000 = 1 mA / 1000 = 1 mA

No.	Name / Range / Selection	Description	Def / Type FbEq 16b / 32b
15	I/O extension module 2	Configuration of I/O extension module 2. See also section Programmable I/O extensions (page 73). **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.	- / uint16
15.02	Module 2 location	See parameter 14.02 Module 1 location.	- / uint16
15.03	Module 2 status	See parameter 14.03 Module 1 status.	No option / uint16

No.	Name / Range / Selection	Description	Def / Type FbEq 16b / 32b
16	I/O extension module 3	Configuration of I/O extension module 3. See also section Programmable I/O extensions (page 73). **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 / uint16
16.02	Module 3 location	See parameter 14.02 Module 1 location.	- / uint16
16.03	Module 3 status	See parameter 14.03 Module 1 status.	No option / uint16

No.	Name / Range / Selection	Description	Def / Type FbEq 16b / 32b
19	Operation mode	Selection of local and external control location sources and operating modes. See also section Operating modes of the drive (page 67).	
19.01	Actual operation mode	Displays the operating mode currently used. See parameters 19.11…19.14. This parameter is read-only.	Speed / uint16
	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
	Voltage	DC voltage control.	7
	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 / uint32
	EXT1	EXT1 (permanently selected).	0
	EXT2	EXT2 (permanently selected).	1
	FBA A MCW bit 11	Control word bit 11 received through fieldbus interface A.	2
	DI1	Digital input DI1 (10.02 DI delayed status, bit 0).	3
	DI2	Digital input DI2 (10.02 DI delayed status, bit 1).	4
	DI3	Digital input DI3 (10.02 DI delayed status, bit 2).	5
	DI4	Digital input DI4 (10.02 DI delayed status, bit 3).	6
	DI5	Digital input DI5 (10.02 DI delayed status, bit 4).	7
	DI6	Digital input DI6 (10.02 DI delayed status, bit 5).	8
	DIO1	Digital input/output DIO1 (11.02 DIO delayed status, bit 0).	11

No.	Name / Range / Selection	Description	Def / Type FbEq 16b / 32b
	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]	See Terms and abbreviations (page 132).	-
19.12	Ext1 control mode	Selects the operating mode for external control location EXT1.	Speed / uint16
	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	Selects the operating mode for external control location EXT2. For the selections, see parameter 19.12 Ext1 control mode.	Speed / uint16
19.16	Local control mode	Selects the operating mode for local control.	Speed / uint16
	Speed	Speed control. The torque reference used is 25.01 Torque reference speed control (output of the speed reference chain).	0
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 / uint16
	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 Operating modes of the drive (page 67), and parameter 99.04 Motor control mode. **Note:** This parameter cannot be changed while the drive is running.	Rpm / uint16
	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 / Range / Selection</th><th>Description</th><th>Def / Type
FbEq 16b / 32b</th></tr>
<tr><td>20</td><td>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 66).</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; In2 Dir / uint16</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 / Range / Selection</th><th>Description</th><th>Def / Type
FbEq 16b / 32b</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>

Note: 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>

Note: The start signal is always edge-triggered with this setting regardless of parameter 20.02 Ext1 start trigger type.</td><td>5</td></tr>
</table>

<table>
<tr><th>No.</th><th>Name / Range / Selection</th><th>Description</th><th>Def / Type
FbEq 16b / 32b</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 20.03 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>Control panel</td><td>The start and stop commands are taken from the control panel.</td><td>11</td></tr>
<tr><td></td><td>Fieldbus A</td><td>The start and stop commands are taken from fieldbus adapter A.

Note: 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>
<tr><td></td><td>M/F link</td><td>The start and stop commands are taken from another drive through the master/follower link.

Note: The start signal is always level-triggered with this setting regardless of parameter 20.02 Ext1 start trigger type.</td><td>15</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 20.02 Ext1 start trigger type.</td><td>21</td></tr>
<tr><td></td><td>ATF</td><td>Reserved.</td><td>22</td></tr>
</table>

No.	Name / Range / Selection	Description	Def / Type FbEq 16b / 32b
	DDCS controller	The start and stop commands are taken from an external (DDCS) controller. **Note:** The start signal is always level-triggered with this setting regardless of parameter 20.02 Ext1 start trigger type.	16
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, In1 Start fwd; In2 Start rev, or Control panel.	Edge / uint16
	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 / uint32
	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]	See Terms and abbreviations (page 132).	-
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 / uint32
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 / uint32
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.	In1 Start / uint16
	Not selected	No start or stop command sources selected.	0

<table>
<tr><th>No.</th><th>Name / Range / Selection</th><th>Description</th><th>Def / Type
FbEq 16b / 32b</th></tr>
<tr><td></td><td>In1 Start</td><td>The source of the start and stop commands is selected by parameter 20.08 Ext2 in1 source. The state transitions of the source bits are interpreted as follows:
<table>
<tr><th>State of source 1 (20.08)</th><th>Command</th></tr>
<tr><td>0→1 (20.07 = Edge)
1 (20.07 = Level)</td><td>Start</td></tr>
<tr><td>0</td><td>Stop</td></tr>
</table></td><td>1</td></tr>
<tr><td></td><td>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>
</table>

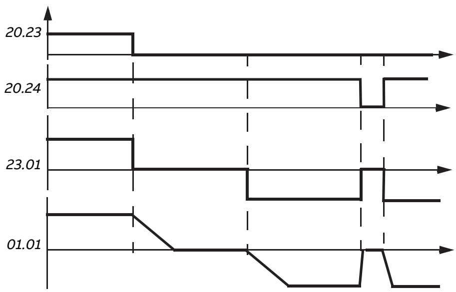
<table>
<tr><th>No.</th><th>Name / Range / Selection</th><th>Description</th><th>Def / Type
FbEq 16b / 32b</th></tr>
<tr><td></td><td>In1P Start; In2 Stop</td><td>The sources of the start and stop commands are selected by parameters 20.08 Ext2 in1 source and 20.09 Ext2 in2 source.
The state transitions 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>
Note: 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>
Note: 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>

No.	Name / Range / Selection	Description	Def / Type FbEq 16b / 32b
	In1P Start fwd; In2P Start rev; In3 Stop	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: **State of source 1 (20.08)** / **State of source 2 (20.09)** / **State of source 3 (20.10)** / **Command** 0→1 / Any / 1 / Start forward Any / 0→1 / 1 / Start reverse Any / Any / 0 / Stop **Note:** The start signal is always edge-triggered with this setting regardless of parameter 20.07 Ext2 start trigger type.	6
	Control panel	The start and stop commands are taken from the control panel.	11
	Fieldbus A	The start and stop commands are taken from fieldbus adapter A. **Note:** The start signal is always edge-triggered with this setting regardless of parameter 20.07 Ext2 start trigger type.	12
	Embedded fieldbus	The start and stop commands are taken from the embedded fieldbus interface. **Note:** The start signal is always edge-triggered with this setting regardless of parameter 20.07 Ext2 start trigger type.	14
	M/F link	The start and stop commands are taken from another drive through the master/follower link. **Note:** The start signal is always edge-triggered with this setting regardless of parameter 20.07 Ext2 start trigger type.	15
	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 edge-triggered with this setting regardless of parameter 20.07 Ext2 start trigger type.	21
	ATF	Reserved.	22

No.	Name / Range / Selection	Description	Def / Type FbEq 16b / 32b
	DDCS controller	The start and stop commands are taken from an external (DDCS) controller. **Note:** The start signal is always edge-triggered with this setting regardless of parameter 20.07 Ext2 start trigger type.	16
20.07	Ext2 start trigger type	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, In1 Start fwd; In2 Start rev, or Control panel.	Level / uint16
	Edge	The start signal is edge-triggered.	0
	Level	The start signal is level-triggered.	1
20.08	Ext2 in1 source	Selects source 1 for parameter 20.06 Ext2 commands. For the available selections, see parameter 20.03 Ext1 in1 source.	Not selected / uint32
20.09	Ext2 in2 source	Selects source 2 for parameter 20.06 Ext2 commands. For the available selections, see parameter 20.03 Ext1 in1 source.	Not selected / uint32
20.10	Ext2 in3 source	Selects source 3 for parameter 20.06 Ext2 commands. For the available selections, see parameter 20.03 Ext1 in1 source.	Not selected / uint32
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) / uint16
	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 (page 267).	1
	Torque limit	Stop according to torque limits (parameters 30.19 and 30.20).	2

No.	Name / Range / Selection	Description	Def / Type FbEq 16b / 32b
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) / uint32
	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. **Note:** • If the drive is running in fieldbus control, 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. In case the active source is the control panel, PC tool or drive I/O, the run enable signal is always on.	34
	Other [bit]	See Terms and abbreviations (page 132).	-

No.	Name / Range / Selection	Description	Def / Type FbEq 16b / 32b
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.) **Note:** • If a level-triggered start command is on when the start enable signal switches on, the drive will start. (An edgetriggered start signal must be cycled for the drive to start.) See parameters 20.02 Ext1 start trigger type, 20.07 Ext2 start trigger type and 20.29 Local 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 / uint32
	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 DIO1 (11.02 DIO delayed status, bit 1).	11
	DIIL	DIIL input (10.02 DI delayed status, bit 15).	30
	Other [bit]	See Terms and abbreviations (page 132).	-

No.	Name / Range / Selection	Description	Def / Type FbEq 16b / 32b
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 ramps down along the currently active deceleration ramp. The drive keeps modulating. 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. 	Selected / uint32
	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]	See Terms and abbreviations (page 132).	-
20.24	Negative speed enable	Selects the source of the negative speed reference enable command. See parameter 20.23 Positive speed enable.	Selected / uint32

No.	Name / Range / Selection	Description	Def / Type FbEq 16b / 32b
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 89).	Not selected / uint32
	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 DIO1 (11.02 DIO delayed status, bit 1).	11
	Other [bit]	See Terms and abbreviations (page 132).	-
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 / uint32
	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 02).	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 / Range / Selection	Description	Def / Type FbEq 16b / 32b
	DIO1	Digital input/output DIO1 (11.02 DIO delayed status, bit 0).	10
	DIO2	Digital input/output DIO1 (11.02 DIO delayed status, bit 0).	11
	Other [bit]	See Terms and abbreviations (page 132).	-
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 / uint32
20.29	Local start trigger type	Defines whether the start signal for local control (for example, control panel or PC tool) is edge-triggered or level-triggered.	Edge / uint16
	Edge	The start signal is edge-triggered.	0
	Level	The start signal is level-triggered.	1
20.30	Enable signals warning function	Selects enable signal (eg. 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, ie. no warning is generated even if the signal is switched off. The bits of this binary number correspond to the following warnings:	- / uint16
b0	Enable Start	AFEA Enable start signal missing	
b1	Run enable 1	AFEB Run enable missing	
b2…15	Reserved		
	0000h…FFFFh		1 = 1 / 1 = 1

No.	Name / Range / Selection	Description	Def / Type FbEq 16b / 32b
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 control mode is set to DTC. **Note:** • 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 97).	Automatic / uint16
	Fast	The drive pre-magnetizes the motor before start. The premagnetizing 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
	Constant time	The drive pre-magnetizes the motor before start. The premagnetizing time is defined by parameter 21.02 Magnetization time. This mode should be selected if constant pre-magnetizing time is required (e.g. if the motor start must be synchronized with the release of a mechanical brake). This setting also guarantees the highest possible break-away torque when the pre-magnetizing time is set long enough. **WARNING!** The drive will start after the set magnetizing time has passed even if motor magnetization is not completed. In applications where a full break-away torque is essential, ensure that the constant magnetizing time is long enough to allow generation of full magnetization and torque.	1
	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
	Flying start	This method is intended for asynchronous motors only, and is optimized for applications where the drive must be started into a rotating motor at high frequencies (above 150 Hz).	3

<table>
<tr><th>No.</th><th>Name / Range / Selection</th><th>Description</th><th>Def / Type
FbEq 16b / 32b</th></tr>
<tr><td>21.02</td><td>Magnetization time</td><td>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 pre-magnetizes the motor for the set time. To ensure full magnetizing, set this parameter to the same value as, or higher than, the rotor time constant. If not known, use the rule-of-thumb value given in the table below:
<table>
<tr><th>Motor rated power</th><th>Constant magnetizing time</th></tr>
<tr><td>< 1 kW</td><td>≥ 50 to 100 ms</td></tr>
<tr><td>1 to 10 kW</td><td>≥ 100 to 200 ms</td></tr>
<tr><td>10 to 200 kW</td><td>≥ 200 to 1000 ms</td></tr>
<tr><td>200 to 1000 kW</td><td>≥ 1000 to 2000 ms</td></tr>
</table>
Note: This parameter cannot be changed while the drive is running.</td><td>500 ms / uint16</td></tr>
<tr><td></td><td>0…10000 ms</td><td>Constant DC magnetizing time.</td><td>1 = 1 ms / 1 = 1 ms</td></tr>
<tr><td>21.03</td><td>Stop mode</td><td>Selects the way the motor is stopped when a stop command is received.
Additional braking is possible by selecting flux braking (see parameter 97.05 Flux braking).
Note: This parameter has no effect in a follower drive in a master/follower configuration.</td><td>Ramp / uint16</td></tr>
<tr><td></td><td>Coast</td><td>Stop by switching off the output semiconductors of the drive.
The motor coasts to a stop.
WARNING!
If a mechanical brake is used, ensure it is safe to stop the drive by coasting.</td><td>0</td></tr>
<tr><td></td><td>Ramp</td><td>Stop along the active deceleration ramp. See parameter group 23 Speed reference ramp (page 267).</td><td>1</td></tr>
<tr><td></td><td>Torque limit</td><td>Stop according to torque limits (parameters 30.19 and 30.20).</td><td>2</td></tr>
<tr><td>21.04</td><td>Emergency stop mode</td><td>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.</td><td>Ramp stop (Off1); Coast stop (Off2) (95.20 b1); Eme ramp stop (Off3) (95.20 b2) / uint16</td></tr>
</table>

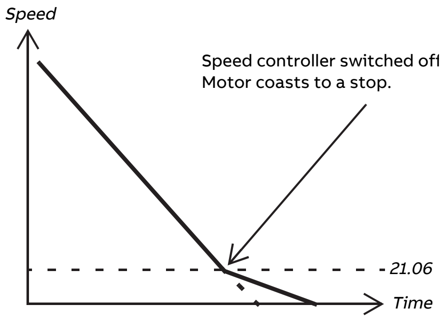
No.	Name / Range / Selection	Description	Def / Type FbEq 16b / 32b
	Ramp stop (Off1)	With the drive running: • 1 = Normal operation. • 0 = Normal stop along the standard deceleration ramp defined for the particular reference type (see section Reference ramping (page 75)). After the drive has stopped, 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) / uint32
	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 / Range / Selection	Description	Def / Type FbEq 16b / 32b
	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]	See Terms and abbreviations (page 132).	-
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. **Note:** If you use a value below the default, make sure the drive is able to stop.	30.00 rpm / real32
	0.00 ... 30000.00 rpm	Zero speed limit. For 16-bit scaling, see parameter 46.01.	- / 100 = 1 rpm

<table>
<tr><th>No.</th><th>Name / Range / Selection</th><th>Description</th><th>Def / Type
FbEq 16b / 32b</th></tr>
<tr><td>21.07</td><td>Zero speed delay</td><td>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.

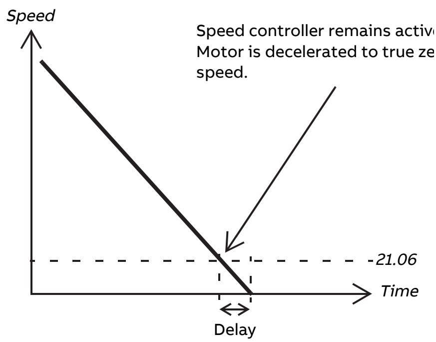
<u>Without zero speed delay:</u>

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. Zero speed delay can be used e.g. with the jogging function.


</td><td>0 ms / real32</td></tr>
<tr><td></td><td>0…30000 ms</td><td>Zero speed delay.</td><td>1 = 1 ms / 1 = 1 ms</td></tr>
</table>

No.	Name / Range / Selection	Description	Def / Type FbEq 16b / 32b
21.08	DC current control	Activates/deactivates the DC hold and post-magnetization functions. See section DC magnetization (page 97). **Note:** • DC hold is only available with speed control in DTC motor control mode (see page 67). • 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.	- / uint16
b0	DC hold	1 = Enable DC hold. See section DC hold (page 97). **Note:** The DC hold function has no effect if the start signal is switched off.	
b1	Post magnetization	1 = Enable post-magnetization. See section Post-magnetization (page 98). **Note:** Post-magnetization is only available when ramping is the selected stop mode (see parameter 21.03 Stop mode).	
b2…15	Reserved		
	0000h…FFFFh		1 = 1 / 1 = 1
21.09	DC hold speed	Defines the DC hold speed. See parameter 21.08 DC current control, and section DC hold (page 97).	5.00 rpm / real32
	0.00 ... 1000.00 rpm	DC hold speed. For 16-bit scaling, see parameter 46.01.	- / 100 = 1 rpm
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 97).	30.0 percent / real32
	0.0 ... 100.0 %	DC hold current.	1 = 1 % / 10 = 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 / uint32
	0...3000 s	Post-magnetization time.	1 = 1 s / 1 = 1 s

No.	Name / Range / Selection	Description	Def / Type FbEq 16b / 32b
21.12	Continuous magnetization command	Activates/deactivates (or selects a source that activates/deactivates) continuous magnetization. See section Continuous magnetization (page 98). The magnetization current is calculated on the basis of flux reference (see parameter group 97 Motor control). **Note:** • This function is only available in DTC motor control mode. • 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 / uint32
	Off	0.	0
	On	1.	1
	Other [bit]	See Terms and abbreviations (page 132).	-
21.13	Autophasing mode	Selects the way autophasing is performed. See section Autophasing (page 93). **Note:** This parameter cannot be changed while the drive is running.	Turning / uint16
	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. Permanent magnet motors: This mode is recommended with salient-pole motors.	1
	Standstill 2	An alternative standstill autophasing mode for Turning autophasing. It can be used if Standstill 1 gives irregular results. This mode is slower than Standstill 1 but works better with PM motors with surface-mounted magnets. The Standstill 2 mode can be used with all synchronous motor types (PM motor, SynRM). Permanent magnet motors: This mode is recommended with non salient-pole motors.	2

No.	Name / Range / Selection	Description	Def / Type FbEq 16b / 32b
	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
21.14	Pre-heating input source	Selects the source of the motor pre-heat on/off command. See section Pre-heating (page 97). **Note:** The pre-heating function will not activate if • the Safe torque off function is active, • a fault is active, • less than one minute has elapsed after stopping, or • PID sleep function is active. Pre-heating is deactivated when the drive is started, and overridden by pre-magnetization, post-magnetization or continuous magnetization. 0 = Pre-heating inactive 1 = Pre-heating active	Inactive (false) / uint32
	Inactive (false)	0. Pre-heating is always deactivated.	0
	Active (true)	1. Pre-heating is always activated when the drive is stopped (apart from conditions stated above).	1
	DI1	Digital input DI1 (10.02 DI delayed status, bit 0).	2
	DI2	Digital input DI2 (10.02 DI delayed status, bit 1).	3
	DI3	Digital input DI3 (10.02 DI delayed status, bit 2).	4
	DI4	Digital input DI4 (10.02 DI delayed status, bit 3).	5
	DI5	Digital input DI5 (10.02 DI delayed status, bit 4).	6
	DI6	Digital input DI6 (10.02 DI delayed status, bit 5).	7
	Supervision 1	Supervision 1 active (32.01 Supervision status, bit 0).	8
	Supervision 2	Supervision 2 active (32.01 Supervision status, bit 1).	9
	Supervision 3	Supervision 3 active (32.01 Supervision status, bit 2).	10
	Other [bit]	See Terms and abbreviations (page 132).	-
21.15	Pre-heating time delay	Defines the delay time for the pre-heating function.	60 s / real32
	10...3000 s	Pre-heating time delay.	1 = 1 s / 1 = 1 s
21.16	Pre-heating current	Defines the motor pre-heating current that is fed into the motor when the source selected by 21.14 Pre-heating input source is on. The value is in percent of the nominal motor current.	0.0 percent / real32
	0.0 ... 30.0 %	Pre-heating current.	1 = 1 % / 10 = 1 %

No.	Name / Range / Selection	Description	Def / Type FbEq 16b / 32b
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 103). When this parameter is set to 0.0 seconds, automatic restarting is disabled. Otherwise, the parameter defines the maximum duration of the power failure after which restarting is attempted. Note that this time also includes the DC precharging delay. **WARNING!** The function restarts the drive automatically and continues operation after a supply break. Make sure that no dangerous situations can occur.	5.0 s / real32
	0.0 ... 10.0 s	0.0 s = Automatic restarting disabled. 0.1 … 10.0 s = Maximum power failure duration.	1 = 1 s / 10 = 1 s
21.19	Scalar start mode	Selects the motor start function for the scalar motor control mode, ie. when99.04 Motor control mode is set to Scalar. **Note:** • 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. See also section DC magnetization (page 97).	Normal / uint16
	Normal	Immediate start from zero speed.	0
	Const time	The drive pre-magnetizes the motor before start. The premagnetizing time is defined by parameter 21.02 Magnetization time. This mode should be selected if constant pre-magnetizing time is required (e.g. if the motor start must be synchronized with the release of a mechanical brake). This setting also guarantees the highest possible break-away torque when the pre-magnetizing time is set long enough. **Note:** This mode cannot be used to start into a rotating motor. **WARNING!** The drive will start after the set 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, and • with permanent magnet motors.	2

No.	Name / Range / Selection	Description	Def / Type FbEq 16b / 32b
21.37	Motor temperature estimation	Selects the source of the motor temperature estimation on/off command. See section Motor temperature estimation (page 99). **Note:** The motor temperature estimation function requires that • ID run is performed • ID run request is not active • a fault is not active, and • drive is in stopped state and ready to run. **WARNING!** The drive starts modulation when the above conditions are fulfilled and the selection is active. Take extra care when rebooting the drive.	Inactive (false) / uint32
	Inactive (false)	0	0
	Active (true)	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
	Supervision 1	Supervision 1 active (32.01 Supervision status, bit 0).	8
	Supervision 2	Supervision 2 active (32.01 Supervision status, bit 1).	9
	Supervision 3	Supervision 3 active (32.01 Supervision status, bit 2).	10
	Drive start command	Motor temperature estimation is performed always with drive start command.	11
	Drive power-up	Motor temperature estimation is performed once after drive power-up (control board boot).	12
21.38	Motor temperature estimation time	Defines the motor temperature estimation time. Motor temperature estimation is activated with parameter 21.37 Motor temperature estimation.	4.0 s / real32
	0.5 ... 20.0 s	Motor temperature estimation time in seconds.	10 = 1 s / 10 = 1 s

No.	Name / Range / Selection	Description	Def / Type FbEq 16b / 32b
22	Speed reference selection	Speed reference selection; motor potentiometer settings. See the control chain diagrams on pages ?...617.	
22.01	Speed ref unlimited	Displays the output of the speed reference selection block. See the control chain diagram on page 616. This parameter is read-only.	- / real32
	-30000.00 ... 30000.00 rpm	Value of the selected speed reference. For 16-bit scaling, see parameter 46.01.	- / 100 = 1 rpm
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.	- / uint16
b0	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.	
b1	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).	
b2…15	Reserved		
	0000h…FFFFh		1 = 1 / 1 = 1

<table>
<tr><th>No.</th><th>Name / Range / Selection</th><th>Description</th><th>Def / Type
FbEq 16b / 32b</th></tr>
<tr><td>22.22</td><td>Constant speed sel1</td><td>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:
<table>
<tr><th>Source defined by par. 22.22</th><th>Source defined by par. 22.23</th><th>Source defined by par. 22.24</th><th>Constant speed active</th></tr>
<tr><td>0</td><td>0</td><td>0</td><td>None</td></tr>
<tr><td>1</td><td>0</td><td>0</td><td>Constant speed 1</td></tr>
<tr><td>0</td><td>1</td><td>0</td><td>Constant speed 2</td></tr>
<tr><td>1</td><td>1</td><td>0</td><td>Constant speed 3</td></tr>
<tr><td>0</td><td>0</td><td>1</td><td>Constant speed 4</td></tr>
<tr><td>1</td><td>0</td><td>1</td><td>Constant speed 5</td></tr>
<tr><td>0</td><td>1</td><td>1</td><td>Constant speed 6</td></tr>
<tr><td>1</td><td>1</td><td>1</td><td>Constant speed 7</td></tr>
</table></td><td>Not selected / uint32</td></tr>
<tr><td></td><td>Not selected</td><td>0</td><td>0</td></tr>
<tr><td></td><td>Selected</td><td>1</td><td>1</td></tr>
<tr><td></td><td>DI1</td><td>Digital input DI1 (10.02 DI delayed status, bit 0).</td><td>2</td></tr>
<tr><td></td><td>DI2</td><td>Digital input DI2 (10.02 DI delayed status, bit 1).</td><td>3</td></tr>
<tr><td></td><td>DI3</td><td>Digital input DI3 (10.02 DI delayed status, bit 2).</td><td>4</td></tr>
<tr><td></td><td>DI4</td><td>Digital input DI4 (10.02 DI delayed status, bit 3).</td><td>5</td></tr>
<tr><td></td><td>DI5</td><td>Digital input DI5 (10.02 DI delayed status, bit 4).</td><td>6</td></tr>
<tr><td></td><td>DI6</td><td>Digital input DI6 (10.02 DI delayed status, bit 5).</td><td>7</td></tr>
<tr><td></td><td>DIO1</td><td>Digital input/output DIO1 (11.02 DIO delayed status, bit 0).</td><td>10</td></tr>
<tr><td></td><td>DIO2</td><td>Digital input/output DIO2 (11.02 DIO delayed status, bit 1).</td><td>11</td></tr>
<tr><td></td><td>Other [bit]</td><td>See Terms and abbreviations (page 132).</td><td>-</td></tr>
</table>

No.	Name / Range / Selection	Description	Def / Type FbEq 16b / 32b
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 / uint32
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 / uint32
22.26	Constant speed 1	Defines constant speed 1 (the speed the motor will turn when constant speed 1 is selected).	300.00 rpm / real32
	-30000.00 ... 30000.00 rpm	Constant speed 1. For 16-bit scaling, see parameter 46.01.	- / 100 = 1 rpm
22.27	Constant speed 2	Defines constant speed 2.	0.00 rpm / real32
	-30000.00 ... 30000.00 rpm	Constant speed 2. For 16-bit scaling, see parameter 46.01.	- / 100 = 1 rpm
22.28	Constant speed 3	Defines constant speed 3.	0.00 rpm / real32
	-30000.00 ... 30000.00 rpm	Constant speed 3. For 16-bit scaling, see parameter 46.01.	- / 100 = 1 rpm
22.29	Constant speed 4	Defines constant speed 4.	0.00 rpm / real32
	-30000.00 ... 30000.00 rpm	Constant speed 4. For 16-bit scaling, see parameter 46.01.	- / 100 = 1 rpm
22.30	Constant speed 5	Defines constant speed 5.	0.00 rpm / real32
	-30000.00 ... 30000.00 rpm	Constant speed 5. For 16-bit scaling, see parameter 46.01.	- / 100 = 1 rpm
22.31	Constant speed 6	Defines constant speed 6.	0.00 rpm / real32
	-30000.00 ... 30000.00 rpm	Constant speed 6. For 16-bit scaling, see parameter 46.01.	- / 100 = 1 rpm
22.32	Constant speed 7	Defines constant speed 7.	0.00 rpm / real32
	-30000.00 ... 30000.00 rpm	Constant speed 7. For 16-bit scaling, see parameter 46.01.	- / 100 = 1 rpm

No.	Name / Range / Selection	Description	Def / Type FbEq 16b / 32b
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.	- / real32
	-30000.00 ... 30000.00 rpm	Safe speed reference. For 16-bit scaling, see parameter 46.01.	- / 100 = 1 rpm
22.42	Jogging 1 ref	Defines the speed reference for jogging function 1. For more information on jogging, see page 89.	0.00 rpm / real32
	-30000.00 ... 30000.00 rpm	Speed reference for jogging function 1. For 16-bit scaling, see parameter 46.01.	- / 100 = 1 rpm
22.43	Jogging 2 ref	Defines the speed reference for jogging function 2. For more information on jogging, see page 89.	0.00 rpm / real32
	-30000.00 ... 30000.00 rpm	Speed reference for jogging function 2. For 16-bit scaling, see parameter 46.01.	- / 100 = 1 rpm
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 76).	- / uint16
b0	Enable	1 = Enable: Critical speeds enabled. 0 = Disable: Critical speeds disabled.	
b1	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.	
b2…15	Reserved		
	0000h…FFFFh		1 = 1 / 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 / real32
	-30000.00 ... 30000.00 rpm	Low limit for critical speed 1. For 16-bit scaling, see parameter 46.01.	- / 100 = 1 rpm
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 / real32
	-30000.00 ... 30000.00 rpm	High limit for critical speed 1. For 16-bit scaling, see parameter 46.01.	- / 100 = 1 rpm
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 / real32

No.	Name / Range / Selection	Description	Def / Type FbEq 16b / 32b
	-30000.00 … 30000.00 rpm	Low limit for critical speed 2. For 16-bit scaling, see parameter 46.01.	- / 100 = 1 rpm
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 / real32
	-30000.00 … 30000.00 rpm	High limit for critical speed 2. For 16-bit scaling, see parameter 46.01.	- / 100 = 1 rpm
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 / real32
	-30000.00 … 30000.00 rpm	Low limit for critical speed 3. For 16-bit scaling, see parameter 46.01.	- / 100 = 1 rpm
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 / real32
	-30000.00 … 30000.00 rpm	High limit for critical speed 3. For 16-bit scaling, see parameter 46.01.	- / 100 = 1 rpm
22.71	Motor potentiometer function	Activates and selects the mode of the motor potentiometer. See section Motor potentiometer (page 101).	Disabled / uint16
	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 NoUnit / real32
	-32768.00 … 32767.00	Initial value for motor potentiometer.	1 = 1 / 100 = 1

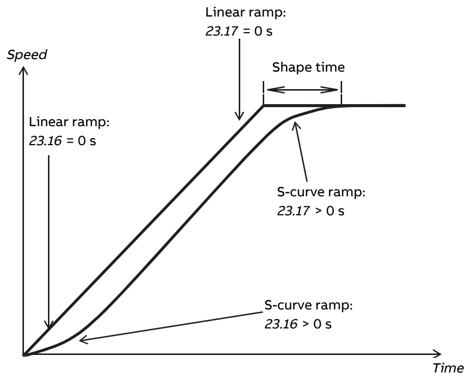
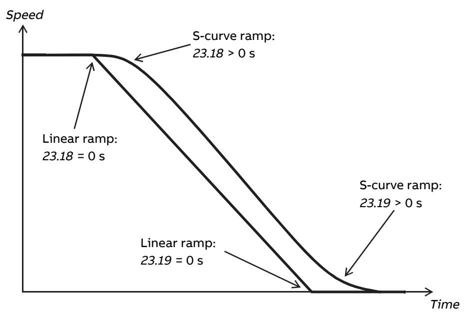
No.	Name / Range / Selection	Description	Def / Type FbEq 16b / 32b
22.73	Motor potentiometer up source	Selects the source of motor potentiometer up signal. 0 = No change 1 = Increase motor potentiometer value. (If both the up and down sources are on, the potentiometer value will not change.)	Not selected / uint32
	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]	See Terms and abbreviations (page 132).	-
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 / uint32
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 / real32
	0.0 ... 3600.0 s	Motor potentiometer change time.	10 = 1 s / 10 = 1 s
22.76	Motor potentiometer min value	Defines the minimum value of the motor potentiometer.	-1500.00 NoUnit / real32
	-32768.00 ... 32767.00	Motor potentiometer minimum.	1 = 1 / 100 = 1
22.77	Motor potentiometer max value	Defines the maximum value of the motor potentiometer.	1500.00 NoUnit / real32
	-32768.00 ... 32767.00	Motor potentiometer maximum.	1 = 1 / 100 = 1

No.	Name / Range / Selection	Description	Def / Type FbEq 16b / 32b
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.	- / real32
	-32768.00 ... 32767.00	Value of motor potentiometer.	1 = 1 / 100 = 1
22.81	Speed reference act 1	Displays the value of speed reference source 1. This parameter is read-only.	- / real32
	-30000.00 ... 30000.00 rpm	Value of reference source 1. For 16-bit scaling, see parameter 46.01.	- / 100 = 1 rpm
22.82	Speed reference act 2	Displays the value of speed reference source 2. This parameter is read-only.	- / real32
	-30000.00 ... 30000.00 rpm	Value of reference source 2. For 16-bit scaling, see parameter 46.01.	- / 100 = 1 rpm
22.83	Speed reference act 3	Displays the value of speed reference source 3. This parameter is read-only.	- / real32
	-30000.00 ... 30000.00 rpm	Speed reference after source selection. For 16-bit scaling, see parameter 46.01.	- / 100 = 1 rpm
22.84	Speed reference act 4	Displays the value of speed reference after application of 1st speed additive. This parameter is read-only.	- / real32
	-30000.00 ... 30000.00 rpm	Speed reference after additive 1. For 16-bit scaling, see parameter 46.01.	- / 100 = 1 rpm
22.85	Speed reference act 5	Displays the value of speed reference after the application of the speed share scaling factor. This parameter is read-only.	- / real32
	-30000.00 ... 30000.00 rpm	Speed reference after speed share scaling. For 16-bit scaling, see parameter 46.01.	- / 100 = 1 rpm
22.86	Speed reference act 6	Displays the value of speed reference after application of 2nd speed additive. This parameter is read-only.	- / real32
	-30000.00 ... 30000.00 rpm	Speed reference after additive 2. For 16-bit scaling, see parameter 46.01.	- / 100 = 1 rpm

No.	Name / Range / Selection	Description	Def / Type FbEq 16b / 32b
22.87	Speed reference act 7	Displays the value of speed reference before application of critical speeds. See the control chain diagram on page 616. The value is received from 22.86 Speed reference act 6 unless overridden by • any constant speed • a jogging reference • network control reference (see Terms and abbreviations (page 19)) • control panel reference • safe speed reference. This parameter is read-only.	- / real32
	-30000.00 … 30000.00 rpm	Speed reference before application of critical speeds. For 16-bit scaling, see parameter 46.01.	- / 100 = 1 rpm

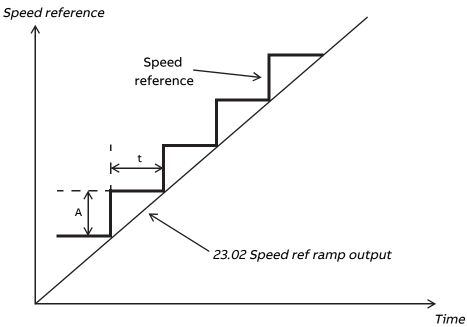
No.	Name / Range / Selection	Description	Def / Type FbEq 16b / 32b
23	Speed reference ramp	Speed reference ramp settings (programming of the acceleration and deceleration rates for the drive). See the control chain diagram on page 617.	
23.01	Speed ref ramp input	Displays the used speed reference (in rpm) before it enters the ramping and shaping functions. See the control chain diagram on page 617. This parameter is read-only.	- / real32
	-30000.00 … 30000.00 rpm	Speed reference before ramping and shaping. For 16-bit scaling, see parameter 46.01.	- / 100 = 1 rpm
23.02	Speed ref ramp output	Displays the ramped and shaped speed reference in rpm. See the control chain diagram on page 617. This parameter is read-only.	- / real32
	-30000.00 … 30000.00 rpm	Speed reference after ramping and shaping. For 16-bit scaling, see parameter 46.01.	- / 100 = 1 rpm
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	Acc/Dec time 1 / uint32
	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]	See Terms and abbreviations (page 132).	-

No.	Name / Range / Selection	Description	Def / Type FbEq 16b / 32b
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 / real32
	0.000 … 1800.000 s	Acceleration time 1.	10 = 1 s / 1000 = 1 s
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 / real32
	0.000 … 1800.000 s	Deceleration time 1.	10 = 1 s / 1000 = 1 s
23.14	Acceleration time 2	Defines acceleration time 2. See parameter 23.12 Acceleration time 1.	60.000 s / real32
	0.000 … 1800.000 s	Acceleration time 2.	10 = 1 s / 1000 = 1 s
23.15	Deceleration time 2	Defines deceleration time 2. See parameter 23.13 Deceleration time 1.	60.000 s / real32
	0.000 … 1800.000 s	Deceleration time 2.	10 = 1 s / 1000 = 1 s

No.	Name / Range / Selection	Description	Def / Type FbEq 16b / 32b
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. **Note:** For safety reasons, shape times are not applied to emergency stop ramps. **Note:** Ramp shape times may not always be obeyed if changed during ramping and reference would overshoot. **Acceleration:**  **Deceleration:**  	- / real32
	0.000 ... 1800.000 s	Ramp shape at start of acceleration.	10 = 1 s / 1000 = 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 / real32
	0.000 ... 1800.000 s	Ramp shape at end of acceleration.	10 = 1 s / 1000 = 1 s

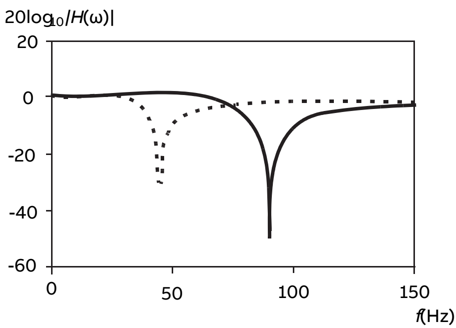
No.	Name / Range / Selection	Description	Def / Type FbEq 16b / 32b
23.18	Shape time dec 1	Defines the shape of the deceleration ramp at the beginning of the deceleration. See parameter 23.16 Shape time acc 1.	0.000 s / real32
	0.000 ... 1800.000 s	Ramp shape at start of deceleration.	10 = 1 s / 1000 = 1 s
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 / real32
	0.000 ... 1800.000 s	Ramp shape at end of deceleration.	10 = 1 s / 1000 = 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. See section Jogging (page 89).	60.000 s / real32
	0.000 ... 1800.000 s	Acceleration time for jogging.	10 = 1 s / 1000 = 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. See section Jogging (page 89).	60.000 s / real32
	0.000 ... 1800.000 s	Deceleration time for jogging.	10 = 1 s / 1000 = 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. This also applies to torque control 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 or 28.71…28.75 (frequency control).	3.000 s / real32
	0.000 ... 1800.000 s	Emergency stop Off3 deceleration time.	10 = 1 s / 1000 = 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 / uint32
	Active	0.	0
	Inactive	1.	1

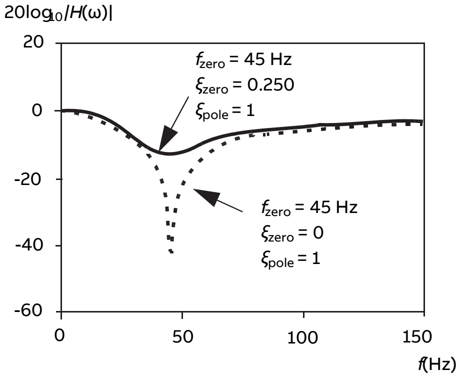
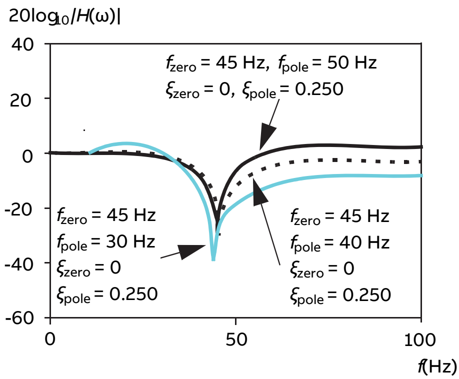
No.	Name / Range / Selection	Description	Def / Type FbEq 16b / 32b
	DI1	Digital input DI1 (10.02 DI delayed status, bit 0).	2
	DI2	Digital input DI2 (10.02 DI delayed status, bit 1).	3
	DI3	Digital input DI3 (10.02 DI delayed status, bit 2).	4
	DI4	Digital input DI4 (10.02 DI delayed status, bit 3).	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]	See Terms and abbreviations (page 132).	-
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	Application program / uint32
	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]	See Terms and abbreviations (page 132).	-
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.	- / real32

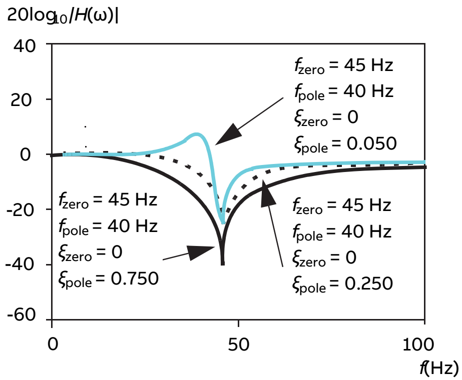
No.	Name / Range / Selection	Description	Def / Type FbEq 16b / 32b
	-30000.00 … 30000.00 rpm	Speed ramp balancing reference. For 16-bit scaling, see parameter 46.01.	- / 100 = 1 rpm
23.28	Variable slope enable	Activates the variable slope function, which controls the slope of the speed ramp during a 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 / uint32
	Off	Variable slope disabled.	0
	On	Variable slope enabled (not available in local control).	1
	Other [bit]	See Terms and abbreviations (page 132).	-
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 / real32
	2…30000 ms	Variable slope rate.	1 = 1 ms / 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 74). This parameter is read-only.	- / real32
	-30000.00 … 30000.00 rpm	Speed correction term. For 16-bit scaling, see parameter 46.01.	- / 100 = 1 rpm

No.	Name / Range / Selection	Description	Def / Type FbEq 16b / 32b
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 74). 0 = Disabled 1 = Enabled	Not selected / uint32
	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]	See Terms and abbreviations (page 132).	-
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 74).	1.00 percent / real32
	0.00 ... 100.00 %	Speed correction term adjustment.	1 = 1 % / 100 = 1 %
23.42	Follower speed corr torq source	Selects the source of the torque reference for the load share function.	MF ref 2 / uint32
	NULL	None.	0
	MF ref 2	.	1
	Other [bit]	Source selection. See Terms and abbreviations (page 132).	-

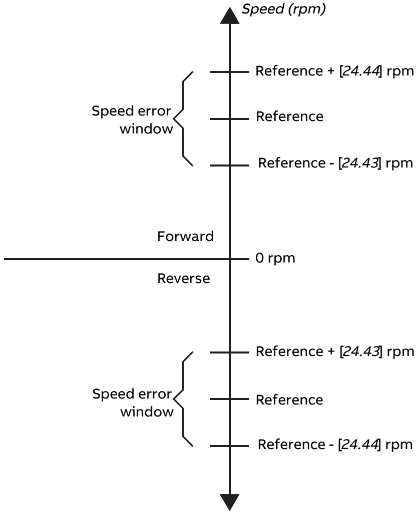
No.	Name / Range / Selection	Description	Def / Type FbEq 16b / 32b
24	Speed reference conditioning	Speed error calculation; speed error window control configuration; speed error step. See the control chain diagrams on pages 620 and 621.	
24.01	Used speed reference	Displays the ramped and corrected speed reference (before speed error calculation). See the control chain diagram on page 620. This parameter is read-only.	- / real32
	-30000.00 ... 30000.00 rpm	Speed reference used for speed error calculation. For 16-bit scaling, see parameter 46.01.	- / 100 = 1 rpm
24.02	Used speed feedback	Displays the speed feedback used for speed error calculation. See the control chain diagram on page 620. This parameter is read-only.	- / real32
	-30000.00 ... 30000.00 rpm	Speed feedback used for speed error calculation. For 16-bit scaling, see parameter 46.01.	- / 100 = 1 rpm
24.03	Speed error filtered	Displays the filtered speed error. See the control chain diagram on page 620. This parameter is read-only.	0.00 rpm / real32
	-30000.00 ... 30000.00 rpm	Filtered speed error. For 16-bit scaling, see parameter 46.01.	- / 100 = 1 rpm
24.04	Speed error inverted	Displays the inverted (unfiltered) speed error. See the control chain diagram on page 620. This parameter is read-only	0.00 rpm / real32
	-30000.00 ... 30000.00 rpm	Inverted speed error. For 16-bit scaling, see parameter 46.01.	- / 100 = 1 rpm
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 620.	0.00 rpm / real32
	-10000.00 ... 10000.00 rpm	Speed reference correction. For 16-bit scaling, see parameter 46.01.	- / 100 = 1 rpm

No.	Name / Range / Selection	Description	Def / Type FbEq 16b / 32b
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 / real32
	0…10000 ms	Speed error filtering time constant. 0 = filtering disabled.	1 = 1 ms / 1 = 1 ms
24.13	RFE speed filter	Enables/disables resonance frequency filtering. The filtering is configured by parameters 24.13…24.17. The speed error value coming to the speed controller is filtered by a common 2nd order band-elimination filter to eliminate the amplification of mechanical resonance frequencies. **Note:** Tuning the resonance frequency filter requires a basic understanding of frequency filters. Incorrect tuning can amplify mechanical oscillations and damage the drive hardware. To ensure the stability of the speed controller, stop the drive or disable the filtering before changing the parameter settings. 0 = Resonance frequency filtering disabled. 1 = Resonance frequency filtering enabled.	Off / uint16
	On	1.	1
	Off	0.	0
24.14	Frequency of zero	Defines the zero frequency of the resonance frequency filter. The value must be set near the resonance frequency, which is filtered out before the speed controller. The drawing shows the frequency response.  	45.00 Hz / real32
	0.50 … 500.00 Hz	Zero frequency.	1 = 1 Hz / 100 = 1 Hz

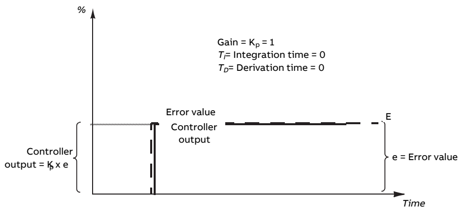
No.	Name / Range / Selection	Description	Def / Type FbEq 16b / 32b
24.15	Damping of zero	Defines the damping coefficient for parameter 24.14. The value of 0 corresponds to the maximum elimination of the resonance frequency.  **Note:** To ensure that the resonance frequency band is filtered (rather than amplified), the value of 24.15 must be smaller than 24.17.	0.000 null / real32
	-1.000 ... 1.000	Damping coefficient.	100 = 1 / 1000 = 1
24.16	Frequency of pole	Defines the frequency of pole of the resonance frequency filter.  **Note:** If this value is very different from the value of 24.14, the frequencies near the frequency of pole are amplified, which can damage the driven machine.	40.00 Hz / real32
	0.50 ... 500.00 Hz	Frequency of pole.	1 = 1 Hz / 100 = 1 Hz

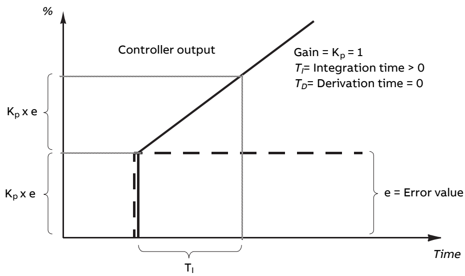
No.	Name / Range / Selection	Description	Def / Type FbEq 16b / 32b
24.17	Damping of pole	Defines the damping coefficient for parameter 24.16. The coefficient shapes the frequency response of the resonance frequency filter. A narrower bandwidth results in better dynamic properties. By setting this parameter to 1, the effect of the pole is eliminated.  **Note:** To ensure that the resonance frequency band is filtered (rather than amplified), the value of 24.15 must be smaller than 24.17.	0.250 null / real32
	-1.000 … 1.000	Damping coefficient.	100 = 1 / 1000 = 1

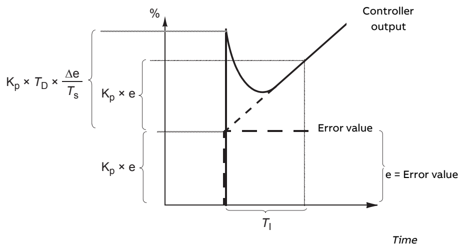
No.	Name / Range / Selection	Description	Def / Type FbEq 16b / 32b
24.41	Speed error window control enable	Enables/disables (or selects a source that enables/disables) speed error window control, sometimes also referred to as deadband control or strip break protection. It forms a speed supervision function 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. In normal operation, window control keeps the speed controller input at zero so the drive stays in torque control. If the motor load is lost, then the motor speed will rise as the torque controller tries to maintain torque. The speed error (speed reference - actual speed) will increase 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) which the torque selector adds to the torque reference. The result is used as the internal torque reference for the drive. The activation of speed error window control is indicated by bit 3 of 06.19 Speed control status word.	Disable / uint32

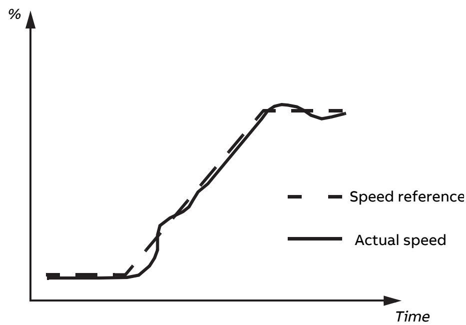
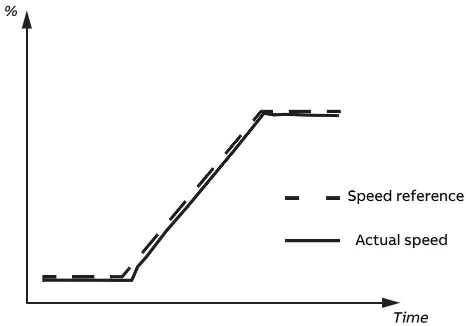
No.	Name / Range / Selection	Description	Def / Type FbEq 16b / 32b
		The window boundaries are defined by 24.43 Speed error window high and 24.44 Speed error window low as follows:  Note that it is parameter 24.44 (rather than 24.43) that defines the overspeed limit in both directions of rotation. This is because the function monitors speed error (which is negative in case of overspeed, positive in case of underspeed). **WARNING!** In a speed-controlled follower, the speed error window must not exceed 21.06 Zero speed limit for a reliable ramp stop. Make sure both 24.43 and 24.44 are smaller than 21.06 (or speed error window control disabled) when a ramp stop is required. 0 = Speed error window control disabled 1 = Speed error window control enabled	
	Disable	0.	0
	Enable	1.	1
	Other [bit]	See Terms and abbreviations (page 132).	-
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 / uint16
	Normal speed control	All three terms (parameters 25.02, 25.03 and 25.04) are observed by the speed controller.	0

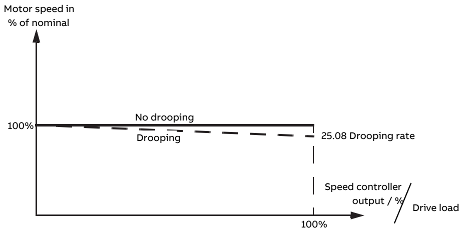
No.	Name / Range / Selection	Description	Def / Type FbEq 16b / 32b
	P-control	Only the proportional term (25.02) is observed by the speed controller. The integral and derivative terms are internally forced to zero.	1
24.43	Speed error window high	Defines the upper boundary of the speed error window. See parameter 24.41 Speed error window control enable.	0.00 rpm / real32
	0.00 ... 3000.00 rpm	Upper boundary of speed error window. For 16-bit scaling, see parameter 46.01.	- / 100 = 1 rpm
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 / real32
	0.00 ... 3000.00 rpm	Lower boundary of speed error window. For 16-bit scaling, see parameter 46.01.	- / 100 = 1 rpm
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 / real32
	-3000.00 ... 3000.00 rpm	Speed error step. For 16-bit scaling, see parameter 46.01.	- / 100 = 1 rpm

No.	Name / Range / Selection	Description	Def / Type FbEq 16b / 32b
25	Speed control	Speed controller settings. See the control chain diagrams on pages 620 and 621.	
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 621. This parameter is read-only.	- / real32
	-1600.0 … 1600.0 %	Limited speed controller output torque. For 16-bit scaling, see parameter 46.03.	- / 10 = 1 %
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 1.00, a 10% error (reference - actual value) in the motor synchronous speed produces a proportional term of 10%. **Note:** This parameter is automatically set by the speed controller autotune function. See section Speed controller autotune (page 77).	10.00; 5.00 (95.21 b1/b2) NoUnit / real32
	0.00 … 250.00	Proportional gain for speed controller.	100 = 1 / 100 = 1

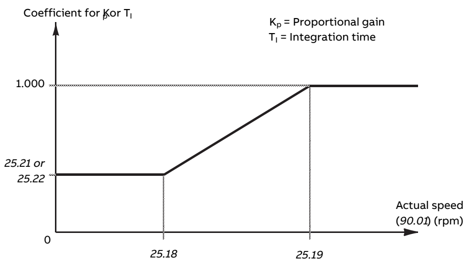
No.	Name / Range / Selection	Description	Def / Type FbEq 16b / 32b
25.03	Speed integration time	Defines the integration time of the speed controller. The integration time defines the rate at which the controller output changes when the error value is constant and the proportional gain of the speed controller is 1. The shorter the integration time, the faster the continuous error value is corrected. 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. The integrator has anti-windup control for operation at a torque or current limit. 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 77).	2.50; 5.00 s (95.21 b1/b2) s / real32
	0.00 … 1000.00 s	Integration time for speed controller.	10 = 1 s / 100 = 1 s

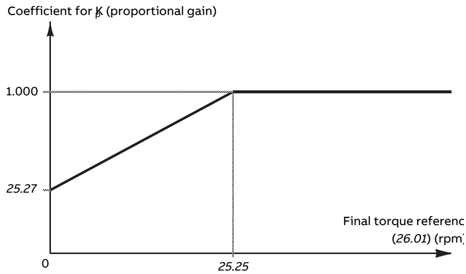
No.	Name / Range / Selection	Description	Def / Type FbEq 16b / 32b
25.04	Speed derivation time	Defines the derivation time of the speed controller. Derivative action boosts the controller output if the error value changes. The longer the derivation time, the more the speed controller output is boosted 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 an encoder), derivative time is not normally required and should be left at zero. The figure below shows the speed controller output after an error step when the error remains constant. The speed error derivative must be filtered with a low pass filter to eliminate external disturbances.  Gain = K_p = 1 T_I = Integration time > 0 T_D= Derivation time > 0 T_s= Sample time period = 500 µs Δe = Error value change between two samples	0.000 s / real32
	0.000 … 10.000 s	Derivation time for speed controller.	1000 = 1 s / 1000 = 1 s
25.05	Derivation filter time	Defines the derivation filter time constant. See parameter 25.04 Speed derivation time.	8 ms / real32
	0…10000 ms	Derivation filter time constant.	1 = 1 ms / 1 = 1 ms

No.	Name / Range / Selection	Description	Def / Type FbEq 16b / 32b
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:** 	- / real32
	0.00 … 1000.00 s	Acceleration compensation derivation time.	10 = 1 s / 100 = 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 / real32
	0.0 … 1000.0 ms	Acceleration/deceleration compensation filter time.	1 = 1 ms / 10 = 1 ms

No.	Name / Range / Selection	Description	Def / Type FbEq 16b / 32b
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, i.e. equal to the value of this parameter. The drooping effect decreases linearly to zero along with the decreasing load. The droop rate can be used e.g. to adjust the load sharing in a Master/Follower application run by several drives. In a Master/Follower application the motor shafts are coupled to each other. The correct droop rate for a process must be found out case by case in practice. **Speed decrease =** Speed controller output × Drooping × Synchronous speed **Example:** Speed controller output is 50 %, droop rate is 1 %, synchronous speed of the drive is 1500 rpm. Speed decrease = 0.50 × 0.01 × 1500 rpm = 7.5 rpm. 	- / real32
	0.00 ... 100.00 %	Droop rate.	100 = 1 % / 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, “bumpless” 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 / uint32
	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

No.	Name / Range / Selection	Description	Def / Type FbEq 16b / 32b
	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]	See Terms and abbreviations (page 132).	-
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 percent / real32
	-300.0 ... 300.0 %	Speed control output balancing reference. For 16-bit scaling, see parameter 46.03.	- / 10 = 1 %
25.11	Speed control min torque	Defines the minimum speed controller output torque.	-300.0 percent / real32
	-1600.0 ... 0.0 %	Minimum speed controller output torque. For 16-bit scaling, see parameter 46.03.	- / 10 = 1 %
25.12	Speed control max torque	Defines the maximum speed controller output torque.	300.0 percent / real32
	0.0 ... 1600.0 %	Maximum speed controller output torque. For 16-bit scaling, see parameter 46.03.	- / 10 = 1 %
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 percent / real32
	-1600.0 ... 0.0 %	Minimum speed controller output torque for ramped emergency stop. For 16-bit scaling, see parameter 46.03.	- / 10 = 1 %
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 percent / real32
	0.0 ... 1600.0 %	Maximum speed controller output torque for ramped emergency stop. For 16-bit scaling, see parameter 46.03.	- / 10 = 1 %
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; 5.00 (95.21 b1/b2) NoUnit / real32
	1.00 ... 250.00	Proportional gain upon an emergency stop.	100 = 1 / 100 = 1

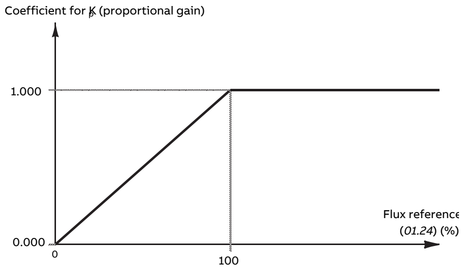
No.	Name / Range / Selection	Description	Def / Type FbEq 16b / 32b
25.18	Speed adapt min limit	Minimum actual speed for speed controller adaptation. Speed controller gain and integration time can be adapted according to actual speed (90.01 Motor speed for control). This is done by multiplying the gain (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 is multiplied by 25.21 Kp adapt coef at min speed, and the integration time divided by 25.22 Ti adapt coef at min speed. 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 621. 	- / real32
	0...30000 rpm	Minimum actual speed for speed controller adaptation.	1 = 1 rpm / 1 = 1 rpm
25.19	Speed adapt max limit	Maximum actual speed for speed controller adaptation. See parameter 25.18 Speed adapt min limit.	- / real32
	0...30000 rpm	Maximum actual speed for speed controller adaptation.	1 = 1 rpm / 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 NoUnit / real32
	0.000 ... 10.000	Proportional gain coefficient at minimum actual speed.	1000 = 1 / 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 NoUnit / real32
	0.000 ... 10.000	Integration time coefficient at minimum actual speed.	1000 = 1 / 1000 = 1

No.	Name / Range / Selection	Description	Def / Type FbEq 16b / 32b
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 621.  	- / real32
	0.0 … 1600.0 %	Maximum torque reference for speed controller adaptation. For 16-bit scaling, see parameter 46.03.	- / 10 = 1 %
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 / real32
	0.000 … 100.000 s	Filter time for adaptation.	100 = 1 s / 1000 = 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 NoUnit / real32
	0.000 … 10.000	Proportional gain coefficient at 0% torque reference.	1000 = 1 / 1000 = 1

<table>
<tr><th>No.</th><th>Name / Range / Selection</th><th>Description</th><th>Def / Type
FbEq 16b / 32b</th></tr>
<tr><td>25.30</td><td>Flux adaptation enable</td><td>
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 621.



</td><td>Enable / uint16</td></tr>
<tr><td></td><td>Disable</td><td>Speed controller adaptation based on flux reference disabled</td><td>0</td></tr>
<tr><td></td><td>Enable</td><td>Speed controller adaptation based on flux reference enabled.</td><td>1</td></tr>
<tr><td>25.33</td><td>Speed controller autotune</td><td>
Activates (or selects a source that activates) the speed controller autotune function. See section Speed controller autotune (page 77).

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.
</td><td>Off / uint32</td></tr>
</table>

No.	Name / Range / Selection	Description	Def / Type FbEq 16b / 32b
	Off	0.	0
	On	1.	1
	Other [bit]	See Terms and abbreviations (page 132).	-
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 / uint16
	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 s / real32
	0.00 ... 1000.00 s	Mechanical time constant.	10 = 1 s / 100 = 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 percent / real32
	0.00 ... 100.00 %	Autotune torque step.	100 = 1 % / 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 percent / real32
	0.00 ... 100.00 %	Autotune speed step.	100 = 1 % / 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 NoUnit / uint16
	1...10	Number of cycles during autotune routine.	1 = 1 / 1 = 1
25.41	Torque reference Autotune2	Reserved	- / real32

No.	Name / Range / Selection	Description	Def / Type FbEq 16b / 32b
25.42	Integral term enable	Selects a source that enables/disables the integral (I) part of the speed controller. 0 = I-part disabled 1 = I-part enabled	Selected / uint32
	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]	See Terms and abbreviations (page 132).	-
25.53	Torque prop reference	Displays the output of the proportional (P) part of the speed controller. See the control chain diagram on page 621. This parameter is read-only.	- / real32
	-30000.0 ... 30000.0 %	P-part output of speed controller. For 16-bit scaling, see parameter 46.03.	- / 10 = 1 %
25.54	Torque integral reference	Displays the output of the integral (I) part of the speed controller. See the control chain diagram on page 621. This parameter is read-only.	- / real32
	-30000.0 ... 30000.0 %	I-part output of speed controller. For 16-bit scaling, see parameter 46.03.	- / 10 = 1 %
25.55	Torque deriv reference	Displays the output of the derivative (D) part of the speed controller. See the control chain diagram on page 621. This parameter is read-only.	- / real32
	-30000.0 ... 30000.0 %	D-part output of speed controller. For 16-bit scaling, see parameter 46.03.	- / 10 = 1 %
25.56	Torque acc compensation	Displays the output of the acceleration compensation function on page 621. See the control chain diagram. This parameter is read-only.	- / real32
	-30000.0 ... 30000.0 %	Output of acceleration compensation function. For 16-bit scaling, see parameter 46.03.	- / 10 = 1 %

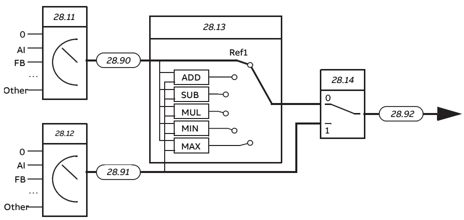
No.	Name / Range / Selection	Description	Def / Type FbEq 16b / 32b
25.57	Torque reference unbalanced	Displays the acceleration-compensated output of the speed controller. See the control chain diagram on page 621. This parameter is read-only.	- / real32
	-30000.0 … 30000.0 %	Acceleration-compensated output of speed controller. For 16-bit scaling, see parameter 46.03.	- / 10 = 1 %

No.	Name / Range / Selection	Description	Def / Type FbEq 16b / 32b
26	Torque reference chain	Settings for the torque reference chain. See the control chain diagrams on pages 612 and 614.	
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. See the control chain diagrams on pages 612 and 614. This parameter is read-only.	- / real32
	-1600.0 ... 1600.0 %	Torque reference for torque control. For 16-bit scaling, see parameter 46.03.	- / 10 = 1 %
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.	- / real32
	-1600.0 ... 1600.0 %	Torque reference for torque control. For 16-bit scaling, see parameter 46.03.	- / 10 = 1 %
26.27	Torque limit filter time	Defines the filtering time of the torque limit. This parameter is used to smooth the step when changing the limit if the drive is running on torque limit.	100 ms / real32
	0...100 ms	Torque limit filter time.	1 = 1 ms / 1 = 1 ms
26.43	Torque step pointer enable	Selects a source that enables/disables the torque step defined by parameter 26.44 Torque step source. 1 = Torque step enabled.	Selected / uint32
	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]	See Terms and abbreviations (page 132).	-
26.44	Torque step source	Selects the source of the torque step enabled by 26.43 Torque step pointer enable.	Zero / uint32
	Zero	None.	0
	AI1 scaled	12.12 AI1 scaled value (page 196).	1
	AI2 scaled	12.22 AI2 scaled value (page 197).	2

No.	Name / Range / Selection	Description	Def / Type FbEq 16b / 32b
	FB A ref1	03.05 FB A reference 1 (page 141).	4
	FB A ref2	03.06 FB A reference 2 (page 141).	5
	EFB ref1	03.09 EFB reference 1 (page 141).	8
	EFB ref2	03.10 EFB reference 2 (page 141).	9
	Motor potentiometer	22.80 Motor potentiometer ref act (output of the motor potentiometer).	15
	Control panel (ref saved)	Control panel reference, with initial value from last-used panel reference. See section Using the control panel as an external control source (page 67).	18
	Control panel (ref copied)	Control panel reference, with initial value from previous source or actual value. See section Using the control panel as an external control source (page 67).	19
	Other [bit]	Source selection. See Terms and abbreviations (page 132).	-
26.51	Oscillation damping	Parameters 26.51…26.58 configure the oscillation damping function. See section Oscillation damping (page 80) This parameter enables (or selects a source that enables) the oscillation damping algorithm. 1 = Oscillation damping algorithm enabled	Not selected / uint32
	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]	See Terms and abbreviations (page 132).	-
26.52	Oscillation damping out enable	Determines (or selects a source that determines) whether the output of the oscillation damping function is applied 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 = Apply oscillation damping output to torque reference	Not selected / uint32

No.	Name / Range / Selection	Description	Def / Type FbEq 16b / 32b
	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]	See Terms and abbreviations (page 132).	-
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 / uint32
	Speed error	24.01 Used speed reference - unfiltered motor speed. **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 / real32
	0.1 ... 60.0 Hz	Center frequency for oscillation damping.	10 = 1 Hz / 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 / real32
	0...360 deg	Phase shift for oscillation damping function output.	10 = 1 deg / 1 = 1 deg

No.	Name / Range / Selection	Description	Def / Type FbEq 16b / 32b
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 percent / real32
	0.0 … 100.0 %	Gain setting for oscillation damping output.	10 = 1 % / 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.	- / real32
	-1600.000 … 1600.000 %	Output of the oscillation damping function.	10 = 1 % / 1000 = 1 %
26.81	Rush control gain	Rush controller gain term. See section Rush control (page 82).	10.0 NoUnit / real32
	0.0 … 10000.0	Rush controller gain (0.0 = disabled).	1 = 1 / 10 = 1
26.82	Rush control integration time	Rush controller integration time term.	2.0 s / real32
	0.0 … 10.0 s	Rush controller integration time (0.0 = disabled).	1 = 1 s / 10 = 1 s

No.	Name / Range / Selection	Description	Def / Type FbEq 16b / 32b
28	Frequency reference chain	Settings for the frequency reference chain. See the control chain diagrams 623 and 624.	
28.01	Frequency ref ramp input	Displays the used frequency reference before ramping. See the control chain diagram on page 624. This parameter is read-only.	- / real32
	-598.00 ... 598.00 Hz	Frequency reference before ramping. For 16-bit scaling, see parameter 46.02.	- / 100 = 1 Hz
28.02	Frequency ref ramp output	Displays the final frequency reference (after selection, limitation and ramping). See the control chain diagram on page 624. This parameter is read-only.	- / real32
	-598.00 ... 598.00 Hz	Final frequency reference. For 16-bit scaling, see parameter 46.02.	- / 100 = 1 Hz
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 / uint32
	Zero	None.	0
	AI1 scaled	12.12 AI1 scaled value (page 196).	1
	AI2 scaled	12.22 AI2 scaled value (page 197).	2
	FB A ref1	03.05 FB A reference 1 (page 141).	4
	FB A ref2	03.06 FB A reference 2 (page 141).	5
	EFB ref1	03.09 EFB reference 1 (page 141).	8
	EFB ref2	03.10 EFB reference 2 (page 141).	9
	Motor potentiometer	22.80 Motor potentiometer ref act (output of the motor potentiometer).	15
	Control panel (ref saved)	Control panel reference, with initial value from last-used panel reference. See section Using the control panel as an external control source (page 67).	18
	Control panel (ref copied)	Control panel reference, with initial value from previous source or actual value. See section Using the control panel as an external control source (page 67).	19

No.	Name / Range / Selection	Description	Def / Type FbEq 16b / 32b
	Other [bit]	Source selection. See Terms and abbreviations (page 132).	-
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 / uint32
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 / uint16
	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 x ref2)	The multiplication of the reference sources is used as frequency reference 1.	3
	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 / uint32
	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]	See Terms and abbreviations (page 132).	-

No.	Name / Range / Selection	Description	Def / Type FbEq 16b / 32b
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.	- / uint16
b0	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.	
b1	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).	
b2…15	Reserved		
	0000h…FFFFh		1 = 1 / 1 = 1

<table>
<tr><th>No.</th><th>Name / Range / Selection</th><th>Description</th><th>Def / Type
FbEq 16b / 32b</th></tr>
<tr><td>28.22</td><td>Constant frequency sel1</td><td>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:
<table>
<tr><th>Source defined by par. 28.22</th><th>Source defined by par. 28.23</th><th>Source defined by par. 28.24</th><th>Constant frequency active</th></tr>
<tr><td>0</td><td>0</td><td>0</td><td>None</td></tr>
<tr><td>1</td><td>0</td><td>0</td><td>Constant frequency 1</td></tr>
<tr><td>0</td><td>1</td><td>0</td><td>Constant frequency 2</td></tr>
<tr><td>1</td><td>1</td><td>0</td><td>Constant frequency 3</td></tr>
<tr><td>0</td><td>0</td><td>1</td><td>Constant frequency 4</td></tr>
<tr><td>1</td><td>0</td><td>1</td><td>Constant frequency 5</td></tr>
<tr><td>0</td><td>1</td><td>1</td><td>Constant frequency 6</td></tr>
<tr><td>1</td><td>1</td><td>1</td><td>Constant frequency 7</td></tr>
</table></td><td>Not selected / uint32</td></tr>
<tr><td></td><td>Not selected</td><td>0</td><td>0</td></tr>
<tr><td></td><td>Selected</td><td>1</td><td>1</td></tr>
<tr><td></td><td>DI1</td><td>Digital input DI1 (10.02 DI delayed status, bit 0).</td><td>2</td></tr>
<tr><td></td><td>DI2</td><td>Digital input DI2 (10.02 DI delayed status, bit 1).</td><td>3</td></tr>
<tr><td></td><td>DI3</td><td>Digital input DI3 (10.02 DI delayed status, bit 2).</td><td>4</td></tr>
<tr><td></td><td>DI4</td><td>Digital input DI4 (10.02 DI delayed status, bit 3).</td><td>5</td></tr>
<tr><td></td><td>DI5</td><td>Digital input DI5 (10.02 DI delayed status, bit 4).</td><td>6</td></tr>
<tr><td></td><td>DI6</td><td>Digital input DI6 (10.02 DI delayed status, bit 5).</td><td>7</td></tr>
<tr><td></td><td>DIO1</td><td>Digital input/output DIO1 (11.02 DIO delayed status, bit 0).</td><td>10</td></tr>
<tr><td></td><td>DIO2</td><td>Digital input/output DIO2 (11.02 DIO delayed status, bit 1).</td><td>11</td></tr>
<tr><td></td><td>Other [bit]</td><td>See Terms and abbreviations (page 132).</td><td>-</td></tr>
</table>

No.	Name / Range / Selection	Description	Def / Type FbEq 16b / 32b
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 / uint32
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 / uint32
28.26	Constant frequency 1	Defines constant frequency 1 (the frequency the motor will turn when constant frequency 1 is selected).	0.00 Hz / real32
	-598.00 ... 598.00 Hz	Constant frequency 1. For 16-bit scaling, see parameter 46.02.	- / 100 = 1 Hz
28.27	Constant frequency 2	Defines constant frequency 2.	0.00 Hz / real32
	-598.00 ... 598.00 Hz	Constant frequency 2. For 16-bit scaling, see parameter 46.02.	- / 100 = 1 Hz
28.28	Constant frequency 3	Defines constant frequency 3.	0.00 Hz / real32
	-598.00 ... 598.00 Hz	Constant frequency 3. For 16-bit scaling, see parameter 46.02.	- / 100 = 1 Hz
28.29	Constant frequency 4	Defines constant frequency 4.	0.00 Hz / real32
	-598.00 ... 598.00 Hz	Constant frequency 4. For 16-bit scaling, see parameter 46.02.	- / 100 = 1 Hz
28.30	Constant frequency 5	Defines constant frequency 5.	0.00 Hz / real32
	-598.00 ... 598.00 Hz	Constant frequency 5. For 16-bit scaling, see parameter 46.02.	- / 100 = 1 Hz
28.31	Constant frequency 6	Defines constant frequency 6.	0.00 Hz / real32
	-598.00 ... 598.00 Hz	Constant frequency 6. For 16-bit scaling, see parameter 46.02.	- / 100 = 1 Hz

No.	Name / Range / Selection	Description	Def / Type FbEq 16b / 32b
28.32	Constant frequency 7	Defines constant frequency 7.	0.00 Hz / real32
	-598.00 ... 598.00 Hz	Constant frequency 7. For 16-bit scaling, see parameter 46.02.	- / 100 = 1 Hz
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.	- / real32
	-598.00 ... 598.00 Hz	Safe frequency reference. For 16-bit scaling, see parameter 46.02.	- / 100 = 1 Hz
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 76).	- / uint16
b0	Enable	1 = Enable: Critical frequencies enabled. 0 = Disable: Critical frequencies disabled.	
b1	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.	
b2…15	Reserved		
	0000h…FFFFh		1 = 1 / 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 / real32
	-598.00 ... 598.00 Hz	Low limit for critical frequency 1. For 16-bit scaling, see parameter 46.02.	- / 100 = 1 Hz
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 / real32
	-598.00 ... 598.00 Hz	High limit for critical frequency 1. For 16-bit scaling, see parameter 46.02.	- / 100 = 1 Hz
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 / real32
	-598.00 ... 598.00 Hz	Low limit for critical frequency 2. For 16-bit scaling, see parameter 46.02.	- / 100 = 1 Hz

No.	Name / Range / Selection	Description	Def / Type FbEq 16b / 32b
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 / real32
	-598.00 ... 598.00 Hz	High limit for critical frequency 2. For 16-bit scaling, see parameter 46.02.	- / 100 = 1 Hz
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 / real32
	-598.00 ... 598.00 Hz	Low limit for critical frequency 3. For 16-bit scaling, see parameter 46.02.	- / 100 = 1 Hz
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 / real32
	-598.00 ... 598.00 Hz	High limit for critical frequency 3. For 16-bit scaling, see parameter 46.02.	- / 100 = 1 Hz
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 / uint32
	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]	See Terms and abbreviations (page 132).	-

No.	Name / Range / Selection	Description	Def / Type FbEq 16b / 32b
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 / real32
	0.000 ... 1800.000 s	Acceleration time 1.	10 = 1 s / 1000 = 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 / real32
	0.000 ... 1800.000 s	Deceleration time 1.	10 = 1 s / 1000 = 1 s
28.74	Freq acceleration time 2	Defines acceleration time 2. See parameter 28.72 Freq acceleration time 1.	60.000 s / real32
	0.000 ... 1800.000 s	Acceleration time 2.	10 = 1 s / 1000 = 1 s
28.75	Freq deceleration time 2	Defines deceleration time 2. See parameter 28.73 Freq deceleration time 1.	60.000 s / real32
	0.000 ... 1800.000 s	Deceleration time 2.	10 = 1 s / 1000 = 1 s
28.76	Freq ramp in zero source	Selects a source that forces the frequency reference to zero. 0 = Force frequency reference to zero 1 = Normal operation	Inactive / uint32
	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

No.	Name / Range / Selection	Description	Def / Type FbEq 16b / 32b
	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]	See Terms and abbreviations (page 132).	-
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 / uint32
	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]	See Terms and abbreviations (page 132).	-
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 out balancing enable.	- / real32
	-598.00 ... 598.00 Hz	Frequency ramp balancing reference. For 16-bit scaling, see parameter 46.02.	- / 100 = 1 Hz
28.79	Freq ramp out 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 / uint32
	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

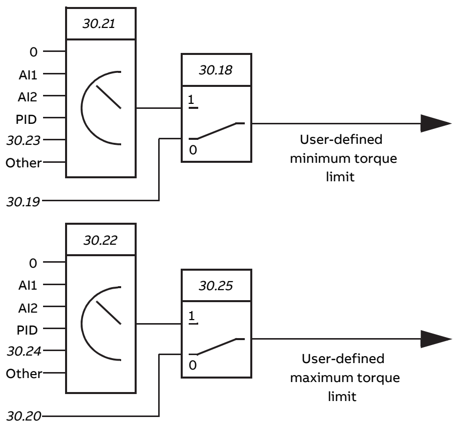
No.	Name / Range / Selection	Description	Def / Type FbEq 16b / 32b
	DIO1	Digital input/output DIO1 (11.02 DIO delayed status, bit 0).	10
	DIO2	Digital input/output DIO2 (11.02 DIO delayed status, bit 1).	11
	Other [bit]	See Terms and abbreviations (page 132).	-
28.90	Frequency ref act 1	Displays the value of frequency reference source 1 (selected by parameter 28.11 Frequency ref1 source). See the control chain diagram on page 623. This parameter is read-only.	- / real32
	-598.00 ... 598.00 Hz	Value of frequency reference source 1. For 16-bit scaling, see parameter 46.02.	- / 100 = 1 Hz
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 623. This parameter is read-only.	- / real32
	-598.00 ... 598.00 Hz	Value of frequency reference source 2. For 16-bit scaling, see parameter 46.02.	- / 100 = 1 Hz
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 623. This parameter is read-only.	- / real32
	-598.00 ... 598.00 Hz	Frequency reference after selection. For 16-bit scaling, see parameter 46.02.	- / 100 = 1 Hz
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 623. This parameter is read-only.	- / real32
	-598.00 ... 598.00 Hz	Frequency reference 7. For 16-bit scaling, see parameter 46.02.	- / 100 = 1 Hz
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 624. This parameter is read-only.	- / real32
	-598.00 ... 598.00 Hz	Frequency reference before ramping and limiting. For 16-bit scaling, see parameter 46.02.	- / 100 = 1 Hz

No.	Name / Range / Selection	Description	Def / Type FbEq 16b / 32b
30	Limits	Drive operation limits.	
30.01	Limit word 1	Displays limit word 1. This parameter is read-only.	- / uint16
b0	Torq lim	1 = Drive torque is being limited by the motor control (overvoltage control, undervoltage control, current control, load angle control or pull-out control), or by the torque limits defined by parameters.	
b1	Spd ctl tlim min	1 = Speed controller output is being limited by 25.11 Speed control min torque	
b2	Spd ctl tlim max	1 = Speed controller output is being limited by 25.12 Speed control max torque	
b3	Torq ref max	1 = Torque reference ramp input is being limited by 26.09 Maximum torque ref, source of 30.25 Maximum torque sel, 30.26 Power motoring limit or 30.27 Power generating limit.	
b4	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.	
b5	Tlim max speed	1 = Torque reference is being limited by the rush control because of maximum speed limit (30.12 Maximum speed)	
b6	Tlim min speed	1 = Torque reference is being limited by the rush control because of minimum speed limit (30.11 Minimum speed)	
b7	Max speed ref lim	1 = Speed reference is being limited by 30.12 Maximum speed, or by maximum permanent magnet motor speed limit based on DC voltage	
b8	Min speed ref lim	1 = Speed reference is being limited by 30.11 Minimum speed, or by maximum permanent magnet motor speed limit based on DC voltage	
b9	Max freq ref lim	1 = Frequency reference is being limited by 30.14 Maximum frequency	
b10	Min freq ref lim	1 = Frequency reference is being limited by 30.13 Minimum frequency	
b11	Reserved		
b12	Sw freq ref lim	1 = Requested output frequency cannot be reached because of switching frequency limitation (because of eg. output filtering or ATEXrelated protections)	

No.	Name / Range / Selection	Description	Def / Type FbEq 16b / 32b
b13	Load angle lim	(With permanent magnet motors and synchronous reluctance motors, and externally-excited synchronous motors in steady state) 1 = Maximum load angle is being limited, ie. the motor cannot produce any more torque (With externally-excited synchronous motors in dynamic situations) 1 = Torque is being limited	
b14…15	Reserved		
	0000h…FFFFh		1 = 1 / 1 = 1
30.02	Torque limit status	Displays the torque controller limitation status word. This parameter is read-only. *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.	- / uint16
b0	Undervoltage	*1 = Torque is being limited by overvoltage controller	
b1	Overvoltage	*1 = Torque is being limited by overvoltage controller	
b2	Minimum torque	*1 = Torque is being limited by 30.26 Power motoring limit, 30.27 Power generating limit or the source of 30.18 Minimum torque sel.	
b3	Maximum torque	*1 = Torque is being limited by 30.26 Power motoring limit, 30.27 Power generating limit or the source of 30.25 Maximum torque sel.	
b4	Internal current	1 = An inverter current limit (identified by bits 8…11) is active	
b5	Maximum load angle	(With permanent magnet motors, synchronous reluctance motors, and externally-excited synchronous motors only) 1 = Maximum load angle limit is active, ie. the motor is producing as much torque as possible	
b6	Motor pullout	(With asynchronous motors only) 1 = Motor pull-out limit is active, ie. the motor cannot produce any more torque	
b7	Reserved		
b8	Thermal	1 = Input current is being limited by the main circuit thermal limit	
b9	Max current	*1 = Maximum output current (I_{MAX}) is being limited	
b10	User current	*1 = Output current is being limited by 30.17 Maximum current	
b11	Thermal IGBT	*1 = Output current is being limited by a calculated thermal current value	
b12	IGBT overtemperature	*1 = Output current is being limited because of estimated IGBT temperature	

No.	Name / Range / Selection	Description	Def / Type FbEq 16b / 32b
b13	IGBT overload	*1 = Output current is being limited because of IGBT junction to case temperature	
b14…15	Reserved		
	0000h…FFFFh		1 = 1 / 1 = 1
30.11	Minimum speed	Defines the minimum allowed speed. **WARNING!** This value must not be higher than 30.12 Maximum speed. **WARNING!** In 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; -1800.00 (95.20 b0) rpm / real32
	-30000.00 ... 30000.00 rpm	Minimum allowed speed. For 16-bit scaling, see parameter 46.01.	- / 100 = 1 rpm
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; 1800.00 (95.20 b0) rpm / real32
	-30000.00 ... 30000.00 rpm	Maximum speed. For 16-bit scaling, see parameter 46.01.	- / 100 = 1 rpm
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; -60.00 (95.20 b0) Hz / real32
	-598.00 ... 598.00 Hz	Minimum frequency. For 16-bit scaling, see parameter 46.02.	- / 100 = 1 Hz

No.	Name / Range / Selection	Description	Def / Type FbEq 16b / 32b
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; 60.00 (95.20 b0) Hz / real32
	-598.00 … 598.00 Hz	Maximum frequency. For 16-bit scaling, see parameter 46.02.	- / 100 = 1 Hz
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. See the rating data in the hardware manual of the drive.	Disable / uint16
	Disable	Start current limit disabled.	0
	Enable	Start current limit enabled.	1
30.16	Maximum start current	Defines a maximum start current when enabled by parameter 30.15 Maximum start current enable.	3.06 A / real32
	0.00 … 30000.00 A	Maximum start current.	1 = 1 A / 1 = 1 A
30.17	Maximum current	Defines the maximum allowed motor current.	3.06 A / real32
	0.00 … 30000.00 A	Maximum motor current.	1 = 1 A / 1 = 1 A

No.	Name / Range / Selection	Description	Def / Type FbEq 16b / 32b
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).  The limit selection parameters are updated on a 10 ms time level. **Note:** In addition to the user-defined limits, torque may be limited for other reasons (such as power limitation).	Minimum torque 1 / uint32
	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

No.	Name / Range / Selection	Description	Def / Type FbEq 16b / 32b
	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]	See Terms and abbreviations (page 132).	-
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. **Note:** Do not set this parameter to 0% in an attempt to prevent reverse rotation. In an open-loop application, that is likely to prevent the motor from stopping altogether. To prevent reverse rotation, use the speed/frequency limits in this parameter group, or parameters 20.23/20.24.	-300.0 percent / real32
	-1600.0 ... 0.0 %	Minimum torque limit 1. For 16-bit scaling, see parameter 46.03.	- / 10 = 1 %
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 percent / real32
	0.0 ... 1600.0 %	Maximum torque 1. For 16-bit scaling, see parameter 46.03.	- / 10 = 1 %
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 / uint32
	Zero	None.	0
	AI1 scaled	12.12 AI1 scaled value (page 196).	1
	AI2 scaled	12.22 AI2 scaled value (page 197).	2
	Minimum torque 2	30.23 Minimum torque 2.	6
	Other [bit]	Source selection. See Terms and abbreviations (page 132).	-

No.	Name / Range / Selection	Description	Def / Type FbEq 16b / 32b
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 Maximum torque sel 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 / uint32
	Zero	None.	0
	AI1 scaled	12.12 AI1 scaled value (page 196).	1
	AI2 scaled	12.22 AI2 scaled value (page 197).	2
	Maximum torque 2	30.24 Maximum torque 2.	6
	Other [bit]	Source selection. See Terms and abbreviations (page 132).	-
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 . **Note:** Do not set this parameter to 0% in an attempt to prevent reverse rotation. In an open-loop application, that is likely to prevent the motor from stopping altogether. To prevent reverse rotation, use the speed/frequency limits in this parameter group, or parameters 20.23/20.24. See diagram at 30.18 Minimum torque sel.	-300.0 percent / real32
	-1600.0 … 0.0 %	Minimum torque limit 2. For 16-bit scaling, see parameter 46.03.	- / 10 = 1 %
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 percent / real32
	0.0 … 1600.0 %	Maximum torque limit 2. For 16-bit scaling, see parameter 46.03.	- / 10 = 1 %
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 / uint32
	Maximum torque 1	0.	0
	Maximum torque 2 source	1.	1

No.	Name / Range / Selection	Description	Def / Type FbEq 16b / 32b
	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 (page 132).	-
30.26	Power motoring limit	Defines the maximum shaft power in motoring mode, ie. when power is being transferred from the motor to the machinery. The value is given in percent of nominal motor power. **Note:** If nominal shaft torque is defined by parameter 99.12 Motor nominal torque then nominal shaft power is calculated according to parameters 99.09 Motor nominal speed and 99.12 Motor nominal torque.	300.00 percent / real32
	0.00 ... 600.00 %	Maximum shaft power in motoring mode.	1 = 1 % / 100 = 1 %
30.27	Power generating limit	Defines the maximum shaft power in generating mode, ie. when power is being transferred from the machinery to the motor. The value is given in percent of nominal motor power. **Note:** Do not set this parameter to 0% in an attempt to prevent reverse rotation. In an open-loop application, that is likely to prevent the motor from stopping altogether. To prevent reverse rotation, use the speed/frequency limits in this parameter group, or parameters 20.23/20.24. **Note:** If nominal shaft torque is defined by parameter 99.12 Motor nominal torque then nominal shaft power is calculated according to parameters 99.09 Motor nominal speed and 99.12 Motor nominal torque.	-300.00 percent / real32
	-600.00 ... 0.00 %	Maximum shaft power in generating mode.	1 = 1 % / 100 = 1 %

No.	Name / Range / Selection	Description	Def / Type FbEq 16b / 32b
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:** With internal brake chopper, drive increases its internal overvoltage control limit to enable higher reliability in breaking.	Enable / uint16
	Disable	Overvoltage control disabled.	0
	Enable	Overvoltage control enabled.	1
30.31	Undervoltage control	Enables the undervoltage control of the intermediate DC link. If the DC voltage drops due to input power cut off, the undervoltage controller will automatically decrease the motor torque in order to keep the voltage above the lower limit. By decreasing the motor torque, the inertia of the load will cause regeneration back to the drive, keeping the DC link charged and preventing an undervoltage trip until the motor coasts to a stop. This will act as a power-loss ride-through functionality in systems with high inertia, such as a centrifuge or a fan.	Enable / uint16
	Disable	Undervoltage control disabled.	0
	Enable	Undervoltage control enabled.	1
30.33	Motor RMS voltage limit	Defines the maximum motor RMS voltage limit.	10000.0 V / real32
	50.0 … 10000.0 V	Maximum motor RMS voltage limit.	1 = 1 V / 1 = 1 V
30.35	Thermal current limitation	Enables/disables temperature-based output current limitation. The limitation should only be disabled if required by the application.	Enable / uint16
	Disable	Thermal current limitation disabled.	0
	Enable	Thermal current limitation enabled.	1

No.	Name / Range / Selection	Description	Def / Type FbEq 16b / 32b
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) / uint32
	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 (page 132).	-
31.02	External event 1 type	Selects the type of external event 1.	Fault (95.20 b8) / uint16
	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 b5) / uint32
31.04	External event 2 type	Selects the type of external event 2.	Fault / uint16
	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

No.	Name / Range / Selection	Description	Def / Type FbEq 16b / 32b
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) / uint32
31.06	External event 3 type	Selects the type of external event 3.	Fault / uint16
	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) / uint32
31.08	External event 4 type	Selects the type of external event 4.	Fault / uint16
	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) / uint32
31.10	External event 5 type	Selects the type of external event 5.	Fault / uint16
	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. This signal will be observed even if it is not the active source in the current control location (EXT1/EXT2/Local). (A reset from the active source will be observed regardless of this parameter.) 0 → 1 = Reset	Not selected / uint32
	Not selected	0	0
	Selected	1	1
	DI1	Digital input DI1 (10.02 DI delayed status, bit 0).	2

No.	Name / Range / Selection	Description	Def / Type FbEq 16b / 32b
	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
	EFB MCW bit 7	Control word bit 7 received through the embedded fieldbus interface.	32
	Other [bit]	See Terms and abbreviations (page 132).	-
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. **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. **Note:** • The autoreset function is only available in external control; see section Local control vs. external control (page 66). • Faults related to the Safe torque off (STO) function cannot be automatically reset. • In case bit 4 (Supply unit) is set and the inverter unit has tripped to 7583 Line side unit faulted, a reset command is given for both the inverter and supply units. The bits of this binary number correspond to the following faults:	0000h / uint16
b0	Overcurrent		
b1	Overvoltage		
b2	Undervoltage		
b3	AI supervision fault		
b4	Supply unit		

No.	Name / Range / Selection	Description	Def / Type FbEq 16b / 32b
b5…7	Reserved		
b8	Application fault 1	Defined in the application program.	
b9	Application fault 2	Defined in the application program.	
b10	Selectable fault	See parameter 31.13 User selectable fault.	
b11	External fault 1	From source selected by parameter 31.01 External event 1 source.	
b12	External fault 2	From source selected by parameter 31.03 External event 2 source.	
b13	External fault 3	From source selected by parameter 31.05 External event 3 source.	
b14	External fault 4	From source selected by parameter 31.07 External event 4 source.	
b15	External fault 5	From source selected by parameter 31.09 External event 5 source.	
	0000h…FFFFh		1 = 1 / 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.	0 / uint32
	0000…FFFFh	Fault code.	1 = 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 NoUnit / uint32
	0...5	Number of automatic resets.	1 = 1 / 1 = 1
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 / real32
	1.0 ... 600.0 s	Time for automatic resets.	10 = 1 s / 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 / real32
	0.0 ... 120.0 s	Autoreset delay.	10 = 1 s / 10 = 1 s

No.	Name / Range / Selection	Description	Def / Type FbEq 16b / 32b
31.19	Motor phase loss	Selects how the drive reacts when a motor phase loss is detected. **Note:** The drive may not be able to reliably detect a phase loss in a multimotor application: a separate protection method (eg. a motor protection switch) should be installed for each motor.	Fault / uint16
	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. See also section Earth (Ground) fault detection (parameter *31.20*) (page 114).	Fault / uint16
	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
31.22	STO indication run/stop	Selects which indications are given when 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. **Note:** • 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. • This parameter cannot be changed while the drive is running. **WARNING!** The drive cannot detect or memorize any changes in the STO circuitry when the drive control unit is not powered or when the main power to the drive is off. If both STO circuits are closed and a level-type start signal is active when the power is restored, it is possible that the drive starts without a fresh start command. Take this into account in the risk assessment of the system. For more information on the STO, see the Hardware manual of the drive.	Fault/Fault / uint16

<table>
<tr><th>No.</th><th>Name / Range / Selection</th><th>Description</th><th>Def / Type
FbEq 16b / 32b</th></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 off5091 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 colspan="2">(Normal operation)</td></tr>
</table>
</td><td>1</td></tr>
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<table>
<tr><th>No.</th><th>Name / Range / Selection</th><th>Description</th><th>Def / Type
FbEq 16b / 32b</th></tr>
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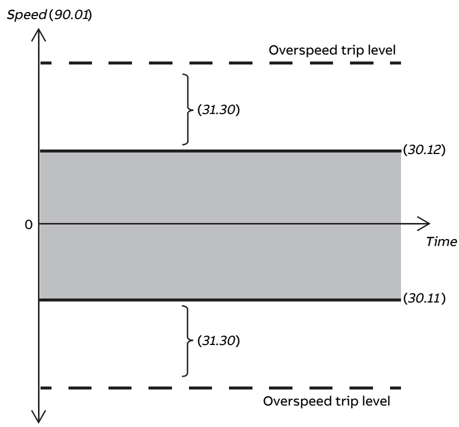
<tr><td>0</td><td>1</td><td>Faults 5091 Safe torque off and FA81 Safe torque off 1 loss</td><td>Event B5A0 STO event and fault FA81 Safe torque off 1 loss</td></tr>
<tr><td>1</td><td>0</td><td>Faults 5091 Safe torque off and FA82 Safe torque off 2 loss</td><td>Event B5A0 STO event and fault FA82 Safe torque off 2 loss</td></tr>
<tr><td>1</td><td>1</td><td colspan="2">(Normal operation)</td></tr>
</table>
</td><td>2</td></tr>
<tr><td></td><td>Warning/Warning</td><td>
<table>
<tr><th colspan="2">Inputs</th><th rowspan="2">Indication (running or stopped)</th></tr>
<tr><th>IN1</th><th>IN2</th></tr>
<tr><td>0</td><td>0</td><td>Warning 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>
</table>

<table>
<tr><th>No.</th><th>Name / Range / Selection</th><th>Description</th><th>Def / Type
FbEq 16b / 32b</th></tr>
<tr><td></td><td>Event/Event</td><td><table><tr><th colspan="2">Inputs</th><th rowspan="2">Indication (running or stopped)</th></tr><tr><th>IN1</th><th>IN2</th></tr><tr><td>0</td><td>0</td><td>Event B5A0 STO event</td></tr><tr><td>0</td><td>1</td><td>Event B5A0 STO event and fault FA81 Safe torque off 1 loss</td></tr><tr><td>1</td><td>0</td><td>Event B5A0 STO event 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 rowspan="2">Indication (running or stopped)</th></tr><tr><th>IN1</th><th>IN2</th></tr><tr><td>0</td><td>0</td><td>None</td></tr><tr><td>0</td><td>1</td><td>Fault 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; No action
(95.20 b15) / uint16</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 Wiring or earth fault.</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 / uint16</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.</td><td>1</td></tr>
</table>

No.	Name / Range / Selection	Description	Def / Type FbEq 16b / 32b
	Fault	The drive trips on fault 7121 Motor stall.	2
31.25	Stall current limit	Stall current limit in percent of the nominal current of the motor. See parameter 31.24 Stall function.	200.0 percent / real32
	0.0 … 1600.0 %	Stall current limit.	10 = 1 % / 10 = 1 %
31.26	Stall speed limit	Stall speed limit in rpm. See parameter 31.24 Stall function.	150.00; 180.00 rpm (95.20 b0) rpm / real32
	0.00 … 10000.00 rpm	Stall speed limit. For 16-bit scaling, see parameter 46.01.	- / 100 = 1 rpm
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; 18.00 Hz (95.20 b0) Hz / real32
	0.00 … 500.00 Hz	Stall frequency limit. For 16-bit scaling, see parameter 46.02.	- / 100 = 1 Hz
31.28	Stall time	Stall time. See parameter 31.24 Stall function.	20 s / real32
	0…3600 s	Stall time.	1 = 1 s / 1 = 1 s
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 90.01 Motor speed for control or the estimated speed 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. **Example:** If the maximum speed is 1420 rpm and speed trip margin is 300 rpm, the drive trips at 1720 rpm.  	500.00 rpm / real32
	0.00 … 10000.00 rpm	Overspeed trip margin. For 16-bit scaling, see parameter 46.01.	- / 100 = 1 rpm

No.	Name / Range / Selection	Description	Def / Type FbEq 16b / 32b
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 If 31.32 is set to 0% and 31.33 is set to 0 s, the emergency stop ramp supervision is disabled.	- / real32
	0...300 %	Maximum deviation from expected deceleration rate.	1 = 1 % / 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.	- / real32
	0...32767 s	Maximum ramp-down time, or supervision activation delay.	1 = 1 s / 1 = 1 s
31.35	Main fan fault function	Selects how the drive reacts when a main cooling fan fault is detected. **Note:** With an inverter unit consisting of one or more frame R8i inverter modules with speed-controlled fans, it may be possible to continue operation even if one main fan of a module stops. When fan failure is detected, the control program will automatically • set the other fan of the module to full speed • set the fans of the other modules (if any) to full speed • decrease the switching frequency to a minimum, and • disable the supervision of temperature difference between the modules. If this parameter is set to Fault, the inverter unit will trip (but still carry out the actions listed above). Otherwise, the inverter will attempt to continue operation. This parameter has no effect with Liquid cooled (LC) inverters and drives. Set parameter 206.07 Fan speed fault limit to zero to disable fault in LC units.	Warning / uint16
	Fault	The drive trips on fault 5080 Fan.	0

No.	Name / Range / Selection	Description	Def / Type FbEq 16b / 32b
	Warning	The drive generates an A581 Fan.	1
	No action	No action taken.	2
31.36	Aux fan fault function	*(Only visible with a ZCU control unit)* Selects how the drive reacts when a modules internal auxiliary fan fault is detected.	Fault / uint16
	Fault	The drive trips on fault 5081 Auxiliary fan not running. **Note:** The fault is suppressed for two minutes after power-up. During this time, the drive only generates a warning, A582 Auxiliary fan not running.	0
	Warning	The drive generates a warning, A582 Auxiliary fan not running.	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. nonemergency) 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 31.37 is set to 0% and 31.38 is set to 0 s, the ramp stop supervision is disabled.	- / real32
	0...300 %	Maximum deviation from expected deceleration rate.	1 = 1 % / 0 = 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 / real32
	0...32767 s	Maximum ramp-down time, or supervision activation delay.	1 = 1 s / 1 = 1 s

No.	Name / Range / Selection	Description	Def / Type FbEq 16b / 32b
31.40	Disable warning messages	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:	- / uint16
b0	Overvoltage	A3A1 DC link overvoltage	
b1	Reserved		
b2	Encoder 1	A7E1 Encoder (for encoder 1)	
b3	Encoder 2	A7E1 Encoder (for encoder 2)	
b4	CU Battery	A5F4 Control unit battery	
b5	EmergencyStop Off2	AFE1 Emergency stop (off2)	
b6	EmergencyStop Off1 Off3	AFE2 Emergency stop (off1 or off3)	
b7…15	Reserved		
	0000h…FFFFh		1 = 1 / 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. **Note:** The limit defines the maximum peak current of one phase. With this parameter at 0.0 A, only the internal limit is in force.	0.00 A / real32
	0.00 ... 30000.00 A	Custom motor current fault limit. For 16-bit scaling, see parameter 46.05.	- / 100 = 1 A
31.54	Fault action	Selects the stop mode when a non-critical fault occurs.	Coast / uint16
	Coast	The drive coasts to a stop.	0
	Emergency ramp	The drive follows the ramp specified for an emergency stop in parameter 23.23 Emergency stop time.	1
31.55	Ext I/O comm loss event	Selects how the drive reacts when the communication to an I/O extension module fails.	Fault / uint16
	No action	No action taken.	0
	Warning	The drive generates a warning, A799 ExtIO comm loss.	1
	Fault	The drive trips on a fault, 7082 Ext I/O comm loss.	2
31.200	Supervision status word	Displays the supervision status word. This parameter is read-only.	- / uint16

No.	Name / Range / Selection	Description	Def / Type FbEq 16b / 32b
b0	Reserved		
b1	Main switch feedback error	Main switch feedback error detected.	
b2	Main switch feedback warning	Main switch feedback warning condition is fulfilled.	
b3	Main switch feedback fault	Main switch feedback fault condition is fulfilled.	
b4…5	Reserved		
b6	Aux switch feedback error	Auxiliary switch feedback error is detected.	
b7	Aux switch feedback warning	Auxiliary switch feedback warning condition is fulfilled.	
b8	Aux switch feedback fault	Auxiliary switch feedback fault condition is fulfilled.	
b9…10	Reserved		
b11	Low pressure feedback error	Low pressure feedback error is detected.	
b12	Low pressure feedback warning	Low pressure feedback warning condition is fulfilled.	
b13	Low pressure feedback fault	Low pressure feedback fault condition is fulfilled.	
b14…15	Reserved		
	0000h…FFFFh		1 / 1
31.201	Main switch feedback	Defines the source to detect main switch feedback status.	Inactive (True) / int32
	Active (False)	Main switch feedback error is detected.	0
	Inactive (True)	Main switch feedback is correct.	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]	See Terms and abbreviations (page 132).	-
31.202	Main switch feedback action	Defines the action for the function.	Disabled / uint32
	Disabled	Function disabled.	0

No.	Name / Range / Selection	Description	Def / Type FbEq 16b / 32b
	No action	Function updates only the status word, however no events are generated.	1
	Warning	D212 Main switch warning.	2
	Fault	D112 Main switch fault.	3
	Other [bit]	See Terms and abbreviations (page 132).	-
31.203	Main switch feed-back action delay	Defines the time period required to verify main switch feedback error status.	0.0 s / real32
	0.0 ... 6400.0 s	Feedback action delay.	10 = 1 s / 1 = 1 s
31.206	Aux switch feed-back	Defines the source to detect auxiliary switch feedback status.	Inactive (True) / int32
	Active (False)	Auxiliary switch feedback error is detected.	0
	Inactive (True)	Auxiliary switch feedback is correct.	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]	See Terms and abbreviations (page 132).	-
31.207	Aux switch feed-back action	Defines aux switch feedback action.	Disabled / uint32
	Disabled	Aux switch feedback action is disabled.	0
	No action	Aux switch feedback action updates only the status word, however no events are generated.	1
	Warning	D213 Aux switch warning.	2
	Fault	D113 Aux switch fault.	3
31.208	Aux switch feed-back action delay	Defines the time period required to verify auxiliary switch feedback error status.	0.0 s / real32
	0.0 ... 6400.0 s	Feedback error status.	10 = 1 s / 1 = 1 s
31.211	Low pressure feed-back	Defines the source to detect Low pressure feedback status.	Inactive (True) / int32
	Active (False)	Low pressure feedback error is detected.	0
	Inactive (True)	Low pressure feedback is correct.	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 / Range / Selection	Description	Def / Type FbEq 16b / 32b
	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]	See Terms and abbreviations (page 132).	-
31.212	Low pressure feed-back action	Defines the action for Low pressure feedback.	Disabled / uint32
	Disabled	Low pressure feedback action is disabled.	0
	No action	Low pressure feedback action updates only status word, however no events are generated.	1
	Warning	D214 Low pressure warning.	2
	Fault	D114 Low pressure fault.	3
31.213	Low pressure feed-back action delay	Defines the time period required to verify low pressure feedback error status.	0.0 s / real32
	0.0 ... 6400.0 s	Time period.	10 = 1 s / 1 = 1 s

No.	Name / Range / Selection	Description	Def / Type FbEq 16b / 32b
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 116).	
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.	- / uint16
b0	Supervision 1 active	1 = Signal selected by 32.07 is outside its limits.	
b1	Supervision 2 active	1 = Signal selected by 32.17 is outside its limits.	
b2	Supervision 3 active	1 = Signal selected by 32.27 is outside its limits.	
b3…15	Reserved		
	0000h…FFFFh		1 = 1 / 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 / uint16
	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 / uint16
	No action	No action taken.	0
	Warning	A warning (A8B0 Signal supervision) is generated.	1

No.	Name / Range / Selection	Description	Def / Type FbEq 16b / 32b
	Fault	The drive trips on 80B0 Signal supervision.	2
	Fault if running	If running, the drive trips on 80B0 Signal supervision.	3
32.07	Supervision 1 signal	Selects the signal to be monitored by signal supervision function 1.	Zero / uint32
	Zero	None.	0
	Speed	01.01 Motor speed used.	1
	Frequency	01.06 Output frequency.	3
	Current	01.07 Motor current.	4
	Torque	01.10 Motor torque.	6
	DC voltage	01.11 DC voltage.	7
	Output power	01.14 Output power.	8
	AI1	12.11 AI1 actual value.	9
	AI2	12.21 AI2 actual value (page 197).	10
	Speed ref ramp in	23.01 Speed ref ramp input (page 267).	18
	Speed ref ramp out	23.02 Speed ref ramp output (page 267).	19
	Speed ref used	24.01 Used speed reference (page 274).	20
	Torque ref used	26.02 Torque reference used (page 293).	21
	Freq ref used	28.02 Frequency ref ramp output (page 297).	22
	Other [bit]	Source selection. See Terms and abbreviations (page 132).	-
32.08	Supervision 1 filter time	Defines a filter time constant for the signal monitored by signal supervision 1.	0.000 s / real32
	0.000 … 30.000 s	Signal filter time.	1000 = 1 s / 1000 = 1 s
32.09	Supervision 1 low	Defines the lower limit for signal supervision 1.	0.00 NoUnit / real32
	-21474830.00 … 21474830.00	Low limit.	- / 100 = 1
32.10	Supervision 1 high	Defines the upper limit for signal supervision 1.	0.00 NoUnit / real32
	-21474830.00 … 21474830.00	Upper limit.	- / 100 = 1
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 / uint16
	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

No.	Name / Range / Selection	Description	Def / Type FbEq 16b / 32b
	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
32.16	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 / uint16
	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
	Fault if running	If running, the drive trips on 80B1 Signal supervision 2.	3
32.17	Supervision 2 signal	Selects the signal to be monitored by signal supervision function 2. For the available selections, see parameter 32.07 Supervision 1 signal.	Zero / uint32
32.18	Supervision 2 filter time	Defines a filter time constant for the signal monitored by signal supervision 2.	0.000 s / real32
	0.000 ... 30.000 s	Signal filter time.	1000 = 1 s / 1000 = 1 s
32.19	Supervision 2 low	Defines the lower limit for signal supervision 2.	0.00 NoUnit / real32
	-21474830.00 ... 21474830.00	Low limit.	- / 100 = 1
32.20	Supervision 2 high	Defines the upper limit for signal supervision 2.	0.00 NoUnit / real32
	-21474830.00 ... 21474830.00	Upper limit.	- / 100 = 1
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 / uint16
	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

No.	Name / Range / Selection	Description	Def / Type FbEq 16b / 32b
	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 / uint16
	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
	Fault if running	If running, the drive trips on 80B2 Signal supervision 3.	3
32.27	Supervision 3 signal	Selects the signal to be monitored by signal supervision function 3. For the available selections, see parameter 32.07 Supervision 1 signal.	Zero / uint32
32.28	Supervision 3 filter time	Defines a filter time constant for the signal monitored by signal supervision 3.	0.000 s / real32
	0.000 … 30.000 s	Signal filter time.	1000 = 1 s / 1000 = 1 s
32.29	Supervision 3 low	Defines the lower limit for signal supervision 3.	0.00 NoUnit / real32
	-21474830.00 … 21474830.00	Low limit.	- / 100 = 1
32.30	Supervision 3 high	Defines the upper limit for signal supervision 3.	0.00 NoUnit / real32
	-21474830.00 … 21474830.00	Upper limit.	- / 100 = 1

No.	Name / Range / Selection	Description	Def / Type FbEq 16b / 32b
33	Generic timer & counter	Configuration of maintenance timers/counters. See also section Maintenance timers and counters (page 116).	
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.	- / uint16
b0	On-time 1	1 = On-time timer 1 has reached its preset limit.	
b1	On-time 2	1 = On-time timer 2 has reached its preset limit.	
b2	Edge 1	1 = Signal edge counter 1 has reached its preset limit.	
b3	Edge 2	1 = Signal edge counter 2 has reached its preset limit.	
b4	Value 1	1 = Value counter 1 has reached its preset limit.	
b5	Value 2	1 = Value counter 2 has reached its preset limit.	
b6…15	Reserved		
	0000h…FFFFh		1 = 1 / 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.	- / uint32
	0...4294967295 s	Actual present value of on-time timer 1.	- / 1 = 1 s
33.11	On-time 1 warn limit	Sets the warning limit for on-time timer 1.	- / uint32
	0...4294967295 s	Warning limit for on-time timer 1.	- / 1 = 1 s
33.12	On-time 1 function	Configures on-time timer 1.	- / uint16
b0	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.	
b1	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	

No.	Name / Range / Selection	Description	Def / Type FbEq 16b / 32b
b2…15	Reserved		
	0000h…FFFFh		1 = 1 / 1 = 1
33.13	On-time 1 source	Selects the signal to be monitored by on-time timer 1.	False / uint32
	False	Constant 0 (timer disabled).	0
	True	Constant 1.	1
	RO1	Bit 0 of 10.21 RO status (page 181).	2
	Other [bit]	See Terms and abbreviations (page 132).	-
33.14	On-time 1 warn message	Selects the optional warning message for on-time timer 1.	On-time 1 exceeded / uint32
	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 fan.	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.	- / uint32
	0…4294967295 s	Actual present value of on-time timer 2.	- / 1 = 1 s
33.21	On-time 2 warn limit	Sets the warning limit for on-time timer 2.	- / uint32
	0…4294967295 s	Warning limit for on-time timer 2.	- / 1 = 1 s
33.22	On-time 2 function	Configures on-time timer 2.	- / uint16

No.	Name / Range / Selection	Description	Def / Type FbEq 16b / 32b
b0	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.	
b1	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	
b2…15	Reserved		
	0000h…FFFFh		1 = 1 / 1 = 1
33.23	On-time 2 source	Selects the signal to be monitored by on-time timer 2.	False / uint32
	False	Constant 0 (timer disabled).	0
	True	Constant 1.	1
	RO1	Bit 0 of 10.21 RO status (page 181).	2
	Other [bit]	See Terms and abbreviations (page 132).	-
33.24	On-time 2 warn message	Selects the optional warning message for on-time timer 2.	On-time 2 exceeded / uint32
	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 cooling fan	A890 Additional cooling fan.	7
	Maintain cabinet fan	A88E Cabinet fan.	8
	Maintain DC capacitors	A88D DC capacitor.	9
	Maintain motor bearing	A880 Motor bearing.	10

No.	Name / Range / Selection	Description	Def / Type FbEq 16b / 32b
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.	- / uint32
	0...4294967295	Actual present value of signal edge counter 1.	- / 1 = 1
33.31	Edge counter 1 warn limit	Sets the warning limit for signal edge counter 1.	- / uint32
	0...4294967295	Warning limit for signal edge counter 1.	- / 1 = 1
33.32	Edge counter 1 function	Configures signal edge counter 1.	- / uint16
b0	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.	
b1	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	
b2	Count rising edges	Count rising edges 0 = Disable: Rising edges are not counted 1 = Enable: Rising edges are counted	
b3	Count falling edges	Count falling edges 0 = Disable: Falling edges are not counted 1 = Enable: Falling edges are counted	
b4…15	Reserved		
	0000h…FFFFh		1 = 1 / 1 = 1
33.33	Edge counter 1 source	Selects the signal to be monitored by signal edge counter 1.	False / uint32
	False	Constant 0.	0
	True	Constant 1.	1

No.	Name / Range / Selection	Description	Def / Type FbEq 16b / 32b
	RO1	Bit 0 of 10.21 RO status (page 181).	2
	Other [bit]	See Terms and abbreviations (page 132).	-
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 NoUnit / uint32
	1...2147483647	Divisor for signal edge counter 1.	- / 1 = 1
33.35	Edge counter 1 warn message	Selects the optional warning message for signal edge counter 1.	Edge counter 1 exceeded / uint32
	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
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.	- / uint32
	0...4294967295	Actual present value of signal edge counter 2.	- / 1 = 1
33.41	Edge counter 2 warn limit	Sets the warning limit for signal edge counter 2.	- / uint32
	0...4294967295	Warning limit for signal edge counter 2.	- / 1 = 1
33.42	Edge counter 2 function	Configures signal edge counter 2.	- / uint16

No.	Name / Range / Selection	Description	Def / Type FbEq 16b / 32b
b0	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.	
b1	Warning enable	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	
b2	Count rising edges	Count rising edges 0 = Disable: Rising edges are not counted 1 = Enable: Rising edges are counted	
b3	Count falling edges	Count falling edges 0 = Disable: Falling edges are not counted 1 = Enable: Falling edges are counted	
b4…15	Reserved		
	0000h…FFFFh		1 = 1 / 1 = 1
33.43	Edge counter 2 source	Selects the signal to be monitored by signal edge counter 2.	False / uint32
	False	0.	0
	True	1.	1
	RO1	Bit 0 of 10.21 RO status (page 181).	2
	Other [bit]	See Terms and abbreviations (page 132).	-
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 NoUnit / uint32
	1...4294967295	Divisor for signal edge counter 2.	- / 1 = 1
33.45	Edge counter 2 warn message	Selects the optional warning message for signal edge counter 2.	Edge counter 2 exceeded / uint32
	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

No.	Name / Range / Selection	Description	Def / Type FbEq 16b / 32b
	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.	0 NoUnit / real32
	-2147483000..2147483000	Actual present value of value counter 1.	- / 1 = 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.	- / real32
	-2147483000..2147483000	Limit for value counter 1.	- / 1 = 1
33.52	Value counter 1 function	Configures value counter 1.	- / uint16
b0	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.	
b1	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	
b2…15	Reserved		
	0000h…FFFFh		1 = 1 / 1 = 1
33.53	Value counter 1 source	Selects the signal to be monitored by value counter 1.	Not selected / uint32
	Not selected	None (counter disabled).	0

No.	Name / Range / Selection	Description	Def / Type FbEq 16b / 32b
	Motor speed	01.01 Motor speed used.	1
	Other [bit]	See Terms and abbreviations (page 132).	-
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 NoUnit / real32
	0.001 … 2147483.000	Divisor for value counter 1.	- / 1 = 1
33.55	Value counter 1 warn message	Selects the optional warning message for value counter 1.	Value counter 1 exceeded / uint32
	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.	0 NoUnit / real32
	-2147483008…2147483008	Actual present value of value counter 2.	- / 1 = 1
33.61	Value counter 2 warn limit	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.	- / real32
	-2147483008…2147483008	Limit for value counter 2.	- / 1 = 1
33.62	Value counter 2 function	Configures value counter 2.	- / uint16

No.	Name / Range / Selection	Description	Def / Type FbEq 16b / 32b
b0	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.	
b1	Warning enable	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	
b2…15	Reserved		
	0000h…FFFFh		1 = 1 / 1 = 1
33.63	Value counter 2 source	Selects the signal to be monitored by value counter 2.	Not selected / uint32
	Not selected	None (counter disabled).	0
	Motor speed	01.01 Motor speed used.	1
	Other [bit]	Source selection. See Terms and abbreviations (page 132).	-
33.64	Value counter 2 divider	Defines a divisor for value counter 2. The value of the monitored signal is divided by this value before integration.	1.000 NoUnit / real32
	0.001 … 2147483.000	Divisor for value counter 2.	- / 1 = 1
33.65	Value counter 2 warn message	Selects the optional warning message for value counter 2.	Value counter 2 exceeded / uint32
	Value counter 2 exceeded	A88B Value counter 2. The message text can be edited on the control panel by choosing Menu – Settings – Edit texts.	5
	Maintain motor bearing	A880 Motor bearing.	10

No.	Name / Range / Selection	Description	Def / Type FbEq 16b / 32b
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 106).	
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 (°C or °F) is selected by parameter 96.16 Unit selection. This parameter is read-only.	- / real32
	-60.0 ... 1000.0 °	Estimated motor temperature.	1 = 1 ° / 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 °F, the range is -76…1832. With a PTC sensor, the range is 0…5000 ohms. This parameter is read-only.	- / real32
	-60...1000 °	Measured temperature 1.	1 = 1 ° / 1 = 1 °
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 °F, the range is -76…1832. With a PTC sensor, the range is 0…5000 ohms. This parameter is read-only.	- / real32
	-60...1000 °	Measured temperature 2.	1 = 1 ° / 1 = 1 °
35.04	FPTC status word	Displays the status of optional FPTC-xx thermistor protection modules. The word can be used as the source of eg. external events. **Note:** The “module found” bits are updated regardless of whether the corresponding module is activated. However, the “fault active” and “warning active” bits are not updated if the module is not activated. Modules are activated by parameter 35.30 FPTC configuration word. This parameter is read-only.	- / uint16
b0	Module found in slot 1	1 = Yes: An FPTC-xx module has been detected in slot 1.	
b1	Fault active in slot 1	1 = Yes: The module in slot 1 has an active fault (4991 Safe motor temperature 1).	
b2	Warning active in slot 1	1 = Yes: The module in slot 1 has an active warning (A497 Motor temperature 1).	
b3	Module found in slot 2	1 = Yes: An FPTC-xx module has been detected in slot 2.	
b4	Fault active in slot 2	1 = Yes: The module in slot 2 has an active fault (4992 Safe motor temperature 2).	

No.	Name / Range / Selection	Description	Def / Type FbEq 16b / 32b
b5	Warning active in slot 2	1 = Yes: The module in slot 2 has an active warning (A498 Motor temperature 2).	
b6	Module found in slot 3	1 = Yes: An FPTC-xx module has been detected in slot 3.	
b7	Fault active in slot 3	1 = Yes: The module in slot 3 has an active fault (4993 Safe motor temperature 3).	
b8	Warning active in slot 3	1 = Yes: The module in slot 3 has an active warning (A499 Motor temperature 3).	
b9…15	Reserved		
	0000h…FFFFh		1 = 1 / 1 = 1
35.05	Motor overload level	Displays the motor overload level as a percent of the motor overload fault limit. See parameter 35.56 Motor overload action .	- / real32
	0.0 ... 300.0 %	Motor overload level. 0.0% No motor overloading. 88.0% Motor overloaded to warning level. 100.0% Motor overloaded to fault level.	10 = 1 % / 10 = 1 %
35.09	Temperature Calibration status word	Shows temperature calibration status word.	- / uint16
b0	Temperature 1 calibration done	Calibration status of temperature 1. See parameter 35.17 Temperature 1 calibration.	
b1	Temperature 2 calibration done	Calibration status of temperature 2. See parameter 35.27 Temperature 2 calibration.	
b2…15	Reserved		
	0000h…FFFFh		1 = 1 / 1 = 1
35.11	Temperature 1 source	Selects the source from which measured temperature 1 is read. For wiring examples, see the hardware manual of the drive. 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 / uint16
	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

No.	Name / Range / Selection	Description	Def / Type FbEq 16b / 32b
	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 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 35.14. In case the input is located on an I/O extension module, use selection Other (see Terms and abbreviations (page 19)) 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 x 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 x Pt100 analog I/O	As selection 1 x Pt100 analog I/O, but with two sensors connected in series. Using multiple sensors improves measurement accuracy significantly.	6
	3 x Pt100 analog I/O	As selection 1 x 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 108). **Note:** Either 0 ohm (normal temperature) or 4000 ohm (excessive temperature) will be shown by 35.02 Measured temperature 1. By default, an excessive temperature will generate a warning as per parameter 35.13 Temperature 1 warning limit. If you want a fault instead, set 35.12 Temperature 1 fault limit to 4000 ohm.	8

No.	Name / Range / Selection	Description	Def / Type FbEq 16b / 32b
	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.	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 x 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 x Pt1000 analog I/O	As selection 1 x Pt1000 analog I/O, but with two sensors connected in series. Using multiple sensors improves measurement accuracy significantly.	14
	3 x Pt1000 analog I/O	As selection 1 x Pt1000 analog I/O, but with three sensors connected in series. Using multiple sensors improves measurement accuracy significantly.	15
	Pt1000 encoder module 1	Pt1000 sensor connected to encoder interface 1. See parameters 91.21 Module 1 temp sensor type and 91.22 Module 1 temp filter time. **Note:** Pt1000 sensor supports FEN-11 and FEN-31 encoder modules only.	16
	Pt1000 encoder module 2	Pt1000 sensor connected to encoder interface 2. See parameters 91.24 Module 2 temp sensor type and 91.25 Module 2 temp filter time. **Note:** Pt1000 sensor supports FEN-11 and FEN-31 encoder modules only.	17

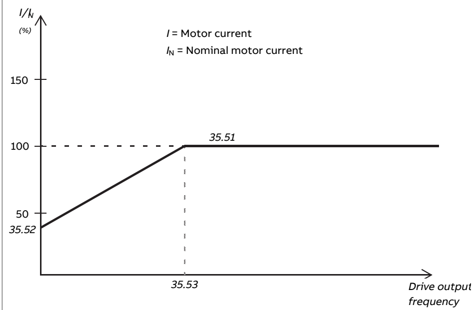
No.	Name / Range / Selection	Description	Def / Type FbEq 16b / 32b
35.12	Temperature 1 fault limit	Defines the fault limit for temperature monitoring function 1. When measured temperature 1 exceeds the limit, the drive trips on fault 4981 External temperature 1. The unit is selected by parameter 96.16 Unit selection. **Note:** With °F, the range is -76…1832. With a PTC sensor, the range is 0…5000 ohms.	130 ° / real32
	-60...1000 °	Fault limit for temperature monitoring function 1.	1 = 1 ° / 1 = 1 °
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 1) is generated. The unit is selected by parameter 96.16 Unit selection. **Note:** With °F, the range is -76…1832. With a PTC sensor, the range is 0…5000 ohms.	110 ° / real32
	-60...1000 °	Warning limit for temperature monitoring function 1.	1 = 1 ° / 1 = 1 °
35.14	Temperature 1 AI source	Specifies the analog input when the setting of 35.11 Temperature 1 source requires measurement through an analog input. **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 / uint32
	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 [bit]	Source selection. See Terms and abbreviations (page 132).	-
35.17	Temperature 1 calibration	Defines the calibration of temperature 1. Calibration can be used to fine-tune the motor temperature measurement. Once the motor has cooled down, measure its ambient temperature and set this value accordingly. This parameter affects only if Pt100 or Pt1000 measurement is using AI and AO of the control unit or I/O extension modules.	0 ° / real32
	-30...1000 °	Calibration of temperature 1 in celsius.	1 = 1 ° / 1 = 1 °

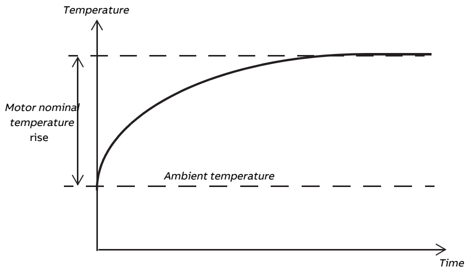
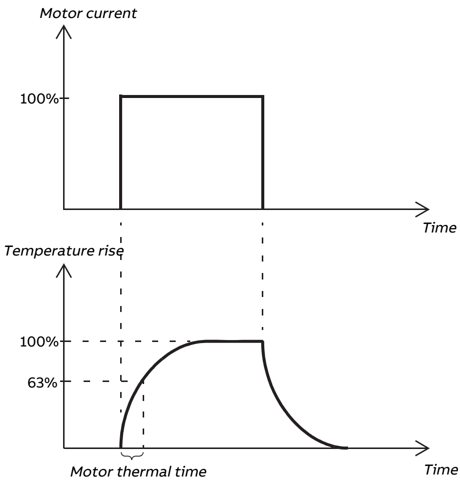
No.	Name / Range / Selection	Description	Def / Type FbEq 16b / 32b
35.21	Temperature 2 source	Selects the source from which measured temperature 2 is read. For wiring examples, see the hardware manual of the drive. Usually this source is from a sensor connected to the motor controlled by the drive, but 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 / uint16
	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 (see Terms and abbreviations (page 19)) 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

No.	Name / Range / Selection	Description	Def / Type FbEq 16b / 32b
	1 x 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 x Pt100 analog I/O	As selection 1 x Pt100 analog I/O, but with two sensors connected in series. Using multiple sensors improves measurement accuracy significantly.	6
	3 x Pt100 analog I/O	As selection 1 x 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 108). **Note:** Either 0 ohm (normal temperature) or 4000 ohm (excessive temperature) will be shown by 35.03 Measured temperature 2. By default, an excessive temperature will generate a warning as per parameter 35.23 Temperature 2 warning limit. If you want a fault instead, set 35.22 Temperature 2 fault limit to 4000 ohm.	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 Pt100 excitation.	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 x 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 Pt100 excitation.	13

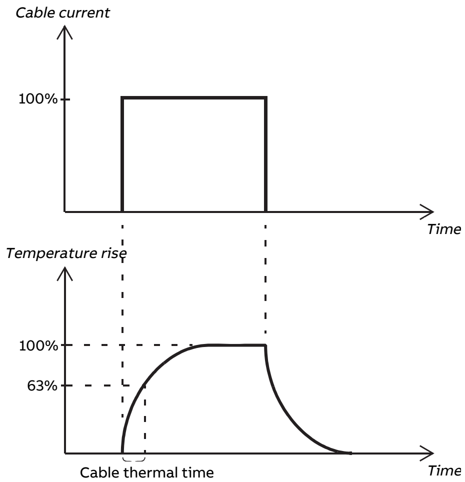
No.	Name / Range / Selection	Description	Def / Type FbEq 16b / 32b
	2 x Pt1000 analog I/O	As selection 1 x Pt1000 analog I/O, but with two sensors connected in series. Using multiple sensors improves measurement accuracy significantly.	14
	3 x Pt1000 analog I/O	As selection 1 x Pt1000 analog I/O, but with three sensors connected in series. Using multiple sensors improves measurement accuracy significantly.	15
	Pt1000 encoder module 1	Pt1000 sensor connected to encoder interface 1. See parameters 91.21 Module 1 temp sensor type and 91.22 Module 1 temp filter time. **Note:** Pt1000 sensor is supported with FEN-11 and FEN-31 encoder modules only.	16
	Pt1000 encoder module 2	Pt1000 sensor connected to encoder interface 2. See parameters 91.24 Module 2 temp sensor type and 91.25 Module 2 temp filter time. **Note:** Pt1000 sensor is supported with FEN-11 and FEN-31 encoder modules only.	17
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 °F, the range is -76…1832. With a PTC sensor, the range is 0…5000 ohms.	130 ° / real32
	-60...1000 °	Fault limit for temperature monitoring function 2.	1 = 1 ° / 1 = 1 °
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 °F, the range is -76…1832. With a PTC sensor, the range is 0…5000 ohms.	110 ° / real32
	-60...1000 °	Warning limit for temperature monitoring function 2.	1 = 1 ° / 1 = 1 °
35.24	Temperature 2 AI source	Selects the input for parameter 35.21 Temperature 2 source, selections KTY84 analog I/O, 1 x Pt100 analog I/O, 2 x Pt100 analog I/O, 3 x Pt100 analog I/O and Direct temperature.	Not selected / uint32
	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 [bit]	Source selection. See Terms and abbreviations (page 132).	-

No.	Name / Range / Selection	Description	Def / Type FbEq 16b / 32b
35.27	Temperature 2 calibration	Defines the calibration of temperature 2. See parameter 35.17 Temperature 1 calibration.	0 ° / real32
	-30...1000 °	Calibration of temperature 2 in celsius.	1 = 1 ° / 1 = 1 °
35.30	FPTC configuration word	Activates FPTC-xx thermistor protection 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.	- / uint16
b0	Module in slot 1	1 = Yes: Module installed in slot 1.	
b1	Disable slot 1 warning	1 = Yes: Warnings from the module in slot 1 suppressed.	
b2	Module in slot 2	1 = Yes: Module installed in slot 2.	
b3	Disable slot 2 warning	1 = Yes: Warnings from the module in slot 2 suppressed.	
b4	Module in slot 3	1 = Yes: Module installed in slot 3.	
b5	Disable slot 3 warning	1 = Yes: Warnings from the module in slot 3 suppressed.	
b6…15	Reserved		
	0000h…FFFFh		1 = 1 / 1 = 1
35.50	Motor ambient temperature	Defines the ambient temperature of the motor for the motor thermal protection model. The unit (°C or °F) 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 ° / real32
	-60...100 °	Ambient temperature.	1 = 1 ° / 1 = 1 °

No.	Name / Range / Selection	Description	Def / Type FbEq 16b / 32b
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 percent / uint16
	50...150 %	Maximum load for the motor load curve.	1 = 1 % / 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.	70 percent / uint16
	25...150 %	Zero speed load for the motor load curve.	1 = 1 % / 1 = 1 %
35.53	Break point	Defines the motor load curve together with parameters 35.51 Motor load curve and 35.52 Zero speed load. Defines the break point frequency of the load curve 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 / uint16
	1.00 ... 500.00 Hz	Break point for the motor load curve. For 16-bit scaling, see parameter 46.02.	- / 100 = 1 Hz

No.	Name / Range / Selection	Description	Def / Type FbEq 16b / 32b
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 (°C or °F) is selected by parameter 96.16 Unit selection.  	80 ° / real32
	0...300 °	Temperature rise.	1 = 1 ° / 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 / uint16
	100...10000 s	Motor thermal time constant.	1 = 1 s / 1 = 1 s
35.56	Motor overload action	Selects the action taken when motor overload is detected. See section .	No action / uint16
	No action	No action taken.	0

No.	Name / Range / Selection	Description	Def / Type FbEq 16b / 32b
	Warning only	Drive generates warning A783 Motor overload when the motor is overloaded to the warning level, that is, parameter 35.05 Motor overload level reaches value 88.0%.	1
	Warning and fault	Drive generates warning A783 Motor overload when the motor is overloaded to the warning level, that is, parameter 35.05 Motor overload level reaches value 88.0%. Drive trips on fault 7122 Motor overload when the motor is overloaded to the fault level, that is, parameter 35.05 Motor overload level reaches value 100.0%.	2
35.57	Motor overload class	Defines the motor overload class to be used. The class of protection is specified by the user as the time for tripping at 7.2 times (IEC 60947-4-1) or 6 times (NEMA ICS) the tripping level current. See section .	Class 20 / uint16
	Class 5	Motor overload class 5.	0
	Class 10	Motor overload class 10.	1
	Class 20	Motor overload class 20.	2
	Class 30	Motor overload class 30.	3
	Class 40	Motor overload class 40.	4
35.60	Cable temperature	Shows the calculated temperature of the motor cable. See section Thermal protection of motor cable (page 112). 102% = overtemperature warning (A480 Motor cable overload) 106% = overtemperature fault (4000 Motor cable overload) This parameter is read-only.	0.0 percent / real32
	0.0 … 200.0 %	Calculated temperature of motor cable.	1 = 1 % / 10 = 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.	30000.00 A / real32
	0.00 … 10000.00 A	Continuous current-carrying capacity of motor cable.	1 = 1 A / 100 = 1 A

No.	Name / Range / Selection	Description	Def / Type FbEq 16b / 32b
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 / uint16
	0...50000 s	0 s → Thermal protection of motor cable disabled. 1…50000 s → Motor cable thermal time constant.	1 = 1 s / 1 = 1 s
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) / uint32
	Off	0 (function disabled).	0
	On	1.	1
	Running	Bit 6 of 06.16 Drive status word 1 (page 158).	2

No.	Name / Range / Selection	Description	Def / Type FbEq 16b / 32b
	Other [bit]	See Terms and abbreviations (page 132).	-
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.	- / uint32
	0…42949673 s	Motor fan start delay.	1 = 1 s / 100 = 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 / uint32
	0…715828 min	Motor fan stop delay.	1 = 1 min / 1 = 1 min
35.103	DOL starter feed-back 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) / uint32
	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]	See Terms and abbreviations (page 132).	-
35.104	DOL starter feed-back 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; 5 (95.20 b6) s / uint32
	0…42949673 s	Motor fan start delay.	1 = 1 s / 1 = 1 s

No.	Name / Range / Selection	Description	Def / Type FbEq 16b / 32b
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.	- / uint16
b0	Start command:	Status of fan control source selected by 35.100. 0 = Stop requested 1 = Start requested	
b1	Delayed start command:	Fan control bit (delays observed). Select this bit as the source of the output controlling the fan. 0 = Stopped 1 = Started	
b2	DOL feedback:	Status of fan feedback (source selected by 35.103). 0 = Stopped 1 = Running	
b3	DOL fault (-1):	Fault status. 0 = Fault (fan feedback missing). The action taken is selected by 35.106. 1 = No fault	
b4…15	Reserved		
	0000h…FFFFh		1 = 1 / 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 / uint16
	No action	No action taken.	0
	Warning	The drive generates a warning (A781 Motor fan).	1
	Fault	Drive trips on 71B1 Motor fan.	2

No.	Name / Range / Selection	Description	Def / Type FbEq 16b / 32b
36	Load analyzer	Peak value and amplitude logger settings. See also section Load analyzer (page 117).	
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 36.12…36.15. The peak value logger can be reset using parameter 36.09 Reset loggers. The logger is also reset whenever the signal source is changed. The date and time of the last reset are stored into parameters 36.16 and 36.17 respectively.	Power inu out / uint32
	Zero	None	0
	Motor speed used	01.01 Motor speed used (page 136).	1
	Output frequency	01.06 Output frequency (page 136).	3
	Motor current	01.07 Motor current (page 136).	4
	Motor torque	01.10 Motor torque (page 136).	6
	DC voltage	01.11 DC voltage (page 137).	7
	Power inu out	01.14 Output power (page 137).	8
	Speed ref ramp in	23.01 Speed ref ramp input (page 267).	10
	Speed ref ramp out	23.02 Speed ref ramp output (page 267).	11
	Speed ref used	24.01 Used speed reference (page 274).	12
	Torq ref used	26.02 Torque reference used (page 293).	13
	Other [bit]	Source selection. See Terms and abbreviations (page 132).	-
36.02	PVL filter time	Defines a filtering time for the peak value logger. See parameter 36.01 PVL signal source.	2.00 s / real32
	0.00 … 120.00 s	Peak value logger filtering time.	100 = 1 s / 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, and can be scaled using parameter 36.07 AL2 signal scaling. 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. Amplitude logger 2 can be reset using parameter 36.09 Reset loggers. The logger is also reset whenever the signal source or scaling is changed. The date and time of the last reset are stored into parameters 36.50 and 36.51 respectively.	Ambient temperature / uint32
	Zero	None	0
	Motor speed used	01.01 Motor speed used (page 136).	1

No.	Name / Range / Selection	Description	Def / Type FbEq 16b / 32b
	Output frequency	01.06 Output frequency (page 136).	3
	Motor current	01.07 Motor current (page 136).	4
	Motor torque	01.10 Motor torque (page 136).	6
	DC voltage	01.11 DC voltage (page 137).	7
	Power inu out	01.14 Output power (page 137).	8
	Speed ref ramp in	23.01 Speed ref ramp input (page 267).	10
	Speed ref ramp out	23.02 Speed ref ramp output (page 267).	11
	Speed ref used	24.01 Used speed reference (page 274).	12
	Torq ref used	26.02 Torque reference used (page 293).	13
	Other [bit]	Source selection. See Terms and abbreviations (page 132).	-
	Ambient temperature	01.70 Ambient temperature % (page 140). The amplitude range of 0…100% corresponds to 0…60 °C or 32…140 °F.	20
36.07	AL2 signal scaling	Defines the signal value that corresponds to 100% amplitude.	100.00 NoUnit / real32
	0.00 ... 32767.00	Signal value corresponding to 100%.	1 = 1 / 100 = 1
36.08	Logger function	Determines whether amplitude loggers 1 and 2 are active continuously or only when the drive is modulating.	- / uint16
b0	AL1	0 = Amplitude logger 1 active continuously 1 = Amplitude logger 1 active only when the drive is modulating	
b1	AL2	0 = Amplitude logger 2 active continuously 1 = Amplitude logger 2 active only when the drive is modulating	
b2…15	Reserved		
	0000h…FFFFh		1 = 1 / 1 = 1
36.09	Reset loggers	Resets the peak value logger and/or amplitude logger 2. (Amplitude logger 1 cannot be reset.)	Done / uint16
	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.	- / real32
	-32768.00 ... 32767.00	Peak value.	1 = 1 / 100 = 1

No.	Name / Range / Selection	Description	Def / Type FbEq 16b / 32b
36.11	PVL peak date	Displays the date on which the peak value was recor-ded.	- / uint16
36.12	PVL peak time	Displays the time at which the peak value was recor-ded.	0 / uint32
	00:00:00…23:59:59	Peak occurrence time.	1 = 1
36.13	PVL current at peak	Displays the motor current at the moment the peak value was recorded.	- / real32
	-32768.00 … 32767.00 A	Motor current at peak.	1 = 1 A / 100 = 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.	- / real32
	0.00 … 2000.00 V	DC voltage at peak.	10 = 1 V / 100 = 1 V
36.15	PVL speed at peak	Displays the motor speed at the moment the peak value was recorded.	- / real32
	-32768.00 … 32767.00 rpm	Motor speed at peak. For 16-bit scaling, see parameter 46.01.	- / 100 = 1 rpm
36.16	PVL reset date	Displays the date on which the peak value logger was last reset.	1/1/1980 / uint16
	-	Last reset date of the peak value logger.	1 = 1
36.17	PVL reset time	Displays the time at which the peak value logger was last reset.	0 / uint32
	00:00:00…23:59:59	Last reset time of the peak value logger.	1 = 1
36.20	AL1 below 10%	Displays the percentage of samples recorded by amplitude logger 1 that were below 10%. Note that this percentage also includes the samples that had a negative value.	- / real32
	0.00 … 100.00 %	Amplitude logger 1 samples below 10%.	1 = 1 % / 100 = 1 %
36.21	AL1 10 to 20%	Displays the percentage of samples recorded by amplitude logger 1 that fall between 10 and 20 %.	- / real32
	0.00 … 100.00 %	Amplitude logger 1 samples between 10 and 20 %.	1 = 1 % / 100 = 1 %
36.22	AL1 20 to 30%	Displays the percentage of samples recorded by amplitude logger 1 that fall between 20 and 30 %.	- / real32
	0.00 … 100.00 %	Amplitude logger 1 samples between 20 and 30 %.	1 = 1 % / 100 = 1 %
36.23	AL1 30 to 40%	Displays the percentage of samples recorded by amplitude logger 1 that fall between 30 and 40 %.	- / real32
	0.00 … 100.00 %	Amplitude logger 1 samples between 30 and 40 %.	1 = 1 % / 100 = 1 %
36.24	AL1 40 to 50%	Displays the percentage of samples recorded by amplitude logger 1 that fall between 40 and 50 %.	- / real32
	0.00 … 100.00 %	Amplitude logger 1 samples between 40 and 50 %.	1 = 1 % / 100 = 1 %
36.25	AL1 50 to 60%	Displays the percentage of samples recorded by amplitude logger 1 that fall between 50 and 60 %.	- / real32
	0.00 … 100.00 %	Amplitude logger 1 samples between 50 and 60 %.	1 = 1 % / 100 = 1 %

No.	Name / Range / Selection	Description	Def / Type FbEq 16b / 32b
36.26	AL1 60 to 70%	Displays the percentage of samples recorded by amplitude logger 1 that fall between 60 and 70 %.	- / real32
	0.00 … 100.00 %	Amplitude logger 1 samples between 60 and 70 %.	1 = 1 % / 100 = 1 %
36.27	AL1 70 to 80%	Displays the percentage of samples recorded by amplitude logger 1 that fall between 70 and 80 %.	- / real32
	0.00 … 100.00 %	Amplitude logger 1 samples between 70 and 80 %.	1 = 1 % / 100 = 1 %
36.28	AL1 80 to 90%	Displays the percentage of samples recorded by amplitude logger 1 that fall between 80 and 90 %.	- / real32
	0.00 … 100.00 %	Amplitude logger 1 samples between 80 and 90 %.	1 = 1 % / 100 = 1 %
36.29	AL1 over 90%	Displays the percentage of samples recorded by amplitude logger 1 that exceed 90 %.	- / real32
	0.00 … 100.00 %	Amplitude logger 1 samples over 90 %.	1 = 1 % / 100 = 1 %
36.40	AL2 below 10%	Displays the percentage of samples recorded by amplitude logger 2 that were below 10 %. Note that this percentage also includes the samples that had a negative value.	- / real32
	0.00 … 100.00 %	Amplitude logger 2 samples below 10 %.	1 = 1 % / 100 = 1 %
36.41	AL2 10 to 20%	Displays the percentage of samples recorded by amplitude logger 2 that fall between 10 and 20 %.	- / real32
	0.00 … 100.00 %	Amplitude logger 2 samples between 10 and 20 %.	1 = 1 % / 100 = 1 %
36.42	AL2 20 to 30%	Displays the percentage of samples recorded by amplitude logger 2 that fall between 20 and 30 %.	- / real32
	0.00 … 100.00 %	Amplitude logger 2 samples between 20 and 30 %.	1 = 1 % / 100 = 1 %
36.43	AL2 30 to 40%	Displays the percentage of samples recorded by amplitude logger 2 that fall between 30 and 40 %.	- / real32
	0.00 … 100.00 %	Amplitude logger 2 samples between 30 and 40 %.	1 = 1 % / 100 = 1 %
36.44	AL2 40 to 50%	Displays the percentage of samples recorded by amplitude logger 2 that fall between 40 and 50 %.	- / real32
	0.00 … 100.00 %	Amplitude logger 2 samples between 40 and 50 %.	1 = 1 % / 100 = 1 %
36.45	AL2 50 to 60%	Displays the percentage of samples recorded by amplitude logger 2 that fall between 50 and 60 %.	- / real32
	0.00 … 100.00 %	Amplitude logger 2 samples between 50 and 60 %.	1 = 1 % / 100 = 1 %
36.46	AL2 60 to 70%	Displays the percentage of samples recorded by amplitude logger 2 that fall between 60 and 70 %.	- / real32
	0.00 … 100.00 %	Amplitude logger 2 samples between 60 and 70 %.	1 = 1 % / 100 = 1 %
36.47	AL2 70 to 80%	Displays the percentage of samples recorded by amplitude logger 2 that fall between 70 and 80 %.	- / real32
	0.00 … 100.00 %	Amplitude logger 2 samples between 70 and 80 %.	1 = 1 % / 100 = 1 %
36.48	AL2 80 to 90%	Displays the percentage of samples recorded by amplitude logger 2 that fall between 80 and 90 %.	- / real32
	0.00 … 100.00 %	Amplitude logger 2 samples between 80 and 90 %.	1 = 1 % / 100 = 1 %

No.	Name / Range / Selection	Description	Def / Type FbEq 16b / 32b
36.49	AL2 over 90%	Displays the percentage of samples recorded by amplitude logger 2 that exceed 90 %.	- / real32
	0.00 ... 100.00 %	Amplitude logger 2 samples over 90 %.	1 = 1 % / 100 = 1 %
36.50	AL2 reset date	Displays the date on which amplitude logger 2 was last reset.	1/1/1980 / uint16
	-	Last reset date of amplitude logger 2.	1 = 1
36.51	AL2 reset time	Displays the time at which amplitude logger 2 was last reset.	0 / uint32
	00:00:00…23:59:59	Last reset time of amplitude logger 2.	1 = 1

No.	Name / Range / Selection	Description	Def / Type FbEq 16b / 32b
37	User load curve	Settings for user load curve. See also section User load curve.	
37.01	ULC output status word	Displays the status of the monitored signal. (The status word is independent of the actions and delays selected by parameters 37.03, 37.04, 37.41 and 37.42.) This parameter is read-only.	- / uint16
b0	Under load limit	1 = Monitored signal is below the underload curve	
b1	Reserved		
b2	Over load limit	1 = Monitored signal is above the overload curve	
b3…15	Reserved		
	0000h…FFFFh		1 = 1 / 1 = 1
37.02	ULC supervision signal	Selects the signal to be monitored. The function compares the absolute value of the signal against the load curve.	Not selected / uint32
	Not selected	No signal selected (monitoring disabled).	0
	Motor current %	01.07 Motor current (page 136).	2
	Motor torque %	01.10 Motor torque (page 136).	3
	Output power % of motor nominal	01.15 Output power % of motor nom (page 137).	4
	Other [bit]	Source selection. See Terms and abbreviations (page 132).	-
37.03	ULC overload actions	Selects how the drive reacts if the absolute value of the monitored signal stays above the overload curve for longer than the value of 37.41 ULC overload timer.	Disabled / uint16
	Disabled	No action taken.	0
	Warning	The drive generates a warning (A8BE ULC overload).	1
	Fault	Drive trips on 8002 ULC overload.	2
	Warning/Fault	The drive generates a warning (A8BE ULC overload) if the signal stays continuously above the overload curve for half of the time defined by 37.41 ULC overload timer. The drive trips on 8002 ULC overload if the signal stays continuously above the overload curve for the time defined by 37.41 ULC overload timer.	3
37.04	ULC underload actions	Selects how the drive reacts if the absolute value of the monitored signal stays below the underload curve for longer than the value of 37.42 ULC underload timer.	Disabled / uint16
	Disabled	No action taken.	0
	Warning	The drive generates a warning (A8BF ULC underload).	1
	Fault	Drive trips on 8001 ULC underload.	2

No.	Name / Range / Selection	Description	Def / Type FbEq 16b / 32b
	Warning/Fault	The drive generates a warning (A8BF ULC underload) if the signal stays continuously below the underload curve for half of the time defined by 37.42 ULC underload timer. The drive trips on 8001 ULC underload if the signal stays continuously below the underload curve for the time defined by 37.42 ULC underload timer.	3
37.11	ULC speed table point 1	Defines the 1st speed point on the X-axis of the user load curve. The speed points are used in DTC motor control mode, and in scalar motor control mode when speed control is being used. The five points must be in order from lowest to highest. The points are defined as positive values, but the range is symmetrically effective also in the negative direction. The monitoring is not active outside these two areas.	150.0 rpm / real32
	0.0 … 30000.0 rpm	Speed.	1 = 1 rpm / 10 = 1 rpm
37.12	ULC speed table point 2	Defines the 2nd speed point on the X-axis of the user load curve.	750.0 rpm / real32
	0.0 … 30000.0 rpm	Speed.	1 = 1 rpm / 10 = 1 rpm
37.13	ULC speed table point 3	Defines the 3rd speed point on the X-axis of the user load curve.	1290.0 rpm / real32
	0.0 … 30000.0 rpm	Speed.	1 = 1 rpm / 10 = 1 rpm
37.14	ULC speed table point 4	Defines the 4th speed point on the X-axis of the user load curve.	1500.0 rpm / real32
	0.0 … 30000.0 rpm	Speed.	1 = 1 rpm / 10 = 1 rpm
37.15	ULC speed table point 5	Defines the 5th speed point on the X-axis of the user load curve.	1800.0 rpm / real32
	0.0 … 30000.0 rpm	Speed.	1 = 1 rpm / 10 = 1 rpm
37.16	ULC frequency table point 1	Defines the 1st frequency point on the X-axis of the user load curve. The frequency points are used in scalar motor control mode when frequency control is being used. The five points must be in order from lowest to highest. The points are defined as positive values, but the range is symmetrically effective also in the negative direction. The monitoring is not active outside these two areas.	5.0 Hz / real32
	0.0 … 598.0 Hz	Frequency.	1 = 1 Hz / 10 = 1 Hz
37.17	ULC frequency table point 2	Defines the 2nd frequency point on the X-axis of the user load curve.	25.0 Hz / real32

No.	Name / Range / Selection	Description	Def / Type FbEq 16b / 32b
	0.0 ... 598.0 Hz	Frequency.	1 = 1 Hz / 10 = 1 Hz
37.18	ULC frequency table point 3	Defines the 3rd frequency point on the X-axis of the user load curve.	43.0 Hz / real32
	0.0 ... 598.0 Hz	Frequency.	1 = 1 Hz / 10 = 1 Hz
37.19	ULC frequency table point 4	Defines the 4th frequency point on the X-axis of the user load curve.	50.0 Hz / real32
	0.0 ... 598.0 Hz	Frequency.	1 = 1 Hz / 10 = 1 Hz
37.20	ULC frequency table point 5	Defines the 5th frequency point on the X-axis of the user load curve.	60.0 Hz / real32
	0.0 ... 598.0 Hz	Frequency.	1 = 1 Hz / 10 = 1 Hz
37.21	ULC underload point 1	Defines the 1st point of the underload curve. Each point of the underload curve must have a lower value than the corresponding overload point.	10.0 percent / real32
	0.0 ... 1600.0 %	Underload point.	1 = 1 % / 10 = 1 %
37.22	ULC underload point 2	Defines the 2nd point of the underload curve.	15.0 percent / real32
	0.0 ... 1600.0 %	Underload point.	1 = 1 % / 10 = 1 %
37.23	ULC underload point 3	Defines the 3rd point of the underload curve.	25.0 percent / real32
	0.0 ... 1600.0 %	Underload point.	1 = 1 % / 10 = 1 %
37.24	ULC underload point 4	Defines the 4th point of the underload curve.	30.0 percent / real32
	0.0 ... 1600.0 %	Underload point.	1 = 1 % / 10 = 1 %
37.25	ULC underload point 5	Defines the 5th point of the underload curve.	30.0 percent / real32
	0.0 ... 1600.0 %	Underload point.	1 = 1 % / 10 = 1 %
37.31	ULC overload point 1	Defines the 1st point of the overload curve. Each point of the overload curve must have a higher value than the corresponding underload point.	300.0 percent / real32
	0.0 ... 1600.0 %	Overload point.	1 = 1 % / 10 = 1 %
37.32	ULC overload point 2	Defines the 2nd point of the overload curve.	300.0 percent / real32
	0.0 ... 1600.0 %	Overload point.	1 = 1 % / 10 = 1 %
37.33	ULC overload point 3	Defines the 3rd point of the overload curve.	300.0 percent / real32
	0.0 ... 1600.0 %	Overload point.	1 = 1 % / 10 = 1 %
37.34	ULC overload point 4	Defines the 4th point of the overload curve.	300.0 percent / real32
	0.0 ... 1600.0 %	Overload point.	1 = 1 % / 10 = 1 %
37.35	ULC overload point 5	Defines the 5th point of the overload curve.	300.0 percent / real32

No.	Name / Range / Selection	Description	Def / Type FbEq 16b / 32b
	0.0 … 1600.0 %	Overload point.	1 = 1 % / 10 = 1 %
37.41	ULC overload timer	Defines the time for which the monitored signal must continuously stay above the overload curve before the drive takes the action selected by 37.03 ULC overload actions.	20.0 s / real32
	0.0 … 10000.0 s	Overload timer.	1 = 1 s / 10 = 1 s
37.42	ULC underload timer	Defines the time for which the monitored signal must continuously stay below the underload curve before the drive takes the action selected by 37.04 ULC underload actions.	20.0 s / real32
	0.0 … 10000.0 s	Underload timer.	1 = 1 s / 10 = 1 s

No.	Name / Range / Selection	Description	Def / Type FbEq 16b / 32b
43	Brake chopper	Settings for the internal brake chopper. See also section DC voltage control (page 102).	
43.01	Brake 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 eventual temperature the resistor would reach when loaded long enough with its rated maximum load capacity (43.09 Brake resistor max cont power). The temperature calculation is based on the values of parameters 43.08, 43.09 and 43.10, and on the assumption that the resistor is installed as instructed by the manufacturer (ie. it cools down as expected). This parameter is read-only.	- / real32
	0.0 ... 120.0 %	Estimated brake resistor temperature.	1 = 1 % / 1000 = 1 %
43.06	Brake chopper function	Enables brake chopper control and selects the brake resistor overload protection method (calculation or measurement). **Note:** Before enabling brake chopper control, ensure that • A brake resistor is connected, • Overvoltage control is switched off (parameter 30.30 Overvoltage control), and • The supply voltage range (parameter 95.01 Supply voltage) has been selected correctly.	Disabled / uint16
	Disabled	Brake chopper control disabled.	0
	Enabled with thermal model	Brake chopper control enabled with resistor overload protection based on a thermal model. If you select this, you must also specify the values needed by the model, ie. parameters 43.08…43.12. See the resistor data sheet.	1
	Enabled without thermal model	Brake chopper control enabled without resistor overload protection based on a thermal model. 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

No.	Name / Range / Selection	Description	Def / Type FbEq 16b / 32b
	Overvoltage peak protection	Brake chopper starts to conduct at 100% pulse width whenever • The DC voltage exceeds the overvoltage fault limit (a hysteresis applies), and • The drive is not modulating (for example, during a coast stop). The thermal model-based resistor overload protection is not active. 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.	3
43.07	Brake chopper run 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 allowed. This parameter can be used to enable chopper operation only when the supply is missing from a drive with a regenerative supply unit.	On / uint32
	Off	0.	0
	On	1.	1
	Other [bit]	See Terms and abbreviations (page 132).	-
43.08	Brake resistor thermal tc	Defines the thermal time constant for the brake resistor thermal model.	0 s / real32
	0…10000 s	Brake resistor thermal time constant, ie. the rated time to achieve 63% temperature.	1 = 1 s / 1 = 1 s
43.09	Brake resistor max cont power	Defines the maximum continuous load of the brake resistor which will eventually raise the resistor temperature to the maximum allowed value (= continuous heat dissipation capacity of the resistor in kW) but not above it. The value is used in the resistor overload protection based on the thermal model. See parameter 43.06 Brake chopper function, and the brake resistor data sheet.	0.00 kW / real32
	0.00 … 10000.00 kW	Maximum continuous load of the brake resistor.	1 = 1 kW / 1 = 1 kW

No.	Name / Range / Selection	Description	Def / Type FbEq 16b / 32b
43.10	Brake resistance	Defines the resistance value of the brake resistor. The value is used for the brake chopper protection based on the thermal model. See parameter 43.06 Brake chopper function.	0.0 Ohm / real32
	0.0 … 1000.0 Ohm	Brake resistor resistance value.	1 = 1 Ohm / 1 = 1 Ohm
43.11	Brake resistor fault limit	Selects the fault limit for the brake resistor protection based on the thermal model. See parameter 43.06 Brake chopper 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 max cont power.	105 percent / real32
	0…150 %	Brake resistor temperature fault limit.	1 = 1 % / 1= 1 %
43.12	Brake resistor warning limit	Selects the warning limit for the brake resistor protection based on the thermal model. See parameter 43.06 Brake chopper 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 max cont power.	95 percent / real32
	0…150 %	Brake resistor temperature warning limit.	1 = 1 % / 1= 1 %

No.	Name / Range / Selection	Description	Def / Type FbEq 16b / 32b
45	Energy efficiency	Settings for the energy saving calculators. See also section Energy saving calculators (page 117).	
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. This parameter is read-only (see parameter 45.21 Energy calculations reset).	0 GWh / uint16
	0…65535 GWh	Energy savings in GWh.	1 = 1 GWh / 1 = 1 GWh
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 MWh / uint16
	0…999 MWh	Energy savings in MWh.	1 = 1 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 kWh / uint16
	0.0 … 999.9 kWh	Energy savings in kWh.	10 = 1 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 thousands / uint32
	0…4294967295 thousands	Monetary savings in thousands of units.	- / 1 = 1 thousands

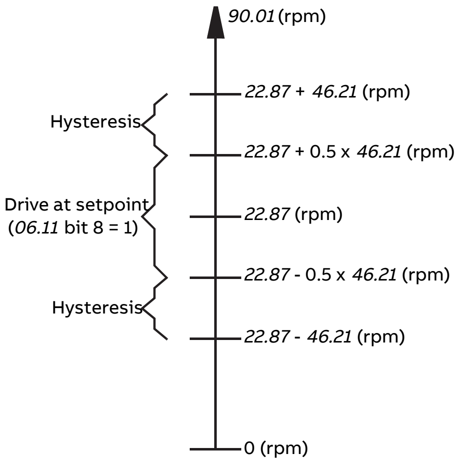
No.	Name / Range / Selection	Description	Def / Type FbEq 16b / 32b
45.06	Saved money	Displays the monetary savings compared to direct-on-line motor connection. This value is a calculated by multiplying the saved energy in kWh by the currently active energy tariff (45.14 Tariff selection). When this parameter 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 units / uint32
	0.00 … 999.99 units	Monetary savings.	1 = 1 units / 100 = 1 units
45.08	CO2 reduction in kilotons	Displays the reduction in CO2 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 metric_kiloton / uint16
	0…65535 metric_kiloton	Reduction in CO_2 emissions in metric kilotons.	1 = 1 metric_kiloton / 1 = 1 metric_kiloton
45.09	CO2 reduction in tons	Displays the reduction in CO2 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 metric_ton / uint16
	0.0 … 999.9 metric_ton	Reduction in CO_2 emissions in metric tons.	1 = 1 metric_ton / 10 = 1 metric_ton

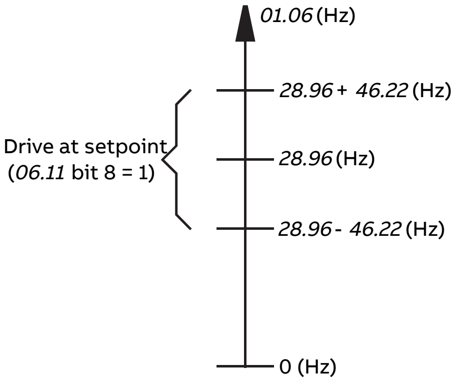
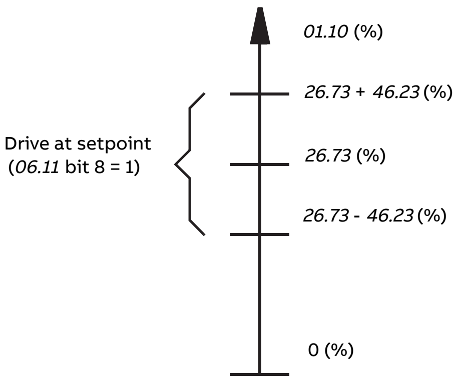
No.	Name / Range / Selection	Description	Def / Type FbEq 16b / 32b
45.11	Energy optimizer	Enables/disables the energy optimization function. The function optimizes the motor flux so that total energy consumption and motor noise level are reduced when the drive operates below the nominal load. The total efficiency (motor and drive) can be improved by 1…20 % depending on load torque and speed. **Note:** • In DTC motor control mode with a permanent magnet motor or a synchronous reluctance motor, energy optimization is always enabled regardless of this parameter. • In scalar motor control mode with an asynchronous motor, the function optimizes the motor flux as described below. Also with a sine filter connected the motor flux is optimized. • In scalar motor control mode with a permanent magnet motor, the function minimizes the motor current. Motor current is also minimized when a sine filter is connected. A model-based optimizer can be enabled by activating parameter 98.01 User motor model mode and giving motor values. • Do not use energy optimizer in multimotor systems.	Disable / uint16
	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 / uint32
	0.000 … 4294967.295 units	Energy tariff 1.	- / 1000 = 1 units
45.13	Energy tariff 2	Defines energy tariff 2 (price of energy per kWh). See parameter 45.12 Energy tariff 1.	2.000 units / uint32
	0.000 … 4294967.295 units	Energy tariff 2.	- / 1000 = 1 units
45.14	Tariff selection	Selects (or defines a source that selects) which predefined energy tariff is used. 0 = 45.12 Energy tariff 1 1 = 45.13 Energy tariff 2	Energy tariff 1 / uint32
	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

No.	Name / Range / Selection	Description	Def / Type FbEq 16b / 32b
	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]	See Terms and abbreviations (page 132).	-
45.17	Tariff currency unit	Specifies the currency used for the savings calculations.	EUR / uint16
	EUR	Euro.	101
	USD	Dollar.	102
	Local currency	Local currency. The name of the currency can be edited by choosing Menu - Settings - Edit texts on the control panel.	100
45.18	CO2 conversion factor	Defines a factor for conversion of saved energy into CO2 emissions (kg/kWh or tn/MWh).	0.500 tn_MWh / uint16
	0.000 … 65.535 tn_MWh	Factor for conversion of saved energy into CO_2 emissions.	1 = 1 tn_MWh / 100 = 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 / real32
	0.0 … 100000.0 kW	Motor power. For 16-bit scaling, see parameter 46.04.	- / 10 = 1 kW
45.21	Energy calculations reset	Resets the savings counter parameters 45.01…45.09	Done / uint16
	Done	Reset not requested (normal operation), or reset complete.	0
	Reset	Reset the savings counter parameters. The value reverts automatically to Done.	1

No.	Name / Range / Selection	Description	Def / Type FbEq 16b / 32b
46	Monitoring/scaling settings	Speed supervision settings; actual signal filtering; general scaling settings. **Note:** The 16-bit scalings apply when parameter values are read or written directly. With protocol- and profile-specific read/write commands (eg. communication objects), the scaling depends on the protocol or profile. See the documentation of the adapter module.	
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; 1800.00 rpm (95.20 b0) rpm / real32
	0.10 … 30000.00 rpm	Acceleration/deceleration terminal/initial speed.	1 = 1 rpm / 100 = 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) Hz / real32
	0.10 … 1000.00 Hz	Acceleration/deceleration terminal/initial frequency.	10 = 1 Hz / 100 = 1 Hz
46.03	Torque scaling	Defines the 16-bit scaling of torque parameters. The value of this parameter (in percent of nominal motor torque) corresponds to 10000 in fieldbus, master/follower etc. communication. See also parameter 46.42 Torque decimals.	100.0 percent / real32
	0.1 … 1000.0 %	Torque corresponding to 10000 on fieldbus.	10 = 1 % / 10 = 1 %
46.04	Power scaling	Defines the output power value that corresponds to 10000 in fieldbus, master/follower etc. communication. The unit is selected by parameter 96.16 Unit selection.	1000.00 kW or hp / real32
	0.10 … 30000.00 kW or hp	Power corresponding to 10000 on fieldbus.	1 = 1 kW or hp / 100 = 1 kW or hp
46.05	Current scaling	Defines the 16-bit scaling of current parameters. The value of this parameter corresponds to 10000 in fieldbus, master/follower etc. communication.	10000 A / real32
	0…30000 A	Current corresponding to 10000 on fieldbus.	1 = 1 A / 1 = 1 A

No.	Name / Range / Selection	Description	Def / Type FbEq 16b / 32b
46.06	Speed ref zero scaling	Defines a speed corresponding to a zero reference received from fieldbus (either the embedded fieldbus interface, or interface FBA A or FBA B). For example, with a setting of 500, the fieldbus reference range of 0…20000 would correspond to a speed of 500…[46.01] rpm. **Note:** This parameter is effective only with the ABB Drives communication profile.	0.00 rpm / real32
	0.00 ... 30000.00 rpm	Speed corresponding to minimum fieldbus reference.	1 = 1 rpm / 100 = 1 rpm
46.07	Frequency ref zero scaling	Defines a frequency corresponding to a zero reference received from fieldbus (either the embedded fieldbus interface, or interface FBA A or FBA B). For example, with a setting of 30, the fieldbus reference range of 0…20000 would correspond to a speed of 30…[46.02] Hz. **Note:** This parameter is effective only with the ABB Drives communication profile.	0.00 Hz / real32
	0.00 ... 1000.00 Hz	Frequency corresponding to minimum fieldbus reference.	10 = 1 Hz / 100 = 1 Hz
46.11	Filter time motor speed	Defines a filter time for signals 01.01 Motor speed used, 01.02 Motor speed estimated, 01.04 Encoder 1 speed filtered and 01.05 Encoder 2 speed filtered.	500 ms / real32
	0...20000 ms	Motor speed signal filter time.	1 = 1 ms / 1 = 1 ms
46.12	Filter time output frequency	Defines a filter time for signal 01.06 Output frequency.	500 ms / real32
	0...20000 ms	Output frequency signal filter time.	1 = 1 ms / 1 = 1 ms
46.13	Filter time motor torque	Defines a filter time for signal 01.10 Motor torque.	100 ms / real32
	0...20000 ms	Motor torque signal filter time.	1 = 1 ms / 1 = 1 ms
46.14	Filter time power out	Defines a filter time for signal 01.14 Output power.	100 ms / real32
	0...20000 ms	Output power signal filter time.	1 = 1 ms / 1 = 1 ms

No.	Name / Range / Selection	Description	Def / Type FbEq 16b / 32b
46.21	At speed hysteresis	Defines the “at setpoint” limits for speed control of the drive. When the absolute difference between reference (22.87 Speed reference act 7) and actual speed (90.01 Motor speed for control) becomes smaller than half the value of 46.21 At speed hysteresis, the drive is considered to be “at setpoint”. This is indicated by bit 8 of 06.11 Main status word. The bit switches off when the absolute difference between reference and actual speed exceeds the value of 46.21 At speed hysteresis.  	100.00 rpm / real32
	0.00 … 30000.00 rpm	Limit for “at setpoint” indication in speed control. For 16-bit scaling, see parameter 46.01.	- / 100 = 1 rpm

No.	Name / Range / Selection	Description	Def / Type FbEq 16b / 32b
46.22	At frequency hysteresis	Defines the “at setpoint” limits for frequency control of the drive. When the absolute difference between reference (28.96 Frequency ref act 7) and actual frequency (01.06 Output frequency) is smaller than 46.22 At frequency hysteresis, the drive is considered to be “at setpoint”. This is indicated by bit 8 of 06.11 Main status word.  	10.00 Hz / real32
	0.00 … 1000.00 Hz	Limit for “at setpoint” indication in frequency control. For 16-bit scaling, see parameter 46.02.	- / 100 = 1 Hz
46.23	At torque hysteresis	Defines the “at setpoint” limits for torque control of the drive. When the absolute difference between reference and actual torque (01.10 Motor torque) is smaller than 46.23 At torque hysteresis, the drive is considered to be “at setpoint”. This is indicated by bit 8 of 06.11 Main status word.  	10.0 percent / real32

No.	Name / Range / Selection	Description	Def / Type FbEq 16b / 32b
	0.0 ... 300.0 %	Limit for "at setpoint" indication in torque control. For 16-bit scaling, see parameter 46.03.	- / 1 = 1 %
46.31	Above speed limit	Defines the trigger level for "above limit" indication in speed control. When actual speed exceeds the limit, bit 10 of 06.17 Drive status word 2 is set.	1500.00 rpm / real32
	0.00 ... 30000.00 rpm	"Above limit" indication trigger level for speed control. For 16-bit scaling, see parameter 46.01.	- / 100 = 1 rpm
46.32	Above frequency limit	Defines the trigger level for "above limit" indication in frequency control. When actual frequency exceeds the limit, bit 10 of 06.17 Drive status word 2 is set.	50.00 Hz / real32
	0.00 ... 1000.00 Hz	"Above limit" indication trigger level for frequency control. For 16-bit scaling, see parameter 46.02.	- / 100 = 1 Hz
46.33	Above torque limit	Defines the trigger level for "above limit" indication in torque control. When actual torque exceeds the limit, bit 10 of 06.17 Drive status word 2 is set.	300.0 percent / real32
	0.0 ... 1600.0 %	"Above limit" indication trigger level for torque control. For 16-bit scaling, see parameter 46.03.	- / 10 = 1 %
46.42	Torque decimals	Defines the number of decimal places of torque-related parameters.	1 NoUnit / uint16
	0...2	Number of decimal places of torque parameters.	1 = 1 / 1 = 1
46.200	Rod torque scaler	Defines 16-bit scaling of rod torque parameters. The value of this parameter corresponds to 16-bit fieldbus equivalent to 1 torque value. (Nm, lbft). For example, if 46.200 Rod torque scaler = 10, then 10 = 1 Nm in fieldbus.	10 NoUnit / int32
	0...100000	16-bit scaling of rod torque parameters.	1 = 1 / 1 = 1
46.201	Rod speed scaler	Defines 16-bit scaling of rod speed parameters. The value of this parameter corresponds to 16-bit fieldbus equivalent to 1 Prpm. For example, if 46.201 Rod speed scaler = 10, then 10 = 1 Prpm in fieldbus.	10 Prpm / int32
	0...100000 Prpm	16-bit scaling of rod speed parameters.	1 = 1 Prpm / 1 = 1 Prpm
46.202	Pump speed ref scaler	Defines 16-bit scaling for writing pump speed reference from Fieldbus, when parameter 74.05 Speed ref source is set to FBA or panel or EFB or panel. The value of this parameter corresponds to 16-bit fieldbus equivalent to 1 ref value (Prpm or Rpm). For example, if parameter 46.202 Pump speed ref scaler = 10, then 10 = 1 Prpm. When 46.202 Pump speed ref scaler is set to 0, then 74.08 Maximum speed corresponds to 20000 in Fieldbus.	1 NoUnit / real32
	0...10000	16-bit scaling for writing pump speed reference.	1 = 1 / 1 = 1

No.	Name / Range / Selection	Description	Def / Type FbEq 16b / 32b
46.203	Motor speed ref scaler	Defines 16-bit scaling of parameter 09.06 Motor speed reference. The value of this parameter corresponds to 16-bit fieldbus equivalent to 1 rpm. For example, if 46.203 Motor speed ref scaler = 10, then 10 = 1 rpm. When 46.203 Motor speed ref scaler is set to 0, then 74.08 Maximum speed corresponds to 20000 in Fieldbus.	0 rpm / int32
	0…10000 rpm	16-bit scaling of rod speed parameters.	1 = 1 rpm / 1 = 1 rpm

No.	Name / Range / Selection	Description	Def / Type FbEq 16b / 32b
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 122).	
47.01	DataStorage 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.	- / real32
	-32768.000 … 32767.000	32-bit real (floating point) number. For 16-bit scaling, see parameter 47.31.	- / 1000 = 1
47.02	DataStorage 2 real32	Data storage parameter 2. See also parameter 47.01 DataStorage 1 real32.	- / real32
	-32768.000 … 32767.000	32-bit real (floating point) number. For 16-bit scaling, see parameter 47.32.	- / 1000 = 1
47.03	DataStorage 3 real32	Data storage parameter 3. See also parameter 47.01 DataStorage 1 real32.	- / real32
	-32768.000 … 32767.000	32-bit real (floating point) number. For 16-bit scaling, see parameter 47.33.	- / 1000 = 1
47.04	DataStorage 4 real32	Data storage parameter 4. See also parameter 47.01 DataStorage 1 real32.	- / real32
	-32768.000 … 32767.000	32-bit real (floating point) number. For 16-bit scaling, see parameter 47.34.	- / 1000 = 1
47.05	DataStorage 5 real32	Data storage parameter 5. See also parameter 47.01 DataStorage 1 real32.	- / real32
	-32768.000 … 32767.000	32-bit real (floating point) number. For 16-bit scaling, see parameter 47.35.	- / 1000 = 1
47.06	DataStorage 6 real32	Data storage parameter 6. See also parameter 47.01 DataStorage 1 real32.	- / real32
	-32768.000 … 32767.000	32-bit real (floating point) number. For 16-bit scaling, see parameter 47.36.	- / 1000 = 1
47.07	DataStorage 7 real32	Data storage parameter 7. See also parameter 47.01 DataStorage 1 real32.	- / real32
	-32768.000 … 32767.000	32-bit real (floating point) number. For 16-bit scaling, see parameter 47.37.	- / 1000 = 1
47.08	DataStorage 8 real32	Data storage parameter 8. See also parameter 47.01 DataStorage 1 real32.	- / real32

No.	Name / Range / Selection	Description	Def / Type FbEq 16b / 32b
	-32768.000 ... 32767.000	32-bit real (floating point) number. For 16-bit scaling, see parameter 47.38.	- / 1000 = 1
47.11	DataStorage 1 int32	Data storage parameter 9.	- / int32
	-2147483648..2147483647	32-bit integer.	- / 1 = 1
47.12	DataStorage 2 int32	Data storage parameter 10.	- / int32
	-2147483648..2147483647	32-bit integer.	- / 1 = 1
47.13	DataStorage 3 int32	Data storage parameter 11.	- / int32
	-2147483648..2147483647	32-bit integer.	- / 1 = 1
47.14	DataStorage 4 int32	Data storage parameter 12.	- / int32
	-2147483648..2147483647	32-bit integer.	- / 1 = 1
47.15	DataStorage 5 int32	Data storage parameter 13.	- / int32
	-2147483648..2147483647	32-bit integer.	- / 1 = 1
47.16	DataStorage 6 int32	Data storage parameter 14.	- / int32
	-2147483648..2147483647	32-bit integer	- / 1 = 1
47.17	DataStorage 7 int32	Data storage parameter 15.	- / int32
	-2147483648..2147483647	32-bit integer.	- / 1 = 1
47.18	DataStorage 8 int32	Data storage parameter 16.	- / int32
	-2147483648..2147483647	32-bit integer.	- / 1 = 1
47.21	DataStorage 1 int16	Data storage parameter 17.	- / int16
	-32768...32767	16-bit integer.	1 = 1 / 1 = 1
47.22	DataStorage 2 int16	Data storage parameter 18.	- / int16
	-32768...32767	16-bit integer.	1 = 1 / 1 = 1
47.23	DataStorage 3 int16	Data storage parameter 19.	- / int16
	-32768...32767	16-bit integer.	1 = 1 / 1 = 1
47.24	DataStorage 4 int16	Data storage parameter 20.	- / int16
	-32768...32767	16-bit integer.	1 = 1 / 1 = 1
47.25	DataStorage 5 int16	Data storage parameter 21.	- / int16
	-32768...32767	16-bit integer.	1 = 1 / 1 = 1
47.26	DataStorage 6 int16	Data storage parameter 22.	- / int16
	-32768...32767	16-bit integer.	1 = 1 / 1 = 1
47.27	DataStorage 7 int16	Data storage parameter 23.	- / int16
	-32768...32767	16-bit integer.	1 = 1 / 1 = 1
47.28	DataStorage 8 int16	Data storage parameter 24.	- / int16
	-32768...32767	16-bit integer.	1 = 1 / 1 = 1

No.	Name / Range / Selection	Description	Def / Type FbEq 16b / 32b
47.31	DataStorage 1 real32 type	Defines the scaling of parameter 47.01 DataStorage 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 / uint16
	Unscaled	Data storage only. Range: -2147483.264 … 2147473.264.	0
	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: -600.00…600.00.	5
47.32	DataStorage 2 real32 type	Defines the 16-bit scaling of parameter 47.02 DataStorage 2 real32. See parameter 47.31 DataStorage 1 real32 type.	Unscaled / uint16
47.33	DataStorage 3 real32 type	Defines the 16-bit scaling of parameter 47.03 DataStorage 3 real32. See parameter 47.31 DataStorage 1 real32 type.	Unscaled / uint16
47.34	DataStorage 4 real32 type	Defines the 16-bit scaling of parameter 47.04 DataStorage 4 real32. See parameter 47.31 DataStorage 1 real32 type.	Unscaled / uint16
47.35	DataStorage 5 real32 type	Defines the 16-bit scaling of parameter 47.05 DataStorage 5 real32. See parameter 47.31 DataStorage 1 real32 type.	Unscaled / uint16
47.36	DataStorage 6 real32 type	Defines the 16-bit scaling of parameter 47.06 DataStorage 6 real32. See parameter 47.31 DataStorage 1 real32 type.	Unscaled / uint16
47.37	DataStorage 7 real32 type	Defines the 16-bit scaling of parameter 47.07 DataStorage 7 real32. See parameter 47.31 DataStorage 1 real32 type.	Unscaled / uint16
47.38	DataStorage 8 real32 type	Defines the 16-bit scaling of parameter 47.08 DataStorage 8 real32. See parameter 47.31 DataStorage 1 real32 type.	Unscaled / uint16

No.	Name / Range / Selection	Description	Def / Type FbEq 16b / 32b
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 NoUnit / uint32
	1...32	Node ID.	1 = 1 / 1 = 1
49.03	Baud rate	Defines the transfer rate of the link.	230.4 kbps / uint32
	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 / uint32
	0.3 ... 3000.0 s	Panel/PC tool communication timeout.	10 = 1 s / 1000 = 1 s
49.05	Communication loss action	Selects how the drive reacts to a control panel (or PC tool) communication break. Changes to this parameter take effect after the control unit is rebooted or the new settings validated by parameter 49.06 Refresh settings. See also parameters 49.07 Panel comm supervision force and 49.08 Secondary comm. loss action.	Fault / uint16
	No action	No action taken.	0
	Fault	Drive trips on 7081 Control panel loss. This only occurs if control is expected from the control panel (it is selected as source of start/stop/reference in the currently active control location), or if supervision is forced using parameter 49.07 Panel comm supervision force.	1
	Last speed	Drive generates an A7EE Control panel loss warning and freezes the speed to the level the drive was operating at. This only occurs if control is expected from the control panel, or if supervision is forced using parameter 49.07 Panel comm supervision force. 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

No.	Name / Range / Selection	Description	Def / Type FbEq 16b / 32b
	Speed ref safe	Drive generates an A7EE Control 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). This only occurs if control is expected from the control panel, or if supervision is forced using parameter 49.07 Panel comm supervision force. **WARNING!** Make sure that it is safe to continue operation in case of a communication break.	3
	Warning	Drive generates an A7EE Control panel loss warning. This only occurs if control is expected from the control panel, or if supervision is forced using parameter 49.07 Panel comm supervision force. **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 Node ID number…49.05. **Note:** Refreshing may cause a communication break, so reconnecting the drive may be required.	Done / uint16
	Done	Refresh done or not requested.	0
	Refresh	Refresh parameters 49.01 Node ID number…49.05. The value reverts automatically to Done.	1
49.07	Panel comm supervision force	Activates control panel communication monitoring separately for each control location (see section Local control vs. external control (page 66)). The parameter is primarily intended for monitoring the communication with the panel when it is connected to the application program and not selected as a control source by drive parameters.	- / uint16
b0	Ext 1	1 = Communication monitoring active when Ext 1 is being used.	
b1	Ext 2	1 = Communication monitoring active when Ext 2 is being used.	
b2	Local	1 = Communication monitoring active when local control is being used.	
b3…15	Reserved		
	0000h…FFFFh		1 = 1 / 1 = 1

No.	Name / Range / Selection	Description	Def / Type FbEq 16b / 32b
49.08	Secondary comm. loss action	Selects how the drive reacts to a control panel (or PC tool) communication break. This action is taken when • the panel is parametrized as an alternative control or reference source but is not currently the active source, and • communication supervision for the active control location is not forced by parameter 49.07 Panel comm supervision force.	No action / uint16
	No action	No action taken.	0
	Warning	Drive generates an A7EE Control panel loss warning. **WARNING!** Make sure that it is safe to continue operation in case of a communication break.	5
49.14	Panel speed reference unit	Defines the unit for speed reference when given from the control panel.	rpm / uint16
	rpm	rpm.	0
	%	Percent of parameter 46.01 Speed scaling.	1
49.15	Minimum ext speed ref panel	Defines a minimum limit for control panel speed reference in external control. In local control, the limits in parameter group 30 Limits are in force. See section Local control vs. external control (page 66).	-30000.00 rpm / real32
	-30000.00 ... 30000.00 rpm	Minimum speed reference. For 16-bit scaling, see parameter 46.01.	- / 100 = 1 rpm
49.16	Maximum ext speed ref panel	Defines a maximum limit for control panel speed reference in external control. In local control, the limits in parameter group 30 Limits are in force. See section Local control vs. external control (page 66).	30000.00 rpm / real32
	-30000.00 ... 30000.00 rpm	Maximum speed reference. For 16-bit scaling, see parameter 46.01.	- / 100 = 1 rpm
49.17	Minimum ext frequency ref panel	Defines a minimum limit for control panel frequency reference in external control. In local control, the limits in parameter group 30 Limits are in force. See section Local control vs. external control (page 66).	-500.00 Hz / real32
	-598.00 ... 598.00 Hz	Minimum frequency reference. For 16-bit scaling, see parameter 46.02.	- / 100 = 1 Hz
49.18	Maximum ext frequency ref panel	Defines a maximum limit for control panel frequency reference in external control. In local control, the limits in parameter group 30 Limits are in force. See section Local control vs. external control (page 66).	500.00 Hz / real32
	-598.00 ... 598.00 Hz	Maximum frequency reference. For 16-bit scaling, see parameter 46.02.	- / 100 = 1 Hz

No.	Name / Range / Selection	Description	Def / Type FbEq 16b / 32b
49.24	Panel actual source	Selects an actual value to be displayed in the top right corner of the control panel. This parameter is only effective when the control panel is not an active reference source.	Automatic / uint32
	Automatic	The active reference is displayed.	0
	Process PID setpoint actual		1
	Other [bit]	Source selection. See Terms and abbreviations (page 132).	-

No.	Name / Range / Selection	Description	Def / Type FbEq 16b / 32b
50	Fieldbus adapter (FBA)	Fieldbus communication configuration. See also chapter Fieldbus control through a fieldbus adapter.	
50.01	FBA A enable	Enables/disables communication between the drive and fieldbus adapter A, and specifies the slot the adapter is installed into. **Note:** This parameter cannot be changed while the drive is running.	Disable / uint16
	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. A time delay for the action can be defined by parameter 50.03 FBA A comm loss t out. See also parameter 50.26 FBA A comm supervision force.	No action / uint16
	No action	No action taken.	0
	Fault	Drive trips on 7510 FBA A communication. This only occurs if control is expected from the FBA A interface (FBA A selected as source of start/stop/reference in the currently active control location), or if supervision is forced using parameter 50.26 FBA A comm supervision force.	1
	Last speed	Drive generates an A7C1 FBA A communication warning and freezes the speed to the level the drive was operating at. This only occurs if control is expected from the FBA A interface, or if supervision is forced using parameter 50.26 FBA A comm supervision force. 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

No.	Name / Range / Selection	Description	Def / Type FbEq 16b / 32b
	Speed ref safe	Drive generates an A7C1 FBA A communication warning 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). This only occurs if control is expected from the FBA A interface, or if supervision is forced using parameter 50.26 FBA A comm supervision force. **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 FBA A interface.	4
	Warning	Drive generates an A7C1 FBA A communication warning. This only occurs if control is expected from the FBA A interface, or if supervision is forced using parameter 50.26 FBA A comm supervision force. **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. **Note:** There is a 60-second boot-up delay immediately after power-up. During the delay, the communication break monitoring is disabled (but communication itself can be active).	0.3 s / uint16
	0.1 … 6553.5 s	Time delay.	10 = 1 s / 10 = 1 s
50.04	FBA A ref1 type	Selects the type and scaling of reference 1 received from fieldbus adapter A. **Note:** Fieldbus-specific communication profiles may use different scalings. For more information, see the manual of the fieldbus adapter.	Auto / uint16
	Auto	Type and scaling are chosen automatically according to which reference chain (see settings Torque, Speed, Frequency) the incoming reference is connected to. If the reference is not connected to any chain, no scaling is applied (as with setting Transparent).	0
	Transparent	No scaling is applied (the 16-bit scaling is 1 = 1 unit).	1
	General	Generic reference with a 16-bit scaling of 100 = 1 (ie. integer and two decimals).	2

No.	Name / Range / Selection	Description	Def / Type FbEq 16b / 32b
	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
50.05	FBA A ref2 type	Selects the type and scaling of reference 2 received from fieldbus adapter A. See parameter 50.04 FBA A ref1 type.	Auto / uint16
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. **Note:** Fieldbus-specific communication profiles may use different scalings. For more information, see the manual of the fieldbus adapter.	Auto / uint16
	Auto	Type/source and scaling follow the type of reference 1 selected by parameter 50.04 FBA A ref1 type. See the individual settings below for the sources and scalings.	0
	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. The scaling is defined by parameter 46.03 Torque scaling.	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. See parameter 50.07 FBA A actual 1 type.	Auto / uint16
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 / uint32
	Not selected	No source selected.	0
	Other [bit]	Source selection. See Terms and abbreviations (page 132).	-

No.	Name / Range / Selection	Description	Def / Type FbEq 16b / 32b
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 / uint32
	Not selected	No source selected.	0
	Other [bit]	Source selection. See Terms and abbreviations (page 132).	-
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 / uint32
	Not selected	No source selected.	0
	Other [bit]	Source selection. See Terms and abbreviations (page 132).	-
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. **Note:** This parameter cannot be changed while the drive is running.	Fast / uint16
	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.	0 / uint32
	00000000…FFFFFFFFh	Control word sent by master to fieldbus adapter A.	1 = 1
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.	- / int32
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.	- / int32
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.	0 / uint32
	00000000…FFFFFFFFh	Status word sent by fieldbus adapter A to master.	1 = 1
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.	- / int32

<table>
<tr><th>No.</th><th>Name / Range / Selection</th><th>Description</th><th>Def / Type
FbEq 16b / 32b</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>- / int32</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.
Note: This parameter cannot be changed while the drive is running.</td><td>Normal / uint16</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>50.26</td><td>FBA A comm supervision force</td><td>Activates fieldbus communication monitoring separately for each control location (see section Local control vs. external control (page 66) on page 20).
The parameter is primarily intended for monitoring the communication with FBA A when it is connected to the application program and not selected as a control source by drive parameters.</td><td>- / uint16</td></tr>
<tr><td>b0</td><td>Ext 1</td><td>1 = Communication monitoring active when Ext 1 is being used.</td><td></td></tr>
<tr><td>b1</td><td>Ext 2</td><td>1 = Communication monitoring active when Ext 2 is being used.</td><td></td></tr>
<tr><td>b2</td><td>Local</td><td>1 = Communication monitoring active when local control is being used.</td><td></td></tr>
<tr><td>b3…15</td><td>Reserved</td><td></td><td></td></tr>
</table>

No.	Name / Range / Selection	Description	Def / Type FbEq 16b / 32b
	0000h…FFFFh		1 = 1 / 1 = 1
50.31	FBA B enable	Enables/disables communication between the drive and fieldbus adapter B, and specifies the slot the adapter is installed into. **Note:** This parameter cannot be changed while the drive is running.	Disable / uint16
	Disable	Communication between drive and fieldbus adapter B disabled.	0
	Option slot 1	Communication between drive and fieldbus adapter B enabled. The adapter is in slot 1.	1
	Option slot 2	Communication between drive and fieldbus adapter B enabled. The adapter is in slot 2.	2
	Option slot 3	Communication between drive and fieldbus adapter B enabled. The adapter is in slot 3.	3
50.32	FBA B comm loss func	Selects how the drive reacts upon a fieldbus communication break. A time delay for the action can be defined by parameter 50.33 FBA B comm loss timeout. See also parameter 50.56 FBA B comm supervision force.	No action / uint16
	No action	No action taken.	0
	Fault	Drive trips on 7520 FBA B communication. This only occurs if control is expected from the FBA B interface (FBA B selected as source of start/stop/reference in the currently active control location), or if supervision is forced using parameter 50.56 FBA B comm supervision force.	1
	Last speed	Drive generates an A7C2 FBA B communication warning and freezes the speed to the level the drive was operating at. This only occurs if control is expected from the FBA B interface, or if supervision is forced using parameter 50.56 FBA B comm supervision force. 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

No.	Name / Range / Selection	Description	Def / Type FbEq 16b / 32b
	Speed ref safe	Drive generates an A7C2 FBA B communication warning 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). This only occurs if control is expected from the FBA B interface, or if supervision is forced using parameter 50.56 FBA B comm supervision force. **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 FBA B interface.	4
	Warning	Drive generates an A7C2 FBA B communication warning. This only occurs if control is expected from the FBA B interface, or if supervision is forced using parameter 50.56 FBA B comm supervision force. **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. **Note:** There is a 60-second boot-up delay immediately after power-up. During the delay, the communication break monitoring is disabled (but communication itself can be active).	0.3 s / uint16
	0.1 ... 6553.5 s	Time delay.	10 = 1 s / 10 = 1 s
50.34	FBA B ref1 type	Selects the type and scaling of reference 1 received from fieldbus adapter B. See parameter 50.04 FBA A ref1 type.	Auto / uint16
50.35	FBA B ref2 type	Selects the type and scaling of reference 2 received from fieldbus adapter B. See parameter 50.04 FBA A ref1 type.	Auto / uint16
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. See parameter 50.07 FBA A actual 1 type.	Auto / uint16

No.	Name / Range / Selection	Description	Def / Type FbEq 16b / 32b
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. See parameter 50.08 FBA A actual 2 type.	Auto / uint16
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 / uint32
	Not selected	No source selected.	0
	Other [bit]	Source selection. See Terms and abbreviations (page 132).	-
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 / uint32
	Not selected	No source selected.	0
	Other [bit]	Source selection. See Terms and abbreviations (page 132).	-
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 / uint32
	Not selected	No source selected.	0
	Other [bit]	Source selection. See Terms and abbreviations (page 132).	-
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. **Note:** This parameter cannot be changed while the drive is running.	Disable / uint16
	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.	0 / uint32
	00000000…FFFFFFFFh	Control word sent by master to fieldbus adapter B.	1 = 1
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.	- / int32

<table>
<tr><th>No.</th><th>Name / Range / Selection</th><th>Description</th><th>Def / Type
FbEq 16b / 32b</th></tr>
<tr><td>50.45</td><td>FBA B reference 2</td><td>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.</td><td>- / int32</td></tr>
<tr><td>50.46</td><td>FBA B status word</td><td>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.</td><td>0 / uint32</td></tr>
<tr><td></td><td>00000000...FFFFFFFFh</td><td>Status word sent by fieldbus adapter B to master.</td><td>1 = 1</td></tr>
<tr><td>50.47</td><td>FBA B actual value 1</td><td>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.</td><td>- / int32</td></tr>
<tr><td>50.48</td><td>FBA B actual value 2</td><td>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.</td><td>- / int32</td></tr>
<tr><td>50.51</td><td>FBA B 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 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.
Note: This parameter cannot be changed while the drive is running.</td><td>Normal / uint16</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>
</table>

No.	Name / Range / Selection	Description	Def / Type FbEq 16b / 32b
50.56	FBA B comm supervision force	Activates fieldbus communication monitoring separately for each control location (see section Local control vs. external control (page 66)). The parameter is primarily intended for monitoring the communication with FBA B when it is connected to the application program and not selected as a control source by drive parameters.	- / uint16
b0	Ext 1	1 = Communication monitoring active when Ext 1 is being used.	
b1	Ext 2	1 = Communication monitoring active when Ext 2 is being used.	
b2	Local	1 = Communication monitoring active when local control is being used.	
b3…15	Reserved		
	0000h…FFFFh		1 = 1 / 1 = 1
50.99	FBA automatic detection	Enables/disables the FBA automatic detection. **Note:** FBA automatic detection works with one fieldbus adapter only.	Enable / uint16
	Disable	FBA automatic detection is disabled.	0
	Enable	FBA automatic detection is enabled.	1

No.	Name / Range / Selection	Description	Def / Type FbEq 16b / 32b
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.	None / uint16
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.	- / uint16
	0...65535	Fieldbus adapter configuration parameter.	1 = 1 / 1 = 1
51.26	FBA A Par26	See parameter 51.02 FBA A Par2.	- / uint16
	0...65535	Fieldbus adapter configuration parameter.	1 = 1 / 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 / uint16
	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.	0 / uint16
	0000…FFFFh	Parameter table revision of adapter module.	1 = 1
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.	- / uint16
		Drive type code stored in the mapping file.	1 = 1 / 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.	- / uint16
		Mapping file revision.	1 = 1 / 1 = 1
51.31	D2FBA A comm status	Displays the status of the fieldbus adapter module communication.	Not configured / uint16
	Not configured	Adapter is not configured.	0
	Initializing	Adapter is initializing.	1

No.	Name / Range / Selection	Description	Def / Type FbEq 16b / 32b
	Time out	A timeout has occurred in the communication between the adapter and the drive.	2
	Configuration error	Adapter configuration error: mapping file not found in the file system of the drive, or mapping file upload has failed more than three times.	3
	Off-line	Fieldbus communication is off-line.	4
	On-line	Fieldbus communication is on-line, or fieldbus adapter has been configured not to detect a communication break. For more information, see the documentation of the fieldbus adapter.	5
	Reset	Adapter is performing a hardware reset.	6
51.32	FBA A comm SW ver	Displays the 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).	0 / uint16
	0000…FFFFh	Patch and build versions of adapter module firmware.	1 = 1
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).	0 / uint16
	0000…FFFFh	Major and minor versions of adapter module firmware.	1 = 1

No.	Name / Range / Selection	Description	Def / Type FbEq 16b / 32b
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 / uint32
	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 [bit]	Source selection. See Terms and abbreviations (page 132).	-
...	...	...	...
52.12	FBA A data in12	See parameter 52.01 FBA A data in1.	None / uint32

No.	Name / Range / Selection	Description	Def / Type FbEq 16b / 32b
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 data out1	Parameters 53.01…53.12 select data to be transferred from the fieldbus controller to the drive through fieldbus adapter A.	None / uint32
	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 [bit]	Source selection. See Terms and abbreviations (page 132).	-
53.02	FBA data out2	Parameters 53.01…53.12 select data to be transferred from the fieldbus controller to the drive through fieldbus adapter A.	None / uint32
	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 [bit]	Source selection. See Terms and abbreviations (page 132).	-
53.12	FBA data out12	See parameter 53.01 FBA data out1.	None / uint32

No.	Name / Range / Selection	Description	Def / Type FbEq 16b / 32b
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.	None / uint16
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.	- / uint16
	0.0 ... 65535.0	Fieldbus adapter configuration parameter.	1 = 1 / 1 = 1
...	...	...	...
54.26	FBA B Par26	See parameter 54.02 FBA B Par2.	- / uint16
	0.0 ... 65535.0	Fieldbus adapter configuration parameter.	1 = 1 / 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 / uint16
	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.	0 / uint16
	0000…FFFFh	Parameter table revision of adapter module.	1 = 1
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.	- / uint16
	0...65535	Drive type code stored in the mapping file.	1 = 1 / 1 = 1
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.	- / uint16
	0...65535	Mapping file revision.	1 = 1 / 1 = 1
54.31	D2FBA B comm status	Displays the status of the fieldbus adapter module communication.	Not configured / uint16
	Not configured	Adapter is not configured.	0
	Initializing	Adapter is initializing.	1

No.	Name / Range / Selection	Description	Def / Type FbEq 16b / 32b
	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).	0 / uint16
	0000…FFFFh	Patch and build versions of adapter module firmware.	1 = 1
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).	0 / uint16
	0000…FFFFh	Major and minor versions of adapter module firmware.	1 = 1

No.	Name / Range / Selection	Description	Def / Type FbEq 16b / 32b
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 / uint32
	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 [bit]	Source selection. See Terms and abbreviations (page 132).	-
...	...	...	...
55.12	FBA B data in12	See parameter 55.01 FBA B data in1.	None / uint32

No.	Name / Range / Selection	Description	Def / Type FbEq 16b / 32b
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 / uint32
	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 [bit]	Source selection. See Terms and abbreviations (page 132).	-
...	...	...	...
56.12	FBA B data out12	See parameter 56.01 FBA B data out1.	None / uint32

No.	Name / Range / Selection	Description	Def / Type FbEq 16b / 32b
58	Embedded fieldbus	Configuration of the embedded fieldbus (EFB) interface. See also chapter Fieldbus control through the embedded fieldbus interface (EFB).	
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. • This parameter cannot be changed while the drive is running.	None / uint16
	None	None (communication disabled).	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.	0 / uint16
	0000…FFFFh	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 NoUnit / uint16
	0…255	Node address (values 1…247 are allowable).	1 = 1 / 1 = 1
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 / uint16
	4.8 kbps	4.8 kbit/s.	1
	9.6 kbps	9.6 kbit/s.	2
	19.2 kbps	19.2 kbit/s.	3
	38.4 kbps	38.4 kbit/s.	4
	57.6 kbps	57.6 kbit/s.	5
	76.8 kbps	76.8 kbit/s.	6
	115.2 kbps	115.2 kbit/s.	7
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 / uint16
	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

No.	Name / Range / Selection	Description	Def / Type FbEq 16b / 32b
	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 / uint16
	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
58.07	Communication diagnostics	Displays the status of the EFB communication. This parameter is read-only.	- / uint16
b0	Init failed	1 = EFB initialization failed	
b1	Addr config err	1 = Node address not allowed by protocol	
b2	Silent mode	1 = Drive not allowed to transmit 0 = Drive allowed to transmit	
b3	Autobauding	Reserved	
b4	Wiring error	1 = Errors detected (A/B wires possibly swapped)	
b5	Parity error	1 = Error detected: check parameters 58.04 and 58.05	
b6	Baud rate error	1 = Error detected: check parameters 58.05 and 58.04	
b7	No bus activity	1 = 0 bytes received during last 5 seconds	
b8	No packets	1 = 0 packets (addressed to any device) detected during last 5 seconds	
b9	Noise or addressing error	1 = Errors detected (interference, or another device with the same address on line)	
b10	Comm loss	1 = 0 packets addressed to the drive received within timeout (58.16)	
b11	CW/Ref loss	1 = No control word or references received within timeout (58.16)	
b12	Not active	Reserved	
b13	Protocol 1	1 = Protocol-dependent status information	
b14	Protocol 2	1 = Protocol-dependent status information	
b15	Internal error	1 = Problem with calls to drive control program	
	0000h…FFFFh		1 = 1 / 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 NoUnit / uint32

No.	Name / Range / Selection	Description	Def / Type FbEq 16b / 32b
	0…4294967295	Number of received packets addressed to the drive.	1 = 1 / 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 NoUnit / uint32
	0…4294967295	Number of transmitted packets.	1 = 1 / 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 NoUnit / uint32
	0…4294967295	Number of all received packets.	1 = 1 / 1 = 1
58.11	UART errors	Displays a count of character errors received by the drive. An increasing count indicates a configuration problem on the bus. Can be reset from the control panel by keeping Reset depressed for over 3 seconds.	0 NoUnit / uint32
	0…4294967295	Number of UART errors.	1 = 1 / 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 NoUnit / uint32
	0…4294967295	Number of CRC errors.	1 = 1 / 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 / uint16
	No	No action taken (monitoring disabled).	0
	Fault	Drive trips on 6681 EFB communication loss. This only occurs if control is expected from the EFB (EFB selected as source of start/stop/reference in the currently active control location), or if supervision is forced using parameter 58.36 EFB comm supervision force.	1

No.	Name / Range / Selection	Description	Def / Type FbEq 16b / 32b
	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, or if supervision is forced using parameter 58.36 EFB comm supervision force. 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, or if supervision is forced using parameter 58.36 EFB comm supervision force. **WARNING!** Make sure that it is safe to continue operation in case of a communication break.	3
	Fault always	Drive trips on 6681 EFB communication loss. This occurs even though no control is expected from the EFB.	4
	Warning	Drive generates an A7CE EFB comm loss warning. This only occurs if control is expected from the EFB, or if supervision is forced using parameter 58.36 EFB comm supervision force. **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 / uint16
	Any message	Any message addressed to the drive resets the timeout.	1
	Cw / Ref1 / Ref2	A write of the control word or a reference from the fieldbus resets the timeout.	2

No.	Name / Range / Selection	Description	Def / Type FbEq 16b / 32b
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. **Note:** There is a 30-second boot-up delay immediately after power-up. During the delay, the communication break monitoring is disabled (but communication itself can be active). See also parameter 58.15 Communication loss mode.	3.0 s / uint16
	0.0 ... 6000.0 s	EFB communication timeout.	1 = 1 s / 10 = 1 s
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 / uint16
	0...65535 ms	Minimum response delay.	1 = 1 ms / 1 = 1 ms
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.	0 / uint32
	00000000...FFFFFFFFh	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.	0 / uint32
	00000000...FFFFFFFFh	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 / uint16
	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.	Auto / uint16
	Auto	Type and scaling are chosen automatically according to which reference chain (see settings Torque, Speed, Frequency) the incoming reference is connected to. If the reference is not connected to any chain, no scaling is applied (as with setting Transparent).	0
	Transparent	No scaling is applied.	1

No.	Name / Range / Selection	Description	Def / Type FbEq 16b / 32b
	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
	Speed	The scaling is defined by parameter 46.01 Speed scaling.	4
	Frequency	The scaling is defined by parameter 46.02 Frequency scaling.	5
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 / uint16
58.28	EFB act1 type	Selects the type/source and scaling of actual value 1 transmitted to the fieldbus network through the embedded fieldbus interface.	Auto / uint16
	Auto	Type/source and scaling follow the type of reference 1 selected by parameter 58.26 EFB ref1 type. See the individual settings below for the sources and scalings.	0
	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 Torque scaling.	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/source and scaling of actual value 2 transmitted to the fieldbus network through the embedded fieldbus interface.	Torque / uint16
	Auto	Type/source and scaling follow the type of reference 2 selected by parameter 58.27 EFB ref2 type. See the individual settings below for the sources and scalings.	0
	Transparent	The value selected by parameter 58.32 EFB act2 transparent source is sent as actual value 2. No scaling is applied (the 16- bit scaling is 1 = 1 unit).	1
	General	The value selected by parameter 58.32 EFB act2 transparent source is sent as actual value 2 with a 16-bit scaling of 100 = 1 unit (ie. integer and two decimals).	2

No.	Name / Range / Selection	Description	Def / Type FbEq 16b / 32b
	Torque	01.10 Motor torque is sent as actual value 2. The scaling is defined by parameter 46.03 Torque scaling.	3
	Speed	01.01 Motor speed used is sent as actual value 2. The scaling is defined by parameter 46.01 Speed scaling.	4
	Frequency	01.06 Output frequency is sent as actual value 2. 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
58.30	EFB status word transparent source	Selects the source of the status word when 58.25 Control profile is set to Transparent.	Not selected / uint32
	Not selected	None.	0
	Other [bit]	Source selection. See Terms and abbreviations (page 132).	-
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 / uint32
	Not selected	None.	0
	Other [bit]	Source selection. See Terms and abbreviations (page 132).	-
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 / uint32
	Not selected	None.	0
	Other [bit]	Source selection. See Terms and abbreviations (page 132).	-
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 / uint16
	Mode 0	<u>16-bit values (groups 1…99, indexes 1…99):</u> Register address = 400000 + 100 × parameter group + parameter index. For example, parameter 22.80 would be mapped to register 400000 + 2200 + 80 = 402280. <u>32-bit values (groups 1…99, indexes 1…99):</u> 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	<u>16-bit values (groups 1…255, indexes 1…255):</u> Register address = 400000 + 256 × parameter group + parameter index. For example, parameter 22.80 would be mapped to register 400000 + 5632 + 80 = 405712.	1

No.	Name / Range / Selection	Description	Def / Type FbEq 16b / 32b
	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 / uint16
	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
58.36	EFB comm supervision force	Activates fieldbus communication monitoring separately for each control location (see section Local control vs. external control (page 66)). The parameter is primarily intended for monitoring the communication with EFB when it is connected to the application program and not selected as a control source by drive parameters.	- / uint16
b0	Ext 1	1 = Communication monitoring active when Ext 1 is being used.	
b1	Ext 2	1 = Communication monitoring active when Ext 2 is being used.	
b2	Local	1 = Communication monitoring active when local control is being used.	
b3…15	Reserved		
	0000h…FFFFh		1 = 1 / 1 = 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 / uint32
	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

No.	Name / Range / Selection	Description	Def / Type FbEq 16b / 32b
	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
	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 [bit]	Source selection. See Terms and abbreviations (page 132).	-
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 / uint32
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 / uint32
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 / uint32
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 / uint32

No.	Name / Range / Selection	Description	Def / Type FbEq 16b / 32b
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 / uint32
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 / uint32
...	...	...	...
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 / uint32

No.	Name / Range / Selection	Description	Def / Type FbEq 16b / 32b
74	Pump setup	Basic functions of applications. See section Pump starting speed (page 41).	
74.01	Pump enable	Enables the pump functions related to parameters in group 74 Pump setup to 79 Pump temperature protection.	Enable / int32
	Disable	Disables pump function.	0
	Enable	Enables pump function.	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 [bit]	See Terms and abbreviations (page 132).	-
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 / int32
	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
74.03	Gear reduction ratio	Defines the transmission reduction ratio for PCP application.	1.000 NoUnit / real32
	1.000 ... 1000.000	Value range.	1000 = 1 / 1 = 1
74.04	Reference type	Selects the reference type between motor speed or pump speed.	Pump speed/torque / int16
	Pump speed/torque	Speed reference of the pump.	0
	Motor speed/torque	The start signal is level-triggered.	1

No.	Name / Range / Selection	Description	Def / Type FbEq 16b / 32b
74.05	Speed ref source	Selects the source for the speed reference.	AI1 scaled / int32
	Zero	Source not selected.	0
	AI1 scaled	12.12 AI1 scaled value (page 196).	1
	AI2 scaled	12.22 AI2 scaled value (page 197).	2
	FBA1 ref	Fieldbus adapter A reference1.	3
	FBA2 ref	Fieldbus adapter A reference2.	4
	EFB1 ref	Embedded fieldbus reference 1.	5
	EFB2 ref	Embedded fieldbus reference 2.	6
	Motor potentiometer ref	22.80 Motor potentiometer ref act (output of the motor potentiometer).	7
	Speed ref constant	Constant speed reference. See par. 74.06.	8
	Panel reference	Reference from the panel	9
	EFB or panel	RefEmbedded fieldbus reference 1 or reference from control panel. **Note:** The reference from the control panel can be used only when EFB ref 1 is zero or EFB communication is lost (see parameter 58.07 Communication diagnostics, bit 10). The EFB or panel selection also allows to start and stop the drive from embedded fieldbus using EFB control word, bit 3.	10
	FBA or panel	Fieldbus adapter A reference 1 or reference from control panel. **Note:** The reference from the control panel can be used only when 03.05 FB A reference 1 is zero or FBA communication is lost (see parameter 51.31 D2FBA A comm status). The selection FBA or panel also allows to start and stop the drive from the fieldbus using Fieldbus control word, bit 3.	11
	Other [bit]	Source selection. See Terms and abbreviations (page 132).	-
74.06	Speed ref constant	Sets the speed reference for parameter 74.05 Speed ref source, if set as Speed ref constant.	0.00 Prpm / real32
	0.00 ... 30000.00 Prpm	Speed reference.	10 = 1 Prpm / 1 = 1 Prpm
74.07	Minimum speed	Defines the minimum allowed rod/pump speed. **WARNING!** This value must not be higher than 74.06 Speed ref constant **Note:** Operational unit for PCP is rpm.	0.00 Prpm / real32

No.	Name / Range / Selection	Description	Def / Type FbEq 16b / 32b
	-10000.00 ... 10000.00 Prpm	Minimum rod speed.	10 = 1 Prpm / 1 = 1 Prpm
74.08	Maximum speed	Defines the maximum allowed rod/pump speed. **WARNING!** This value must not be lower than 74.07 Minimum speed. **Note:** Operational unit for PCP is rpm.	1500.00 Prpm / real32
	-10000.00 ... 10000.00 Prpm	Maximum rod speed	10 = 1 Prpm / 1 = 1 Prpm
74.10	Acc time	Defines the acceleration time for the rod/pump: from zero to 74.08 Maximum speed.	20.000 s / uint32
	0.000 ... 10000000.000 s	Rod acceleration time.	10 = 1 s / 1 = 1 s
74.11	Dec time	Defines the deceleration time for the rod/pump: from 74.08 Maximum speed to zero speed.	20.000 s / uint32
	0.000 ... 10000000.000 s	Rod acceleration time.	10 = 1 s / 1 = 1 s
74.12	Starting speed enable	Enables the pump starting speed function. See section Pump starting speed (page 41).	Disable / int32
	Disable	Disables pump ramp up.	0
	Enable	Enables pump ramp up.	1
	Other [bit]	Source selection. See Terms and abbreviations (page 132).	-
74.13	Starting speed	Defines the starting speed. See section Pump starting speed (page 41).	0.00 Prpm / real32
	-10000.00 ... 10000.00 Prpm	Pump starting speed.	10 = 1 Prpm / 1 = 1 Prpm
74.14	Starting speed acc time	Defines the acceleration time for the Pump starting speed function. See section Pump starting speed (page 41).	0.000 s / uint32
	0.000 ... 10000000.000 s	Pump starting speed acceleration time.	10 = 1 s / 1 = 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 / uint32
	0.000 ... 10000000.000 s	Starting speed delay time.	10 = 1 s / 1 = 1 s
74.18	Minimum torque	Defines minimum allowed torque reference for PCP. **WARNING!** Default = 0 is recommended for safety purpose to avoid unexpected backward rotation and rod damages.	0.00 Nm / real32

No.	Name / Range / Selection	Description	Def / Type FbEq 16b / 32b
	-10000.00 ... 0.00 Nm	Minimum rod torque reference.	10 = 1 Nm / 1 = 1 Nm
74.19	Maximum torque	Defines maximum allowed torque reference for PCP.	0.00 Nm / real32
	0.00 ... 10000.00 Nm	Maximum rod torque reference.	10 = 1 Nm / 1 = 1 Nm
74.21	Brake confirmation enable	Enables the Brake confirmation function or selects the source for the enable signal. See section Pump backspin control (page 54).	Disable / int32
	Disable	Disables brake confirmation function.	0
	Enable	Enables brake confirmation function.	1
	Other [bit]	Source selection. See Terms and abbreviations (page 132).	-
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 (page 54).	Zero / int32
	Zero	Source not selected.	0
	AI1 scaled	12.12 AI1 scaled value (page 196).	1
	AI2 scaled	12.22 AI2 scaled value (page 197).	2
	Other [bit]	Source selection. See Terms and abbreviations (page 132).	-
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 % / real32
	0.00 ... 100.00%	Brake confirmation limit.	100 = 1% / 1 = 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 / real32
	-500.00 ... 0.00 Prpm	Brake confirmation speed.	10 = 1 Prpm / 1 = 1 Prpm
74.25	Brake confirmation time	Defines the time limit for the Brake confirmation function. See parameter 74.22 Brake confirmation source.	0.000 s / uint32
	0.000 ... 30000.000 s	Brake confirmation time.	10 = 1 s / 1 = 1 s
74.26	Pressure unit selection	Selects the unit to display for pressure related values on the keypad.	kPa / uint32
	kPa	kPa.	0
	psi	psi	1
	Bar	Bar	3

No.	Name / Range / Selection	Description	Def / Type FbEq 16b / 32b
74.27	Level unit selection	Selects the unit to display for depth related values on the keypad.	m / uint32
	m	Meters	0
	ft	Feet	1
	Joints	Joints	2
	Bar	Bar	3
	kPa	Kilopascals	4
	psi	psi	5
74.40	Speed ref 2	Selects the source for the speed reference.	Zero / uint32
	Zero	Source not selected.	0
	AI1 scaled	12.12 AI1 scaled value (page 196).	1
	AI2 scaled	12.22 AI2 scaled value (page 197).	2
	FBA1 ref	Fieldbus adapter A reference 1.	3
	FBA2 ref	Fieldbus adapter A reference 2.	4
	EFB1 ref	Embedded fieldbus reference 1.	5
	EFB2 ref	Embedded fieldbus reference 2.	6
	Motor potentiometer ref	See parameter 22.80 Motor potentiometer ref act (output of the motor potentiometer).	7
	Speed ref constant	Constant speed reference. See parameter 74.06.	8
	Panel reference	Reference from the panel	9
	EFB or panel	Embedded fieldbus reference 1 or reference from control panel. **Note:** The reference from the control panel can be used only when EFB ref 1 is zero or EFB communication is lost (see parameter 58.07 Communication diagnostics, bit 10). The EFB or panel selection also allows to start and stop the drive from embedded fieldbus using EFB control word, bit 3.	10
	FBA or panel	Fieldbus adapter A reference 1 or reference from control panel. **Note:** The reference from the control panel can be used only when 03.05 FB A reference 1 is zero or FBA communication is lost (see parameter 51.31 D2FBA A comm status). The selection FBA or panel also allows to start and stop the drive from the fieldbus using Fieldbus control word, bit 3.	11
	Other [bit]	Source selection. See Terms and abbreviations (page 132).	-
74.42	Speed ref1/2 selection	Configures the selection between speed references 1 and 2.	Speed reference 1 / int32

No.	Name / Range / Selection	Description	Def / Type FbEq 16b / 32b
	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
	Other [bit]	Source selection. See Terms and abbreviations (page 132).	-
74.81	Pump speed reference	Displays the pump speed reference. This parameter is read-only.	0.00 Prpm / real32
	-30000.00 ... 30000.00 Prpm	Pump speed reference.	10 = 1 Prpm / 1 = 1 Prpm

No.	Name / Range / Selection	Description	Def / Type FbEq 16b / 32b
75	Pump Level control	Pump level control function. See section Pump level control (page 41).	
75.01	Level control enable	Enables Pump level control function.	Disable / int32
	Disable	Disables brake confirmation function.	0
	Enable	Enables brake confirmation function.	1
	Other [bit]	Source selection. See Terms and abbreviations (page 132).	-
75.02	Fluid level ref	Defines the fluid level set point for the Pump level control function.	0.00 m / real32
	0.00 … 100000.00 m	Reference	100 = 1 m / 1 = 1 m
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.	Source 1 / uint32
	Source 1	See parameter 75.04 Fluid level source 1.	0
	Source 2	See parameter 75.05 Fluid level source 2.	1
	Source 1 + Source 2	Sum of sources defined in parameter 75.04 Fluid level source 1 and 75.05 Fluid level source 2.	2
	Source 1 - Source 2	Difference of sources defined in parameter 75.05 Fluid level source 2 and 75.04 Fluid level source 1.	3
	Source 1 x Source 2	75.04 Fluid level source 1 multiplied by 75.05 Fluid level source 2.	4
	Source 1 / Source 2	75.04 Fluid level source 1 divided by 75.05 Fluid level source 2.	5
75.04	Fluid level source 1	Defines source 1 for parameter 75.03 Fluid level source function.	Zero / int32
	Zero	Source not selected.	0
	AI1 scaled	12.12 AI1 scaled value (page 196).	1
	AI2 scaled	12.22 AI2 scaled value (page 197).	2
	FBA1 ref	Fieldbus adapter A reference1.	3
	FBA2 ref	Fieldbus adapter A reference2.	4
	Other [bit]	Source selection. See Terms and abbreviations (page 132).	-
75.05	Fluid level source 2	Defines source 2 for parameter 75.03 Fluid level source function.	Zero / int32
	Zero	Source not selected.	0
	AI1 scaled	12.12 AI1 scaled value (page 196).	1
	AI2 scaled	12.22 AI2 scaled value (page 197).	2
	FBA1 ref	Fieldbus adapter A reference 1.	3
	FBA2 ref	Fieldbus adapter A reference 2.	4

No.	Name / Range / Selection	Description	Def / Type FbEq 16b / 32b
	Other [bit]	Source selection. See Terms and abbreviations (page 132).	-
75.06	Level meas range	Defines the measuring range for the Pump level control function.	0.00 m / real32
	0.00 … 100000.00 m	Measuring range	100 = 1 m / 1 = 1 m
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 NoUnit / real32
	0.00 … 5.00	Proportional gain	100 = 1 / 1 = 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 / uint32
	0.000 … 3600000.000 s	Integration time	10 = 1 s / 1 = 1 s
75.09	Level control invert	Selects the reaction characteristics of the Pump level control function.	Disable / int32
	Disable	When the feedback signal selected by 75.03 Fluid level source function 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 function is greater than 75.02 Fluid level ref, the PI regulator output increases, causing the speed reference to increase.	1
	Other [bit]	Source selection. See Terms and abbreviations (page 132).	-
75.10	Level ref change rate	Defines the pump level reference change rate.	0.0000 m/min / real32
	0.0000 … 30000.0000 m/min	Level reference change rate	100 = 1 m/min / 1 = 1 m/min
75.30	Sleep control enable	Enables the warning for the Sleep and wake up function. See section Sleep and wake up function (page 43).	Disable / int32
	Disable	Disables sleep and wake up control function.	0
	Enable	Enables sleep and wake up control function.	1
	Other [bit]	Source selection. See Terms and abbreviations (page 132).	-
75.31	Sleep warning enable	Enables the warning for the Sleep and wake up function. See section Sleep and wake up function (page 43).	Disable / int32
	Disable	Disables sleep and wake up warning.	0
	Enable	Enables sleep and wake up warning.	1

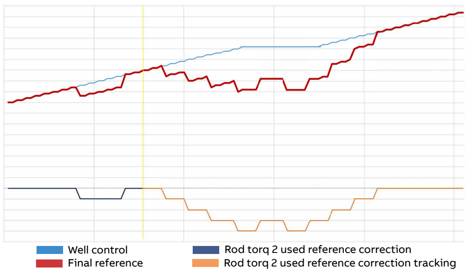
No.	Name / Range / Selection	Description	Def / Type FbEq 16b / 32b
	Other [bit]	Source selection. See Terms and abbreviations (page 132).	-
75.32	Sleep limit type	Selects the sleep function type: sleep at low limit or sleep at high limit.	Low limit / uint32
	Low limit	If 75.30 Sleep control enable is enabled and 75.34 Sleep signal source 1 is less than or equal to 75.36 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 75.34 Sleep signal source 1 increases to a level greater than or equal to 75.38 Wakeup level. See section Sleep and wake up function (page 43).	0
	High limit	If 75.34 Sleep signal source 1 is greater than or equal to 75.36 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 75.34 Sleep signal source 1 increases to a level less than or equal to 75.38 Wakeup level. See section Sleep and wake up function (page 43).	1
75.33	Sleep signal source function	Selects a mathematical function between the feedback sources selected by parameters 75.34 Sleep signal source 1 and 75.35 Sleep signal source 2.	Source 1 / uint32
	Source 1	See parameter 75.34 Sleep signal source 1.	0
	Source 2	See parameter 75.35 Sleep signal source 2	1
	Source 1 + Source 2	Sum of sources 1 and 2	2
	Source 1 - Source 2	Source 2 subtracted from source 1	3
	Source 1 x Source 2	Source 1 multiplied by source 2	4
	Source 1 / Source 2	Source 1 divided by source 2	5
75.34	Sleep signal source 1	Defines the source 1 signal monitored for activation of sleep function.	Zero / int32
	Zero	Zero	0
	AI1 scaled	12.12 AI1 scaled value (page 196).	1
	AI2 scaled	12.22 AI2 scaled value (page 197).	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 (page 132).	-
75.35	Sleep signal source 2	Defines the source 2 signal monitored for activation of sleep function.	Zero / int32
	Zero	Zero	0
	AI1 scaled	12.12 AI1 scaled value (page 196).	1

No.	Name / Range / Selection	Description	Def / Type FbEq 16b / 32b
	AI2 scaled	12.22 AI2 scaled value (page 197).	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 (page 132).	-
75.36	Sleep level	Defines the set point for activation of sleep function. The set point percentage of range selected by analog input source in parameter 75.34 Sleep signal source 1 or 75.35 Sleep signal source 2. See section Sleep and wake up function (page 43) on page 40. **Note:** The Wakeup level has higher priority than the Sleep level.	0.00 SourceUnit / real32
	0.00 ... 100000000.00 SourceUnit	Sleep level.	10 = 1 SourceUnit / 1 = 1 SourceUnit
75.37	Sleep delay time	Defines the time period required to verify Sleep condition.	0.000 s / uint32
	0.000 ... 10000000.000 s	Sleep delay time.	10 = 1 s / 1 = 1 s
75.38	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 75.34 Sleep signal source 1 or 75.35 Sleep signal source 2. **Note:** The Wakeup level has higher priority than the Sleep level.	0.00 SourceUnit / real32
	0.00 ... 100000000.00 SourceUnit	Wakeup level.	10 = 1 SourceUnit / 1 = 1 SourceUnit
75.39	Wakeup delay time	Defines the time period required for verifying Wakeup condition.	0.000 s / uint32
	0.000 ... 10000000.000 s	Wakeup delay time.	10 = 1 s / 1 = 1 s
75.40	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 / uint32
	0.000 ... 100000000.000 s	Value range	10 = 1 s / 1 = 1 s

No.	Name / Range / Selection	Description	Def / Type FbEq 16b / 32b
76	Pump pressure protection	Pump pressure protection function. See section Pump pressure protection (page 47)	
76.01	Pressure protection function	Enables Pump pressure protection function.	Disable / int32
	Disable	Disables Pump pressure protection function.	0
	Enable	Enables Pump pressure protection function.	1
	Other [bit]	Source selection. See Terms and abbreviations (page 132).	-
76.02	Pressure protection latching	Defines the latching type for pump pressure protection.	Nonlatching / uint32
	Nonlatching	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 / int32
	FALSE	Disables digital feedback.	0
	TRUE	Enables digital feedback.	1
	Other [bit]	Source selection. See Terms and abbreviations (page 132).	-
76.04	Digital feedback source	Selects the source of digital feedback for high pressure protection.	FALSE / int32
	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

No.	Name / Range / Selection	Description	Def / Type FbEq 16b / 32b
	DIO2	Digital input/output DIO2 (11.02 DIO delayed status, bit 1).	9
	Other [bit]	Source selection. See Terms and abbreviations (page 132).	-
76.05	Analog feedback source enable	Enables the source of analog feedback for high pressure protection.	FALSE / int32
	FALSE	Disables analog feedback.	0
	TRUE	Enables digital feedback.	1
	Other [bit]	Source selection. See Terms and abbreviations (page 132).	-
76.06	Analog feedback source	Selects the source of analog feedback for high pressure protection.	Zero / int32
	Zero	Zero	0
	AI1 scaled	12.12 AI1 scaled value (page 196).	1
	AI2 scaled	12.22 AI2 scaled value (page 197).	2
	Other [bit]	Source selection. See Terms and abbreviations (page 132).	-
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 / real32
	0.00 ... 10000.00 kPa	Analog feedback limit.	100 = 1 kPa / 1 = 1 kPa
76.08	Analog feedback limit delay time	Defines the time period required to verify the analog feedback limit.	0.000 s / uint32
	0.000 ... 3600000.000 s	Analog feedback limit delay time.	10 = 1 s / 1 = 1 s

No.	Name / Range / Selection	Description	Def / Type FbEq 16b / 32b
77	Pump torque protection	Pump torque protection function. See section Pump torque protection (page 48).	
77.01	Rod torq limit display	Selects the rod protection measurement as torque or current.	Torque / int32
	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
77.02	Rod torq1 function	Enables the Rod torque 1 function for pump torque protection.	Disable / int32
	Disable	Disables the Rod torque 1 function.	0
	Enable	Enables the Rod torque 1 function.	1
	Other [bit]	See Terms and abbreviations (page 132).	-
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 / uint32
	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 09.01 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 [77.04 Rod torq1 limit + (09.01 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 09.01 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 [[77.04 Rod torq1 limit - (09.01 Rod torque * 05)].	1
77.04	Rod torq1 limit	Defines the torque limit for Rod torque 1 function in engineering units.	0.00 Nm / real32
	0.00 ... 10000.00 Nm	Rod torque 1 limit.	10 = 1 Nm / 1 = 1 Nm
77.05	Rod torq1 speed	Defines the speed limit for Rod torque 1 function in engineering units.	0.00 Prpm / real32
	-3600.00 ... 3600.00 Prpm	Rod torque 1 speed.	10 = 1 Prpm / 1 = 1 Prpm

No.	Name / Range / Selection	Description	Def / Type FbEq 16b / 32b
77.06	Rod torq1 delay time	Defines the time period for confirming the high torque 1 condition.	0.000 s / uint32
	0.000 … 10000000.000 s	Rod torque 1 delay time.	10 = 1 s / 1 = 1 s
77.07	Rod torq2 function	Defines the Rod torque 2 function for pump torque protection.	Disable / int32
	Disable	0	0
	Enable	1	1
	Other [bit]	See Terms and abbreviations (page 132).	-
77.08	Rod torq2 limit type	Selects the Rod torque 2 limit type for the fault condition in parameter 77.09 Rod torq2 limit. For low and high limit selections, the additional speed reference can be added only when the condition is fulfilled. For low and high limit tracking parameter 77.11 Rod torq2 additive speed ref is added every time when condition is fulfilled. When the condition disappears, parameter 77.11 Rod torq2 additive speed ref is removed by defined steps.  **Note:** The program displays a warning during the shutdown process.	Low limit / uint32
	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 09.01 * 5%) is present in the comparator meaning, once the condition is set, it latches until the 09.01 increases to a value of [77.09+ (09.01 * 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 the time period greater than 77.10 Rod torq2 delay time. A hysteresis (of 09.01 * 5%) is present in the comparator meaning, once the condition is set, it latches until the 09.01 decreases to a value of [77.09 - (09.01 * 05)].	1

No.	Name / Range / Selection	Description	Def / Type FbEq 16b / 32b
	Low limit tracking	The control program triggers multiple times 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. Each time it triggers, the value in parameter 77.11 Rod torq2 additive speed ref is added to the active reference. The accumulated additional speed is decreased in steps, as defined in the parameter 77.11 Rod torq2 additive speed ref, at intervals defined in parameter 77.10 Rod torq2 delay time, until the condition is no longer present.	2
	High limit tracking	The control program triggers multiple times the torque pressure protection function when 09.01 Rod torque is greater than or equal to 77.09 Rod torq2 limit for the time period greater than 77.10 Rod torq2 delay time. Each time it triggers, the value in parameter 77.11 Rod torq2 additive speed ref is added to the active reference. The accumulated additional speed is decreased by steps, as defined in parameter 77.11 Rod torq2 additive speed ref, at intervals defined in parameter 77.10 Rod torq2 delay time, until the condition is no longer present.	3
77.09	Rod torq2 limit	Defines the torque limit for Rod torque 2 limit in engineering units.	0.00 Nm / real32
	0.00 ... 10000.00 Nm	Rod torque 2 limit.	10 = 1 Nm / 1 = 1 Nm
77.10	Rod torq2 delay time	Defines the time period for confirming high torque 2 condition.	0.000 s / uint32
	0.000 ... 10000000.000 s	Rod torque 2 delay time.	10 = 1 s / 1 = 1 s
77.11	Rod torq2 additive speed ref	Defines the additional speed reference that adds to the speed reference when the 77.09 Rod torq2 limit function is triggered.	0.00 Prpm / real32
	-3600.00 ... 3600.00 Prpm	Rod torque 2 additive speed reference.	10 = 1 Prpm / 1 = 1 Prpm
77.12	Rod torq2 speed delay time	Defines the time to keep the parameter 77.11 Rod torq2 additive speed ref active even when the required condition is not available.	0.000 s / uint32
	0.000 ... 100000000.000 s	Rod torque 2 speed delay time.	10 = 1 s / 1 = 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 NoUnit / uint32
	0...100	Rod torque 2 limit counter.	1 = 1 / 1 = 1
77.14	Rod torq2 time window	Defines the time at which 77.13 Rod torq2 limit counter exceeds its limit and triggers a fault condition.	0.000 s / uint32

No.	Name / Range / Selection	Description	Def / Type FbEq 16b / 32b
	0.000 ... 7200000.000 s	Rod torque 2 time window.	10 = 1 s / 1 = 1 s

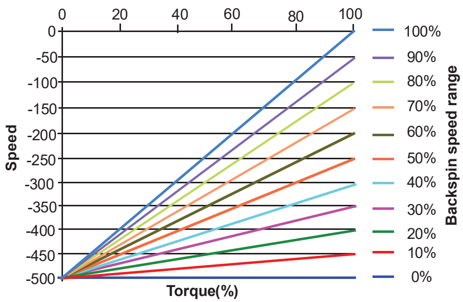
No.	Name / Range / Selection	Description	Def / Type FbEq 16b / 32b
78	Pump underload protection	See section Pump underload protection (page 51).	
78.01	Underload limit display	Selects the pump underload protection measurement as torque or current.	Torque / uint32
	Torque	Rod torque value for rod torque 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 torque.	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 Pump underload protection (page 51).	No / uint32
	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(%) / real32
	0.00 ... 10000.00 T(%)	Torque 1	10 = 1 T(%) / 1 = 1 T(%)
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 / real32
	-3600.00 ... 3600.00 Prpm	Speed 1	10 = 1 Prpm / 1 = 1 Prpm
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(%) / real32
	0.00 ... 10000.00 T(%)	Torque 2	10 = 1 T(%) / 1 = 1 T(%)
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 / real32
	-3600.00 ... 3600.00 Prpm	Speed 2	10 = 1 Prpm / 1 = 1 Prpm
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(%) / real32
	0.00 ... 10000.00 T(%)	Torque 3	10 = 1 T(%) / 1 = 1 T(%)

No.	Name / Range / Selection	Description	Def / Type FbEq 16b / 32b
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 under-load curve for the system.	1500.00 Prpm / real32
	-3600.00 ... 3600.00 Prpm	Speed 3	10 = 1 Prpm / 1 = 1 Prpm
78.09	Underload delay time	Defines the time required to confirm the underload condition.	0.000 s / uint32
	0.000 ... 100000000.000 s	Underload delay time.	10 = 1 s / 1 = 1 s

No.	Name / Range / Selection	Description	Def / Type FbEq 16b / 32b
79	Pump temperature protection	Pump temperature protection function. See section Pump temperature protection (page 52).	
79.01	Temperature protection function	Selects the Pump temperature protection function.	No / uint32
	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	Display 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 / uint32
	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 / int32
	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 1).	9
	Other [bit]	See Terms and abbreviations (page 132).	-
79.04	PT-100 source	Analog feedback source for PT100.	Zero / int32
	Zero	Zero.	0
	AI1 scaled	12.12 AI1 scaled value (page 196).	1

No.	Name / Range / Selection	Description	Def / Type FbEq 16b / 32b
	AI2 scaled	12.22 AI2 scaled value (page 197).	2
	Other [bit]	See Terms and abbreviations (page 132).	-
79.05	PT-100 exitation source	Feeding current for 1…3 PT100 sensors.	Zero / uint32
	Zero	Zero.	0
	Internal selection	See par 79.06 Pt100 internal selection.	1
	Other [bit]	See Terms and abbreviations (page 132).	-
79.06	Pt100 internal selection	User defined feeding current.	9.10 mA / real32
	0.00 ... 20.00 mA	PT100 internal selection.	100 = 1 mA / 1 = 1 mA
79.07	Number of PT-100 sensors in series	Number of connected PT100 sensors.	1 NoUnit / uint32
	1...3	Number of PT100 sensors connected in series.	1 = 1 / 1 = 1
79.08	Warning temperature limit	Temperature limit for displaying warning message.	0.00 C / real32
	0.00 ... 200.00 C	Warning temperature limit.	10 = 1 C / 1 = 1 C
79.09	Fault temperature limit	Temperature limit, that triggers a fault.	0.00 C / real32
	0.00 ... 200.00 C	Fault temperature limit.	10 = 1 C / 1 = 1 C

No.	Name / Range / Selection	Description	Def / Type FbEq 16b / 32b
80	Pump backspin control	Pump backspin control function. See section Pump backspin control (page 54).	
80.01	Backspin enable	Enables the backspin function for pump backspin control.	Disable / int32
	Disable	Disables backspin function.	0
	Enable	Enables backspin function.	1
	Other [bit]	See Terms and abbreviations (page 132).	-
80.02	Backspin ref limit	Defines the reference speed/frequency limit for the Backspin function. See section Pump backspin control (page 54). **WARNING!** The Pump backspin controlis not effective, if the 80.02 is set to 0.	0.00 Prpm / real32
	-30000.00 ... 0.00 Prpm	Reference limit.	10 = 1 Prpm / 1 = 1 Prpm
80.03	Backspin acc time	Defines the time required by the backspin function to accelerate from zero speed to 80.02 Backspin ref limit.	60.000 s / uint32
	0.000 ... 10000000.000 s	Acceleration time	10 = 1 s / 1 = 1 s
80.04	Backspin stop torque	Defines a torque limit for the Backspin function. See section Pump backspin control (page 54). 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 Nm / real32
	0.00 ... 10000.00 Nm	Torque limit	10 = 1 Nm / 1 = 1 Nm

No.	Name / Range / Selection	Description	Def / Type FbEq 16b / 32b
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 % / real32
	0.00 … 100.00%	Speed reference in percent of 80.02 Backspin ref limit.	100 = 1% / 1 = 1%
80.06	Backspin stop delay	Defines the time delay for the Backspin control. If the torque is below parameter 80.04 Backspin stop torque longer than the time set in parameter 80.06 Backspin stop delay then the controlled backspin function is complete.	3.000 s / uint32
	0.000 … 3600000.000 s	Delay time	1000 = 1 s / 1 = 1 s
80.11	Restart delay enable	Enables start delay function. See Pump backspin control (page 54).	Disable / int32
	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]	See Terms and abbreviations (page 132).	-

No.	Name / Range / Selection	Description	Def / Type FbEq 16b / 32b
80.12	Restart 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.	3600.000 s / uint32
	0.000 … 4294967295.000 s	Start delay time	10 = 1 s / 1 = 1 s
80.21	Backspin dec time	If a new start is given during Backspin operation then the parameter 80.21 Backspin dec time defines the deceleration ramp time when ramped from backspin speed to zero speed. When zero speed is reached then the normal acceleration ramp defined in parameter 74.10 Acc time is followed to ramp to the given reference speed. If the value is zero then the ramp time defined in parameter 74.11 Dec time is followed.	0.000 s / uint32
	0.000 … 1800000.000 s	Deceleration time	1000 = 1 s / 1 = 1 s

No.	Name / Range / Selection	Description	Def / Type FbEq 16b / 32b
82	Well control	Well control function. See section Well control (page 59).	
82.01	Ramp input	Displays the used pump reference (Prpm) before it enters the ramping function. This parameter is read-only.	0.00 Prpm / real32
	0.00 … 32000.00 Prpm	Pump reference speed.	10 = 1 Prpm / 1 = 1 Prpm
82.02	Ramp output	Displays the ramped reference (Prpm). This parameter is read-only.	0.00 Prpm / real32
	0.00 … 32000.00 Prpm	Ramp output.	10 = 1 Prpm / 1 = 1 Prpm
82.05	Well control status word	Displays the status word of well control. This parameter is read-only.	0000 0000 0000 0000 / uint16
b0	Well control enabled	Advanced pressure control function is enabled.	
b1	Ramp disabled	Reference is bypassing the ramp function.	
b2	Ramp hold	Reference value from the ramp function is frozen.	
b3	Ramp zero	Ramp input is forced to zero reference.	
b4	Well control inverted logic	Level or pressure function is used in inverted condition.	
b5	Well pressure above hysteresis max	Actual level or pressure is above the maximum limit.	
b6	Well pressure optimal	Actual level or pressure is within optimal threshold.	
b7	Well pressure below hysteresis min	Actual level or pressure is below the minimum limit.	
b8	Process recovery enabled	Process recovery function is enabled.	
b9	Process recovery active	Process recovery in action (can be used to activate Ramp set 2).	
b10	Maintenance mode enabled	Maintenance mode is enabled and maintenance reference ramp times are in use.	
b11	Level warning reached	Warning level is reached.	
b12	Level warning	Warning condition is fulfilled (remains active until condition presented).	
b13	Level fault reached	Fault level is reached.	
b14	Level fault	Fault condition is fulfilled (pulse is generated to trigger the fault).	
b15	Reserved		
	0000h…FFFFh		1 / 1

No.	Name / Range / Selection	Description	Def / Type FbEq 16b / 32b
82.06	Well control status word 2	Displays status word 2 of well control. This parameter is read-only.	- / uint16
b0	Started	Drive started and running.	
b1	Reserved		
b2	Reference min reached	Reached minimum reference defined in parameter 74.07 Minimum speed.	
b3	Reference decreas-ing	Used speed reference is decreasing.	
b4	Reference on hold	Used speed reference is on hold.	
b5	Reference increas-ing	Used speed reference is increasing.	
b6	Reference max reached	Reached reference value defined in 74.05 Speed refer-ence source.	
b7…9	Reserved		
b10	Pressure below minimum	Pressure signal is below hysteresis minimum limit.	
b11	Pressure optimal	Pressure signal is within the hysteresis optimal limit.	
b12	Pressure above max	Pressure signal is above hysteresis maximum limit.	
b13…14	Reserved		
b15	Pressure feedback lost	Pressure feedback lost source is active.	
	0000h…FFFFh		1 / 1
82.11	Well control enable	Defines the source to enable well control function.	Disable / int32
	Disable	Well control function disabled.	0
	Enable	Well control function 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).	10
	DIO2	Digital input/output DIO2 (11.02 DIO delayed status, bit 1).	11
	Other [bit]	See Terms and abbreviations (page 132).	-
	Other [bit]	See Terms and abbreviations (page 132).	-
82.21	Well pressure source	Selects the source for well pressure feedback.	Zero / uint32

No.	Name / Range / Selection	Description	Def / Type FbEq 16b / 32b
	Zero	No source defined.	0
	AI1 scaled	AI1 used as well pressure feedback source.	1
	AI2 scaled	AI2 used as well pressure feedback source.	2
	FBA1 ref	FBA1 reference used as well pressure feedback source. See parameter 03.05 FB A reference 1.	3
	FBA2 ref	FBA2 reference used as well pressure feedback source. See parameter 03.06 FB A reference 2.	4
	Other [bit]	See Terms and abbreviations (page 132).	-
82.22	Well pressure actual	Displays the actual value of well pressure.	0.00 kPa / real32
	0.00 … 32000.00 kPa	Actual well pressure.	100 = 1 kPa / 1 = 1 kPa
82.23	Well pressure optimal	Defines the optimal value for well pressure.	0.00 kPa / real32
	0.00 … 32000.00 kPa	Optimal well pressure.	100 = 1 kPa / 1 = 1 kPa
82.24	Well pressure hysteresis	Defines the hysteresis for optimal well pressure defined in parameter 82.23.	0.00 kPa / real32
	0.00 … 32000.00 kPa	Well pressure hysteresis.	100 = 1 kPa / 1 = 1 kPa
82.25	Well control inverted logic	Selects the reaction characteristics of well control function. For more information on direct reaction and inverted reaction of well control see section Well control logic (page 61).	Enable / int32
	Disable	Well control logic is activated as Direct reaction (page 61).	0
	Enable	Well control logic is activated as an Inverted reaction (page 61).	1
	Other [bit]	See Terms and abbreviations (page 132).	-
82.30	Ramp set selection	Selects ramp times used by well control function.	Ramp set 2 at recovery mode / int32
	Ramp set 1	Set ramp time 1 with parameters 82.33 Acceleration time 1 and 82.34 Deceleration time 1.	0
	Ramp set 2	Set ramp time 2 with parameters 82.37 Acceleration time 2 and 82.38 Deceleration time 2.	1
	Ramp set 2 at recovery mode	When recovery mode is active, parameters 82.37 Acceleration time 2 and 82.38 Deceleration time 2 are enabled automatically.	10
	DI1	Digital input DI1 (10.02 DI delayed status, bit 0).	2
	DI2	Digital input DI2 (10.02 DI delayed status, bit 1).	3
	DI3	Digital input DI3 (10.02 DI delayed status, bit 2).	4
	DI4	Digital input DI4 (10.02 DI delayed status, bit 3).	5
	DI5	Digital input DI5 (10.02 DI delayed status, bit 4).	6

No.	Name / Range / Selection	Description	Def / Type FbEq 16b / 32b
	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]	See Terms and abbreviations (page 132).	-
82.31	Cycle time	Defines ramp reference generator update cycle.	0.1 min / real32
	0.1 ... 32000.0 min	Ramped reference cycle time.	10 = 1 min / 1 = 1 min
82.33	Acceleration time 1	Defines the time required to reach the set speed (difference of parameters 74.08 Maximum speed and 74.07 Minimum speed).	0.000 Days / real32
	0.000 ... 32.000 Days	Acceleration time 1.	1000 = 1 Days / 1 = 1 Days
82.34	Deceleration time 1	Defines the time required to reach the set speed (difference of parameters 74.07 Minimum speed and 74.08 Maximum speed).	0.100 Days / real32
	0.000 ... 32.000 Days	Deceleration time 1.	1000 = 1 Days / 1 = 1 Days
82.37	Acceleration time 2	Defines the time required to reach the set speed (difference of parameters 74.08 Maximum speed and 74.07 Minimum speed).	0.000 Days / real32
	0.000 ... 32.000 Days	Acceleration time 2.	1000 = 1 Days / 1 = 1 Days
82.38	Deceleration time 2	Defines the time required to reach the set speed (difference of parameters 74.07 Minimum speed and 74.08 Maximum speed).	0.000 Days / real32
	0.000 ... 32.000 Days	Deceleration time 2.	1000 = 1 Days / 1 = 1 Days
82.40	Maintenance mode	Selects the source to force parameters 82.41 Maintenance acceleration and 82.42 Maintenance deceleration.	Disable / int32
	Disable	Maintenance mode is disabled.	0
	Enable	Maintenance mode is 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).	10
	DIO2	Digital input/output DIO2 (11.02 DIO delayed status, bit 1).	11
	Other [bit]	See Terms and abbreviations (page 132).	-

No.	Name / Range / Selection	Description	Def / Type FbEq 16b / 32b
82.41	Maintenance acceleration	Defines the time required to reach the set speed (difference of parameters 74.08 Maximum speed and 74.07 Minimum speed).	0.000 Days / real32
	0.000 … 32.000 Days	Acceleration time.	1000 = 1 Days / 1 = 1 Days
82.42	Maintenance deceleration	Defines the time required to reach the set speed (difference of parameters 74.08 Maximum speed and 74.07 Minimum speed).	0.000 Days / real32
	0.000 … 32.000 Days	Deceleration time.	1000 = 1 Days / 1 = 1 Days
82.45	Process recovery	Selects the source to activate monitoring for the process recovery mode.	Disable / int32
	Disable	Process recovery is disabled.	0
	Enable	Process recovery is enabled. Function will switch to recovery mode ramp when condition is fulfilled.	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]	See Terms and abbreviations (page 132).	-
82.46	Process recovery trigger time	The recovery time triggered by the well control function after the drive stops and attempts recovery. For more details refer section, Process recovery (page 62).	0.000 Days / real32
	0.000 … 32.000 Days	Process recovery trigger time.	1000 = 1 Days / 1 = 1 Days

No.	Name / Range / Selection	Description	Def / Type FbEq 16b / 32b
82.50	Well pressure warning level	Defines warning pressure level limit. If the parameter 82.22 Well pressure actual is below the 82.50 Well pressure warning level for a period longer than the defined time in parameter 82.51 Well pressure warning delay, then the warning D20E Pressure level is displayed. **Note:** • Warning function disabled if parameter 82.50 Well pressure warning level is set as 0. • Warning function disabled when drive stopped (not modulating). • Warning function disabled when Well pressure supervision function has detected signal lose condition:82.80 Well pressure supervision status word function bit 0 Signal lose detected = 1.	0.00 kPa / real32
	0.00 ... 32000.00 kPa	Well pressure warning level.	100 = 1 kPa / 1 = 1 kPa
82.51	Well pressure warning delay	Defines the time period required to verify that Pressure or level below warning limit.	0.0 min / real32
	0.0 ... 32000.0 min	Well pressure warning delay.	10 = 1 min / 1 = 1 min

82.52	Well pressure fault level	Defines the set point level when the drive trips on fault.
		When the value in parameter 82.22 Well pressure actual is below the value set in parameter 82.52 Well pressure fault level for a time duration equal to or above the defined time in parameter 82.53 Well pressure fault delay drive trips on fault D10E Pressure level.
		
		Note:
		• The fault level function is disabled when,
		  • the value in parameter 82.52 Well pressure fault level is set to 0,
		  • the drive is not running,
		  • the well pressure supervision function has detected a signla lose condition (parameter 82.80 Well pressure supervision status word, bit 0 signal lose detected).
			0.00 kPa / real32

	0.00 ... 32000.00 kPa	Well pressure fault level.	100 = 1 kPa / 1 = 1 kPa
82.53	Well pressure fault delay	Well pressure fault delay is the time period when the actual well pressure (82.22 Well pressure actual) is below the fault level (82.52 Well pressure fault level) before a fault occurs.	0.0 min / real32
	0.0 ... 32000.0 min	Well pressure fault delay.	10 = 1 min / 1 = 1 min
82.61	Well pressure feedback lost	Selects the source to confirm well pressure feedback lost. **Note:** When Well pressure feedback signal is lost then well control freezes the reference on the last used one.	82.80 Well presure supervision / int32

No.	Name / Range / Selection	Description	Def / Type FbEq 16b / 32b
	Feedback presented	Status False = feedback signal is presented.	0
	Feedback lost	Status True = feedback signal is lost.	1
	82.80 Well presure supervision	Connected to well pressure supervision function by default.	2
	Other [bit]	See Terms and abbreviations (page 132).	-
82.80	Well pressure supervision status word	Displays well pressure supervision status word. This parameter is read-only.	- / uint16
b0	Signal lose detected	Pressure signal lost condition fulfilled.	
b1	Reserved		
b2	Above high limit	Signal is above allowed level.	
b3	Below low limit	Signal is below allowed level.	
b4…5	Reserved		
b6	Above speed limit	Signal is above 74.07 Minimum speed.	
b7	Reserved		
b8	Time delay	Time limit is defined when the condition is present.	
b9	Reserved		
b10	Running state	Drive is in modulating state.	
b11…12	Reserved		
b13	Supervision warning triger	Warning condition is fulfilled.	
b14	Supervision fault trigger	Fault condition is fulfilled (Pulse is generated to trigger the fault).	
b15	Reserved		
	0000h…FFFFh		1 / 1
82.81	Well pressure supervision	Defines action for well pressure supervision.	Disabled / uint32
	Disabled	Well pressure supervision is disabled.	0
	No action	Well pressure supervision updates only the status word, however no events are generated.	1
	Warning	D211 Pressure feedback supervision warning.	2
	Fault	D111 Pressure feedback supervision fault.	3
82.82	Well pressure supervision configuration word	Displays the well pressure supervision configuration method. This parameter is read-only.	0000 0000 0000 0000 / uint16
b0…1	Reserved		
b2	High limit supervision	Well pressure is greater than the level defined in 82.84 Well pressure high limit supervision.	

No.	Name / Range / Selection	Description	Def / Type FbEq 16b / 32b
b3	Low limit supervision	Well pressure is below the allowed level defined in 82.83 Well pressure low limit supervision.	
b4…5	Reserved		
b6	Min speed level supervision	Actual speed reference is greater than 74.07 Minimum speed.	
b7	Reserved		
b8	Time delay supervision	Supervision functionality uses time-based filtering to determine the condition presented.	
b9	Reserved		
b10	Running state supervision	Reserved	
b11…15	Reserved		
	0000h…FFFFh		1 / 1
82.83	Well pressure low limit supervision	Defines the low-pressure limit for well pressure feedback supervision functionality. Well pressure feedback is lost when actual pressure feedback signal is below the defined limit.	0.00 kPa / real32
	0.00 ... 32000.00 kPa	Well pressure low limit supervision.	100 = 1 kPa / 1 = 1 kPa
82.84	Well pressure high limit supervision	Defines the high-pressure limit for well pressure feedback supervision functionality. Well pressure feedback is lost when actual pressure feedback signal is above the defined limit.	0.00 kPa / real32
	0.00 ... 32000.00 kPa	Well pressure high limit supervision.	100 = 1 kPa / 1 = 1 kPa
82.88	Well pressure supervision delay	Defines the time period required to verify pressure feedback error status.	0.0 min / real32
	0.0 ... 64000.0 min	Well pressure supervision delay.	10 = 1 min / 1 = 1 min

No.	Name / Range / Selection	Description	Def / Type FbEq 16b / 32b
84	Belt slip detection	Belt slip detection. See description Belt slip detection (page 63).	
84.01	Motor speed used	Displays the used motor speed.	0.00 rpm / real32
	-32000.00 … 32000.00 rpm	Motor speed used	100 = 1 rpm / 1 = 1 rpm
84.02	Pump speed converted	Displays the pump speed converted to motor speed.	0.00 rpm / real32
	-32000.00 … 32000.00 rpm	Pump speed converted	100 = 1 rpm / 1 = 1 rpm
84.03	Speed difference	Displays the speed difference between motor and converted pump speed.	0.00 rpm / real32
	-32000.00 … 32000.00 rpm	Speed difference between motor and pump.	100 = 1 rpm / 1 = 1 rpm
84.05	Belt slip detection status word	Displays belt slip detection status word.	0000 0000 0000 0000 / uint16
b0	Belt slip detection enabled	Belt slip detection function is enabled.	
b1	Belt slipping	Speed difference is above the defined limit.	
b2	Belt slip detected	Speed difference is above the defined limit during 84.23 Belt slip limit delay.	
b3	Belt slip warning	Triggers D210 Belt slipping warning.	
b4	Belt slip fault	Triggers D110 Belt slipping fault.	
b5…15	Reserved		
	0000h…FFFFh		1 / 1
84.21	Belt slip detection action	Enables belt slip detection function.	Disabled / uint32
	Disabled	Belt slip detection action is disabled.	0
	No action	Belt slip detection action updates only the status word, however no events are generated	1
	Warning	Triggers D210 Belt slipping warning.	2
	Fault	Triggers D110 Belt slipping fault.	3
	Other [bit]	See Terms and abbreviations (page 132).	-
84.22	Belt slip limit	Defines the speed difference above which the condition is identified as belt slipping.	0.00 rpm / real32
	0.00 … 32000.00 rpm	Belt slip limit.	100 = 1 rpm / 1 = 1 rpm
84.23	Belt slip limit delay	Defines the time period required to verify belt slip condition.	5 s / real32
	0…32000 s	Belt slip limit delay.	1 = 1 s / 1 = 1 s

No.	Name / Range / Selection	Description	Def / Type FbEq 16b / 32b
84.25	Load side speed source	Defines the analogue source for the load side speed signal. **Note:** Parameter 84.25 Load side speed source signal is used only when parameter 84.31 Load side pulse per revolution is set to 0.	NULL / uint32
	NULL	0	0
	AI1 scaled	12.12 AI1 scaled value (page 196).	1
	AI2 scaled	12.22 AI2 scaled value (page 197).	2
	90.03 Load speed	Load side speed is taken from 90.03 Load speed	3
	Other [bit]	See Terms and abbreviations (page 132).	-
84.30	Load side pulse source	Selects a digital source for digital sensor (proximity switch) load side for speed calculation. **Note:** Parameter 84.25 Load side speed source signals are used only when 84.31 Load side pulse per revolution set more than 0. **Note:** The function can detect pulses that appear at intervals of at least 2 milliseconds.	FALSE / int32
	FALSE	0	0
	TRUE	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]	See Terms and abbreviations (page 132).	-
	Other [bit]	See Terms and abbreviations (page 132).	-
84.31	Load side pulse per revolution	Defines the number of pulses generated per revolution. **Note:** Load side pulse per revolution can detect pulses that appear not faster than once in 2 ms. The maximum speed at 1 pulse per revolution can be: 1 [rev/pulse] * 60 [s/min] * 1000 [ms/s] / 2 [ms] = 30000 [rpm]	0 NoUnit / real32
	0…32000	Pulses generated per revolution.	1 = 1 / 1 = 1
84.35	Load side speed filter time	Defines a filter time for 84.02 Pump speed converted.	0.000 s / real32

No.	Name / Range / Selection	Description	Def / Type FbEq 16b / 32b
	0.000 ... 320.000 s	Filter time for 84.02 Pump speed converted.	1000 = 1 s / 1 = 1 s

No.	Name / Range / Selection	Description	Def / Type FbEq 16b / 32b
90	Feedback selection	Motor and load feedback configuration. See also section Encoder support (page 82), and the diagram on page 618.	
90.01	Motor speed for control	Displays the estimated or measured motor speed that is used for speed 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). Estimated speed is always used in scalar control. **Note:** This parameter is read-only.	- / real32
	-32768.00 … 32767.00 rpm	Motor speed used for control. For 16-bit scaling, see parameter 46.01.	- / 100 = 1 rpm
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). **Note:** This parameter is read-only.	- / real32
	0.00000000 … 1.00000000 rev	Motor position.	32767 = 1 rev / 100000000 = 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 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). **Note:** This parameter is read-only.	- / real32
	-32768.00 … 32767.00 rpm	Load speed. For 16-bit scaling, see parameter 46.01.	- / 100 = 1 rpm

No.	Name / Range / Selection	Description	Def / Type FbEq 16b / 32b
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. **Note:** This parameter is read-only.	- / int32
		Load position.	- / 1 = 1
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. **Note:** This parameter is read-only.	- / real32
	-2147483.648 ... 2147483.647	Scaled load position in decimal format.	- / 100000 = 1
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. **Note:** This parameter is read-only.	- / int32
	-2147483.648 ... 2147483.647	Motor position.	1 = 1 / 1000 = 1
90.07	Load position scaled int	Displays the output of the position counter function as an integer, enabling backwards compatibility with ACS 600 and ACS800 drives. The position is relative to the initial position set by parameters 90.58 and 90.59. See section Position counter (page 84), and the block diagram on page 619. **Note:** This parameter is read-only.	- / int32

No.	Name / Range / Selection	Description	Def / Type FbEq 16b / 32b
		Scaled load position in integer format.	- / -
90.10	Encoder 1 speed	Displays encoder 1 speed in rpm. **Note:** This parameter is read-only.	- / real32
	-32768.00 ... 32767.00 rpm	Encoder 1 speed. For 16-bit scaling, see parameter 46.01.	- / 100 = 1 rpm
90.11	Encoder 1 position	Displays the actual position of encoder 1 within one revolution. **Note:** This parameter is read-only.	- / real32
	0.00000000 ... 1.00000000 rev	Encoder 1 position within one revolution.	32767 = 1 rev / 100000000 = 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). **Note:** This parameter is read-only.	- / uint32
	0...16777215	Encoder 1 revolutions.	- / 1 = 1
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. **Note:** This parameter is read-only.	- / int32
	-2147483648...2147483647	Encoder 1 revolution count extension.	- / 1 = 1
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. **Note:** This parameter is read-only.	- / uint32
	0...16777215	Raw encoder 1 position within one revolution.	- / 1 = 1
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. **Note:** This parameter is read-only.	- / uint32
	0...16777215	Raw encoder 1 revolution count.	- / 1 = 1
90.20	Encoder 2 speed	Displays encoder 2 speed in rpm. **Note:** This parameter is read-only.	- / real32

No.	Name / Range / Selection	Description	Def / Type FbEq 16b / 32b
	-32768.00 ... 32767.00 rpm	Encoder 2 speed. For 16-bit scaling, see parameter 46.01.	- / 100 = 1 rpm
90.21	Encoder 2 position	Displays the actual position of encoder 2 within one revolution. **Note:** This parameter is read-only.	- / real32
	0.00000000 ... 1.00000000 rev	Encoder 2 position within one revolution.	- / 100000000 = 1 rev
90.22	Encoder 2 multiturn revolutions	Displays the revolutions of (multiturn) encoder 2 within its value range (see parameter 93.14 Revolution data width). **Note:** This parameter is read-only.	- / uint32
	0...16777215	Encoder 2 revolutions.	- / 1 = 1
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. **Note:** This parameter is read-only.	- / int32
		Encoder 2 revolution count extension.	- / 1 = 1
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. **Note:** This parameter is read-only.	- / uint32
	0...16777215	Raw encoder 2 position within one revolution.	- / 1 = 1
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. **Note:** This parameter is read-only.	- / uint32
	0...16777215	Raw encoder 2 revolution count.	- / 1 = 1
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. **Note:** This parameter is read-only.	- / int32
	-2147483648...2147483647	Motor revolution count extension.	- / 1 = 1

No.	Name / Range / Selection	Description	Def / Type FbEq 16b / 32b
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. **Note:** This parameter is read-only.	- / int32
	-2147483648...2147483647	Load revolution count extension.	- / 1 = 1
90.35	Pos counter status	Status information related to the position counter function. See section Position counter (page 84). **Note:** This parameter is read-only.	- / uint16
b0	Encoder 1 feedback	1 = Encoder 1 selected as load feedback source	
b1	Encoder 2 feedback	1 = Encoder 2 selected as load feedback source	
b2	Internal position feedback	1 = Internal load position estimate selected as load feedback source	
b3	Motor feedback	1 = Motor feedback selected as load feedback source	
b4	Pos counter init ready	0 = Position counter not initialized, or encoder feedback was lost. Fresh counter initialization recommended. 1 = Position counter successfully initialized	
b5	Position counter re-init disabled	1 = Position counter initialization is being prevented by par. 90.68	
b6	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.)	
b7…15	Reserved		
	0000h…FFFFh		1 = 1 / 1 = 1
90.38	Pos counter decimals	Scales the values of parameters 90.05 Load position scaled and 90.65 Pos counter init value when accessed 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 NoUnit / uint16
	0...9	Number of position counter decimal places.	1 = 1 / 1 = 1

No.	Name / Range / Selection	Description	Def / Type FbEq 16b / 32b
90.41	Motor feedback selection	Selects the motor speed feedback value used during motor control. **Note:** With a permanent magnet motor, make sure an autophasing routine (see page 93) is performed using the selected encoder. If necessary, set parameter 99.13 ID run requested to Autophasing to request a fresh autophasing routine.	Estimate / uint16
	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 speed control (90.01 Motor speed for control).	3 ms / real32
	0…10000 ms	Motor speed filter time.	1 = 1 ms / 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. $\frac{90.43}{90.44} = \frac{\text{Motor speed}}{\text{Encoder speed}}$ See also section Load and motor feedback (page 83). **Note:** This parameter cannot be changed while the drive is running.	1 NoUnit / int32
	-2147483648..2147483647	Motor gear numerator.	- / 1 = 1
90.44	Motor gear denominator	See parameter 90.43 Motor gear numerator. **Note:** This parameter cannot be changed while the drive is running.	1 NoUnit / int32
	-2147483648..2147483647	Motor gear denominator.	- / 1 = 1
90.45	Motor feedback fault	Selects how the drive reacts to loss of measured motor feedback.	Fault / uint16
	Fault	Drive trips on a 7301 Motor speed feedback or 7381 Encoder fault.	0
	Warning	Drive generates an A798 Encoder option comm loss, 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

No.	Name / Range / Selection	Description	Def / Type FbEq 16b / 32b
90.46	Force open loop	Forces the DTC motor model to use estimated motor speed as feedback. This parameter can be activated when the encoder data is obviously unreliable because of slippage, for example. **Note:** This parameter only affects the selection of feedback for the motor model, not for the speed controller.	No / uint16
	No	The motor model uses the feedback selected by 90.41 Motor feedback selection.	0
	Yes	The motor model uses the calculated speed estimate (regardless of the setting of 90.41 Motor feedback selection, which in 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 / uint16
	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 NoUnit / uint16
	0...31	Motor position resolution.	- / 1 = 1
90.51	Load feedback selection	Selects the source of load speed and position feedbacks used in control.	None / uint16
	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

No.	Name / Range / Selection	Description	Def / Type FbEq 16b / 32b
	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 (ie. 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 / real32
	0…10000 ms	Load speed filter time.	- / 1 = 1 ms
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. $\frac{90.53}{90.54} = \frac{\text{Load speed}}{\text{Encoder speed}}$ See also section Load and motor feedback (page 83). **Note:** This parameter cannot be changed while the drive is running.	1 NoUnit / int32
	-2147483648…2147483647	Load gear numerator.	- / 1 = 1
90.54	Load gear denominator	See parameter 90.53 Load gear numerator. **Note:** This parameter cannot be changed while the drive is running.	1 NoUnit / int32
	-2147483648…2147483647	Load gear denominator.	- / 1 = 1
90.55	Load feedback fault	Selects how the drive reacts to loss of load feedback.	Fault / uint16
	Fault	Drive trips on a 73A1 Load position feedback fault.	0
	Warning	Drive generates an A798 Encoder option comm loss or 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.	0.0 rev / int32
	-2147483648…2147483647 rev	Load-side position offset.	- / 1 = 1 rev
90.57	Load position resolution	Defines how many bits are used for load position count within one revolution. For example, with the setting of 18, the position value is multiplied by 65536 for display in parameter 90.04 Load position.	16 NoUnit / uint16
	0…31	Load position resolution.	- / 1 = 1

No.	Name / Range / Selection	Description	Def / Type FbEq 16b / 32b
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 84).	- / int32
	-2147483648..2147483647	Initial integer value for position counter.	- / 1 = 1
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 / uint32
	Zero	0.	0
	Pos counter init value int	Parameter 90.58 Pos counter init value int.	1
	Other [bit]	Source selection. See Terms and abbreviations (page 132).	-
90.60	Pos counter error and boot action	Selects how the position counter reacts to loss of load feedback.	Request re-initialization / uint16
	Request re-initialization	Bit 4 of 90.35 Pos counter status is cleared. Reinitialization of position counter is recommended.	0
	Continue from previous value	Position counting resumes from the previous value over a loss of load feedback or control unit reboot. Bit 4 of 90.35 Pos counter status is not cleared, but bit 6 is set to indicate that an error has occurred. **Note:** If load feedback is lost when the drive is in stopped state or not powered, the counter is not updated even if the load moves.	1
90.61	Gear numerator	Parameter 90.61 and 90.62 define a gear function between the motor and load speeds. $\frac{90.61}{90.62} = \frac{\text{Motor speed}}{\text{Load speed}}$ See also section Load and motor feedback (page 83).	1 NoUnit / int32
	-2147483648..2147483647	Gear numerator (motor-side).	- / 1 = 1
90.62	Gear denominator	See parameter 90.61 Gear numerator.	1 NoUnit / int32
	-2147483648..2147483647	Gear denominator (load-side).	- / 1 = 1

No.	Name / Range / Selection	Description	Def / Type FbEq 16b / 32b
90.63	Feed constant numerator	Parameters 90.63 and 90.64 define the feed constant for the position calculation: $\frac{90.63}{90.64}$ 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 90.07 Load position scaled int. Note that the load position is only updated after new position input data is received.	1 NoUnit / int32
	-2147483648..2147483647	Feed constant numerator.	- / 1 = 1
90.64	Feed constant denominator	See parameter 90.63 Feed constant numerator.	1 NoUnit / int32
	-2147483648..2147483647	Feed constant denominator.	- / 1 = 1
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. The number of decimal places is defined by parameter 90.38 Pos counter decimals.	0.000 null / real32
	-2147483.648 … 2147483.647	Initial value for position counter.	- / 1 = 1
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 / uint32
	Zero	0.	0
	Pos counter init value	Parameter 90.65 Pos counter init value.	1
	Other [bit]	Source selection. See Terms and abbreviations (page 132).	-
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 / uint32
	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

No.	Name / Range / Selection	Description	Def / Type FbEq 16b / 32b
	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]	See Terms and abbreviations (page 132).	-
90.68	Disable pos counter initialization	Selects a source that prevents the initialization of the position counter.	Not selected / uint32
	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]	See Terms and abbreviations (page 132).	-
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 / uint32
	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]	See Terms and abbreviations (page 132).	-

No.	Name / Range / Selection	Description	Def / Type FbEq 16b / 32b
90.47	Enable motor encoder drift detection	Enables/disables detection of encoder drift, ie. slippage between the encoder and the shaft. The function is designed to detect erroneous feedback in static operating conditions. However, because of limitations in estimating the motor speed, drift detection must be disabled or will be internally ignored in the following circumstances: • Motor model is not operative (drive is not modulating, ID run is in progress, or motor is coasting) • Estimated motor speed has not settled (motor start time delay has not elapsed). • Estimated motor speed is below 50 rpm • Speed error (encoder speed - estimated motor speed) is below 100 rpm, and • During high dynamic motion with the speed reference changing rapidly.	Yes / uint16
	No	Drift detection disabled.	0
	Yes	Drift detection enabled.	1

No.	Name / Range / Selection	Description	Def / Type FbEq 16b / 32b
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. **Note:** This parameter is read-only.	- / uint16
b0	DI1 /module 1	DI1 of interface module 1 (see parameters 91.11 and 91.12)	
b1	DI2 /module 1	DI2 of interface module 1 (see parameters 91.11 and 91.12)	
b2…3	Reserved		
b4	DI1 /module 2	DI1 of interface module 2 (see parameters 91.13 and 91.14)	
b5	DI2 /module 2	DI2 of interface module 2 (see parameters 91.13 and 91.14)	
b6…15	Reserved		
	0000h…FFFFh		1 = 1 / 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. **Note:** This parameter is read-only.	No option / uint16
	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. **Note:** This parameter is read-only.	No option / uint16
91.04	Module 1 temperature	Displays the temperature measured through the sensor input of interface module 1. The unit (°C or °F) is selected by parameter 96.16 Unit selection. **Note:** With a PTC sensor, the unit is ohms. **Note:** This parameter is read-only.	- / real32

No.	Name / Range / Selection	Description	Def / Type FbEq 16b / 32b
	0…1000 °	Temperature measured through interface module 1.	- / -
91.06	Module 2 temperature	Displays the temperature measured through the sensor input of interface module 2. The unit (°C or °F) is selected by parameter 96.16 Unit selection. **Note:** With a PTC sensor, the unit is ohms. **Note:** This parameter is read-only.	- / real32
	0…1000 °	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. • Permanent magnet motors only: The drive will perform a fresh autophasing routine (see page 93) at next start if the motor feedback encoder settings have been changed. • The parameter cannot be changed while the drive is running.	Done / uint16
	Done	Refreshing done.	0
	Refresh	Refreshing.	1
91.11	Module 1 type	Defines the type of the module used as interface module 1.	None / uint16
	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-03 extension adapter.	2 NoUnit / uint16
	1...254	Slot 1 = 1; Slot 2 = 2; Slot 3 = 3 4…254: Node ID of the slot on the FEA-03 extension adapter	1 = 1 / 1 = 1
91.13	Module 2 type	Defines the type of the module used as interface module 2.	None / uint16
	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

No.	Name / Range / Selection	Description	Def / Type FbEq 16b / 32b
	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-03 extension adapter.	3 NoUnit / uint16
	1...254	Slot 1 = 1; Slot 2 = 2; Slot 3 = 3 4…254: Node ID of the slot on the FEA-03 extension adapter	1 = 1 / 1 = 1
91.21	Module 1 temp sensor type	Specifies the type of temperature sensor connected to interface module 1. Note that the module must also be activated by parameters 91.11 … 91.12.	None / uint16
	None	None.	0
	PTC	PTC. (The unit is ohms.)	1
	KTY-84	KTY84. (The unit is selected by parameter 96.16 Unit selection.)	2
	Pt1000	Pt1000 (The unit is selected by parameter 96.16 Unit selection). **Note:** Pt1000 sensor supports FEN-11 and FEN-31 encoder modules only.	3
91.22	Module 1 temp filter time	Defines a filtering time for the temperature measurement through interface module 1.	1500 ms / real32
	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. Note that the module must also be activated by parameters 91.13 … 91.14.	None / uint16
	None	None.	0
	PTC	PTC. (The unit is ohms.)	1
	KTY-84	KTY84. (The unit is selected by parameter 96.16 Unit selection.)	2
	Pt1000	Pt1000 (The unit is selected by parameter 96.16 Unit selection). **Note:** Pt1000 sensor supports FEN-11 and FEN-31 encoder modules only.	3
91.25	Module 2 temp filter time	Defines a filtering time for the temperature measurement through interface 2.	1500 ms / real32
	0...10000 ms	Filtering time for temperature measurement.	- / 1 = 1 ms
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 82).	Not selected / uint16
	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

No.	Name / Range / Selection	Description	Def / Type FbEq 16b / 32b
91.32	Module 1 emulation pulses/rev	Defines the number of TTL pulses per revolution for encoder emulation output of interface module 1.	- / uint16
	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.	- / real32
	0.00000 … 1.00000 rev	Position of emulated zero pulses.	32767 = 1 rev / 100000 = 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 82).	Not selected / uint16
	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.	- / uint16
	0…65535	Number of TTL pulses for emulation.	1 = 1 / 1 = 1
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.	- / real32
	0.00000 … 1.00000 rev	Position of emulated zero pulses.	32767 = 1 rev / 100000 = 1 rev

No.	Name / Range / Selection	Description	Def / Type FbEq 16b / 32b
92	Encoder 1 configuration	Settings for encoder 1. **Note:** The contents of this parameter group vary according to the selected encoder type. **Note:** 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 / uint16
	None configured	None.	0
	TTL	TTL. Module type (input): FEN-01 (X31), FEN-11 (X41) or FEN-21 (X51).	1
	TTL+	TTL+. 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). Not supported at the time of publication.	7
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 / uint16
	Module 1	Interface module 1.	0
	Module 2	Interface module 2.	1
92.10	Excitation signal frequency	(Visible when 92.01 Encoder 1 type = Resolver) Defines the frequency of the excitation signal. **Note:** With an EnDat or HIPERFACE encoder and FEN-11 FPGA version VIE12200 or later, this parameter is automatically set upon validation of encoder settings (91.10 Encoder parameter refresh).	1 kHz / uint16
	1…20 kHz	Excitation signal frequency.	1 = 1 kHz / 1 = 1 kHz
92.10	Sine/cosine number	(Visible when 92.01 Encoder 1 type = Absolute encoder) 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 NoUnit / uint16
	0…65535	Number of sine/cosine wave cycles within one revolution.	- / 1 = 1

No.	Name / Range / Selection	Description	Def / Type FbEq 16b / 32b
92.10	Pulses/revolution	(Visible when 92.01 Encoder 1 type = HTL 1) Defines the pulse number per revolution.	2048 NoUnit / uint16
	0...65535	Number of pulses.	- / 1 = 1
92.11	Pulse encoder type	(Visible when 92.01 Encoder 1 type = HTL 1) Selects the type of encoder.	Quadrature / uint16
	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 92.01 Encoder 1 type = Absolute encoder) Selects the source of the absolute position information.	None / uint16
	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 17/23-bit single or multiturn encoder. See parameters 92.13 and 92.14.	5
92.11	Excitation signal amplitude	(Visible when 92.01 Encoder 1 type = Resolver) Defines the rms amplitude of the excitation signal.	4.0 V / uint16
	4.0 ... 12.0 V	Excitation signal amplitude.	10 = 1 V / 100 = 1 V
92.12	Speed calculation mode	(Visible when 92.01 Encoder 1 type = HTL 1) 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 / uint16
	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 typee, 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

<table>
<tr><th>No.</th><th>Name / Range / Selection</th><th>Description</th><th>Def / Type
FbEq 16b / 32b</th></tr>
<tr><td></td><td>Auto rising</td><td>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 rising</td></tr>
</table></td><td>4</td></tr>
<tr><td></td><td>Auto falling</td><td>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></td><td>5</td></tr>
<tr><td>92.12</td><td>Zero pulse enable</td><td>(Visible when 92.01 Encoder 1 type = Absolute encoder)
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.</td><td>Disable / uint16</td></tr>
<tr><td></td><td>Disable</td><td>Zero pulse disabled.</td><td>0</td></tr>
<tr><td></td><td>Enable</td><td>Zero pulse enabled.</td><td>1</td></tr>
<tr><td>92.12</td><td>Resolver polepairs</td><td>(Visible when 92.01 Encoder 1 type = Resolver)
Defines the number of pole pairs of the resolver.</td><td>1 NoUnit / uint16</td></tr>
<tr><td></td><td>1…32</td><td>Number of resolver pole pairs.</td><td>1 = 1 / 1 = 1</td></tr>
<tr><td>92.13</td><td>Position estimation enable</td><td>(Visible when 92.01 Encoder 1 type = HTL 1)
Selects whether position estimation is used with encoder 1 to increase position data resolution or not.</td><td>Enable / uint16</td></tr>
<tr><td></td><td>Disable</td><td>Measured position used. (The resolution is 4 × pulses per revolution for quadrature encoders, 2 × pulses per revolution for single-track encoders.)</td><td>0</td></tr>
<tr><td></td><td>Enable</td><td>Estimated position used. (Uses position interpolation; extrapolated at the time of data request.)</td><td>1</td></tr>
</table>

No.	Name / Range / Selection	Description	Def / Type FbEq 16b / 32b
92.13	Position data width	(Visible when 92.01 Encoder 1 type = Absolute encoder) 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. **Note:** With FEN-11 revision N and earlier, 17 bits data width is always used. With revision P and later, values 0 and 17 can select 17 bits and the value 23 selects 23 bits. **Note:** With an EnDat or HIPERFACE encoder and FEN-11 FPGA version VIE12200 or later, this parameter is automatically set upon validation of encoder settings (91.10 Encoder parameter refresh).	0 NoUnit / uint16
	0…32	Number of bits used in position indication within one revolution.	1 = 1 / 1 = 1
92.14	Speed estimation enable	(Visible when 92.01 Encoder 1 type = HTL 1) Selects whether calculated or estimated speed is used. Estimation increases the speed ripple in steady state operation, but improves the dynamics. **Note:** This parameter is not effective with FEN-xx modules with FPGA version VIEx 2000 or later.	Disable / uint16
	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
92.14	Revolution data width	(Visible when 92.01 Encoder 1 type = Absolute encoder) 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 16 bit multiturn data. **Note:** With an EnDat or HIPERFACE encoder and FEN-11 FPGA version VIE12200 or later, this parameter is automatically set upon validation of encoder settings (91.10 Encoder parameter refresh).	0 NoUnit / uint16
	0…32	Number of bits used in revolution count.	1 = 1 / 1 = 1
92.15	Transient filter	(Visible when 92.01 Encoder 1 type = HTL 1) Activates transient filtering for the encoder (changes in direction of rotation are ignored above the selected pulse frequency).	4880Hz / uint16
	4880Hz	Change in direction of rotation allowed below 4880 Hz.	0

No.	Name / Range / Selection	Description	Def / Type FbEq 16b / 32b
	2440Hz	Change in direction of rotation allowed below 2440 Hz.	1
	1220Hz	Change in direction of rotation allowed below 1220 Hz.	2
	Disabled	Change in direction of rotation allowed at any pulse frequency.	3
92.17	Accepted pulse freq of encoder 1	(Visible when 92.01 Encoder 1 type = HTL 1) Defines the maximum pulse frequency of encoder 1.	0 kHz / uint16
	0...300 kHz	Pulse frequency.	1 = 1 kHz / 1 = 1 kHz
92.21	Encoder cable fault mode	(Visible when 92.01 Encoder 1 type = HTL 1) Selects which encoder cable channels and wires are monitored for wiring faults.	A, B / uint16
	A+, A-, B+, B-, Z+, Z-	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
92.24	Pulse edge filtering	(Visible when 92.01 Encoder 1 type = HTL) Enables pulse edge filtering. Pulse edge filtering can improve the reliability of measurements especially from encoders with a single-ended connection. **Note:** Pulse edge filtering is only supported by FEN-31 modules with FPGA version VIE3 2200 or later. **Note:** Pulse edge filtering decreases the maximum pulse frequency. With 2 µs filtering time, the maximum pulse frequency is 200 kHz.	No filtering / uint16
	No filtering	Filtering disabled.	0
	1 µs	Filtering time: 1 microsecond.	1
	2 µs	Filtering time: 2 microseconds.	2
92.30	Serial link mode	(Visible when 92.01 Encoder 1 type = Absolute encoder) Selects the serial link mode with an EnDat or SSI encoder.	Initial position / uint16
	Initial position	Single position transfer mode (initial position).	0
	Continuous	Continuous position data transfer mode. **Note:** Motor control is forced internally as a open loop and estimated speed used.	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 / Range / Selection	Description	Def / Type FbEq 16b / 32b
92.31	EnDat max calcula-tion time	(Visible when 92.01 Encoder 1 type = Absolute encoder) 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 / uint16
	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 92.01 Encoder 1 type = Absolute encoder) 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 incre-mental sin/cos signals (supported only as encoder 1). See also parameter 92.30 Serial link mode.	100 us / uint16
	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 92.01 Encoder 1 type = Absolute encoder) 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 NoUnit / uint16
	2...127	SSI message length.	- / 1 = 1
92.34	SSI position msb	(Visible when 92.01 Encoder 1 type = Absolute encoder) With an SSI encoder, defines the location of the MSB (most significant bit) of the position data within an SSI message.	1 NoUnit / uint16
	1...126	Position data MSB location (bit number).	- / 1 = 1
92.35	SSI revolution msb	(Visible when 92.01 Encoder 1 type = Absolute encoder) With an SSI encoder, defines the location of the MSB (most significant bit) of the revolution count within an SSI message.	1 NoUnit / uint16
	1...126	Revolution count MSB location (bit number).	- / 1 = 1
92.36	SSI data format	(Visible when 92.01 Encoder 1 type = Absolute encoder) Selects the data format for an SSI encoder.	Binary / uint16
	Binary	Binary code.	0
	Gray	Gray code.	1

No.	Name / Range / Selection	Description	Def / Type FbEq 16b / 32b
92.37	SSI baud rate	(Visible when 92.01 Encoder 1 type = Absolute encoder) Selects the baud rate for an SSI encoder.	100 kBit/s / uint16
	10 kBit/s	10 kbit/s.	0
	50 kBit/s	50 kbit/s.	1
	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 92.01 Encoder 1 type = Absolute encoder) 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 / uint16
	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
92.41	EnDat max clock frequency	(Visible when 92.01 Encoder 1 type = Absolute encoder) Defines EnDat encoder clock frequency in continuous speed and position mode (92.30 Serial link mode is Continuous speed and position). Parameter is visible only when FEN-11 TTL absolute encoder interface module (option +L518) is installed in the drive.	1 MHz / uint16
	1 MHz	1 MHz	0
	2 MHz	2 MHz	1
	4 MHz	4 MHz	2
	8 MHz	8 MHz	3
92.45	Hiperface parity	(Visible when 92.01 Encoder 1 type = Absolute encoder) Defines the use of parity and stop bits with a HIPERFACE encoder. Typically this parameter need not be set.	Odd / uint16
	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 92.01 Encoder 1 type = Absolute encoder) Defines the transfer rate of the link with a HIPERFACE encoder. Typically this parameter need not be set.	4800 bits/s / uint16

No.	Name / Range / Selection	Description	Def / Type FbEq 16b / 32b
	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 92.01 Encoder 1 type = Absolute encoder) Defines the node address for a HIPERFACE encoder. Typically this parameter need not be set.	64 NoUnit / uint16
	0...255	HIPERFACE encoder node address.	- / 1 = 1
92.50	Position delta limit	(Visible when 92.01 Encoder 1 type = Absolute encoder) Defines the position delta for the position delta validation limit. This equation defines the position delta validation limit: 92.50 Position delta limit / 92.51 Position delta mask time. The position delta validation measures the position feedback values in 250 µs intervals. If a change rate (rev/s) between two consequent values is smaller than the position delta validation limit (92.50/92.51), the validation accept the latest position feedback value for the use in the position control. If the change is bigger, the validation rejects the latest position feedback value and defines (extrapolates) a new value for the use based on the previous valid position feedback values. The configuration parameters (92.50 and 92.51) are visible for the absolute encoders only. For other position feedback sources, the position delta validation limit is 500 rev/s. A control board boot is required for parameter changes to take effect. This functionality filters out unexplained short spikes in SSI position measurements caused by electrical disturbances or timing issues. The limit per sec. must be higher than the application's maximum speed due to measurement jitter, especially in the continuous mode under 92.30/93.30 Serial link mode.	500 rev / uint16
	0 ... 1000.0 rev	Position delta limit	- / 1 = 1 rev
92.51	Position delta mask time	(Visible when 92.01 Encoder 1 type = Absolute encoder) Defines the position delta mask time for the position delta validation limit. This equation defines the position delta validation limit: 92.50 Position delta limit / 92.51 Position delta mask time. Refer to parameter 92.50 Position delta limit.	2 ms / uint16
	0...3000 ms	Position delta mask time	- / 1 = 1 ms

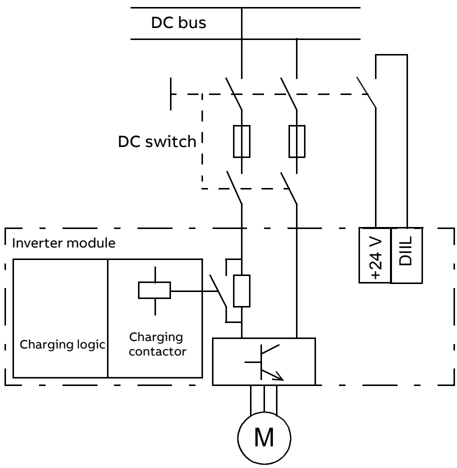
No.	Name / Range / Selection	Description	Def / Type FbEq 16b / 32b
93	Encoder 2 configuration	Settings for encoder 2. **Note:** The contents of the parameter group vary according to the selected encoder type. **Note:** It is recommended that encoder connection 1 (group 92 Encoder 1 configuration) is 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 / uint16
	None configured	None.	0
	TTL	TTL. Module type (input): FEN-01 (X31), FEN-11 (X41) or FEN-21 (X51).	1
	TTL+	TTL+. 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). Not supported at the time of publication.	7
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 2 / uint16
	Module 1	Interface module 1.	1
	Module 2	Interface module 2.	2
93.10	Pulses/revolution	(Visible when 93.01 Encoder 2 type = HTL 1) See parameter 92.10 Pulses/revolution.	- / uint16
93.10	Sine/cosine number	(Visible when 93.01 Encoder 2 type = Absolute encoder) See parameter 92.10 Sine/cosine number.	- / uint16
93.10	Excitation signal frequency	(Visible when 93.01 Encoder 2 type = Resolver) See parameter 92.10 Excitation signal frequency.	- / uint16
93.11	Pulse encoder type	(Visible when 93.01 Encoder 2 type = HTL 1) See parameter 92.11 Pulse encoder type.	Quadrature / uint16
93.11	Absolute position source	(Visible when 93.01 Encoder 2 type = Absolute encoder) See parameter 92.11 Absolute position source.	None / uint16
93.11	Excitation signal amplitude	(Visible when 93.01 Encoder 2 type = Resolver) See parameter 92.11 Excitation signal amplitude.	- / uint16
93.12	Speed calculation mode	(Visible when 93.01 Encoder 2 type = HTL 1) See parameter 92.12 Speed calculation mode.	Auto rising / uint16
93.12	Zero pulse enable	(Visible when 93.01 Encoder 2 type = Absolute encoder) See parameter 92.12 Zero pulse enable.	Disable / uint16

No.	Name / Range / Selection	Description	Def / Type FbEq 16b / 32b
93.12	Resolver polepairs	(Visible when 93.01 Encoder 2 type = Resolver) See parameter 92.12 Resolver polepairs.	- / uint16
93.13	Position estimation enable	(Visible when 93.01 Encoder 2 type = HTL 1) See parameter 92.13 Position estimation enable.	Enable / uint16
93.13	Position data width	(Visible when 93.01 Encoder 2 type = Absolute encoder) See parameter 92.13 Position data width.	- / uint16
93.14	Speed estimation enable	(Visible when 93.01 Encoder 2 type = HTL 1) See parameter 92.14 Speed estimation enable.	Disable / uint16
93.14	Revolution data width	(Visible when 93.01 Encoder 2 type = Absolute encoder) See parameter 92.14 Revolution data width.	- / uint16
93.15	Transient filter	(Visible when 93.01 Encoder 2 type = HTL 1) See parameter 92.15 Transient filter.	4880Hz / uint16
93.17	Accepted pulse freq of encoder 2	(Visible when 93.01 Encoder 2 type = HTL 1) See parameter 92.17 Accepted pulse freq of encoder 1.	- / uint16
93.21	Encoder cable fault mode	(Visible when 93.01 Encoder 2 type = HTL 1) See parameter 92.21 Encoder cable fault mode.	A, B / uint16
93.24	Pulse edge filtering	(Visible when 93.01 Encoder 2 type = HTL) See parameter 92.24 Pulse edge filtering.	No filtering / uint16
93.30	Serial link mode	(Visible when 93.01 Encoder 2 type = Absolute encoder) See parameter 92.30 Serial link mode.	Initial position / uint16
93.31	EnDat calc time	(Visible when 93.01 Encoder 2 type = Absolute encoder) See parameter 92.31 EnDat max calculation time.	50 ms / uint16
93.32	SSI cycle time	(Visible when 93.01 Encoder 2 type = Absolute encoder) See parameter 92.32 SSI cycle time.	100 us / uint16
93.33	SSI clock cycles	(Visible when 93.01 Encoder 2 type = Absolute encoder) See parameter 92.33 SSI clock cycles.	- / uint16
93.34	SSI position msb	(Visible when 93.01 Encoder 2 type = Absolute encoder) See parameter 92.34 SSI position msb.	- / uint16
93.35	SSI revolution msb	(Visible when 93.01 Encoder 2 type = Absolute encoder) See parameter 92.35 SSI revolution msb.	- / uint16
93.36	SSI data format	(Visible when 93.01 Encoder 2 type = Absolute encoder) See parameter 92.36 SSI data format.	Binary / uint16
93.37	SSI baud rate	(Visible when 93.01 Encoder 2 type = Absolute encoder) See parameter 92.37 SSI baud rate.	100 kBit/s / uint16
93.40	SSI zero phase	(Visible when 93.01 Encoder 2 type = Absolute encoder) See parameter 92.40 SSI zero phase.	315-45 deg / uint16
93.41	EnDat max clock frequency	(Visible when 93.01 Encoder 1 type = Absolute encoder) Defines EnDat encoder clock frequency in continuous speed and position mode (92.30 Serial link mode is Continuous speed and position). Parameter is visible only when FEN-11 TTL absolute encoder interface module (option +L518) is installed in the drive.	1 MHz / uint16
	1 MHz	1 MHz	0
	2 MHz	2 MHz	1

No.	Name / Range / Selection	Description	Def / Type FbEq 16b / 32b
	4 MHz	4 MHz	2
	8 MHz	8 MHz	3
93.45	Hiperface parity	(Visible when 93.01 Encoder 2 type = Absolute encoder) See parameter 92.45 Hiperface parity.	Odd / uint16
93.46	Hiperface baud rate	(Visible when 93.01 Encoder 2 type = Absolute encoder) See parameter 92.46 Hiperface baud rate.	4800 bits/s / uint16
93.47	Hiperface node address	(Visible when 93.01 Encoder 2 type = Absolute encoder) See parameter 92.47 Hiperface node address.	- / uint16
93.50	Position delta limit	(Visible when 93.01 Encoder 1 type = Absolute encoder) Defines the position delta for the position delta validation limit. This equation defines the position delta validation limit: 92.50 Position delta limit / 92.51 Position delta mask time. The position delta validation measures the position feedback values in 250 µs intervals. If a change rate (rev/s) between two consequent values is smaller than the position delta validation limit (92.50/92.51), the validation accept the latest position feedback value for the use in the position control. If the change is bigger, the validation rejects the latest position feedback value and defines (extrapolates) a new value for the use based on the previous valid position feedback values. The configuration parameters (92.50 and 92.51) are visible for the absolute encoders only. For other position feedback sources, the position delta validation limit is 500 rev/s. A control board boot is required for parameter changes to take effect. This functionality filters out unexplained short spikes in SSI position measurements caused by electrical disturbances or timing issues. The limit per sec. must be higher than the application's maximum speed due to measurement jitter, especially in the continuous mode under 92.30/93.30 Serial link mode.	500 rev / uint16
	0 ... 1000.0 rev	Position delta limit	- / 1 = 1 rev
93.51	Position delta mask time	(Visible when 93.01 Encoder 1 type = Absolute encoder) Defines the position delta mask time for the position delta validation limit. This equation defines the position delta validation limit: 92.50 Position delta limit / 92.51 Position delta mask time. Refer to parameter 92.50 Position delta limit.	2 ms / uint16
	0...3000 ms	Position delta mask time	- / 1 = 1 ms

No.	Name / Range / Selection	Description	Def / Type FbEq 16b / 32b
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. **Note:** This parameter cannot be changed while the drive is running.	Not given / uint16
	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 the IGBT supply unit is active (95.20 HW options word 1), the voltage limits are related to the DC voltage reference transmitted to the supply unit assuming that the reference is high enough. 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. *Affected by 95.20 HW options word 1, bit 15.	Disable; Enable (95.20 b15) / uint16
	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. *The default value depends on the type of control unit and the setting of parameter 95.20 HW options word 1, bit 4.	Internal 24V (ZCU); External 24V (BCU; 95.20 b4) / uint16

No.	Name / Range / Selection	Description	Def / Type FbEq 16b / 32b
	Internal 24V	The drive control unit is powered from the drive power unit it is connected to. **Note:** If reduced run is required, select External 24V or Redundant external 24V instead.	0
	External 24V	The drive control unit is powered from an external power supply. The drive power unit and power unit link faults are masked when the drive is in stopped state, so the main circuit can be powered down without faults while the control unit is powered.	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). The drive power unit and power unit link faults are masked when the drive is in stopped state, so the main circuit can be powered down without faults while the control unit is powered.	2

No.	Name / Range / Selection	Description	Def / Type FbEq 16b / 32b
95.08	DC switch monitor-ing	*(Only visible with a ZCU control unit)* 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 re-charged. **Note:** By default, DIIL is the input for the Run enable signal. Adjust 20.12 Run enable 1 source if necessary. **Note:** 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) / uint16
	Disable	DC switch monitoring through the DIIL input disabled.	0
	Enable	DC switch monitoring through the DIIL input enabled.	1

No.	Name / Range / Selection	Description	Def / Type FbEq 16b / 32b
95.09	Switch fuse controller	*(Only visible with a BCU control unit)* Activates communication to a BSFC 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. On units without a DC switch, this parameter should be set to Disable. The charging controller monitors the charging of the inverter unit, and sends an enable command when the charging has finished (ie. DC switch is closed after the 'charging OK' lamp lights, and charging switch opened). For more information, see BSFC documentation.	- / uint16
	Disable	Communication with BSFC disabled.	0
	Enable	Communication with BSFC enabled.	1
95.13	Reduced run mode	*(Only visible with a BCU control unit)* Specifies the number of inverter modules available. This parameter must be set if reduced run is required. A value other than 0 activates the reduced run function. If the control program cannot detect the number of modules specified by this parameter, a fault (5695 Reduced run) is generated. See section Reduced run function (page 122). 0 = Reduced run disabled 1…12 = Number of modules available **Note:** This parameter cannot be changed while the drive is running.	- / uint16
	0…65535	Number of inverter modules available.	- / -
95.14	Connected modules	*(Only visible with a BCU control unit)* Shows which of the parallel-connected inverter modules have been detected by the control program. **Note:** This parameter is read-only.	0000h / uint16
b0	Module 1	Module 1 has been detected.	
b1	Module 2	Module 2 has been detected.	
b2	Module 3	Module 3 has been detected.	
b3	Module 4	Module 4 has been detected.	
b4	Module 5	Module 5 has been detected.	
b5	Module 6	Module 6 has been detected.	
b6	Module 7	Module 7 has been detected.	
b7	Module 8	Module 8 has been detected.	
b8	Module 9	Module 9 has been detected.	

No.	Name / Range / Selection	Description	Def / Type FbEq 16b / 32b
b9	Module 10	Module 10 has been detected.	
b10	Module 11	Module 11 has been detected.	
b11	Module 12	Module 12 has been detected.	
b12…15	Reserved		
	0000h…FFFFh		1 = 1 / 1 = 1
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. **Note:** This parameter cannot be changed while the drive is running.	- / uint16
b0	EX motor	1 = The driven motor is an Ex motor provided by ABB for potentially explosive atmospheres. This sets the required minimum switching frequency for ABB Ex motors. **Note:** For non-ABB Ex motors, contact your local ABB representative.	
b1	ABB sine filter	1 = An ABB sine filter is connected to the output of the drive/inverter.	
b2	High speed mode	1 = Minimum switching frequency limit adaptation to output frequency active. This setting improves control performance at high output frequencies (typically above 120 Hz.	
b3	Custom sine filter	1 = A custom sine filter is connected to the output of the drive/inverter. See also parameters 97.01, 97.02, 99.18, 99.19.	
b4…15	Reserved		
	0000h…FFFFh		1 = 1 / 1 = 1
95.16	Router mode	*(Only visible with a BCU control unit)* Enables/disables router mode of the BCU control unit. When router mode is active, the PSL2 channels connected to another BCU (ie. those selected by 95.17 Router channel config) are routed to the power units (converter modules) connected to this BCU. **Note:** This parameter cannot be changed while the drive is running.	Off / uint32
	Off	Router mode inactive.	0
	On	Router mode active.	1
	Other [bit]	See Terms and abbreviations (page 132).	-

No.	Name / Range / Selection	Description	Def / Type FbEq 16b / 32b
95.17	Router channel config	*(Only visible with a BCU control unit)* Selects which PSL2 channels on the BCU control unit are connected to another BCU and routed to a local power unit. **Note:** The local power units are to be connected to successive channels starting from CH1. The other BCU is then connected to one or more successive channels starting from the first free channel. **Note:** The lowest channel selected in this parameter is routed to the local power unit with the lowest number, etc. **Note:** There must be at least as many local power modules as there are routed channels. **Note:** This parameter cannot be changed while the drive is running.	- / uint16
b0	ch1	0	
b1	ch2	1 = Channel CH2 is routed to the local power unit (which is connected to CH1)	
b2	ch3	1 = Channel CH3 is routed to the local power unit (which is connected to CH1)	
b3	ch4	1 = Channel CH4 is routed to a local power unit	
b4	ch5	1 = Channel CH5 is routed to a local power unit	
b5	ch6	1 = Channel CH6 is routed to a local power unit	
b6	ch7	1 = Channel CH7 is routed to a local power unit	
b7	ch8	1 = Channel CH8 is routed to a local power unit	
b8	ch9	1 = Channel CH9 is routed to a local power unit	
b9	ch10	1 = Channel CH10 is routed to a local power unit	
b10	ch11	1 = Channel CH11 is routed to a local power unit	
b11	ch12	1 = Channel CH12 is routed to a local power unit	
b12…15	Reserved		
	0000h…FFFFh		1 = 1 / 1 = 1

No.	Name / Range / Selection	Description	Def / Type FbEq 16b / 32b
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 many 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. **WARNING!** After switching any bits in this word, recheck the values of the affected parameters. **Note:** This parameter cannot be changed while the drive is running.	- / uint16
b0	Supply frequency 60 Hz	0 = 50 Hz; 1 = 60 Hz. Affects 11.45, 11.59, 12.20, 13.18, 30.11, 30.12, 30.13, 30.14, 31.26, 31.27, , , , , 46.01, 46.02.	
b1	Emergency stop Cat 0	1 = Emergency stop, Category 0, without FSO module. Affects 21.04, 21.05, 23.11.	
b2	Emergency stop Cat 1	1 = Emergency stop, Category 1, without FSO module. Affects 10.24, 21.04, 21.05, 23.11.	
b3	RO2 for -07 cabinet cooling fan	1 = Control of cabinet cooling fan (used only with specific ACS880-07 hardware). Affects 10.27, 10.28, 10.29.	
b4	Externally powered control unit	1 = Control unit powered externally. Affects 95.04. *(Only visible with a ZCU control unit)*	
b5	DC supply switch	1 = DC switch monitoring active. Affects 20.12, 31.03, 95.08. *(Only visible with a ZCU control unit)*	
b6	DOL motor switch	1 = Motor fan control active. Affects 10.24, 35.100, 35.103, 35.104.	
b7	xSFC-01fuse switch controller	1 = xSFC-01 fuse switch controller. Affects 95.09. *(Only visible with a BCU control unit)*	
b8	Service switch or PTC/Pt100 relay	1 = Service switch or PTC/Pt100 relay connected. Affects 31.01, 31.02.	
b9	Output contactor	1 = Output contactor present. Affects 10.24, 20.12.	
b10	Brake resistor, sine filter, IP54 fan	1 = Status (eg. thermal) switches connected to DIIL input. Affects 20.11, 20.12.	
b11	INU-DSU communication	*1 = Diode supply unit control by inverter unit active. Makes several parameters visible in groups 06.	
b12	Reserved		

No.	Name / Range / Selection	Description	Def / Type FbEq 16b / 32b
b13	du/dt filter activation	1 = Active: An external du/dt filter is connected to the drive output. The setting will limit the output switching frequency. With inverter module frame sizes R5i to R7i, the fan of the module will be forced to full speed. **Note:** This bit is to be left at 0 if the drive/inverter module is equipped with internal du/dt filtering (eg. frame R8i inverter modules with option +E205).	
b14	DOL fan activation	1 = The inverter unit consists of frame R8i modules with direct-on-line cooling fans (option +C188). Disables fan feedback monitoring and changes fan control to ON/OFF type.	
b15	INU-ISU communication	*1 = IGBT supply unit control by inverter unit active. Affects 31.23 and 95.02. Makes several parameters visible in groups 01, 05, 06, 07, 30, 31, , , , and 96.	
	0000h…FFFFh		1 = 1 / 1 = 1
95.21	HW options word 2	Specifies more hardware-related options that require differentiated parameter defaults. See parameter 95.20 HW options word 1. **WARNING!** After switching any bits in this word, recheck the values of the affected parameters. **Note:** This parameter cannot be changed while the drive is running.	- / uint16
b0	Dual use	1 = Dual use active. For drives with option +N8200. (Allows higher output speeds/frequencies and speed/frequency reference limits.)	
b1	SynRM	1 = Synchronous reluctance motor used. Affects 25.02, 25.03, 25.15, 99.03.	
b2	Salient PM	1 = Salient-pole permanent magnet motor used. Affects 25.02, 25.03, 25.15, 99.03. 99.1	
b3	LV Synchro	1 = Externally-excited synchronous motor used. Requires a license. Contact your local ABB representative for more information.	
b4	Aux fan 1 supervision	1 = Auxiliary fan 1 installed and supervised.	
b5	Aux fan 2 supervision	1 = Auxiliary fan 2 installed and supervised.	
b6…15	Reserved		
	0000h…FFFFh		1 = 1 / 1 = 1

No.	Name / Range / Selection	Description	Def / Type FbEq 16b / 32b
95.31	Parallel type configuration	*(Only visible with a BCU control unit)* Defines the drive/inverter type if it consists of parallel-connected modules. If the drive/inverter consists of a single module, leave the value at Not selected. **Note:** This parameter cannot be changed while the drive is running.	Not selected / uint16
	Not selected	The drive/inverter does not consist of parallel-connected modules, or type not selected.	0
	[Drive/inverter type]	Drive/inverter type consisting of parallel-connected modules.	-
95.40	Transformation ratio	Defines the ratio of the step-up transformer.	0.000 NoUnit / real32
	0.000 … 100.000	Step-up transformer ratio.	1000 = 1 / 1000 = 1

No.	Name / Range / Selection	Description	Def / Type FbEq 16b / 32b
96	System	Language selection; access levels; macro selection; parameter save and restore; control unit reboot; user parameter sets; unit selection; data logger triggering; parameter checksum calculation; user lock.	
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. **Note:** This parameter does not affect the languages visible in the Drive Composer PC tool. (Those are specified under View – Settings.)	Not selected / uint16
	Deutsch	German.	1031
	Italiano	Italian.	1040
	Español	Spanish.	3082
	Português	Portuguese.	2070
	Nederlands	Dutch.	1043
	Français	French.	1036
	Dansk	Danish.	1030
	Suomi	Finnish.	1035
	Svenska	Swedish.	1053
	Русский	Russian.	1049
	Not selected	None.	0
	Polski	Polish.	1045
	Česky	Czech.	1029
	Chinese (Simplified, PRC)	Simplified Chinese.	2052
	Türkçe	Turkish.	1055
	Japanese	Japanese.	1041
	English	English.	1033

No.	Name / Range / Selection	Description	Def / Type FbEq 16b / 32b
96.02	Pass code	Pass codes can be entered into this parameter to activate further access levels (see parameter 96.03 Access levels active) or to configure the user lock. Entering "358" toggles the parameter lock, which prevents the changing of all other parameters through the control panel or the Drive Composer PC tool. Entering the user pass code (by default, "10000000") enables parameters 96.100…96.102, which can be used to define a new user pass code and to select the actions that are to be prevented. Entering an invalid pass code will close the user lock if open, i.e. hide parameters 96.100…96.102. After entering the code, check that the parameters are in fact hidden. If they are not, enter another (random) pass code. Entering invalid pass code introduces a delay before a new attempt can be made. **Note:** You must change the default user pass code to maintain a high level of cybersecurity. Store the code in a safe place – the protection cannot be disabled even by ABB if the code is lost. See also section User lock (page 121).	0 / uint32
	0…99999999	Pass code.	1 = 1
96.03	Access levels active	Shows which access levels have been activated by pass codes entered into parameter 96.02 Pass code. **Note:** This parameter is read-only.	- / uint16
b0	End user	End user.	
b1	Service	Service.	
b2	Advanced programmer	Advanced programmer.	
b3	Reserved		
b11	OEM access level 1	OEM access level 1.	
b12	OEM access level 2	OEM access level 2.	
b13	OEM access level 3	OEM access level 3.	
b14	Parameter lock	Parameter lock.	
b15	Reserved		
	0000h…FFFFh		1 = 1 / 1 = 1

No.	Name / Range / Selection	Description	Def / Type FbEq 16b / 32b
96.04	Macro select	Selects the application macro. See chapter Application macros for more information. After a selection is made, the parameter reverts automatically to Done. **Note:** This parameter cannot be changed while the drive is running.	Done / uint16
	Done	Macro selection complete; normal operation.	0
	Factory	Factory macro.	1
	Hand/Auto	Hand/Auto macro.	2
	PID-CTRL	PID control macro.	3
	T-CTRL	Torque control macro.	4
	Sequence control	Sequential control macro.	5
	FIELDBUS	Reserved.	6
96.05	Macro active	Shows which application macro is currently selected. To change the macro, use parameter 96.04 Macro select.	Factory / uint16
	Factory	Factory macro.	1
	Hand/Auto	Hand/Auto macro.	2
	PID-CTRL	PID control macro.	3
	T-CTRL	Torque control macro.	4
	Sequence control	Sequential control macro.	5
	FIELDBUS	Reserved.	6
96.06	Parameter restore	Restores the original settings of the control program, i.e. parameter default values. **Note:** This parameter cannot be changed while the drive is running.	Done / uint16
	Done	Restoring is completed.	0
	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 95.21 HW options word 2 • parameter 95.09 Switch fuse controller • differentiated defaults implemented by parameters 95.20 HW options word 1 and 95.21 HW options word 2 • user lock configuration parameters 96.100 … 96.102.	8

No.	Name / Range / Selection	Description	Def / Type FbEq 16b / 32b
	Clear all	All editable parameter values are restored to default values, except • control panel/PC communication settings • application macro selection and the parameter defaults implemented by it • parameter 95.01 Supply voltage • parameter 95.09 Switch fuse controller • differentiated defaults implemented by parameters 95.20 HW options word 1 and 95.21 HW options word 2 • user lock configuration parameters 96.100 … 96.102. PC tool communication is interrupted during the restoring. **Note:** Activating this selection will restore the default settings of the fieldbus adapter if one is connected, potentially including settings that cannot be accessed through drive parameters.	62
	Reset all fieldbus settings	Fieldbus adapter and embedded fieldbus interface settings (parameter groups 50…58) are restored to default values. This will also restore the default settings of the fieldbus adapter if one is connected, potentially including settings that cannot be accessed through drive parameters.	32
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 / uint16
	Done	Save completed.	0
	Save	Start save, or 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. **Note:** This parameter cannot be changed while the drive is running.	- / uint16
	0…1	1 = Reboot the control unit.	1 = 1 / 1 = 1
96.09	FSO reboot	Changing the value of (or the source selected by) this parameter from 0 to 1 reboots the optional FSO-xx safety functions module. **Note:** The value does not revert to 0 automatically.	False / uint32
	False	0.	0
	True	1.	1

No.	Name / Range / Selection	Description	Def / Type FbEq 16b / 32b
	Other [bit]	See Terms and abbreviations (page 132).	-
96.10	User set status	Shows the status of the user parameter sets. **Note:** This parameter is read-only. See also section User parameter sets (page 119).	n/a / uint16
	n/a	No user parameter sets have been saved.	0
	Loading	A user set is being loaded.	1
	Saving	A user set is being saved.	2
	Faulted	Invalid parameter set.	3
	User set 1	User set 1 has been loaded.	4
	User set 2	User set 2 has been loaded.	5
	User set 3	User set 3 has been loaded.	6
	User set 4	User set 4 has been loaded.	7
96.11	User set save/load	Enables the saving and restoring of up to four custom sets of parameter settings. See section User parameter sets (page 119). The set that was in use before powering down the drive is in use after the next power-up. **Note:** Hardware configuration settings such as I/O extension module, fieldbus and encoder configuration parameters (groups 14…16, 51…56, 58 and 92…93, and parameters 50.01 and 50.31), and forced input/output values (such as 10.03 and 10.04) are not included in user parameter sets. **Note:** Parameter changes made after loading a set are not automatically stored – they must be saved using this parameter. **Note:** If no sets have been saved, attempting to load a set will create all sets from the currently active parameter settings. **Note:** Switching between sets is only possible with the drive stopped.	No action / uint16
	No action	Load or save operation complete; normal operation.	0
	User set I/O mode	Load user parameter set using parameters 96.12 and 96.13.	1
	Load set 1	Load user parameter set 1.	2
	Load set 2	Load user parameter set 2.	3
	Load set 3	Load user parameter set 3.	4
	Load set 4	Load user parameter set 4.	5
	Save to set 1	Save user parameter set 1.	18
	Save to set 2	Save user parameter set 2.	19

<table>
<tr><th>No.</th><th>Name / Range / Selection</th><th>Description</th><th>Def / Type
FbEq 16b / 32b</th></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 I/O mode in1</td><td>When parameter 96.11 is set to User set I/O mode (page 490), selects the user parameter set together with parameter 96.13 as follows:
<table>
<tr><th>Status of source defined by 96.12</th><th>Status of source defined by 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 / uint32</td></tr>
<tr><td></td><td>Not selected</td><td>0</td><td>0</td></tr>
<tr><td></td><td>Selected</td><td>1</td><td>1</td></tr>
<tr><td></td><td>DI1</td><td>Digital input DI1 (10.02 DI delayed status, bit 0).</td><td>2</td></tr>
<tr><td></td><td>DI2</td><td>Digital input DI2 (10.02 DI delayed status, bit 1).</td><td>3</td></tr>
<tr><td></td><td>DI3</td><td>Digital input DI3 (10.02 DI delayed status, bit 2).</td><td>4</td></tr>
<tr><td></td><td>DI4</td><td>Digital input DI4 (10.02 DI delayed status, bit 3).</td><td>5</td></tr>
<tr><td></td><td>DI5</td><td>Digital input DI5 (10.02 DI delayed status, bit 4).</td><td>6</td></tr>
<tr><td></td><td>DI6</td><td>Digital input DI6 (10.02 DI delayed status, bit 5).</td><td>7</td></tr>
<tr><td></td><td>DIO1</td><td>Digital input/output DIO1 (11.02 DIO delayed status, bit 0).</td><td>10</td></tr>
<tr><td></td><td>DIO2</td><td>Digital input/output DIO2 (11.02 DIO delayed status, bit 1).</td><td>11</td></tr>
<tr><td></td><td>Other [bit]</td><td>See Terms and abbreviations (page 132).</td><td>-</td></tr>
<tr><td>96.13</td><td>User set I/O mode in2</td><td>See parameter 96.12 User set I/O mode in1.</td><td>Not selected / uint32</td></tr>
<tr><td>96.16</td><td>Unit selection</td><td>Selects the unit of parameters indicating power, temperature and torque.</td><td>- / uint16</td></tr>
<tr><td>b0</td><td>Power unit</td><td>0 = kW
1 = hp</td><td></td></tr>
<tr><td>b1</td><td>Reserved</td><td></td><td></td></tr>
<tr><td>b2</td><td>Temperature unit</td><td>0 = C (°C)
1 = F (°F)</td><td></td></tr>
<tr><td>b3</td><td>Reserved</td><td></td><td></td></tr>
<tr><td>b4</td><td>Torque unit</td><td>0 = Nm (N·m)
1 = lbft (lbf·ft)</td><td></td></tr>
<tr><td>b5…15</td><td>Reserved</td><td></td><td></td></tr>
<tr><td></td><td>0000h…FFFFh</td><td></td><td>1 = 1 / 1 = 1</td></tr>
</table>

No.	Name / Range / Selection	Description	Def / Type FbEq 16b / 32b
96.20	Time sync primary source	Defines the 1st priority external source for synchronization of the drive's time and date. The date and time can also be directly set into 96.24 … 96.26 in which case this parameter is ignored.	DDCS Controller / uint16
	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
	D2D or M/F	The master station on a master/follower or drive-to-drive link.	5
	Embedded FB	Embedded fieldbus interface.	6
	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.	12055 days / uint16
	1...59999 days	Days count. 1 = 1st January 1980.	1 = 1 days / 1 = 1 days
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 / uint16
	0...1439 min	Minutes since midnight.	1 = 1 min / 1 = 1 min
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 / uint16
	0...59999 ms	Number of milliseconds since last minute.	1 = 1 ms / 1 = 1 ms
96.29	Time sync source status	Time source status word. **Note:** This parameter is read-only.	- / uint16
b0	Time tick received	1 = 1st priority tick received: Tick has been received from 1st priority source (or from 96.24 … 96.26).	
b1	Aux Time tick received	1 = 2nd priority tick received: Tick has been received from 2nd priority source.	
b2	Tick interval is too long	1 = Yes: Tick interval too long (accuracy compromised).	
b3	DDCS controller	1 = Tick received: Tick has been received from an external controller.	

No.	Name / Range / Selection	Description	Def / Type FbEq 16b / 32b
b4	Master/Follower	1 = Tick received: Tick has been received through the master/follower link.	
b5	Reserved		
b6	D2D	1 = Tick received: Tick has been received through the drive-to-drive link.	
b7	FbusA	1 = Tick received: Tick has been received through fieldbus interface A.	
b8	FbusB	1 = Tick received: Tick has been received through fieldbus interface B.	
b9	EFB	1 = Tick received: Tick has been received through the embedded fieldbus interface.	
b10	Reserved		
b11	Panel link	1 = Tick received: Tick has been received from the control panel, or Drive Composer PC tool connected to the control panel.	
b12	Ethernet tool link	1 = Tick received: Tick has been received from Drive Composer PC tool through an FENA module.	
b13	Parameter setting	1 = Tick received: Tick has been set by parameters 96.24 … 96.26.	
b14	RTC	1 = RTC time in use: Time and date have been read from the real-time clock.	
b15	Drive On-Time	1 = Drive on-time in use: Time and date are displaying drive on-time.	
	0000h…FFFFh		1 = 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 null / uint16
	0…32767	ID number.	1 = 1 / 1 = 1
96.39	Power up event logging	Enables/disables power-up logging. When enabled, an event (B5A2 Power up) is logged by the drive upon each power-up.	Enable / uint16
	Disable	Power-up event logging disabled.	0
	Enable	Power-up event logging enabled.	1
96.51	Clear fault and event logger	Clears the contents of the event logs. See section Warning/fault history and analysis (page 519).	- / uint16
	0…65535	00001 = Clear the event logs. (The value will automatically revert to 00000.)	1 = 1 / 1 = 1

No.	Name / Range / Selection	Description	Def / Type FbEq 16b / 32b
96.53	Actual checksum	Displays the actual parameter configuration checksum. The checksum is generated and updated whenever an action is selected in 96.54 Checksum action. If parameter 96.54 is set to No action, the value of parameter 96.53 will be 0. The parameters included in the calculation have been pre-selected, but the selection can be edited using the Drive customizer PC tool. See also section Parameter checksum calculation (page 119).	0 / uint32
	00000000…FFFFFFFFh	Actual checksum.	1 = 1
96.54	Checksum action	Selects how the drive reacts if the parameter checksum (96.53 Actual checksum) does not match any of the active approved checksums (96.56 … 96.59). The active checksums are selected by 96.55 Checksum control word.	No action / uint16
	No action	No action taken. (The checksum feature is not in use.)	0
	Pure event	The drive generates an event log entry (B686 Checksum mismatch).	1
	Warning	The drive generates a warning (A686 Checksum mismatch).	2
	Warning and prevent start	The drive generates a warning (A686 Checksum mismatch). Starting the drive is prevented.	3
	Fault	The drive trips on 6200 Checksum mismatch.	4
96.55	Checksum control word	Bits 0…3 select to which approved checksums (out of 96.56 … 96.59) the actual checksum (96.53) is compared. Bits 4…7 select an approved (reference) checksum parameter (96.56 … 96.59) into which the actual checksum from parameter 96.53 is copied.	- / uint16
b0	Approved checksum 1	1 = Enabled: Checksum 1 (96.56) is observed.	
b1	Approved checksum 2	1 = Enabled: Checksum 2 (96.57) is observed.	
b2	Approved checksum 3	1 = Enabled: Checksum 3 (96.58) is observed.	
b3	Approved checksum 4	1 = Enabled: Checksum 4 (96.59) is observed.	
b4	Set approved checksum 1	1 = Set: Copy value of 96.53 into 96.56.	
b5	Set approved checksum 2	1 = Set: Copy value of 96.53 into 96.57.	
b6	Set approved checksum 3	1 = Set: Copy value of 96.53 into 96.58.	
b7	Set approved checksum 4	1 = Set: Copy value of 96.53 into 96.59.	

No.	Name / Range / Selection	Description	Def / Type FbEq 16b / 32b
b8…15	Reserved		
	0000h…FFFFh		1 = 1 / 1 = 1
96.56	Approved checksum 1	Approved (reference) checksum 1.	0 / uint32
	00000000…FFFFFFFFh	Approved checksum 1.	1 = 1
96.57	Approved checksum 2	Approved (reference) checksum 2.	0 / uint32
	00000000…FFFFFFFFh	Approved checksum 2.	1 = 1
96.58	Approved checksum 3	Approved (reference) checksum 3.	0 / uint32
	00000000…FFFFFFFFh	Approved checksum 3.	1 = 1
96.59	Approved checksum 4	Approved (reference) checksum 4.	0 / uint32
	00000000…FFFFFFFFh	Approved checksum 4.	1 = 1
96.61	User data logger status word	Provides status information on the user data logger. See section Warning/fault history and analysis (page 519). **Note:** This parameter is read-only.	0001h / uint16
b0	Running	1 = The user data logger is running. The bit is cleared after the post-trigger time has passed.	
b1	Triggered	1 = The user data logger has been triggered. The bit is cleared when the logger is restarted.	
b2	Data available	1 = The user data logger contains data that can be read. Note that the bit is not cleared because the data is saved to the memory unit.	
b3	Configured	1 = The user data logger has been configured. Note that the bit is not cleared because the configuration data is saved to the memory unit.	
b4…15	Reserved		
	0000h…FFFFh		1 = 1 / 1 = 1
96.63	User data logger trigger	Triggers, or selects a source that triggers, the user data logger.	Off / uint32
	Off	0.	0
	On	1.	1
	Other [bit]	See Terms and abbreviations (page 132).	-
	Other [bit]	See Terms and abbreviations (page 132).	-
96.64	User data logger start	Starts, or selects a source that starts, the user data logger.	Off / uint32
	Off	0.	0
	On	1.	1
	Other [bit]	See Terms and abbreviations (page 132).	-

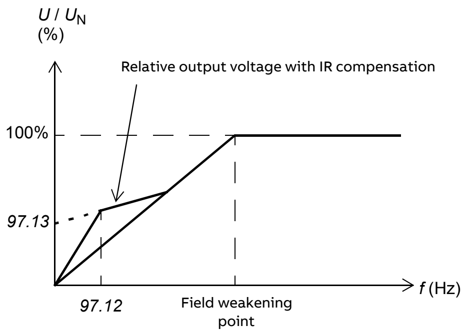
No.	Name / Range / Selection	Description	Def / Type FbEq 16b / 32b
96.65	Factory data logger time level	Selects the sampling interval for the factory data logger. See section Warning/fault history and analysis (page 519).	500us / uint16
	500us	500 microseconds.	500
	2ms	2 milliseconds.	2000
	10ms	10 milliseconds.	10000
96.70	Disable adaptive program	Disables/enables the adaptive program (if present). See also section Adaptive programming (page 71). **Note:** This parameter cannot be changed while the drive is running.	No / uint16
	No	Adaptive program enabled.	0
	Yes	Adaptive program disabled.	1
96.100	Change user pass code	*(Visible when user lock is open)* To change the current user pass code, enter a new code into this parameter as well as 96.101 Confirm user pass code. A warning will be active until the new pass code is confirmed. To cancel changing the pass code, close the user lock without confirming. To close the lock, enter an invalid pass code in parameter 96.02 Pass code, activate parameter 96.08 Control board boot, or cycle the power. See also section User lock (page 121).	10000000 / uint32
	10000000…99999999	New user pass code.	1 = 1
96.101	Confirm user pass code	*(Visible when user lock is open)* Confirms the new user pass code entered in 96.100 Change user pass code (page 496).	10000000 / uint32
	10000000…99999999	Confirmation of new user pass code.	1 = 1
96.102	User lock functionality	*(Visible when user lock is open)* Selects the actions or functionalities to be prevented by the user lock. Note that the changes made take effect only when the user lock is closed. See parameter 96.02 Pass code. **Note:** We recommend you select all the actions and functionalities unless otherwise required by the application.	- / uint16
b0	Disable ABB access levels	1 = ABB access levels (service, advanced programmer, etc. [see 96.03]) disabled	
b1	Freeze parameter lock state	1 = Changing the parameter lock state prevented, ie. pass code 358 has no effect	

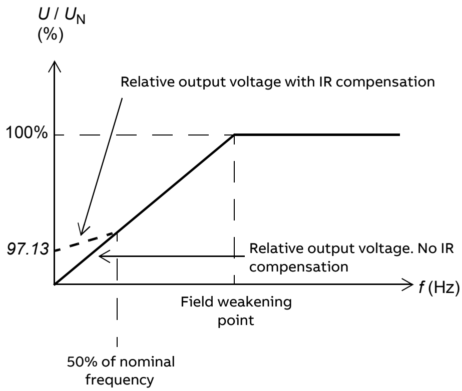
No.	Name / Range / Selection	Description	Def / Type FbEq 16b / 32b
b2	Disable file download	1 = Loading of files to drive prevented. This applies to • firmware upgrades • safety functions module (FSO-xx) configuration • parameter restore • loading an adaptive program • loading and debugging an application program • changing home view of control panel • editing drive texts • editing the favorite parameters list on control panel • configuration settings made through control panel such as time/date formats and enabling/disabling clock display.	
b3	Disable FB access to hidden	1 = Access to parameters on disabled access levels from fieldbus prevented	
b4…5	Reserved		
b6	Protect AP	1 = Creating a backup and restoring from a backup prevented	
b7	Disable panel bluetooth	1 = Bluetooth disabled on ACS-AP-W control panel. If the drive is part of a panel bus, Bluetooth is disabled on all panels.	
b8…10	Reserved		
b11	Disable OEM access level 1	1 = OEM access level 1 disabled	
b12	Disable OEM access level 2	1 = OEM access level 2 disabled	
b13	Disable OEM access level 3	1 = OEM access level 3 disabled	
b14…15	Reserved		
	0000h…FFFFh		1 = 1 / 1 = 1

No.	Name / Range / Selection	Description	Def / Type FbEq 16b / 32b
97	Motor control	Motor model settings.	
97.01	Switching frequency reference	When parameter 97.09 Switching freq mode is set to Custom, defines the switching frequency when it is not otherwise being internally limited. **Note:** This is an expert level parameter and should not be adjusted without appropriate skill.	4.500 kHz / real32
	0.000 ... 24.000 kHz	Switching frequency reference.	1000 = 1 kHz / 1000 = 1 kHz
97.02	Minimum switching frequency	When parameter 97.09 Switching freq mode is set to Custom, defines a minimum switching frequency reference. The actual switching frequency will not fall below this limit under any circumstances. **Note:** This is an expert level parameter and should not be adjusted without appropriate skill. **Note:** The drive has internal switching frequency limits that may override the value entered here.	1.500 kHz / real32
	0.000 ... 24.000 kHz	Minimum switching frequency.	1000 = 1 kHz / 1000 = 1 kHz
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 percent / real32
	0...200 %	Slip gain.	1 = 1 % / 100 = 1 %

No.	Name / Range / Selection	Description	Def / Type FbEq 16b / 32b
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. **Note:** The default value for ACS880-11/31/14/34 and R8, R11 of ACS880-17/37 is -3%.	-2 percent / real32
	-5...50 %	Voltage reserve.	1 = 1 % / 100 = 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 96). **Note:** This is an expert level parameter and should not be adjusted without appropriate skill.	Disabled / uint16
	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 / uint32
	Zero	None.	0
	User flux reference	Parameter 97.07 User flux reference.	1
	Other [bit]	Source selection. See Terms and abbreviations (page 132).	-
97.07	User flux reference	Defines the flux reference when parameter 97.06 Flux reference select is set to User flux reference.	100.00 percent / real32
	0.00 ... 200.00 %	User-defined flux reference.	100 = 1 % / 100 = 1 %

No.	Name / Range / Selection	Description	Def / Type FbEq 16b / 32b
97.08	Optimizer minimum torque	This parameter can be used to improve the control dynamics of a synchronous reluctance motor or a salient permanent magnet synchronous motor. As a rule of thumb, define a level to which the output torque must rise with minimum delay. This will increase the motor current and improve the torque response at low speeds.	0.0 percent / real32
	0.0 … 1600.0 %	Optimizer torque limit.	10 = 1 % / 10 = 1 %
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. **Note:** Other settings than Normal may require derating. Refer to the rating data in the hardware manual of the drive. **Note:** To improve the control performance, the switching frequency reference is automatically increased with ABB sine filter if the motor/drive current ratio is less than 0.55.	Normal / uint16
	Normal	Control performance optimized for long motor cables.	0
	Low noise	Minimizes motor noise.	1
	Cyclic	Control performance optimized for cyclic load applications.	2
	Custom	This setting is to be used by ABB-authorized service personnel only.	3
97.10	Signal injection	Enables signal injection. A high-frequency alternating signal is injected into the motor at low speeds to improve the stability of torque control. Signal injection can be enabled with different amplitude levels. **Note:** This is an expert level parameter and should not be adjusted without appropriate skill. **Note:** Use as low a level as possible that gives satisfactory performance. **Note:** Signal injection cannot be applied to asynchronous motors.	Disabled / uint16
	Disabled	Signal injection disabled.	0
	Enabled (5 %)	Signal injection enabled with an amplitude level of 5%.	1
	Enabled (10 %)	Signal injection enabled with an amplitude level of 10%.	2
	Enabled (15 %)	Signal injection enabled with an amplitude level of 15%.	3

No.	Name / Range / Selection	Description	Def / Type FbEq 16b / 32b
	Enabled (20 %)	Signal injection enabled with an 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 percent / real32
	25…400 %	Rotor time constant tuning.	1 = 1 % / 100 = 1 %
97.12	IR comp step-up frequency	IR compensation (i.e. 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 %, a specific type of IR compensation should be used. This parameter adds a frequency breakpoint for parameter 97.13 IR compensation as shown.  0.0 Hz = Breakpoint disabled. **Note:** This parameter cannot be changed while the drive is running.	0.0 Hz / real32
	0.0 … 50.0 Hz	IR compensation breakpoint for step-up applications.	1 = 1 Hz / 10 = 1 Hz

No.	Name / Range / Selection	Description	Def / Type FbEq 16b / 32b
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 (page 92).	0.00 percent / real32
	0.00 … 50.00 %	Voltage boost at zero speed in percent of nominal motor voltage.	1 = 1 % / 10000 = 1 %
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 / uint16
	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
97.18	Hexagonal field weakening	Activates hexagonal motor flux pattern in the field weakening area, i.e. above the limit defined by parameter 97.19 Hexagonal field weakening point. **Note:** This parameter is only effective in scalar motor control mode. See also section Hexagonal motor flux pattern (page 99).	Off / uint16
	Off	The rotating flux vector follows a circular pattern.	0

No.	Name / Range / Selection	Description	Def / Type FbEq 16b / 32b
	On	The flux vector follows a circular pattern below, and a hexagonal pattern above, the hexagonal field weakening point (97.19).	1
97.19	Hexagonal field weakening point	Defines the activation limit for hexagonal field weakening (in percent of the field weakening point, i.e. the frequency at which maximum output voltage is reached). See parameter 97.18 Hexagonal field weakening. **Note:** This parameter is only effective in scalar motor control mode.	120.0 percent / real32
	0.0 … 500.0 %	Activation limit for hexagonal field weakening.	1 = 1 % / 1000 = 1 %
97.32	Motor torque unfiltered	Unfiltered motor torque in percent of the nominal motor torque. **Note:** This parameter is read-only.	0.0 percent / real32
	-1600.0 … 1600.0 %	Unfiltered motor torque. For 16-bit scaling, see parameter 46.03.	- / 10 = 1 %
97.33	Speed estimate filter time	Defines a filtering time for estimated speed See the diagram on page 618.	5.00 ms / real32
	0.00 … 100.00 ms	Filtering time for estimated speed.	1 = 1 ms / 100 = 1 ms

No.	Name / Range / Selection	Description	Def / Type FbEq 16b / 32b
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. **Note:** 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. **Note:** 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. **Note:** This parameter cannot be changed while the drive is running.	Not selected / uint16
	Not selected	The values detected during the ID run are being used.	0
	Motor parameters	The values of parameters 98.02 … 98.14 are used in 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 in the motor model, and the value of parameter 98.15 is used as the rotor angle offset.	3
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. Resistance value is given at 20 °C (68 °F).	0.00000 pu / real32
	0.00000 ... 0.50000 pu	Stator resistance in per unit.	- / 100000 = 1 pu
98.03	Rr user	Defines the rotor resistance R_R of the motor model. Resistance value is given at 20 °C (68 °F). **Note:** This parameter is valid only for asynchronous motors.	0.00000 pu / real32
	0.00000 ... 0.50000 pu	Rotor resistance in per unit.	- / 100000 = 1 pu
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 pu / real32

No.	Name / Range / Selection	Description	Def / Type FbEq 16b / 32b
	0.00000 ... 10.00000 pu	Main inductance in per unit.	- / 100000 = 1 pu
98.05	SigmaL user	Defines the leakage inductance σL_S. **Note:** This parameter is valid only for asynchronous motors.	0.00000 pu / real32
	0.00000 ... 1.00000 pu	Leakage inductance in per unit.	- / 100000 = 1 pu
98.06	Ld user	Defines the direct axis (synchronous) inductance. **Note:** This parameter is valid only for permanent magnet motors and SynRM. With SynRM the value can be used to tune the saturation curve.	0.00000 pu / real32
	0.00000 ... 10.00000 pu	Direct axis inductance in per unit.	- / 100000 = 1 pu
98.07	Lq user	Defines the quadrature axis (synchronous) inductance. **Note:** This parameter is valid only for permanent magnet motors and SynRM. With SynRM the value can be used to tune the saturation curve.	0.00000 pu / real32
	0.00000 ... 10.00000 pu	Quadrature axis inductance in per unit.	- / 100000 = 1 pu
98.08	PM flux user	Defines the permanent magnet flux. **Note:** This parameter is valid only for permanent magnet motors.	0.00000 pu / real32
	0.00000 ... 2.00000 pu	Permanent magnet flux in per unit.	- / 100000 = 1 pu
98.09	Rs user SI	Defines the stator resistance R_S of the motor model. Resistance value is given at 20 °C (68 °F).	0.00000 Ohm / real32
	0.00000 ... 100.00000 Ohm	Stator resistance.	- / 100000 = 1 Ohm
98.10	Rr user SI	Defines the rotor resistance R_R of the motor model. Resistance value is given at 20 °C (68 °F). **Note:** This parameter is valid only for asynchronous motors.	0.00000 Ohm / real32
	0.00000 ... 100.00000 Ohm	Rotor resistance.	100 = 1 Ohm / 100000 = 1 Ohm
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 / real32
	0.00 ... 100000.00 mH	Main inductance.	10 = 1 mH / 100 = 1 mH

No.	Name / Range / Selection	Description	Def / Type FbEq 16b / 32b
98.12	SigmaL user SI	Defines the leakage inductance σL_S. **Note:** This parameter is valid only for asynchronous motors.	0.00 mH / real32
	0.00 … 100000.00 mH	Leakage inductance.	10 = 1 mH / 100 = 1 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 / real32
	0.00 … 100000.00 mH	Direct axis inductance.	10 = 1 mH / 100 = 1 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 / real32
	0.00 … 100000.00 mH	Quadrature axis inductance.	10 = 1 mH / 100 = 1 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 an absolute encoder or an incremental encoder with Z-pulse is used. The value can be fine-tuned by setting 98.01 User motor model mode to Position offset or Motor parameters & position offset. **Note:** The value is in electrical degrees. The electrical angle equals the mechanical angle multiplied by the number of motor pole pairs. **Note:** This parameter is valid only for permanent magnet motors.	0.0 deg / real32
	0.0 … 360.0 deg	Angle offset.	1 = 1 deg / 1 = 1 deg

No.	Name / Range / Selection	Description	Def / Type FbEq 16b / 32b
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; SynRM (95.21 b1); Permanent magnet motor (95.21 b2) / uint16
	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 motor and sinusoidal BackEMF voltage.	1
	SynRM	Synchronous reluctance motor. Three-phase AC synchronous motor with salient pole rotor without permanent magnets.	2
99.04	Motor control mode	Selects the motor control mode. **Note:** This parameter cannot be changed while the drive is running.	DTC / uint16
	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 67).	0
	Scalar	Scalar control. The outstanding motor control accuracy of DTC cannot be achieved in scalar control. Refer to the selection DTC 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 92) and section Operating modes of the drive (page 67).	1

No.	Name / Range / Selection	Description	Def / Type FbEq 16b / 32b
99.06	Motor nominal current	Defines the nominal motor current. This setting must match the value on the rating plate of the motor. If multiple motors are connected to the drive, enter the total current of the motors. **Note:** Correct motor operation requires that the magnetizing current of the motor does not exceed 90% of the nominal current of the drive. **Note:** This parameter cannot be changed while the drive is running.	0.0 A / real32
	0.0 ... 10000.0 A	Nominal current of the motor. The allowable range is 1/6…2 × I_N (nominal current) of the drive and 0…2 × I_N with scalar control mode.	10 = 1 A / 10 = 1 A
99.07	Motor nominal voltage	Defines the nominal motor voltage supplied to the motor. This setting must match the value on the rating plate of the motor. **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 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). **Note:** 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. **Note:** This parameter cannot be changed while the drive is running.	0.0 V / real32
	0.0 ... 1500.0 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 / 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.	0.00 Hz / real32
	0.00 ... 1000.00 Hz	Nominal frequency of the motor.	10 = 1 Hz / 100 = 1 Hz

No.	Name / Range / Selection	Description	Def / Type FbEq 16b / 32b
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. **Note:** (Asynchronous generator) Nominal speed needs to be adjusted as running the generator as a motor.	0 rpm / real32
	0…30000 rpm	Nominal speed of the motor.	1 = 1 rpm / 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.	- / real32
	0.00 … 26000.00 kW or hp	Nominal power of the motor.	1 = 1 kW or hp / 100 = 1 kW or hp
99.11	Motor nominal cos Φ	Defines the cosphi of the motor for a more accurate motor model. The value is not obligatory, but is useful with an asynchronous motor, especially when performing a standstill identification run. With a permanent magnet or synchronous reluctance motor, this value is not needed. **Note:** Do not enter an estimated value. If you do not know the exact value, leave the parameter at zero. **Note:** This parameter cannot be changed while the drive is running.	0.00 NoUnit / real32
	0.00 … 1.00	Cosphi of the motor.	100 = 1 / 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. **Note:** This parameter cannot be changed while the drive is running.	0.000 Nm or lb·ft / uint32
	0.000 … 4000000.000 Nm or lb·ft	Nominal motor torque.	1 = 1 Nm or lb·ft / 1000 = 1 Nm or lb·ft

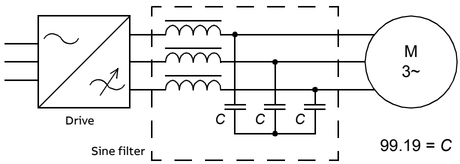
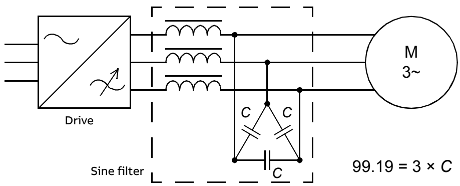
No.	Name / Range / Selection	Description	Def / Type FbEq 16b / 32b
99.13	ID run requested	Selects the type of the motor identification routine (ID run) performed at the next start of the drive. During the ID run, the drive will identify the characteristics of the motor for optimum motor control. If no 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. **Note:** Before activating the ID run, configure motor temperature measurement (if used) in parameter group 35 Motor thermal protection, and in parameter 97.15. **Note:** If a sine filter is installed, set the appropriate bit in parameter 95.15 Special HW settings before activating the ID run. With a non-ABB (custom) filter, set also 99.18 and 99.19. **Note:** With scalar control mode (99.04 Motor control mode = Scalar), the ID run is not requested automatically. However, an ID run can be performed for more accurate torque estimation. **Note:** Once the ID run is activated, it can be canceled by stopping the drive. **Note:** The ID run must be performed every time any of the motor parameters (99.04, 99.06 … 99.12) have been changed. **Note:** Make sure that the Safe torque off and emergency stop circuits (if any) are closed during the ID run. **Note:** Mechanical brake (if present) is not opened by the logic for the ID run. **Note:** For the permanent magnet and SynRM, the Reduced, Normal, and Advanced ID runs are the same. In addition, the Standstill and Advanced Standstill ID runs are identical. **Note:** This parameter cannot be changed while the drive is running.	None; Standstill (95.21 b1/b2) / uint16
	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 / Range / Selection	Description	Def / Type FbEq 16b / 32b
	Normal	Normal ID run: • supports all motor types • load to be decoupled • good performance. Guarantees good control accuracy for all cases. 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 with-stand the nominal torque transient during the ID run, then the driven machinery must be de-coupled from the motor during a Normal ID run. With the permanent magnet or SynRM motors the transient torque value can be up to two times the nominal torque. **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 approxim-ately 50…100% of the nominal speed during the ID run. MAKE SURE THAT IT IS SAFE TO RUN THE MOTOR BEFORE PERFORMING THE ID RUN!	1
	Reduced	Reduced ID run: • supports only induction motors • especially for conical rotor brake motors used in crane applications • load to be decoupled • good performance. 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 run-ning (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 ne-cessarily 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 approxim-ately 50…100% of the nominal speed during the ID run. MAKE SURE THAT IT IS SAFE TO RUN THE MOTOR BEFORE PERFORMING THE ID RUN!	2

No.	Name / Range / Selection	Description	Def / Type FbEq 16b / 32b
	Standstill	Standstill ID run: • supports all motor types • not necessary to decouple the load • moderate performance. 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 because of the restrictions caused by the connected mechanics (e.g. with lift or crane applications. See also selection Advanced Standstill.	3
	Autophasing	The autophasing routine determines the start angle of a permanent magnet or synchronous reluctance motor (see section Autophasing (page 93)). 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. **Note:** 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, i.e. identification of current measurement offset and gain errors. The calibration will be performed at next start.	5

No.	Name / Range / Selection	Description	Def / Type FbEq 16b / 32b
	Advanced	Advanced ID run: • supports only induction motors • load to be decoupled • highest level of performance • takes more time. 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:** If the load torque is 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 Advanced ID run. **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. Several accelerations and decelerations are done. MAKE SURE THAT IT IS SAFE TO RUN THE MOTOR BEFORE PERFORMING THE ID RUN!	6
	Advanced Standstill	Advanced Standstill ID run: • only for Induction motors • recommended <50 kW • not necessary to decouple the load • good performance • takes more time. 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	Displays 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 / uint16
	None	No ID run has been performed.	0
	Normal	Normal ID run.	1
	Reduced	Reduced ID run.	2
	Standstill	Standstill ID run.	3

No.	Name / Range / Selection	Description	Def / Type FbEq 16b / 32b
	Autophasing	Autophasing.	4
	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. This parameter is read-only.	0 NoUnit / uint16
	0…1000	Number of pole pairs.	1 = 1 / 1 = 1
99.16	Motor phase order	Switches the rotation direction of the 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. **Note:** 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. **Note:** This parameter cannot be changed while the drive is running.	U V W / uint16
	U V W	Normal.	0
	U W V	Reversed rotation direction.	1
99.18	Sine filter inductance	Defines the inductance of a custom sine filter, i.e. when parameter 95.15 Special HW settings bit 3 is activated. **Note:** For an ABB sine filter (95.15 Special HW settings bit 1), this parameter is set automatically and should not be adjusted.	0.000 mH / real32
	0.000 … 100000.000 mH	Inductance of custom sine filter.	1000 = 1 mH / 1 = 1 mH

No.	Name / Range / Selection	Description	Def / Type FbEq 16b / 32b
99.19	Sine filter capacitance	Defines the capacitance of a custom sine filter, i.e. when parameter 95.15 Special HW settings bit 3 is activated. If the capacitors are star/wye-connected, enter the capacitance of <u>one leg</u> into the parameter.  If the capacitors are delta-connected, multiply the capacitance of <u>one leg</u> by 3 and enter the result into the parameter.  **Note:** For an ABB sine filter (95.15 Special HW settings bit 1), this parameter is set automatically and should not be adjusted.	2.20 uF / real32
	0.00 … 100000.00 uF	Capacitance of custom sine filter.	100 = 1 uF / 1 = 1 uF

No.	Name / Range / Selection	Description	Def / Type FbEq 16b / 32b
200	Safety	FSO-xx settings. This group contains parameters related to the optional FSO-xx safety functions module. For details, refer to the documentation of the FSO-xx module.	

No.	Name / Range / Selection	Description	Def / Type FbEq 16b / 32b
206	I/O bus configuration	Distributed I/O bus settings. This group is only visible with a BCU control unit. This group contains parameters related to the distributed I/O bus, which is used with some drives for monitoring the cooling fans of the cabinet system. For details, refer to CIO-01 I/O module for distributed I/O bus control user’s manual (3AXD50000126880 [English]).	

No.	Name / Range / Selection	Description	Def / Type FbEq 16b / 32b
207	I/O bus service	Distributed I/O bus settings. This group is only visible with a BCU control unit. This group contains parameters related to the distributed I/O bus, which is used with some drives for monitoring the cooling fans of the cabinet system. For details, refer to CIO-01 I/O module for distributed I/O bus control user's manual (3AXD50000126880 [English]).	

No.	Name / Range / Selection	Description	Def / Type FbEq 16b / 32b
208	I/O bus diagnostics	Distributed I/O bus settings. This group is only visible with a BCU control unit. This group contains parameters related to the distributed I/O bus, which is used with some drives for monitoring the cooling fans of the cabinet system. For details, refer to CIO-01 I/O module for distributed I/O bus control user's manual (3AXD50000126880 [English]).	

No.	Name / Range / Selection	Description	Def / Type FbEq 16b / 32b
209	I/O bus fan identification	Distributed I/O bus settings. This group is only visible with a BCU control unit. This group contains parameters related to the distributed I/O bus, which is used with some drives for monitoring the cooling fans of the cabinet system. For details, refer to CIO-01 I/O module for distributed I/O bus control user's manual (3AXD50000126880 [English]).	

9

Fault tracing

What this chapter contains

The chapter lists the warning and fault messages including possible causes and corrective actions. The causes of most warnings and faults can be identified and corrected using the information in this chapter. If not, contact an ABB service representative. If you have the possibility to use the *Drive Composer* PC software, send the Support package created by the Drive Composer tool to the ABB service representative.

Warnings and faults are listed below in separate tables. Each table is sorted by warning/fault code.

Safety

WARNING!
Only qualified electricians are allowed to service the drive. Read the instructions in the *Safety instructions* chapter of the *Hardware manual* of the drive before working on the drive.

Indications

Warnings and faults

Warnings and faults indicate an abnormal drive status. The codes and names of active warnings/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.

Warnings do not need to be reset; they stop showing when the cause of the warning ceases. Warnings do not latch and the drive will continue to operate the motor.

Faults do latch inside the drive and cause the drive to trip, and the motor stops. After the cause of a fault has been removed, the fault can be reset from a selectable source (parameter 31.11 Fault reset selection)), such as the control panel, the *Drive Composer* PC tool, the digital inputs of the drive, or fieldbus. After the fault is reset, the drive can be restarted.

Note that some faults require a reboot of the control unit either by switching the power off and on, or using parameter 96.08 Control board boot – this is mentioned in the fault listing wherever appropriate.

Warning and fault indications can be directed to a relay output or a digital input/output by selecting Warning, Fault or Fault (-1) in the source selection parameter. See the following sections:

- Programmable digital inputs and outputs (page 72)
- Programmable relay outputs (page 73), and
- Programmable I/O extensions (page 73).

Pure events

In addition to warnings and faults, there are pure events that are only recorded in the event logs of the drive. The codes of these events are included in the Warning, fault and pure event messages table.

Editable messages

For some warnings and faults, the message text can be edited and instructions and contact information added. To edit these messages, choose **Menu** - **Settings** - **Edit texts** on the control panel, or use the Localization editor in Drive Composer pro.

Warning/fault history and analysis

Event logs

The drive has two event logs. One log contains faults and fault resets; the other contains warnings, pure events, and clearing entries. Each log contains the 64 most recent events with a time stamp and other information.

The logs can be accessed separately from the main Menu on the control panel. The logs are displayed as a single list when viewed using the Drive Composer PC tool.

The logs can be cleared using parameter 96.51 Clear fault and event logger.

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.

Factory data logger

The drive has a data logger that samples preselected drive values at 500-microsecond (default; see parameter 96.65 Factory data logger time level) intervals.

The fault data of the last five faults is accessible in the event log when viewed in the Drive Composer pro PC tool. (The fault data is not accessible through the control panel.)

The values that are recorded in the factory data log are 01.07 Motor current, 01.10 Motor torque, 01.11 DC voltage, 01.24 Flux actual %, 06.01 Main control word, 06.11 Main status word, 24.01 Used speed reference, 30.01 Limit word 1, 30.02 Torque limit status and 90.01 Motor speed for control. The selection of parameters cannot be changed by the user.

Other data loggers

User data logger

A custom data logger can be configured using the Drive Composer pro PC tool. This functionality enables the free selection of up to eight drive parameters to be sampled at selectable intervals. The triggering conditions and the length of the monitoring period can also be defined by the user within the limit of approximately 8000 samples. In addition to the PC tool, the status of the logger is shown by drive parameter 96.61 User data logger status word. The triggering sources can be selected by parameters 96.63 User data logger trigger and 96.64 User data logger start. The configuration, status and collected data is saved to the memory unit for later analysis.

PSL2 data logger

The BCU control unit used with certain drive types (especially those with parallel-connected inverter modules) contains a data logger that collects data from the inverter modules to help fault tracing and analysis. The data is saved onto the SD card attached to the BCU, and can be analyzed by ABB service personnel.

Parameters that contain warning/fault information

The drive is able to store a list of the active faults actually causing the drive to trip at the present time. The faults are displayed in parameter group 04 Warnings and faults (page 143). The parameter group also displays a list of faults and warnings that have previously occurred.

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, fault and pure event messages

Code (hex)	Event name / Aux. code	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. If the control unit is externally powered, check the setting of parameter 95.04 Control board supply. Check acceleration times in parameter group 23 Speed reference ramp (speed control), 26 Torque reference chain (torque control) or 28 Frequency reference chain (frequency control). Also check parameters 46.01 Speed scaling, 46.02 Frequency scaling and 46.03 Torque scaling. Check motor and motor cable (including phasing and delta/star connection). Check there are no contactors opening and closing in motor cable. Check that the start-up data in parameter group 99 corresponds to the motor rating plate. Check that there are no power factor correction capacitors or surge absorbers in motor cable. Check encoder cable (including phasing). Check the auxiliary code (format XXXY YYZZ). With parallel-connected inverter modules, “Y YY” specifies through which BCU control unit channel the fault was received. “**ZZ**” indicates the phase that triggered the fault (**0**: No detailed information available, **1:** U-phase, **2:** Vphase, **4:** W-phase, **3/5/6/7:** multiple phases).
2330	Earth leakage	Drive has detected load unbalance typically due to earth fault in motor or motor cable.	If the control unit is externally powered, check the setting of parameter 95.04 Control board supply. Check there are no power factor correction capacitors or surge absorbers in motor cable. Check for an earth fault in motor or motor cables by measuring the insulation resistances of motor and motor cable. Try running the motor in scalar control mode if allowed. (See parameter 99.04 Motor control mode.)

Code (hex)	Event name / Aux. code	Cause	What to do
			With parallel-connected modules, check the auxiliary code (format XXXY YYZZ). "Y YY" specifies through which BCU control unit channel the fault was received. 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 for cabling errors. If the control unit is externally powered, check the setting of parameter 95.04 Control board supply. Check that parameter 99.10 Motor nominal power has been set correctly. Check there are no power factor correction capacitors or surge absorbers in motor cable. Check the auxiliary code (format XXXY YYZZ). With parallel-connected inverter modules, "Y YY" specifies through which BCU control unit channel the fault was received. "ZZ" indicates the location of the short circuit (**0:** No detailed information available, **1:** Upper branch of U-phase, **2:** Lower branch of U-phase, **4:** Upper branch of V-phase, **8:** Lower branch of V-phase, **10:** Upper branch of W-phase, **20:** Lower branch of W-phase, **other:** combinations of the above). Check auxiliary code 40h = DC capacitor short circuit. After correcting the cause of the fault, reboot the control unit (using parameter 96.08 Control board boot) or by cycling power.
2381	IGBT overload	Excessive IGBT junction to case temperature. This fault protects the IGBT(s) and can be activated by a short circuit in the motor cable.	Check motor cable. Check ambient conditions. Check air flow and fan operation. Check heatsink fins for dust pick-up. Check motor power against drive power.
2391	BU current difference	AC phase current difference between parallel-connected inverter modules is excessive.	Check motor cabling. Check there are no power factor correction capacitors or surge absorbers in motor cable. Check the auxiliary code (format XXXY YYZZ). "XXX" specifies the source of the first error (see "YYY"). "YYY" specifies the module through which BCU control unit channel the fault was received (**1:** Channel 1, **2:** Channel 2, **4:** Channel 3, **8:** Channel 4, …, **800:** Channel 12, **other:** combinations of the

Code (hex)	Event name / Aux. code	Cause	What to do
			above). “ZZ” indicates the phase (**1:** U, **2:** V, **3:** W).
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.
2E01	Earth leakage	IGBT supply unit has detected an earth fault.	Check AC fuses. Check for earth leakages. Check supply cabling. Check power modules. Check there are no power factor correction capacitors or surge absorbers in supply cable. If no earth fault can be detected, contact your local ABB representative.
3130	Supply phase loss	Intermediate circuit DC voltage is oscillating due to missing input power line phase or blown fuse or unstable control.	Check input power line fuses. Check for loose power cable connections. Check for input power supply imbalance. Check the control stability and the speed controller settings.
3180	Charge relay lost	No acknowledgement received from charge relay.	Contact your local ABB representative.
3181	Wiring or earth fault	1. The drive hardware is supplied from a common DC bus.	1. Switch off the protection in parameter 31.23.
		2. Incorrect input power and motor cable connection (i.e. input power cable is connected to the motor connection).	2. Check the power connections. Check the input fuses.
		3. Drive has detected load unbalance typically due to earth fault in motor or motor cable.	3. Check there are no power factor correction capacitors or surge absorbers in motor cable. Check for an earth fault in motor or motor cables by measuring the insulation resistances of motor and motor cable. Try running the motor in scalar control mode if allowed. (See parameter 99.04 Motor control mode.)
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.

Code (hex)	Event name / Aux. code	Cause	What to do
			Use coast-to-stop function (if applicable). Retrofit drive with brake chopper and brake resistor. With parallel-connected modules, check the auxiliary code (format XXXY YYZZ). "Y YY" specifies through which BCU control unit channel the fault was received. ZZ = 01. Enabling the brake chopper in the logic has failed.
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. With parallel-connected modules, check the auxiliary code (format XXXY YYZZ). "Y YY" specifies through which BCU control unit channel the fault was received.
3280	Standby timeout	Automatic restart failed (see section Automatic restart (page 103)).	Check the condition of the supply (voltage, cabling, fuses, switchgear).
3291	DC voltage difference	Difference in DC voltages between parallel-connected inverter modules.	Check the auxiliary code (format XXXY YYZZ). "XXX" specifies the source of the first error (see "YYY"). "YYY" specifies the module through which BCU control unit channel the fault was received (**1:** Channel 1, **2:** Channel 2, **4:** Channel 3, **8:** Channel 4, …, **800:** Channel 12).
3381	Output phase loss	Motor circuit fault due to missing motor connection (all three phases are not connected).	Connect motor cable.
3385	Autophasing	Autophasing routine (see section Autophasing (page 93)) has failed.	For more information, check the auxiliary code. Check that the motor ID run has been successfully completed. Clear parameter 98.15 Position offset user. Check the setting of parameter 99.03 Motor type.
	0001	Estimated and measured positions have opposite signs.	Check the signs of measured and estimated speeds. Reverse encoder cable phasing or edit parameter 99.16. Check that the load torque is not too high for the Turning mode (must be less than 5%).
	0002	Motor is rotating during autophasing.	Check that the motor is not already rotating when the autophasing routine starts.
	0003	Too much difference between measured and estimated positions.	Check that encoder is not slipping.

Code (hex)	Event name / Aux. code	Cause	What to do
			Check parameter 98.15 several times to verify that the autophasing routine gives consistent results. Check the motor model parameters.
	0004	Rotor did not rotate as expected between zero pulses.	Check that the zero pulses are given correctly.
	0005	Position estimate did not stabilize.	Check that the selected mode (parameter 21.13) is appropriate for the motor.
	0006	Measured position status information changed.	Check that parameter 90.41 is not changed to Estimate during the routine.
	0007	General autophasing failure.	Contact your local ABB representative.
	0008	Selected mode not supported.	Check that the selected mode (parameter 21.13) is supported by the motor type.
	0009	(LV-Synchro) Standstill failure.	Contact your local ABB representative.
3E00	Input phase loss	Input phase loss detected by the IGBT bridge.	Check the auxiliary code. Check the source of the fault corresponding to the code: 1: Phase A 2: Phase B 4: Phase C 8: Phase cannot be detected Check the AC fuses. Check for input power supply imbalance.
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.
4100	Ambient temperature	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.
4110	Control board temperature	Control board temperature is too high.	Check proper cooling of the drive. Check the auxiliary cooling fan.
4210	IGBT overtemperature	Estimated drive IGBT temperature is excessive.	Check ambient conditions. Check air flow and fan operation. Check heatsink fins for dust pick-up. Check motor power against drive power.
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

Code (hex)	Event name / Aux. code	Cause	What to do
			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.	See A4B0 Excess temperature.
4380	Excess temp difference	High temperature difference between the IGBTs of different phases.	See A4B1 Excess temperature difference (page 541).
4981	External temperature 1	Measured temperature 1 has exceeded fault limit.	Check the value of parameter 35.02 Measured temperature 1. Check the cooling of the motor (or other equipment whose temperature is being measured). Check the value of parameter 35.12 Temperature 1 fault limit.
4982	External temperature 2	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	FPTC not found	A thermistor protection module has been activated by parameter 35.30 but cannot be detected.	Power down the control unit and make sure 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	The thermistor protection 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	The thermistor protection module installed in slot 2 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.
4993	Safe motor temperature 3	The thermistor protection module installed in slot 3 indicates overtemperature.	Check the cooling of the motor. Check the motor load and drive ratings.

Code (hex)	Event name / Aux. code	Cause	What to do
			Check the wiring of the temperature sensor. Repair wiring if faulty. Measure the resistance of the sensor. Replace sensor if faulty.
5080	Fan	Cooling fan feedback missing.	See A581 Fan.
5081	Auxiliary fan not running	An auxiliary cooling fan (connected to the fan connectors on the control unit) is stuck or disconnected.	See A582 Auxiliary fan not running.
5090	STO hardware failure	Safe torque off hardware failure.	Contact your local ABB representative, quoting the auxiliary code. 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	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 320).
5092	PU logic error	Power unit memory has cleared.	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.
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 (format 0X0Y). “X” indicates the first faulty PU channel in hexadecimal (1…C) (With a ZCU control unit, “X” can be 1 or 2 but this is irrelevant to the fault). “Y” indicates the auxiliary code category.

Code (hex)	Event name / Aux. code	Cause	What to do
			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. 8 = PU not supported (illegal rating ID). 9 = Incompatible module current rating (unit contains a module with too low a current rating). **A** - Selected parallel rating ID not found from database. With parallel connection faults (BCU control unit), the format of the auxiliary code is 0X0Y.
5094	Measurement circuit temperature	Problem with internal temperature measurement of the drive.	See A5EA Measurement circuit temperature (page 543).
5681	PU communication	The way the control unit is powered does not correspond to parameter setting. Communication errors detected between the drive control unit and the power unit.	Check setting of 95.04 Control board supply. Check the connection between the control unit and the power unit. Check the auxiliary code (format XXXY YYZZ). With parallel-connected modules, "Y YY" specifies the affected BCU control unit channel (**0:** broadcast). "ZZ" specifies the error source (**1:** Transmitter side [link error], **2:** Transmitter side [no communication], **3:** Receiver side [link error], **4:** Receiver side [no communication], **5:** Transmitter FIFO error [see "XXX"], **6:** Module [xINT board] not found, **7:** BAMU board not found). "XXX" specifies the transmitter FIFO error code (**1:** Internal error [invalid call parameter], **2:** Internal error [configuration not supported], **3:** Transmission buffer full).
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.

Code (hex)	Event name / Aux. code	Cause	What to do
5690	PU communication internal	Internal communication error.	Contact your local ABB representative.
5691	Measurement circuit ADC	Measurement circuit fault.	If the control unit is externally powered, check the setting of parameter 95.04 Control board supply. If the problem persists, contact your local ABB representative, quoting the auxiliary code.
5692	PU board powerfail	Power unit power supply failure.	Check the auxiliary code (format ZZZY YYXX). "YY Y" specifies the affected inverter module (**0…C**, always **0** for ZCU control units). "XX" specifies the affected power supply (**1:** Power supply 1, **2:** Power supply 2, **3:** both supplies).
5693	Measurement circuit DFF	Measurement circuit fault.	Contact your local ABB representative, quoting the auxiliary code.
5694	PU communication conf	Number of connected power modules differs from expected.	Check setting of 95.31 Parallel type configuration. 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.
	0001	BAMU 1 is in the wrong channel.	
	0002	BAMU 2 is in the wrong channel.	
	0003	Power unit (xINT) is in the wrong channel.	
	0005	Too many power units (xINTs).	
5695	Reduced run	Number of inverter modules detected does not match the value of parameter 95.13 Reduced run mode.	Check that the value of 95.13 Reduced run mode corresponds to the number of inverter modules present. Check that the modules present are powered from the DC bus and connected by fiber optic cables to the BCU control unit. If all modules of the inverter unit are in fact available (eg. maintenance work has been completed), check that parameter 95.13 Reduced run mode is set to 0 (reduced run function disabled).
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	• Incorrect parameter setting.	• Check the setting of 95.09 Switch fuse controller. The parameter should be enabled only if an xSFC charging controller is installed.

Code (hex)	Event name / Aux. code	Cause	What to do
		• The charging switch and DC switch were operated out of sequence, or a start command was issued before the unit was ready.	• The normal power-up sequence is: 1. Close charging switch. 2. After charging finishes (charging OK lamp lights), close DC switch. 3. Open charging switch.
		• Charging circuit fault.	• Check the charging circuit. With a frame R6i/R7i inverter module, the auxiliary code “FA” indicates that the charging contactor status feedback does not match the control signal. With parallel-connected frame R8i modules, the auxiliary code (format XX00), “XX” specifies the affected BCU control unit channel.
		• Brake circuit fault.	• Check the wiring and condition of brake resistor.
5698	Unknown PU fault	Unidentified power unit logic fault.	Check power unit logic and firmware compatibility. Contact your local ABB representative.
6000	Internal SW error	Internal error.	Contact your local ABB representative, quoting the auxiliary code.
6181	FPGA version incompatible	• Firmware and FPGA file version in the power unit are incompatible.	• Reboot the control unit (using parameter 96.08 Control board boot) or by cycling power. If the problem persists, contact your local ABB representative.
		• Update of power unit logic failed.	• Retry.
			• Check the auxiliary code to identify FPGA version compatibility (format: XXYYZZ). "XX" (**8**: cannot recognize power unit logic, FPGA logic not compatible, **9** = power unit FPGA logic is old, update FPGA logic, **10** = software is not compatible with power unit FPGA logic, update software (or downgrade power unit FPGA)). YY = BCU control unit channel (first channel = 0)
6200	Checksum mismatch	The calculated parameter checksum does not match any enabled reference checksum.	See A686 Checksum mismatch.
6306	FBA A mapping file	Fieldbus adapter A mapping file read error.	Contact your local ABB representative.
6307	FBA B mapping file	Fieldbus adapter B mapping file read error.	Contact your local ABB representative.

Code (hex)	Event name / Aux. code	Cause	What to do
6481	Task overload	Internal fault.	Reboot the control unit (using parameter 96.08 Control board boot) or by cycling power. If the problem persists, contact your local ABB representative.
6487	Internal SW error 3	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.
6488	Restart after firmware malfunction	Control board rebooted due to an internal malfunction.	If the Drive Composer PC tool is available, send a support package to your local ABB representative. For instructions, see the *Drive Composer start-up and maintenance PC tool user's manual* (3AUA0000094606 [English]).
64A1	Internal file load	File read error.	Reboot the control unit (using parameter 96.08 Control board boot) or by cycling power. If the problem persists, contact your local ABB representative.
64A2	Internal record load	Internal record load error.	Contact your local ABB representative.
64A3	Application loading	Application file incompatible or corrupted.	Check the auxiliary code. See actions for each code below.
	8006	Not enough memory for the application.	Reduce the size of the application. Reduce the number of parameter mappings. See the drive-specific log generated by Automation Builder.
	8007	The application contains the wrong system library version.	Update the system library or reinstall Automation Builder. See the drive-specific log generated by Automation Builder.
	8008	The application is empty.	In Automation Builder, give a "Clean" command and reload the application.
	8009	The application contains invalid tasks.	In Automation Builder, check application task configuration, give a "Clean all" command, and reload the application.
	800A	The application contains an unknown target (system) library function.	Update the system library or reinstall Automation Builder. See the drive-specific log generated by Automation Builder.
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.
64A6	Adaptive program	Error running the adaptive program.	Check the auxiliary code (format XXXX YYYY). "XXXX" specifies the number of the function block (0000 = generic

Code (hex)	Event name / Aux. code	Cause	What to do
			error). "YYYY" indicates the problem (see actions for each code below).
	000A	Program corrupted or block non-existent.	Restore the template program or download the program to the drive.
	000C	Required block input missing.	Check the inputs of the block.
	000E	Program corrupted or block non-existent.	Restore the template program or download the program to the drive.
	0011	Program too large.	Remove blocks until the error stops.
	0012	Program is empty.	Correct the program and download it to the drive.
	001C	A nonexisting parameter or block is used in the program.	Edit the program to correct the parameter reference, or to use an existing block.
	001D	Parameter type invalid for selected pin.	Edit the program to correct the parameter reference.
	001E	Output to parameter failed because the parameter was write-protected.	Check the parameter reference in the program. Check for other sources affecting the target parameter.
	0023, 0024	Program file incompatible with current firmware version.	Adapt the program to current block library and firmware version.
	002A	Too many blocks.	Edit the program to reduce the number of blocks.
64B0	Memory unit detached	The memory unit was detached when the control unit was powered.	Switch off the power to the control unit and reinstall the memory unit. In case the memory unit was not actually removed when the fault occurred, check that the memory unit is properly inserted into its connector and its mounting screw is tight. Reboot the control unit (using parameter 96.08 Control board boot) or by cycling power. If the problem persists, contact your local ABB representative.
64B1	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 • set is not compatible with control program • drive was switched off during loading.	Ensure that a valid user parameter set exists. Reload if uncertain.
64E1	Kernel overload	Operating system error.	Reboot the control unit (using parameter 96.08 Control board boot) or by cycling power. If the problem

Code (hex)	Event name / Aux. code	Cause	What to do
			persists, contact your local ABB representative.
64FF	Fault reset	Informative fault.	An active fault has been reset.
6581	Parameter system	Parameter load or save failed.	Try forcing a save using parameter 96.07 Parameter save manually. Retry.
6591	Backup/Restore Timeout	Parameter load or save timeout caused by communication break between drive and control panel, or control panel and PC tool.	Check the communication between drive and control panel or PC. 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.
65A2	FBA B 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 54 FBA B settings.
65B1	Reference source parametrization	A reference source is simultaneously connected to multiple parameters with different units.	See A6DA Reference source parametrization (page 546).
6681	EFB communication loss	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 configuration 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. • 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 an option module is lost.	See A798 Encoder option comm loss (page 549).
7081	Control panel loss	Control panel (or PC tool) has stopped communicating.	Check PC tool or control panel connection.

Code (hex)	Event name / Aux. code	Cause	What to do
			Check control panel connector. Disconnect and reconnect the control panel. Check the auxiliary code. The code specifies the I/O port used as follows: **0:** Panel, **1:** Fieldbus interface A, **2:** Fieldbus interface B, **3:** Ethernet, **4:** D2D/EFB port).
7082	Ext I/O comm loss	The I/O extension module types specified by parameters do not match the detected configuration.	See A799 ExtIO comm loss (page 549).
7083	Panel reference conflict	Use of saved control panel reference in multiple control modes attempted.	The control panel reference can only be saved for one reference type at a time. Consider the possibility of using a copied reference instead of saved reference (see the reference selection parameter).
7084	Panel/PC tool version conflict	The current version of the control panel and/or PC tool does not support a function. (For example, older panel versions cannot be used as a source of external reference.)	Update control panel and/or PC tool. Contact your local ABB representative if necessary.
7085	Incompatible option module	Option module not supported. (For example, type Fxxx-xx-M fieldbus adapter modules are not supported.)	Check the auxiliary code. The code specifies the interface to which the unsupported module is connected: **1:** Fieldbus interface A, **2:** Fieldbus interface B. Replace the module with a supported type. **A** - FSO-xx module is not supported by the control board. Remove FSO-xx module to clear the fault. Connect FSO-xx module to the supported control board.
7121	Motor stall	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.
7122	Motor overload	Motor current is too high.	Check for overloaded motor. Adjust the parameters used for the motor overload function 35.51…35.53) and 35.55…35.56.
7181	Brake resistor	DC overvoltage detected during braking.	Check that a brake resistor has been connected. Check the condition of the brake resistor. Check the dimensioning of the brake chopper and resistor.
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).

Code (hex)	Event name / Aux. code	Cause	What to do
			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. After correcting the cause of the fault, reboot the control unit (using parameter 96.08 Control board boot) or by cycling power.
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). After correcting the cause of the fault, reboot the control unit (using parameter 96.08 Control board boot) or by cycling power.
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	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	No motor speed feedback received.	See A7B0 Motor speed feedback (page 551).
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, 30.12 Maximum speed and 31.30 Overspeed trip margin. Check adequacy of motor braking torque. Check applicability of torque control. Check need for brake chopper and resistor(s).

Code (hex)	Event name / Aux. code	Cause	What to do
		• Incorrect estimated speed.	• Check the status of motor current measurement. Perform a Normal, Advanced or Advanced Standstill ID run instead of, for example, a Reduced or Standstill. See parameter 99.13 ID run requested (page 510).
7380	Encoder internal	Internal fault.	Contact your local ABB representative.
7381	Encoder	Encoder feedback fault.	See A7E1 Encoder (page 552).
73A0	Speed fbk configuration	Speed feedback configuration incorrect.	See A797 Speed feedback configuration (page 548).
73A1	Load position feedback	No load position feedback 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	Encoder stopped working.	Check encoder status.
	0002	Feed constant definition invalid or outside limits.	Check feed constant settings (90.63 and 90.64).
	0003	Motor/load gear definition invalid or outside limits.	Check motor/load gear settings (90.61 and 90.62).
	0004	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.
	0005	Encoder stopped working.	Check encoder status.
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.
73F0	Overfrequency	Maximum allowed output frequency exceeded.	Without a dual-use license, the fault limit is 598 Hz. Contact your local ABB representative for dual-use licensing information.

Code (hex)	Event name / Aux. code	Cause	What to do
7510	FBA A communication	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.
	0002	Communication problem between adapter and control unit.	Check communication connections between adapter and drive.
	0004	Communication problem between adapter and PLC or parameters refreshed using the parameter 51.27 FBA A par refresh while PLC was communicating with the adapter.	Refresh parameters only when necessary to avoid loss of communication.
	0005	Lost communication with fieldbus communication adapter.	Check fieldbus communication adapter.
7520	FBA B communication	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.
	0002	Communication problem between adapter and drive.	Check communication connections between adapter and drive.
	0004	Communication problem between adapter and PLC or parameters refreshed using the parameter 51.27 FBA A par refresh while PLC was communicating with the adapter.	Refresh parameters only when necessary to avoid loss of communication.
	0005	Lost communication with fieldbus communication adapter.	Check fieldbus communication adapter.
7580	INU-LSU comm loss	DDCS (fiber optic) communication between converters (for example, the inverter unit and the supply unit) is lost.	Check status of other converter (parameter group 06 Control and status words). Check the corresponding settings in the control program of the other converter. Check cable connections. If necessary, replace cables.
7583	Line side unit faulted	The supply unit (or other converter) connected to the inverter unit has generated a fault.	The auxiliary code specifies the original fault code in the supply unit control program. See section Auxiliary codes for line-side converter faults (page 569).
8001	ULC underload	Selected signal has fallen below the user underload curve.	See A8BF ULC underload (page 555).

Code (hex)	Event name / Aux. code	Cause	What to do
8002	ULC overload	Selected signal has exceeded the user overload curve.	See A8BE ULC overload (page 555).
80A0	AI Supervision	An analog signal is outside the limits specified for the analog input.	Check the auxiliary code (format XXXX XYZZ). "Y" specifies the location of the input (**0:** Control unit, **1:** I/O extension module 1, **2:** I/O extension module 2, **3:** I/O extension module 3). "ZZ" specifies the limit (**01:** AI1 under minimum, **02:** AI1 above maximum, **03:** AI2 under minimum, **04:** AI2 above maximum). 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.
80B0	Signal supervision	Fault generated by the signal supervision 1 function.	Check the source of the fault (parameter 32.07 Supervision 1 signal).
80B1	Signal supervision 2	Fault generated by the signal supervision 2 function.	Check the source of the fault (parameter 32.17 Supervision 2 signal).
80B2	Signal supervision 3	Fault generated by the signal supervision 3 function.	Check the source of the fault (parameter 32.27 Supervision 3 signal).
8E12	Fan speed	Fan speed is under limit (parameter 206.07).	Check fan feedback. See parameters 206.30…206.33 for individual failing fans.
8E13	I/O module version mismatch	Communication services of the CIO-01 module are incompatible with the firmware version on the control unit.	See the auxiliary code for incompatible CIO-01 module. Auxiliary code is a bit word where bit 0 indicates CIO-01 module assigned to node ID 1. Replace the incompatible CIO-01 module.
8E14	CIO MCB monitoring	Fault related to miniature circuit breaker. Some of the bits of the MCB status word are 0.	Check miniature circuit breaker and digital input DI5.
8E15	CIO fuse monitoring	Fault related to fuses. Some of the bits of the fuse status word are 0.	Check fuses and digital input DI6.
8E17	CIO DI8 monitoring	Fault related to digital input DI8.	Check digital input DI8.
9081	External fault 1	Fault in external device 1.	Check the external device. Check setting of parameter 31.01 External event 1 source.
9082	External fault 2	Fault in external device 2.	Check the external device. Check setting of parameter 31.03 External event 2 source.
9083	External fault 3	Fault in external device 3.	Check the external device. Check setting of parameter 31.05 External event 3 source.
9084	External fault 4	Fault in external device 4.	Check the external device.

Code (hex)	Event name / Aux. code	Cause	What to do
			Check setting of parameter 31.07 External event 4 source.
9085	External fault 5	Fault in external device 5.	Check the external device. Check setting of parameter 31.09 External event 5 source.
A2A1	Current calibration	Current offset and gain measurement calibration will occur at next start.	Informative warning. (See parameter 99.13 ID run requested.)
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. Try running the motor in scalar control mode if allowed. (See parameter 99.04 Motor control mode.) If no earth fault can be detected, contact your local ABB representative.
A2B4	Short circuit	Short-circuit in motor cable(s) or motor.	Check motor and motor cable for cabling errors. Check there are no power factor correction capacitors or surge absorbers in motor cable.
A2BA	IGBT overload	Excessive IGBT junction to case temperature. This warning protects the IGBT(s) and can be activated by a short circuit in the motor cable.	Check motor cable. Check ambient conditions. Check air flow and fan operation. Check heatsink fins for dust pick-up. Check motor power against drive power.
A3A1	DC link overvoltage	Intermediate circuit DC voltage too high (when the drive is stopped).	Check the supply voltage setting (parameter 95.01 Supply voltage). Note that the wrong setting of the parameter may cause the motor to rush uncontrollably, or may overload the 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).	Check the supply voltage setting (parameter 95.01 Supply voltage). Note that the wrong setting of the parameter may cause the motor to rush uncontrollably, or may overload the brake chopper or resistor. Check the supply voltage. If the problem persists, contact your local ABB representative.
A3AA	DC not charged	The voltage of the intermediate DC circuit has not yet risen to operating level.	Check the supply voltage setting (parameter 95.01 Supply voltage). Note that the wrong setting of the parameter may cause the motor to

Code (hex)	Event name / Aux. code	Cause	What to do
			rush uncontrollably, or may overload the brake chopper or resistor. Check the supply voltage. If the problem persists, 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	Problem with motor temperature measurement.	Check the auxiliary code (format 0XYY ZZZZ). "X" identifies the affected temperature monitoring function (1 = parameter 35.11, 2 = parameter 35.21). "YY" indicates the selected temperature source, ie. the setting of the selection parameter in hexadecimal. "ZZZZ" indicates the problem (see actions for each code below).
	0001	Sensor type mismatch.	Check parameters 35.11/35.21 against 91.21/91.24.
	0002	Temperature under limit.	Check parameters 35.11…35.14/35.21…35.24 (and 91.21/91.24 if sensor is connected to an encoder interface). Check the sensor and its wiring.
	0003	Short circuit.	Check parameters 35.11…35.14/35.21…35.24 (and 91.21/91.24 if sensor is connected to an encoder interface). Check the sensor and its wiring.
	0004	Open circuit.	Check parameters 35.11…35.14/35.21…35.24 (and 91.21/91.24 if sensor is connected to an encoder interface). Check the sensor and its wiring.
A491	External temperature 1	Measured temperature 1 has exceeded warning limit.	Check the value of parameter 35.02 Measured temperature 1. Check the cooling of the motor (or other equipment whose temperature is being measured). Check the value of 35.13 Temperature 1 warning limit.
A492	External temperature 2	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.

Code (hex)	Event name / Aux. code	Cause	What to do
A497	Motor temperature 1	The thermistor protection 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.
A498	Motor temperature 2	The thermistor protection module installed in slot 2 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.
A499	Motor temperature 3	The thermistor protection module installed in slot 3 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.
A4A0	Control board temperature	Control unit temperature is excessive.	Check the auxiliary code. See actions for each code below.
	–	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.
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.
A4B0	Excess temperature	Power unit temperature is excessive.	Check ambient conditions. Check air flow and fan operation. Check the setting of 31.36 Aux fan fault function (if present). Check heatsink fins for dust pick-up. Check motor power against drive power. See A5EA Measurement circuit temperature (page 543).
A4B1	Excess temperature difference	High temperature difference between the IGBTs of different phases.	Check the motor cabling. Check cooling of drive module(s). Check the auxiliary code (format XXXY YYZZ). “XXX” indicates the source of difference (**0:** Single module, difference between phase IGBTs, **1:**

Code (hex)	Event name / Aux. code	Cause	What to do
			parallelconnected modules, minimum-maximum difference between all IGBTs of all modules, **2:** parallel-connected modules, minimum-maximum difference between auxiliary power supply boards). With parallel-connected modules, “Y YY” specifies through which BCU control unit channel the highest temperature was measured. “ZZ” specifies the phase (**0:** single module, **1:** U-phase [parallel connection], **2:** V-phase [parallel connection], **3:** W-phase [parallel connection]).
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. Check the auxiliary code (format XXXY YYZZ). With parallel-connected modules, “Y YY” specifies the affected BCU control unit channel (**0:** broadcast). “ZZ” specifies the error source (**8:** Transmission errors in PSL link [see “XXX”], **9:** Transmitter FIFO warning limit hit). “XXX” specifies the transmission error direction and detailed warning code (0: Rx/communication error, **1:** Tx/Reed-Solomon symbol error, **2:** Tx/no synchronization error, **3:** Tx/Reed-Solomon decoder failures, **4:** Tx/Manchester coding errors). Read the PSL2 data log. In Drive Composer pro, check the time stamp of the A580 fault. Load the log with the same date and time. When the file opens, click “Show fault log”. Check the power unit hardware.
A581	Fan	Cooling fan feedback missing.	Check the setting of parameter 95.20 HW options word 1, bit 14. Check the auxiliary code to identify the fan. Code 0 denotes main fan 1. Other codes (format XYZ): “X” specifies state code (**1:** ID run, **2:** normal). “Y” specifies the index of the inverter module connected to BCU (**0…n**, always **0** for ZCU control units). “Z” specifies the index of the fan (**1:** Main fan 1, **2:** Main fan 2, **3:** Main fan 3).

Code (hex)	Event name / Aux. code	Cause	What to do
			Note that modules are coded starting from 0. For example, the code **101** means that Main fan 1 of module 1 (connected to BCU channel V1T/V1R) has faulted during its ID run. Check fan operation and connection. Replace fan if faulty.
A582	Auxiliary fan not running	An auxiliary cooling fan (connected to the fan connectors on the control unit) is stuck or disconnected.	The auxiliary code identifies the fan (**1:** Auxiliary fan 1, **2:** Auxiliary fan 2). Check that the auxiliary fan supervision selection in parameter 95.21 HW options word 2 matches the hardware. Make sure the front cover of the drive module is in place and tightened. Check auxiliary fan(s) and connection(s). Replace faulty fan.
A5A0	Safe torque off	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 320).
A5EA	Measurement circuit temperature	Problem with internal temperature measurement of the drive.	Check the auxiliary code (format XXXY YYZZ). "Y YY" specifies through which BCU control unit channel the fault was received ("0 00" with a ZCU control unit). "ZZ" specifies the location: With control program version 2.8x and later: **1:** U-phase IGBT, **2:** V-phase IGBT, **3:** W-phase IGBT, **4:** Power supply board, **5:** Power unit xINT board, **6:** Brake chopper, **7:** Air inlet (TEMP3, X10), **8:** du/dt filter (TEMP2, X7), **9:** TEMP1 (X6) Power supply heatsink on ACS880-x04LC frame R7i module. With control program version up to and including 2.7x: **1:** U-phase IGBT, **2:** V-phase IGBT, **3:** W-phase IGBT, **4:** Power unit INT board, **5:** Brake chopper, **6:** Air inlet, **7:** Power supply board, **8:** du/dt filter, **FAh:** Air in temp.
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	Problem with measurement circuit of power unit (analog to digital converter).	Contact your local ABB representative.
A5EE	Measurement circuit DFF	Problem with current or voltage measurement of power unit.	Contact your local ABB representative.

Code (hex)	Event name / Aux. code	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 in progress.	Informative warning. Wait until charging finishes before starting the inverter unit. Charging with the manual fuse switch controller (xSFC) must be ended within two minutes. After that the warning informs that the charging resistor is still connected.
A5F3	Switching frequency below requested	Adequate motor control at requested output frequency cannot be reached because of limited switching frequency (eg. by parameter 95.15).	Informative warning.
A5F4	Control unit battery	The battery of the control unit is low.	Replace control unit battery. This warning can be suppressed using parameter 31.40.
A682	Flash erase speed exceeded	The flash memory (in the memory unit) has been erased too frequently, compromising the lifetime of the memory.	Avoid forcing unnecessary parameter saves by parameter 96.07 or cyclic parameter writes (such as user logger triggering through parameters). Check the auxiliary code (format XYYY YZZZ). “X” specifies the source of warning (1: generic flash erase supervision). “ZZZ” specifies the flash subsector number that generated the warning.
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, 1	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.
	2	Write error.	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.
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.
	0	No SD card.	Insert a compatible, writable SD card into the SD CARD slot of the BCU control unit.
	1	SD card write-protected.	Insert a compatible, writable SD card into the SD CARD slot of the BCU control unit.

Code (hex)	Event name / Aux. code	Cause	What to do
	2	SD card unreadable.	Insert a compatible, writable SD card into the SD CARD slot of the BCU control unit.
	3	SD card initialization failed.	Insert a compatible, writable SD card into the SD CARD slot of the BCU control unit.
A685	Power fail saving	Power fail saving is requested too frequently. Because of the limited saving interval, some of the requests do not trigger the saving and power fail data may be lost. This may be caused by DC voltage oscillation.	Check the supply voltage.
A686	Checksum mismatch	The calculated parameter checksum does not match any enabled reference checksum.	Check that all necessary approved (reference) checksums (96.56…96.59) are enabled in 96.55 Checksum control word. Check the parameter configuration. Using 96.55 Checksum control word, enable a checksum parameter and copy the actual checksum into that parameter.
A687	Checksum configuration	An action has been defined for a parameter checksum mismatch but the feature has not been configured.	Contact your local ABB representative for configuring the feature, or disable the feature in 96.54 Checksum action.
A688	Parameter map configuration	Too much data in parameter mapping table created in Drive customizer.	See the *Drive customizer PC tool user's manual* (3AUA0000104167 [English]).
A689	Mapped parameter value cut	Parameter value saturated eg. by the scaling specified in parameter mapping table (created in Drive customizer).	Check parameter scaling and format in parameter mapping table. See the *Drive customizer PC tool user's manual* (3AUA0000104167 [English]).
A6A4	Motor nominal value	The motor parameters are set incorrectly. The drive is not dimensioned correctly.	Check the auxiliary code. See actions for each code below.
	1	Slip frequency is too small.	Check the settings of the motor configuration parameters in groups 98 and 99. Check that the drive is sized correctly for the motor.
	2	Synchronous and nominal speeds differ too much.	Check the settings of the motor configuration parameters in groups 98 and 99. Check that the drive is sized correctly for the motor.
	3	Nominal speed is higher than synchronous speed with 1 pole pair.	Check the settings of the motor configuration parameters in groups 98 and 99. Check that the drive is sized correctly for the motor.
	4	Nominal current is outside limits.	Check the settings of the motor configuration parameters in groups 98 and 99.

Code (hex)	Event name / Aux. code	Cause	What to do
			Check that the drive is sized correctly for the motor.
	5	Nominal voltage is outside limits.	Check the settings of the motor configuration parameters in groups 98 and 99. Check that the drive is sized correctly for the motor.
	6	Mechanical nominal power is higher than electrical active power.	Check the settings of the motor configuration parameters in groups 98 and 99. Check that the drive is sized correctly for the motor.
	7	Nominal power not consistent with nominal speed and torque.	Check the settings of the motor configuration parameters in groups 98 and 99. 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 and continue until the motor data is entered.
A6A6	Supply voltage unselected	The supply voltage has not been defined.	Set supply voltage in parameter 95.01 Supply voltage.
A6B0	User lock open	The user lock is open, ie. user lock configuration parameters 96.100…96.102 are visible.	Close the user lock by entering an invalid pass code in parameter 96.02 Pass code. See section User lock (page 121).
A6B1	User pass code not confirmed	A new user pass code has been entered in parameter 96.100 but not confirmed in 96.101.	Confirm the new pass code by entering the same code in 96.101. To cancel, close the user lock without confirming the new code. See section User lock (page 121).
A6D1	FBA A parameter conflict	The drive does not have a functionality requested by a PLC, or requested functionality has not been activated.	Check PLC programming. Check settings of parameter groups 50 Fieldbus adapter (FBA) 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.
A6DA	Reference source parametrization	A reference source is simultaneously connected to multiple parameters with different units.	Check the reference source selection parameters.
A6E5	AI parametrization	The current/voltage hardware 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.

Code (hex)	Event name / Aux. code	Cause	What to do
			Adjust either the hardware setting (on the drive control unit) or parameter 12.15/12.25. **Note:** Control board reboot (either by cycling the power or through parameter 96.08 Control board boot) is required to validate any changes in the hardware settings.
A6E6	ULC configuration	User load curve configuration error.	Check the auxiliary code (format XXXX ZZZZ). “ZZZZ” indicates the problem (see actions for each code below).
	0000	Speed points inconsistent.	Check that each speed point (parameters 37.11…37.15) has a higher value than the previous point.
	0001	Frequency points inconsistent.	Check that each frequency point (37.16…37.20) has a higher value than the previous point.
	0002	Underload point above overload point.	Check that each overload point (37.31…37.35) has a higher value than the corresponding underload point (37.21…37.25).
	0003	Overload point below underload point.	Check that each overload point (37.31…37.35) has a higher value than the corresponding underload point (37.21…37.25).
A780	Motor stall	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	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. Check the settings of parameters 91.21 and 91.24. Check that the corresponding module is activated in parameters 91.11…91.14. Use parameter 91.10 Encoder parameter refresh to validate any changes in the settings.
		• 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.
A783	Motor overload	Motor current is too high.	Check for overloaded motor.

Code (hex)	Event name / Aux. code	Cause	What to do
			Adjust the parameters used for the motor overload function (35.51…35.53) and 35.55…35.56.
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 the resistor has been dimensioned correctly. Check that braking cycle meets allowed limits.
A794	BR data	Brake resistor data has not been given.	One or more of the resistor data settings (parameters 43.08…43.10) is incorrect. 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.
A797	Speed feedback configuration	Speed feedback configuration has changed.	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	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).

Code (hex)	Event name / Aux. code	Cause	What to do
	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.
A798	Encoder option comm loss	Encoder feedback not used as actual feedback, or measured motor feedback lost (and parameter 90.45/90.55 is set to Warning).	Check that the encoder is selected as feedback source in parameter 90.41 or 90.51. Check that the encoder interface module is properly seated in its slot. Check that the encoder interface module or slot connectors are not damaged. To pinpoint the problem, try installing the module into a different slot. If the module is installed on an FEA-03 extension adapter, check the fiber optic connections. Check the auxiliary code (format XXXX YYYY). "YYYY" indicates the problem (see actions for each code below).
	0001	Failed answer to encoder configuration message.	Contact your local ABB representative.
	0002	Failed answer to adapter watchdog disable message.	Contact your local ABB representative.
	0003	Failed answer to adapter watchdog enable message.	Contact your local ABB representative.
	0004	Failed answer to adapter configuration message.	Contact your local ABB representative.
	0005	Too many failed answers inline to speed and position messages.	Contact your local ABB representative.
	0006	DDCS driver failed.	Contact your local ABB representative.
A799	Ext I/O comm loss	The I/O extension module types specified by parameters do not match the detected configuration.	Check the auxiliary code (format XXYY YYYY). "XX" specifies the number of the I/O extension module (01: parameter group 14 I/O extension module 1, 02: 15 I/O extension module 2 2, 03: 16 I/O extension module 3). "YY YYYY" indicates the problem (see actions for each code below).
	00 0001	Communication with module failed.	Check that the module is properly seated in its slot. Check that the module and the slot connector is not damaged. Try installing the module into another slot.
	00 0002	Module not found.	Check the type and location settings of the modules (parameters 14.01/14.02, 15.01/15.02 or 16.01/16.02). Check that the module is properly seated in its slot.

Code (hex)	Event name / Aux. code	Cause	What to do
			Check that the module and the slot connector is not damaged. Try installing the module into another slot.
	00 0003	Configuration of module failed.	Check the type and location settings of the modules (parameters 14.01/14.02, 15.01/15.02 or 16.01/16.02). Check that the module is properly seated in its slot. Check that the module and the slot connector is not damaged. Try installing the module into another slot.
	00 0004	Configuration of module failed.	Check the type and location settings of the modules (parameters 14.01/14.02, 15.01/15.02 or 16.01/16.02). Check that the module is properly seated in its slot. Check that the module and the slot connector is not damaged. Try installing the module into another slot.
A79B	BC short circuit	Short circuit in brake chopper IGBT.	Replace brake chopper if external. Drives with internal choppers will need to be returned to ABB. 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 minimum allowed resistor value for the chopper being used. Check that braking cycle meets allowed limits. Check that drive supply AC voltage is not excessive.
A7AA	Extension AI parameterization	The hardware current/voltage setting of an analog input (on an I/O extension module) does not correspond to parameter settings.	Check the auxiliary code (format XX00 00YY). “XX” specifies the number of the I/O extension module (**01:** parameter group 14 I/O extension module 1, **02:** 15 I/O extension module 2, **03:** 16 I/O extension module 3). “YY” specifies the analog input on the module. For example, in case of I/O extension module 1, analog input AI1 (auxiliary

Code (hex)	Event name / Aux. code	Cause	What to do
			code 0100 0000), the hardware current/voltage setting on the module is shown by parameter 14.29. The corresponding parameter setting is 14.30. Adjust either the hardware setting on the module or the parameter to solve the mismatch. **Note:** Control board reboot (either by cycling the power or through parameter 96.08 Control board boot) is required to validate any changes in the hardware settings.
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 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. Check the auxiliary code. See *Drive application programming manual (IEC 61131-3)* (3AUA0000127808 [English]).
A7B0	Motor speed feedback	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	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).

Code (hex)	Event name / Aux. code	Cause	What to do
	0002	Feed constant definition invalid or outside limits.	Check feed constant settings (90.63 and 90.64).
	0003	Encoder stopped working.	Check encoder status.
	0004	Encoder drift detected.	Check for slippage between encoder and motor.
A7C1	FBA A communication	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.
	0002	Communication problem between adapter and drive.	Check communication connections between adapter and drive.
	0004	Communication problem between adapter and PLC or parameters refreshed using the parameter 51.27 FBA A par refresh.	Check communication connections between adapter and PLC. Stop using parameter 51.27 FBA A par refresh to refresh parameters.
	0005	Lost communication with fieldbus communication adapter.	Check fieldbus communication adapter.
	Other aux code value	Unknown internal issues.	Contact your local ABB representative.
A7C2	FBA B communication	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.
	0002	Communication problem between adapter and drive.	Check communication connections between adapter and drive.
	0004	Communication problem between adapter and PLC or parameters refreshed using the parameter 51.27 FBA A par refresh.	Check communication connections between adapter and PLC. Stop using parameter 51.27 FBA A par refresh to refresh parameters.
	0005	Lost communication with fieldbus communication adapter.	Check fieldbus communication adapter.
	Other aux code value	Unknown internal issues.	Contact your local ABB representative.
A7CE	EFB comm loss	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	Encoder error.	Check the auxiliary code (format XXYY ZZZZ). “XX” specifies the number of the encoder interface module (**01:**

Code (hex)	Event name / Aux. code	Cause	What to do
			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	Cable fault.	Check the conductor order at both ends of the encoder cable. Check the groundings of the encoder cable. If the encoder was working previously, check the encoder, encoder cable and encoder interface module for damage. See also parameter 92.21 Encoder cable fault mode.
	0002	No encoder signal.	Check the condition of the encoder.
	0003	Overspeed.	Contact your local ABB representative.
	0004	Overfrequency.	Contact your local ABB representative.
	0005	Resolver ID run failed.	Contact your local ABB representative.
	0006	Resolver overcurrent fault.	Contact your local ABB representative.
	0007	Speed scaling error.	Contact your local ABB representative.
	0008	Absolute encoder communication error.	Contact your local ABB representative.
	0009	Absolute encoder initialization error.	Contact your local ABB representative.
	000A	Absolute SSI encoder configuration error.	Contact your local ABB representative.
	000B	Encoder reported an internal error.	See the documentation of the encoder.
	000C	Encoder reported a battery error.	See the documentation of the encoder.
	000D	Encoder reported overspeed or decreased resolution due to overspeed.	See the documentation of the encoder.
	000E	Encoder reported a position counter error.	See the documentation of the encoder.
	000F	Encoder reported an internal error.	See the documentation of the encoder.
A7EE	Control panel loss	Control panel (or PC tool) has stopped communicating.	Check PC tool or control panel connection. Check control panel connector. Check mounting platform if being used. Disconnect and reconnect the control panel.
A880	Motor bearing	Warning generated by an ontime 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.

Code (hex)	Event name / Aux. code	Cause	What to do
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	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.
A883	Power ups	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.
A884	Main contactor	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.
A885	DC charge	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.
A886	On-Time 1	Warning generated by on-time timer 1.	Check the source of the warning (parameter 33.13 On-time 1 source).
A887	On-Time 2	Warning generated by on-time timer 2.	Check the source of the warning (parameter 33.23 On-time 2 source).
A888	Edge counter 1	Warning generated by edge counter 1.	Check the source of the warning (parameter 33.33 Edge counter 1 source).
A889	Edge counter 2	Warning generated by edge counter 2.	Check the source of the warning (parameter 33.43 Edge counter 2 source).
A88A	Value counter 1	Warning generated by value counter 1.	Check the source of the warning (parameter 33.53 Value counter 1 source).
A88B	Value counter 2	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 ontime 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 Main fan on-time counter.
A88D	DC capacitor	Warning generated by an ontime timer. Programmable warnings: 33.14 On-time 1 warn message	Check the auxiliary code. Check the source of the warning corresponding to the code: 0: 33.13 On-time 1 source

Code (hex)	Event name / Aux. code	Cause	What to do
		33.24 On-time 2 warn message	1: 33.23 On-time 2 source 10: 05.04 Main fan on-time counter.
A88E	Cabinet fan	Warning generated by an ontime 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 Main fan on-time counter.
A88F	Cooling fan	Warning generated by an ontime 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 Main fan on-time counter.
A890	Additional cooling fan	Warning generated by an ontime 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 Main fan on-time counter.
A8A0	AI Supervised Warning	An analog signal is outside the limits specified for the analog input.	Check the auxiliary code (format XYY). “X” specifies the location of the input (**0:** AI on control unit; **1:** I/O extension module 1, etc.), “YY” specifies the input and limit (**01:** AI1 under minimum, **02:** AI1 over maximum, **03:** AI2 under minimum, **04:** AI2 over maximum). 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, 14 I/O extension module 1, 15 I/O extension module 2 or 16 I/O extension module 3.
A8B0	Signal supervision	Warning generated by the signal supervision 1 function.	Check the source of the warning (parameter 32.07 Supervision 1 signal).
A8B1	Signal supervision 2	Warning generated by the signal supervision 2 function.	Check the source of the warning (parameter 32.17 Supervision 2 signal).
A8B2	Signal supervision 3	Warning generated by the signal supervision 3 function.	Check the source of the warning (parameter 32.27 Supervision 3 signal).
A8BE	ULC overload	Selected signal has exceeded the user overload curve.	Check for any operating conditions increasing the monitored signal (for example, the loading of the motor if the torque or current is being monitored). Check the definition of the load curve (parameter group 37 User load curve).
A8BF	ULC underload	Selected signal has fallen below the user underload curve.	Check for any operating conditions decreasing the monitored signal (for

Code (hex)	Event name / Aux. code	Cause	What to do
			example, loss of load if the torque or current is being monitored). Check the definition of the load curve (parameter group 37 User load curve).
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.
A981	External warning 1	Fault in external device 1.	Check the external device. Check setting of parameter 31.01 External event 1 source.
A982	External warning 2	Fault in external device 2.	Check the external device. Check setting of parameter 31.03 External event 2 source.
A983	External warning 3	Fault in external device 3.	Check the external device. Check setting of parameter 31.05 External event 3 source.
A984	External warning 4	Fault in external device 4.	Check the external device. Check setting of parameter 31.07 External event 4 source.
A985	External warning 5	Fault in external device 5.	Check the external device. Check setting of parameter 31.09 External event 5 source.
AE90	I/O bus communication	Communication break noticed on I/O bus.	Check I/O bus wiring, powering of the nodes and node number settings on the CIO-01 module. Parameters of parameter group 208 I/O bus diagnostics can be used to identify the nodes that are timing out.
AE91	Fan lifetime exceeded	Warning limit for fan lifetime (parameter 206.08) has been exceeded.	See the auxiliary code for indication of module IDs that contain fans that have exceeded their lifespan. Auxiliary code is a bit word where bit 0 indicates CIO-01 module assigned to node ID 1. Replace the failing fan and reset the fan data via parameter group 207 I/O bus service.
AE92	Fan speed	Fan speed is under limit (parameter 206.06).	Check fan feedback. See parameters 206.30…206.33 for individual failing fans.
AE93	Fan speed feedback error	Error in fan speed feedback.	See the auxiliary code for node(s) giving faulty feedback indication for fan(s). Auxiliary code is a bit word where bit 0 indicates CIO-01 module assigned to node ID 1.

Code (hex)	Event name / Aux. code	Cause	What to do
			Check fan feedback. Verify the identification run results against the tachometer pulse count of the fan feedback.
AE94	CIO MCB monitoring	Warning related to miniature circuit breaker. Some of the bits of the MCB status word are 0.	Check miniature circuit breaker and digital input DI5.
AE95	CIO fuse monitoring	Warning related to fuses. Some of the bits of the fuse status word are 0.	Check fuses and digital input DI6.
AE97	CIO DI8 monitoring	Warning related to digital input DI8.	Check digital input DI8.
AF85	Line side unit warning	The supply unit (or other converter) has generated a warning.	The auxiliary code specifies the original warning code in the supply unit control program. See section Auxiliary codes for line-side converter warnings (page 566).
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 Speed controller autotune (page 77).
	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).
	0004	Motor could not decelerate with full autotune torque.	Decrease torque step (parameter 25.38) or speed step (25.39), or increase torque limits depending on limit source indicated in parameters 30.01 and 30.02.
AFAA	Autoreset	A fault is about to be autoreset.	Informative warning. See the settings in parameter group 31 Fault functions.
AFE1	Emergency stop (off2)	• Drive has received an emergency stop (mode selection off2) command. • (Follower drive in a master/follower configuration)	• Check that it is safe to continue operation. Reset the source of the emergency stop signal (such as an emergency stop push button). Restart drive. If the emergency stop was unintentional, check the source of the stop signal (for example, 21.05 Emergency stop source, or control word received from an external control system). • Informative warning. After stopping on a ramp stop (Off1 or Off3) command, the master sends

Code (hex)	Event name / Aux. code	Cause	What to do
		Drive has received a stop command from the master.	a short, 10-millisecond coast stop (Off2) command to the follower(s). The Off2 stop is stored in the event log of the follower.
AFE2	Emergency stop (off1 or off3)	Drive has received an emergency stop (mode selection Off1 or Off3) command.	Check that it is safe to continue operation. Reset the source of the emergency stop signal (such as an emergency stop push button). Restart drive. If the emergency stop was unintentional, check the source of the stop signal (for example, 21.05 Emergency stop source, or control word received from an external control system).
AFE7	Follower	A follower drive has tripped.	Check the auxiliary code. Add 2 to the code to find out the node address of the faulted drive. Correct the fault in the follower drive.
AFEA	Enable start signal missing	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 selected	Motor ID run will occur at next start, or is in progress.	Informative warning.
AFF7	Autophasing	Autophasing will occur at next start.	Informative warning.
B5A0	STO event	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.
B5A2	Power up	The drive has been powered up.	Informative event.
B5F6	ID run done	ID run completed.	Informative event. The auxiliary code specifies the type of ID run. 0: None 1: Normal 2: Reduced 3: Standstill 4: Autophasing 5: Current measurement calibration 6: Advanced 7: Advanced standstill

Code (hex)	Event name / Aux. code	Cause	What to do
B680	SW internal diagnostics	SW internal malfunction.	Contact your local ABB representative, quoting the auxiliary code. If the Drive Composer tool is available, also create and send a 'support package' (see Drive composer manual for instructions).
B686	Checksum mismatch	The calculated parameter checksum does not match any enabled reference checksum.	See A686 Checksum mismatch (page 545).
D100	Overtemperature fault	09.10 Measured temperature exceeds 79.08 Warning temperature limit for 3 sec or the Klixon digital input is false.	Check the measurement device. Check the temperature measurement circuit. Check for excessive pressure from the well and discharge point, excessive pressure can cause heating. Check the warning function settings in the parameters.
D101	Pressure fault	Measured 09.09 Pressure is over the defined limits. Fault condition has been fulfilled.	Check the measurement device. Check for high gas content. Check the warning function settings in the 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 Torque1 - 78.08 Speed3) for a time period defined by parameter 78.08 Speed3.	Check the parameter settings. Check if parameter 78.02 Underload function is set to fault. Check the pumps mechanical condition. Check the 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 than 77.05 Rod torq1 speed for a period of time defined by parameter 77.06 Rod torq1 delay time.	See parameters 77.02 Rod torq1 function - 77.06 Rod torq1 delay time. Check the warning function settings in parameters and set the values as required. Check the pumps mechanical condition.
D104	Rod torque 2 limit fault	77.07 Rod torq2 function has been triggered more than the defined 77.13 Rod torq2 limit counter counter times during 77.14 Rod torq2 time window.	Check the parameter settings and set values as required.
D105	Brake confirmation fault	Mechanical brake (if present) did not pass the Pump backspin control procedure.	Check the operational condition of the mechanical brake (if present). Check parameters 74.21 Brake confirmation enable...74.25 Brake confirmation time.
D10E	Pressure level	To do	To do
D110	Belt slipping fault	Motor and connected load speed have difference more than 84.22 Belt slip limit during 84.23 Belt slip limit delay and Fault reaction is selected.	Check that the parameter value corresponds to the actual value. Check the the belt tension.

Code (hex)	Event name / Aux. code	Cause	What to do
D111	Pressure feedback supervision fault	Pressure value exceeds the defined limits.	Check that the parameter value corresponds to the actual value. Check that the source defined by 82.21 Well pressure source is providing a feedback signal.
D112	Main switch fault	Digital source used as feedback is active.	Check that the used digital source signal status corresponds to the actual value. 31.201 Main switch feedback.
D113	Aux switch fault	Digital source used as feedback is active.	Check that the used digital source signal status corresponds to actual value. See parameter 31.206 Aux switch feedback.
D114	Low pressure fault	Digital source used as feedback was activated.	Check that the used digital source signal status corresponds to the actual value. 31.211 Low pressure feedback.
D200	Overtemperature	09.10 Measured temperature exceeds 79.07 Warning temperature limit for 5 sec or the Klixon digital input is false.	Check the measurement device. Check for high gas content. Check for problem in the temperature measurement circuit. Check the well and discharge pressures (excessive pressure can cause heating). Check the warning function settings in the parameters.
D201	Pressure	The parameter value 09.09 Pressure exceeds 76.07 Analog feedback limit for 76.08 Analog feedback limit delay time or 76.04 Digital feedback source is set as false.	Check the measurement device. Check for high gas content. Check the warning function settings in the parameters.
D202	Underload	78.02 Underload function is set to warning when 09.01 Rod torque and 09.05 Rod speed values are lower than user defined curve (parameters 78.03 Torque1 - 78.08 Speed3) for 78.09 Underload delay time.	Check the parameter settings. Check setting of parameter78.02 Underload function.
D203	Check curve	There are identical torque values in parameters 78.03 Torque1 - 78.08 Speed3.	Check the parameter settings and set the values as required.
D204	Rod torque 1 limit	Actual 09.01 Rod torque exceeds the defined limits. Warning condition has been fulfilled. Shut-down procedure is active.	See parameters 77.02 Rod torq1 function - 77.06 Rod torq1 delay time. 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 the parameter settings and set the values as required.
D206	Rod torque 2 limit	77.11 Rod torq2 additive speed ref has been triggered more than 77.13 Rod	Check the wiring of the End limit 2 connection.

Code (hex)	Event name / Aux. code	Cause	What to do
		torq2 limit counter times during 77.14 Rod torq2 time window. Shutdown procedure is active.	Run the motor in the opposite direction and deactivate the End limit 2 command.
D207	Sleep mode	Sleep condition is fulfilled.	Check and correct the possible causes for the warning, and then give the start command again.
D208	Backspin limit	Actual 09.05 Rod speed is faster than 09.11 Backspin speed reference.	Check the parameter settings and set the values as required.
D209	Backspin active	Pump backspin control procedure is in process.	See parameters 80.01 Backspin enable - 80.05 Backspin speed range trim. Wait for the procedure to complete.
D20A	Brake confirmation active	74.21 Brake confirmation enable is active and procedure is in process.	Wait for the procedure to complete.
D20B	Fault delay active	The fault triggers, and the trip is delayed until the drive stops.	Wait for the drive to stop.
D20C	Start delay active	Start delay procedure is active. You cannot start the drive.	Wait till procedure is completed in time 09.12 Start delay remain.
D20D	Replace ZCU battery	The battery of the ZCU board is low.	Replace the battery of the ZCU board.
D20E	Pressure level	This is the block, where writer describes in more detail what causes the event.	This is the block, where writer describes in more details what to do about the event.
D20F	Recovery process in action	to do	to do
D210	Belt slipping	Motor and connected load speed have difference more than 84.22 Belt slip limit during 84.23 Belt slip limit delay and Fault reaction is selected.	Check that the parameter value corresponds to the actual value. Check the belt tensions and mechanics.
D211	Pressure feedback supervision warning	Pressure value exceeds the defined limits.	Check that the parameter value corresponds to the actual value. Check that the source defined in parameter 82.21 Well pressure source is really providing feedback signal.
D212	Main switch warning	Digital source used as feedback is active.	Check that used digital source signal status corresponds to the actual value. See parameter 31.201 Main switch feedback.
D213	Aux switch warning	Digital source used as feedback is active.	Check that the used digital source signal status corresponds to the actual value. See parameter 31.206 Aux switch feedback.
D214	Low pressure warning	Digital source used as feedback is active.	Check that the used digital source signal status corresponds to the actual value. 31.211 Low pressure feedback.

Code (hex)	Event name / Aux. code	Cause	What to do
D215	Autoreset in action	Auto reset 2 function in above to provide attempt to reset active fault or faults.	Check the auto reset 2 function configurations.
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 320). Check the auxiliary code, 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)
FA82	Safe torque off 2 loss	Safe torque off function is active, ie. STO circuit 2 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 320). Check the auxiliary code, 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)

Code (hex)	Event name / Aux. code	Cause	What to do
FA90	STO diagnostics failure	SW internal malfunction.	Contact your local ABB representative.
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 memory unit is empty, or contains incompatible or corrupted firmware.	Recycle the power to the control unit. Check the sticker on the memory unit to confirm that the firmware is compatible with the control unit (ZCU-1x/BCU-x2). Connect Drive Composer PC tool (version 2.3 or later) to the drive. Select Tools - Recover drive. 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 the motor shaft is not locked. Check the auxiliary code. The second number of the code indicates the problem (see actions for each code below).
	0001	Maximum current limit too low.	Check settings of parameters 99.06 Motor nominal current and 30.17 Maximum current. Make sure that 30.17 Maximum current > 99.06 Motor nominal current. Check that the drive is dimensioned correctly according to the motor.
	0002	Maximum speed limit or calculated field weakening point too low.	Check settings of parameters • 30.11 Minimum speed • 30.12 Maximum speed • 99.07 Motor nominal voltage • 99.08 Motor nominal frequency

Code (hex)	Event name / Aux. code	Cause	What to do
			• 99.09 Motor nominal speed. Make sure that • 30.12 Maximum speed > (0.55 × 99.09 Motor nominal speed) > (0.50 × synchronous speed) • 30.11 Minimum speed < 0, and • supply voltage > (0.66 × 99.07 Motor nominal voltage).
	0003	Maximum torque limit too low.	Check settings of parameter 99.12 Motor nominal torque, and the torque limits in group 30 Limits. Make sure that the maximum torque limit in force is greater than 100%.
	0004	Current measurement calibration did not finish within reasonable time.	Contact your local ABB representative.
	0005…0008	Internal error.	Contact your local ABB representative.
	0009	(Asynchronous motors only) Acceleration did not finish within reasonable time.	Contact your local ABB representative.
	000A	(Asynchronous motors only) Deceleration did not finish within reasonable time.	Contact your local ABB representative.
	000B	(Asynchronous motors only) Speed dropped to zero during ID run.	Contact your local ABB representative.
	000C	(Permanent magnet motors only) First acceleration did not finish within reasonable time.	Contact your local ABB representative.
	000D	(Permanent magnet motors only) Second acceleration did not finish within reasonable time.	Contact your local ABB representative.
	000E…0010	Internal error.	Contact your local ABB representative.
	0011	(SynRM only) Rotor orientation not correct during the pulse test.	Try to perform ID run again. Contact your local ABB representative.
	0012	Not possible to perform Advanced Standstill ID run.	Check that nominal power is as advised in Advanced Standstill ID run description. Contact your local ABB representative.
	0013	(Asynchronous motors only) Error in motor data.	Check name plate data. Contact your local ABB representative.
	0014	Acceleration did not finish within reasonable time during Autophasing ID run.	Contact your local ABB representative.
	0015	Advanced standstill failure.	Contact your local ABB representative.
	0016	Rs estimation failure.	Check cabling. Check that switching frequency is high enough. Check sine filter settings if connected. Contact your local ABB representative.

Code (hex)	Event name / Aux. code	Cause	What to do
FF7E	Follower	A follower drive has tripped.	Check the auxiliary code. Add 2 to the code to find out the node address of the faulted drive. Correct the fault in the follower drive.
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.

Auxiliary codes for line-side converter warnings

The table below lists the auxiliary codes of AF85 Line side unit warning. For advanced troubleshooting, see the firmware manual of the line converter.

Code (hex)	Event name / Aux. code	Cause	What to do
AE01	Overcurrent	Output current has exceeded internal fault limit.	Check supply voltage. Check that there are no power factor correction capacitors or surge absorbers in supply cable. Check motor load and acceleration times. Check power semiconductors (IGBTs) and current transducers.
AE02	Earth leakage	IGBT supply has detected load unbalance.	Check AC fuses. Check for earth leakages. Check supply cabling. Check power modules. Check there are no power factor correction capacitors or surge absorbers in supply cable.
AE04	IGBT overload	Excessive IGBT junction to case temperature.	Check supply cable.
AE05	BU current difference	Current difference detected by the branching unit (BU).	Check converter fuses. Check converter(s). Check inverter(s). Check LCL filter.
AE06	BU earth leakage	Earth leakage detected by the branching unit: sum of all currents exceeds the level.	Check AC fuses. Check for earth leakages. Check supply cabling. Check power modules. Check there are no power factor correction capacitors or surge absorbers in supply cable.
AE09	DC link overvoltage	Excessive intermediate circuit DC voltage. **Note:** This warning can be shown only when the IGBT supply unit is not modulating.	Check that parameter 95.01 Supply voltage is set according to the supply voltage in use.
AE0A	DC link undervoltage	Intermediate circuit DC voltage is not sufficient due to missing phase in supply voltage, blown fuse or rectifier bridge internal fault. **Note:** This warning can be shown only when the IGBT supply unit is not modulating.	Check supply and fuses. Check that parameter 95.01 Supply voltage is set according to the supply voltage in use.

Code (hex)	Event name / Aux. code	Cause	What to do
AE0B	DC not charged	The voltage of the intermediate DC circuit has not yet risen to operating level. One input phase could be disconnected. **Note:** This warning can be shown only when the IGBT supply unit is not modulating.	Check the input voltage setting in parameter 95.01 Supply voltage. Check the input voltage. Check charging resistors. If the problem persists, contact your local ABB representative.
AE0C	BU DC link difference	DC link voltage difference detected by the branching unit.	Check DC fuses. Check converter module connections to DC link.
AE0D	BU voltage difference	Main voltage difference detected by the branching unit.	Check AC fuses. Check supply cable.
AE14	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 IGBT supply unit power.
AE15	Excess temperature difference	High temperature difference between the IGBTs of different phases.	Check the cabling. Check cooling of power module(s).
AE16	IGBT temperature	IGBT temperature is excessive.	Check ambient conditions. Check air flow and fan operation. Check heatsink fins for dust pick-up. Check motor power against IGBT supply unit power.
AE24	Voltage category unselected	The supply voltage range has not been defined.	Define the supply voltage range (parameter 95.01 Supply voltage).
AE58	Emergency stop (OFF2)	Supply unit 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 the drive.
AE5F	Temperature Warning	Supply module temperature is excessive due to eg, module overload or fan failure.	Check module cooling air flow and fan operation. Check ambient temperature. If it exceeds 40 °C (104 °F), ensure that load current does not exceed derated load capacity. See appropriate hardware manual. Check inside of cabinet and heatsink of supply module for dust pick-up. Clean whenever necessary.
AE73	Fan	Cooling fan is stuck or disconnected.	Check the auxiliary code in the line-side converter program to identify the fan. Check fan operation and connection. Replace fan if faulty.

Code (hex)	Event name / Aux. code	Cause	What to do
AE78	Net lost	Net lost is detected.	Resynchronize the IGBT supply unit to the grid after net lost.
AE85	Charging count	There are too many DC link charging attempts.	Two attempts in five minutes is allowed to prevent charging circuit overheating.

Auxiliary codes for line-side converter faults

The table below lists the auxiliary codes of 7583 Line side unit faulted. For advanced troubleshooting, see the firmware manual of the line converter.

Code (hex)	Event name / Aux. code	Cause	What to do
2E00	Overcurrent	Output current has exceeded internal fault limit.	Check supply voltage. Check that there are no power factor correction capacitors or surge absorbers in supply cable. Check motor load and acceleration times. Check power semiconductors (IGBTs) and current transducers.
2E01	Earth leakage	IGBT supply unit has detected an earth fault.	Check AC fuses. Check for earth leakages. Check supply cabling. Check power modules. Check there are no power factor correction capacitors or surge absorbers in supply cable. If no earth fault can be detected, contact your local ABB representative.
2E02	Short circuit	IGBT supply unit has detected short circuit.	Check supply cable. Check there are no power factor correction capacitors or surge absorbers in supply cable. After correcting the cause of the fault, reboot the control unit (using parameter 96.08 Control board boot or by cycling power.
2E04	IGBT overload	Excessive IGBT junction to case temperature.	Check the load.
2E05	BU current difference	Current difference detected by the branching unit (BU).	Check converter fuses. Check converter(s). Check inverter(s). Check LCL filter. Power off all boards. If the fault persists, contact your local ABB representative.
2E06	BU earth leakage	Earth leakage detected by the branching unit: sum of all currents exceeds the level.	Check AC fuses. Check for earth leakages. Check supply cabling. Check power modules. Check there are no power factor correction capacitors or surge absorbers in supply cable. If no earth fault can be detected, contact your local ABB representative.

Code (hex)	Event name / Aux. code	Cause	What to do
3E00	Input phase loss	Input phase loss detected by the IGBT bridge.	Check the auxiliary code. Check the source of the fault corresponding to the code: 1: Phase A 2: Phase B 4: Phase C 8: Phase cannot be detected Check the AC fuses. Check for input power supply imbalance.
3E04	DC link overvoltage	Excessive intermediate circuit DC voltage.	Check that parameter 95.01 Supply voltage is set according to the supply voltage in use.
3E05	DC link undervoltage	Intermediate circuit DC voltage is not sufficient because of a missing supply phase or blown fuse.	Check supply cabling, fuses and switchgear. Check that parameter 95.01 Supply voltage is set according to the supply voltage in use.
3E06	BU DC link difference	Difference in DC voltages between parallel-connected supply modules.	Check the DC fuses. Check the connection to the DC bus. If the problem persists, contact your local ABB representative.
3E07	BU voltage difference	Difference in main voltages between parallel-connected supply modules.	Check the supply network connections. Check the AC fuses. If the problem persists, contact your local ABB representative.
3E08	LSU charging	DC link voltage is not high enough after charging.	Check parameter 95.01 Supply voltage. Check supply voltage and fuses. Check the connection from the relay output to the charging contactor. Check that the DC voltage measuring circuit is working correctly.
4E01	Cooling	Power module temperature is excessive.	Check ambient temperature. If it exceeds 40 °C (104 °F), ensure that load current does not exceed derated load capacity. See appropriate hardware manual. Check power module cooling air flow and fan operation. Check inside of cabinet and heatsink of power module for dust pick-up. Clean whenever necessary.
4E02	IGBT temperature	IGBT temperature is excessive.	Check ambient conditions. Check air flow and fan operation. Check heatsink fins for dust pick-up. Check motor power against IGBT supply unit power.
4E03	Excess temperature	Power unit module temperature is excessive.	See AE14 Excess temperature (page 567).

Code (hex)	Event name / Aux. code	Cause	What to do
4E04	Excess temperature difference	High temperature difference between the IGBTs of different phases. The amount of available temperatures depends on the frame size.	See AE15 Excess temperature difference.
4E06	Cabinet or LCL overtemperature	Overtemperature detected either in cabinet, LCL filter or auxiliary transformer.	Check the cooling of the cabinet, LCL filter and auxiliary transformer.
5E01	Auxiliary fan broken	An auxiliary cooling fan is stuck or disconnected.	Check the fan operation and connection. Replace the fan if faulty.
5E05	Rating ID mismatch	The hardware of the supply unit 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 supply unit. If the control unit is externally powered, reboot the control unit by cycling its power. If the problem persists, contact your local ABB representative.
5E06	Main contactor Fault	Control program does not receive main contactor on (1) acknowledgement through digital input even control program has closed the contactor control circuit with relay output. Main contactor / main breaker is not functioning properly, or there is a loose / bad connection.	Check main contactor / main breaker control circuit wiring. Check the status of other switches connected to contactor control circuit. See the delivery-specific circuit diagrams. Check main contactor operating voltage level (should be 230 V). Check digital input DI3 connections. Check related 48V power supply and connected fans.
6E19	Synchronization fault	Synchronization to supply network has failed.	Monitor possible network transients.
6E1A	Rating ID fault	Rating ID load error.	Contact your local ABB representative.
6E1F	Licensing fault	There are two types of licenses being used in ACS880 drives: licenses that need to be found from the unit which allow the firmware to be executed, and licenses that prevent the firmware from running. The license is indicated by the value of the auxiliary code field. The license is Nxxxx, where xxxx is indicated by the 4-digit value of the auxiliary code field. 8201: A restrictive license is found from the unit. The firmware on this inverter unit cannot be executed because a Low harmonic license is found from the unit. This unit is meant to be used with IGBT supply control program (2Q) only.	Check the line-converter control program. Record the auxiliary codes of all active licensing faults and contact your product vendor for further instructions. This fault requires a reboot of the control unit either by switching the power off and on. 8201: Contact your product vendor for further instructions.

Code (hex)	Event name / Aux. code	Cause	What to do
6E21	Macro parameterization error	Macro file has a parameter defined in such a way that it cannot be written.	Check aux code for the exact parameter group and index. Check if the parameter exists in the drive. Check the parameter value from the macro file matches the parameter's minimum and maximum limits. If the aux code is zero, a generic file error occurs. Contact your local ABB representative. Aux-code in hexadecimal format contains an 8-bit Group, 8-bit Index, and 16-bit error code.
	0005	Parameter is not accessible from the macro file.	
	0009	Value written is below the parameter minimum limit.	
	000A	Value written is above the parameter maximum limit.	
	000B	Value written is not listed in the parameter selection list.	
	000C	Parameter function prevents to display the value.	
	000D	Parameter does not exist.	
	001F	Parameter in the macro file does not match the parameter in the drive. The unit or display format is different.	
	0022	Pointer parameter is written to target a parameter or bit that does not exist or that is not available to be targeted from macro.	
7E01	Panel loss	Control panel or PC tool selected as active control location has ceased communicating.	Check PC tool or control panel connection. Check control panel connector. Replace control panel in mounting platform.
8E07	Net lost	Net lost is detected. Duration of net lost is too long.	Resynchronize the IGBT supply unit to the grid after net lost.

10

Fieldbus control through the embedded fieldbus interface (EFB)

What this chapter contains

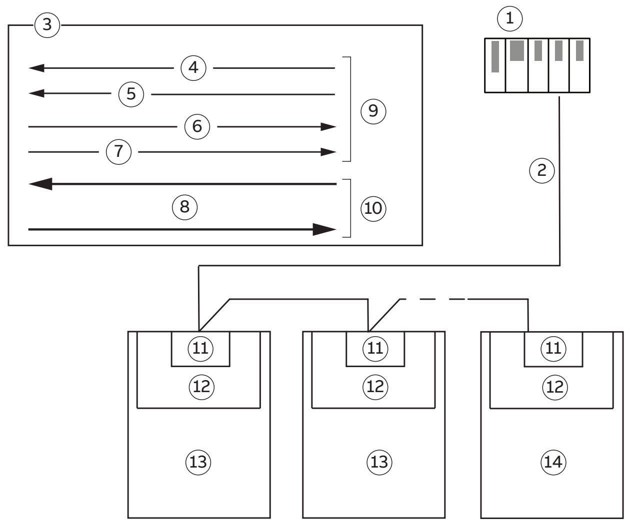
The chapter describes how the drive can be controlled by external devices over a communication network (fieldbus) using the embedded fieldbus interface.

System overview

The drive can be connected to an external control system through a communication link using either a fieldbus adapter or the embedded fieldbus interface.

The embedded fieldbus interface supports the Modbus RTU protocol. The drive control program can handle 10 Modbus registers in a 10-millisecond time level. For example, if the drive receives a request to read 20 registers, it will start its response within 22 ms of receiving the request – 20 ms for processing the request and 2 ms overhead for handling the bus. The actual response time depends on other factors as well, such as the baud rate (a parameter setting in the drive).

The drive can be set to receive all of its control information through the fieldbus interface, or the control can be distributed between the embedded fieldbus interface and other available sources, for example, digital and analog inputs.



1) Fieldbus controller	8) Parameter R/W requests/responses
2) Fieldbus controller	9) Process I/O (cyclic)
3) Data Flow	10) Service messages (acyclic)
4) Control Word (CW)	11) XD2D
5) Reference	12) Control unit
6) Status Word (SW)	13) Termination OFF
7) Actual values	14) Termination ON

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 time-out limit for the communication monitoring.
58.17 Transmit delay	0 ms (default)	Defines a response delay for the drive.

Parameter	Setting for fieldbus control	Function/Information
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 578).
58.26 EFB ref1 type … … 58.29 EFB act2 type	Auto, Transparent, General, Torque, Speed, Frequency	Selects the reference and actual value types. With the Auto setting, the type is selected automatically according to the currently active drive control mode.
58.30 EFB status word transparent source	Other (see Terms and abbreviations)	Defines the source of status word when 58.25 Control profile = Transparent.
58.31 EFB act1 transparent source	Other (see Terms and abbreviations)	Defines the source of actual value 1 when 58.28 EFB act1 type = Transparent or General.
58.32 EFB act2 transparent source	Other (see Terms and abbreviations)	Defines the source of actual value 2 when 58.29 EFB act2 type = Transparent or General.
58.33 Addressing mode	eg. Mode 0 (default)	Defines the mapping between parameters and holding registers in the 400001…465536 (100…65535) Modbus register range.
58.34 Word order	LO-HI (default)	Defines the order of the data words in the Modbus message frame.
58.101 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, or .
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.

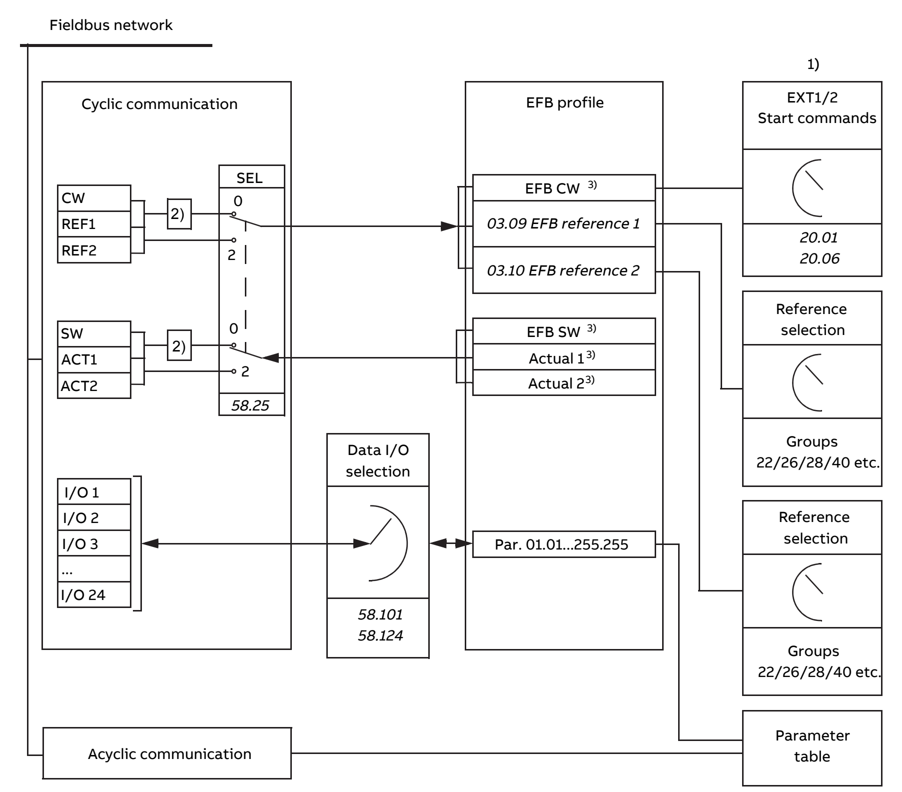
Parameter	**Setting for fieldbus control**	**Function/Information**
CONTROL COMMAND SOURCE SELECTION		
20.01 Ext1 commands	Embedded fieldbus	Selects fieldbus as the source for the start and stop commands when EXT1 is selected as the active control location.
20.02 Ext1 start trigger type	Embedded fieldbus	Selects fieldbus as the source for the start and stop commands when EXT2 is selected as the active control location.
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 REFERENCE SELECTION		
74.05 Speed ref source	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 (see Terms and abbreviations), 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.

Parameter	Setting for fieldbus control	Function/Information
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 581).
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 581).

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 581).

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 581).

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 581).

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.

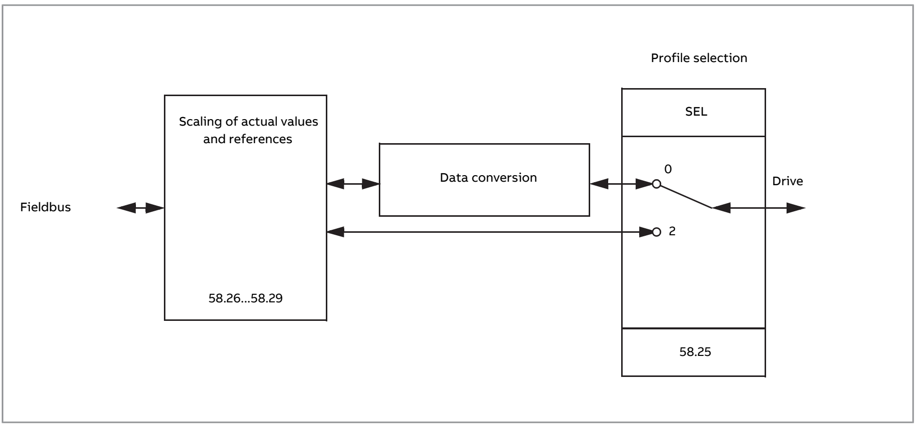
Note: Register addresses of 32-bit parameters cannot be accessed by using 5-digit register numbers.

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 (page 585).

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**.

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. 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.
8	JOGGING_1	1	Accelerate to jogging 1 reference. **Note:** • Bits 4…6 must be 0. • See also section Jogging (page 89).
		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	Fieldbus control disabled (some bits still operate e.g. Reset).

Bit	Name	Value	STATE/Description
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 (page 585).

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.

Bit	Name	Value	STATE/Description
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 out-side tolerance limits.
9	REMOTE	1	Drive control location: REMOTE (EXT1 or EXT2).
		0	Drive control location: LOCAL.
10	ABOVE_ LIMIT	1	Actual frequency or speed equals or exceeds supervision limit (set by drive parameter). Valid in both directions of rotation.
		0	Actual frequency or speed within supervision limit.
11	USER_0		Status bits that can be combined with drive logic for application-specific 12 USER_1 func-tionality.
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 (page 582) and Status Word (page 584).

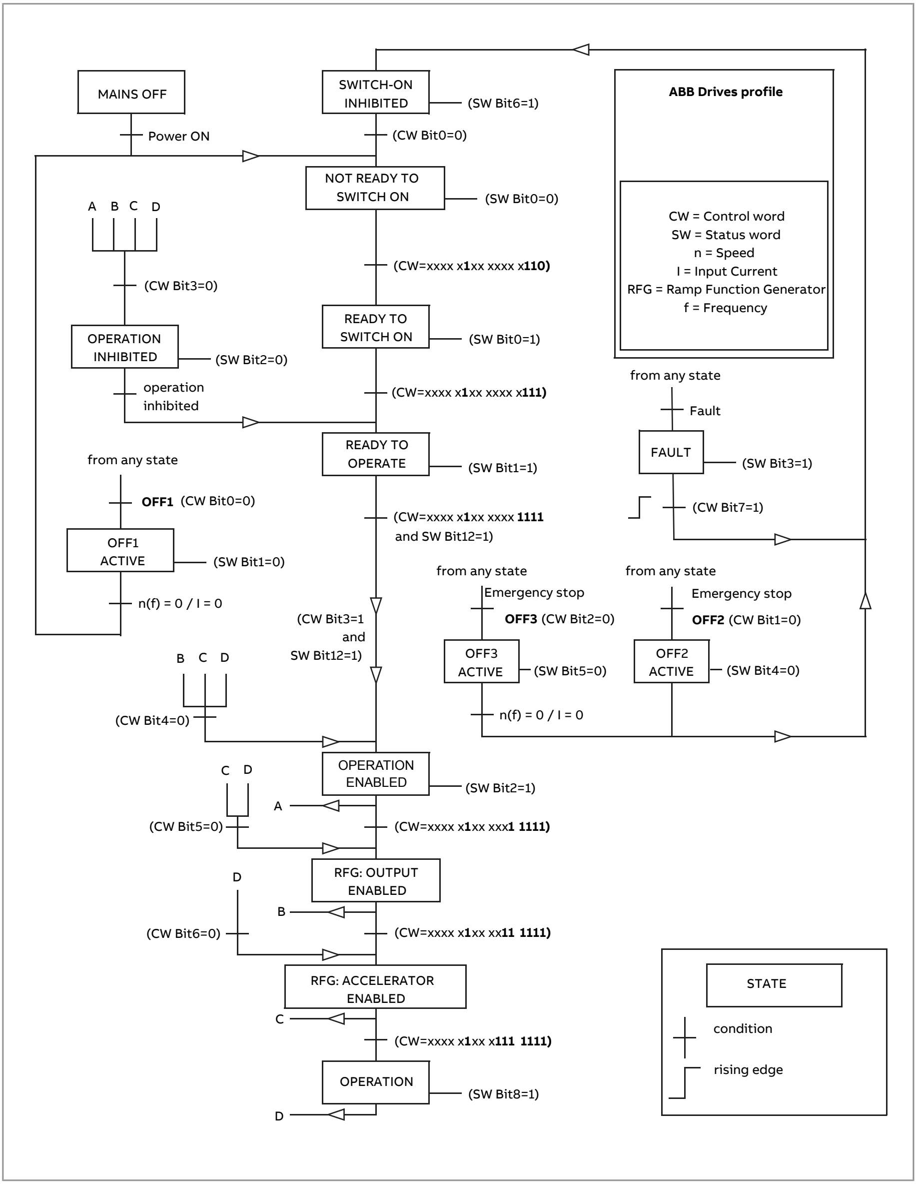
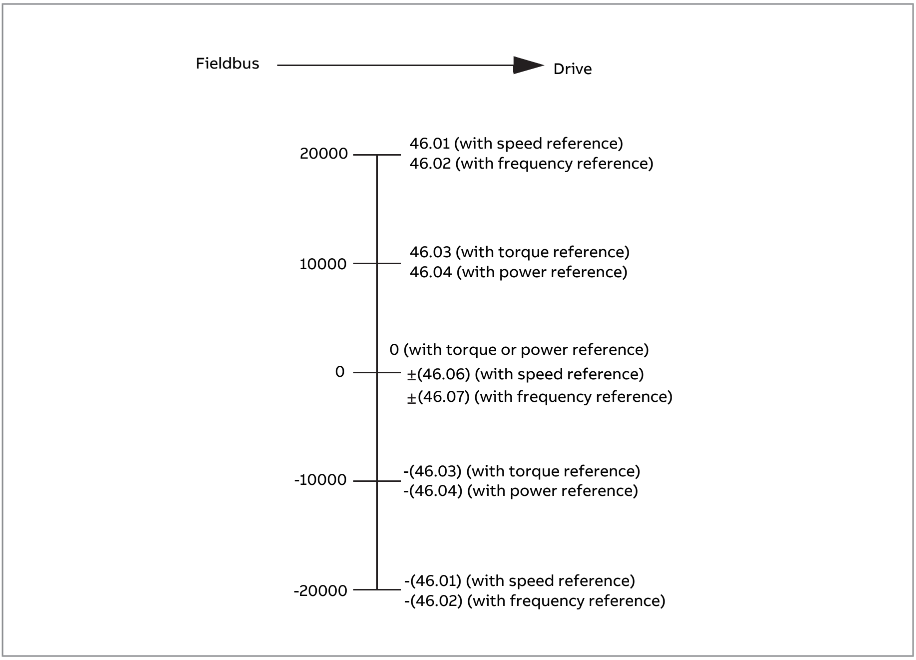


ABB Drives profile
CW = Control word
SW = Status word
n = Speed
I = Input Current
RFG = Ramp Function Generator
f = Frequency
MAINS OFF
Power ON
SWITCH-ON INHIBITED
(SW Bit6=1)
(CW Bit0=0)
NOT READY TO SWITCH ON
(SW Bit0=0)
(CW=xxxx x1xx xxxx x110)
READY TO SWITCH ON
(SW Bit0=1)
(CW=xxxx x1xx xxxx x111)
READY TO OPERATE
(SW Bit1=1)
(CW=xxxx x1xx xxxx 1111 and SW Bit12=1)
A B C D
(CW Bit3=0)
OPERATION INHIBITED
(SW Bit2=0)
operation inhibited
from any state
OFF1 (CW Bit0=0)
OFF1 ACTIVE
(SW Bit1=0)
n(f) = 0 / I = 0
(CW Bit3=1 and SW Bit12=1)
B C D
(CW Bit4=0)
OPERATION ENABLED
(SW Bit2=1)
C D
A
(CW Bit5=0)
(CW=xxxx x1xx xxx1 1111)
RFG: OUTPUT ENABLED
D
B
(CW Bit6=0)
(CW=xxxx x1xx xx11 1111)
RFG: ACCELERATOR ENABLED
C
(CW=xxxx x1xx x111 1111)
OPERATION
(SW Bit8=1)
D
from any state
Fault
FAULT
(SW Bit3=1)
(CW Bit7=1)
from any state
Emergency stop
OFF3 (CW Bit2=0)
OFF3 ACTIVE
(SW Bit5=0)
n(f) = 0 / I = 0
from any state
Emergency stop
OFF2 (CW Bit1=0)
OFF2 ACTIVE
(SW Bit4=0)
STATE
condition
rising edge

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 (page 411).

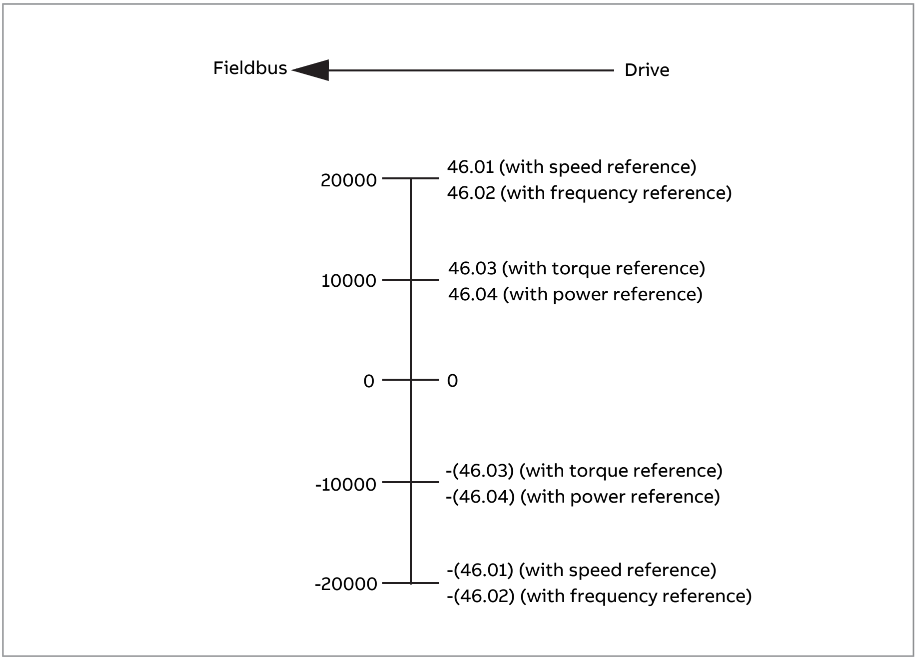


The scaled references are shown by parameters 03.09 EFB reference 1 and 03.10 EFB reference 2.

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 (page 411).



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 582). 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 584). 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 595).
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 589).

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.

Code	Function name	Description
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.
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.

Code	Name	Description
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) (page 595).
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

Reference	ABB drives profile	Transparent profile
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
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

Reference	ABB drives profile	Transparent profile
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 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
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

Reference	ABB drives profile	Transparent profile
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
90	Reset Error Registers	1 = Reset internal error registers (91…95).
91	Error Function Code	Function code of the failed query.
92	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
93	Failed Register	The last register (discrete input, coil, or holding register) that failed to be read or written.
94	Last Register Written Successfully	The last register that was written successfully.

Reference	Name	Description
95	Last Register Read Successfully	The last register that was read successfully.

11

Fieldbus control through a fieldbus adapter

What this chapter contains

This chapter describes how the drive can be controlled by external devices over a communication network (fieldbus) through an optional fieldbus adapter module.

The fieldbus control interface of the drive is described first, followed by a configuration example.

System overview

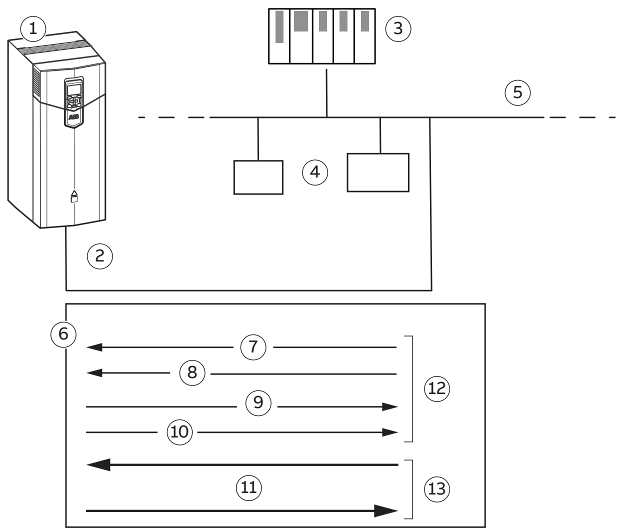
The drive can be connected to an external control system through an optional fieldbus adapter mounted onto the control unit of the drive. The drive actually has two independent interfaces for fieldbus connection, called “fieldbus adapter A” (FBA A) and “fieldbus adapter B” (FBA B). The drive can be configured to receive all of its control information through the fieldbus interface(s), or the control can be distributed between the fieldbus interface(s) and other available sources such as digital and analog inputs, depending on how control locations EXT1 and EXT2 are configured.

Note: The text and examples in this chapter describe the configuration of one fieldbus adapter (FBA A) by parameters 50.01...50.21 and parameter groups 51...53. The second adapter (FBA B), if present, is configured in a similar fashion by parameters 50.31...50.51 and parameter groups 54...56. It is recommended that the FBA B interface is only used for monitoring.

Fieldbus adapters are available for various 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).

Note: Fieldbus adapters with the suffix “M” (eg. FPBA-01-M) are not supported.



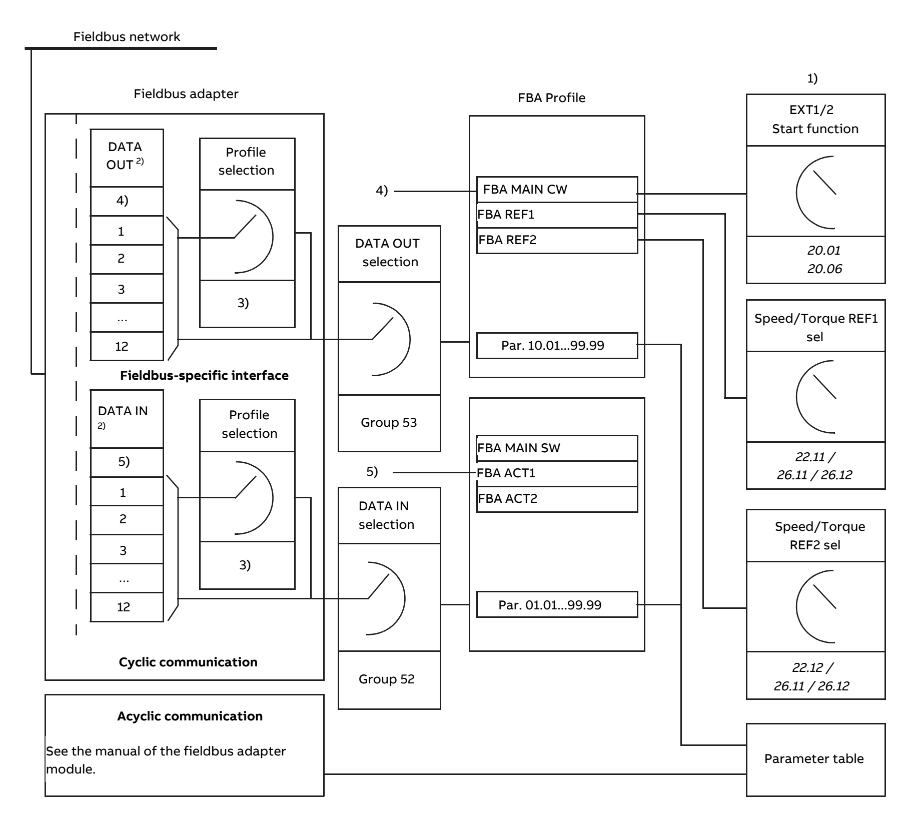
1) Drive	8) References
2) Type Fxxx fieldbus adapter installed onto drive control unit (slot 1, 2 or 3)	9) Status word (SW)
3) Fieldbus controller	10) Actual values

4) Other devices	11) Parameter R/W requests/responses
5) Fieldbus	12) Process I/O (cyclic)
6) Data Flow	13) Process I/O (cyclic) or Service messages (acyclic)
7) Control word (CW)	-

Basics of the fieldbus control interface

The cyclic communication between a fieldbus system and the drive consists of 16- or 32-bit input and output data words. The drive is able to support a maximum of 12 data words (16 bits) in each direction.

Data transmitted from the drive to the fieldbus controller is defined by parameters 52.01 FBA A data in1 ... 52.12 FBA A data in12. The data transmitted from the fieldbus controller to the drive is defined by parameters 53.01 FBA data out1 ... 53.12 FBA data out12.



1)	See also other parameters which can be controlled from fieldbus.
2)	The maximum number of data words used is protocol-dependent.

3)	Profile/instance selection parameters. Fieldbus module specific parameters. For more information, see the *User's Manual* of the appropriate fieldbus adapter module.
4)	With DeviceNet, the control part is transmitted directly.
5)	With DeviceNet, the actual value part is transmitted directly.

Control word and Status word

The Control word is the principal means for controlling the drive from a fieldbus system. It is sent by the fieldbus master station to the drive through the adapter module. The drive switches between its states according to the bit-coded instructions in the Control word, and returns status information to the master in the Status word.

For the ABB Drives communication profile, the contents of the Control word and the Status word are detailed on pages 573 and 574 respectively. The drive states are presented in the state diagram (page 575).

When a transparent communication profile is selected eg. by parameter group 51 FBA A settings, the control word received from the PLC is available in 06.03 FBA A transparent control word. The individual bits of the word can then be used for drive control through bit pointer parameters. The source of the status word, for example 06.50 User status word 1, can be selected in 50.09 FBA A SW transparent source.

Debugging the network words

If parameter 50.12 FBA A debug mode is set to Fast, the Control word received from the fieldbus is shown by parameter 50.13 FBA A control word, and the Status word transmitted to the fieldbus network by 50.16 FBA A status word. This “raw” data is very useful to determine if the fieldbus master is transmitting the correct data before handing control to the fieldbus network.

References

References are 16-bit words containing a sign bit and a 15-bit integer. A negative reference (indicating reversed direction of rotation) is formed by calculating the two's complement from the corresponding positive reference.

ABB drives can receive control information from multiple sources including analog and digital inputs, the drive control panel and a fieldbus adapter module. In order to have the drive controlled through the fieldbus, the module must be defined as the source for control information such as reference. This is done using the source selection parameters in groups 22 Speed reference selection, 26 Torque reference chain and 28 Frequency reference chain.

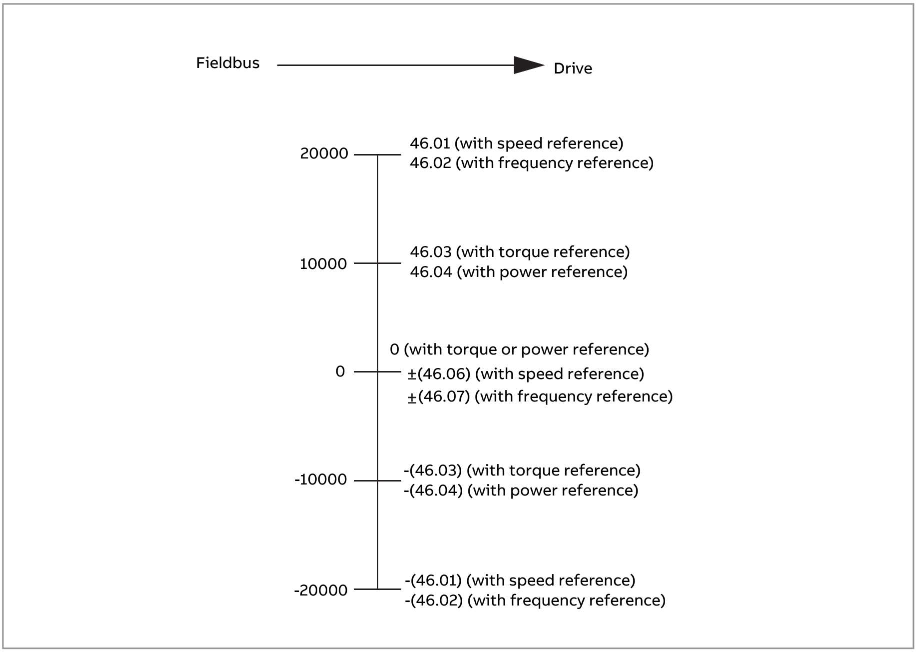
Debugging the network words

If parameter 50.12 FBA A debug mode is set to Fast, the references received from the fieldbus are displayed by 50.14 FBA A reference 1 and 50.15 FBA A reference 2.

Scaling of references

Note: The scalings described below are for the ABB Drives communication profile. Fieldbus-specific communication profiles may use different scalings. For more information, see the manual of the fieldbus adapter

The references are scaled as defined 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.

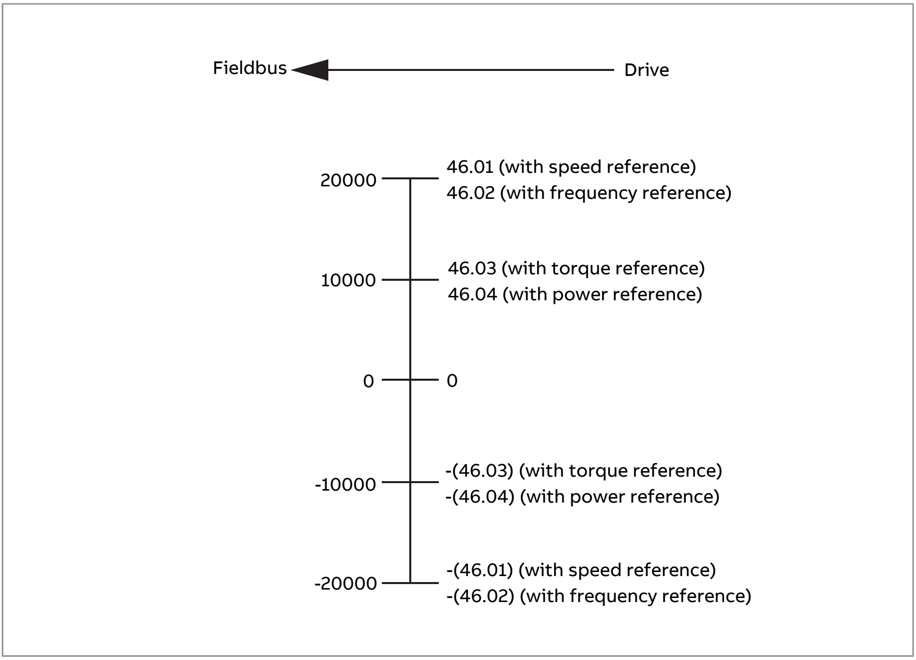
Debugging the network words

If parameter 50.12 FBA A debug mode is set to Fast, the actual values sent to the fieldbus are displayed by 50.17 FBA A actual value 1 and 50.18 FBA A actual value 2.

Scaling of actual values

Note: The scalings described below are for the ABB Drives communication profile. Fieldbus-specific communication profiles may use different scalings. For more information, see the manual of the fieldbus adapter.

The actual values are scaled as defined by parameters 46.01...46.04; which scaling is in use depends on the setting of parameters 50.07 FBA A actual 1 type and 50.08 FBA A actual 2 type.



Contents of the fieldbus Control word (ABB Drives profile)

The upper case boldface text refers to the states shown in the state diagram (page 575).

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. If the drive is set to receive the Run enable signal from the fieldbus, this bit activates the signal. See also parameter 06.18 Start inhibit status word.
		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. The drive will immediately decelerate 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).

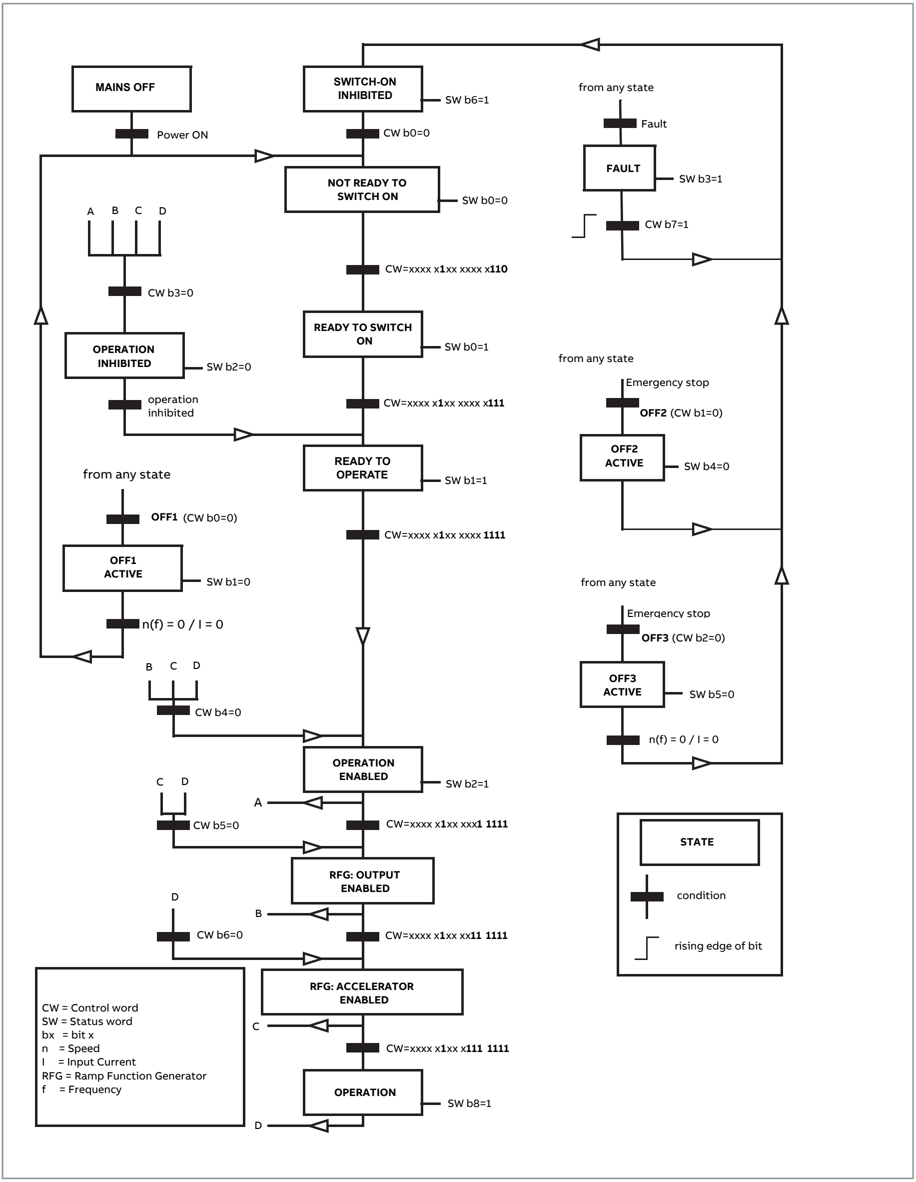
Bit	Name	Value	STATE/Description
6	Ramp in zero	1	Normal operation. Proceed to **OPERATING**. **Note:** This bit is effective only if the fieldbus interface is set as the source for this signal by drive parameters.
		0	Force Ramp function generator input to zero.
7	Reset	0=>1	Fault reset if an active 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. **Note:** • Bits 4…6 must be 0. • See also section Jogging (page 89).
		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 0…2.
11	Ext ctrl loc	1	Select External Control Location EXT2. Effective if control location is parameterized to be selected from fieldbus.
		0	Select External Control Location EXT1. Effective if control location is parameterized to be selected from fieldbus.
12 to 15	Reserved.		

Contents of the fieldbus Status word (ABB Drives profile)

The upper case boldface text refers to the states shown in the state diagram (page 575).

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**. See parameters 06.18 Start inhibit status word and 06.25 Drive inhibit status word 2 for the inhibiting condition.
3	Tripped	1	**FAULT**.
		0	No fault.
4	Off 2 inactive	1	OFF2 inactive.
		0	**OFF2 ACTIVE**.
5	Off 3 inactive	1	OFF3 inactive.
		0	**OFF3 ACTIVE**.
6	Switch-on inhibited	1	**SWITCH-ON INHIBITED**.
		0	–
7	Warning	1	Warning active.
		0	No warning active.
8	At setpoint	1	**OPERATING**. Actual value equals reference = is within tolerance limits (see parameters 46.21…46.23).
		0	Actual value differs from reference = is outside tolerance limits.
9	Remote	1	Drive control location: REMOTE (EXT1 or EXT2).
		0	Drive control location: LOCAL.
10	Above limit	-	See parameter 06.29 MSW bit 10 sel.
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 (ABB Drives profile)



Setting up the drive for fieldbus control

1. Install the fieldbus adapter module mechanically and electrically according to the instructions given in the *User's manual* of the module.
2. Power up the drive.
3. Enable the communication between the drive and the fieldbus adapter module with parameter 50.01 FBA A enable.
4. With 50.02 FBA A comm loss func, select how the drive should react to a fieldbus communication break.

   Note: This function monitors both the communication between the fieldbus master and the adapter module and the communication between the adapter module and the drive.

5. With 50.03 FBA A comm loss t out, define the time between communication break detection and the selected action.
6. Select application-specific values for the rest of the parameters in group 50 Fieldbus adapter (FBA), starting from 50.04. Examples of appropriate values are shown in the tables below.
7. Set the fieldbus adapter module configuration parameters in group 51 FBA A settings. As a minimum, set the required node address and the control profile.
8. Define the process data transferred to and from the drive in parameter groups 52 FBA A data in and 53 FBA A data out.

   Note: Depending on the communication protocol and profile being used, the Control word and Status word may already be configured to be sent/received by the communication system.

9. Save the valid parameter values to permanent memory by setting parameter 96.07 Parameter save manually to Save.
10. Validate the settings made in parameter groups 51, 52 and 53 by setting parameter 51.27 FBA A par refresh to Refresh.
11. Configure control locations EXT1 and EXT2 to allow control and reference signals to come from the fieldbus. Examples of appropriate values are shown in the tables below.

Parameter setting example: FPBA (PROFIBUS DP)

This example shows how to configure a basic speed control application that uses the PROFIdrive communication profile with PPO Type 2. The start/stop commands and reference are according to the PROFIdrive profile, speed control mode.

The reference values sent over the fieldbus have to be scaled within the drive so they have the desired effect. The reference value ±16384 (4000h) corresponds to the range of speed set in parameter 46.01 Speed scaling (both forward and reverse directions). For example, if 46.01 is set to 480 rpm, then 4000h sent over fieldbus will request 480 rpm.

Direction	PZD1	PZD2	PZD3	PZD4	PZD5	PZD6
Out	Control word	Speed reference	Acc time 1		Dec time 1	
In	Status word	Speed actual value	Motor current		DC voltage	

The table below gives the recommended drive parameter settings.

Drive parameter	Setting for ACS880 drives	Description
50.01 FBA A enable	**1...3** = [slot number]	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/source and scaling according to the currently active control mode (as displayed by parameter 19.01).
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

Drive parameter	**Setting for ACS880 drives**	**Description**
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	**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.

1) Read-only or automatically detected/set
2) Example

The start sequence for the parameter example above is given below.

Control word

- after power-on, fault or emergency stop:
  - 476h (1142 decimal) –> NOT READY TO SWITCH ON
- in normal operation:
  - 477h (1143 decimal) –> READY TO SWITCH ON (stopped)
  - 47Fh (1151 decimal) –> OPERATING (running)

12

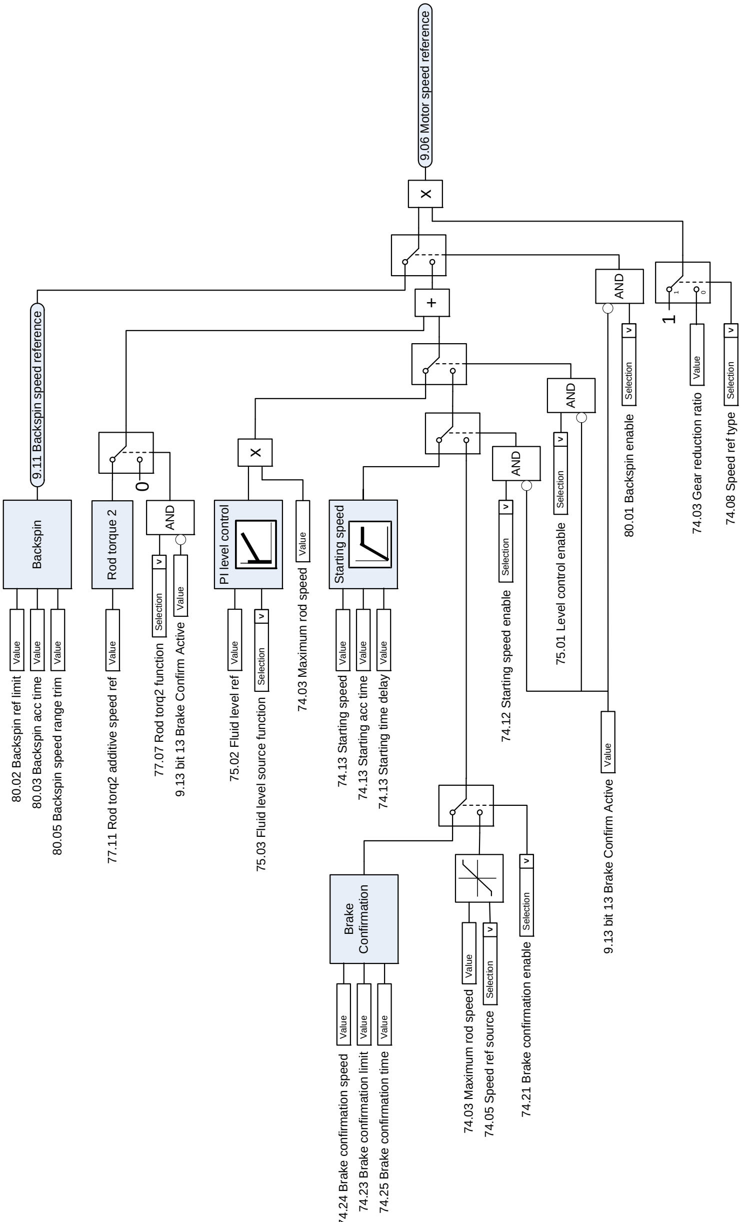
Control chain diagrams

Contents of this chapter

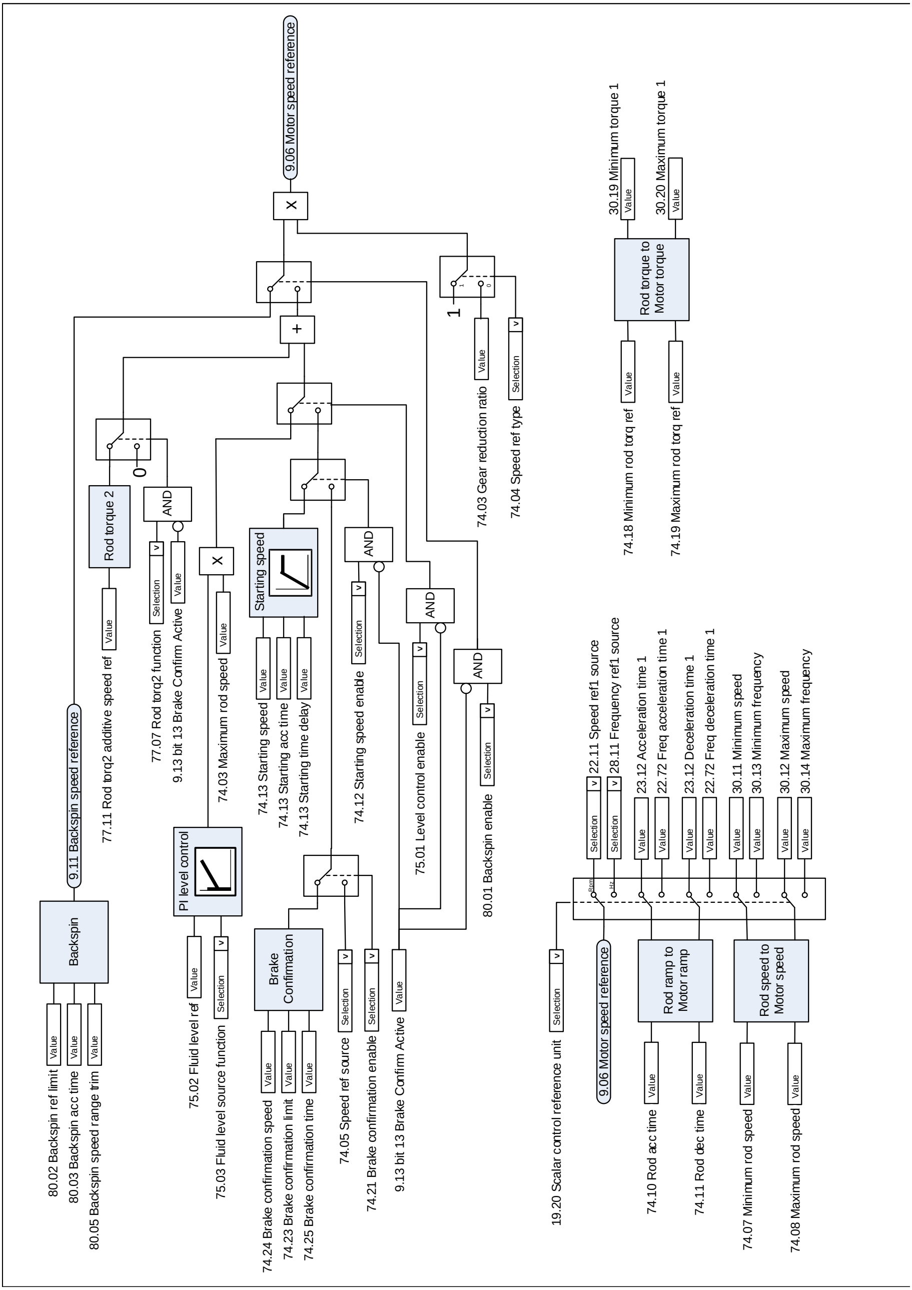
The chapter presents the reference chains of the drive. The control chain diagrams can be used to trace how parameters interact and where parameters have an effect within the drive parameter system.

For a more general diagram, see section Operating modes of the drive (page 56).

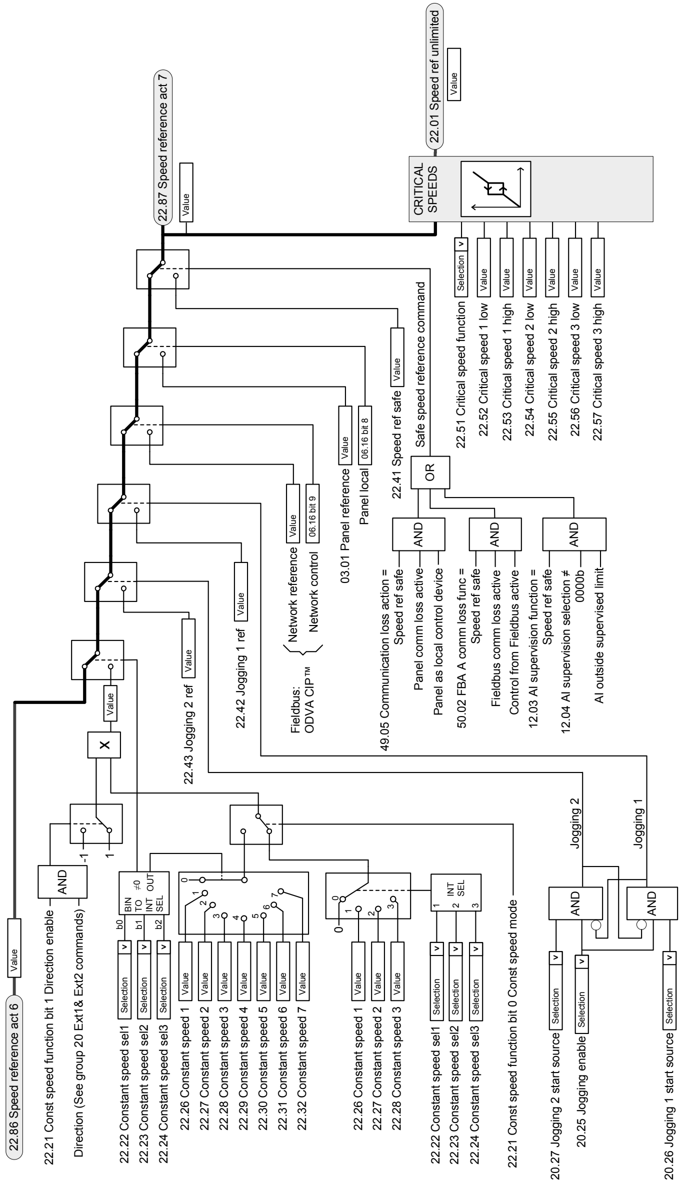
Speed reference source selection I for PCP application


9.06 Motor speed reference
9.11 Backspin speed reference
Backspin
Rod torque 2
AND
PI level control
Starting speed
Brake Confirmation
80.02 Backspin ref limit
80.03 Backspin acc time
80.05 Backspin speed range trim
77.11 Rod torq2 additive speed ref
77.07 Rod torq2 function
9.13 bit 13 Brake Confirm Active
75.02 Fluid level ref
75.03 Fluid level source function
74.03 Maximum rod speed
74.13 Starting speed
74.13 Starting acc time
74.13 Starting time delay
74.12 Starting speed enable
75.01 Level control enable
80.01 Backspin enable
74.03 Gear reduction ratio
74.08 Speed ref type
74.24 Brake confirmation speed
74.23 Brake confirmation limit
74.25 Brake confirmation time
74.03 Maximum rod speed
74.05 Speed ref source
74.21 Brake confirmation enable
9.13 bit 13 Brake Confirm Active

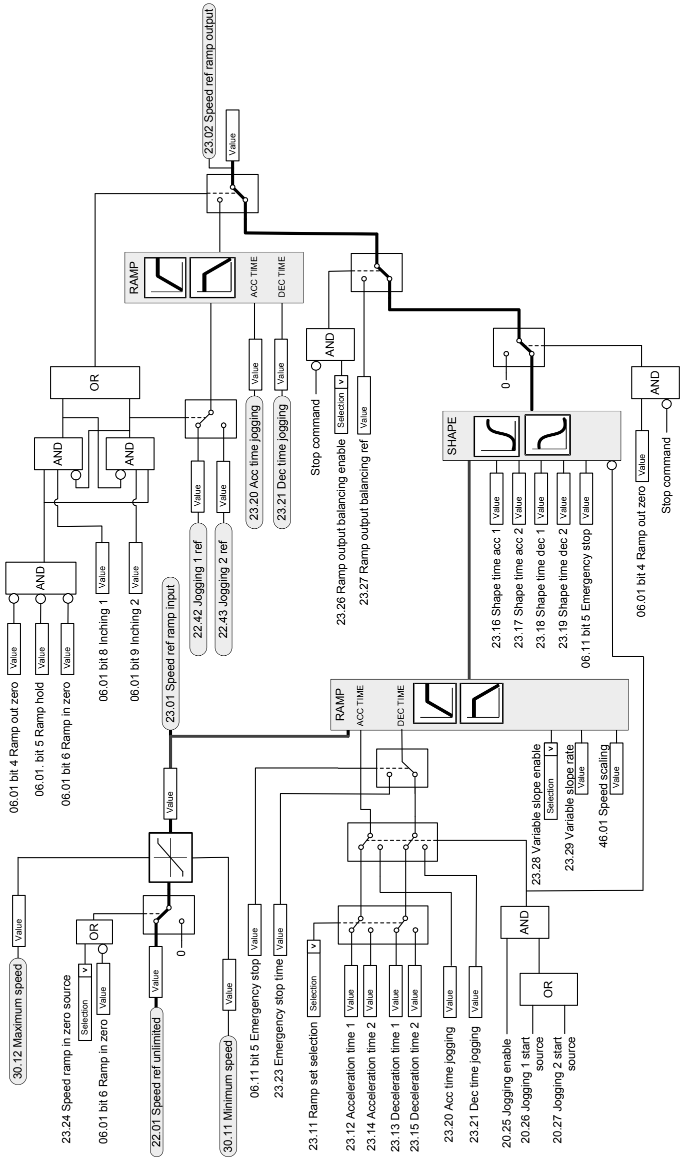
Speed reference source selection II for PCP application


9.06 Motor speed reference
X
+
1
0
74.03 Gear reduction ratio
Value
74.04 Speed ref type
Selection
30.19 Minimum torque 1
30.20 Maximum torque 1
Rod torque to Motor torque
74.18 Minimum rod torq ref
74.19 Maximum rod torq ref
Rod torque 2
AND
77.11 Rod torq2 additive speed ref
77.07 Rod torq2 function
9.13 bit 13 Brake Confirm Active
74.03 Maximum rod speed
Starting speed
74.13 Starting speed
74.13 Starting acc time
74.13 Starting time delay
74.12 Starting speed enable
75.01 Level control enable
80.01 Backspin enable
9.11 Backspin speed reference
Backspin
80.02 Backspin ref limit
80.03 Backspin acc time
80.05 Backspin speed range trim
PI level control
75.02 Fluid level ref
75.03 Fluid level source function
Brake Confirmation
74.24 Brake confirmation speed
74.23 Brake confirmation limit
74.25 Brake confirmation time
74.05 Speed ref source
74.21 Brake confirmation enable
9.13 bit 13 Brake Confirm Active
22.11 Speed ref1 source
28.11 Frequency ref1 source
23.12 Acceleration time 1
22.72 Freq acceleration time 1
23.12 Deceleration time 1
22.72 Freq deceleration time 1
30.11 Minimum speed
30.13 Minimum frequency
30.12 Maximum speed
30.14 Maximum frequency
Rpm
Hz
19.20 Scalar control reference unit
Rod ramp to Motor ramp
Rod speed to Motor speed
74.10 Rod acc time
74.11 Rod dec time
74.07 Minimum rod speed
74.08 Maximum rod speed

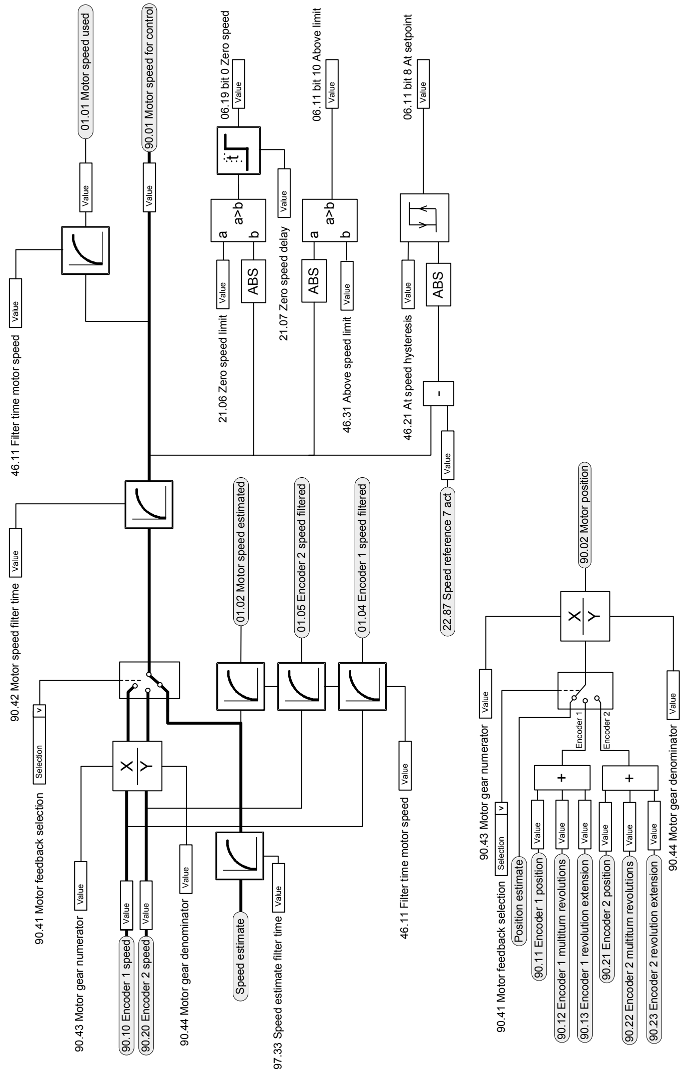
Speed reference source selection II



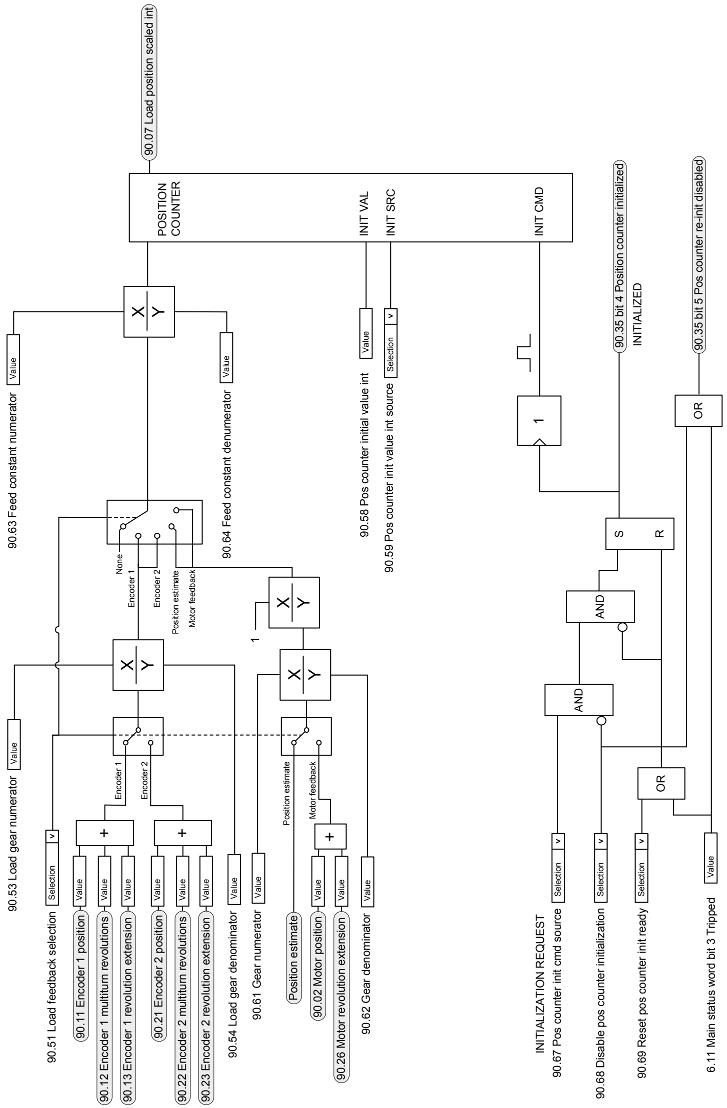
Speed reference ramping and shaping



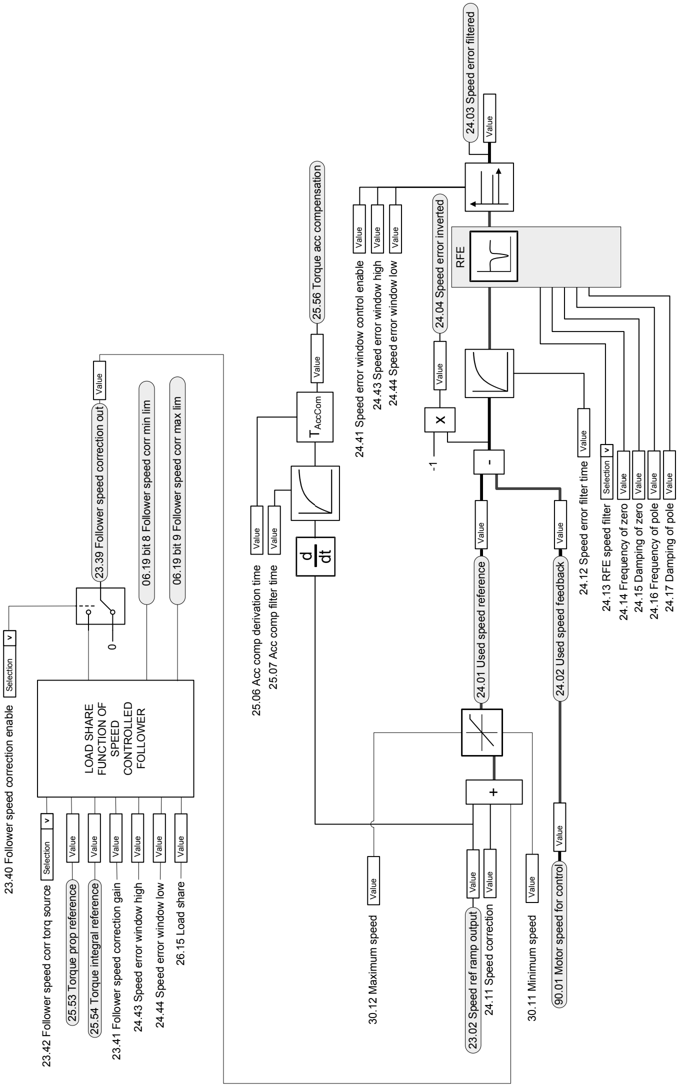
Motor feedback configuration



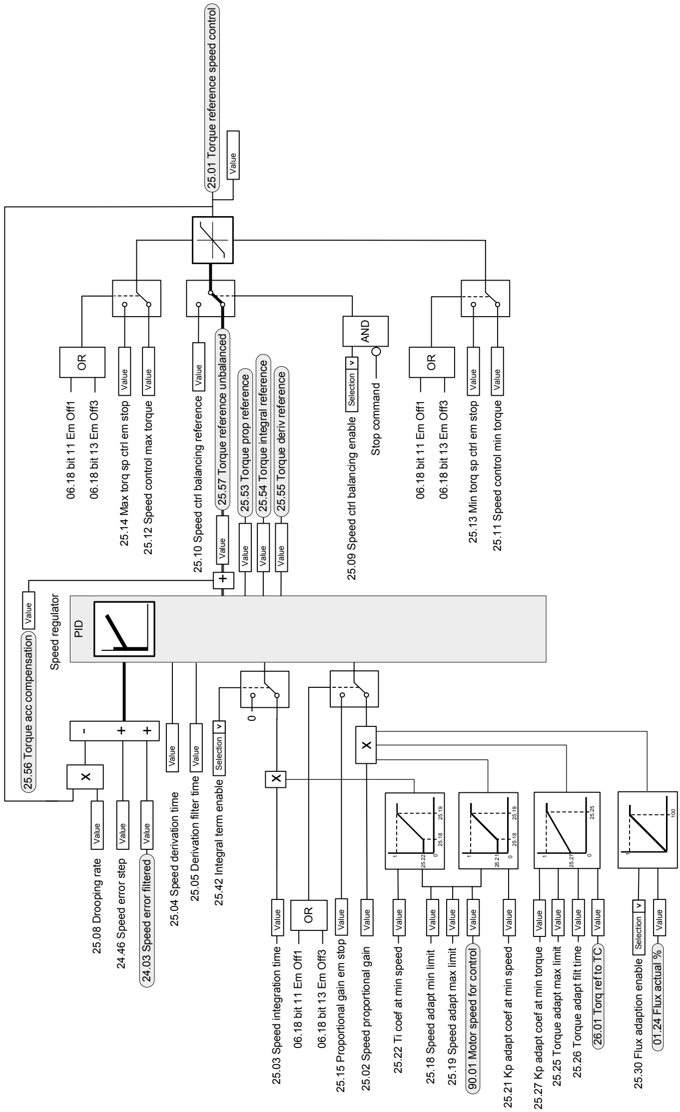
Load feedback and position counter configuration



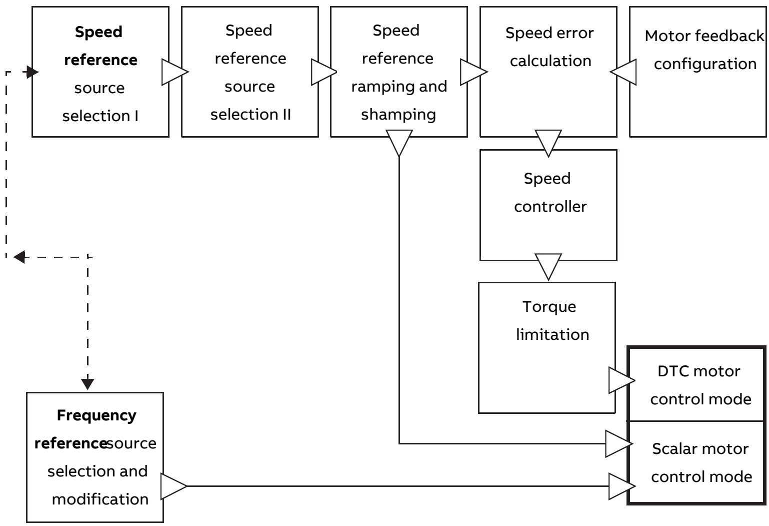
Speed error calculation



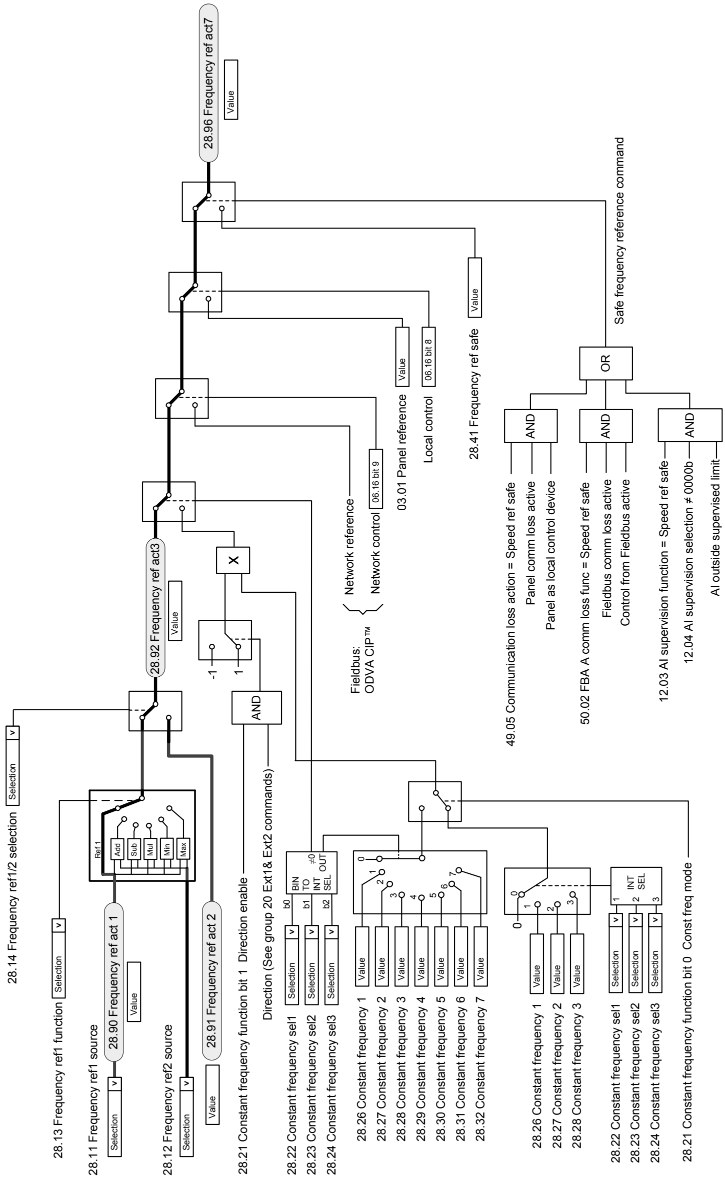
Speed controller



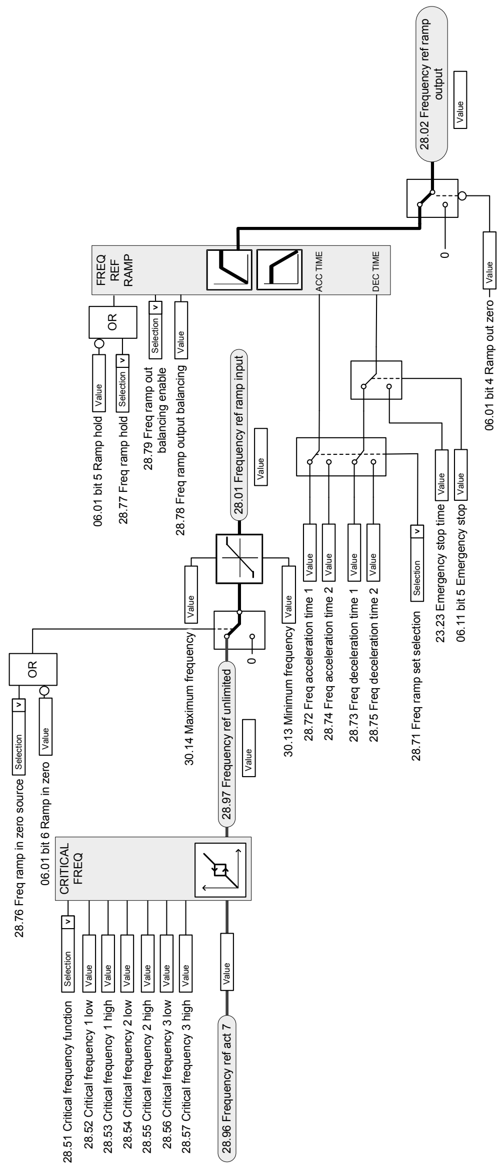
Operating modes of the drive



Frequency reference selection



Frequency reference modification



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/contact-centers.

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