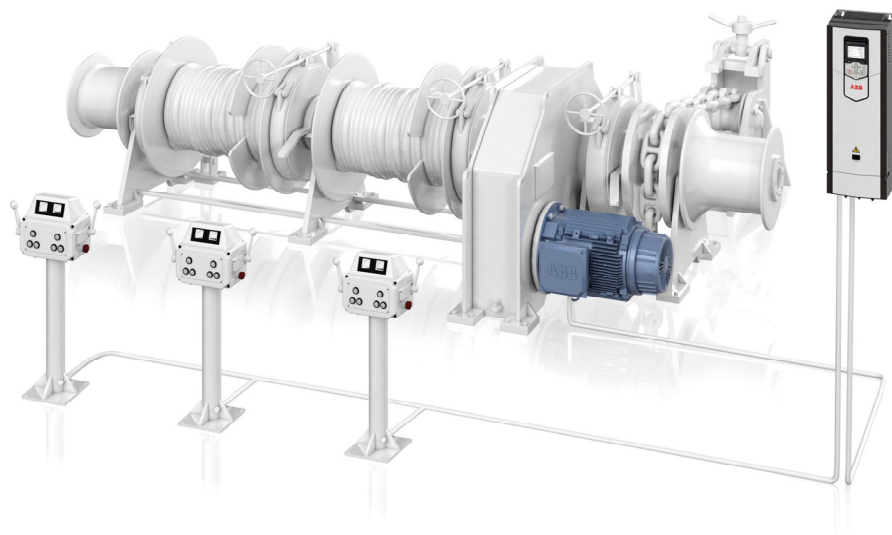


ABB INDUSTRIAL DRIVES

ACS880 winch control program (option +N5100) for ZCU or BCU control unit (AWCL)

Firmware manual



ACS880 winch control program (option +N5100) for ZCU or BCU control unit (AWCL)

Firmware manual

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2. Quick start-up guide



3AXD50000021887 Rev F
EN

Original instructions
EFFECTIVE: 2025-04-30

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Further information



1

Introduction to the manual

What this chapter contains

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 winch control program (option +N5100) for ZCU and BCU control program (AWCLC). You can refer 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	3.4x or later
07.06 Loading package name	AWCLC
07.07 Loading package version	4.13.0.0
07.24 Application version	4.00.0.21

This winch application program is based on IEC standard 61131-3 and has a flexibility with adaptive programming. It is an in-house application, therefore the application code is locked and cannot be modified by the user.

Safety instructions

Follow all safety instructions delivered with 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

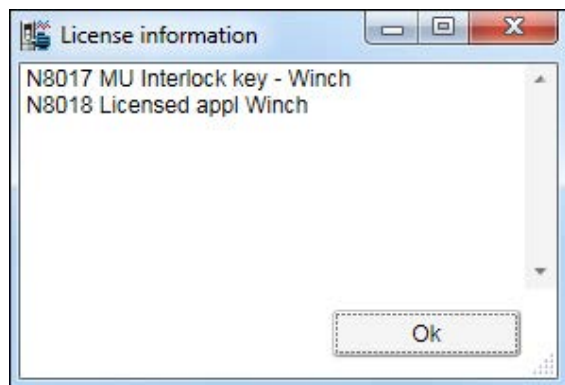
This manual is intended for people who design, commission, or operate the drive system.

Licensing

The Winch control program (+N5100), 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 winch software.

Device	License key
ZMU-02 memory unit license key	N8017 MU Interlock key - Winch
Winch software (loading package)	N8018 Licensed appl Winch

You can see the license information in the Drive Composer PC tool or in the Assistant control panel (ACS-AP-I and ACS-AP-W types) 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 N8017. For further assistance, contact your local ABB representative.

Parameter access levels

The parameters in the Winch control program are visible based on the two access levels: Short menu and Long menu.

Short menu (pass code 1) – Lists the most common winch parameters. This is the default menu when the drive is powered up for the first time. See parameter [96.02 Pass code](#).

Long menu (pass code 584) – Lists the complete signals and parameters in the control program. These parameters are visible only when you set parameter [96.02 Pass code](#)= 584.

Note: It is recommended that you create the backup of complete parameters list using the long menu. However, you can also access the complete parameters list in the offline mode.

Related manuals

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

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 (160 to 3200 kW)	9AKK106354A1499
ACS880-37 drives (160 to 3200 kW)	9AKK106354A1500
Drive hardware manuals	
ACS880-01 drives hardware manual	3AUA0000078093
ACS880-04 drive modules (200 to 710 kW, 300 to 700 hp) hardware manual	3AUA0000128301
ACS880-04 single drive module packages hardware manual	3AUA0000138495
ACS880-07 drives (45 to 630 kW, 50 to 700 hp) hardware manual	3AUA0000105718
ACS880-07 drives (560 to 2800 kW) hardware manual	3AUA0000143261
ACS880-17 drives hardware manual	3AXD50000020436
ACS880-37 drives hardware manual	3AXD50000020437
ACS880-104 inverter modules hardware manual	3AUA0000104271
ACS880-107 inverter units hardware manual	3AUA0000102519
Drive firmware manuals and guides	
ACS880 winch control program (option +N5100) for UCU control unit (YWCL) firmware manual	3AXD50001158750
Adaptive programming application guide	3AXD50000028574
Drive application programming manual (IEC 61131-3)	3AUA0000127808
SynRM motor control program (+N7502) supplement	3AXD50000026332
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

Name	Code
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. Refer 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
ACS-AP-I	Industrial assistant non-Bluetooth control panel
ACS-AP-W	Industrial assistant control panel with Bluetooth interface
AI	Analog input
AO	Analog output
BCU	Type of control unit
CIO	I/O module for controlling cooling fans
DC link	DC circuit between rectifier and inverter
DDCS	Distributed Drives Communication System. Optical fiber-based industrial protocol.
DI	Digital input
DO	Digital output
Drive	Frequency converter for controlling AC motors
DTC	Direct torque control, a motor control method
EFB	Embedded fieldbus
FAIO-01	Analog I/O extension module
FBA	Fieldbus adapter
FCAN	Optional CANopen® adapter module
FCNA-01	Optional ControlNet™ adapter module
FDCO-01	DDCS communication module with two pairs of 10 Mbit/s DDCS channels
FDIO-01	Optional digital I/O extension module
FDNA-01	Optional DeviceNet™ adapter module
FEA-03	Optional I/O extension adapter
FECA-01	Optional EtherCAT® adapter module
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
FENA-11	Optional Ethernet adapter module for EtherNet/IP™, Modbus TCP® and PROFINET IO® protocols
FENA-21	Optional Ethernet adapter module for EtherNet/IP™, Modbus TCP and PROFINET IO protocols, 2-port
FEPL-02	Optional Ethernet POWERLINK adapter module
FIO-01	Optional digital I/O extension module
FIO-11	Optional analog I/O extension module
FPBA-01	Optional PROFIBUS DP® adapter module
FPTC-01	Optional thermistor protection module
FPTC-02	Optional ATEX-certified thermistor protection module for potentially explosive atmospheres

Term	Description
FSCA-01	Optional RS-485 (Modbus/RTU) adapter
FSO-12, FSO-21	Optional functional safety modules
HTL	High-threshold logic
ID run	Motor identification run. During the identification run, the drive will identify the characteristics of the motor for optimum motor control.
IGBT	Insulated gate bipolar transistor
INU	Inverter unit
Inverter unit	Inverter module(s) under control of one control unit, and related components. One inverter unit typically controls one motor.
ISU	IGBT supply unit
Line-side converter	Converts alternating voltage to direct voltage for the intermediate DC link of the drive
ModuleBus	A communication link used by, for example, ABB controllers. ACS880 drives can be connected to the optical ModuleBus link of the controller.
Motor-side converter	Converts intermediate DC link current to AC current for the motor
Network control	With fieldbus protocols based on the Common Industrial Protocol (CIP™), such as DeviceNet and Ethernet/IP, denotes the control of the drive using the Control Supervisor and AC/DC drive objects of the ODVA AC/DC Drive Profile. For more information, refer to www.odva.org .
Parameter	In the drive control program, user-adjustable operation instruction to the drive, or signal measured or calculated by the drive. In some (for example fieldbus) contexts, a value that can be accessed as an object. For example, variable, constant, or signal.
PLC	Programmable logic controller
Power unit	Contains the power electronics and power connections of the drive module. The control unit is connected to the power unit.
PSL2	Protocol used in communication inside ABB inverters
PTC	Positive temperature coefficient
RDCO	Optical DDCS communication module
RO	Relay output
STO	Safe torque off (IEC/EN 61800-5-2)
Supply unit	Supply module(s) under control of one control unit, and related components.
TTL	Transistor-transistor logic
UPS	Uninterruptible power supply
ZCU	Type of control unit

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.

Also, refer section [User lock \(page 135\)](#).

2

Quick start-up guide

Contents of this chapter

This chapter contains the basic start-up sequence of the drive and additional alternative checklists for starting up the drive with the control program.

In this chapter, the drive is set up using the ACS-AP-I control panel. You can also do the start-up sequence using the Drive composer PC tool.

Before you start

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

Make sure that the ZMU-02 memory unit contains winch control program license key. When the license is found in the ZMU-02 memory unit, the control program activates and registers as *N8018 Licensed appl Winch*.

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



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.

1 – Power-up, date and time settings

☐

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  below the display. The commands assigned to the softkeys vary depending on the context.

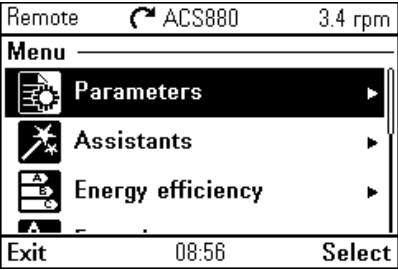
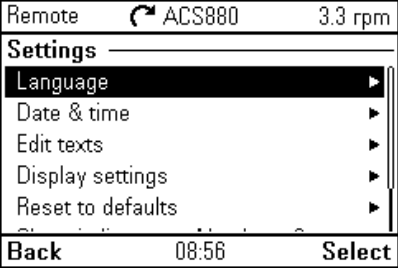
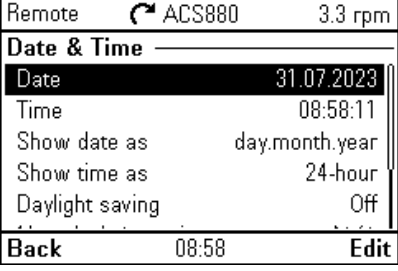
Remote  ACS880 3.3 rpm

Motor speed used0.00rpm

Motor current0.00A

Motor torque0.0%

Options08:56Menu

1 – Power-up, date and time settings		
☐	In the Home view, press  (Menu). The main Menu (right) appears.	
☐	Highlight Settings on the menu using  and  press (Select).	
☐	In the Settings menu, highlight Date & time (if not already highlighted) and press  (Select).	
☐	In the Date & time menu, highlight Date (if not already highlighted) and press  (Edit).	

1 – Power-up, date and time settings

- ☐ 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.

Remote	ACS880	3.3 rpm
Motor speed used	0.00	rpm
Motor current	0.00	A
Motor torque	0.0	%
Options	08:56	Menu

2 – Supply voltage and motor data settings

- ☐ Switch to local control to ensure that external control is disabled by pressing the key. Local control is indicated by the text “Local” in the top pane.

Local	ACS880	1200.1 rpm
Motor speed used	1200.33	rpm
Motor current	0.72	A
Motor torque	14.9	%
Options	15:24	Menu

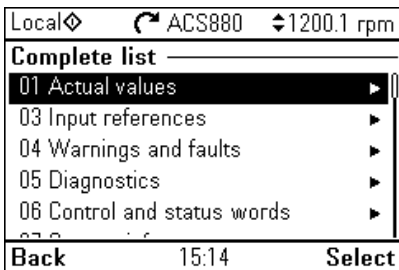
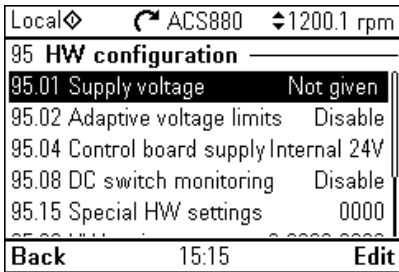
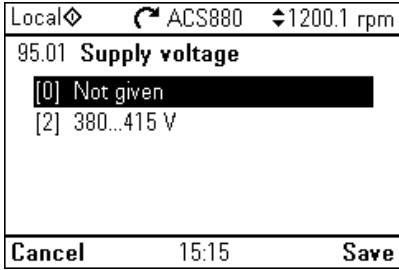
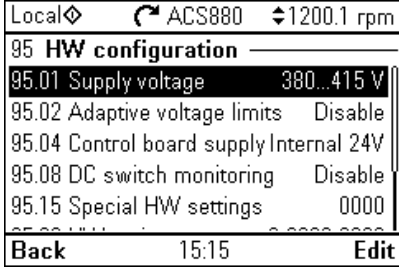
- ☐ Open the main **Menu** by pressing (**Menu**).

Local	ACS880	1200.1 rpm
Menu		
	Parameters	
	Assistants	
	Energy efficiency	
Exit	15:13	Select

- ☐ Highlight **Parameters** and press (**Select**).

Local	ACS880	1200.1 rpm
Parameters		
	Complete list	
	By function	
	Favorites	
	Modified	
Back	15:13	Select

2 – Supply voltage and motor data settings

☐	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.	
☐	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.	

2 – Supply voltage and motor data settings

- ☐
- Set parameter **99.04 Motor control mode**.

DTC = Direct torque control; **Scalar**

 - **DTC** can be used for desk machinery winches (anchor and mooring), in open or closed loop motor control.
 - **Scalar** is a test mode and can be used with or without motor.

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:

ABB Motors CE

3 ~ motor M2AA 200 MLA 4

IEC 200 M/L 55

No

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

Cat. no 3GAA 202 001 - ADA

6312/C3 6210/C3 180 kg

IEC 34-1

☐

Example of a nameplate of a permanent magnet motor:

ABB Motors CE

3 ~ motor M2BJ 280SMB 10 B3

S1 SPEC INSUL. No 3424522

JK-21640-1 Ins.cl. F IP 55

V	Hz	kW	r/min	A	cos φ	I _A /I _N	I _E /s
400 D	50	55	600	103	0.97		

Prod. code 2GBJ285220-ADA05445477

6316/C3 6316/C3 630kg

IEC 34-1

- ☐
- 99.06 Motor nominal current**

The allowable range is

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

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.

Make the following parameter settings in the same manner.

- ☐
- 99.07 Motor nominal voltage**

The allowable range is $1/6 \times U_N \dots 2 \times U_N$ 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 $3 \times 60 \text{ V} = 180 \text{ V}$. 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).

2 – Supply voltage and motor data settings

☐	99.08 Motor nominal frequency With permanent magnet motors, if the nominal frequency is not shown on the name-plate, 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.
☐	99.13 ID run requested This parameter selects the mode of the identification run (DTC motor control mode only). Note: The drive must be in local control for the identification run. Note: If clutch is open, normal ID run can be performed for a deck machinery winch (anchoring or mooring).  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. The open loop motor control of electrical driven deck machinery (anchor & mooring) require accurate motor control model. Use Normal ID run mode and rotate the motor + gearbox + inner drum, if the clutch is open. *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.



2 – Supply voltage and motor data settings		
☐	Ensure that the Safe torque off and emergency stop circuits (if present) are closed.	
☐	Start the identification run by pressing the  (Start) button.	A warning will indicate that the identification run is in progress.
☐	Check that the motor runs in the correct direction (forward direction shown below). Note: When winch is taking in rope, the speed should be positive and while giving out ropes its negative speeds.  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.	



Winch control start-up

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

■ Motor ID run

Safety	
☐	 WARNING! Obey all safety instructions for the drive. Only qualified electricians are allowed to start up the drive.
Parameter settings	
☐	Enable ID run request. 99.13 ID run requested 99.14 Last ID run performed

■ Mechanical disc brake control

Safety	
☐	 WARNING! Obey all safety instructions for the drive. Only qualified electricians are allowed to start up the drive.
Parameter settings	
☐	Make sure that the brake circuit is working: 1. Start the winch drive in LOCAL mode and check that the brake is open and motor is running. 2. If the brake does not open, check parameters 10.24 RO1 source = 44.204 and 44.06 Brake control enable= Selected.
☐	Define the brake opening and closing delays. 44.08 Brake open delay 44.13 Brake close delay
☐	Select the source for the brake acknowledge signal. 44.07 Brake acknowledge selection = According to the application requirements. For example, No acknowledge (page 482).
☐	Make sure that the brake open torque parameters are set by default. 44.200 Brake open torque source = Brake open torque . 44.10 Brake open torque = 30% After the trial run, select the brake opening torque source according to the application requirements.

Brake circuit check	
☐	Make sure that you can safely do the brake circuit check.
☐	Make sure that the brake circuit is working: • Open the brake temporarily by setting parameter 10.24 RO1 source to Energized. • Set parameter 10.24 RO1 source back to its default value (P.44.204.0).
Trial run	
☐	Make sure that you can safely do the brake circuit check.
☐	During final testing, and especially when you monitor the actual speed and torque, tune the brake control parameters. The aim is to get the fastest possible response for the control commands without any jerk or roll-back in the actual speed while opening or closing the brake.



■ Winch interface for three control stands

This section describes how to set up the drive for winch interface for three control stands with dedicated AI reference and DI control commands.

Safety	
☐	 WARNING! Obey all safety instructions for the drive. Only qualified electricians are allowed to start up the drive.

Parameter settings	
☐	Make sure that the source for external control location is set by default. 19.11 Ext1/Ext2 selection = EXT2 (page 332). Enable control stand 1 or control stand 2 or control stand 3. 75.10 Control stand 1 enable = DI1 (page 597) 75.14 Control stand 2 enable = FALSE (page 599) 75.18 Control stand 3 enable = FALSE (page 599)
☐	Activate control stand 1 heave or lower. 75.11 Control stand 1 reference = AI1 scaled (page 598) 75.12 Control stand 1 heave = DI2 (page 598) 75.13 Control stand 1 lower = DI3 (page 599) 75.16 Control stand 2 heave = FALSE (page 598) 75.17 Control stand 2 lower = FALSE (page 599) 75.20 Control stand 3 heave = FALSE (page 598) 75.21 Control stand 3 lower = FALSE (page 599)



■ **Winch retrofit interface for three control stands**

This section describes how to set up the drive for winch retrofit interface for three control stands.

In winch retrofit interface, where three speed DOL (drive online) motor control is replaced with a VSD motor control. The winch retrofit interface for three control stands work with old control stands DI commands (reference and control commands).

Safety	
☐	WARNING! Obey all safety instructions for the drive. Only qualified electricians are allowed to start up the drive.
Parameter settings	
☐	Enable control stand 1 heave, lower. 75.12 Control stand 1 heave =DI2 (page 598) 75.13 Control stand 1 lower= DI3 (page 599) Set the signal source for control stand 1 reference. 75.11 Control stand 1 reference = Step reference
☐	Set step reference selector 2 and 3. 75.30 Step reference selector 2= FALSE 75.31 Step reference selector 3 = FALSE
☐	Set step reference values. 75.34 Step reference 1 = For example, 50% 75.35 Step reference 2 = For example, 70% 75.36 Step reference 3 = For example, 100%



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

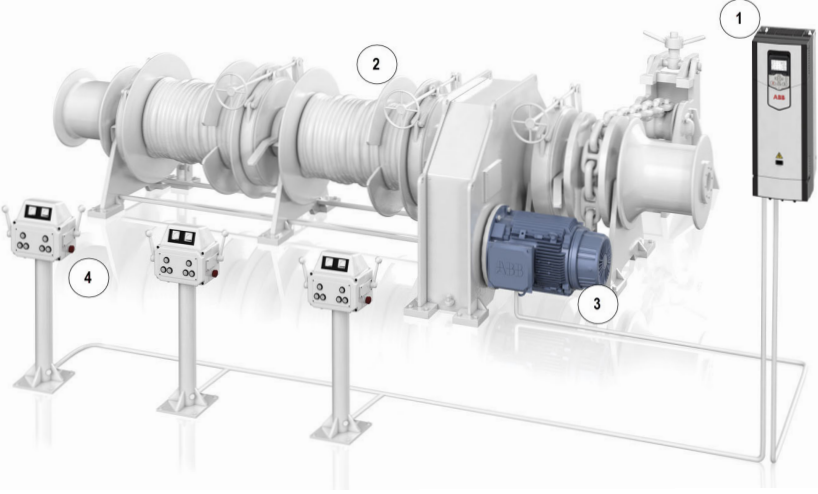
Winch program features

Contents of this chapter

This chapter contains descriptions of program features and functions.

Supported features

The figure below shows the main features supported by the winch control program.

	
1	Winch control program is included in the drive. Also includes, • adaptive block programming (free blocks) for flexibility • Primary control program (platform) • Functional safety modules FSO-21 (option +Q972) and FSE-31 (option +L521).
2	Built-in winch control program includes features like anchor control, hand mooring mode, automooring mode, clutch control mode, mechanical brake control, and master-follower operation (for controlling multiple winches).
3	Full control of speed and torque without a shaft encoder. Supports AM, PM, SynRM motor types.
4	Max. three control stands and one wireless controller can be connected directly to the drive.

See also this interesting video (click on [Winch drive](#)).

Overview of winch control program

The winch control program is a marine application designed for electrically driven deck machinery winches. It supports anchor control and mooring control applications. For tailor made requirements, the drive adaptive program can be used to create customer specific features. Refer to the overview of winch application benefits, software supported features and programming control as shown in the table below.

Winch application benefits	Software +N5100	Programming
 For more information, refer section Supported features .	AP adaptive block programming • Small PLC inside free block programming • 50 empty AP blocks Winch application with IEC61131 (fixed and locked) • Dedicated marine winch functionality • Standalone or master/follower via D2D link • WInch IO joystick interface CC1, CC2, CC3 • Anchor mode • Mooring mode • Clutch control mode Platform system software • Primary control program, motor control DTC • Mechanical brake control, speed/position	 Control panel
		 Drive Composer PC tool (Optional)

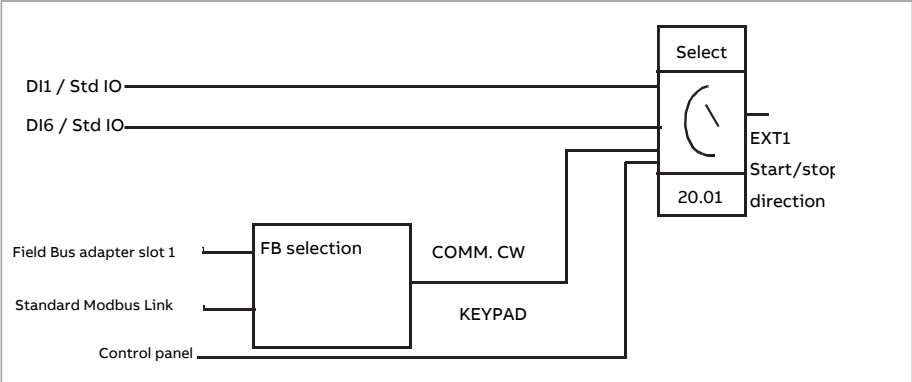
The start, stop and control signals can be analog, digital or fieldbus-based from a programmable logic controller (PLC). The wireless radio controller can be connected through PLC or directly to the drive IO board (D2D link-embedded Modbus).

The control program includes four different user parameter sets for customizing the parameter settings. Each set includes two different control places. For more information, refer section [User parameter sets \(page 198\)](#).

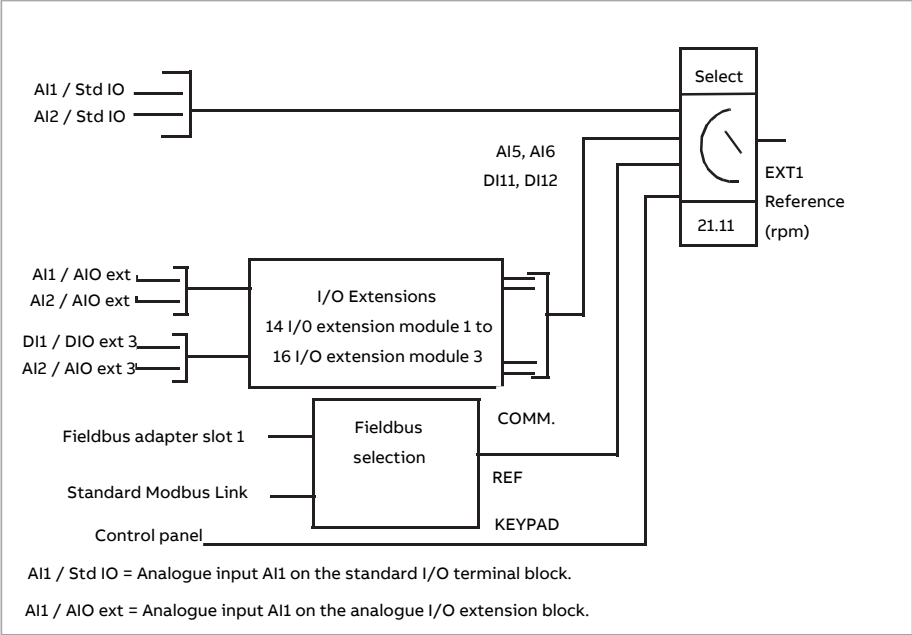
The speed match is used to increase the safety with measurement from the anchor chain length on the drum. The winch motor operates in open loop DTC and do not require external speed feedback. If the user has an encoder or sensor to measure the chain length, then the encoder feedback can be used for speed match safety.

■ Standalone speed control without winch feature (EXT1)

Select standalone speed control mode (control location EXT1), so that the drive works in the basic speed control mode without any winch features. The figure below shows the parameters that select the interface for start, stop, and direction for external control location EXT1.



The figure below shows the parameters that select the interface for the speed reference of external control location EXT1.



■ Winch control mode (EXT2)

Select winch control mode through control location EXT2, so that the drive works with all winch features.

Winch interface EXT2

EXT2 is the default control location for anchoring and mooring modes in winch control program. These applications need multiple control stands or desks. The program supports up to four control stands and one wireless controller.

- Control stands 1, 2 and 3 are connected with IO signals (IO control stand).
- Wireless controller (typically a radio controller) is connected through the fieldbus (FB control stand) and PLC.

You can enable connections to the control stands with parameter [20.06 Ext2 commands](#) = **Not selected** and can set the appropriate reference sources in parameters [75.11 Control stand 1 reference](#), [75.15 Control stand 2 reference](#) and [75.19 Control stand 3 reference](#).

Connection to the FB control stand can be enabled with parameter [75.22 Include FB control stand](#). Refer to the below connections diagram.

44 Winch program features



Note: The wireless radio controller can be connected through a PLC or directly to the drive through embedded Modbus (D2D link).

Settings and diagnostics

Parameters: [20.06 Ext2 commands \(page 338\)](#), [75.11 Control stand 1 reference \(page 598\)](#), [75.15 Control stand 2 reference \(page 599\)](#), [75.19 Control stand 3 reference \(page 600\)](#) and [75.22 Include FB control stand \(page 600\)](#).

Winch control interface

The control program includes external control locations EXT1 and EXT2 for normal operation. For more information on the external control locations, refer section [Local control vs. external control \(page 132\)](#).

You can connect the control stands directly to the drive IO extension modules. All control stand inputs are freely programmed in parameter group [75 Winch interface](#).

To enable the control stands in winch interface, activate EXT2 with parameter [20.06 Ext2 commands](#) = **Not selected**.

Control stands are used to control the winch operation manually. Each control stand contains the following IO signals:

- Emergency stop
- Enable control stand with DI input
- Joystick heaving command with DI input
- Joystick lowering command with DI input
- Joystick reference with AI signal or DI steps
- Enable Automoorring with a DI input
- Automoorring setpoint switch or potentiometer AI input.

Settings and diagnostics

Parameter group: [75 Winch interface \(page 594\)](#).

Parameter: [20.06 Ext2 commands \(page 338\)](#).

■ Priority mode

Priority mode selects the control stand priority. It defines if the control is moved to another control stand during run. For further information, refer parameter [75.03 Control stand priority selection](#).

Settings and diagnostics

Parameter: [75.03 Control stand priority selection \(page 594\)](#).

■ Winch interface for retrofits

Winch interface includes a retrofit interface in which a 3-speed DOL control motor consists of 3-windings for low, medium and high speeds. The speed is converted to step-less speed control with a ACS880 drive. The old joystick with three speed positions are in the retrofit interface controlling the old motor in three speed levels with smooth ramps.

■ Using fieldbus control stand

Fieldbus control stand can be used in winch interface with parameter group [75 Winch interface](#). To enable fieldbus connections, do the following configurations:

- Set parameters [19.11 Ext1/Ext2 selection](#) to [EXT2](#) control location and [20.06 Ext2 commands](#) to [Not selected](#) to enable winch interface/control stands.
- Include FB control stand in the control stand logic and by setting parameter [75.22 Include FB control stand](#) to [Yes](#).
- Enable FB control stand and heave/lower write to the corresponding bits in parameter [09.09 Winch FB control word](#).
 - Bit0 - FB control stand enable
 - Bit1 - FB control stand heave
 - Bit2 - FB control stand lower
 - Bit3 - FB clutch speed 1 start
 - Bit4 - FB clutch speed 2 start
 - Bit5 - FB control stand fault reset.
- Write FB control stand reference to parameter [03.06 FB A reference 2](#).
 - Reference shall be in %, where 100% equals the maximum speed of the current winch mode, for example, Handmooring mode max speed.

Note: Standard FB control word is not used when using FB control stand logic, as the heave/lower source is not the standard FB control word, but the parameter [09.09 Winch FB control word](#).

Note: Parameter [09.09 Winch FB control word](#), bit3 - FB clutch speed 1 start and bit4 - FB clutch speed 2 start always works in parallel with parameters [84.02 Synchro sel](#) and [84.03 Sync corr mode](#).

Profile settings for winch interface

When using fieldbus with the winch, either mapping of a parameter can be completed through parameter groups [52 FBA A data in](#) and [53 FBA A data out](#) or direct writing with the help of EDS file. Select the appropriate reference Ref 2 16bit or Ref 2 32bit in one of the parameter in parameter group [53 FBA A data out](#).

The following fieldbus specific configurations are required for using winch interface with PLC:

- Set parameter [50.05 FBA A ref2 type](#) to [Transparent](#). The reference values are in percentage, where 100% equals the maximum speed of the winch mode.
- Map the corresponding PPO in parameter group [53 FBA A data out](#) to [09.09 Winch FB control word](#). For example, [53.02](#) to [09.09](#).

With the help of an EDS file, you can write the FB control stand bits directly to parameter [09.09 Winch FB control word](#). Write the reference directly to parameter [03.06 FB A reference 2](#).

Note: Parameter [09.09 Winch FB control word](#) is write protected. In case of errors, check EDS file. ABB provided EDS files support writing to [09.09 Winch FB control word](#).

Communication loss supervision

For communication loss supervision with winch interface, select,

- parameter [50.26 FBA A comm supervision force](#), bit1 EXT2 to TRUE, to force supervision for EXT2 (winch modes).
 - an appropriate response in parameter [50.02 FBA A comm loss func](#).
-

Using standard fieldbus control

If controlling the winch over fieldbus is required but the winch interface feature is not desired, then set the parameter [20.06 Ext2 commands](#) to [Fieldbus A](#), selected as a source of start command and the reference is selected in group [22 Speed reference selection](#).

Note: Parameter group [75 Winch interface](#) control stand logic and IO control stands are not in use now.

Settings and diagnostics

Parameter group: [22 Speed reference selection](#) (page 359) and [75 Winch interface](#) (page 594).

Parameter: [20.06 Ext2 commands](#) (page 338).

Speed reference handling

■ Possible control devices

You can give the speed reference either with:

- control panel
- PC tool (Drive composer)
- joystick connected to an analog input
- control device connected to the fieldbus interface
- control device connected to digital inputs or the step references.

Unipolar joysticks

Unipolar joysticks give the speed reference value with analog signal 0...10 V. The direction commands are specified with two digital inputs.

Bipolar joysticks

Bipolar joysticks give the speed reference value with analog signal -10...10 V. The direction commands are specified with polarity of the analog signal scaled value (- 100%...100%). One digital input is required for starting the winch.

Parameter [75.04 Control stand joystick mode](#) is used for selecting between Unipolar/Bipolar joysticks.

■ Step reference selection

The step reference feature is used when using the drive with an old 3 step reference control, for example, in case of a retrofit. The step reference is selected as the source of reference for any of the control stands ([75.11 Control stand 1 reference](#), [75.15 Control stand 2 reference](#) and [75.19 Control stand 3 reference](#)). The direction and Step reference 1 is selected by the heave/lower command of that particular control stand. Steps 2 and 3 are selected by the logic combinations in the table below. The currently calculated step reference is shown in parameter [09.35 Step reference output](#).

50 Winch program features

The table below shows how the control program determines which step reference speed is used. Any other parameter value combination selects step reference speed 1 (75.34). Also, refer section [Speed reference priorities](#).

75.12, 75.16 or 75.20	75.13, 75.17 or 75.21	75.30	75.31	Used reference
1	0	0	0	75.34 Step reference 1 (+)
0	1	0	0	75.34 Step reference 1 (-)
1	0	1	0	75.35 Step reference 2 (+)
0	1	1	0	75.35 Step reference 2 (-)
1	0	1	1	75.36 Step reference 3 (+)
0	1	1	1	75.36 Step reference 3 (-)

Settings and diagnostics

Parameters: [75.30 Step reference selector 2](#) (page 601), [75.31 Step reference selector 3](#) (page 602), [75.34 Step reference 1](#) (page 602), [75.35 Step reference 2](#) (page 602) and [75.36 Step reference 3](#) (page 602).

■ Speed reference priorities

The speed references of the control program have the following priorities.

- If winch interface control stands are used, (if EXT2 is active and [20.06 Ext2 commands](#) to Not selected) their reference overrides any selection in [22.11](#), [22.12](#) and [22.14](#).
- If the clutch speed function is selected, the drive uses the constant speeds ([84.04 Synchro corr rate](#) and [84.05 Synchro corr min speed](#)) as the speed reference.
- If the Step reference is enabled in parameters [75.11 Control stand 1 reference](#), [75.15 Control stand 2 reference](#), [75.19 Control stand 3 reference](#), and when the drive is not in local control, the drive uses the Step reference as the speed reference.

The value that results is the final speed reference used by the winch system.

For more information on the speed references and related parameters, refer sections:

- [Speed reference ramping](#) (page 51)
 - [Constant speeds](#) (page 154)
 - [Step reference selection](#) (page 49)
 - [Anchor control](#) (page 52)
 - [Supervision logic](#) (page 118).
-

■ Speed reference ramping

The control program has two user-selectable ramps.

- Acceleration ramp
- Deceleration ramp.

You can adjust the acceleration and deceleration times, ramp shape, and the control switching between the two ramps through a digital input.

Based on parameter [23.200 Ramp set selection](#), different ramp times are used:

- Set 1 means acceleration time 1 (parameter [23.202 Acceleration time 1](#)) and deceleration time 1 (parameter [23.203 Deceleration time 1](#)) are used.
- Set 2 means acceleration time 2 (parameter [23.204 Acceleration time 2](#)) and deceleration time 2 (parameter [23.205 Deceleration time 2](#)) are used.
- By direction means acceleration time 1 (parameter [23.202 Acceleration time 1](#)) and deceleration time 1 (parameter [23.203 Deceleration time 1](#)) are used when motor is running in the forward direction, and acceleration time 2 (parameter [23.204 Acceleration time 2](#)) and deceleration time 2 (parameter [23.205 Deceleration time 2](#)) are used when motor is running in the reverse direction.

Based on selection in parameter [23.201 Enable winch ramps](#), either the ramps selected by parameter [23.200 Ramp set selection](#) or winch specific ramps are used:

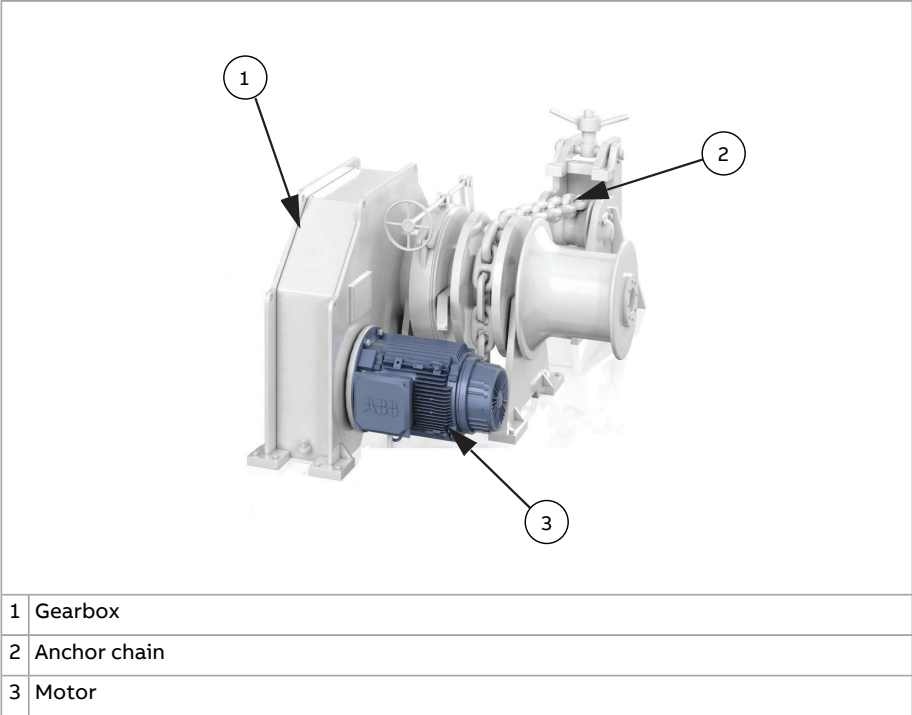
- Primary ramps only; ramps are directly selected by parameter [23.200 Ramp set selection](#) and no winch mode ramps are used.
- Winch ramps included; depending on selected winch mode or active protection, the corresponding ramp times are used. If no winch mode or protection is active, the selection in parameter [23.201 Enable winch ramps](#) defines the used ramp times. Note that the winch ramps work only in EXT2.

Settings and diagnostics

Parameters: [23.16 Shape time acc 1 \(page 370\)](#) ... [23.19 Shape time dec 2 \(page 371\)](#), [23.200 Ramp set selection \(page 374\)](#) ... [23.205 Deceleration time 2 \(page 377\)](#), and [46.01 Speed scaling \(page 493\)](#).

Anchor control

The Anchor control is a speed controlled application mode where the operator controls the anchor winch manually from one of the control stands. The operator starts heaving and lowering the Anchor winch and gives the speed reference with the joystick. Anchor mode speed switches to slowdown Anchor speed when the anchor is near the stowing position.



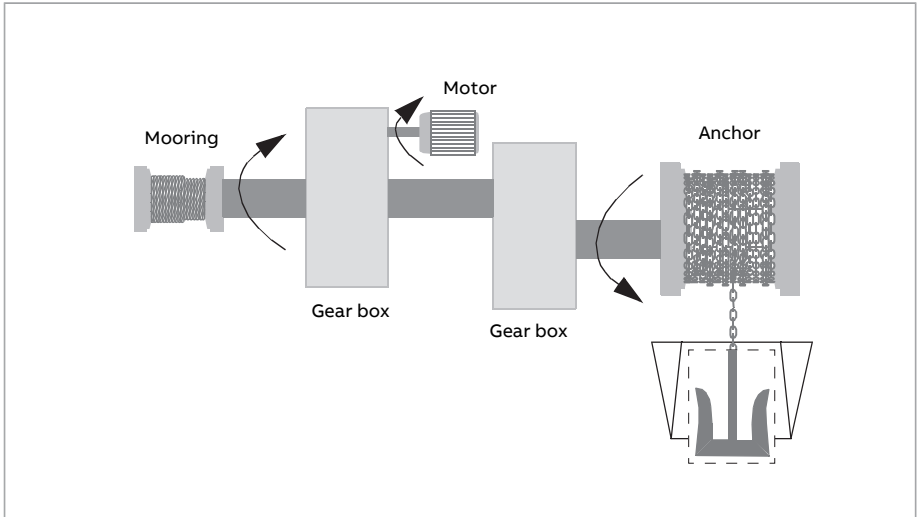
1	Gearbox
2	Anchor chain
3	Motor

The Anchor mode can be activated with parameter [74.01 Anchor mode enable](#).

■ Anchor gearbox direction

The direction of motor speed can be swapped with parameter [74.27 Anchor invert direction](#), if the gearbox shaft output for the anchor has different directions compared to the mooring shaft direction.

The following figure shows the anchor winch mooring with a motor.



Settings and diagnostics

Parameter group: [74 Winch general \(page 573\)](#).

■ **Anchor overload at start**

The anchor overload at start function can be used to achieve the marine requirements for lifting force for anchor/windlass in winch operations.

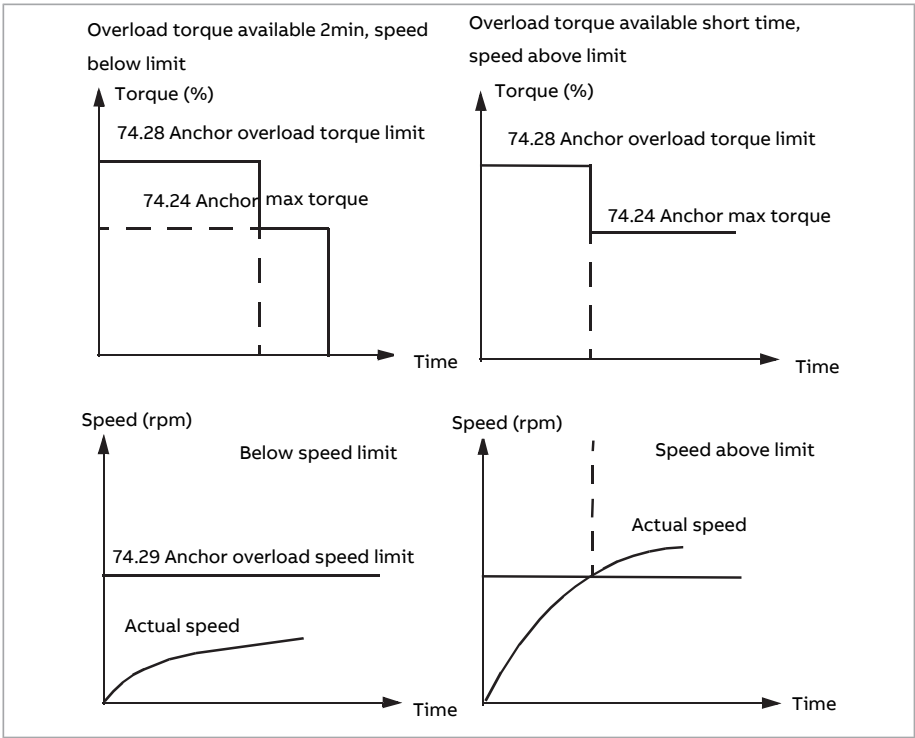
This function is used at start of anchor only in heaving direction. If the anchor is jammed in the sea bottom and not moving, a temporary overload force is needed to heave the anchor. The temporary time for the lifting force is limited to two minutes.

Maximum lifting force for two minutes (no speed requirement) = 1.5 x normal lifting force

You can define the maximum lifting force and normal lifting force for anchor torque limits with parameters [74.24 Anchor max torque](#) and [74.28 Anchor overload torque limit](#).

The function works below the user defined speed limit only. If the anchor is moving up and the motor speed is above the limit, the normal anchor maximum torque limit is used.

The figure below illustrates the anchor overload at start function operation in winch application.



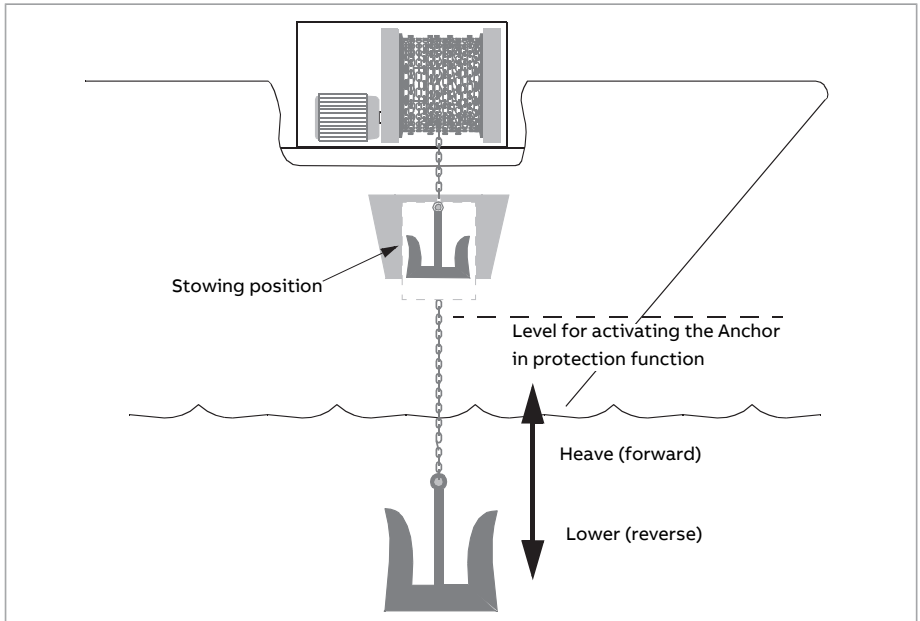
Note: Anchor overload feature can be enabled/disabled using parameter [74.09 Winch configuration word](#), bit 2.

Settings and diagnostics

Parameters: [74.09 Winch configuration word](#) (page 576), [74.24 Anchor max torque](#) (page 579), [74.27 Anchor invert direction](#) (page 580), [74.28 Anchor overload torque limit](#) (page 580) and [74.29 Anchor overload speed limit](#) (page 580).

■ Anchor stowing protection

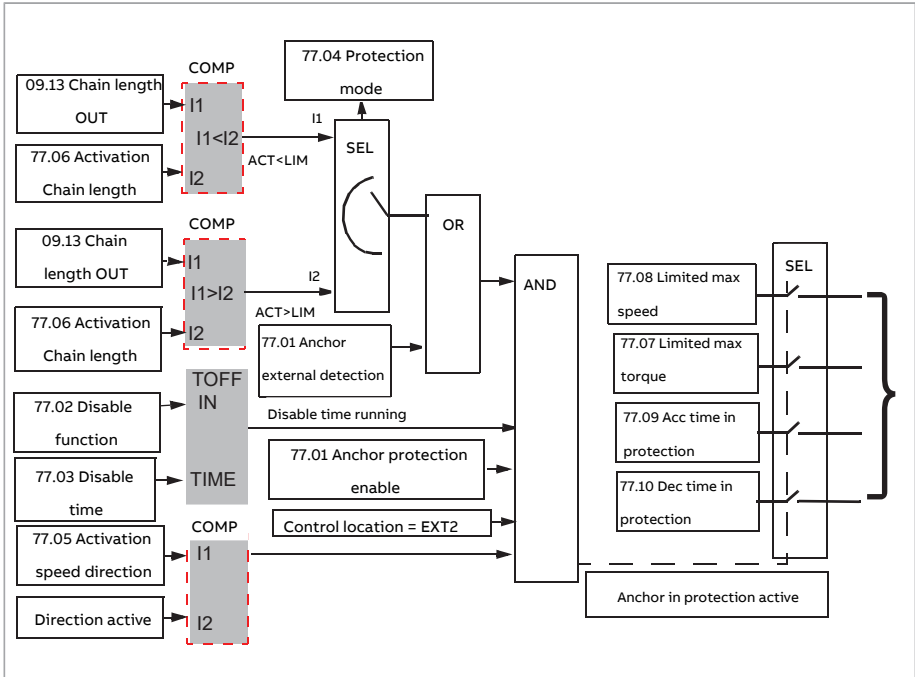
The anchor stowing protection function can automatically apply a reduced speed reference and a lower torque limit before the anchor reaches its stowing position when an anchor is heaved. The function can be triggered by the measured chain length reaching a preset limit and/or an external proximity switch. The function can be enabled with parameter [77.01 Anchor protection enable](#).



Note:

- The winch operator has to give the final stop command. The anchor stowing protection function reduces the speed and torque.
- The function works only in the winch mode (EXT2).

Block diagram



Protection mode

The protection mode selection (par. 77.04) defines the activation criteria for the function based on the chain length:

ACT>LIM: Calculated chain length (par. 09.13) is above the limit (par. 77.06).

ACT<LIM: Calculated chain length (par. 09.13) is below the limit (par. 77.06).

In addition to monitoring the calculated chain length value, it is also possible to activate the protection based on an external proximity switch (Dlx). User can define the source for the signal by parameter 77.11.

Disable function

The anchor stowing protection can be deactivated temporarily with parameter 77.02. When the signal specified with 77.02 is ON, anchor protection is disabled. After the signal is switched OFF, anchor detection continues to be disabled for the period defined with parameter 77.03. After this time elapses anchor protection is re-enabled.

Activation speed direction

You can define the activation speed direction ([77.05](#)) in which the anchor stowing protection is active.

Heave/forward: Anchor protection speed and torque limit, and the acceleration and deceleration times ([77.07...77.10](#)) applies only when the drive is running in forward direction and stowing position is reached. In the reverse direction the drive runs with input speed reference.

Lower/reverse: Anchor protection speed and torque limit, and the acceleration and deceleration times ([77.07...77.10](#)) applies only when the drive is running in reverse direction and stowing position is reached. In the forward direction, the drive runs with input speed reference.

Both: Anchor stowing protection is active for both heave and lower directions.

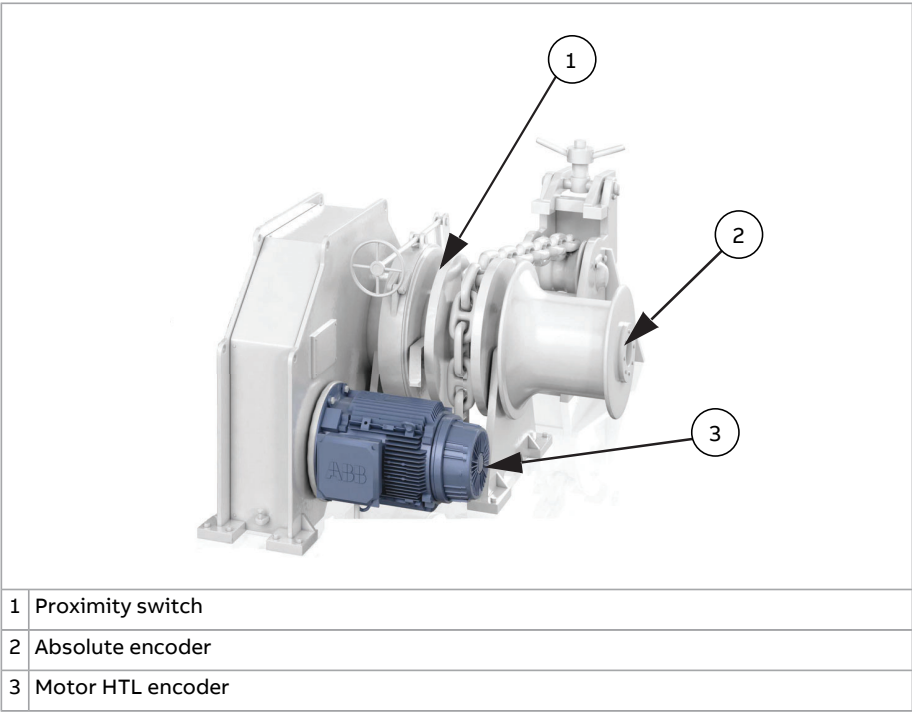
Settings and diagnostics

Parameter group: [77 Anchor stowing protection \(page 619\)](#).

■ **Anchor chain length**

The winch program has a built in functionality to calculate actual length of a chain. The chain length can be calculated using different alternatives:

- proximity switch on the inner anchor drum 4-8 pulses/rev
- drum shaft with an absolute encoder
- motor shaft with an HTL encoder.



To configure chain length calculation,

- enable parameter [74.10 Chain length calc enable](#)
- define the source of a chain length in parameter [74.11 Chain length source](#)
- define the absolute length of the chain in parameter [74.12 Chain absolute length](#) (optional).

To use proximity as the source of a chain length,

- select [Proximity switch position scaled](#) in parameter [74.11 Chain length source](#).

- configure parameters [90.205 Proximity switch mode](#) to [90.208 Pulses per drum revolution](#) appropriately. The program use the value of parameter [90.201 Proximity switch load position scaled](#) as the chain position.
- chain length is given by the below formula:

Proximity switch load position scaled ([90.201](#)) = ((Pulse count)/(Pulses per drum revolution ([90.208](#))) x Feed constant ratio

Feed constant ratio= ([90.63 Feed constant numerator](#))/([90.64 Feed constant denominator](#))

- reset chain length by giving a rising edge to the digital source selected in parameter [90.67 Pos counter init cmd source](#).
- if motor encoder is used for anchor chain length measurement, set appropriate Load gear ratio in parameters [90.53 Load gear numerator](#) and [90.54 Load gear denominator](#) after making appropriate selection in parameter [90.51 Load feedback selection](#).

To use an encoder as the source of a chain length,

- select [Load position scaled](#) in parameter [74.11 Chain length source](#). The program then use the value of parameter [90.05 Load position scaled](#) as the chain position.
- configure the encoder settings in parameter groups [90 Feedback selection](#) to [93 Encoder 2 configuration](#) accordingly.

The winch control program supports absolute encoders only for chain length calculation. The absolute encoder is mounted on the winch drum and the position is scaled to match the drive speed through gear ratio parameters [90.53 Load gear numerator](#) and [90.54 Load gear denominator](#). Refer chapter [Position counter](#).

For retrofits, an absolute encoder with an analogue output can also be connected to the analogue input of the drive and by selecting the appropriate selection in parameter [74.11 Chain length source](#).

To scale the load position to the desired unit of length, use feed constant parameters [90.63 Feed constant numerator](#) and [90.64 Feed constant denominator](#).

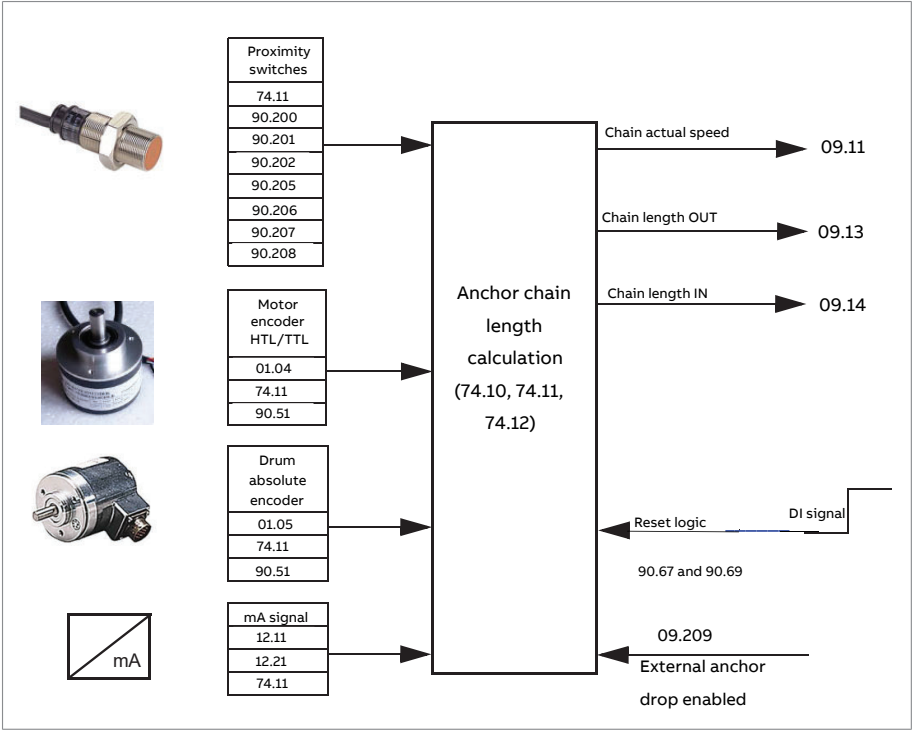
To initiate the position counter, refer parameters [90.65 Pos counter init value](#) to [90.67 Pos counter init cmd source](#).

Monitoring anchor chain data

You can monitor anchor chain data using the following parameters.

- 09.11 Chain actual speed shows the actual chain speed.
- 09.13 Chain length OUT shows the length of chain rolled out.
- 09.14 Chain length IN shows the length of the chain still on the drum. It requires defining the length of the whole chain in parameter 74.12 Chain absolute length.

The following figure shows a block diagram of measuring the actual length of a chain.

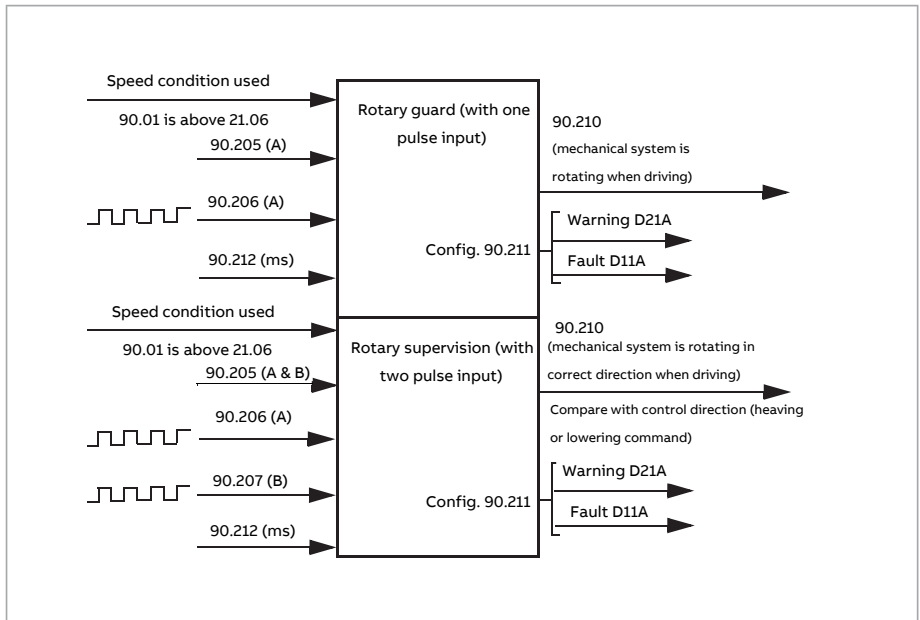


Rotary supervision

The anchor drum rotation supervision function is based on the feedback from proximity sensors (90.206 Prox signal A source and 90.207 Prox signal B source) and complies with system commands (heave or lower). The function supervises that the incoming signals from proximity sensors are received in the defined time interval (90.212) and confirms the rotation of anchor drum. If the supervision detects an error, the function can trigger a fault D11A Rotary supervision or warning D21A Rotary supervision based on the event type selected in 90.211 Rotary supervision.

The supervision starts checking the following conditions as soon as the absolute value of 90.01 Motor speed for control is above the zero speed limit (21.06):

- **Rotary guard supervision** (when only one proximity signal is used) checks that pulses from feedback sensor are received in defined time frames (90.212 Motor speed filter time) and confirms mechanical system rotation.
- **Rotary direction supervision** (when two proximity signals are used) checks that pulses from feedback sensor are received in correct sequence and confirms the direction of mechanical system rotation.



Settings and diagnostics

Signals: [01.05 Encoder 2 speed filtered \(page 212\)](#), [09.11 Chain actual speed \(page 258\)](#), [09.13 Chain length OUT \(page 258\)](#), and [09.14 Chain length IN \(page 259\)](#).

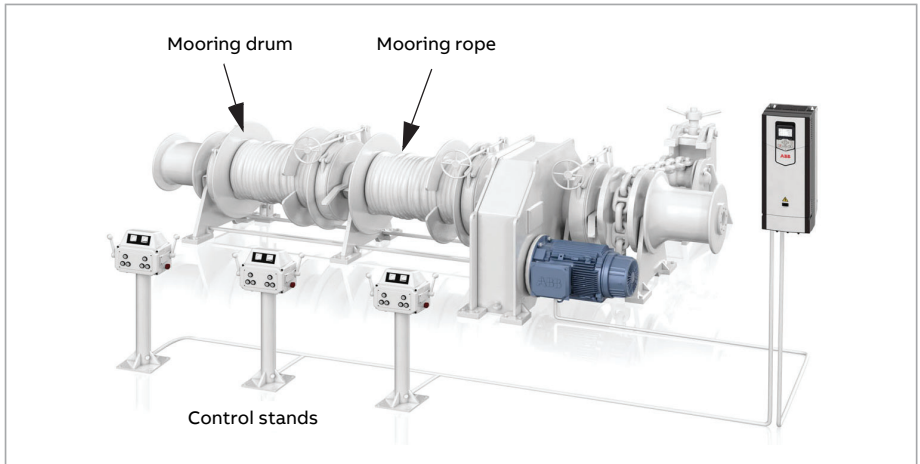
Parameter groups: [12 Standard AI \(page 280\)](#), [74 Winch general \(page 573\)](#) and [90 Feedback selection \(page 643\)](#).

Events: [D11A Rotary supervision \(page 772\)](#) and [D21A Rotary supervision \(page 772\)](#).

Handmooring

Handmooring is a speed control application mode where the operator controls the mooring winch manually from one of the control stands. The operator pays out and hauls in the mooring winch and gives the speed reference with the joystick. The target of the handmooring is to connect the vessel to a harbor pier with ropes and create pretension in the ropes.

When handmooring is completed and pretension is achieved in the ropes, the operator can switchover to automooring mode for controlling the tension of the ropes.



Settings and diagnostics

Parameters: [74.30 Handmooring max speed heave](#) (page 580), [74.32 Handmooring acc time](#) (page 581), [74.33 Handmooring dec time](#) (page 581) and [74.34 Handmooring max torque](#) (page 581).

■ Handmooring application protections

For handmooring application protections, refer [Slip detection](#) and [Peak torque protection](#).

Settings and diagnostics

Parameter: [79.01 Peak torque protection enable](#) (page 627).

Automooring

Automooring is a speed-control application with torque limitation. The automooring maintains stable tension in the ropes between the vessel and the harbor pier with the help of an automooring control program sequence.

Automooring can be used when handmooring is completed and required pretension is achieved in the ropes (parameter [76.05 Auto mooring min tension](#)). This optional protection prevents starting automooring with slack ropes.

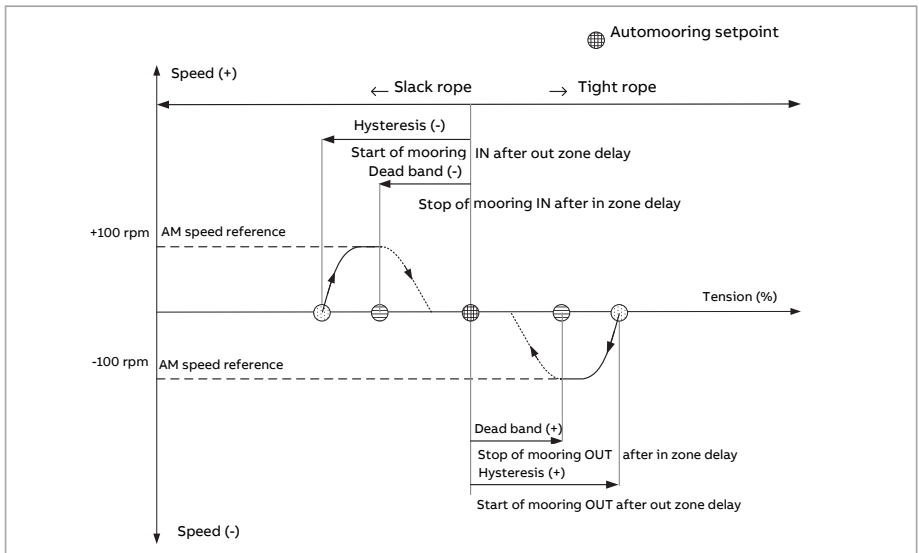
A speed control reference (parameter [74.40 Auto mooring speed ref](#)) defines the speed reference and the maximum speed that the winch uses when creating torque/tension in the ropes according to the automooring setpoint selection (parameter [76.13 Auto mooring setpoint selection](#)).



■ Overview of Automoorings mode

The automoorings can be used in different modes. You can select the mode with parameter [76.01 Automoorings mode](#).

- **Time control** - This mode uses the internal torque signal (DTC) as the rope tension feedback. Automoorings is controlled by defined time control sequence where the program waits with closed brake for the Re-moorings time and then checks the tension in the rope. If required, the program corrects the tension in the rope and then waits the Re-moorings time.
- **Load cell** - This mode uses the external load cell signal as the rope tension feedback. If the rope tension is outside the limits for a certain time, the program corrects the tension to the desired value and closes the brake.
- **Continuous** - This mode uses the internal DTC feedback as the rope tension feedback. The program is continuously correcting the tension in the rope according to the desired setpoint value.
- **Continuous + Time control** - This mode is a combination of continuous and time control modes. The program switches from Continuous to Time control after a predefined time.



Settings and diagnostics

Parameter: [76.01 Automoorings mode](#) (page 603).

■ Automoorng setpoints

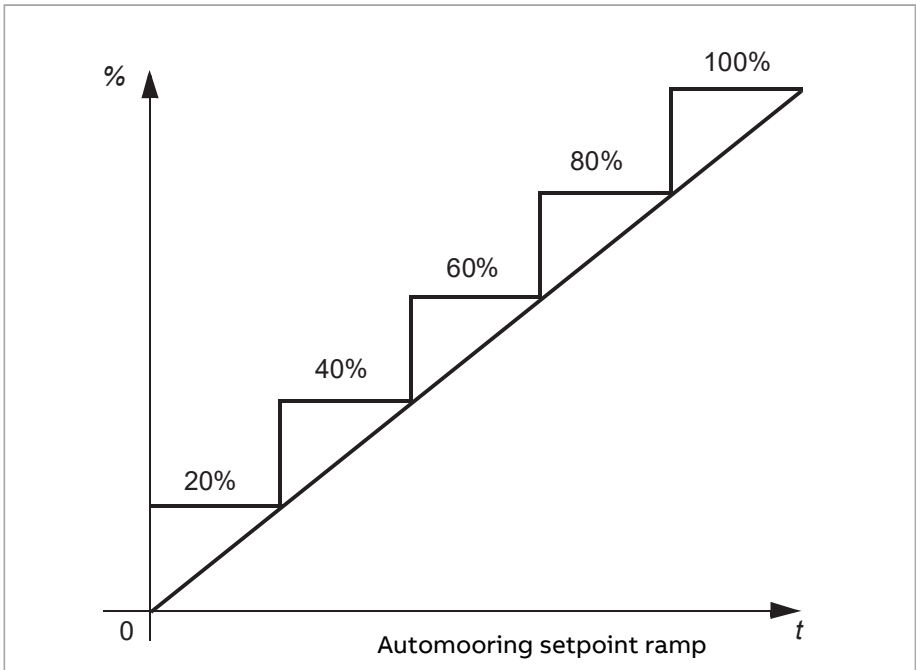
The desired tension in the rope is defined with parameter [76.13 Automoorng setpoint selection](#). The setpoint can be selected as:

- Analogue inputs
- Constant values
- Automoorng setpoint switch output
- Joystick motor potentiometer.

Parameter [09.22 Automoorng actual setpoint](#) shows the used setpoint.

Automoorng setpoint ramp

The ramp time for Automoorng setpoint is defined for Automoorng reference ranging from 0 to 100% or from 100 to 0%. The rate of change of the ramp time can be modified with parameter [76.19 AM setpoint ref ramp](#).



For example, if automoorng setpoint reference ramp is 10 seconds and automoorng setpoint switch is changed from 0 to 20%, then it takes 2 seconds to ramp up the automoorng setpoint reference. Parameter [09.22 Automoorng actual setpoint](#) shows the actual automoorng setpoint reference.

Automoooring setpoint switches

The automoooring setpoint switch can be selected with parameter [76.13 Automoooring setpoint selection](#). A total of three switches can be set up with parameters [76.20...76.28](#). Each switch can be used with two (A, B) or three inputs (A, B, C) depending on the desired levels (3 to 5 levels). The switches select between the automoooring setpoints 1 to 5 ([76.14...76.18](#)).

Automoooring setpoint switch configuration

You can customize the switch signals as shown in the truth table below.

Selections	76.75 AM setpoint selector conf A	76.76 AM setpoint selector conf B	76.77 AM setpoint selector conf C
AM disabled	b0	b0	b0
Setpoint 1	b1	b1	b1
Setpoint 2	b2	b2	b2
Setpoint 3	b3	b3	b3
Setpoint 4	b4	b4	b4
Setpoint 5	b5	b5	b5

The setpoint defined with parameters [76.75...76.77](#) have identical combinations of input selected from the following active selector switches:

- selector 1 ([76.20...76.22](#))
- selector 2 ([76.23...76.25](#))
- selector 3 ([76.26...76.28](#)).

Parameter [09.30 AM setpoint switch output](#) shows the selected logic of the selector switches. This output selection can be the source of parameter [76.13 Automoooring setpoint selection](#).

Following are the examples of truth tables.

Example 1

Selections	76.75 AM setpoint selector conf A	76.76 AM setpoint selector conf B	76.77 AM setpoint selector conf C
AM disabled	0	0	0
Setpoint 1	1	0	0
Setpoint 2	1	1	0
Setpoint 3	0	1	0
Setpoint 4	0	1	1
Setpoint 5	1	1	1

Example 2

Selections	76.75 AM setpoint selector conf A	76.76 AM setpoint selector conf B	76.77 AM setpoint selector conf C
AM disabled	0	0	0
Setpoint 1	0	1	0
Setpoint 2	1	1	0
Setpoint 3	1	0	0
Setpoint 4	1	0	1
Setpoint 5	1	1	1

Example 3

Selections	76.75 AM setpoint selector conf A	76.76 AM setpoint selector conf B	Status
AM disabled	0	0	Handmooring (0%)
Setpoint 1	1	0	Automooring setpoint 50%
Setpoint 2	1	1	Automooring setpoint 75%
Setpoint 3	0	1	Automooring setpoint 100%

For bit list values, refer parameters [76.75 AM setpoint selector conf A](#) and [76.76 AM setpoint selector conf B](#).

Note: You can also use truth tables with different combinations, not shown in the above examples.

The program works on the first switch that moves away from Off position. The other switches are ignored.

These automooring switches can be used to enable automooring mode using parameter [74.03 Automooring mode enable](#) by selecting [AM setpoint switch](#).

Automoooring setpoint change during re-moooring

In the time control mode, the drive automatically corrects the tension if the setpoint changes during re-moooring time.

Settings and diagnostics

Parameter groups: [74 Winch general \(page 573\)](#) and [76 Automoooring \(page 603\)](#).

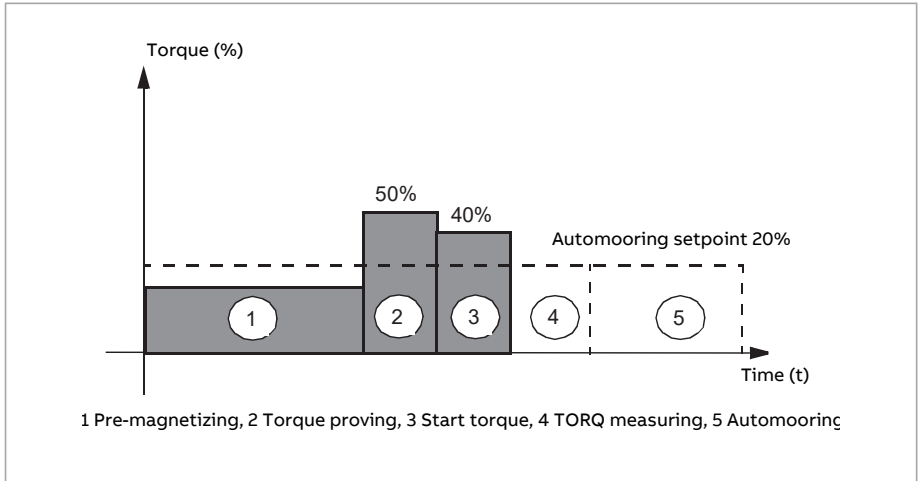
Signals: [09.22 Automoooring actual setpoint \(page 259\)](#) and [09.30 AM setpoint switch output \(page 260\)](#).

Parameters: [76.13 Automoooring setpoint selection \(page 606\)](#), [76.14 Automoooring setpoint1 \(page 607\)](#)...[76.18 Automoooring setpoint5 \(page 607\)](#), [76.19 AM setpoint ref ramp \(page 607\)](#), [76.20 AM setpoint selector 1 srcA \(page 608\)](#)...[76.28 AM setpoint selector 3 srcC \(page 609\)](#) and [76.75 AM setpoint selector conf A \(page 615\)](#)...[76.77 AM setpoint selector conf C \(page 616\)](#).

■ Adaptive torque proving and start torque limits

The adaptive limit functionality limit the torque proving and start torque value to maximum value of the actual automoooring setpoint value.

Enable adaptive limits with parameter [76.04 Automoooring config word](#), bit 7.



For example, set torque proving reference limit to 50% and set brake open torque limit to 40%. The torque proving or start torque is limited to maximum value of 20%.

Settings and diagnostics

Parameters: [44.201 Brake open torque \(page 487\)](#), [76.04 Automoooring config word \(page 604\)](#), [81.01 Torque proving enable \(page 634\)](#) and [81.02 Torque proving reference \(page 634\)](#).

■ Automoorings hysteresis and dead band

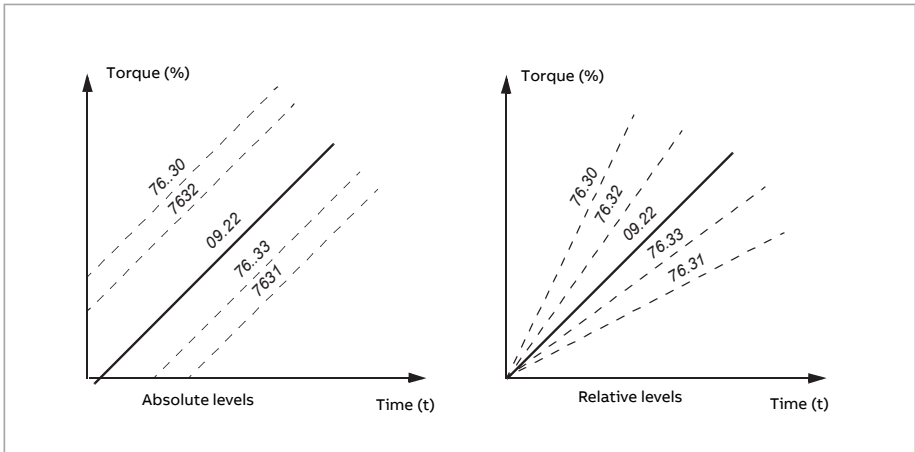
Hysteresis limits define the limits for the rope tension. If the tension exceeds the limits, the automoorings program starts a corrective action to get the tension towards the setpoint. The hysteresis values are defined in parameters [76.30 Hysteresis high level](#) and [76.31 Hysteresis low level](#). They are defined as percentage values of the currently active automoorings actual setpoint ([09.22 Automoorings actual setpoint](#)).

The deadband limits define the limits for an acceptable tension value. When the tension is within the deadband, the automoorings is stopped after In zone delay. The deadband values are defined in parameters [76.32 Deadband high level](#) and [76.33 Deadband low level](#). They are defined as percentage values of the currently active automoorings actual setpoint ([09.22 Automoorings actual setpoint](#)).

The final calculated absolute value of these parameters are in the corresponding parameter group [09 Winch actual signals](#) and the parameters [09.26 AM hysteresis high used](#) to [09.29 AM deadband low used](#).

Absolute and relative deadband hysteresis levels

In absolute levels, the parameter value of a deadband and hysteresis levels are fixed. Enable absolute levels with parameter [76.04 Automoorings config word](#), bit 2.



In relative levels, the parameter value of a deadband and hysteresis levels are multiplied with the actual automoorings setpoint reference value.

Settings and diagnostics

Signal: [09.22 Automoorings actual setpoint](#) (page 259).

Parameters: [76.04 Automooring config word](#) (page 604), [76.30 Hysteresis high level](#) (page 609), [76.31 Hysteresis low level](#) (page 609), [76.32 Deadband high level](#) (page 609) and [76.33 Deadband low level](#) (page 610).

■ Automooring tension feedback

With parameter [76.10 Tension feedback source](#), you can define the rope tension with internal DTC calculation or external measurement. The rope force can be measured externally using a load cell sensor mounted on the winch system between the vessel and the harbor.

Parameter [09.23 Rope actual tension](#) always shows the actual rope tension value when a load cell sensor is selected in parameter [76.10 Tension feedback source](#), and shows the tension value with internal DTC measurement as long as the drive is started.

Parameter [09.24 Rope tension memorized](#) always shows the actual rope tension value with an internal DTC tension measurement and also memorizes the last tension value, as the mechanical brake is closed and shows this value when the drive is stopped.

The configuration with parameter [74.09 Winch configuration word](#), bits 1,5 and 6 defines how this parameter behaves when the drive is stopping in handmooring mode or automooring mode or when lowering in handmooring mode.

Settings and diagnostics

Parameters: [09.23 Rope actual tension](#), [09.24 Rope tension memorized](#) and [76.10 Tension feedback source](#).

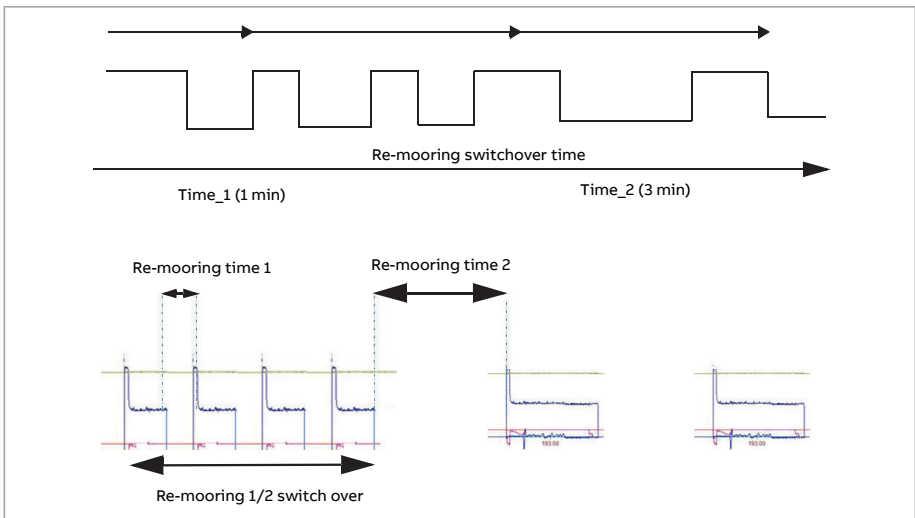
■ Automoorings modes

Time control mode

When time control is selected as automoorings mode (parameter [76.01 Automoorings mode](#)), automoorings is based on a time sequence defined with parameter [76.50 Re-moorings time interval 1](#) or [76.51 Re-moorings time interval 2](#) and [76.52 Re-moorings time 1/2 switch src](#). During re-moorings time, the drive/motor is switched Off and the mechanical brake is closed. After re-moorings time, the drive/motor is switched On and the rope tension is corrected according to the automoorings actual setpoint (parameter [09.22 Automoorings actual setpoint](#)) if needed.

Re-moorings times

With parameter [76.52 Re-moorings time 1/2 switch src](#), either [76.50 Re-moorings time interval 1](#) or [76.51 Re-moorings time interval 2](#) can be selected. Additionally, a switchover timer can be selected. The time is defined in parameter [76.53 Re-moorings switchover time 1/2](#). For the time defined in parameter [76.53 Re-moorings switchover time 1/2](#), re-moorings time interval 1 ([76.50 Re-moorings time interval 1](#)) is used, and after that re-moorings time interval 2 ([76.51 Re-moorings time interval 2](#)) is used. When the timer runs out, this can be seen in parameter [09.03 Winch status word 3](#), bit 6-AM re-moorings time active. The timer selection can be used when the ship arrives at port and is unloaded during an initial time that requires more frequent adjusting of the rope tension during the initial time.



Rope tension based on internal DTC torque calculation program

With parameter [76.10 Tension feedback source](#), you can select the internal DTC calculation or the external measurement as the load source. If you select the internal DTC calculation, automoorings can be used without any external load cell sensor.

The rope tension is detected during a torque measurement time (parameter [76.41 Torque measuring time](#)). During this time, the drive/motor is started and the mechanical brake is opened. The speed reference is temporarily forced to zero and the automooring max torque is used as the torque limit. During the measurement time, the drive detects the actual tension in the ropes and if the tension is outside the automooring hysteresis limits, the program performs an automooring sequence to correct the tension.

Automoooring styles

Automoooring styles are applicable in both time control and load cell automoooring modes. The automoooring style is selected with parameter [74.03 Automoooring mode enable](#).

AM Style 1

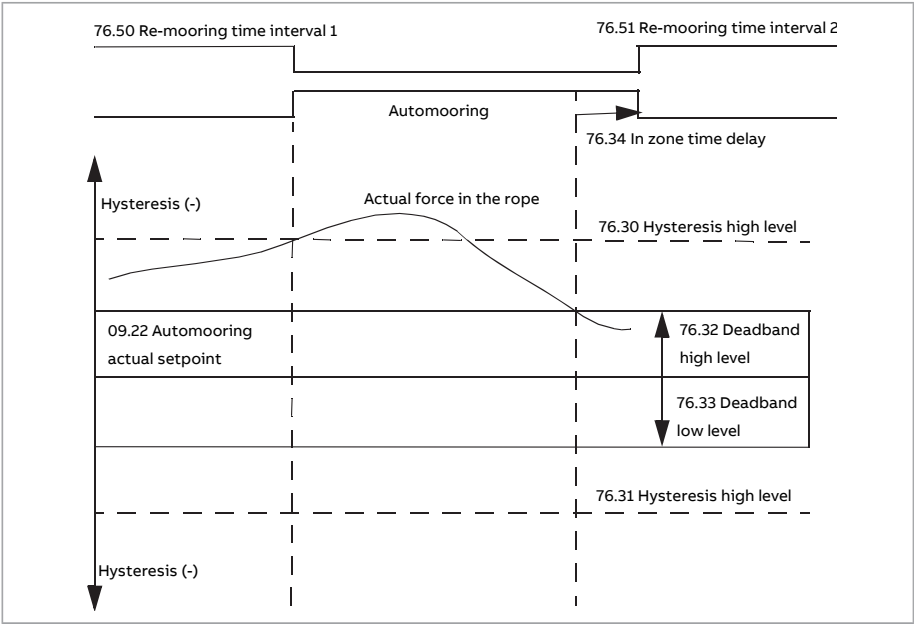
When tension is outside the hysteresis high or low limits during [76.41 Torque measuring time](#), the program starts correcting the tension towards the setpoint.

If the tension is too tight, the program uses the parameter [74.40 Automoooring speed ref](#) with a negative sign as speed reference to roll out (loosen) the rope.

If the tension is too low, the program uses parameter [74.40 Automoooring speed ref](#) with a positive sign as speed reference to roll in (tighten) the rope.

When the tension is within the deadband, the speed is limited by automoooring torque limits and the parameter [76.34 In zone time delay](#) timer starts. When the timer ends, the brake is closed and the drive is stopped and then waits for the re-moooring time again.

To achieve efficiency, the deadband limits can be close to the setpoint (5-10%).



AM Style 2

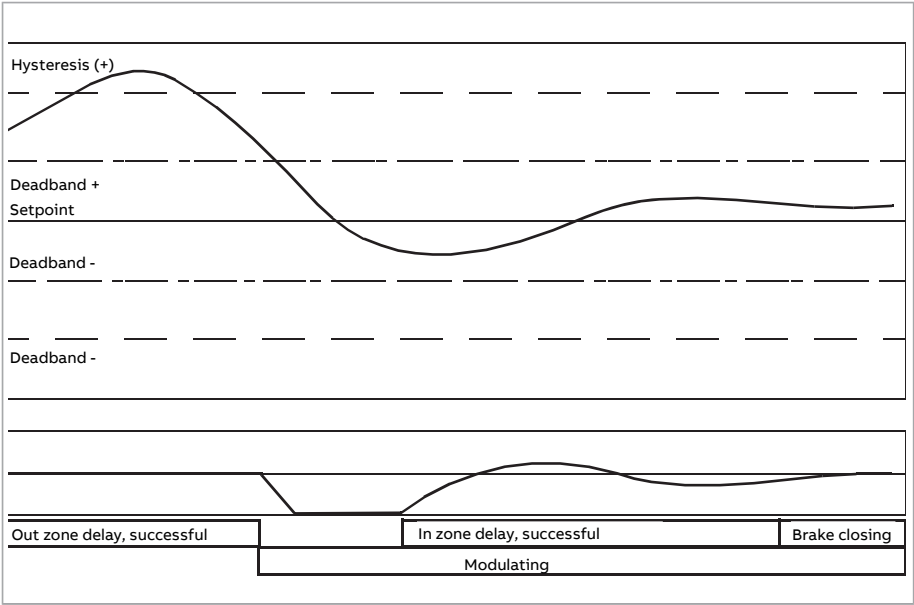
When the tension is within the deadband limits, the speed reference is proportional to the tension deviation.

$$Speed\ reference = \pm AM\ reference \times \frac{Rope\ actual\ tension - AM\ setpoint}{Deadband - AM\ setpoint}$$

This decreases the speed and the tension deviation between the current rope tension and the setpoints.

The parameter 76.34 In zone time delay counter starts when the tension enters the deadband, and zeroed if the tension moves outside the deadband before the timer is ended. When the tension remains inside the deadband in In zone time delay, then the brake closes and the drive stops.

To achieve efficiency, the deadband limits can be made wider than Style 1 (20-30%).



AM Style 3

The proportional speed is similar to AM Style 2. If the tension crosses the setpoint value, the speed reference is set to zero to minimize oscillation if short steel ropes are used. If the tension is outside the deadband during In zone delay, the speed reference is again adjusted as in AM Style 2 and the In zone counter is stopped and reset.

To achieve an efficiency, the deadband limits can be made wider than in AM Style1 (20-30%).

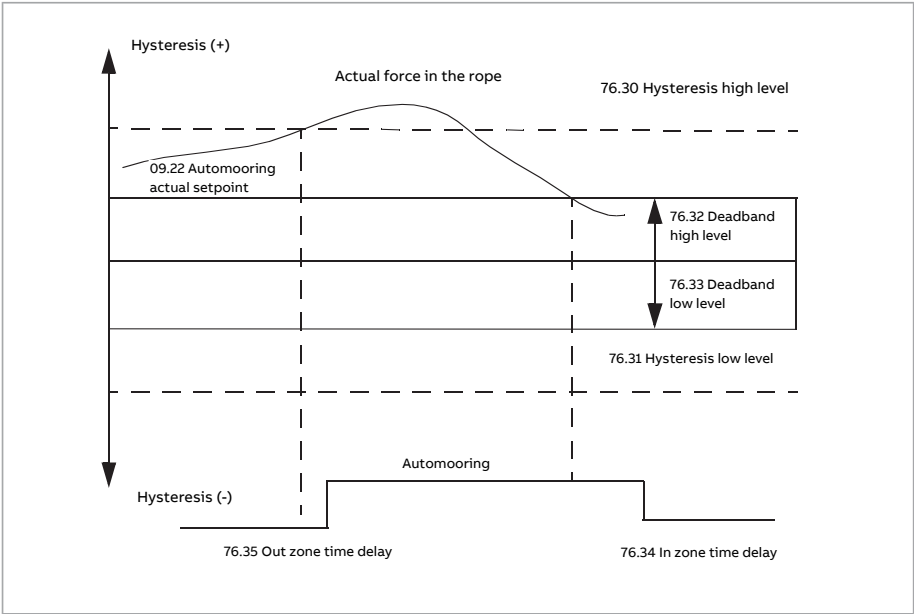
Comparison table

	Style 1	Style 2	Style 3
Torque	Limited to setpoint	Limited to Hysteresis high, AM maximum torque	Limited to Hysteresis high, AM maximum torque
Speed reference	Constant limit to AM max speed	Linearly decreased than closer to set-point when inside the dead-band area	Linearly decreases than closer to set-point when inside the dead-band area, pre-set to zero as soon as setpoint is reached. Outside dead-band reference change back to maximum

Load cell mode

When load cell is selected as automooring mode in parameter [76.01 Automooring mode](#), automooring is based on externally measured load cell information. If any detection of slack rope or tight rope, the drive starts and the rope tension is corrected according to the automooring actual setpoint. You can define the load cell input using parameter [76.10 Tension feedback source](#) (for example, analogue input).

The drive remains stopped with the brake closed until the tension outside the upper or lower hysteresis limits ([76.30](#) and [76.31](#)) for the out zone time delay (parameter [76.35 Out zone time delay](#)).



Automoorng styles in load cell

Automoorng styles are applicable in both time control and load cell automoorng modes. The automoorng style can be selected in parameter [76.03 Automoorng style](#).

Scaling of external load cell sensor

The parameter [09.22 Automoorng actual setpoint](#) is defined in terms of nominal torque where 100% is the winch motor nominal torque.

The winch motor nominal torque is calculated from the nominal data in parameter group [99 Motor data](#).

$$T_N = \frac{9550 \cdot P_N}{n_N}$$

Where:

- T_N is the winch motor nominal torque in Nm
- P_N is the winch motor nominal power in kW
- n_N is the winch motor nominal speed in rpm.

Example

The winch motor nominal power is 48 kW and the nominal speed is 978 rpm. The motor nominal torque calculated using the previous equation is 469 N·m. 100% Automoorng set point (parameters [76.14 Automoorng setpoint1](#)...[76.18 Automoorng setpoint5](#)) corresponds to winch motor torque of 469 N·m.

The external load cell sensor has the output range 0 ... 20 mA that corresponds to the measuring range 0 ... 500 N·m. The sensor is connected to the analog input AI1.

The load cell sensor needs to be scaled in parameter [12.20 AI1 scaled at AI1 max](#) according to the nominal torque. The result is 18.76 mA = 469 N·m. This is the reason why the scaling factor has to be 500 N·m / 469 N·m = 106.6.

Therefore, to get the final scaling factor for parameter [12.20](#), the scaling factor 106.6 has to be divided by 2. The result is 53.3.

$$x = \frac{10000}{20000} \cdot \frac{100 \cdot T_{LOADCELLMAX}}{T_N} = 0.5 \cdot \frac{100 \cdot 500(N \cdot m)}{469(N \cdot m)} = 53.3$$

where:

- x is the scaling constant in parameter [12.20](#) for AI1 in this example
- $T_{LOAD CELL MAX}$ is the maximum measuring range of the load cell sensor
- T_N is the maximum measuring range of the load cell sensor.

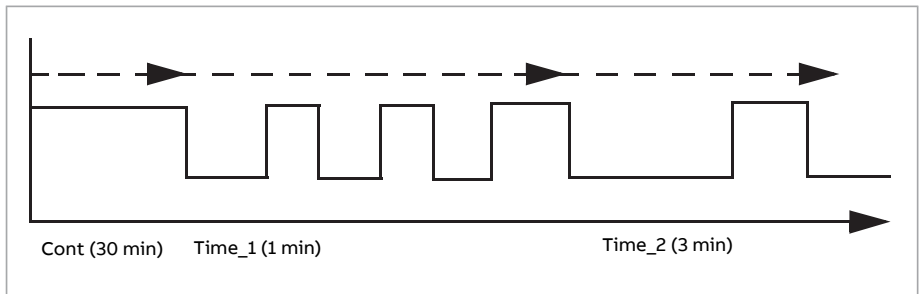
The Automoorng set point must be scaled accordingly if it is taken from an analogue input. For example, [76.13 Automoorng setpoint selection](#) = AI1 scaled.

Continuous mode

When continuous is selected as automooring mode (parameter [76.01 Automooring mode](#)), automooring is always On without any stopping or starting levels. The continuous automooring mode keeps the rope tension constant according to the parameter [09.22 Automooring actual setpoint](#). Continuous mode can be used with both internal DTC and external load cell tension feedbacks in parameter [76.10 Tension feedback source](#).

Continuous + Time control mode

This selection is a combination of continuous and time control modes. The program switches from continuous to time control after a predefined time. The two modes work independently. This selection can be used in instances where continuous adjustment of rope tension is needed for an initial time (for example, 30 minutes, as shown in the below figure) when the ship arrives at port. After the predefined time (par. [76.56](#)) elapses, the drive automatically switches to time control automooring mode.



■ Override functionality

For parallel operation to any Automooring mode, the override input is used for forcing (opens mechanical brake and continuous tension control when the input condition is True) Automooring On by a dedicated input using parameter [76.02 Override control](#). Also, it switches internally to Internal DTC feedback when the load cell is broken and quick auto tension correction is required.

Settings and diagnostics

Parameters: [76.02 Override control](#) and [76.10 Tension feedback source](#).

■ Maximum Automooring time protection

Maximum Automooring time protection is a protection against an abnormal Automooring sequence, broken ropes, wrong actual rope tension feedback, or a too high Automooring setpoint. It enables you to define the maximum running time for the drive/motor (parameter [76.60 Max AM time](#)). If the drive/motor is running longer than the defined time, a protection action can be taken depending on the selection (parameter [76.61 Max AM timeout function](#)).

■ Pretension and minimum tension protection

A definable pretension (parameter [76.05 Automoorings min tension](#)) must be present in the ropes from the Handmooring sequence before Automoorings is started. If the actual rope tension is below this limit, the system performs the action in parameter [76.07 AM min protection action](#) (either a warning or a fault). The user can select in parameter [76.06 AM min protection mode](#), if this protection should only be used when activating Automoorings after the Handmooring sequence, or in addition should be active also between each Re-moorings time interval and after possible powering cycling of the drive.

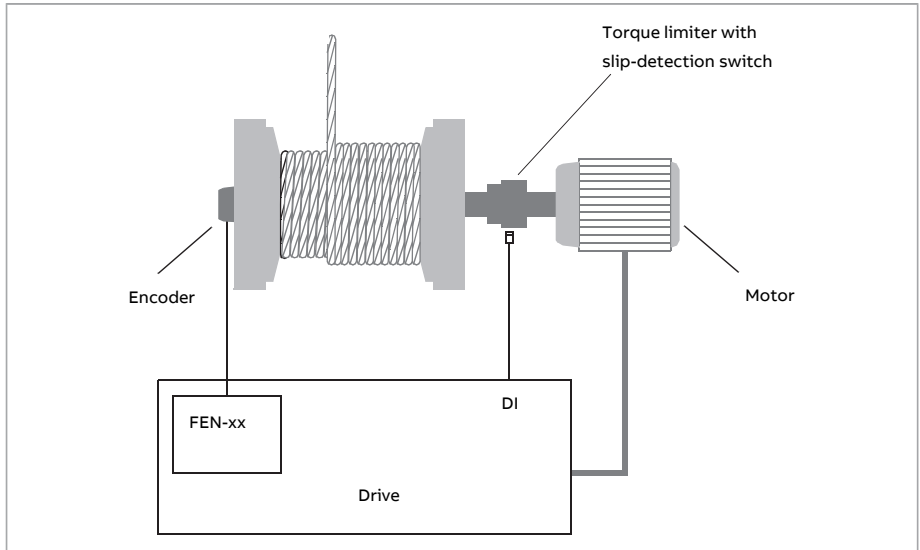
■ Behavior at power up

After the drive is powered On with the Automoorings mode, the Automoorings sequence can either start automatically (continue from last time) or remain stopped and require a new rising edge of the Automoorings mode selection. This is defined in parameter [76.04 Automoorings config word](#), bit0-AM continues after power fail.

Slip detection

To protect a torque limiter (for example, a slip clutch), it is possible to automatically apply a reduced (or zero) speed reference whenever slippage is detected. Slip detection can be based on the difference of chain speed on either side of the torque limiter, or an external slip-detection switch.

Note: This function works only in the winch mode (EXT2).



When parameter [78.04 Slip detection mode](#) is set to Internal, slip detection is based on the comparison of drive speed, drive torque and chain speed (measured by an encoder) with the supervision limits. The new reference (protection speed) is applied after a predefined delay (parameter [78.09 Activation delay time](#)).

In practice, the protection speed is often set to zero if the clutch cannot re-engage until the motor is stopped.

After the function is activated, the protection speed is active until the user reference signal reverts to zero.

When parameter [78.04 Slip detection mode](#) is set to parameter [78.11 Slip external detection](#), slip detection is based on an external slip-detection switch connected, for example, to a digital input. The state of the input is read through the pointer parameter. When the source of the pointer switches On, the drive waits for the slip delay time to elapse, and then applies the protection speed.

Settings and diagnostics

Parameter group [78 Slip detection](#) (page 623).

Peak torque protection

Peak torque protection is used to soften the mechanical loads caused by a tightening Handmooring chain or rope. The function stops the Handmooring mode if the rope tension is high. The function is activated, whenever the torque and the speed values exceed the preset limits, causing the drive to decelerate down to another preset speed.

When activated, the function resets when the drive has stopped, the mechanical brake has been closed, and the brake close delay and extended run time have elapsed (no modulation). You can set the peak torque protection parameters in group [79 Peak torque protection](#).

Note: This function works only in the winch mode (EXT2).

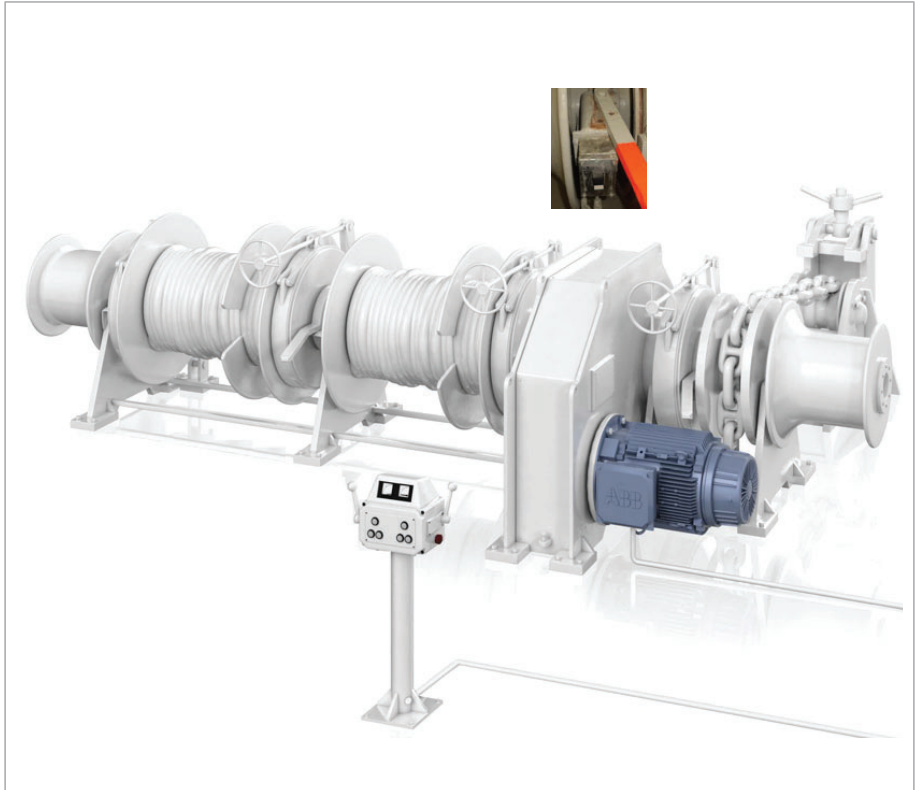
Settings and diagnostics

Parameter group: [79 Peak torque protection \(page 627\)](#).

Clutch control

The clutch control function limits the speed of the drum in the winch system. When changing the mechanical clutch on the system, the winch drum must be rotated slowly. The clutch control speed and maximum torque values can be set in parameter group [82 Clutch control](#).

The below figure shows a typical clutch control system. Note that the clutch control push buttons are located near the winch drum.



Note: A special fieldbus control stand can also be used in the clutch control system. Refer parameter [75.22 Include FB control stand \(page 600\)](#).

Settings and diagnostics

Parameter group: [82 Clutch control \(page 636\)](#).

Parameter: [75.22 Include FB control stand \(page 600\)](#).

Power control

Power control limits the speed of the winch according to the actual torque on the winch motor. With less load, for example, the winch can run at high speed, but if the load is heavy, the speed can be limited.

Note: Power control works only in the winch mode (EXT2).

Speed is limited depending on the torque of the system. You can define two torque/speed curves with 5-crosspoints on each curve, SET1 power curve and SET2 power curve. Each crosspoint has a speed (rpm) and torque (%) connection. You can select the crosspoints with the power control parameters in group [80.01 Power control enable](#).

Power control function can be activated with parameter [80.01 Power control enable](#). The function can be always active or only in defined control modes.

Note: If you activate the function when drive is running, the function is effective only after the drive is stopped and started again.

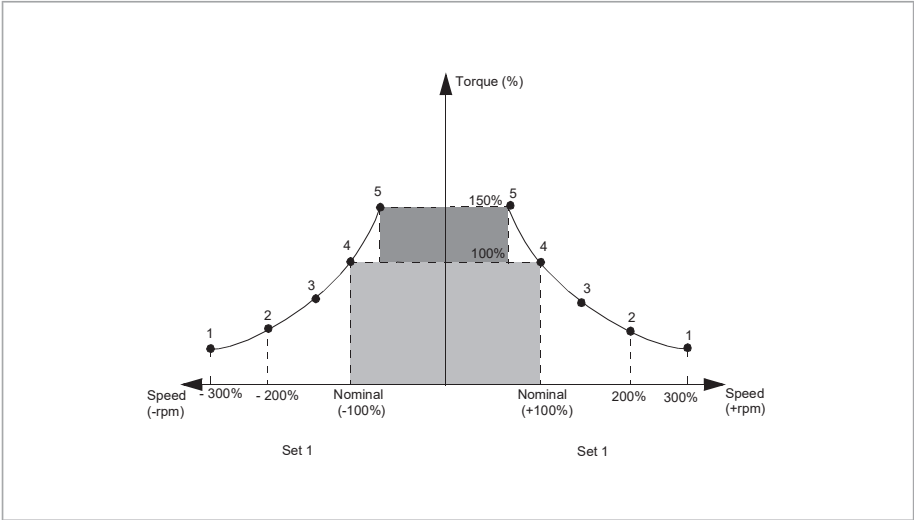
For example,

Selection	Description
Enabled	Always in use
In Anchor mode	Used when the system is in Anchor mode. Parameter 09.01 Winch status word 1 , bit 0 - Anchor mode active = 1
In Anchor or Handmooring mode	Used when the system is in Anchor mode. Parameter 09.01 Winch status word 1 , bit 0 - Anchor mode active = 1 or bit 1 - Handmooring mode = 1

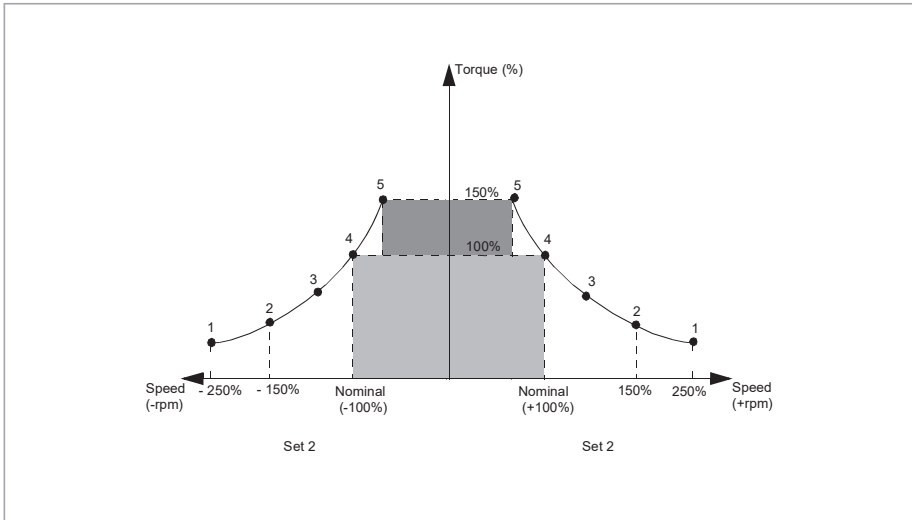
The two power curves can be selected with parameter [80.30 Set1/Set2 switch](#).

Selection	Description
Set1	Used in forward and reverse direction.
Set2	The speed crosspoints are mirrored in the torque axis.
Forward/Reverse	Set1 and Set2 are used in forward and reverse directions respectively.
Anchor/Handmooring	Set1 is used in Anchor mode and Set2 in Handmooring mode. In parameter 80.01 Power control enable , select In Anchor or Handmooring mode.
Other	Any bit or digital input can be used for selecting between Set1 and Set2.

■ **Anchor mode**



■ Handmooring mode



Actual signal [09.21 Power control ref](#) shows the final total torque reference used in the power control against the crosspoints.

The power control crosspoints 1...5 of the used curve (Set1/Set2) are compared to the total torque reference shown in the parameter [09.21 Power control ref](#).

In the forward operation, [09.21 Power control ref](#) is same as the calculated motor torque [01.10 Motor torque](#).

In the reverse operation, high speed is allowed depending on the crosspoint parameter settings.

- Parameter [80.22 Acc torque buffer](#) defines the torque buffer for stopping acceleration.
- Parameter [80.23 Dec torque buffer](#) defines the buffer for starting deceleration in the reverse operation if the stop command is given.

You can set the power control filter time ([80.24](#)) and hysteresis value ([80.25](#)) to prevent power control torque and speed oscillations between the crosspoints. If the value of signal [09.21 Power control ref](#) is within the hysteresis value ([80.25](#)), there is no change in the power control speed reference, which prevents oscillation at speed limitation break points.

Settings and diagnostics

Parameter group: [80.01 Power control enable](#) (page 629).

Signals: [01.10 Motor torque](#) (page 212), [09.01 Winch status word 1](#) (page 254) and [09.21 Power control ref](#) (page 259).

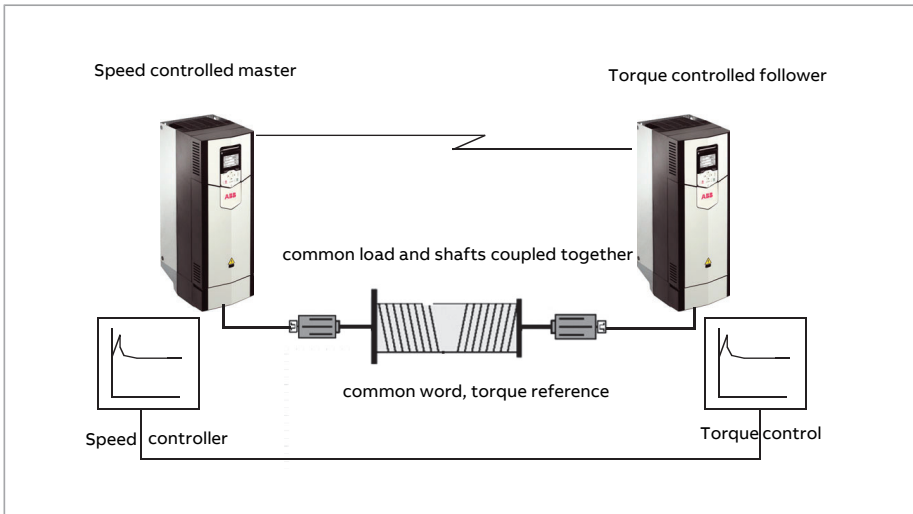
Parameters: 80.01 Power control enable (page 629), 80.22 Acc torque buffer (page 631), 80.23 Dec torque buffer (page 631) and 80.30 Set1/Set2 switch (page 632).

Master/follower communication in winch application

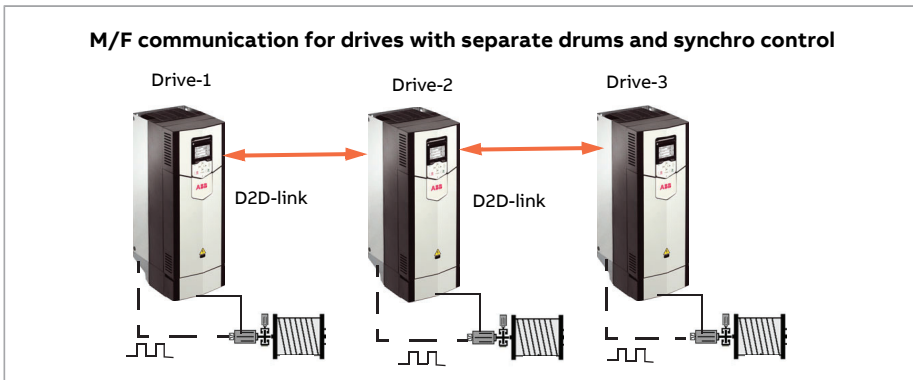
■ M/F communication types in winch application

The following M/F connections are possible in a winch application:

- When the motor shafts are coupled to each other for running a common load, the master drive is speed controlled and transmits torque reference to the follower drives.



- When the motor shafts are not coupled to each other, the speed reference of the master drive is transmitted to the follower drives. In this case, the follower drive is speed controlled. Refer the below figure.

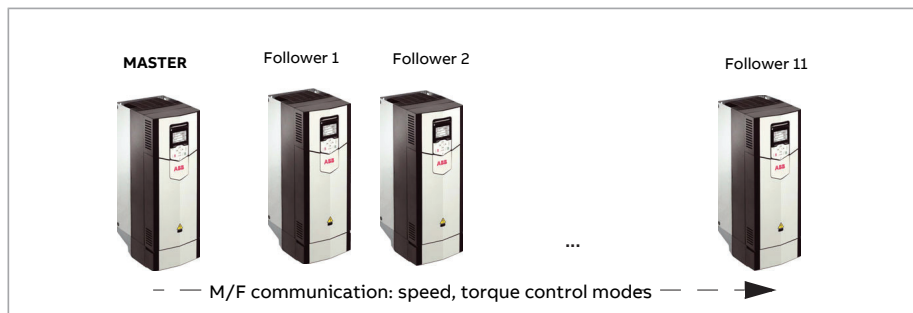


- In a synchro control, the speed reference and position of the master drive are transmitted to the follower drives. The follower drives are in speed control

mode with speed correction, where the position of the follower drives is compared with the position of the master drive and the required speed correction is added to its own speed reference chain. For more information, refer [Shaft synchro control \(page 100\)](#).

■ D2D-link configuration in winch application

The figure below shows the winch master-follower/D2D link configuration. The configuration consists of one master and 11 follower drives.



The master drive is responsible for communication network which must exist always in the system.

The winch system has two control modes.

- EXT1 - for standalone speed.
- EXT2 - for master/follower.

You can switch between EXT1 and EXT2 control modes.

For information on D2D connections and terminations, refer Hardware Manual of the drive.

M/F communication: The winch control program supports the following configurations:

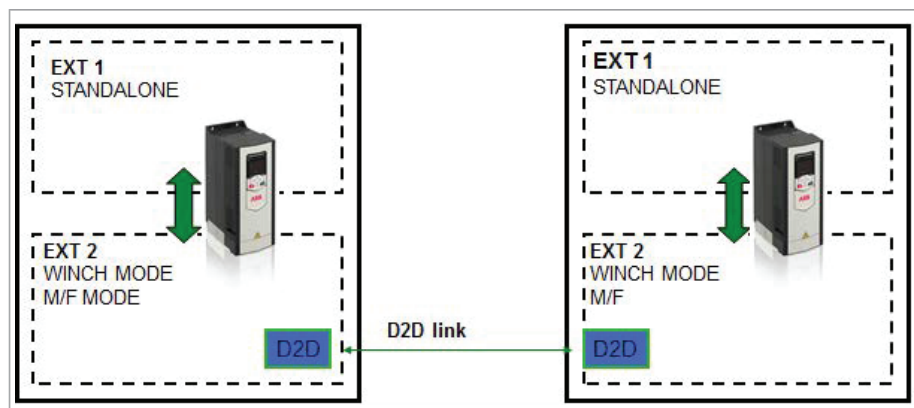
- One master drive and up to 11 fully controlled follower drives.
- Two master drives (main master winch and sub-master winch) and up to 10 fully controlled follower drives.

Note: The main master winch drive must be in the D2D network.

- One master drive and up to eleven fully controlled follower drives, in addition to 20 free follower drives (not supervised by master).
- Two master drives (main master winch and sub-master winch) and up to 10 fully controlled follower drives, in addition to 20 free follower drives (not supervised by master).

The master drive communicates with follower drives through command and status words, interlocks and references. This communication works only when both master and follower(s) are in the EXT2 control location.

Note: When the master received a start command, both master drive and follower drives must have the same control location EXT2. If the drives have wrong control locations, the warning **D206 M/F control location mismatch** appears.



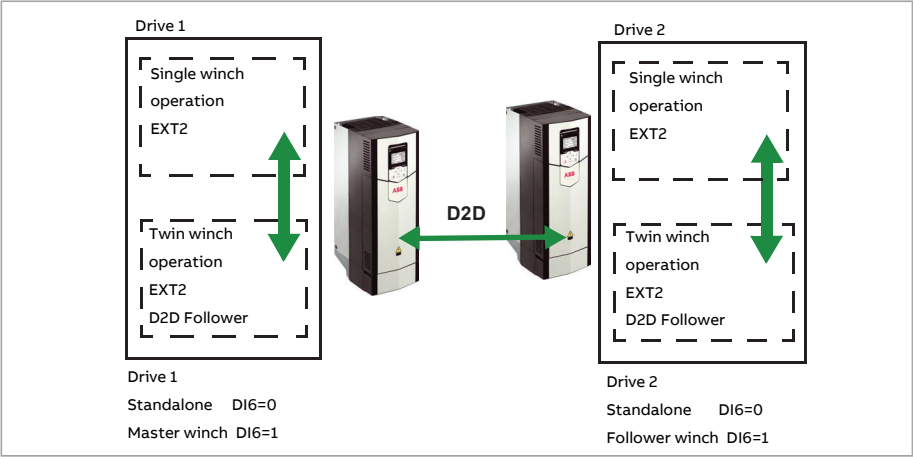
D2D-link: In each drive the M/F communication in the D2D-link is activated with parameter **60.200 Winch drive type** by selecting the appropriate drive type.

Communication supervision is activated with the following parameters:

- **60.201 Winch drive structure 1**, when **60.205 Winch drive structure sel** = Structure 1, or
- **60.202 Winch drive structure 2**, when **60.205 Winch drive structure sel** = Structure 2.

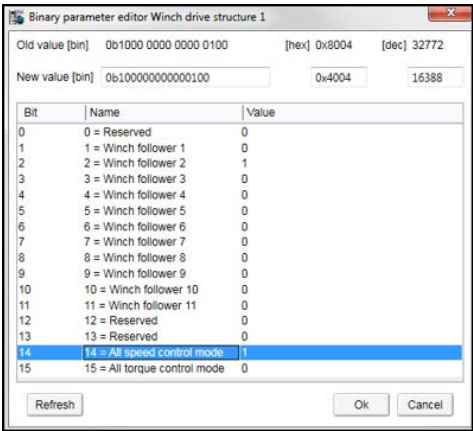
Standalone or M/F winch mode: The winch M/F communication in the D2D-link can be activated using parameter **60.208 Winch M/F enable** (no user set is required). For example, set parameter **60.208 Winch M/F enable** to DI6.

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Example of parameter settings for D2D-link configuration: Speed controlled follower setup

The table below shows master-follower settings for speed-controlled follower setup:

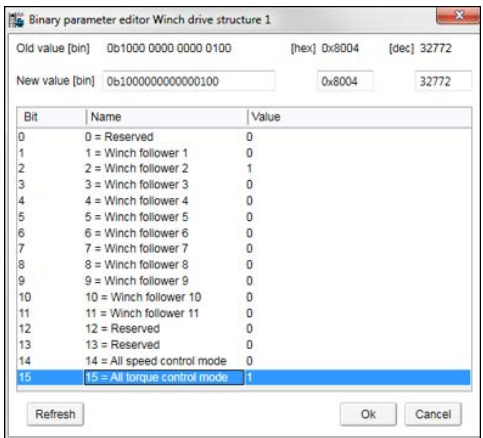
Parameter	Master	Follower	Notes
Selecting the control location			
19.11	EXT2	EXT2	Any but pointer source which should be <i>ON</i> .
19.14	Speed	Not needed	Master can define the control mode of follower drives. Parameter 60.201 Winch drive structure 1, bit 14 = 1.
Setting D2D communication parameters			
60.200	Main winch	Winch follower 2	Not needed
60.201	 The screenshot shows a dialog box titled "Binary parameter editor Winch drive structure 1". It contains fields for "Old value [bin]" (0b1000 0000 0000 0100), "[hex]" (0x8004), and "[dec]" (32772). Below these are fields for "New value [bin]" (0b1000000000000100), "[hex]" (0x4004), and "[dec]" (16388). A table lists bits 0 through 15 with their names and current values. Bit 14 is highlighted in blue, with its name "14 = All speed control mode" and value "1". Bit 15 is "15 = All torque control mode" with value "0". Buttons for "Refresh", "Ok", and "Cancel" are at the bottom.		Define which follower drives belong to the master (bit 2 = 1 for Winch follower 2), and select bit 14 = All speed control mode.
60.205	Structure 1	Not needed	Not needed
Setting reference signals parameters			

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Parameter	Master	Follower	Notes
22.12	AI1 scaled	Not needed	If winch is operated from control stands, select appropriate speed reference source in group 75 Winch interface.
22.14	Follow Ext1/Ext2	Follow Ext1/Ext2	Not needed
Setting Start/Stop/Direction parameters			
20.06	In1 Start fwd; In2 Start rev	Not needed	If winch is operated from control stands, select appropriate digital input source in group 75 Winch interface.
20.07	Level	Not needed	Not needed
20.08	DI1	Not needed	Start command forward
20.09	DI2	Not needed	Start command reverse

Example of parameter settings for D2D-link configuration: Torque controlled follower setup

The table below shows master-follower settings for torque controlled follower setup:

Parameter	Master	Follower	Notes
Selecting the control location			
19.11	EXT2	EXT2	Any bit pointer source which should be ON.
19.14	Speed	Not needed	Master can define the control mode of follower drives. Parameter 60.201 Winch drive structure 1 , bit 14 = 1.
Setting D2D communication parameters			
60.200	Main winch	Winch follower 2	Not needed
60.201	 The screenshot shows a 'Binary parameter editor' window for 'Winch drive structure 1'. It displays a table with columns 'Bit', 'Name', and 'Value'. Bit 15 is highlighted in blue and has a value of 1, with the name '15 = All torque control mode'. Other bits (0-14) have values of 0. The window also shows 'Old value [bin]: 0b1000 0000 0000 0100', 'New value [bin]: 0b1000000000000100', and hexadecimal/decimal equivalents.		Define which follower drives belong to the master (bit 2 = 1 for Winch follower 2), and select bit 15 = All torque control mode.
60.205	Structure 1	Not needed	Not needed
Setting reference signals parameters			

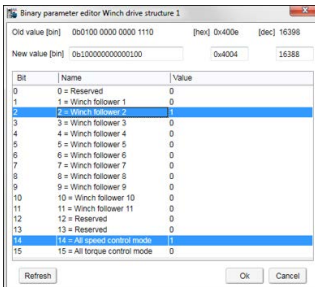
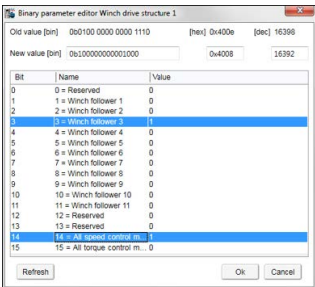
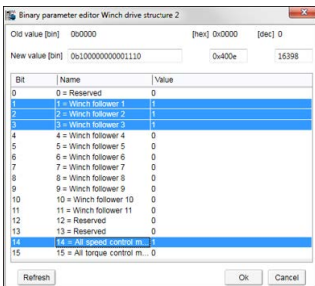
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Parameter	Master	Follower	Notes
22.12	AI1 scaled	Not needed	If winch is operated from control stands, select appropriate speed reference source in group 75 Winch interface .
22.14	Follow Ext1/Ext2	Follow Ext1/Ext2	Not needed
26.14	Not needed	Torque reference 2	Not needed
Setting Start/Stop/Direction parameters			
20.06	In1 Start fwd; In2 Start rev	Not needed	If winch is operated from control stands, select appropriate digital input source in group 75 Winch interface .
20.07	Level	Not needed	Not needed
20.08	DI1	Not needed	Start command forward
20.09	DI2	Not needed	Start command reverse

Note: The above parameter settings is sufficient to change the bits 14 and 15 in the master drive parameter [60.201 Winch drive structure 1](#) to change the control mode of the follower drive.

Example of parameter settings for D2D-link configuration: Combined/Split system

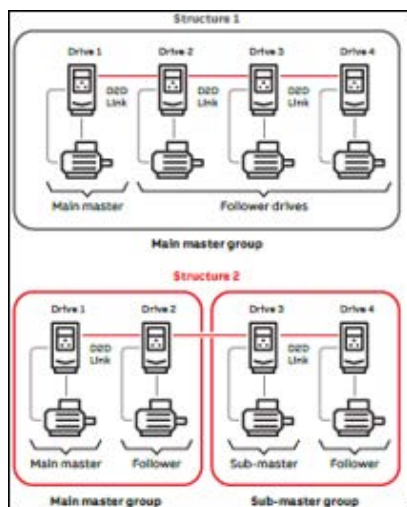
The table below shows master-follower settings for fast changing system: From one Winch master and three follower drives to two separate systems that has two master drives with its own follower drive.

Parameter	Main D2D Master	Follower	Follower or master	Followers
Selecting the control location				
19.11	EXT2	EXT2	Ext2	EXT2
19.14	Speed	Not needed	Speed	Not needed
Setting D2D communication parameters				
60.200	Main winch	Winch follower 2	Winch follower 1 / Sub master winch	Winch follower 3
60.201				
60.202			Not needed	
60.205	Pointer to 10.2.5 (DI6) 0 (False) = Structure 1 1 (True) = Structure 2	Not needed	Structure 1	Not needed
Setting reference signals parameters				
22.12	AI1 scaled	Not needed	AI1 scaled	Not needed

Parameter	Main D2D Master	Follow-er	Follower or master	Follow-ers
22.14	Follow Ext1/Ext2	Follow Ext1/Ext2	Follow Ext1/Ext2	Follow Ext1/Ext2
Setting Start/Stop/Direction parameters				
20.06	In1 Start fwd; In2 Start rev	Not needed	In1 Start fwd; In2 Start rev	Not needed
	Level	Not needed	Level	Not needed
20.08	DI1	Not needed	DI1	Start com- mand for- ward
20.09	DI2	Not needed	DI2	Start com- mand reverse

The selections Structure 1 or Structure 2 can be set in the main master winch, parameter [60.205 Winch drive structure sel.](#)

- Structure 1: Winch works with one master and three followers. All motors are together in one D2D link group.
- Structure 2: Winch is split and works with one master and one follower. Two drives and two motors work in D2D link group. In the below example, two master followers are in one D2D link (main master and sub-master).

**Note:**

- Main master winch controls all drives (Winch follower 1,2,3), when DI6 = 1 (True).
- Main master winch controls only Winch follower 2, when DI6 is set = 0 (False), and Winch follower 1 acts as a Sub master winch and controls Winch follower 3.

Shaft synchro control

The Shaft synchro function synchronises the master and follower drives based on the target position.

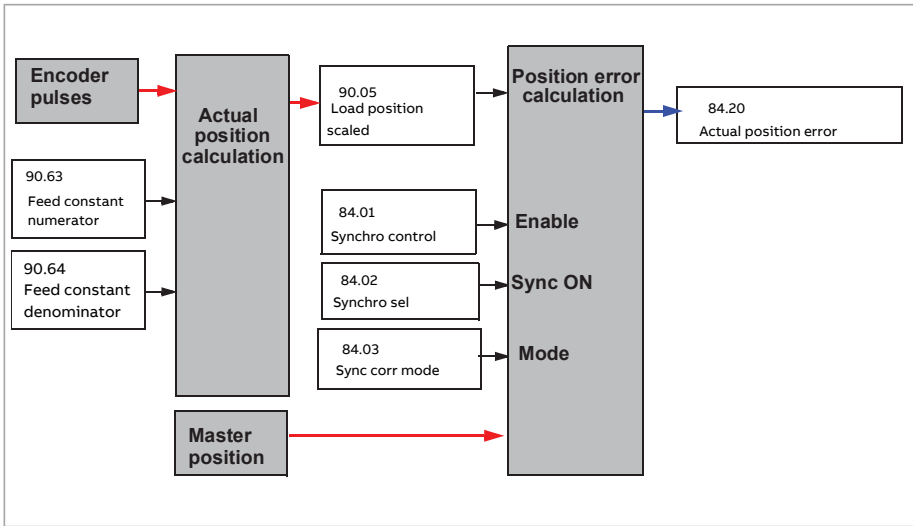
Shaft synchro function works in control location EXT2, with following conditions:

- drives are in D2D master/follower speed/ speed mode. Refer [Master/follower communication in winch application](#)
- standalone drive and target position is provided from external device, eg. PLC.

The speed reference correction is added to the used speed reference to eliminate the differences in drive current position (par. [90.05 Load position scaled](#)) and target position (par. [84.40 Target position source](#)).

■ Synchro control function - block diagram

The below diagram shows the basic functionality of the synchro control function.



With D2D link:

The parameter [84 Synchro control](#) = On activates the execution of the synchro function in the follower drives. The master drive sends to the follower drives own speed reference defined with parameter [24.01 Used speed reference](#) and position value selected in parameter [84.40 Target position source](#).

In follower drives, parameter [84.02 Synchro sel](#) activates the position error and the speed correction reference calculation. If parameter [84.02 Synchro sel](#) = No, the follower drive does not provide any correction reference to follow the master position.

With standalone drive:

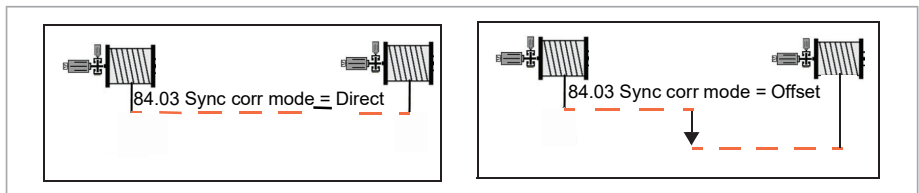
The parameter **84 Synchro control** = On activates the execution of the synchro function in the standalone drives. The master system (PLC) provides the target position (par. **84.21 Target position**) based on the value selected in parameter **84.40 Target position source**.

Parameter **84.02 Synchro sel** activates the position error and speed correction reference calculation to eliminate the position difference.

At least two correction modes are defined with parameter **84.03 Sync corr mode**:

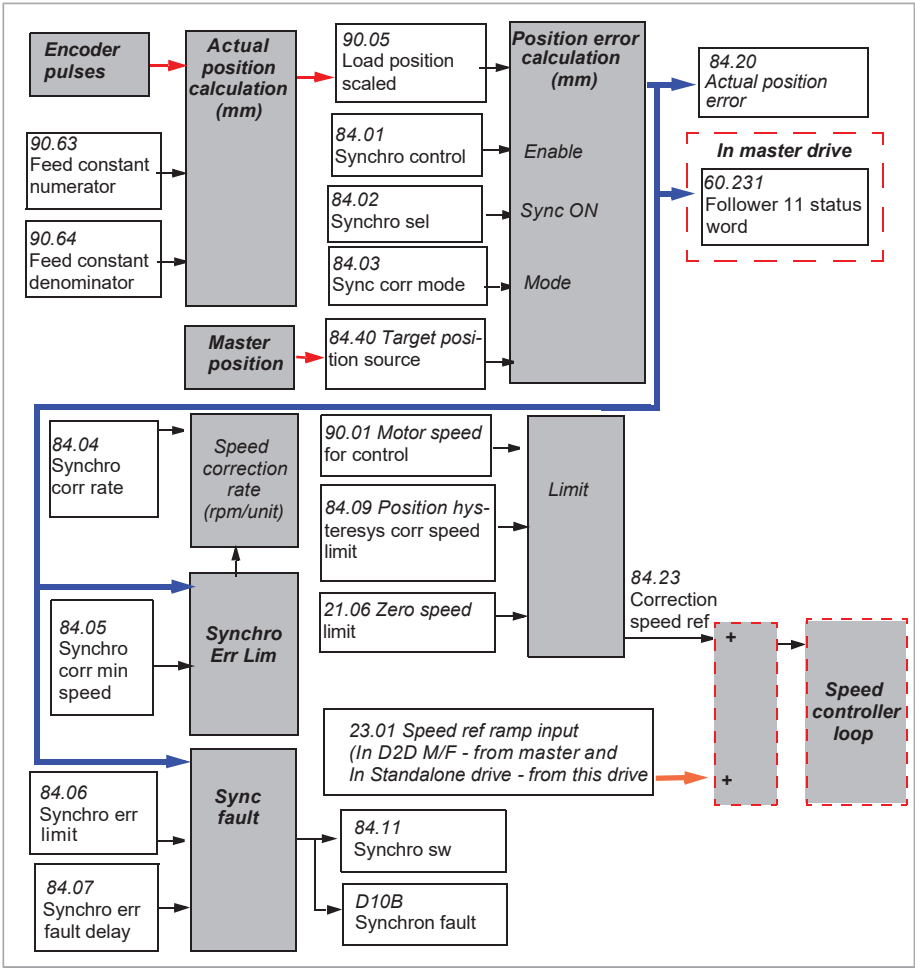
Direct mode: In this mode, the follower runs at the same position as the master drive (master position = follower position). Refer to the below figure.

Offset mode: In this mode, the follower runs at the master position with the offset value (master position + offset value = follower position). Refer to the below figure.



■ **Synchro control with synchro correction**

The below diagram shows the combination of basic synchro control functionality and the synchro correction.



The first part of the synchro control function is the basic function described in [Synchro control function - block diagram](#). The second part of the synchro control function is the synchro correction with parameter **84.04 Synchro corr rate** in combination with different limit conditions. Refer description in parameter **84.05 Synchro corr min speed**.

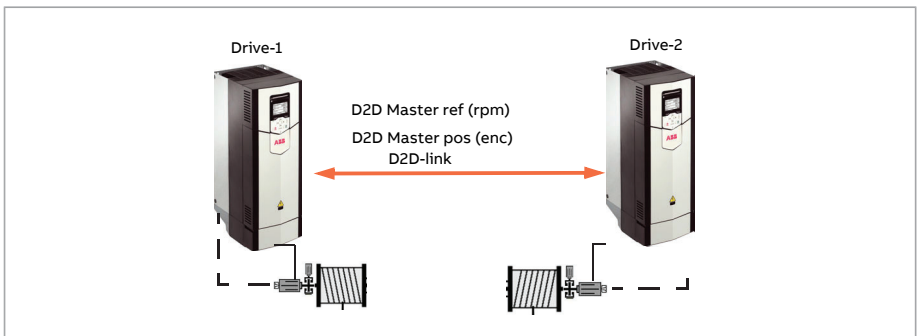
When the detected absolute error is greater than the value defined in parameter **84.06 Synchro err limit** for a period longer than **84.07 Synchro err fault delay**, the drive trips on **D10B Synchro fault** and parameter **84.11 Synchro sw**, bit 2 is set.

To reset the fault, set parameter **84.20 Actual position error** less than **84.06 Synchro err limit** or set parameter **84.02 Synchro sel** = No, to deactivate.

Note also, the following alternate synchro control connections:

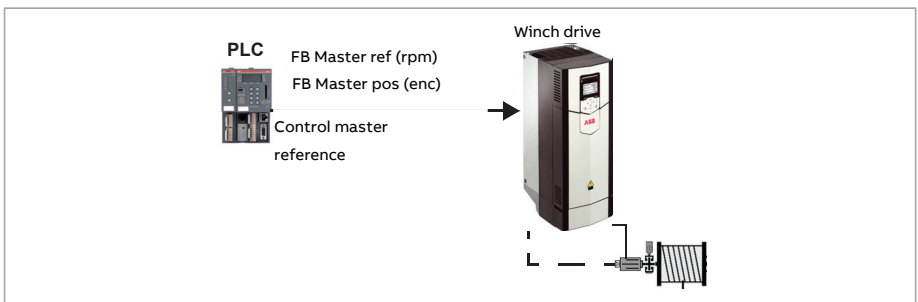
Synchro control between drives in D2D M/F network:

All drives (masters and followers) are in the same D2D network. Each master provides speed reference and master position to followers defined by parameter **84.40 Target position source** = Position from D2D master. Each drive receives the actual position from its motor encoder.



Synchro control between PLC and drives in fieldbus mode:

All drives connected to PLC as a master provides speed reference and master position from master encoder defined by parameter **84.40 Target position source** = Other or Fieldbus source. Each drive receives actual position from its motor encoder.



■ Example: Parameter settings for Synchro control (Speed-speed+position) setup

The example below shows the parameter settings of the winch system with master drive and follower drive.

Note: Do not change any other parameters in group 60 than listed here. The selection in parameter 60.200 Winch drive type automatically changes the rest of communication parameters.

Parameter	Master	Follower	Remarks
Selecting the control location			
19.11 Ext1/Ext2 selection	DI6	DI6	Or another source
19.14 Ext2 control mode	Speed	Speed	-
Setting D2D communication parameters			
60.200 Winch drive type	Main hoist	Follower hoist 1	Main hoist is D2D master. D2D communication can be established only if the main hoist drive exists.
60.201 Winch drive structure 1	3 = Follower hoist1 = 1 Rest of the bits = 0	Not needed	Setup the bits of used drives in the master drive
Setting reference signals parameters			
22.11 Speed ref1 source	AI1 scaled	AI1 scaled	If reference comes from AI1.
22.12 Speed ref2 source	AI1 scaled	Not needed	If reference comes from AI1.
22.14 Speed ref1/2 selection	Follow Ext1/Ext2	Not needed	-
Setting Start/Stop/Direction parameters			
20.01 Ext1 commands	In1 Start fwd; In2 Start rev	In1 Start fwd; In2 Start rev	Default value
20.02 Ext1 start trigger type	Level	Level	Default value
20.03 Ext1 in1 source	DI1	DI1	Start command fwd

Parameter	Master	Follower	Remarks
20.04 Ext1 in2 source	DI2	DI2	Start command rev
20.06 Ext2 commands	In1 Start fwd; In2 Start rev	Not selected	The Follower drive must be set to Not selected .
20.07 Ext2 start trigger type	Level	Not needed	Default value
20.08 Ext2 in1 source	DI1	Not needed	Start command fwd
20.09 Ext2 in2 source	DI2	Not needed	Start command rev
Setting the Synchro control function parameters			
84 Synchro control	ON	ON	or pointer to DI
84.02 Synchro sel	Select	Select	or pointer to DI
84.03 Sync corr mode	Offset	Offset	Or Direct
84.04 Synchro corr rate	Not needed	3 rpm/unit	Position to speed coefficient that is used by P-controller
84.05 Synchro corr min speed	Not needed	100	Minimum speed correction value that is used by P-controller.
84.06 Synchro err limit	Not needed	50 unit	Allowed position error difference that triggers the fault delay timer.
84.07 Synchro err fault delay	Not needed	5 s	Delay time before the detected Sync error appears.
84.08 Position hysteresis	Not needed	10 unit	Allowed position difference between the master and follower drives.
Setting the position feedback source and position scaling parameters.			
90.51 Load feedback selection	Encoder 1	Encoder 1	-
90.63 Feed constant numerator	1 (scale: gear ratio, diameter)	1	Rev to mm scaling parameter

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Parameter	Master	Follower	Remarks
90.64 Feed constant denominator	1 (scale: gear ratio, diameter)	1	Rev to mm scaling parameter

Settings and diagnostics

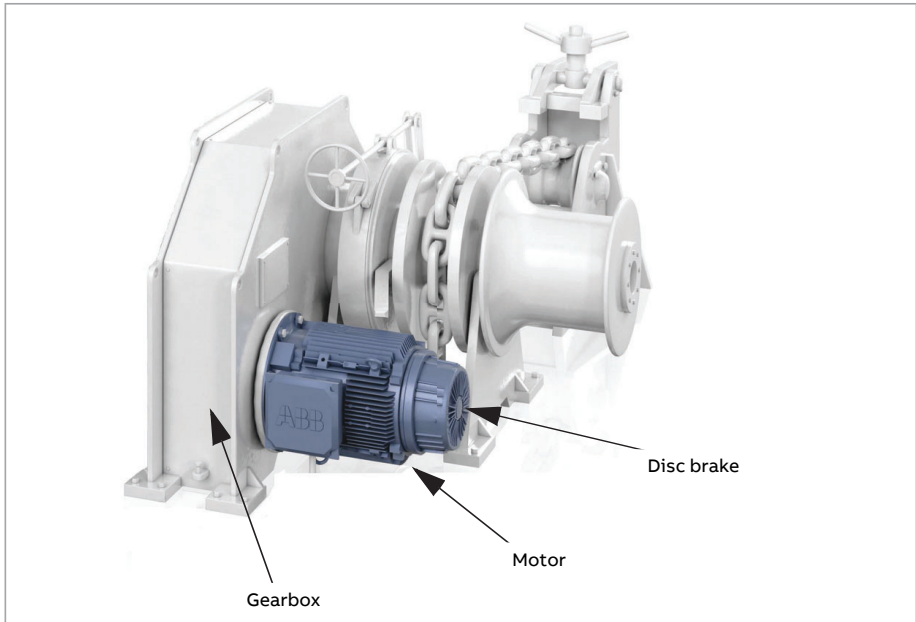
Parameters: 84 Synchro control (page 639), 84.02 Synchro sel (page 639), 84.03 Sync corr mode (page 639), 84.04 Synchro corr rate (page 639), 84.05 Synchro corr min speed (page 640), 84.06 Synchro err limit (page 640), 84.07 Synchro err fault delay (page 640), 84.08 Position hysteresis (page 641), 84.09 Position hysteresis corr speed limit (page 641), 90.53 Load gear numerator (page 650), 90.54 Load gear denominator (page 650), 90.63 Feed constant numerator (page 652) and 90.64 Feed constant denominator (page 652).

Signals: 84.11 Synchro sw (page 641), 84.19 Actual position (page 641), 84.20 Actual position error (page 641), 84.21 Target position (page 641), 84.22 Offset value (page 642), 84.23 Correction speed ref (page 642) and 84.50 Position from D2D master (page 642).

Event: D10B Synchron fault (page 772).

Mechanical brake control

A mechanical brake is used for holding the motor and driven machinery at zero speed when the drive is stopped, or not powered. The brake control program observes the settings of parameter group [44 Mechanical brake control](#) as well as several external signals. The [Mechanical brake control diagram](#) shows an example of a close-open-close sequence. The following figure shows the gearbox and a brake.



■ Inputs of the brake control program

Signals that affect the state of the control program are,

- brake status acknowledgement (optional, defined by parameter [44.07 Brake acknowledge selection](#)),
- parameter [06.11 Main status word](#), bit 2 (indicates whether the drive is ready to follow the given reference or not),
- parameter [06.16 Drive status word 1](#), bit 6 (indicates whether the drive is modulating or not),
- optional FSO-xx safety functions module.

The brake control is enabled by default without supervision ([44.07 Brake acknowledge selection](#) = [No acknowledge](#)).

■ Outputs of the brake control program

The mechanical brake is controlled by parameter [44.204 Winch brake status](#), bit 0. This bit is selected by default as the source of the relay output RO1. Refer [Wiring example \(page 112\)](#).

The brake control program in various states, requests the drive control program to hold the motor, increase the torque, or ramp down the speed. These requests are visible in parameter [44.204 Winch brake status](#).

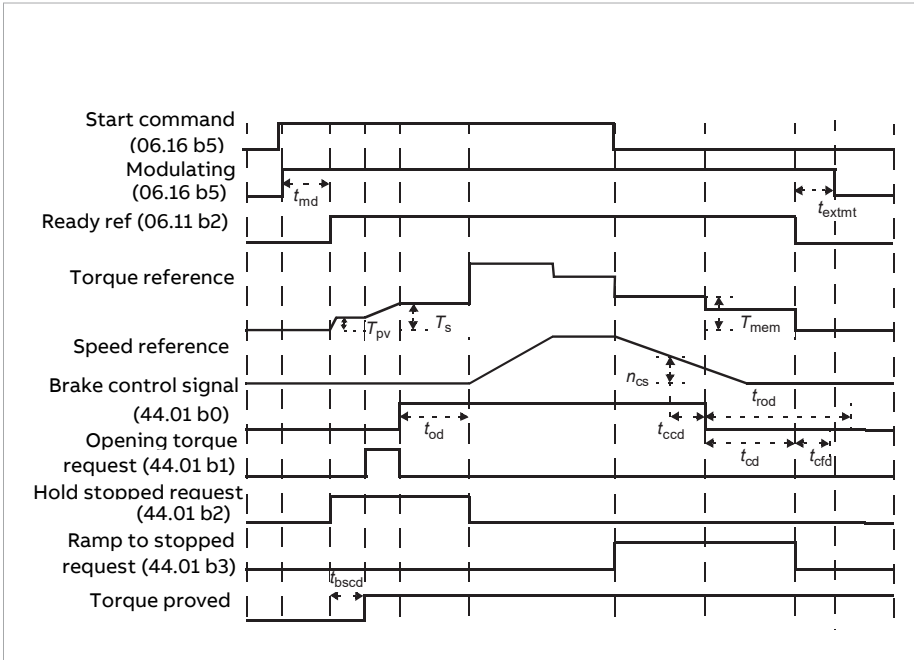
Note: Do not use parameter [44.01 Brake control status](#), bit 0-Open command, standard brake control bit.

Settings and diagnostics

Parameter group: [44 Mechanical brake control \(page 481\)](#).

■ Mechanical brake control diagram

The simplified timing diagram illustrates the operation of the brake control function.



T_s Start torque at brake open (parameter [44.03 Brake open torque reference](#))

T_{mem} Stored torque value at brake close (parameter [44.02 Brake torque memory](#))

t_{md} Motor magnetization delay

T_{pv} Torque proving reference (parameter [81.02 Torque proving reference](#))

t_{od} Brake open delay (parameter [44.08 Brake open delay](#))

n_{cs} Brake close speed (parameter [44.14 Brake close level](#))

t_{ccd} Brake close command delay (parameter [44.15 Brake close level delay](#))

t_{cd} Brake close delay (parameter [44.13 Brake close delay](#))

t_{cfd} Brake close fault delay (parameter [44.18 Brake fault delay](#))

t_{rod} Brake reopen delay (parameter [44.16 Brake reopen delay](#))

t_{bscd} Brake system check time (parameter [81.03 Winch system check time](#))

t_{extmt} Extended run time (parameter [44.202 Extended runtime](#))

Note: In case of any fault, the brake will close immediately. The brake control uses relay output RO1 as default.

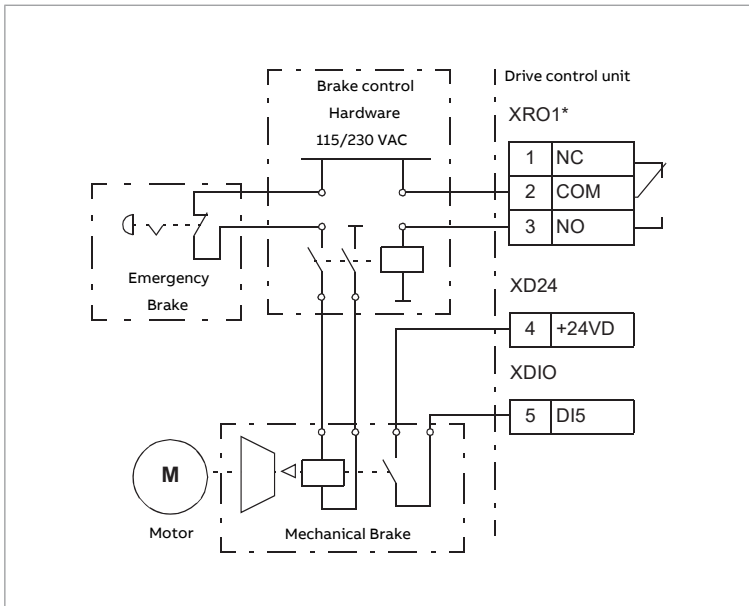
■ Wiring example

The following figure shows a brake control wiring example. The brake control hardware and wiring is acquired and installed by the customer.

WARNING! Make sure that the machinery into which the drive with brake control function is integrated fulfills the personnel safety regulations. Note that the drive (a Complete Drive Module or a Basic Drive Module, as defined in IEC 61800-2), is not considered 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 drive feature (such as the brake control function), but it has to be implemented as defined in the application-specific regulations.

The brake is controlled by a parameter [44.204 Winch brake status](#), bit 0. The source of brake acknowledge (status supervision) is selected by parameter [44.07 Brake acknowledge selection](#). In this example,

- parameter [10.24 RO1 source](#) is set to bit 0 of [44.204 Winch brake status](#), and
- parameter [44.07 Brake acknowledge selection](#) is set to [DI5](#).



Note: Parameter [10.24 RO1 source](#) must be set to bit 0 of par. [44.204 Winch brake status](#).

■ Overview of winch system check

The winch system check function consists of electrical and mechanical tests:

Electrical test – The torque proving test makes sure that the drive can produce torque before it releases the brake and starts the winch operation. That is, electrical components like the drive, motor cable and motor itself are ready to start.

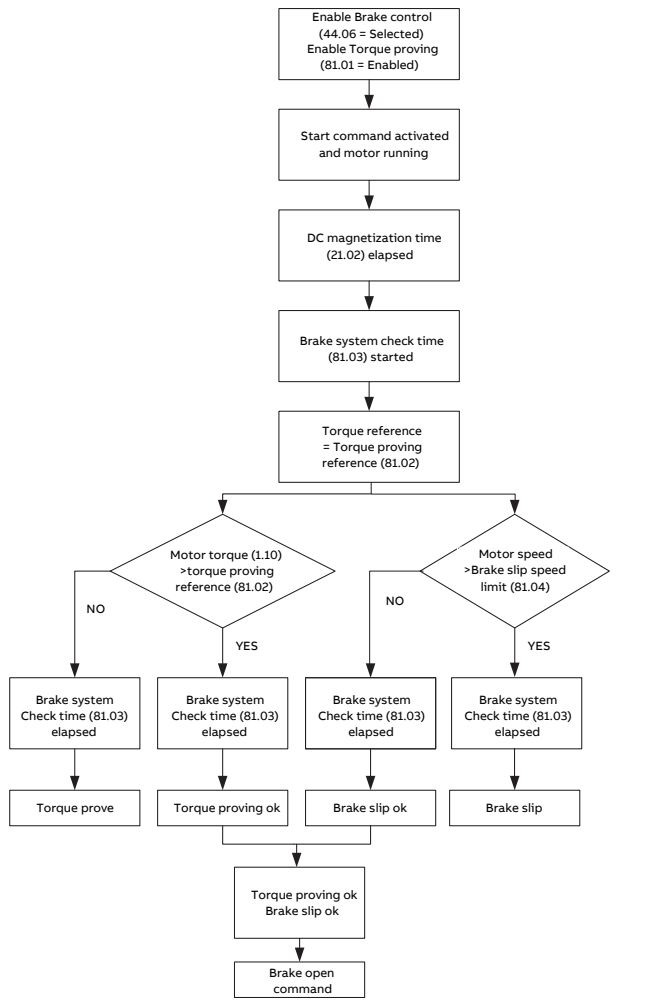
Mechanical test – Brake slip test makes sure that the motor brake is not slipping.

Both tests are completed during a user-defined check time period (parameter [81.03 Winch system check time](#)). The function is active when torque proving is enabled. In addition, brake control must be enabled and used for the function to work because the tests are completed against a closed mechanical brake. Refer parameter group [44 Mechanical brake control](#).

Note: In winch applications with open-loop motor control, the motor slip speed level (parameter [81.04 Brake slip speed limit](#)) must be high because the brake slip test is performed against a closed mechanical brake, and only estimated speed is available as an actual rpm signal.

For more detailed information on the tests, refer sections [Brake system checks – Torque proving \(page 116\)](#) and [Brake system checks – Brake slip \(page 116\)](#).

This flowchart shows the brake system check sequence.



■ Brake system checks – Torque proving

The torque proving test makes sure that the drive can produce torque before it releases the brake and starts the winch operation. This test can be activated in the drive that controls winch motions and if the drive uses encoder feedback.

Torque proving gives a positive torque reference against a closed mechanical brake. Negative torque reference is used when Anchor invert direction (par. 74.27) is active. If torque proving is successful, in other words, the actual torque of the drive reaches the reference level (81.02), the drive lets the brake open and starts the next step in the starting sequence.

Winch system check time (81.03) defines the time during which the torque reference (81.02) is active and the electrical and mechanical tests of the winch system are completed. Unsuccessful torque proving trips the drive.

Refer [Timing diagrams](#).

Settings and diagnostics

Parameters: [81.01 Torque proving enable \(page 634\)](#), [81.02 Torque proving reference \(page 634\)](#) and [81.03 Winch system check time \(page 635\)](#).

■ Brake system checks – Brake slip

The brake slip function examines the system for brake slips while the control program is performing torque proving with the brake closed. If the motor actual speed exceeds a speed limit (81.04) during a check time (81.03), and stays there for longer than a time delay (81.05), the drive trips on a fault (D103).

Refer [Timing diagrams](#).

Settings and diagnostics

Parameters: [81.03 Winch system check time \(page 635\)](#), [81.04 Brake slip speed limit \(page 635\)](#) and [81.05 Brake slip fault delay \(page 635\)](#).

Event: [D103 Motor brake slipping \(page 772\)](#).

■ Brake opening torque selection

The brake opening torque selection function ensures the right starting torque level after brake opening. This way, the function prevents the load from rolling back. The function is in operation when torque proving is complete and the brake open command is given.

The alternative sources for the brake opening torque reference are:

- Brake open torque: a fixed value defined by a parameter [44.201](#).
- Brake torque memory: a torque value that was in use when the brake was closed
- Torque reference defined by an analog input or fieldbus references.

You can select the direction of the brake opening torque with parameter [44.201](#).

Settings and diagnostics

Parameters: [44.200 Brake open torque source](#) (page 486) and [44.201 Brake open torque](#) (page 487).

■ Extended run time

The extended run time function minimizes the delay between consecutive start commands. It keeps the motor magnetized for a defined time period after the brake is closed and the brake close delay time is elapsed. During the delay period, the motor is kept magnetized (modulating), to be ready for immediate restart. Because of this action, the next start can be considerably faster by skipping certain start sequence steps, such as magnetization and torque proving.

The function works based on timer off module using the inverted signal brake closed state as input (parameter [44.01 Brake control status](#), bit 5 [Closed](#)). If the drive trips during the extended run time operation, the function timer resets.

Refer [Mechanical brake control diagram](#), to see the operation of the extended run time function.

Note: The extended run time function is available only in DTC motor control mode when the drive is in remote mode.



WARNING!

Make sure the motor is capable of absorbing or dissipating the thermal energy generated by continuous magnetization, for example by forced ventilation.

Settings and diagnostics

Parameters: [44.01 Brake control status](#) (page 481), [44.202 Extended runtime](#) (page 487), and [44.203 Extended runtime sw](#) (page 487).

Supervision logic

■ Speed matching

Speed match function matches the motor speed reference with the load speed (considering the gear ratio) to ensure that all mechanical parts are healthy and working correctly.

The motor speed reference is divided by the gear ratio and it is continuously compared with the load speed measured with an encoder or proximity switches. There are two different parameters for defining the speed matching deviation, one during acceleration/deceleration and the other during a steady state.

Parameter [74.51 Speed steady deviation level](#) is used for checking the speed deviation when the motor is running in a steady state. Parameter [74.52 Speed ramp deviation level](#) is used for checking the speed deviation during acceleration and deceleration. If the deviation is more than the value of parameter [74.51 Speed steady deviation level](#) (during steady state) or [74.52 Speed ramp deviation level](#) (during ramping) for a delay of parameter [74.54 Speed match action delay](#), the drive generates either a fault or a warning based on the selection in parameter [74.53 Speed match action](#).

You can select the source of the load speed with parameters [74.11 Chain length source](#) and [90.51 Load feedback selection](#).

Settings and diagnostics

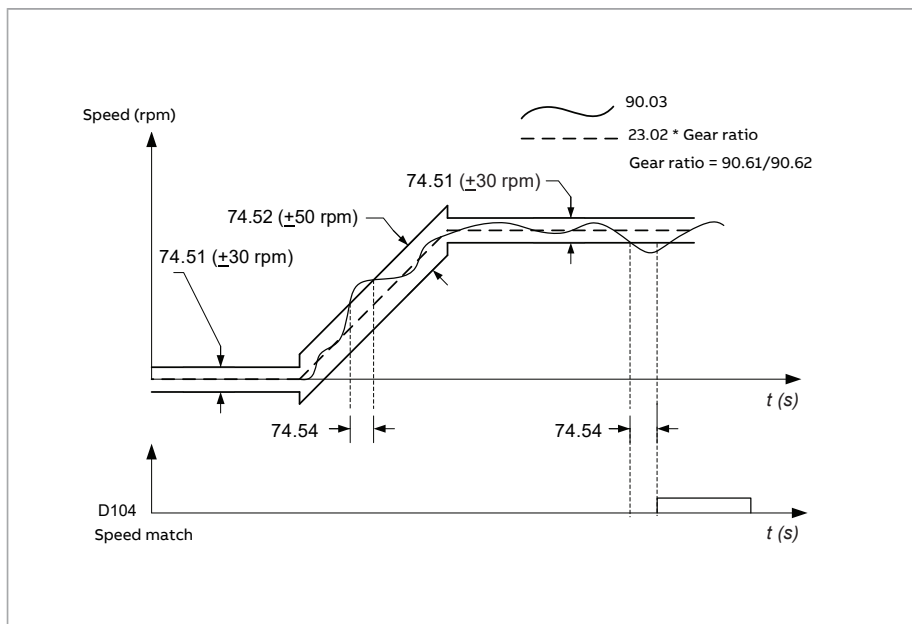
Parameters: [74.11 Chain length source](#) (page 578), [74.50 Speed match enable](#) (page 583), [74.51 Speed steady deviation level](#) (page 583), [74.52 Speed ramp deviation level](#) (page 584), [74.53 Speed match action](#) (page 584), [74.54 Speed match action delay](#) (page 584) and [90.51 Load feedback selection](#) (page 649).

Diagnostics

Signals	Description
Actual signals	
90.03 Load speed	Load speed in rpm
Faults/Warnings (alarms)	
Speed match	The load speed error is higher than as defined in parameter 74.51 Speed steady deviation level in steady state or parameter 74.52 Speed ramp deviation level during ramping for longer than the delay (parameter 74.54 Speed match action delay).

Timing diagrams

A timing diagram for fault **D104 Speed match** or warning **D20C Speed match** is shown below.



Settings and diagnostics

Parameter group: **74 Winch general** (page 573)

Motor encoder support

When encoder mounted on load drum is used for implementing speed match protection, set parameters **74.10 Chain length calc enable** to **Enabled**, **74.11 Chain length source** to **Load position scaled** and select the appropriate selection in parameter **90.51 Load feedback selection**. The load speed displayed in parameter **90.03 Load speed** is used for speed match comparison.

Proximity switch

When proximity switch mounted on load drum is used for implementing speed match protection, set parameters **74.10 Chain length calc enable** to **Enabled**, **74.11 Chain length source** to **Proximity switch position scaled** and set parameters **90.205 Proximity switch mode** to **90.208 Pulses per drum revolution** to appropriate values. The load speed displayed in parameter **90.202 Motor speed filter time** is used for speed match comparison.

■ Inverter overload detection

The Inverter overload detection function makes sure that the inverter is capable of providing sufficient current and torque and that the drive is operating within the defined inverter current and torque limits. The function is meant for both motor and generator modes depending on the configuration.

To make sure that the inverter current and torque limits are not exceeded, the function monitors the corresponding status bits. The function is in operation while the motor is in the motoring or generating mode and generating more than 10% of the motor nominal power and running at an actual speed greater than 5% of the motor synchronous speed. If the limits are exceeded in this condition, and a time delay (31.204) elapses, the drive trips on a fault (D106 Inverter overload) and closes the brake for safety reasons.

The function monitors the following inverter current and torque limit status bits in parameter 30.02 Torque limit status:

- Bit 2 Minimum torque
- Bit 3 Maximum torque
- Bit 4 Internal current
- Bit 5 Load angle
- Bit 6 Motor pullout.

To activate the status bit monitoring, you need to select the above-mentioned bits with the corresponding bits of parameter 31.202 Inverter overload selection. You can also select to monitor an additional bit of your own selection (31.203).

Settings and diagnostics

Parameters: 31.202 Inverter overload selection (page 438), 31.203 User limit bit selection (page 438) and 31.204 Inverter overload delay (page 439).

Signal: 30.02 Torque limit status (page 416).

Event: D106 Inverter overload (page 772).

■ Gear ratio

The speed reference ramped (parameter 23.02 Speed ref ramp output) is scaled to the load speed by using the gear ratio numerator and gear ratio denominator entered in parameters 90.61 Gear numerator and 90.62 Gear denominator.

$$\text{Load speed estimate} = \frac{90.61 \text{ Gear numerator}}{90.62 \text{ Gear denominator}} \times 23.02 \text{ Speed ref ramp output}$$

The load speed estimate calculated is then compared with the actual load speed measured with the help of an absolute encoder mounted on the load drum. For further information on gear ratio and scaling, refer chapter Standard program features, section Position counter.

Settings and diagnostics

Parameters: [23.02 Speed ref ramp output \(page 369\)](#), [90.61 Gear numerator \(page 651\)](#) and [90.62 Gear denominator \(page 651\)](#).

Miscellaneous

■ Power on acknowledgment

The power on acknowledgement function checks that the main power is connected and the drive is ready for operation. You can use this function, for example, to automatically reset faults that are generated when drive is in standby.

The source to the power on acknowledgement signal (par. [20.200](#)) can be from the following sources:

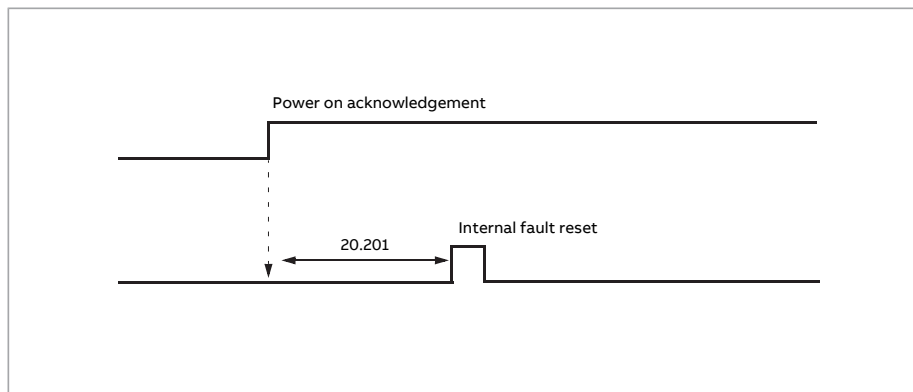
- typically from the auxiliary contact of the main contactor. By default, the signal is connected to the DIIL input of the drive control unit. This is the default connection.

or

- from the Safe torque off (STO), parameter [06.18 Start inhibit status word](#), bit 7 inverted.

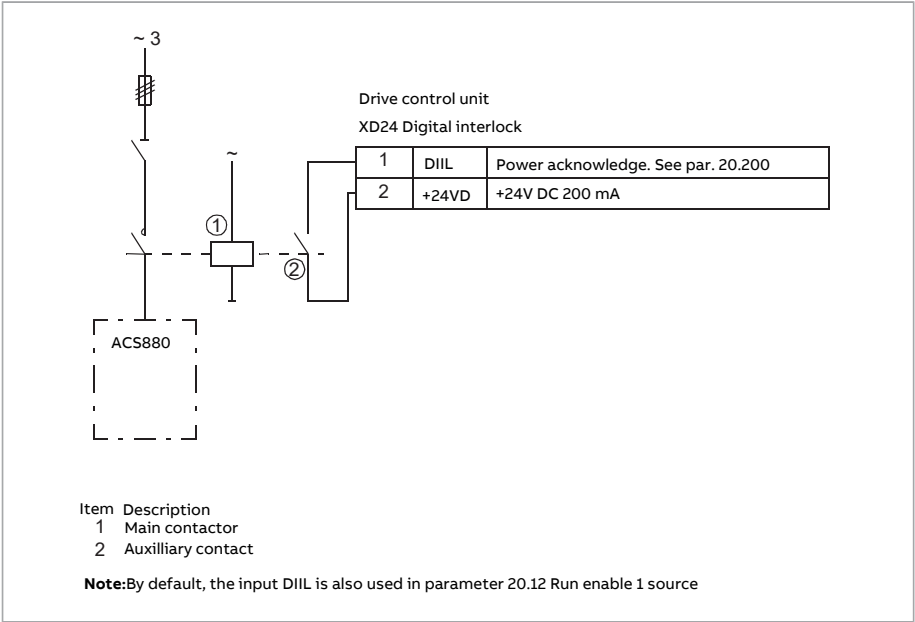
If the drive trips on a fault, and the power on acknowledgment signal is activated (a rising edge), the drive generates one internal fault reset after a time delay ([20.201 Power on ackn reset delay](#)).

Timing diagram

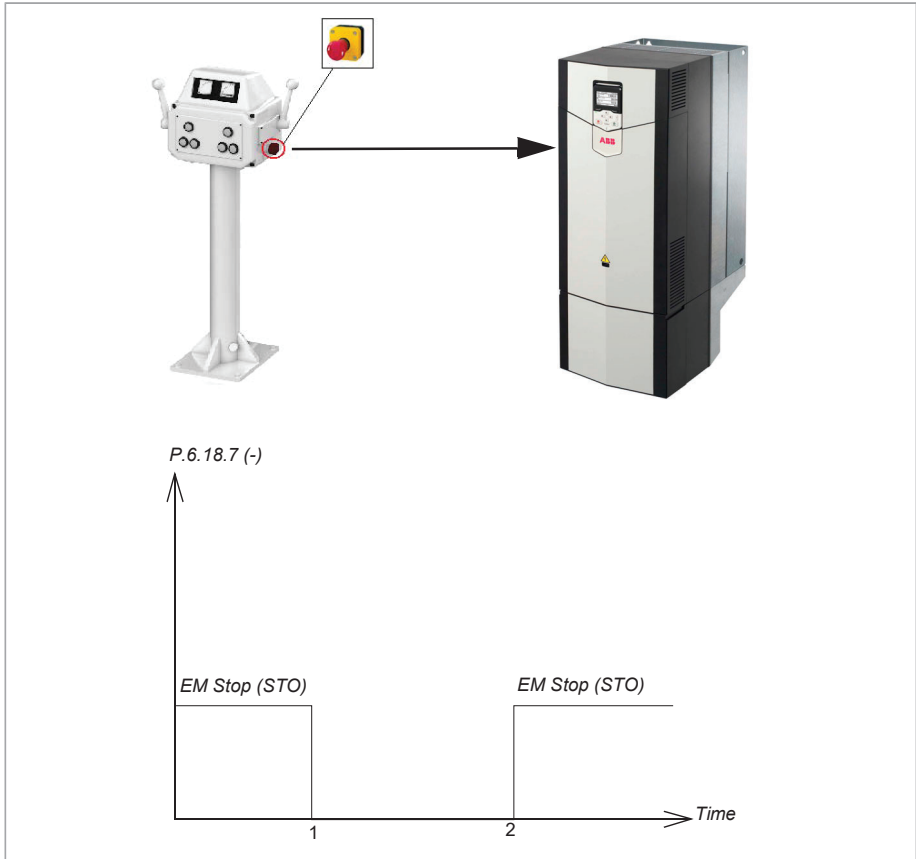


Note: The same input [DIIL or STO status (P.6.18.7)] for Power on acknowledge (par. [20.200](#)) is also used for RUN ENABLE (parameter [20.12 Run enable 1 source](#)).

Wiring example



Example: Overview of emergency stop and fault reset

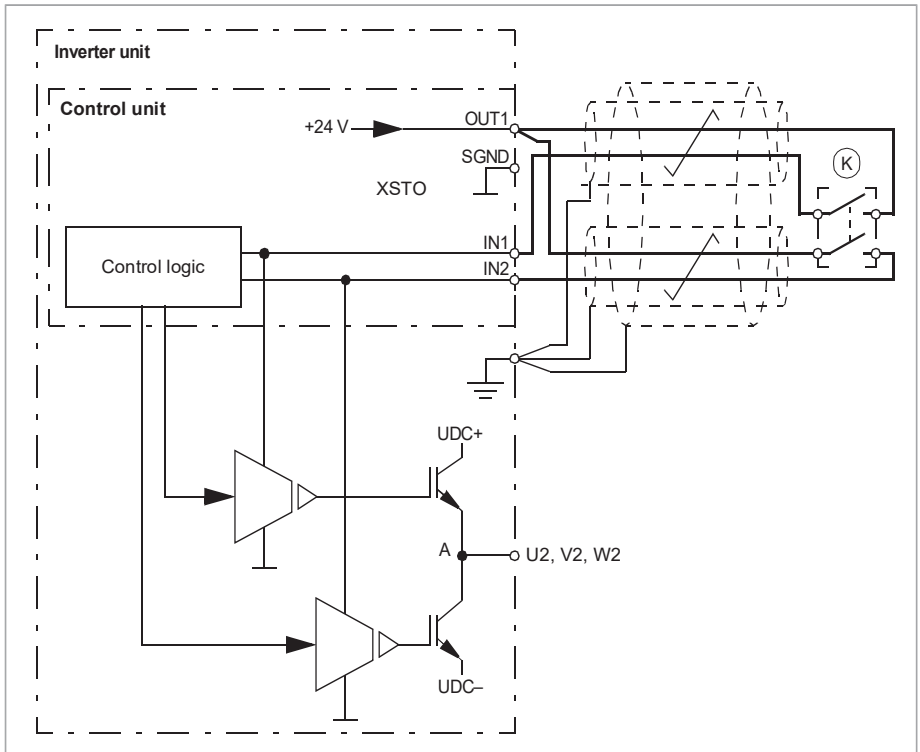


¹ EM Stop (STO) triggered and the mechanical brake is closed.

² When EM Stop is back to normal condition. You can generate fault reset through parameter [20.200 Power on acknowledge](#) to P.6.18.7 (-).

Note: If a wireless control stand is used over the fieldbus, the emergency stop button is used to reset. Send a reset command on the rising edge of the EM Stop (return to normal position) of the wireless controller to [09.09 Winch FB control word](#), bit5 - [FB control stand fault reset](#).

For detailed information of bits, refer parameter [09.09 Winch FB control word](#).

Example: Winch control stand emergency stop wired to STO input

Where K = Emergency stop

The STO ON_OFF bits can be internally fault reset. Set parameter [20.200 Power on acknowledge](#) to P.6.18.7 (-).

Settings and diagnostics

Parameters: [20.12 Run enable 1 source](#) (page 343), [20.200 Power on acknowledge](#) (page 347), [20.201 Power on ackn reset delay](#) (page 348), and [09.01 Winch status word 1](#) (page 254).

Winch system ID-run

The winch system ID run is an advanced feature to identify tension inaccuracies like inertia and dynamic friction in the rope and compensates for these in the rope tension signal.

Note: The winch system ID run is not replacing the standard motor ID run. The motor ID run in group [99 Motor data](#) has to be performed to set up the motor.

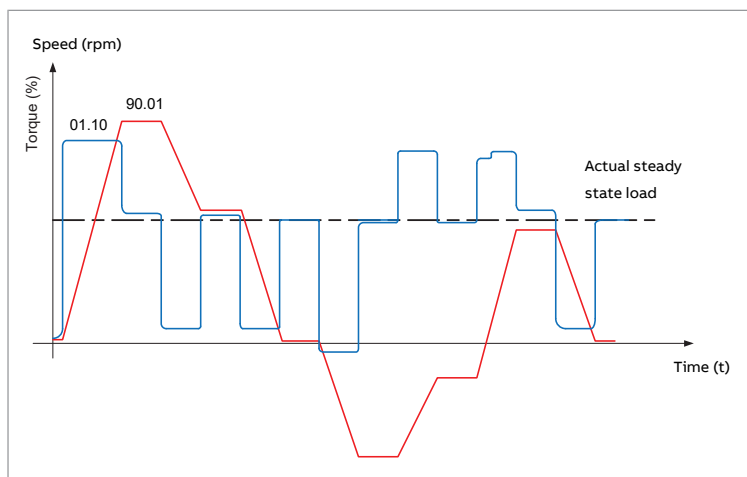
■ Tension inaccuracies

The tension inaccuracies can be found while operating the winch system without an external load cell sensor. The estimated torque in the drive is commonly used for representing the tension in the rope.

The following are the few sources of inaccuracy:

- Inertia of motor rotor, gearbox and shaft - The inertia of these components are not insignificant, especially when doing quick accelerations and decelerations. The effect will be higher torque during acceleration and a lower torque during deceleration. With one to three seconds ramp time, the effect can be 20 to 50% of the motor nominal torque.
- Dynamic friction of motor rotor, gearbox and shaft - When running at a constant speed, the system requires torque to maintain a constant speed. This torque depends on the speed. When tightening the rope, the drive has to generate a torque to overcome the dynamic friction as well as torque to tighten the rope. Therefore, the drive will estimate a too high tension in the rope. When loosening the rope, the tension in the rope has to overcome the dynamic friction. Therefore, the drive will estimate a too low tension in the rope.

The figure below shows some of the inaccuracies that appear during the winch operation.



The parameters [01.10 Motor torque](#) and [90.01 Motor speed for control](#) shows the motor torque in percent of nominal torque and estimated motor speed used for motor control.

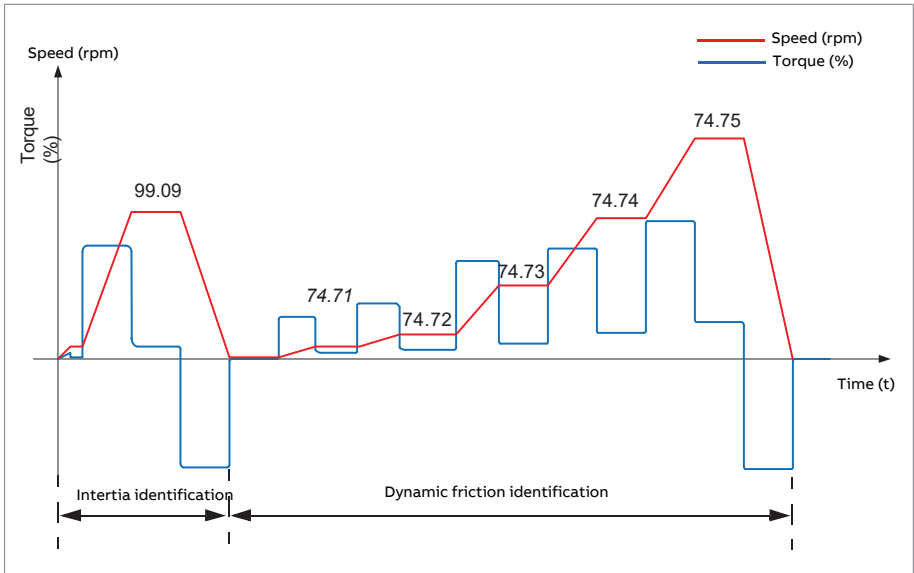
Settings and diagnostics

Signals: [01.10 Motor torque](#) (page 212) and [90.01 Motor speed for control](#) (page 643).

■ Winch system ID run sequence

The winch system ID run sequence identifies the inertia and dynamic friction components. The compensated rope tension is displayed in signals [09.23 Rope actual tension](#) and [09.24 Rope tension memorized](#).

The figure below shows the winch system ID run sequence with actual speed and actual torque.



The following steps describe how to perform the winch system ID run:

☐	Configure motor data parameters with parameter group 99 Motor data and perform motor ID run.
☐	Configure winch mode parameters and set the mode maximum speed in group 74 Winch general . Note: The maximum speed in group 30 Limits must be set to highest of any of the mode maximum speed.
☐	Enable Handmooring mode (and other winch modes) with parameter 74.02 Handmooring mode enable .
☐	Define if both inertia and dynamic friction can be identified or any one value with parameter 74.61 Winch system ID-run configuration .
☐	Set parameter 74.60 Winch system ID-run enable to At next start . The warning D20E Winch system ID run active is displayed.
☐	Activate forward start command and keep it active until the ID run procedure is completed. The logic executes a sequence as shown in the Winch system ID run sequence figure. Note: The winch system ID run can be aborted at any point by removing the start command. To enable, set parameter 74.60 Winch system ID-run enable to Done and then set to At next start . Make sure the warning D20E Winch system ID run active is displayed.

After the winch system ID run is completed, the drive stops and displays a warning [D20F Winch system ID run done](#). The parameter [74.60 Winch system ID-run enable](#) will revert to [Done](#) automatically. You can remove the start command after the ID run procedure is completed.

The following parameters are updated as a result of ID run. The resulting values can be manually edited to tune the system.

- Parameter [74.65 Winch system inertia](#) shows the calculated inertia value.
- Parameters [74.66 Winch system speed 1 torque](#) to [74.70 Winch system speed 5 torque](#) show the actual torque values logged at corresponding speeds defined with parameters [74.71...74.75](#).

Note: It is recommended to run the winch system ID run by decoupling the drum or without attaching the rope to the drum. The system does not know the amount of rope on the drum while in normal operation.

Settings and diagnostics

Parameter groups: [30 Limits \(page 415\)](#), [74 Winch general \(page 573\)](#) and [99 Motor data \(page 705\)](#).

Signals: [09.23 Rope actual tension \(page 260\)](#) and [09.24 Rope tension memorized \(page 260\)](#).

Events: [D20E Winch system ID run active \(page 772\)](#) and [D20F Winch system ID run done \(page 772\)](#).

■ Compensated rope tension signals

The compensated rope tension value is shown in signals [09.23 Rope actual tension](#) and [09.24 Rope tension memorized](#). You can select both inertia and dynamic friction or any one value with rope tension configuration parameter [74.62 Rope tension configuration](#).

Settings and diagnostics

Parameter groups: [09 Winch actual signals \(page 254\)](#) and [74 Winch general \(page 573\)](#).

Signals: [09.23 Rope actual tension \(page 260\)](#) and [09.24 Rope tension memorized \(page 260\)](#).

■ Advanced fine-tuning

Note: Adjusting and filtering the speed rate change deadband is rarely required if the compensated rope signal is used only for displaying in a meter on the control stand. However, the compensated rope signal can be used with the Power control (group [80 Power control](#)) functionality. It is required to adjust these settings to minimize possible oscillation.

You can fine-tune the inertia component by compensating rope tension by following the procedure:

☐	Perform the winch system ID run. Refer Winch system ID run sequence .
☐	Enable parameter 74.62 Rope tension configuration , bit 0 and disable bit 1.
☐	Monitor the following signals in the Drive Composer tool: • 01.10 Motor torque • 09.23 Rope actual tension and 09.24 Rope tension memorized • 90.01 Motor speed for control
☐	Start the drive and accelerate to full speed. Stop the drive after it runs for few seconds in steady state at full speed. • If the inertia value is close to correct then in average the value of signal 09.23 Rope actual tension will remain at the same level as during the steady state value during acceleration and deceleration. The signal 01.10 Motor torque will have more fluctuations. • If the value of signal 09.24 Rope tension memorized in average remains above that during the steady state, reduce the inertia value with parameter 74.65 Winch system inertia. • If the value of signal 09.24 Rope tension memorized in average clearly remains above that during the steady state, reduce the inertia value with 74.65 Winch system inertia. For example, if the initial estimated value is 1.65 kgm², then first change the value to 1.60 kgm² and then to 1.55 kgm². Repeat the acceleration/steady state/deceleration sequence and evaluate the result. If the results are not matching, then increase the value with parameter 74.65 Winch system inertia.
☐	Check the behavior when running in reverse direction.
☐	If there are significant and distracting spikes in the compensated tension signals 09.23 Rope actual tension and 09.24 Rope tension memorized at the beginning and the end of acceleration/deceleration states, then: Enter the pass code 584 in parameter 96.02 Pass code to open the long parameter view with additional parameters.
☐	Parameter 74.63 Rope tension filter number can be increased to filter the compensated tension signal. Note: The higher filtering will increase the delay in the signal to actual rise/lowering of the rope tension.
☐	Parameter 74.64 Speed change rate deadband can be reduced to react quicker to change in the signal 90.01 Motor speed for control. If the change in 90.01 Motor speed for control is less than the value in 74.64 Speed change rate deadband during a 40 ms time interval, the inertia component is not compensated.
☐	Enter 1 in parameter 96.02 Pass code to return to the short parameter view.

Settings and diagnostics

Parameter groups: [01 Actual values \(page 212\)](#), [30 Limits \(page 415\)](#), [74 Winch general \(page 573\)](#), [80 Power control \(page 629\)](#), [96 System \(page 684\)](#) and [99 Motor data \(page 705\)](#).

Signals: [09.23 Rope actual tension \(page 260\)](#) and [09.24 Rope tension memorized \(page 260\)](#).

5

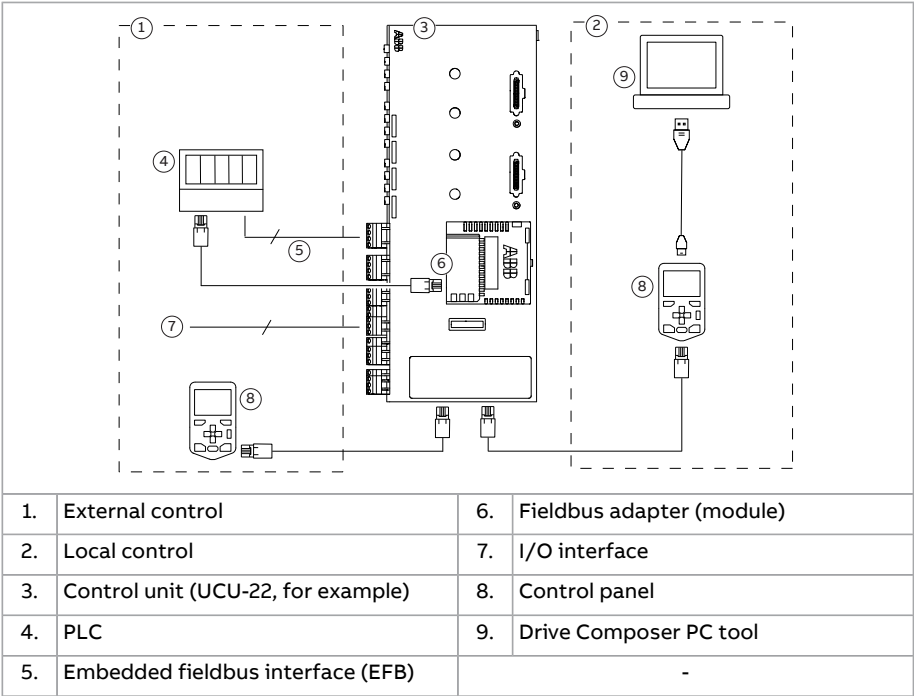
Control locations and operating modes

What this chapter contains

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

Local control vs. external control

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



■ Local control

The control commands are given from the control panel keypad or from a PC equipped with Drive Composer when the drive is 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 drive-to-drive link interface, and
- 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.

The panel reference is saved whenever another reference source is selected. If the reference source selection parameter is set to [Control panel \(ref saved\)](#), the saved value is used as the initial reference when control switches back to the panel. Note that only one type of reference can be saved at a time: for example, attempting to use the same saved reference with different operating modes (speed, torque, etc.) causes the drive to trip on [7083](#). The panel reference can be separately limited by parameters in group [49](#).

With the reference source selection parameter set to [Control panel \(ref copied\)](#), the initial panel reference value depends on whether the operating mode changes with the reference source. If the source switches to the panel and the operating mode does not change, the last reference from the previous source is adopted. If the operating mode changes, the drive actual value corresponding to the new mode is adopted as the initial value.

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.

■ Torque control mode

Motor torque follows a torque reference given to the drive. Torque control is possible without feedback, but is much more dynamic and accurate when used in conjunction with a feedback device such as an encoder or a resolver. It is recommended that a feedback device is used in crane, winch or lift control situations.

Torque control mode is available in DTC motor control mode for both local and external control locations.

■ Frequency control mode

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

■ Special control modes

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

- Emergency stop modes Off1 and Off3: Drive stops along the defined deceleration ramp and drive modulation stops.
 - Jogging mode: Drive starts and accelerates to the defined speed when the jogging signal is activated. For more information, refer section [Jogging \(page 167\)](#).
-

6

Standard program features

What this chapter contains

This chapter describes

- some of the more important functions in the control program that are not specific to winch applications, such as motor control.

Cyber security

■ 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 \(page 24\)](#).

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, 10 000 000, 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.
- 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 \(page 685\)](#) and [96.100 Change user pass code...96.102 User lock functionality \(page 694\)](#).

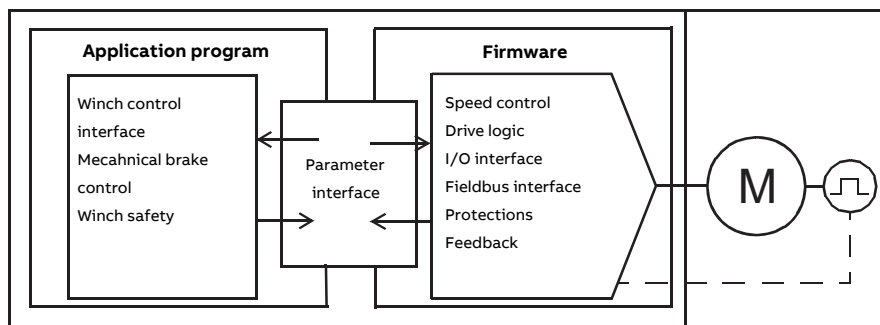
Events: [A6B0 User lock open \(page 772\)](#).

Drive configuration and programming

The drive control program is divided into two parts:

- firmware program
- application program

Winch control 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.

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 \(page 252\)](#) and [96.70 Disable adaptive program \(page 694\)](#).

Events: [64A6 Adaptive program \(page 772\)](#).

■ 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 \(page 280\)](#).

■ 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.

Settings and diagnostics

Parameter group: [13 Standard AO \(page 286\)](#).

■ 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.

Note: With UCU-20 control units, terminal XD24 can be used as DIIL/DIO3.

One digital input (DI6) doubles as a PTC thermistor input. Refer section [Motor thermal protection \(page 185\)](#).

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 \(page 264\)](#) and [11 Standard DIO, FI, FO \(page 273\)](#).

■ 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 \(page 264\)](#).

■ 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.

Note: With UCU-20 control units, terminal XD24 pin can be used as DIIL/DIO3.

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 292), 15 I/O extension module 2 (page 320) and 16 I/O extension module 3 (page 326).

Parameter: 60.41 Extension adapter com port (page 544).

Events: 7082 Ext I/O comm loss (page 772) and A799 Ext I/O comm loss (page 772).

■ Fieldbus control

The drive can be connected to several different automation systems through its fieldbus interfaces. Refer 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 504), 51 FBA A settings (page 514), 52 FBA A data in (page 516), 53 FBA A data out (page 517), 54 FBA B settings (page 519), 55 FBA B data in (page 521), 56 FBA B data out (page 522) and 58 Embedded fieldbus (page 523).

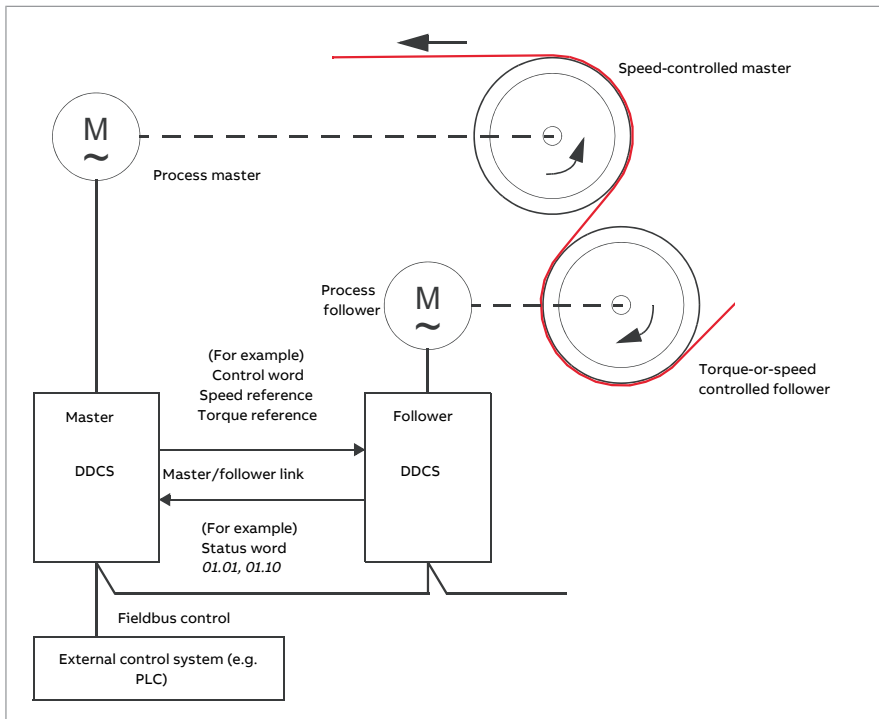
Events: 7510 FBA A communication (page 772), 7520 FBA B communication (page 772), A7C1 FBA A communication (page 772), A7C2 FBA B communication (page 772) and A7CE EFB comm loss (page 772).

■ Master/follower functionality

General

The master/follower functionality can be used to link several drives together so that the load can be evenly distributed between the drives. This is ideal in applications where the motors are coupled to each other via gearing, chain, belt, etc.

The external control signals are typically connected to one drive only which acts as the master. The master controls up to 10 followers by sending broadcast messages over an electrical cable or fiber optic link. The master can read feedback signals from up to 3 selected followers.



The master drive is typically speed-controlled and the other drives follow its torque or speed reference. In general, a follower should be

- torque-controlled when the motor shafts of the master and the follower are rigidly coupled by gearing, chain etc. so that no speed difference between the drives is possible.
- speed-controlled when the motor shafts of the master and the follower are flexibly coupled so that a slight speed difference is possible. When both the master and the follower are speed-controlled, drooping is also typically used (see parameter 25.08). The distribution of load between the master and follower can alternatively be adjusted as described under [Load share function with a speed-controlled follower](#) below.

Note: With a speed-controlled follower (without load sharing), pay attention to the acceleration and deceleration ramp times of the follower. If the ramp times are set longer than in the master, the follower will follow its own acceleration/deceleration ramp times rather than those from the master. In general, it is recommended to set identical ramp times in both the master and the follower(s). Any ramp shape settings (see parameters 23.16...23.19) should only be applied in the master.

In some applications, both speed control and torque control of the follower are required. In those cases, the operating mode can be switched by parameter (19.12 or 19.14). Another method is to set one external control location to speed control mode, the other to torque control mode. Then, a digital input of the follower can be used to switch between the control locations.

With torque control, follower parameter 26.15 can be used to scale the incoming torque reference for optimal load sharing between the master and the follower. Some torque-controlled follower applications, eg. where the torque is very low, or very low speed operation is required, may require encoder feedback.

If a drive needs to quickly switch between master and follower statuses, one user parameter set (see page 198) can be saved with the master settings, another with the follower settings. The suitable settings can then be activated using for example, digital inputs.

Load share function with a speed-controlled follower

Load sharing between the master and a speed-controlled follower can be used in various applications. The load share function is implemented by fine-tuning the follower speed reference with an additional trim signal based on a torque reference. The torque reference is selected by parameter 23.42 (by default, reference 2 received from the master). Load share is adjusted by parameter 26.15 and activated by the source selected by 23.40. Parameter 23.41 provides a gain adjustment for the speed correction. The final correction signal added to the speed reference is shown by 23.39. See the block diagram on page 825.

Note:

- The function can be enabled only when the drive is a speed-controlled follower in remote control mode.
- Drooping (25.08) is ignored when the load share function is active.
- The master and follower should have the same speed control tuning values.
- The speed correction term is limited by the speed error window parameters 24.44 and 24.43. An active limitation is indicated by 06.19.

Communication

A master/follower link can be built by connecting the drives together with fiber optic cables (may require additional equipment depending on existing drive hardware), or by wiring together the XD2D connectors of the drives. The medium is selected by parameter 60.01.

Parameter 60.03 defines whether the drive is the master or a follower on the communication link. Typically, the speed-controlled process master drive is also configured as the master in the communication.

The communication on the master/follower link is based on the DDCS protocol, which employs data sets (specifically, data set 41). One data set contains three 16-bit words. The contents of the data set are freely configurable using parameters 61.01...61.03. The data set broadcast by the master typically contains the control word, speed reference and torque reference, while the followers return a status word with two actual values.

The default setting of parameter 61.01 is **Follower CW**. With this setting in the master, a word consisting of bits 0...11 of 06.01 and four bits selected by parameters 06.45...06.48 is broadcast to the followers. However, bit 3 of the follower control word is modified so that it remains on as long as the master is modulating, and its switching to 0 causes the follower to coast to a stop. This is to synchronize the stopping of both master and follower.

Note: When the master is ramping down to a stop, the follower observes the decreasing reference but receives no stop command until the master stops modulating and clears bit 3 of the follower control word. Because of this, the maximum and minimum speed limits on the follower drive should not have the same sign – otherwise the follower would be pushing against the limit until the master finally stops.

Three words of additional data can optionally be read from each follower. The followers from which data is read are selected by parameter 60.14 in the master. In each follower drive, the data to be sent is selected by parameters 61.01...61.03. The data is transferred in integer format over the link, and displayed by parameters 62.28...62.36 in the master. The data can then be forwarded to other parameters using 62.04...62.12.

To indicate faults in the followers, each follower must be configured to transmit its status word as one of the above-mentioned data words. In the master, the corresponding target parameter must be set to **Follower SW**. The action to be taken when a follower is faulted is selected by parameter 60.17. External events (see parameter group 31 **Fault functions**) can be used to indicate the status of other bits of the status word.

For block diagrams of the master/follower communication are presented on pages 837 and 838.

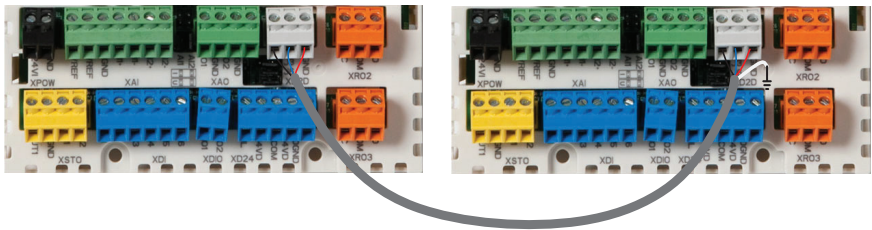
Construction of the master/follower link

The master/follower link is formed by connecting the drives together using either

- shielded twisted-pair cable between the XD2D terminals of the drives*, or
- fiber optic cables. Drives with a ZCU control unit require an additional FDCO DDCS communication module; drives with a BCU control unit require an RDCO or FDCO module.

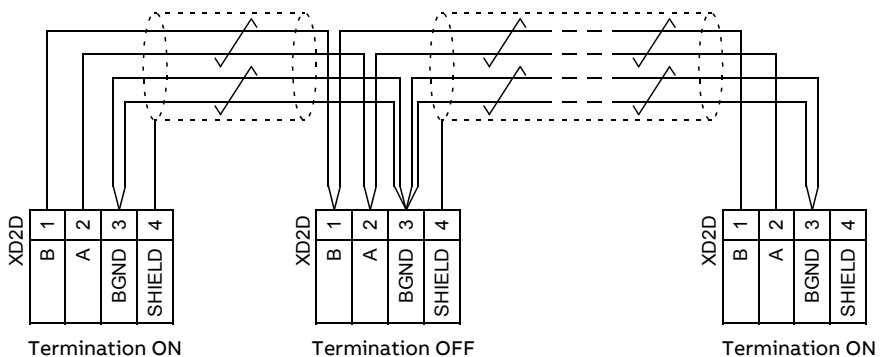
*This connection cannot co-exist with, and is not to be confused with, drive-to-drive (D2D) communication implemented by application programming (detailed in *Drive application programming manual (IEC 61131-3)*, 3AUA0000127808 [English]).

The figure below shows the connections between two ZCU control units.



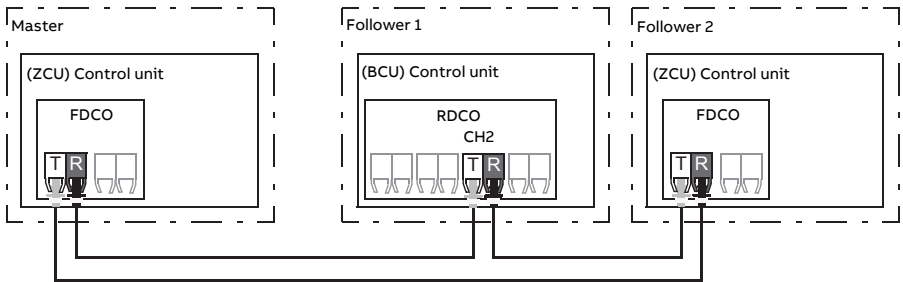
Connection examples are shown below. Note that a star configuration using fiber optic cables requires an NDBU-95C DDCS branching unit.

Master/follower wiring with electrical cable



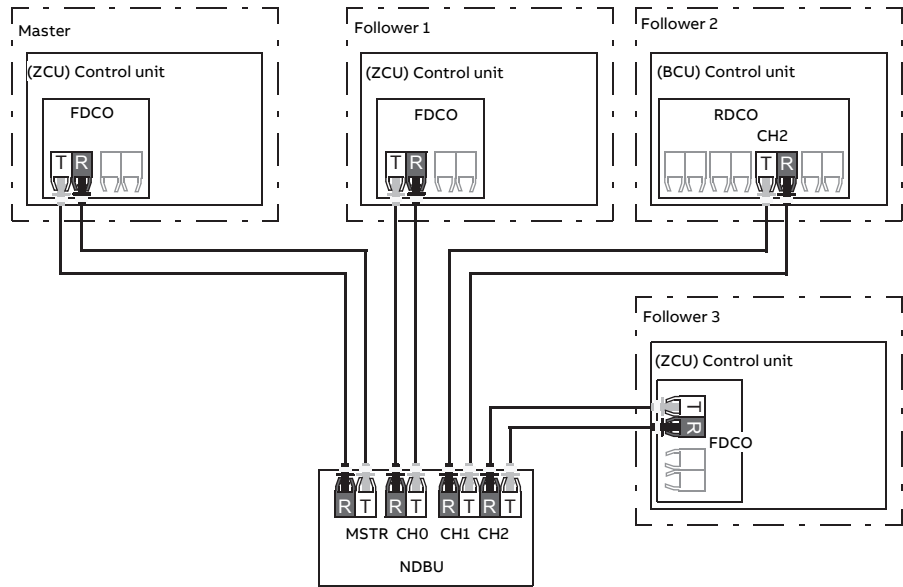
See the hardware manual of the drive for wiring and termination details.

Ring configuration with fiber optic cables



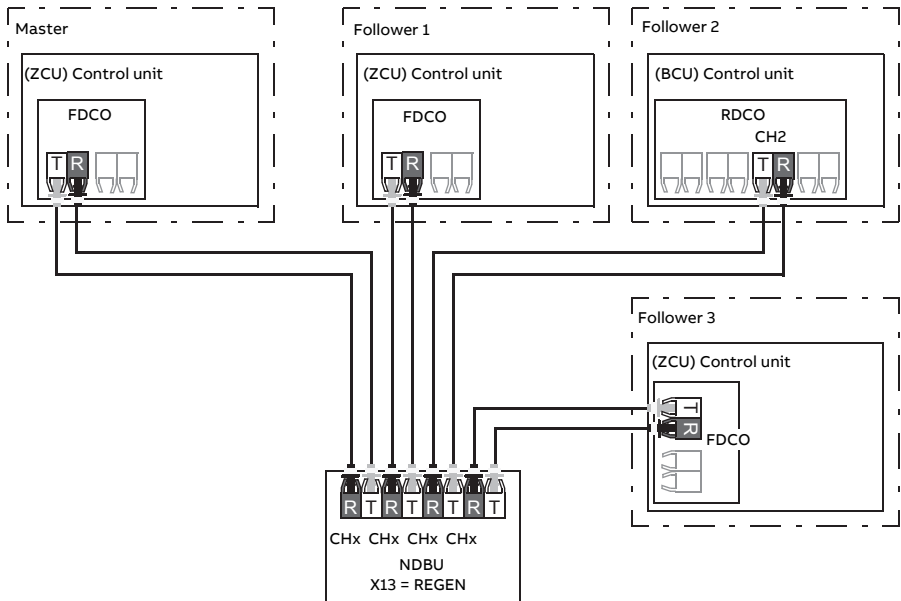
Where, T = Transmitter; R = Receiver

Star configuration with fiber optic cables (1)



Where, T = Transmitter; R = Receiver

Star configuration with fiber optic cables (2)



Where, T = Transmitter; R = Receiver

Example parameter settings

The following is a checklist of parameters that need to be set when configuring the master/follower link. In this example, the master broadcasts the Follower control word, a speed reference and a torque reference. The follower returns a status word and two actual values (this is not compulsory but is shown for clarity).

Master settings

- **Master/follower link activation**
 - 60.01 M/F communication port (fiber optic channel or XD2D selection)
 - (60.02 M/F node address = 1)
 - 60.03 M/F mode = *DDCS master* (for both fiber optic and wire connection)
 - 60.05 M/F HW connection (*Ring* or *Star* for fiber optic, *Star* for wire)
- **Data to be broadcast to the followers**
 - 61.01 M/F data 1 selection = *Follower CW* (Follower control word)
 - 61.02 M/F data 2 selection = *Used speed reference*
 - 61.03 M/F data 3 selection = *Torque reference act 5*
- **Data to be read from the followers (optional)**
 - 60.14 M/F follower selection (selection of followers that data is read from)

- [62.04 Follower node 2 data 1 sel ... 62.12 Follower node 4 data 3 sel](#)
(mapping of data received from followers)

Follower settings

- **Master/follower link activation**
 - [60.01 M/F communication port](#) (fiber optic channel or XD2D selection)
 - [60.02 M/F node address](#) = 2...60
 - [60.03 M/F mode](#) = *DDCS follower* (for both fiber optic and wire connection)
 - [60.05 M/F HW connection](#) (*Ring* or *Star* for fiber optic, *Star* for wire)
- **Mapping of data received from master**
 - [62.01 M/F data 1 selection](#) = *CW 16bit*
 - [62.02 M/F data 2 selection](#) = *Ref1 16bit*
 - [62.03 M/F data 3 selection](#) = *Ref2 16bit*
- **Selection of operating mode and control location**
 - [19.12 Ext1 control mode](#) = *Speed* or *Torque*
 - [20.01 Ext1 commands](#) = *M/F link*
 - [20.02 Ext1 start trigger type](#) = *Level*
- **Selection of reference sources**
 - [22.11 Speed ref1 source](#) = *M/F reference 1*
 - [26.11 Torque ref1 source](#) = *M/F reference 2*
- **Selection of data to be sent to master (optional)**
 - [61.01 M/F data 1 selection](#) = *SW 16bit*
 - [61.02 M/F data 2 selection](#) = *Act1 16bit*
 - [61.03 M/F data 3 selection](#) = *Act2 16bit*

Specifications of the fiber optic master/follower link

- Maximum fiber optic cable length:
 - FDCO-01/02 or RDCO-04 with POF (Plastic Optic Fiber): 30 m
 - For distances up to 1000 m, use two NOCR-01 optical converter/repeaters with glass optic cable (GOF, 62.5 micrometers, Multi-Mode)
- Maximum shielded twisted-pair cable length: 50 m
- Transmission rate: 4 Mbit/s
- Total performance of the link: < 5 ms to transfer references between the master and followers.
- Protocol: DDCS (Distributed Drives Communication System)

Settings and diagnostics

Parameter groups: [60 DDCS communication](#) (page 533), [61 D2D and DDCS transmit data](#) (page 557) and [62 D2D and DDCS receive data](#) (page 562).

Events: [7582 M/F comm loss](#) (page 772) and [A7CB M/F comm loss](#) (page 772).

■ External ABB controller interface

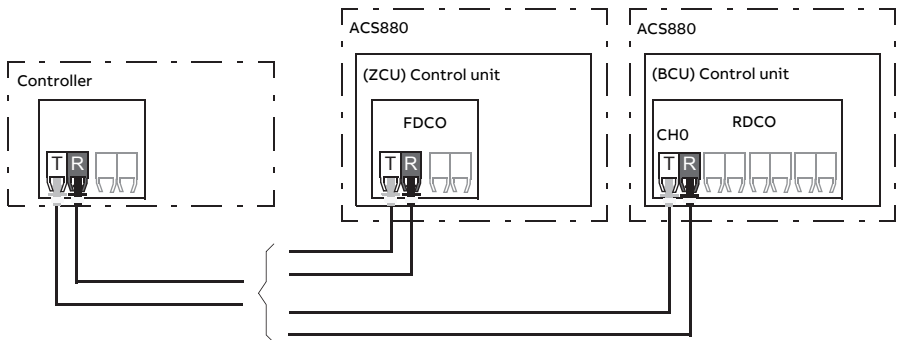
General

The drive can be connected to an external controller (such as the ABB AC 800M) using either fiber optic or twisted-pair cable. The ACS880 is compatible with both the ModuleBus and DriveBus connections. Note that some features of DriveBus (such as BusManager) are not supported.

Topology

An example connection with either a ZCU-based or BCU-based drive using fiber optic cables is shown below.

Drives with a ZCU control unit require an additional FDCO DDCS communication module; drives with a BCU control unit require an RDCO or FDCO module. The BCU has a dedicated slot for the RDCO – an FDCO module can also be used with a BCU control unit but it will reserve one of the three universal option module slots. Ring and star configurations are also possible much in the same way as with the master/follower link (refer section [Master/follower functionality \(page 141\)](#)); the notable difference is that the external controller connects to channel CH0 on the RDCO module instead of CH2. The channel on the FDCO communication module can be freely selected.



T = Transmitter, R = Receiver

The external controller can also be wired to the D2D (RS-485) connector using shielded, twisted-pair cable. The selection of the connection is made by parameter [60.51](#).

The transfer rate can be selected by parameter [60.56](#).

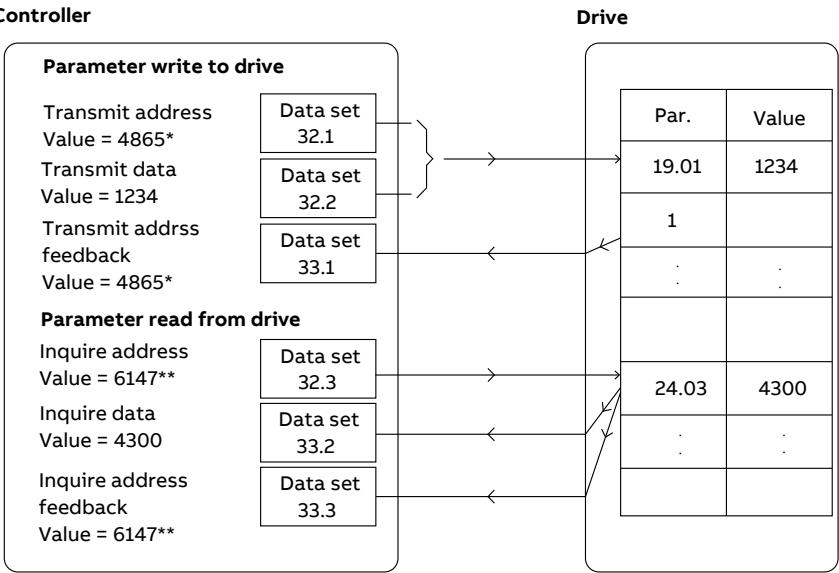
Communication

The communication between the controller and the drive consists of data sets of three 16-bit words each. The controller sends a data set to the drive, which returns the next data set to the controller.

The communication uses data sets 10...33. The contents of the data sets are freely configurable, but data set 10 typically contains the control word and one or two references, while data set 11 returns the status word and selected actual values. For ModuleBus communication, the ACS880 can be set up as a “standard drive” or an “engineered drive” by parameter 60.50. ModuleBus communication uses data sets 1...4 with a “standard drive” and data sets 10...33 with an “engineered drive”.

The word that is defined as the control word is internally connected to the drive logic; the coding of the bits is as presented in section [Contents of the fieldbus Control word \(ABB Drives profile\)](#) (page 812). Likewise, the coding of the status word is as shown in section [Contents of the fieldbus Status word \(ABB Drives profile\)](#) (page 814).

By default, data sets 32 and 33 are dedicated for the mailbox service, which enables the setting or inquiry of parameter values as follows:



*19.01 → 13h.01h → 1301h = 4865

**24.03 → 18h.03h → 1803h = 6147

By parameter [60.64](#), data sets 24 and 25 can be selected instead of data sets 32 and 33.

The update intervals of the data sets are as follows:

- Data sets 10...11: 2 ms
- Data sets 12...13: 4 ms
- Data sets 14...17: 10 ms
- Data sets 18...25, 32, 33: 100 ms.

Settings and diagnostics

Parameter groups: [60 DDCS communication \(page 533\)](#), [61 D2D and DDCS transmit data \(page 557\)](#) and [62 D2D and DDCS receive data \(page 562\)](#).

Events: [7581 DDCS controller comm loss \(page 772\)](#) and [A7CA DDCS controller comm loss \(page 772\)](#).

■ Control of a supply unit (LSU)

General

If the drive has separately-controlled supply and inverter units (also known as line-side and motor-side converters), the supply unit can be controlled through the inverter unit. For example, the inverter unit can send a control word and references to the supply unit, enabling the control of both units from the interfaces of one control program.

With ACS880 single drives, the two control units are connected at the factory. In ACS880 multidrives (drive systems with one supply unit and multiple inverter units), the feature is not typically used.

Communication

The communication between the converters and the drive consists of data sets of three 16-bit words each. The inverter unit sends a data set to the supply unit, which returns the next data set to the inverter unit.

The communication uses data sets 10 and 11, updated at 2 ms intervals. Data set 10 is sent by the inverter unit to the supply unit, while data set 11 is sent by the supply unit to the inverter unit. The contents of the data sets are freely configurable, but data set 10 typically contains the control word, while data set 11 returns the status word.

The basic communication is initialized by parameter [95.20](#). This will make several parameters visible (see below).

If the supply unit is regenerative (such as an IGBT supply unit), it is possible to send a DC voltage and/or reactive power reference to it from inverter parameter

group [94 LSU control](#). A regenerative supply unit will also send actual signals to the inverter unit which are visible in parameter group [01 Actual values](#).

Settings and diagnostics

Parameters: [01.102 Line current \(page 216\)](#)...[01.164 LSU nominal power](#), [05.111 Line converter temperature](#)...[05.121 MCB closing counter](#), [06.36 LSU Status Word](#)...[06.43 LSU CW user bit 3 selection](#), [06.116 LSU drive status word 1](#)...[06.118 LSU start inhibit status word](#), [07.106 LSU loading package name](#)...[07.107 LSU loading package version](#), [30.101 LSU limit word 1](#)...[30.149 LSU maximum power limit](#), [31.120 LSU earth fault](#)...[31.121 LSU supply phase loss](#), [95.20 HW options word 1 \(page 681\)](#) and [96.108 LSU control board boot \(page 695\)](#).

Parameter groups: [60 DDCS communication \(page 533\)](#), [61 D2D and DDCS transmit data \(page 557\)](#), [62 D2D and DDCS receive data \(page 562\)](#) and [94 LSU control \(page 673\)](#).

Events: [7580 INU-LSU comm loss \(page 772\)](#), [7584 LSU charge failed \(page 772\)](#), [AF80 INU-LSU comm loss \(page 772\)](#) and [AF85 Line side unit warning \(page 772\)](#).

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 \(page 170\)](#).

Settings and diagnostics

Parameters: [99.04 Motor control mode \(page 705\)](#) and [99.13 ID run requested \(page 708\)](#).

■ 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; refer section [Jogging \(page 167\)](#).

The change rate of the motor potentiometer function ([page 178](#)) 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: [23.200 Ramp set selection \(page 374\)](#) ... [23.205 Deceleration time 2 \(page 377\)](#).
 - Torque reference ramping: [01.30 Nominal torque scale \(page 214\)](#), [26.18 Torque ramp up time \(page 398\)](#) and [26.19 Torque ramp down time \(page 398\)](#).
 - Frequency reference ramping: [28.71 Freq ramp set selection...](#)[28.75 Freq deceleration time 2](#) and [46.02 Frequency scaling \(page 493\)](#).
 - Motor potentiometer: [22.75 Motor potentiometer ramp time \(page 366\)](#).
 - Emergency stop (“Off3” mode): [23.23 Emergency stop time \(page 371\)](#).
-

■ Constant speeds

Constant speeds 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.

Note: This feature does not work in EXT2 mode.



WARNING!

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

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

Settings and diagnostics

Parameter groups: [22 Speed reference selection \(page 359\)](#).

■ 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.

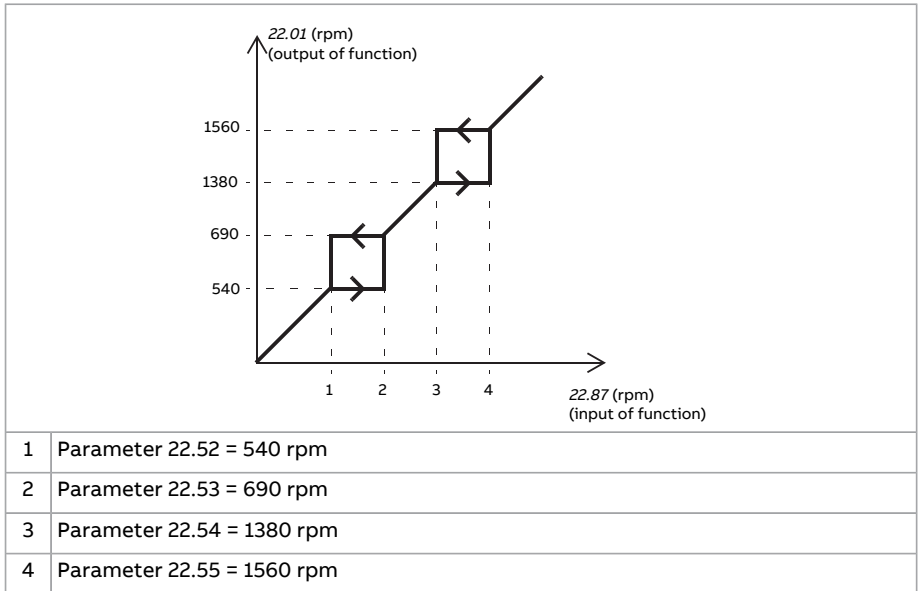
The critical speeds function prevents the reference from dwelling within a critical band for extended times. When a changing reference (22.87) enters a critical range, the output of the function (22.01) freezes until the reference exits the range. Any instant change in the output is smoothed out by the 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, the output by parameter 28.97.

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.
-



Settings and diagnostics

Parameters:

- Critical speeds: 22.51 Critical speed function...22.57 Critical speed 3 high
- Critical frequencies: 28.51 Critical frequency function...28.57 Critical frequency 3 high.

■ Critical speeds

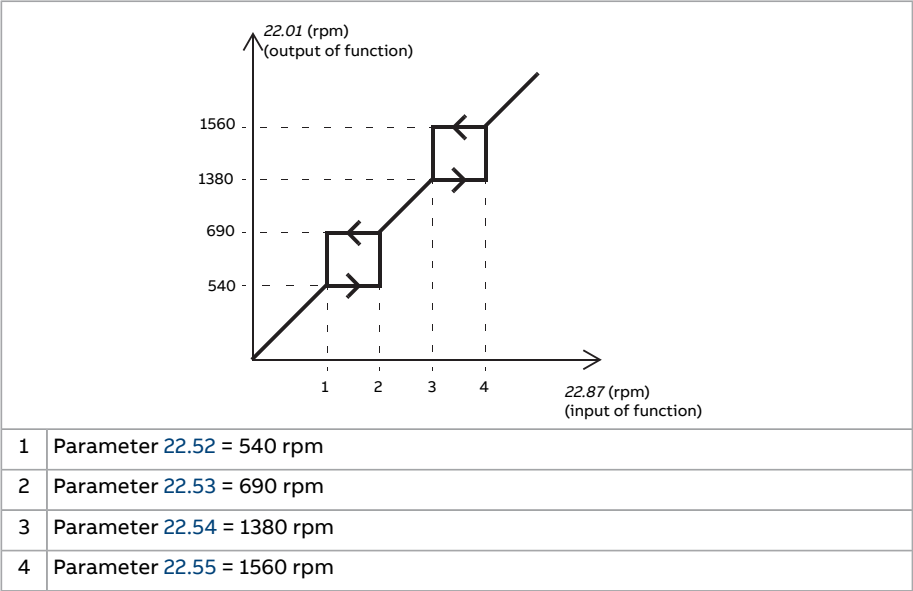
Critical speeds (sometimes called “skip speeds”) can be predefined for applications where it is necessary to avoid certain motor speeds or speed ranges because of, for example, mechanical resonance problems.

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.

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.



Settings and diagnostics

Parameters: 22.51 Critical speed function (page 364)...22.57 Critical speed 3 high (page 365).

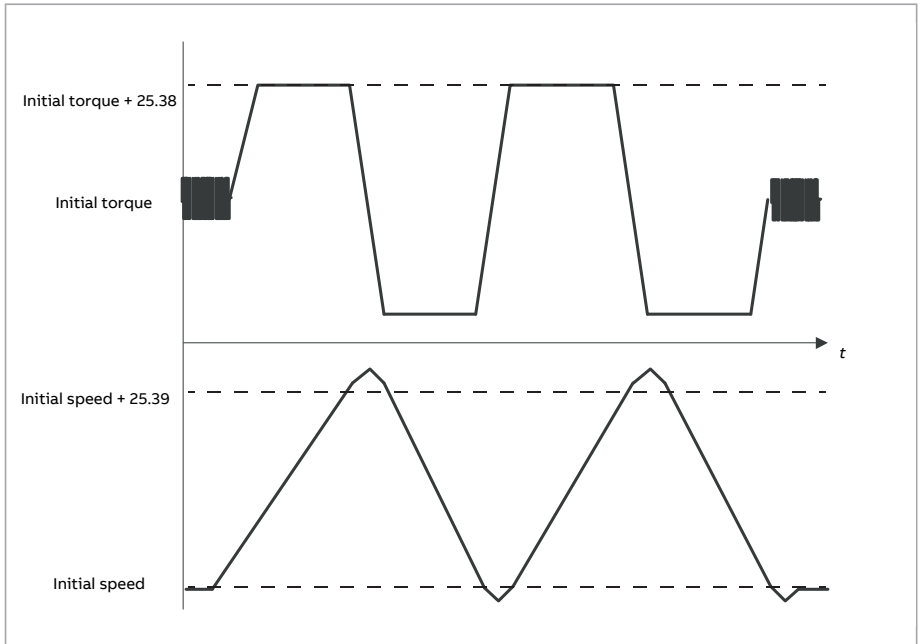
■ Speed controller autotune

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) or the nominal motor torque (parameter group 99). 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

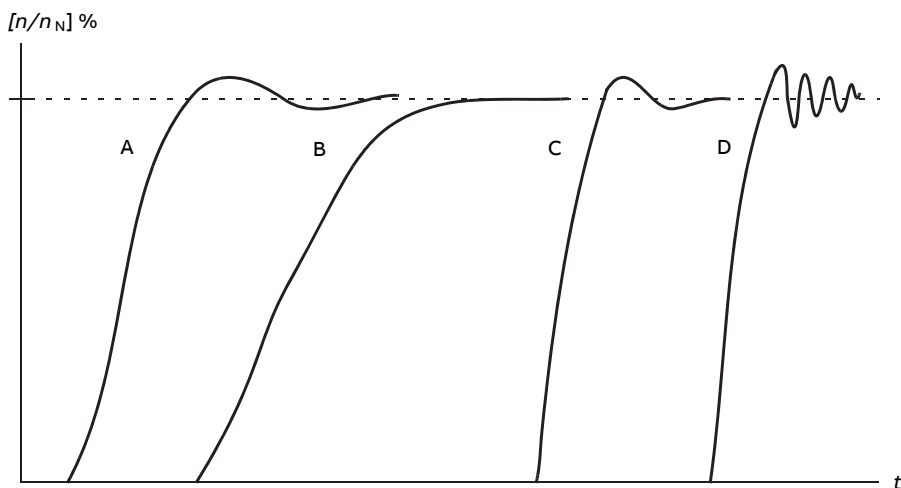
The prerequisites for performing the autotune routine are:

- The motor identification run (ID run) has been successfully completed
- Speed and torque limits (parameter group 30) 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)
 - speed error filtering (parameter group 24) and
 - zero speed (21 Start/stop mode)
- 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. 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

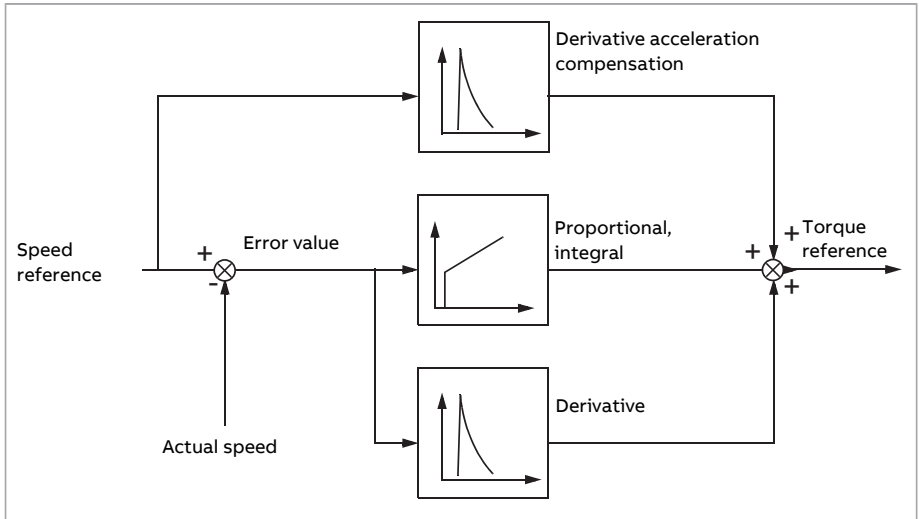
Autotune results

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

- 25.02 (proportional gain of the speed controller)
- 25.03 (integration time of the speed controller)
- 25.37 (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

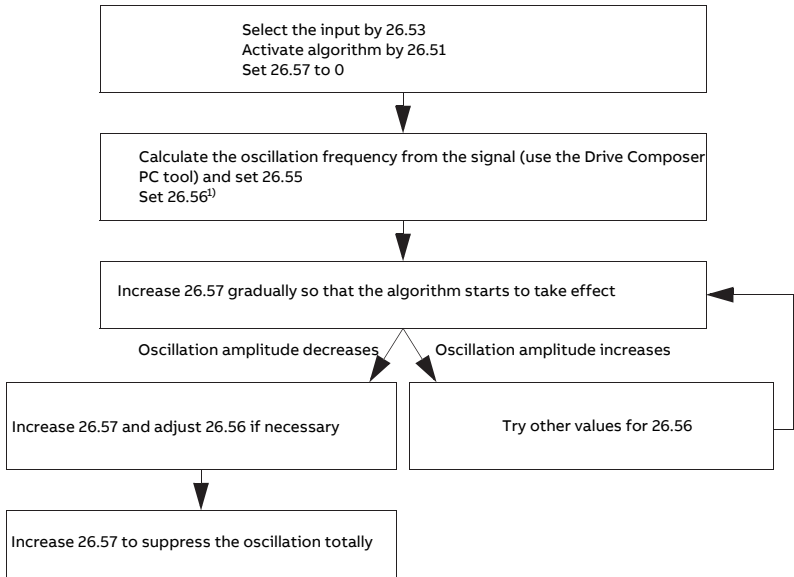
Parameters: 25.33 Speed controller autotune...25.40 Autotune repeat times.

■ 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 \(page 401\)](#)...[26.58 Oscillation damping output \(page 403\)](#).

■ Resonance frequency elimination

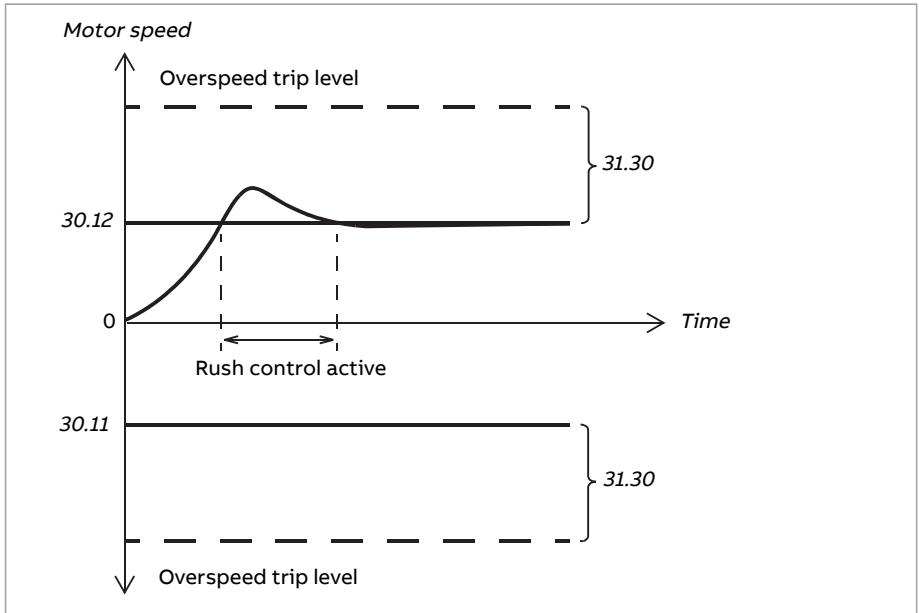
The control program contains a notch filter function for removing the resonance frequencies from the speed error signal.

Settings and diagnostics

Parameters: [24.13 RFE speed filter \(page 379\)](#)...[24.17 Damping of pole \(page 381\)](#).

■ 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, 31 Fault functions and 90 Feedback selection.

Parameters: 26.81 Rush control gain and 26.82 Rush control integration time.

■ Encoder support

The program supports one 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.

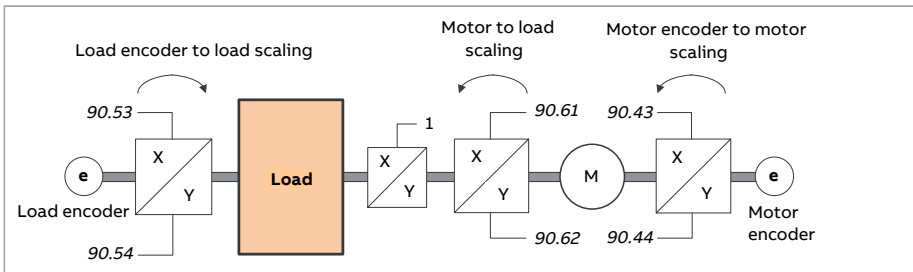
Encoder emulation also relays the encoder signal to the output, but the signal is either scaled, or position data converted to pulses. Emulation can be used when absolute encoder or resolver position needs to be converted to TTL pulses, or when the signal must be converted to a different pulse number 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 [823](#) and [824](#). For more information on load position calculation, refer section [Position counter \(page 163\)](#).

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



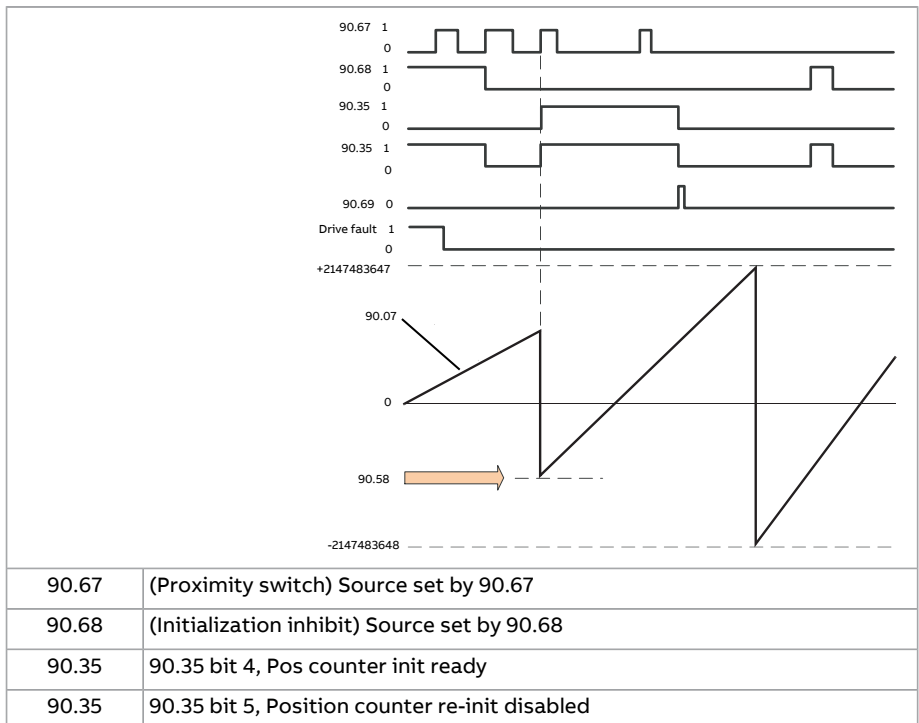
Any gear ratio between the load encoder and the load is defined by 90.53 and 90.54. Similarly, any gear ratio between the motor encoder and the motor is defined by 90.43 and 90.44. In case the internal estimated position is chosen as load feedback, the gear ratio between the motor and load can be defined 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 (refer section [Load and motor feedback \(page 162\)](#)).

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 824.



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 643), 91 Encoder module settings (page 658), 92 Encoder 1 configuration (page 662) and 93 Encoder 2 configuration (page 670).

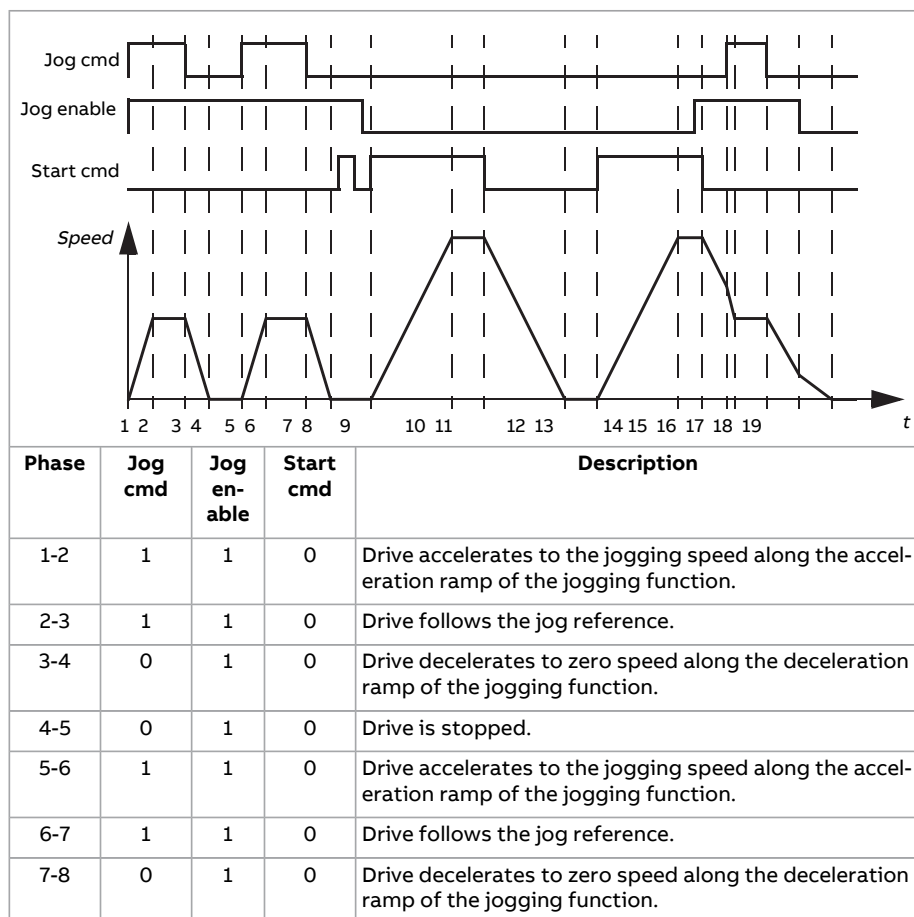
■ Jogging

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.



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 23.200 ... 23.205).
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 23.200 ... 23.205).
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 23.200 ... 23.205).
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 23.200 ... 23.205). 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 23.16...23.19).

The jogging function operates on a 2 ms time level.

Note:

- For winch application, jogging is not available in EXT2 mode, but available in EXT1.
- 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, 20.26 Jogging 1 start source, 20.27 Jogging 2 start source, 22.42 Jogging 1 ref, 22.43 Jogging 2 ref, 23.20 Acc time jogging and 23.21 Dec time jogging.

■ 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)

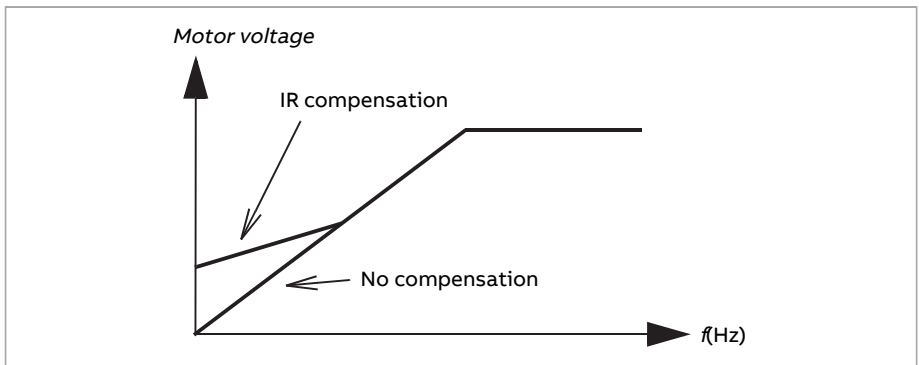
In scalar control, some standard features are not available.

See also section [Operating modes of the drive](#).

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, 97.12 IR comp stepup frequency, 97.13 IR compensation and 99.04 Motor control mode.

Parameter group: 28 Frequency reference chain.

■ Autophasing

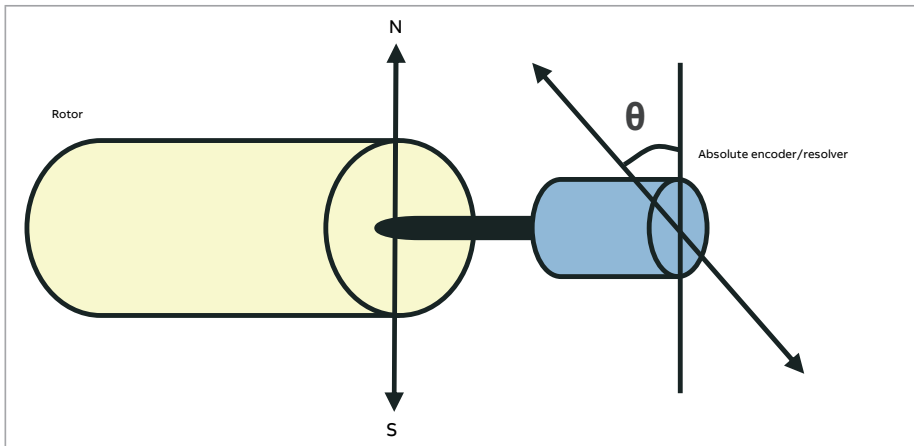
Autophasing is an automatic measurement routine to determine the angular position of the magnetic flux of a permanent magnet synchronous motor or the magnetic axis of a synchronous reluctance motor. The motor control requires the absolute position of the rotor flux in order to control motor torque accurately.

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 ($\pm 360/\text{polepairs}$)° 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 238), 21.13 Autophasing mode (page 354), 98.15 Position offset user (page 704) and 99.13 ID run requested (page 708).

■ Flux braking

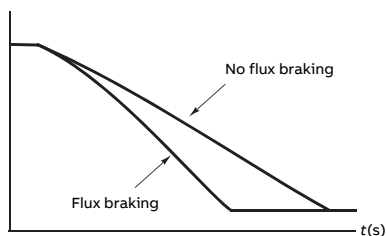


WARNING!

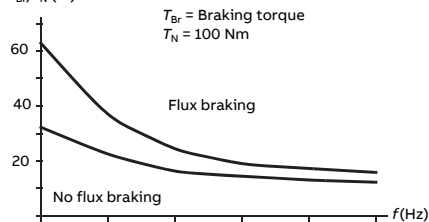
The motor needs to be rated to absorb the thermal energy generated by flux braking.

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.

Motor speed



T_{Br}/T_N (%)



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 \(page 697\)](#).

■ 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](#).

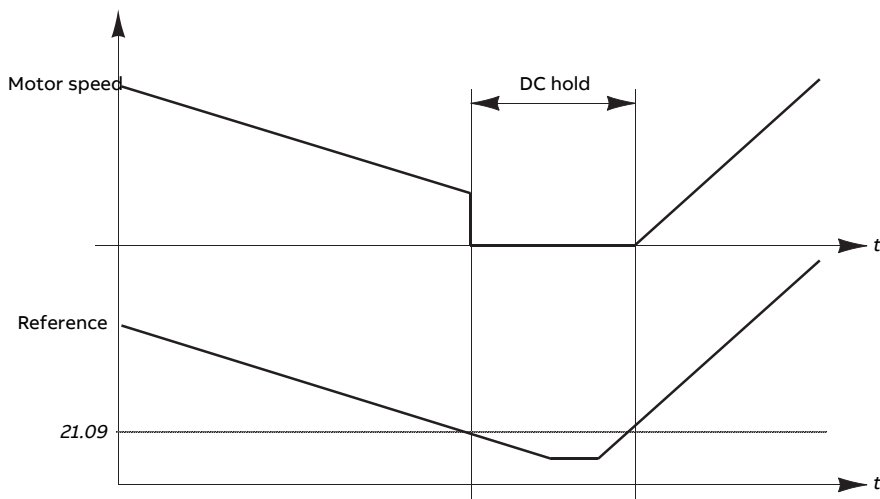
Pre-magnetization

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 133).
- 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 when ramping is the selected stop mode (see parameter [21.03](#)).

Settings and diagnostics

Parameters: [06.21 Drive status word 3 \(page 238\)](#), [21.02 Magnetization time \(page 350\)](#), [21.08 DC current control...](#)[21.10](#) [21.14 Pre-heating input source \(page 355\)](#) and [21.16 Pre-heating current \(page 356\)](#).

■ 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 \(page 357\)](#) and [21.38 Motor temperature estimation time \(page 358\)](#).

■ Hexagonal motor flux pattern

Note: This feature is only available in scalar motor control mode (see page [133](#)).

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 ... $1.6 \times \text{FWP}$ 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 \(page 700\)](#) and [97.19 Hexagonal field weakening point \(page 701\)](#).

■ Motor potentiometer

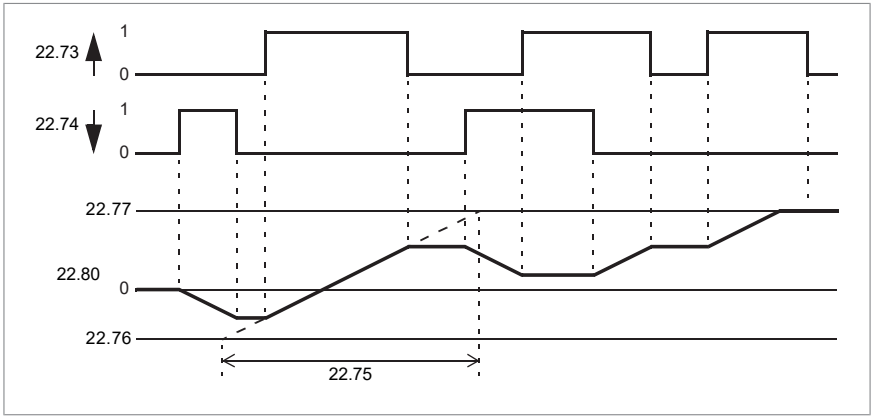
The motor potentiometer is, in effect, a counter whose value can be adjusted up and down using two digital signals selected by parameters [22.73 Motor potentiometer up source](#) and [22.74 Motor potentiometer down source](#). Note that these signals have no effect when the drive is stopped.

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

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

The output of the function is shown by [22.80 Motor potentiometer ref act](#), which can directly be set as the source of any selector parameter such as [22.11 Speed ref1 source](#).

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



Settings and diagnostics

Parameters: [22.71...22.80](#).

DC voltage control

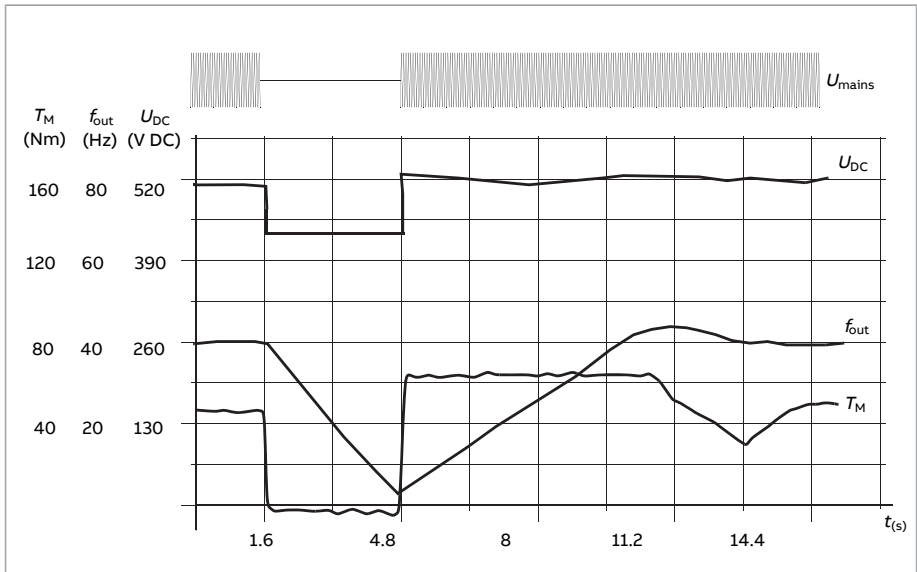
■ Overvoltage control

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](#).

Settings and diagnostics

Parameter: [21.18 Auto restart time](#) (page 356).

Event: [3280 Standby timeout](#) (page 772).

■ 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).

ACS880-01 and ACS880-04

	U_{ac} [V AC]						
	208...240		380...415	440...480	500	525...600	660...690
	R1-R3	R4-R8					
	DC voltage limits [V DC]						
U_{DC}	281...324		513...560	594...648	675	709...810	891...932
$U_{DC,chr}$	225		410	475	540	567	713
$U_{DC,ove}$	389		700	778	810	1013	1118
$U_{DC,uvc}$	239		436	505	574	602	757
$U_{DC,ovt}$	489	440	800	878	880	1113	1218
$U_{DC,uvt}$	168		308	355	405	425	535
U_{DCmax}	324		560	648	675	810	932
$U_{DC,brel}$	375		648	749	780	936	1077
$U_{DC,brch}$	403		697	806	806	1008	1159

U_{ac}	AC input voltage. Set also parameter 95.01 in the drive control program to this value. All drives on the common DC system must have the same setting. Set parameter 95.02 to Disabled.
U_{DC}	Nominal DC link voltage = $1.35 \times U_{ac}$ in normal motoring operation mode of the drive.
$U_{DC,chr}$	Charging limit. Drive opens the charging circuit when the DC voltage reaches this limit at power up.
$U_{DC,ovc}, U_{DC,uvc}$	Overvoltage control limit and Undervoltage control limit. The overvoltage and undervoltage control of the DC link voltage level are enabled by default. The drive limits the motoring and generating torque when necessary to keep the DC link voltage within the control limits. When a brake chopper and resistor are in use, you must disable the overvoltage control.
$U_{DC,ovt}, U_{DC,uvt}$	DC overvoltage trip limit and DC undervoltage trip limit. The drive trips and gives a fault message if the DC link voltage reaches these levels.
U_{DCmax}	DC voltage at upper bound of supply voltage range.
$U_{DC,brch}, U_{DC,brch}$	Brake chopper limit low and Brake chopper limit high. The brake chopper starts operation when the DC link voltage reaches the low level and you have enabled the chopper with the drive parameter. If the DC link voltage level reaches the high level, the brake chopper will be at its maximum load.

ACS880-11, -31, -14 and -34

	U_n [V AC]				
	380	415	500	660	690
	DC voltage limits [V DC]				
U_{DC}	555	605	730	960	1005
$U_{DC,ovc}$	695	755	830	1200	1255
$U_{DC,ovt}$	795	845	880	1300	1350
$U_{DC,uvc}$ ¹⁾	455	505	625	None	None
$U_{DC,uvc}$ ²⁾	455	500	600	795	830
$U_{DC,stdby}$ ¹⁾	415	465	585	None	None
$U_{DC,stdby}$ ²⁾	430	470	565	745	780
$U_{DC,uvt}$ ¹⁾	385	435	555	None	None
$U_{DC,uvt}$ ²⁾	320	350	425	560	585
¹⁾ ACS880-11 and -31 ²⁾ ACS880-14 and -34					
U_n	Nominal AC input voltage. Set also parameter 95.01 in the drive control program to this value. All drives on the common DC system must have the same setting. Set parameter 95.02 to Disabled.				
U_{DC}	Nominal DC link voltage.				
$U_{DC,ovc}, U_{DC,uvc}$	Overvoltage control limit and Undervoltage control limit. The overvoltage and undervoltage control of the DC link voltage level are enabled by default. When enabled, the drive limits the motoring and generating torque when necessary to keep the DC link voltage within the control limits. ABB recommends to disable the overvoltage control limit in ACS880-11 and -14 drives. When a brake chopper and resistor are in use, you must disable the overvoltage control.				
$U_{DC,ovt}, U_{DC,uvt}$	DC overvoltage trip limit and DC undervoltage trip limit. The drive trips and gives a fault message if the DC link voltage reaches these levels.				
$U_{DC,stdby}$	DC voltage charging activation (standby) limit				

Settings and diagnostics

Parameters: [01.11 DC voltage \(page 213\)](#), [30.30 Overvoltage control \(page 423\)](#), [30.31 Undervoltage control \(page 423\)](#), [95.01 Supply voltage \(page 677\)](#), and [95.02 Adaptive voltage limits \(page 677\)](#).

■ Brake chopper

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

The brake chopper (43.06) can be enabled with the overvoltage controller (30.30) still active. In such case, make sure the overvoltage controller limits are set high enough not to limit before the full braking power is reached. This function in certain applications avoids unnecessary overvoltage trip and implements a simpler control logic if the resistor cannot absorb enough energy or when the resistor breaks during braking.

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 $1.156 \times U_{DCmax}$. 100% pulse width is reached at approximately $1.2 \times U_{DCmax}$, 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 \(page 213\)](#) and [30.30 Overvoltage control \(page 423\)](#).

Parameter group: [43 Brake chopper \(page 478\)](#).

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 (FSO-xx is supported only by UCU-22...24 control units). 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.
- Speed and torque reference additives (parameters [22.15](#), [22.17](#), [26.16](#), [26.25](#) and [26.41](#)) and reference ramp shapes ([23.16](#)...[23.19](#)) are ignored in case of emergency ramp stops.
- Speed reference additives (parameters [22.15](#) and [22.17](#)) and reference ramp shapes ([23.16](#)...[23.19](#)) are ignored in case of emergency ramp stops.

Settings and diagnostics

Parameters: [06.17 Drive status word 2](#) (page 235), [06.18 Start inhibit status word](#) (page 236), [21.04 Emergency stop mode](#) (page 350), [21.05 Emergency stop source](#) (page 351), [23.23 Emergency stop time](#) (page 371), [25.13 Min torq sp ctrl em stop](#) (page 389), [25.14 Max torq sp ctrl em stop](#) (page 389), [25.15 Proportional gain em stop](#) (page 390), [31.32 Emergency ramp supervision](#) (page 434) and [31.33 Emergency ramp supervision delay](#) (page 434).

■ 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](#).

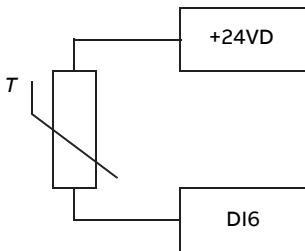
Note: The motor thermal model can be used when only one motor is connected to the drive.

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 through an option module or a relay that provides the reinforced insulation. Refer to the drive or inverter unit hardware manual.

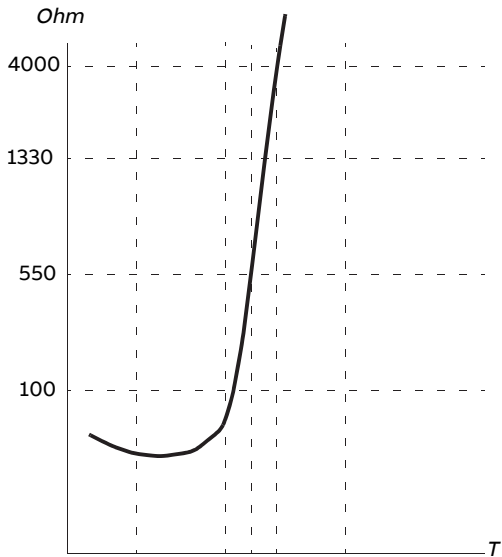
If the temperature sensor has reinforced insulation, one PTC sensor can be connected to digital input DI6.



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.

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 that have reinforced insulation. 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 through an option module or a relay that provides the reinforced insulation. Refer to the drive or inverter unit hardware manual.

If the temperature sensor has reinforced insulation, 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!

If the temperature sensor has reinforced insulation, 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 through an option module or a relay that provides the reinforced insulation. Refer to the drive or inverter unit hardware manual.

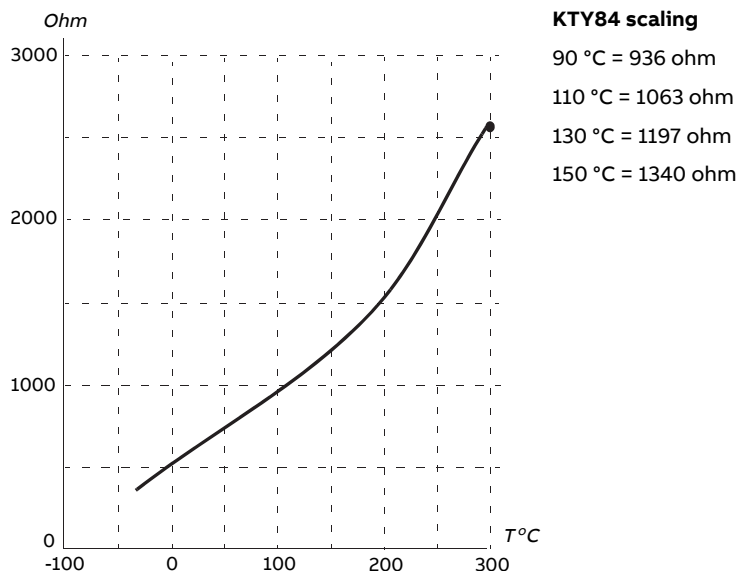
If the temperature sensor has reinforced insulation, one KTY84 sensor can be connected to an analog input and an analog output on the control unit.

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 with reinforced insulation.

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

190 Standard program features



The warning and fault limits can be adjusted by parameters.

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 \(page 454\)](#) and [91 Encoder module settings \(page 658\)](#).

Parameters: [95.15 Special HW settings \(page 680\)](#).

■ Motor overload protection

This section describes motor overload protection without using motor thermal protection model, either with estimated or measured temperature. For protection with the motor thermal protection model, refer section [Motor thermal protection \(page 185\)](#).

Motor overload protection is required and specified by multiple standards including the US National Electric Code (NEC), UL 508C and the common UL\IEC 61800-5-1 standard in conjunction with IEC 60947-4-1. The standards allow for motor overload protection without external temperature sensors.

The Motor overload protection 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.

The protection feature allows the user to specify the class of operation in the same manner as the overload relays are specified in standards IEC 60947-4-1 and NEMA ICS 2.

Motor overload protection requires that you specify a motor current tripping level. This is defined by a curve using parameters [35.51](#), [35.52](#) and [35.53](#). The tripping level is the motor current at which the overload protection will ultimately trip if the motor current remains at this level continuously.

The motor overload class (class of operation), parameter [35.57](#), is given as the time required for the overload relay to trip when operating at 7.2 times the tripping level in the case of IEC 60947-4-1 and 6 times the tripping level in the case of NEMA ICS 2. The standards also specify the time to trip for current levels between the tripping level and the 6 times tripping level. The drive satisfies the IEC standard and NEMA standard trip times.

Using class 20 satisfies the UL 508C requirements.

The motor overload algorithm monitors the squared ratio (motor current / tripping level)² and accumulates this over time. This is sometimes referred to as I^2t protection. The accumulated value is shown in parameter [35.05](#).

You can define with parameter [35.56](#) that when [35.05](#) reaches 88%, a motor overload warning will be generated, and when it reaches 100%, the drive will trip on the motor overload fault. The rate at which this internal value is increased depends on the actual current, tripping level current and overload class selected.

Parameters [35.51](#), [35.52](#) and [35.53](#) serve a dual purpose. They determine the load curve for temperature estimate as well as specify the overload tripping level.

Settings and diagnostics

Parameters common to motor thermal protection and motor overload protection: [35.51 Motor load curve ...](#) [35.53 Break point \(page 463\)](#).

Parameters specific to motor overload protection: [35.05 Motor overload level \(page 455\)](#), [35.56 Motor overload action ... 35.57 Motor overload class \(page 465\)](#).

■ 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 \(page 466\)](#).

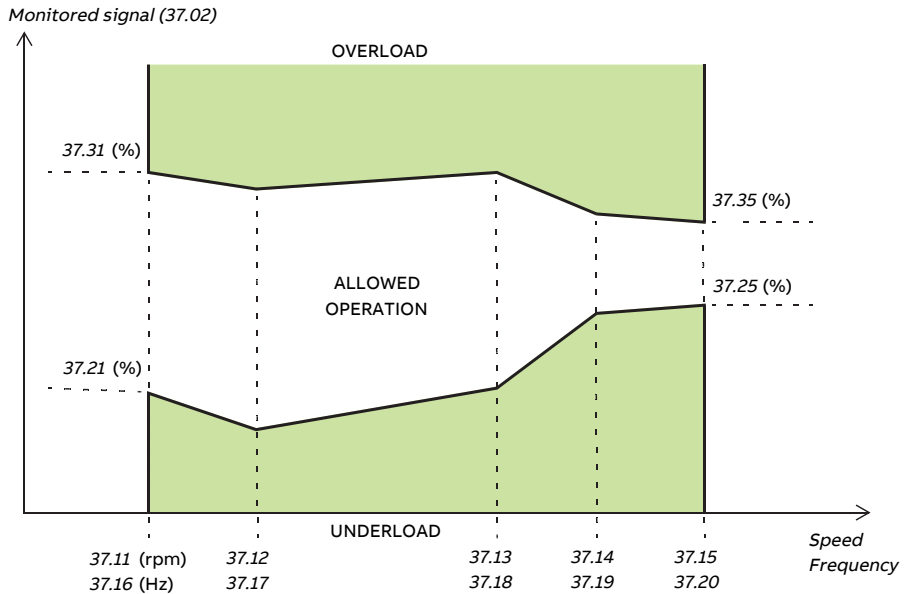
Events: [A480 Motor cable overload \(page 772\)](#) and [4000 Motor cable overload \(page 772\)](#).

■ 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 474).

Events: [A6E6 ULC configuration](#) (page 772), [A8BE ULC overload](#) (page 772), [A8BF ULC underload](#) (page 772), [8001 ULC underload](#) (page 772) and [8002 ULC overload](#) (page 772).

■ 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 \(page 428\)](#).

■ 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 31.35 and 31.43.

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 \(page 440\)](#).

Events: [A8B0 Signal supervision \(page 772\)](#), [A8B1 Signal supervision 2 \(page 772\)](#), [A8B2 Signal supervision 3 \(page 772\)](#), [80B0 Signal supervision \(page 772\)](#), [80B1 Signal supervision 2 \(page 772\)](#) and [80B2 Signal supervision 3 \(page 772\)](#).

■ 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 \(page 444\)](#).

■ 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 CO₂ emissions, and
- A load analyzer showing the load profile of the drive (see separate section on [page 197](#)).

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 \(page 489\)](#).

■ Load analyzer

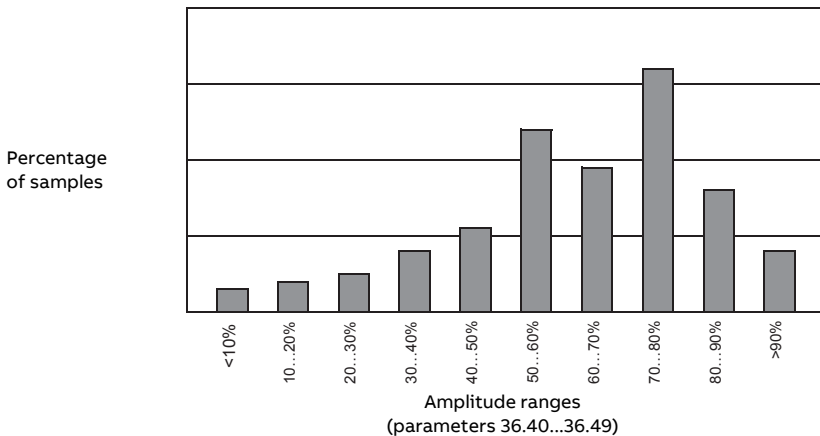
Peak value logger

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 \(page 469\)](#).

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 \(page 264\)](#), [10.04 DI force data \(page 264\)](#), [50.01 FBA A enable \(page 504\)](#), [50.31 FBA B enable \(page 509\)](#), and [96.10 User set status \(page 688\)...](#)[96.13 User set I/O mode in2 \(page 689\)](#).

Parameter group: [95 HW configuration \(page 677\)](#).

Events: [64B2 User set fault \(page 772\)](#).

■ 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 \(page 692\)](#)...[96.59 Approved checksum 4 \(page 693\)](#).

Events: [6200 Checksum mismatch \(page 772\)](#) and [A686 Checksum mismatch \(page 772\)](#).

■ 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 \(page 498\)](#).

■ 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 \(page 680\)](#), [97.01 Switching frequency reference \(page 696\)](#), [97.02 Minimum switching frequency \(page 696\)](#).

■ Parameter ranges with option +N8200 (High speed license)

With option +N8200 (High speed license), the following speed and frequency parameters have an extended range:

Range	Parameters
-90000 ... 90000 rpm	01.02 , 22.01 , 22.26...22.32 , 22.41...22.43 , 22.52...22.57 , 22.81...22.87 , 23.01 , 23.02 , 23.27 , 23.39 , 24.01...24.4 , 30.11 , 30.12 , 36.15 , 49.15 , 49.16 , and 90.01 .

Range	Parameters
0...90000 rpm	01.61, 21.06, 25.18, 25.19, 37.11...37.15, 46.01, 46.06, 46.21, 46.31, and 99.09.
-1500 ... 1500 Hz	01.06, 28.01, 28.02, 28.26...28.32, 28.52...28.57, 28.78, 28.90...28.92, 28.96, 28.97, 30.13, 30.14, 49.17, and 49.18.
0...1500 Hz	01.63, 46.02, and 99.08.

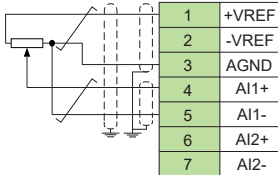
7

Default control connections

What this chapter contains

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

Winch I/O control connections

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

Connection	Term	Description
	NC	P 44.204.0, Winch brake open command
	COM	250 V AC / 30 V DC
	NO	2 A
	NC	Ready run
	COM	250 V AC / 30 V DC
	NO	2 A
	NC	Fault (-1)
	COM	250 V AC / 30 V DC
	NO	2 A
XD24 Digital interlock		
	DIIL	Power ackn. (par. 20.200) / Run enable (par.20.12,)
	+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	Control stand 1 enable (EXT2)
	DI2	Control stand 1 heave (EXT2), In1 Start Fwd (EXT1)
	DI3	Control stand 1 lower (EXT2), In2 Start Rev (EXT1)
	DI4	Not in use
	DI5	Not in use
	DI6	Not in use
	XSTO	Safe torque off circuits must be closed for the drive to start. See <i>Hardware manual</i> of drive.
	X12	Safety options connection
	X13	Control panel connection
	X205	Memory unit connection

8

Parameters

What this chapter contains

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, refer 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.

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Term	Definition
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

Group	Contents	Page
01 Actual values	Basic signals for monitoring the drive.	212
03 Input references	Values of references received from various sources.	217
04 Warnings and faults	Information on warnings and faults that occurred last.	219
05 Diagnostics	Various run-time-type counters and measurements related to drive maintenance.	231
06 Control and status words	Drive control and status words.	233
07 System info	Information on drive hardware, firmware and application program.	250
09 Winch actual signals	Monitoring signals related to winch control program.	254
10 Standard DI, RO	Configuration of digital inputs and relay outputs.	264
11 Standard DIO, FI, FO	Configuration of digital input/outputs and frequency inputs/outputs.	273
12 Standard AI	Configuration of standard analog inputs.	280
13 Standard AO	Configuration of standard analog outputs.	286
14 I/O extension module 1	Configuration of I/O extension module 1.	292
15 I/O extension module 2	Configuration of I/O extension module 2.	320
16 I/O extension module 3	Configuration of I/O extension module 3.	326
19 Operation mode	Selection of local and external control location sources and operating modes.	332
20 Start/stop/direction	Start/stop/direction and run/start/jog enable signal source selection; positive/negative reference enable signal source selection.	335
21 Start/stop mode	Start and stop modes; emergency stop mode and signal source selection; DC magnetization settings; autophasing mode selection.	349
22 Speed reference selection	Speed reference selection; motor potentiometer settings.	359
23 Speed reference ramp	Speed reference ramp settings (programming of the acceleration and deceleration rates for the drive).	369
24 Speed reference conditioning	Speed error calculation; speed error window control configuration; speed error step.	378
25 Speed control	Speed controller settings.	385
26 Torque reference chain	Settings for the torque reference chain.	396
28 Frequency reference chain	Settings for the frequency reference chain.	405

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Group	Contents	Page
30 Limits	Drive operation limits.	415
31 Fault functions	Configuration of external events; selection of behavior of the drive upon fault situations.	425
32 Supervision	Configuration of signal supervision functions 1...3.	440
33 Generic timer & counter	Configuration of maintenance timers/counters.	444
35 Motor thermal protection	Motor thermal protection settings such as temperature measurement configuration, load curve definition and motor fan control configuration.	454
36 Load analyzer	Peak value and amplitude logger settings.	469
37 User load curve	Settings for user load curve.	474
43 Brake chopper	Settings for the internal brake chopper.	478
44 Mechanical brake control	Configuration of mechanical brake control.	481
45 Energy efficiency	Settings for the energy saving calculators.	489
46 Monitoring/scaling settings	Speed supervision settings; actual signal filtering; general scaling settings.	493
47 Data storage	Data storage parameters that can be written to and read from using other parameters' source and target settings.	498
49 Panel port communication	Communication settings for the control panel port on the drive.	501
50 Fieldbus adapter (FBA)	Fieldbus communication configuration.	504
51 FBA A settings	Fieldbus FBA A interface configuration.	514
52 FBA A data in	Selection of data to be transferred from drive to fieldbus controller through fieldbus FBA A interface.	516
53 FBA A data out	Selection of data to be transferred from fieldbus controller to drive through fieldbus FBA A interface.	517
54 FBA B settings	Fieldbus FBA B interface configuration.	519
55 FBA B data in	Selection of data to be transferred from drive to fieldbus controller through fieldbus FBA B interface.	521
56 FBA B data out	Selection of data to be transferred from fieldbus controller to drive through fieldbus FBA B interface.	522
58 Embedded fieldbus	Configuration of the embedded fieldbus (EFB) interface.	523
60 DDCS communication	DDCS communication configuration.	533
61 D2D and DDCS transmit data	Defines the data sent to the DDCS link.	557
62 D2D and DDCS receive data	Mapping of data received through the DDCS link.	562

Group	Contents	Page
74 Winch general	General settings for winch.	573
75 Winch interface	Winch control stand configuration.	594
76 Automoorings	Settings for Automoorings.	603
77 Anchor stowing protection	Settings for anchor stowing protection.	619
78 Slip detection	Settings for slip detection.	623
79 Peak torque protection	Settings for peak torque protection.	627
80 Power control	Settings for power control.	629
81 Winch system check	Settings for torque proving and brake slip detection.	634
82 Clutch control	Settings for clutch control.	636
84 Synchro control	Settings for synchro control.	639
90 Feedback selection	Motor and load feedback configuration.	643
91 Encoder module settings	Configuration of encoder interface modules.	658
92 Encoder 1 configuration	Settings for encoder 1.	662
93 Encoder 2 configuration	Settings for encoder 2.	670
94 LSU control	Control of the supply unit of the drive, such as DC voltage and reactive power reference.	673
95 HW configuration	Various hardware-related settings.	677
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.	684
97 Motor control	Motor model settings.	696
98 User motor parameters	Motor values supplied by the user that are used in the motor model.	702
99 Motor data	Motor configuration settings.	705
200 Safety	FSO safety module settings.	713

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

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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 kilowatt-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

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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. Also, refer 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 .	- / 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
01.102	Line current	<i>(Only visible when IGBT supply unit control activated by 95.20)</i> Estimated line current flowing through the supply unit.	- / real32
	0.00 ... 30000.00 A	Estimated line current. For 16-bit scaling, see parameter 46.05 .	- / 100 = 1 A
01.164	LSU nominal power	<i>(Only visible when IGBT supply unit control activated by 95.20)</i> Nominal power of the supply unit.	- / real32
	0...30000 kW	Nominal power.	1 = 1 kW / 1 = 1 kW

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. Also, refer 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
03.11	DDCS controller ref 1	Reference 1 received from the external (DDCS) controller. The value has been scaled according to parameter 60.60 DDCS controller ref1 type . Also, refer section External ABB controller interface .	- / real32
	-30000.00 ... 30000.00	Scaled reference 1 received from external controller.	10 = 1 / 100 = 1

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No.	Name / Range / Selection	Description	Def / Type FbEq 16b / 32b
03.12	DDCS controller ref 2	Reference 2 received from the external (DDCS) controller. The value has been scaled according to parameter 60.61 DDCS controller ref2 type .	- / real32
	-30000.00 ... 30000.00	Scaled reference 2 received from external controller.	10 = 1 / 100 = 1
03.13	M/F or D2D ref1	Master/follower reference 1 received from the master. The value has been scaled according to parameter 60.10 M/F ref1 type . Also, refer section Master/follower functionality .	- / real32
	-30000.00 ... 30000.00	Scaled reference 1 received from master.	10 = 1 / 100 = 1
03.14	M/F or D2D ref2	Master/follower reference 2 received from the master. The value has been scaled according to parameter 60.11 M/F ref2 type .	- / real32
	-30000.00 ... 30000.00	Scaled reference 2 received from master.	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.	- / -

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, refer 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

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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
		Bit	ACS800 fault name		ACS880 events indicated by this bit see Fault tracing (page 715).	
			(04.120 = ACS800 Standard ctrl program)	(04.120 = ACS800 System ctrl program)		
			0	SHORT CIRC	SHORT CIRC	2340
			1	OVERCURRENT	OVERCURRENT	2310
			2	DC OVERVOLT	DC OVERVOLT	3210
			3	ACS800 TEMP	ACS800 TEMP	2381, 4210, 4290, 42F1, 4310, 4380
			4	EARTH FAULT	EARTH FAULT	2330, 2392, 3181
			5	THERMISTOR	MOTOR TEMP M	4981, 4991, 4992, 4993
			6	MOTOR TEMP	MOTOR TEMP	4982
			7	SYSTEM_FAULT	SYSTEM_FAULT	6481, 6487, 64A1, 64A2, 64A3, 64B1, 64E1, 6881, 6882, 6883, 6885
			8	UNDERLOAD	UNDERLOAD	-
			9	OVERFREQ	OVERFREQ	7310
			10	Reserved	MPROT SWITCH	9081
			11	Reserved	CH2 COMM LOSS	7582
			12	Reserved	SC (INU1)	2340 (XXYY YY01)
			13	Reserved	SC (INU2)	2340 (XXYY YY02)
			14	Reserved	SC (INU3)	2340 (XXYY YY03)
			15	Reserved	SC (INU4)	2340 (XXYY YY04)

No.	Name / 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

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No.	Name / Range / Selection	Description			Def / Type FbEq 16b / 32b
		Bit	ACS800 fault name (04.120 = ACS800 Standard ctrl program) (04.120 = ACS800 System ctrl program)		ACS880 events indicated by this bit see Fault tracing (page 715).
		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 SW-FREQ	OVER SW-FREQ	-
		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, 7581
		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

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No.	Name / Range / Selection	Description			Def / Type FbEq 16b / 32b
		Bit	ACS800 alarm name (04.120 = ACS800 Standard ctrl program)		ACS880 events indicated by this bit see Fault tracing (page 715).
		0	STARTINHIBIT	STARTINHIBIT	A5A0
		1	Reserved	EM STOP	AFE1, AFE2
		2	THERMISTOR	MOTOR TEMP M	A491, A497, A498, A499
		3	MOTOR TEMP	MOTOR TEMP	A492
		4	ACS800 TEMP	ACS800 TEMP	A2BA, A4A9, A4B0, A4B1, A4F6
		5	ENCODER ERR	ENCODER ERR	A797, A7B0, A7B1, A7E1
		6	T MEAS ALM	T MEAS CIRC	A490, A5EA, A782, A8A0
		7	Reserved	DIGITAL IO	-
		8	Reserved	ANALOG IO	-
		9	Reserved	EXT DIGITAL IO	-
		10	Reserved	EXT ANALOG IO	A6E5, A7AA, A7AB
		11	Reserved	CH2 COMM LOSS	A7CB, AF80
		12	COMM MODULE	MPROT SWITCH	A981
		13	Reserved	EM STOP DEC	-
		14	EARTH FAULT	EARTH FAULT	A2B3
		15	Reserved	SAFETY SWITC	A983
	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

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No.	Name / Range / Selection	Description			Def / Type FbEq 16b / 32b
		Bit	ACS800 alarm name (04.120 = ACS800 Standard ctrl program) (04.120 = ACS800 System ctrl program)		ACS880 events indicated by this bit see Fault tracing (page 715).
		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, A7CA, A7CE
		12	Reserved	BAT FAILURE	-
		13	PANEL LOSS	PANEL LOSS	A7EE
		14	Reserved	DC UNDER-VOLT	A3A2
		15	Reserved	RESTARTED	-
	0000h...FFFFh				1 = 1 / 1 = 1

No.	Name / Range / Selection	Description	Def / Type FbEq 16b / 32b
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
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 . The event codes are listed in chapter (see Fault tracing (page 715))	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 . The event codes are listed in chapter (see Fault tracing (page 715))	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
...	...	...	...

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No.	Name / Range / Selection	Description	Def / Type FbEq 16b / 32b
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
	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
05.22	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 %
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 %

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No.	Name / Range / Selection	Description	Def / Type FbEq 16b / 32b
05.111	Line converter temperature	<i>(Only visible when IGBT supply unit control activated by 95.20)</i> 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 %
05.121	MCB closing counter	<i>(Only visible when IGBT supply unit control activated by 95.20)</i> Counts the closures of the main circuit breaker of the supply unit.	- / uint32
	0...4294967295	Count of closures of main circuit breaker.	1 = 1 / 1 = 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 812. The related status word and state diagram are presented on pages 814 and 815 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. Refer 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 812. 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. Refer section Control word and Status word (page 809). 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. Refer section Control word and Status word (page 809). 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. Refer section The Transparent profile (page 797). 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 814. The related control word and state diagram are presented on pages 812 and 815. Note: In fieldbus control, this parameter value is not exactly the same as the status word that the drive sends to the PLC. Refer 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 814. - This bit is not affected by the presence of a fault.	
b1	Inhibited	1 = Start inhibited. Refer 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. Refer Terms and abbreviations (page 22) .	
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 (refer 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 (refer section Sine filter support (page 200)).	
b13	Reserved		
b14	Stop failed	1 = Stopping failed (refer parameters 31.37 and 31.38)	
b15	Reserved		
	0000h...FFFFh		1 = 1 / 1 = 1

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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. Refer bit-specific notes. Also, refer 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. Refer 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 . Note: - This bit is not updated when mechanical brake control is enabled by par. 44.06 and the drive is modulating. - During a ramp stop when the drive is running forward, the delay count runs whenever [90.01] < [21.06]. From the reverse direction, the delay count runs whenever 90.01 > -[21.06].	
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 feedback	1 = Estimated speed feedback used in motor control, ie. estimated speed is selected by par. 90.41 or 90.46 , or selected encoder has faulted (par. 90.45) 0 = Encoder 1 or 2 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

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No.	Name / Range / Selection	Description	Def / Type FbEq 16b / 32b
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 . 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	
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). Refer section Autophasing (page 171) .	
b5	Brake chopper active	Brake chopper active. Refer section Brake chopper (page 184) .	
b6	Motor temperature estimation active	1 = Motor temperature estimation.	
b7	FSO speed estimate reversed	FSO module speed estimate has been reversed.	
b8...15	Reserved		
	0000h...FFFFh		1 = 1 / 1 = 1

No.	Name / Range / Selection	Description	Def / Type FbEq 16b / 32b
06.25	Drive inhibit status word 2	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.	
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 235).	2
	Other [bit]	See Terms and abbreviations (page 207).	-
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 233).	2
	Other [bit]	See Terms and abbreviations (page 207).	-
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

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No.	Name / Range / Selection	Description	Def / Type FbEq 16b / 32b
	Ext run enable	Inverted bit 5 of 06.18 Start inhibit status word (page 236).	2
	Other [bit]	See Terms and abbreviations (page 207).	-
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 207).	-
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 207).	-
06.36	LSU Status Word	<i>(Only visible when supply unit control activated by 95.20)</i> Shows the status of the supply unit. See also section Control of a supply unit (LSU) (page 151). Parameter group 60 DDCS communication. This parameter is read-only.	0000h / uint16
b0	Ready on	1 = Ready to switch on	
b1	Ready run	1 = Ready to operate, DC link charged	
b2	Ready ref	1 = Operation enabled	
b3	Tripped	1 = A fault is active	
b4	Not In Use	Reserved	
b5	Not In Use	Reserved	
b6	Not In Use	Reserved	
b7	Warning	1 = A warning is active	
b8	Modulating	1 = The supply unit is modulating	
b9	Remote	1 = Remote control (EXT1 or EXT2) 0 = Local control	
b10	Net ok	1 = Supply network voltage OK	
b11	Not In Use	Selectable in supply control program	
b12	Not In Use	Selectable in supply control program	
b13	Not in use	Selectable in supply control program	
b14	Charging	1 = Charging circuit active 0 = Charging circuit inactive	
b15	Not In Use	Selectable in supply control program	

No.	Name / Range / Selection	Description	Def / Type FbEq 16b / 32b
	0000h...FFFFh		1 = 1 / 1 = 1
06.39	Internal state machine LSU CW	<i>(Only visible when supply unit control activated by 95.20)</i> Shows the control word sent to the supply unit from the INU-LSU (inverter unit/supply unit) state machine. This parameter is read-only.	0000h / uint16
b0	ON/OFF	1 = Start charging 0 = Open main contactor (switch power off)	
b1	OFF 2	0 = Emergency stop (Off2)	
b2	OFF 3	0 = Emergency stop (Off3)	
b3	START	1 = Start modulating 0 = Stop modulating	
b4	Not In Use	Reserved	
b5	Not In Use	Reserved	
b6	Not In Use	Reserved	
b7	RESET	0→1 = Reset an active fault. A fresh start command is required after reset.	
b8	Not In Use	Reserved	
b9	Not In Use	Reserved	
b10	Not In Use	Reserved	
b11	Not In Use	Reserved	
b12	USER BIT 0	See parameter 06.40 LSU CW user bit 0 selection.	
b13	USER BIT 1	See parameter 06.41 LSU CW user bit 1 selection.	
b14	USER BIT 2	See parameter 06.42 LSU CW user bit 2 selection.	
b15	USER BIT 3	See parameter 06.43 LSU CW user bit 3 selection.	
	0000h...FFFFh		1 = 1 / 1 = 1
06.40	LSU CW user bit 0 selection	<i>(Only visible when supply unit control activated by 95.20)</i> Selects a binary source whose status is transmitted as bit 12 of 06.39 Internal state machine LSU CW to the supply unit.	MCW user bit 0 / uint32
	FALSE	0	0
	TRUE	1	1
	MCW user bit 0	Bit 12 of 06.01 Main control word (page 233).	2
	MCW user bit 1	Bit 13 of 06.01 Main control word (page 233).	3
	MCW user bit 2	Bit 14 of 06.01 Main control word (page 233).	4
	MCW user bit 3	Bit 15 of 06.01 Main control word (page 233).	5
	Other [bit]	See Terms and abbreviations (page 207).	-

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No.	Name / Range / Selection	Description	Def / Type FbEq 16b / 32b
06.41	LSU CW user bit 1 selection	<i>(Only visible when supply unit control activated by 95.20)</i> Selects a binary source whose status is transmitted as bit 13 of 06.39 Internal state machine LSU CW to the supply unit.	MCW user bit 1 / uint32
	FALSE	0	0
	TRUE	1	1
	MCW user bit 0	Bit 12 of 06.01 Main control word (page 233) .	2
	MCW user bit 1	Bit 13 of 06.01 Main control word (page 233) .	3
	MCW user bit 2	Bit 14 of 06.01 Main control word (page 233) .	4
	MCW user bit 3	Bit 15 of 06.01 Main control word (page 233) .	5
	Other [bit]	See Terms and abbreviations (page 207) .	-
06.42	LSU CW user bit 2 selection	<i>(Only visible when supply unit control activated by 95.20)</i> Selects a binary source whose status is transmitted as bit 14 of 06.39 Internal state machine LSU CW to the supply unit.	MCW user bit 2 / uint32
	FALSE	0	0
	TRUE	1	1
	MCW user bit 0	Bit 12 of 06.01 Main control word (page 233) .	2
	MCW user bit 1	Bit 13 of 06.01 Main control word (page 233) .	3
	MCW user bit 2	Bit 14 of 06.01 Main control word (page 233) .	4
	MCW user bit 3	Bit 15 of 06.01 Main control word (page 233) .	5
	Other [bit]	See Terms and abbreviations (page 207) .	-
06.43	LSU CW user bit 3 selection	<i>(Only visible when supply unit control activated by 95.20)</i> Selects a binary source whose status is transmitted as bit 15 of 06.39 Internal state machine LSU CW to the supply unit.	MCW user bit 3 / uint32
	FALSE	0	0
	TRUE	1	1
	MCW user bit 0	Bit 12 of 06.01 Main control word (page 233) .	2
	MCW user bit 1	Bit 13 of 06.01 Main control word (page 233) .	3
	MCW user bit 2	Bit 14 of 06.01 Main control word (page 233) .	4
	MCW user bit 3	Bit 15 of 06.01 Main control word (page 233) .	5
	Other [bit]	See Terms and abbreviations (page 207) .	-
06.45	Follower CW user bit 0 selection	Selects a binary source whose status is transmitted as bit 12 of the Follower control word to follower drives. (Bits 0...11 of the Follower control word are taken from 06.01 Main control word .) See also section Master/follower functionality .	MCW user bit 0 / uint32

No.	Name / Range / Selection	Description	Def / Type FbEq 16b / 32b
	FALSE	0	0
	TRUE	1	1
	MCW user bit 0	Bit 12 of 06.01 Main control word (page 233) .	2
	MCW user bit 1	Bit 13 of 06.01 Main control word (page 233) .	3
	MCW user bit 2	Bit 14 of 06.01 Main control word (page 233) .	4
	MCW user bit 3	Bit 15 of 06.01 Main control word (page 233) .	5
	Other [bit]	See Terms and abbreviations (page 207) .	-
06.46	Follower CW user bit 1 selection	Selects a binary source whose status is transmitted as bit 13 of the Follower control word to follower drives. (Bits 0...11 of the Follower control word are taken from 06.01 Main control word .)	MCW user bit 1 / uint32
	FALSE	0	0
	TRUE	1	1
	MCW user bit 0	Bit 12 of 06.01 Main control word (page 233) .	2
	MCW user bit 1	Bit 13 of 06.01 Main control word (page 233) .	3
	MCW user bit 2	Bit 14 of 06.01 Main control word (page 233) .	4
	MCW user bit 3	Bit 15 of 06.01 Main control word (page 233) .	5
	Other [bit]	See Terms and abbreviations (page 207) .	-
06.47	Follower CW user bit 2 selection	Selects a binary source whose status is transmitted as bit 14 of the Follower control word to follower drives. (Bits 0...11 of the Follower control word are taken from 06.01 Main control word .)	MCW user bit 2 / uint32
	FALSE	0	0
	TRUE	1	1
	MCW user bit 0	Bit 12 of 06.01 Main control word (page 233) .	2
	MCW user bit 1	Bit 13 of 06.01 Main control word (page 233) .	3
	MCW user bit 2	Bit 14 of 06.01 Main control word (page 233) .	4
	MCW user bit 3	Bit 15 of 06.01 Main control word (page 233) .	5
	Other [bit]	See Terms and abbreviations (page 207) .	-
06.48	Follower CW user bit 3 selection	Selects a binary source whose status is transmitted as bit 15 of the Follower control word to follower drives. (Bits 0...11 of the Follower control word are taken from 06.01 Main control word .)	MCW user bit 3 / uint32
	FALSE	0	0
	TRUE	1	1
	MCW user bit 0	Bit 12 of 06.01 Main control word (page 233) .	2
	MCW user bit 1	Bit 13 of 06.01 Main control word (page 233) .	3
	MCW user bit 2	Bit 14 of 06.01 Main control word (page 233) .	4
	MCW user bit 3	Bit 15 of 06.01 Main control word (page 233) .	5
	Other [bit]	See Terms and abbreviations (page 207) .	-

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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 207) .	-
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 237) .	2
	Other [bit]	See Terms and abbreviations (page 207) .	-
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 235) .	2
	Other [bit]	See Terms and abbreviations (page 207) .	-
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 235) .	2
	Other [bit]	See Terms and abbreviations (page 207) .	-
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 207) .	-
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 207) .	-
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 207) .	-
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 235) .	2
	Other [bit]	See Terms and abbreviations (page 207) .	-
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 236) .	2
	Other [bit]	See Terms and abbreviations (page 207) .	-
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

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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 234) .	2
	Other [bit]	See Terms and abbreviations (page 207) .	-
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 235) .	2
	Other [bit]	See Terms and abbreviations (page 207) .	-
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 237) .	2
	Other [bit]	See Terms and abbreviations (page 207) .	-
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 237) .	2
	Other [bit]	See Terms and abbreviations (page 207) .	-
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 207) .	-
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 207) .	-
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 207) .	-
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.	

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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
06.116	LSU drive status word 1	<i>(Only visible when IGBT supply unit control activated by 95.20)</i> Drive status word 1 received from the supply unit. See also section Control of a supply unit (LSU) (page 151). Parameter group 60 DDCS communication. This parameter is read-only.	- / uint16
b0	Enabled	1 = Run enable and start enable signals are present	
b1	Inhibited	1 = Start inhibited	
b2	Operation allowed	1 = Drive is ready to operate	
b3	Ready to start	1 = Drive is ready to receive a start command	
b4	Running	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 is active	
b8	Local control	1 = Drive is in local control	
b9	Network control	1 = Drive is in network control	

No.	Name / Range / Selection	Description	Def / Type FbEq 16b / 32b
b10	Ext1 active	1 = Control location Ext1 active	
b11	Ext2 active	1 = Control location Ext2 active	
b12	Charging relay	1 = Charging contactor is energized. The actual state depends on the hardware topology (NO or NC).	
b13	MCB relay	1 = MCB relay is closed	
b14...15	Reserved		
	0000h...FFFFh		1 = 1 / 1 = 1
06.118	LSU start inhibit status word	<i>(Only visible when IGBT supply unit control activated by 95.20)</i> This word specifies the source of the inhibiting condition that is preventing the supply unit from starting. See also section Control of a supply unit (LSU) (page 151). Parameter group 60 DDCS communication. This parameter is read-only.	- / uint16
b0	Not ready run		
b1	Ctrl location changed		
b2	SSW inhibit		
b3	Fault reset		
b4	Lost start enable		
b5	Lost run enable		
b6...8	Reserved		
b9	Charging overload		
b10...11	Reserved		
b12	Em Off2		
b13	Em Off3		
b14	Auto reset inhibit		
b15	Reserved		
	0000h...FFFFh		1 = 1 / 1 = 1

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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	<i>(Only visible with option +N8010 [application programmability])</i> Shows which tasks of the application program are running. See the <i>Drive (IEC 61131-3) application programming manual (3AUA0000127808 [English])</i> .	- / 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	<i>(Only visible with option +N8010 [application programmability])</i> Shows the status of the openings in the application program. See the <i>Drive (IEC 61131-3) application programming manual</i> (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	<i>(Only visible with option +N8010 [application programmability])</i> 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	<i>(Only visible with option +N8010 [application programmability])</i> 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

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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. Refer section Adaptive programming (page 138) .	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	<i>(Only visible with option +N8010 [application programmability])</i> 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	<i>(Only visible with option +N8010 [application programmability])</i> 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
07.106	LSU loading package name	<i>(Only visible when IGBT supply unit control activated by 95.20)</i> Name of the loading package of the supply unit firmware.	- / uint32

No.	Name / Range / Selection	Description	Def / Type FbEq 16b / 32b
07.107	LSU loading package version	<i>(Only visible when IGBT supply unit control activated by 95.20)</i> Version number of the loading package of the supply unit firmware.	- / uint32

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No.	Name / Range / Selection	Description	Def / Type FbEq 16b / 32b
09	Winch actual signals	Monitoring signals related to winch control program.	
09.01	Winch status word 1	A 16-bit data word. Displays the status of various winch modes or functions that are active.	0000 0000 0000 0000 / uint16
b0	Anchor mode active	Anchor mode is enabled by activating the configured input in parameter 74.01 Anchor mode enable .	
b1	Handmooring mode active	Handmooring mode is enabled by activating the configured input in parameter 74.02 Handmooring mode enable .	
b2	Automooring mode active	Automooring mode is enabled by activating the configured input in parameter 74.03 Auto mooring mode enable or by Auto mooring setpoint selector source in parameter group 76 Auto mooring.	
b3	Reserved		
b6	Speed lim in set1 from power ctrl	Speed limitation in forward operation from the power control logic.	
b7	Speed lim in set2 from power ctrl	Speed limitation in reverse operation from the power control logic.	
b8	Anchor stowing prot active	Anchor stowing protection is active	
b9	Anchor at chain length limit	Anchor chain position inside protection region.	
b10	Anchor stowing prot disable time	Anchor stowing protection is temporarily disabled.	
b11	Slip detected	Slip detection is active.	
b12	Slip detection disable time	Slip detection disable time running.	
b13	Peak torque protection active	Peak torque protection is active.	
b14	Torque proving ok	Torque proving successful.	
b15	Reserved		
	0000h...FFFFh		1 / 1
09.02	Winch status word 2	A 16-bit data word. Displays the status of various control stands and currently active speed selection and direction. Active=1 Inactive=0	0000 0000 0000 0000 / uint16
b0	Control stand 1 active	Control stand 1 is activated to control the winch. See parameter 75.10 Control stand 1 enable .	
b1	Control stand 2 active	Control stand 2 is activated to control the winch. See parameter 75.14 Control stand 2 enable .	
b2	Control stand 3 active	Control stand 3 is activated to control the winch. See parameter 75.18 Control stand 3 enable .	

No.	Name / Range / Selection	Description	Def / Type FbEq 16b / 32b
b3	FB control stand active	Fieldbus control stand is activated to control the winch. See parameter 75.22 Include FB control stand .	
b4	Control stand 1 start heaving	Winch operates from control stand 1 in the heaving direction. See parameter 75.12 Control stand 1 heave .	
b5	Control stand 1 start lowering	Winch operates from control stand 1 in the lowering direction. See parameter 75.13 Control stand 1 lower .	
b6	Control stand 2 start heaving	Winch operates from control stand 2 in the heaving direction. See parameter 75.16 Control stand 2 heave .	
b7	Control stand 2 start lowering	Winch operates from control stand 2 in the lowering direction. See parameter 75.13 Control stand 1 lower .	
b8	Control stand 3 start heaving	Winch operates from control stand 3 in the heaving direction. See parameter 75.20 Control stand 3 heave .	
b9	Control stand 3 start lowering	Winch operates from control stand 3 in the lowering direction. See parameter 75.21 Control stand 3 lower .	
b10	FB control stand start heaving	Winch operates from fieldbus control stand in the heaving direction.	
b11	FB control stand start lowering	Winch operates from fieldbus control stand in the lowering direction.	
b12	Any stand active	Any one of the control stand is enabled at present.	
b13	Any stand heaving	Any one of the control stand is heaving at present.	
b14	Any stand lowering	Any one of the control stand is lowering at present.	
b15	Reserved		
	0000h...FFFFh		1 / 1
09.03	Winch status word 3	A 16-bit data word. Displays the status of various Automoorings states that are active. Active=1 Inactive=0	0000 0000 0000 0000 / uint16
b0	AM load above hysteresis high	Automoorings load or actual rope tension is above hysteresis high level.	
b1	AM load btw hyst high and DB high	Automoorings load or actual rope tension is between hysteresis high level and deadband high level.	
b2	AM load inside upper deadband	Automoorings load or actual rope tension is between upper deadband and Automoorings setpoint level.	
b3	AM load inside lower deadband	Automoorings load or actual rope tension is between lower deadband and Automoorings setpoint level.	
b4	AM load btw DB low and hyst low	Automoorings load or actual rope tension is between deadband low level and hysteresis low level.	
b5	AM load below hysteresis low	Automoorings re-moorings load or actual rope tension is below the hysteresis low level.	
b6	AM re-moorings time active	Automoorings re-moorings time is active.	
b7	AM torque measuring active	Automoorings torque measuring time is active.	

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No.	Name / Range / Selection	Description	Def / Type FbEq 16b / 32b
b8	AM max time reached	Automooring maximum time is reached see parameter 76.60 Max AM time .	
b9	AM re-mooring switchover elapsed	Automooring re-mooring switchover time has elapsed and Re-mooring time interval 2 (76.52 Re-mooring time 1/2 switch src and 76.53 Re-mooring switchover time 1/2) is active.	
b10	AM tension below min level	Automooring load or actual rope tension is below the minimum level set in parameter 76.05 Automooring min tension .	
b11	AM enable by set-point switch	Automooring is enabled by any of the Automooring setpoint selector source defined in parameter 76.20 AM setpoint selector 1 srcA to 76.28 AM setpoint selector 3 srcC . In parameter 74.03 Automooring mode enable , select AM setpoint switch for this feature to work.	
b12	AM joystick motpot active	Automooring setpoint is varied using control stand joystick.	
b13	AM Cont to Time switchover elapsed	Automooring mode switched over to Time control mode from the initial continuous mode. See parameter 76.01 Automooring mode .	
b14	Automooring indication	Automooring is active without any faults. This bit becomes FALSE when the drive is tripped.	
b15	Reserved		
	0000h...FFFFh		1 / 1
09.04	Winch status word 4	A 16-bit data word. Displays the status of clutch control speed.	0000 0000 0000 0000 / uint16
b0	Clutch control speed 1 active	Winch is running with Clutch control speed 1.	
b1	Clutch control speed 2 active	Winch is running with Clutch control speed 2.	
b2	Anchor mode heaving	Anchor mode in the heave direction.	
b3	Anchor mode lowering	Anchor mode in the lower direction.	
b4	Reserved		
b5	AM cont & time switch list	Active automooring setpoint is greater than setpoint 1. See parameter 09.22 . This bit is mapped to Setpoint switch list in parameter 76.55 to switch between Continuous + Time control modes in parameter 76.01 .	
b6	Winch system ID run active	Winch system ID run is active. See parameter 74.60 .	
b7...9	Reserved		
b10	Parking mode	Reserved	
b11...15	Reserved		
	0000h...FFFFh		1 / 1

No.	Name / Range / Selection	Description	Def / Type FbEq 16b / 32b
09.05	Winch abnormal condition status	A 16-bit data word. Displays the status of winch abnormal condition.	0000 0000 0000 0000 / uint16
b0	Indication signal	Combined indication signal: Bit continuous = 1, when the system has an active fault Bit continuous blinking = 1 -> 0 -> 1, when actual torque is above the abnormal torque level of motor (par. 74.110) for more than one second.	
b1	Faulted	1 = Drive is faulted 0 = Drive has no active faults	
b2	High torque in anchor mode	1 = High torque condition detected in anchor mode, that is actual torque is above the abnormal torque level of motor (par. 74.110) for more than one second. 0 = No high torque condition detected in anchor mode.	
b3	High torque in handmooring mode	1 = High torque condition detected in handmooring mode, that is actual torque is above the abnormal torque level of motor (par. 74.110) for more than one second. 0 = No high torque condition detected in handmooring mode.	
b4	High torque in automooring mode	1 = High torque condition detected in automooring mode, that is actual torque is above the abnormal torque level of motor (par. 74.110) for more than one second. 0 = No high torque condition detected in automooring mode.	
b5	Fault/ secondary fault indication	Fault and Secondary fault indication status bit: Every new fault resets the bit to False status and after two seconds reverts back to True status. Bit provides information for up to five active faults.	
b6...15	Reserved		
	0000h...FFFFh		1 / 1
09.06	Winch M/F status	Displays the current role of drive in the D2D network.	None / uint32
	None	Drive role in D2D network is not defined	0
	Main master winch	Drive is a D2D Main master winch	1
	Sub master winch	Drive is a Sub master winch	2
	Follower for main master	Drive is a follower for the Main master winch drive	3
	Follower for sub master	Drive is a follower for the sub master winch drive	4
09.07	Winch actual status	Displays the actual winch status in text form.	Local control / uint16
	Local control	Drive in local control mode	0
	EXT1	Drive in Ext 1 control mode	1

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No.	Name / Range / Selection	Description	Def / Type FbEq 16b / 32b
	EXT2 No mode	Drive in Ext 2 control mode, none of winch modes are active.	2
	Anchor mode	Drive in Anchor mode	3
	Handmooring mode	Drive in Handmooring mode	4
	Automooring mode	Drive in automooring mode	5
	Clutch control	Drive in clutch control mode	6
	D2D follower	Drive is a D2D follower	7
	Anchor parking mode	Reserved	8
09.09	Winch FB control word	Displays the status of fieldbus control stand, active speed selection and direction. When parameter 75.22 Include FB control stand is selected as Yes then this parameter defines the fieldbus control stand bits. The winch control word from the fieldbus, that is, parameter Ref2 16bit , must be mapped to this parameter.	0000 0000 0000 0000 / uint16
b0	FB control stand enable	0 = Enable command from fieldbus is FALSE 1 = Enable command from fieldbus is TRUE	
b1	FB control stand heave	0 = Heave command from fieldbus is FALSE 1 = Heave command from fieldbus is TRUE	
b2	FB control stand lower	0 = Lower command from fieldbus is FALSE 1 = Lower command from fieldbus is TRUE	
b3	FB clutch speed 1 start	0 = Clutch speed1 start command from fieldbus is FALSE 1 = Clutch speed1 start command from fieldbus is TRUE	
b4	FB clutch speed 2 start	0 = Clutch speed2 start command from fieldbus is FALSE 1 = Clutch speed2 start command from fieldbus is TRUE	
b5	FB control stand fault reset	0 = Fault reset command from fieldbus is FALSE 1 = Fault reset command from fieldbus is TRUE	
b6...15	Reserved		
	0000h...FFFFh		1 / 1
09.11	Chain actual speed	Displays the chain/rope speed in millimetres per second. The chain actual speed is calculated from the position information signal received from the source selected with parameter 74.11 Chain length source .	0.000 m/s / real32
	-2000.000 ... 2000.000 m/s	Chain actual speed.	100 = 1 m/s / 1 = 1 m/s
09.13	Chain length OUT	Actual length of chain in mm rolled out from the winch drum. The total length of chain on the winch drum is set in parameter 74.12 Chain absolute length .	0.000 m / real32

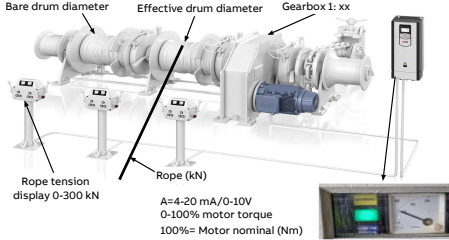
No.	Name / Range / Selection	Description	Def / Type FbEq 16b / 32b
	-2000.000 ... 2000.000 m	Chain length OUT.	100 = 1 m / 1 = 1 m
09.14	Chain length IN	Actual length of chain in mm still on the winch drum. The total length of chain on the winch drum is set in parameter 74.12 Chain absolute length .	0.000 m / real32
	-2000.000 ... 2000.000 m	Chain length IN.	100 = 1 m / 1 = 1 m
09.15	Chain actual speed m/min	Displays the chain/rope speed in meters per minute. The chain/rope actual speed is calculated from the position information signal received from the source selected with parameter 74.11 Chain length source .	0.000 m/min / real32
	-120000.000 ... 120000.000 m/min	Chain actual speed in m/min.	100 = 1 m/min / 1 = 1 m/min
09.17	Winch motor torque	Winch motor torque in percent of the nominal motor torque.	0.0 % / real32
	-600.0 ... 600.0%	Motoring power limit for handmooring.	10 = 1% / 1 = 1%
09.19	Winch motor torque capacity	Defines the torque of the winch motor in Nm that corresponds to 100% setpoint of the reference.	0.000 Nm / real32
	0.000 ... 4000000.000 Nm	Torque (Nm) corresponding to the 100% setpoint of the reference.	1000 = 1 Nm / 1 = 1 Nm
09.20	Winch speed ref	Final winch speed reference in rpm.	0 rpm / real32
	-15000...15000 rpm	Winch speed reference.	1 = 1 rpm / 1 = 1 rpm
09.21	Power control ref	The torque reference used in power control against the cross points. In forward operation (heaving the winch), this value is same as the calculated motor torque 01.10 Motor torque. In reverse operation (lowering the winch), this value is the calculated motor actual torque 01.10 Motor torque plus the buffer torques in 80.22 Acc torque buffer and 80.23 Dec torque buffer.	0.00 % / real32
	-600.00 ... 600.00%	Power control ref	10 = 1% / 1 = 1%
09.22	Automooring actual setpoint	Actual Automooring set point (%) defined by parameter 76.13 Automooring setpoint selection and limited by parameters 76.11 Min automooring setpoint level and 76.12 Max automooring setpoint level. 100% corresponds to the nominal torque of the winch motor is required.	0.0 % / real32
	0.0 ... 1000000.0%	Automooring actual setpoint.	10 = 1% / 1 = 1%

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No.	Name / Range / Selection	Description	Def / Type FbEq 16b / 32b
09.23	Rope actual tension	Actual rope tension/force (%). 100% corresponds to the nominal torque of the winch motor. Note: When a load cell sensor is selected with parameter 76.10 Tension feedback source, this signal always shows the actual rope tension value. When internal DTC calculation is selected with parameter 76.10 Tension feedback source, this signal shows the calculated tension only when Automoor- ing stop command is given. When tension feedback source is selected as load cell, this parameter continuously displays the actual load cell feedback value.	0.0 % / real32
	0.0 ... 32767.0%	Rope actual tension.	10 = 1% / 1 = 1%
09.24	Rope tension memorized	Actual motor torque value memorized when Automoor- ing stop command is given. When tension feedback source is selected as load cell, this parameter continuously displays the actual load cell feedback value.	0.0 % / real32
	0.0 ... 32767.0%	Rope tension memorized.	10 = 1% / 1 = 1%
09.25	Automoor- ing control deviation	Automoor- ing control deviation between the reference value and the actual value (difference between 09.22 Automoor- ing actual setpoint and 09.23 Rope actual tension).	0.0 % / real32
	-32768.0 ... 32767.0%	Automoor- ing control deviation.	10 = 1% / 1 = 1%
09.26	AM hysteresis high used	Calculated actual value of Automoor- ing hysteresis high level.	0.0 % / real32
	0.0 ... 32767.0%	Automoor- ing hysteresis high used.	10 = 1% / 1 = 1%
09.27	AM hysteresis low used	Calculated actual value of Automoor- ing hysteresis low level.	0.0 % / real32
	0.0 ... 32767.0%	Automoor- ing hysteresis low used.	10 = 1% / 1 = 1%
09.28	AM deadband high used	Calculated actual value of Automoor- ing deadband high level.	0.0 % / real32
	0.0 ... 32767.0%	AM deadband high used.	10 = 1% / 1 = 1%
09.29	AM deadband low used	Calculated actual value of Automoor- ing deadband low level.	0.0 % / real32
	0.0 ... 32767.0%	AM deadband low used.	10 = 1% / 1 = 1%
09.30	AM setpoint switch output	The final Automoor- ing setpoint based on the status of the digital input source defined in parameter 76.20 AM setpoint selector 1 srcA to 76.28 AM setpoint selector 3 srcC. In parameter 76.13 Automoor- ing setpoint selection, select Switch list output to use this value as AM setpoint.	0.0 % / real32
	0.0 ... 1000000.0%	AM setpoint switch output.	10 = 1% / 1 = 1%
09.31	Rotating mode rope tension	Actual rope tension calculated when the torque measuring mode is set to rotating mode.	0.0 % / real32
	0.0 ... 32767.0%	AM setpoint switch output.	10 = 1% / 1 = 1%

No.	Name / Range / Selection	Description	Def / Type FbEq 16b / 32b
09.32	Winch scaled tension	Actual torque of the electric motor scaled to the nominal load of the actual winch. The calculation is made using the below mentioned equation. $\text{Actual tension} \times \frac{100\%}{\text{Winch actual tension}}$	0.0 % / real32
	0.0 ... 32767.0%	Winch actual tension.	10 = 1% / 1 = 1%
09.33	AM joystick motpot output	Displays the value of Automoorring setpoint when Automoorring mode is active and the parameter 76.13 Automoorring setpoint selection is set to joystick motor potentiometer.	0.0 % / real32
	0.0 ... 1000000.0%	Automoorring joystick motpot output.	10 = 1% / 1 = 1%
09.35	Step reference output	Displays the value of step speed reference, when source of control stand reference (parameter 75.11 , 75.15 or 75.19) is set to Step reference.	0.00 % / real32
	0.00 ... 100.00%	Step reference output	100 = 1% / 1 = 1%
09.36	AM scaled setpoint	Displays Automoorring setpoint scaled to the value of parameter 74.44 Automoorring max torque .	0.0 % / real32
	0.0 ... 1000000.0%	Automoorring scaled setpoint.	10 = 1% / 1 = 1%
09.37	AM combined setpoint/actual	Displays the Automoorring scaled setpoint whenever there is a change in Automoorring setpoint. Otherwise, this parameter displays the winch scaled tension. See parameters 09.32 Winch scaled tension and 09.36 AM scaled setpoint . Parameter 76.54 Re-moorring wakeup level affects the change in setpoint required to switch temporarily from parameters 09.32 Winch scaled tension to 09.36 AM scaled setpoint .	0.0 % / real32
	0.0 ... 1000000.0%	Automoorring combined setpoint/actual.	10 = 1% / 1 = 1%
09.40	Winch operating time	Displays the number of hours the winch is operating with open brake. The counter can be initialized with parameters 33.200 Reset winch counters and 33.201 Winch operating time preset value .	0 hours / uint32
	0...1100000 hours	Winch operating time in hours.	1 = 1 hours / 1 = 1 hours
09.41	Number of power on	Displays the number of times the winch system is powered on. The counter can be initialized with parameters 33.200 Reset winch counters and 33.202 Number of power on preset value .	0 NoUnit / uint16
	0...65535	Number of power on.	1 = 1 / 1 = 1

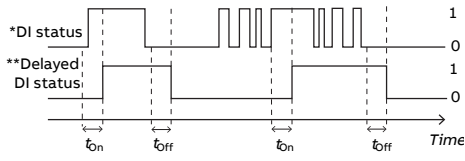
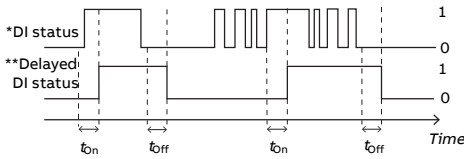
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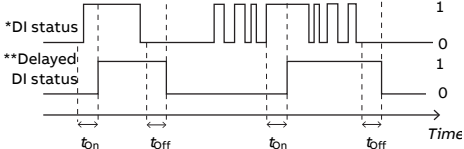
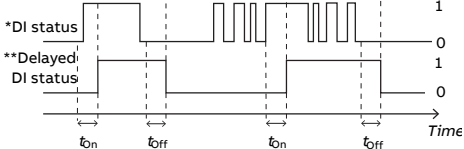
No.	Name / Range / Selection	Description	Def / Type FbEq 16b / 32b
09.42	Number of brake open	Displays the number of times the mechanical brake is opened. The counter can be initialized with parameters 33.200 Reset winch counters and 33.203 Number of brake open preset value .	0 NoUnit / uint32
	0...2147483647	Number of brake open	1 = 1 / 1 = 1
09.50	Rope actual force	Shows the calculated value of rope actual force in kN based on actual rope tension in percent, gear ratio, and the actual diameter of the drum. See parameters 09.51 Gear ratio motor to drum and 09.52 Drum actual diameter .	0.00 kN / real32
			
	0.00 ... 32000.00 kN	Rope actual tension converted	100 = 1 kN / 1 = 1 kN
09.51	Gear ratio motor to drum	Defines gear ratio motor to drum. Used in calculation to convert motor torque to torque in the load side.	1.000 NoUnit / real32
	-32000.000 ... 32000.000	Gear ratio of the motor to the drum.	1000 = 1 / 1 = 1
09.52	Drum actual diameter	Defines actual diameter of the drum with rope. The actual diameter is used in arm calculations to convert torque to tension fore.	1.000 m / real32
	0.000 ... 32.000 m	Actual diameter of the drum.	1000 = 1 m / 1 = 1 m
09.53	Winch efficiency	Displays the winch efficiency in percentage.	100.0 % / real32
	0.0 ... 200.0%	Winch efficiency.	10 = 1% / 1 = 1%
09.55	Rope force update delay	Displays the delay time in updating the actual rope force.	0.00 s / real32
	0.00 ... 32.00 s	Rope force update delay.	100 = 1 s / 1 = 1 s
09.60	Rope force memorized	Shows the calculated value of memorized rope force in kN.	0.00 kN / real32
	0.00 ... 32000.00 kN	Rope force.	100 = 1 kN / 1 = 1 kN
09.200	CC Winch SW 1	A 16-bit data word. Displays the status of clutch control speed.	0000 0000 0000 0000 / uint16
	b0 Control stand 2 ref active	0 = Control stand 2 reference is inactive 1 = Control stand 2 reference is active	

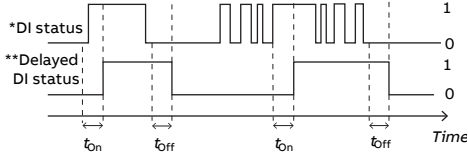
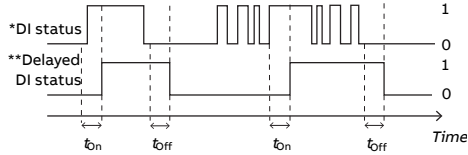
No.	Name / Range / Selection	Description	Def / Type FbEq 16b / 32b
b1	Control stand 3 ref active	0 = Control stand 3 reference is inactive 1 = Control stand 3 reference is active	
b2	Brake force time delay	0 = Brake force time delay is inactive 1 = Brake force time delay is active	
b3	General failure	0 = General failure is inactive 1 = General failure is active	
b4...15	Reserved		
	0000h...FFFFh		1 / 1

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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

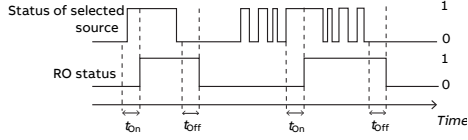
No.	Name / Range / Selection	Description	Def / Type FbEq 16b / 32b
10.05	DI1 ON delay	Defines the activation delay for digital input DI1.  t_{On} = 10.05 DI1 ON delay t_{Off} = 10.06 DI1 OFF delay *Electrical status of digital input. Indicated by 10.01 DI status. **Indicated by 10.02 DI delayed status.	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

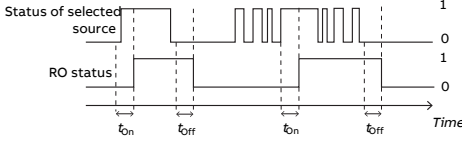
No.	Name / Range / Selection	Description	Def / Type FbEq 16b / 32b
10.13	DI5 ON delay	Defines the activation delay for digital input DI5.  t_{On} = 10.13 DI5 ON delay t_{Off} = 10.14 DI5 OFF delay *Electrical status of digital input. Indicated by 10.01 DI status. **Indicated by 10.02 DI delayed status.	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 234).	2

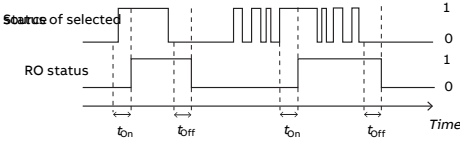
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No.	Name / Range / Selection	Description	Def / Type FbEq 16b / 32b
	Enabled	Bit 0 of 06.16 Drive status word 1 (page 234) .	4
	Started	Bit 5 of 06.16 Drive status word 1 (page 234) .	5
	Magnetized	Bit 1 of 06.17 Drive status word 2 (page 235) .	6
	Running	Bit 6 of 06.16 Drive status word 1 (page 234) .	7
	Ready ref	Bit 2 of 06.11 Main status word (page 234) .	8
	At setpoint	Bit 8 of 06.11 Main status word (page 234) .	9
	Reverse	Bit 2 of 06.19 Speed control status word (page 237) .	10
	Zero speed	Bit 0 of 06.19 Speed control status word (page 237) .	11
	Above limit	Bit 10 of 06.17 Drive status word 2 (page 235) .	12
	Warning	Bit 7 of 06.11 Main status word (page 234) .	13
	Fault	Bit 3 of 06.11 Main status word (page 234) .	14
	Fault (-1)	Inverted bit 3 of 06.11 Main status word (page 234) .	15
	Start request	Bit 13 of 06.16 Drive status word 1 (page 234) .	16
	Open brake com- mand	Bit 0 of 44.01 Brake control status (page 481) .	22
	Ext2 active	Bit 11 of 06.16 Drive status word 1 (page 234) .	23
	Remote control	Bit 9 of 06.11 Main status word (page 234) .	24
	Supervision 1	Bit 0 of 32.01 Supervision status (page 440) .	33
	Supervision 2	Bit 1 of 32.01 Supervision status (page 440) .	34
	Supervision 3	Bit 2 of 32.01 Supervision status (page 440) .	35
	RO/DIO control word bit0	Bit 0 of 10.99 RO/DIO control word (page 272) .	40
	RO/DIO control word bit1	Bit 1 of 10.99 RO/DIO control word (page 272) .	41
	RO/DIO control word bit2	Bit 2 of 10.99 RO/DIO control word (page 272) . Note: This selection is applicable for ZCU and UCU-22...24 control units.	42
	RO/DIO control word bit8	Bit 8 of 10.99 RO/DIO control word (page 272) .	43
	RO/DIO control word bit9	Bit 9 of 10.99 RO/DIO control word (page 272) .	44
	Other [bit]	See Terms and abbreviations (page 207) .	-

No.	Name / Range / Selection	Description	Def / Type FbEq 16b / 32b
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
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 234).	2
	Enabled	Bit 0 of 06.16 Drive status word 1 (page 234).	4
	Started	Bit 5 of 06.16 Drive status word 1 (page 234).	5
	Magnetized	Bit 1 of 06.17 Drive status word 2 (page 235).	6
	Running	Bit 6 of 06.16 Drive status word 1 (page 234).	7
	Ready ref	Bit 2 of 06.11 Main status word (page 234).	8
	At setpoint	Bit 8 of 06.11 Main status word (page 234).	9
	Reverse	Bit 2 of 06.19 Speed control status word (page 237).	10
	Zero speed	Bit 0 of 06.19 Speed control status word (page 237).	11
	Above limit	Bit 10 of 06.17 Drive status word 2 (page 235).	12
	Warning	Bit 7 of 06.11 Main status word (page 234).	13
	Fault	Bit 3 of 06.11 Main status word (page 234).	14
	Fault (-1)	Inverted bit 3 of 06.11 Main status word (page 234).	15
	Start request	Bit 13 of 06.16 Drive status word 1 (page 234).	16
	Open brake command	Bit 0 of 44.01 Brake control status (page 481).	22
	Ext2 active	Bit 11 of 06.16 Drive status word 1 (page 234).	23
	Remote control	Bit 9 of 06.11 Main status word (page 234).	24
	Supervision 1	Bit 0 of 32.01 Supervision status (page 440).	33
	Supervision 2	Bit 1 of 32.01 Supervision status (page 440).	34
	Supervision 3	Bit 2 of 32.01 Supervision status (page 440).	35
	RO/DIO control word bit0	Bit 0 of 10.99 RO/DIO control word (page 272).	40

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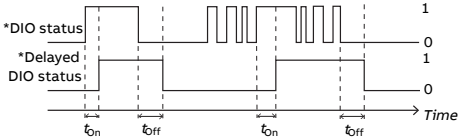
No.	Name / Range / Selection	Description	Def / Type FbEq 16b / 32b
	RO/DIO control word bit1	Bit 1 of 10.99 RO/DIO control word (page 272) .	41
	RO/DIO control word bit2	Bit 2 of 10.99 RO/DIO control word (page 272) . Note: This selection is applicable for ZCU and UCU-22...24 control units.	42
	RO/DIO control word bit8	Bit 8 of 10.99 RO/DIO control word (page 272) .	43
	RO/DIO control word bit9	Bit 9 of 10.99 RO/DIO control word (page 272) .	44
	Other [bit]	See Terms and abbreviations (page 207) .	-
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 234) .	2
	Enabled	Bit 0 of 06.16 Drive status word 1 (page 234) .	4
	Started	Bit 5 of 06.16 Drive status word 1 (page 234) .	5
	Magnetized	Bit 1 of 06.17 Drive status word 2 (page 235) .	6
	Running	Bit 6 of 06.16 Drive status word 1 (page 234) .	7
	Ready ref	Bit 2 of 06.11 Main status word (page 234) .	8
	At setpoint	Bit 8 of 06.11 Main status word (page 234) .	9
	Reverse	Bit 2 of 06.19 Speed control status word (page 237) .	10
	Zero speed	Bit 0 of 06.19 Speed control status word (page 237) .	11
	Above limit	Bit 10 of 06.17 Drive status word 2 (page 235) .	12
	Warning	Bit 7 of 06.11 Main status word (page 234) .	13
	Fault	Bit 3 of 06.11 Main status word (page 234) .	14
	Fault (-1)	Inverted bit 3 of 06.11 Main status word (page 234) .	15

No.	Name / Range / Selection	Description	Def / Type FbEq 16b / 32b
	Start request	Bit 13 of 06.16 Drive status word 1 (page 234).	16
	Open brake command	Bit 0 of 44.01 Brake control status (page 481).	22
	Ext2 active	Bit 11 of 06.16 Drive status word 1 (page 234).	23
	Remote control	Bit 9 of 06.11 Main status word (page 234).	24
	Supervision 1	Bit 0 of 32.01 Supervision status (page 440).	33
	Supervision 2	Bit 1 of 32.01 Supervision status (page 440).	34
	Supervision 3	Bit 2 of 32.01 Supervision status (page 440).	35
	RO/DIO control word bit0	Bit 0 of 10.99 RO/DIO control word (page 272).	40
	RO/DIO control word bit1	Bit 1 of 10.99 RO/DIO control word (page 272).	41
	RO/DIO control word bit2	Bit 2 of 10.99 RO/DIO control word (page 272). Note: This selection is applicable for ZCU and UCU-22...24 control units.	42
	RO/DIO control word bit8	Bit 8 of 10.99 RO/DIO control word (page 272).	43
	RO/DIO control word bit9	Bit 9 of 10.99 RO/DIO control word (page 272).	44
	Other [bit]	See Terms and abbreviations (page 207).	-
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

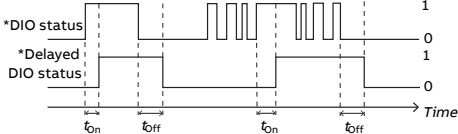
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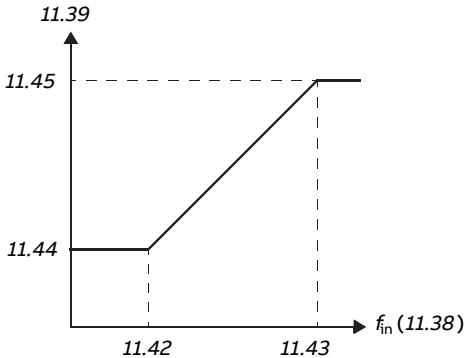
No.	Name / Range / Selection	Description	Def / Type FbEq 16b / 32b
10.99	RO/DIO control word	Storage parameter for controlling the relay outputs and digital input/outputs eg. through the embedded fieldbus interface. To control the relay outputs (RO) and the digital input/outputs (DIO) of the drive, send 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 .	
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

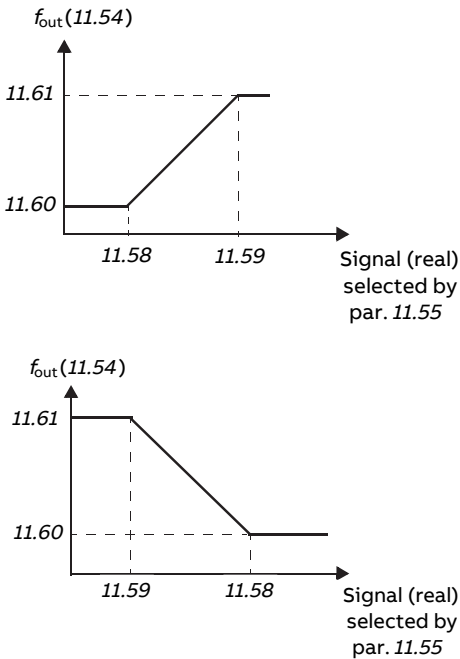
No.	Name / Range / Selection	Description	Def / Type FbEq 16b / 32b
11	Standard DIO, FI, FO	Configuration of digital input/outputs and frequency inputs/outputs.	
11.01	DIO status	Displays the status of digital input/outputs DIO2 and DIO1. Note: DIO3 is compatible with UCU-20 control units only. The activation/deactivation 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. Note: DIO3 is compatible with UCU-20 control units only. 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 234) .	2
	Enabled	Bit 0 of 06.16 Drive status word 1 (page 234) .	4
	Started	Bit 5 of 06.16 Drive status word 1 (page 234) .	5
	Magnetized	Bit 1 of 06.17 Drive status word 2 (page 235) .	6
	Running	Bit 6 of 06.16 Drive status word 1 (page 234) .	7
	Ready ref	Bit 2 of 06.11 Main status word (page 234) .	8
	At setpoint	Bit 8 of 06.11 Main status word (page 234) .	9
	Reverse	Bit 2 of 06.19 Speed control status word (page 237) .	10
	Zero speed	Bit 0 of 06.19 Speed control status word (page 237) .	11
	Above limit	Bit 10 of 06.17 Drive status word 2 (page 235) .	12
	Warning	Bit 7 of 06.11 Main status word (page 234) .	13

No.	Name / Range / Selection	Description	Def / Type FbEq 16b / 32b
	Fault	Bit 3 of 06.11 Main status word (page 234) .	14
	Fault (-1)	Inverted bit 3 of 06.11 Main status word (page 234) .	15
	Start request	Bit 13 of 06.16 Drive status word 1 (page 234) .	16
	Open brake command	Bit 0 of 44.01 Brake control status (page 481) . Bit 0 of 44.1 Brake control status .	22
	Ext2 active	Bit 11 of 06.16 Drive status word 1 (page 234) .	23
	Remote control	Bit 9 of 06.11 Main status word (page 234) .	24
	Supervision 1	Bit 0 of 32.01 Supervision status (page 440) .	33
	Supervision 2	Bit 1 of 32.01 Supervision status (page 440) .	34
	Supervision 3	Bit 2 of 32.01 Supervision status (page 440) .	35
	RO/DIO control word bit0	Bit 0 of 10.99 RO/DIO control word (page 272) .	40
	RO/DIO control word bit1	Bit 1 of 10.99 RO/DIO control word (page 272) .	41
	RO/DIO control word bit2	Bit 2 of 10.99 RO/DIO control word (page 272) .	42
	RO/DIO control word bit8	Bit 8 of 10.99 RO/DIO control word (page 272) .	43
	RO/DIO control word bit9	Bit 9 of 10.99 RO/DIO control word (page 272) .	44
	Other [bit]	See Terms and abbreviations (page 207) .	-
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

No.	Name / Range / Selection	Description	Def / Type FbEq 16b / 32b
	Output	DIO2 is used as a digital output.	0
	Input	DIO2 is used as a digital input.	1
	Frequency	DIO2 is used as a frequency output.	2
11.10	DIO2 output source	Selects a drive signal to be connected to digital input/output DIO2 when parameter 11.09 DIO2 function is set to Output .	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 234).	2
	Enabled	Bit 0 of 06.16 Drive status word 1 (page 234).	4
	Started	Bit 5 of 06.16 Drive status word 1 (page 234).	5
	Magnetized	Bit 1 of 06.17 Drive status word 2 (page 235).	6
	Running	Bit 6 of 06.16 Drive status word 1 (page 234).	7
	Ready ref	Bit 2 of 06.11 Main status word (page 234).	8
	At setpoint	Bit 8 of 06.11 Main status word (page 234).	9
	Reverse	Bit 2 of 06.19 Speed control status word (page 237).	10
	Zero speed	Bit 0 of 06.19 Speed control status word (page 237).	11
	Above limit	Bit 10 of 06.17 Drive status word 2 (page 235).	12
	Warning	Bit 7 of 06.11 Main status word (page 234).	13
	Fault	Bit 3 of 06.11 Main status word (page 234).	14
	Fault (-1)	Inverted bit 3 of 06.11 Main status word (page 234).	15
	Start request	Bit 13 of 06.16 Drive status word 1 (page 234).	16
	Open brake command	Bit 0 of 44.01 Brake control status (page 481).	22
	Ext2 active	Bit 11 of 06.16 Drive status word 1 (page 234).	23
	Remote control	Bit 9 of 06.11 Main status word (page 234).	24
	Supervision 1	Bit 0 of 32.01 Supervision status (page 440).	33
	Supervision 2	Bit 1 of 32.01 Supervision status (page 440).	34
	Supervision 3	Bit 2 of 32.01 Supervision status (page 440).	35
	RO/DIO control word bit0	Bit 0 of 10.99 RO/DIO control word (page 272).	40
	RO/DIO control word bit1	Bit 1 of 10.99 RO/DIO control word (page 272).	41
	RO/DIO control word bit2	Bit 2 of 10.99 RO/DIO control word (page 272). Note: This selection is applicable for ZCU and UCU-22...24 control units.	42
	RO/DIO control word bit8	Bit 8 of 10.99 RO/DIO control word (page 272).	43

No.	Name / Range / Selection	Description	Def / Type FbEq 16b / 32b
	RO/DIO control word bit9	Bit 9 of 10.99 RO/DIO control word (page 272) .	44
	Other [bit]	See Terms and abbreviations (page 207) .	-
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 (through 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 (through 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

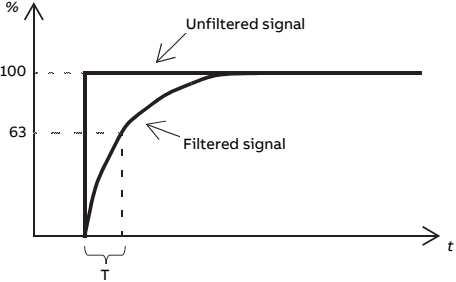
No.	Name / Range / Selection	Description	Def / Type FbEq 16b / 32b
11.42	Freq in 1 min	Defines the minimum for the frequency actually arriving at frequency input 1 (DIO1 when it is used as a frequency input). The incoming frequency signal (11.38 Freq in 1 actual value) is scaled into an internal signal (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...100000 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

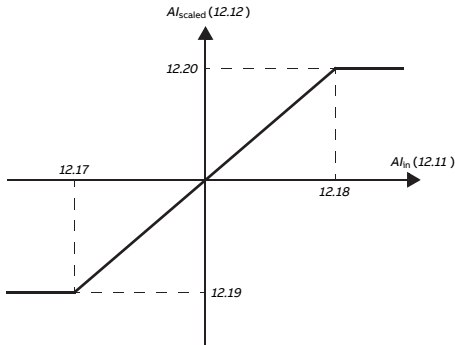
No.	Name / Range / Selection	Description	Def / Type FbEq 16b / 32b
	Motor speed used	01.01 Motor speed used (page 212).	1
	Output frequency	01.06 Output frequency (page 212).	3
	Motor current	01.07 Motor current (page 212).	4
	Motor torque	01.10 Motor torque (page 212).	6
	DC voltage	01.11 DC voltage (page 213).	7
	Power inu out	01.14 Output power (page 213).	8
	Speed ref ramp in	23.01 Speed ref ramp input (page 369).	10
	Speed ref ramp out	23.02 Speed ref ramp output (page 369).	11
	Speed ref used	24.01 Used speed reference (page 378).	12
	Torq ref used	26.02 Torque reference used (page 396).	13
	Freq ref used	28.02 Frequency ref ramp output (page 405).	14
	Other [bit]	Source selection. See Terms and abbreviations (page 207) .	-
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).  The figure contains two graphs. Both graphs have $f_{out}(11.54)$ on the vertical axis with values 11.60 and 11.61, and 'Signal (real) selected by par. 11.55' on the horizontal axis. The top graph shows a horizontal line at 11.60 for signals up to 11.58, then a linear increase to 11.61 at signal 11.59, and then a horizontal line at 11.61 for higher signals. The bottom graph shows a horizontal line at 11.61 for signals up to 11.59, then a linear decrease to 11.60 at signal 11.58, and then a horizontal line at 11.60 for lower signals.	0.000 NoUnit / real32

No.	Name / Range / Selection	Description	Def / Type FbEq 16b / 32b
	-32768.000 ... 32767.000	Real signal value corresponding to minimum value of frequency output 1.	1 = 1 / 1000 = 1
11.59	Freq out 1 src max	Defines the real value of the signal (selected by parameter 11.55 Freq out 1 source and shown by parameter 11.54 Freq out 1 actual value) that corresponds to the maximum value of frequency output 1 (defined by parameter 11.61 Freq out 1 at src max). See parameter 11.58 Freq out 1 src min .	1500.000; 1800.000 (95.20 b0) 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

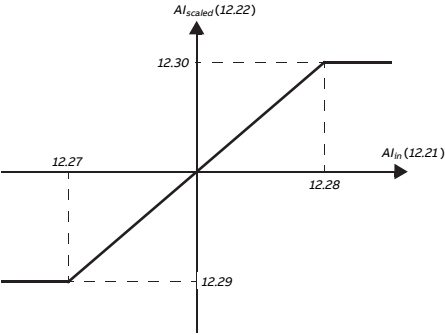
No.	Name / Range / Selection	Description	Def / Type FbEq 16b / 32b
12	Standard AI	Configuration of standard analog inputs.	
12.01	AI tune	Triggers the analog input tuning function. Connect the signal to the input and select the appropriate tuning function.	No action / uint16
	No action	AI tune is not 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 - the analog input is set as the source (using the AI1 scaled or AI2 scaled selection) in parameter 22.11, 22.12, 22.15, 22.17, 23.42, 26.11, 26.12, 26.16, 26.25, 28.11, 28.12, 30.21, 30.22, or 44.09, and is being used as the active source, or - 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 (refer section Local control vs. external control (page 132)). 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.  $O = I \times (1 - e^{-t/T})$ I = filter input (step) O = filter output t = time T = filter time constant Note: The signal is also filtered due to the signal interface hardware (approximately 0.25 ms time constant). This cannot be changed by any parameter.	0.100 s / 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 .	20.000 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

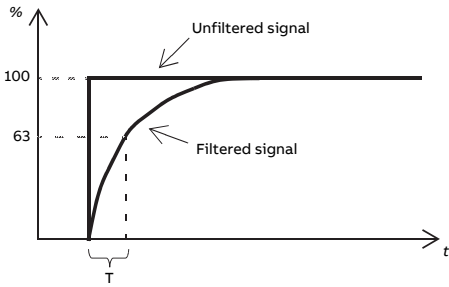
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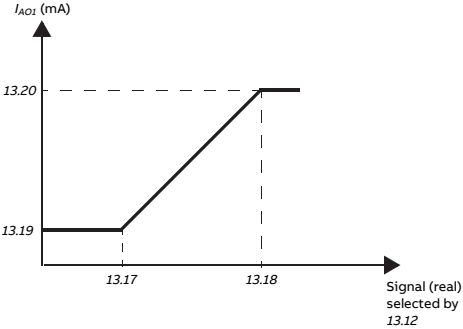
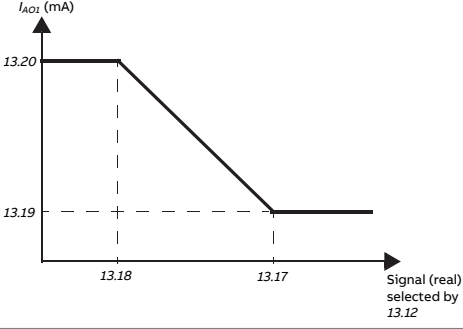
No.	Name / Range / Selection	Description	Def / Type FbEq 16b / 32b
12.25	AI2 unit selection	Selects the unit for readings and settings related to analog input AI2. Note: This setting must match the corresponding hardware setting on the drive control unit (see the hardware manual of the drive). Control 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.	$1 = 1 / 1000 = 1$
12.200	EXT1 scaled AI reference	Displays the scaled value of the analog signal selected in parameter 12.201 EXT1 scaled AI reference source. This parameter could be used as source of speed reference in parameter 22.11 Speed ref1 source in EXT1 mode. This parameter is read-only.	0.00 rpm / real32
	-30000.00 ... 30000.00 rpm	EXT1 scaled AI reference.	$1 = 1 \text{ rpm} / 1 = 1 \text{ rpm}$
12.201	EXT1 scaled AI reference source	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.	Not selected / int32
	Not selected	0	0
	AI1 scaled	Analog input AI1.	1
	AI2 scaled	Analog input AI2.	2

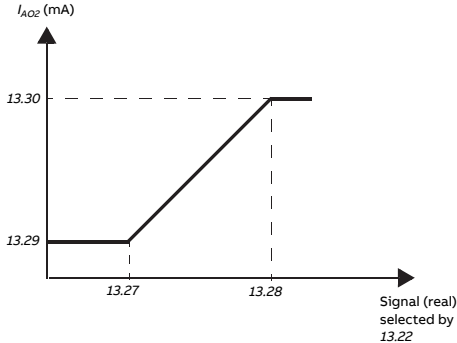
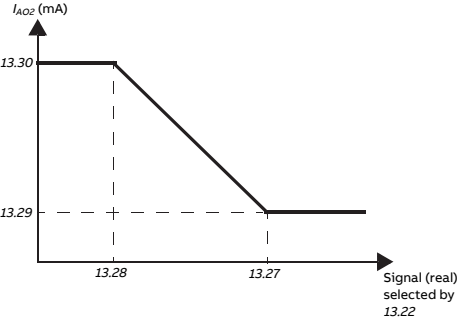
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No.	Name / Range / Selection	Description	Def / Type FbEq 16b / 32b
13	Standard AO	Configuration of standard analog outputs.	
13.11	AO1 actual value	Displays the value of AO1 in mA. This parameter is read-only.	- / real32
	0.000 ... 22.000 mA	Value 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 212) .	1
	Output frequency	01.06 Output frequency (page 212) .	3
	Motor current	01.07 Motor current (page 212) .	4
	Motor torque	01.10 Motor torque (page 212) .	6
	DC voltage	01.11 DC voltage (page 213) .	7
	Power inu out	01.14 Output power (page 213) .	8
	Speed ref ramp in	23.01 Speed ref ramp input (page 369) .	10
	Speed ref ramp out	23.02 Speed ref ramp output (page 369) .	11
	Speed ref used	24.01 Used speed reference (page 378) .	12
	Torq ref used	26.02 Torque reference used (page 396) .	13
	Freq ref used	28.02 Frequency ref ramp output (page 405) .	14
	Other [bit]	Source selection. See Terms and abbreviations (page 207) .	-
	Force Pt100 excitation	The output is used to feed an excitation current to 1...3 Pt100 sensors. Refer section Motor thermal protection (page 185) .	20
	Force KTY84 excitation	The output is used to feed an excitation current to a KTY84 sensor. Refer section Motor thermal protection (page 185) .	21
	Force PTC excitation	The output is used to feed an excitation current to 1...3 PTC sensors. Refer section Motor thermal protection (page 185) .	22
	Force Pt1000 excitation	The output is used to feed an excitation current to 1...3 Pt1000 sensors. Refer section Motor thermal protection (page 185) .	23
	AO1 data storage	13.91 AO1 data storage (page 291) .	37
	AO2 data storage	13.92 AO2 data storage (page 291) .	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

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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 140) . 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
	FDIO-01	An FDIO-01 module has been detected and is active.	25

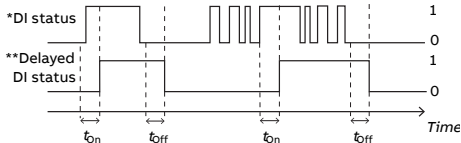
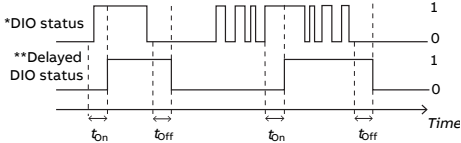
No.	Name / Range / Selection	Description	Def / Type FbEq 16b / 32b
14.05	DI status	(Visible when 14.01 Module 1 type = FDIO-01) Displays the status of the digital inputs on the extension module. The activation/deactivation delays (if any are specified) are ignored. A filtering time (for input mode) can 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

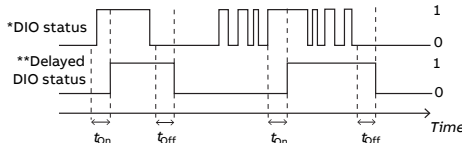
No.	Name / Range / Selection	Description	Def / Type FbEq 16b / 32b
14.06	DI delayed status	(Visible when 14.01 Module 1 type = FDIO-01) Displays the delayed status of the digital inputs on the extension module. The word is updated only after activation/deactivation delays (if any are specified). Bit 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 = FDIO-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 234) .	2
	Enabled	Bit 0 of 06.16 Drive status word 1 (page 234) .	4
	Started	Bit 5 of 06.16 Drive status word 1 (page 234) .	5
	Magnetized	Bit 1 of 06.17 Drive status word 2 (page 235) .	6
	Running	Bit 6 of 06.16 Drive status word 1 (page 234) .	7
	Ready ref	Bit 2 of 06.11 Main status word (page 234) .	8
	At setpoint	Bit 8 of 06.11 Main status word (page 234) .	9
	Reverse	Bit 2 of 06.19 Speed control status word (page 237) .	10
	Zero speed	Bit 0 of 06.19 Speed control status word (page 237) .	11
	Above limit	Bit 10 of 06.17 Drive status word 2 (page 235) .	12
	Warning	Bit 7 of 06.11 Main status word (page 234) .	13
	Fault	Bit 3 of 06.11 Main status word (page 234) .	14
	Fault (-1)	Inverted bit 3 of 06.11 Main status word (page 234) .	15
	Start request	Bit 13 of 06.16 Drive status word 1 (page 234) .	16
	Open brake command	Bit 0 of 44.01 Brake control status (page 481) .	22
	Ext2 active	Bit 11 of 06.16 Drive status word 1 (page 234) .	23
	Remote control	Bit 9 of 06.11 Main status word (page 234) .	24
	Supervision 1	Bit 0 of 32.01 Supervision status (page 440) .	33
	Supervision 2	Bit 1 of 32.01 Supervision status (page 440) .	34

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No.	Name / Range / Selection	Description	Def / Type FbEq 16b / 32b
	Supervision 3	Bit 2 of 32.01 Supervision status (page 440) .	35
	RO/DIO control word bit0	Bit 0 of 10.99 RO/DIO control word (page 272) .	40
	RO/DIO control word bit1	Bit 1 of 10.99 RO/DIO control word (page 272) .	41
	RO/DIO control word bit2	Bit 2 of 10.99 RO/DIO control word (page 272) . Note: This selection is applicable for ZCU and UCU-22...24 control units.	42
	RO/DIO control word bit8	Bit 8 of 10.99 RO/DIO control word (page 272) .	43
	RO/DIO control word bit9	Bit 9 of 10.99 RO/DIO control word (page 272) .	44
	Other [bit]	See Terms and abbreviations (page 207) .	-
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 234) .	2
	Enabled	Bit 0 of 06.16 Drive status word 1 (page 234) .	4
	Started	Bit 5 of 06.16 Drive status word 1 (page 234) .	5
	Magnetized	Bit 1 of 06.17 Drive status word 2 (page 235) .	6
	Running	Bit 6 of 06.16 Drive status word 1 (page 234) .	7
	Ready ref	Bit 2 of 06.11 Main status word (page 234) .	8
	At setpoint	Bit 8 of 06.11 Main status word (page 234) .	9
	Reverse	Bit 2 of 06.19 Speed control status word (page 237) .	10
	Zero speed	Bit 0 of 06.19 Speed control status word (page 237) .	11
	Above limit	Bit 10 of 06.17 Drive status word 2 (page 235) .	12
	Warning	Bit 7 of 06.11 Main status word (page 234) .	13
	Fault	Bit 3 of 06.11 Main status word (page 234) .	14
	Fault (-1)	Inverted bit 3 of 06.11 Main status word (page 234) .	15
	Start request	Bit 13 of 06.16 Drive status word 1 (page 234) .	16
	Open brake command	Bit 0 of 44.01 Brake control status (page 481) .	22
	Ext2 active	Bit 11 of 06.16 Drive status word 1 (page 234) .	23
	Remote control	Bit 9 of 06.11 Main status word (page 234) .	24
	Supervision 1	Bit 0 of 32.01 Supervision status (page 440) .	33
	Supervision 2	Bit 1 of 32.01 Supervision status (page 440) .	34

No.	Name / Range / Selection	Description	Def / Type FbEq 16b / 32b
	Supervision 3	Bit 2 of 32.01 Supervision status (page 440) .	35
	RO/DIO control word bit0	Bit 0 of 10.99 RO/DIO control word (page 272) .	40
	RO/DIO control word bit1	Bit 1 of 10.99 RO/DIO control word (page 272) .	41
	RO/DIO control word bit2	Bit 2 of 10.99 RO/DIO control word (page 272) . Note: This selection is applicable for ZCU and UCU-22...24 control units.	42
	RO/DIO control word bit8	Bit 8 of 10.99 RO/DIO control word (page 272) .	43
	RO/DIO control word bit9	Bit 9 of 10.99 RO/DIO control word (page 272) .	44
	Other [bit]	See Terms and abbreviations (page 207) .	-
14.12	DI1 ON delay	(Visible when 14.01 Module 1 type = FDIO-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 = FDIO-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 = FDIO-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 = FDIO-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 = FAIO-01) Selects how the drive reacts when an analog input signal moves out of the minimum and/or maximum limits specified for the input. The inputs and the limits to be observed are selected by parameter 14.20 AI supervision selection .	No action / 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 = FAIO-01) Specifies the analog input limits to be supervised. See parameter 14.19 AI supervision function . Note: The number of active bits in this 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.	
	b4 AI3 < MIN	1 = Minimum limit supervision of AI3 active.	

No.	Name / Range / Selection	Description	Def / Type FbEq 16b / 32b
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 = FAIO-01) Triggers the analog input tuning function, which enables the use of actual measurements as the minimum and maximum input values instead of potentially inaccurate estimates. Apply the minimum or maximum signal to the input and select the appropriate tuning function. See also the drawing at parameter 14.35 AI1 scaled at AI1 min .	No action / 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
	AI2 max tune	The measured value of AI2 is set as the maximum value of AI2 into parameter 14.49 AI2 max .	4

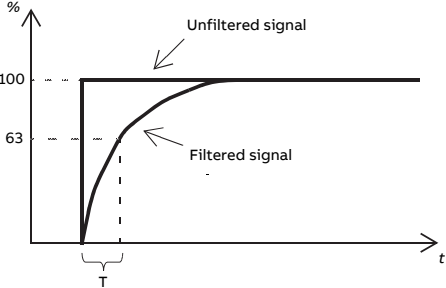
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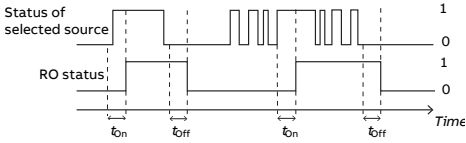
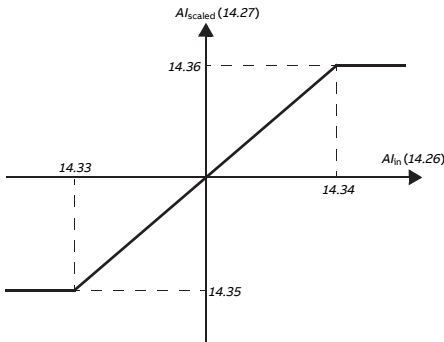
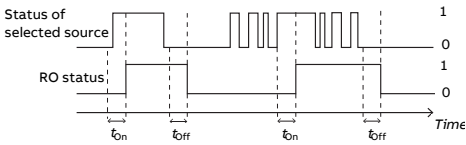
No.	Name / Range / Selection	Description	Def / Type FbEq 16b / 32b
	AI3 min tune	The measured value of AI3 is set as the minimum value of AI3 into parameter 14.63 AI3 min .	5
	AI3 max tune	The measured value of AI3 is set as the maximum value of AI3 into parameter 14.64 AI3 max .	6
14.21	DIO3 output 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 = FAIO-01) The true readings of the analog inputs can be overridden for eg. testing purposes. A forced value parameter is provided for each analog input, and its value is applied whenever the corresponding bit in this parameter is 1.	- / 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 = FDIO-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
	0.00 ... 3000.00 s	Activation delay for DIO3.	10 = 1 s / 100 = 1 s

No.	Name / Range / Selection	Description	Def / Type FbEq 16b / 32b
14.23	DI3 OFF delay	(Visible when 14.01 Module 1 type = FDIO-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 = FAIO-01) Displays the value of analog input AI1 in mA or V (depending on whether the input is set to current or voltage). This parameter is read-only.	- / 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 = FAIO-01) Displays the value of analog input AI1 after scaling. See parameter 14.35 AI1 scaled at AI1 min . This parameter is read-only.	- / 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 = FAIO-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
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

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No.	Name / Range / Selection	Description	Def / Type FbEq 16b / 32b
	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 = FAIO-01) Shows the position of the hardware current/voltage selector on the I/O extension module. Note: The setting of the current/voltage selector must match the unit selection made in parameter 14.30 AI1 unit selection . I/O module reboot either by cycling the power or through parameter 96.08 Control board boot is required to validate any changes in the hardware settings.	mA / uint16
	mA	Milliamperes.	10
	V	Volts.	2
14.30	AI1 unit selection	(Visible when 14.01 Module 1 type = FAIO-01) Selects the unit for readings and settings related to analog input AI1. Note: This setting must match the corresponding hardware setting on the I/O extension module (see the manual of the I/O extension module). The hardware setting is shown by parameter 14.29 AI1 HW switch 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 = FDIO-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 = FAIO-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

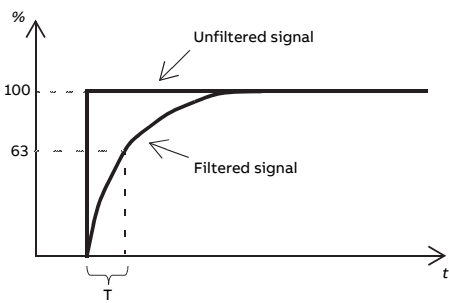
No.	Name / Range / Selection	Description	Def / Type FbEq 16b / 32b
14.31	RO status	(Visible when 14.01 Module 1 type = FIO-01) Status of relay outputs on the I/O extension module. Example: 0001b = RO1 is energized, RO2 is de-energized.	- / uint16
	0000h...FFFFh		1 = 1 / 1 = 1
14.32	AI1 filter time	(Visible when 14.01 Module 1 type = FAIO-01) Defines the filter time constant for analog input AI1.  $O = I \times (1 - e^{-t/T})$ I = filter input (step) O = filter output t = time T = filter time constant Note: The signal is also filtered due to the signal interface hardware. See parameter 14.31 AI1 filter gain .	0.100 s / 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 = FAIO-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 = FDIO-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 = FAIO-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

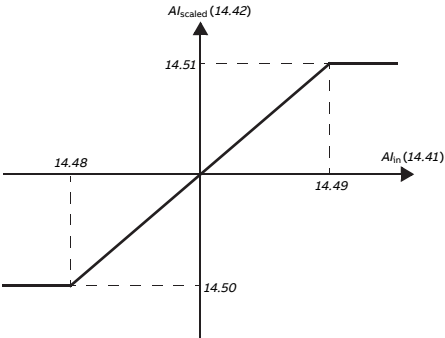
No.	Name / Range / Selection	Description	Def / Type FbEq 16b / 32b
14.34	RO1 source	(Visible when 14.01 Module 1 type = FIO-01) Selects a drive signal to be connected to relay output RO1. For the available selections, see parameter 14.11 DIO1 output source.	Not energized / uint32
14.35	RO1 ON delay	(Visible when 14.01 Module 1 type = FDIO-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 = FAIO-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 = FDIO-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 = FAIO-01) Defines the real value that corresponds to the maximum analog input AI1 value defined by parameter 14.34 AI1 max . See the drawing at parameter 14.35 AI1 scaled at AI1 min .	100.000 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 = FDIO-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 = FDIO-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 = FDIO-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

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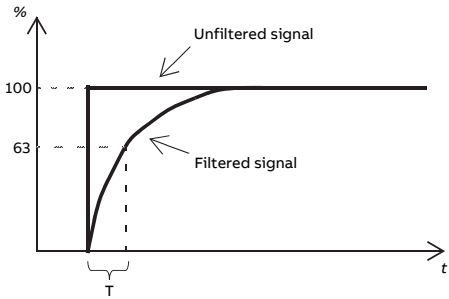
No.	Name / Range / Selection	Description	Def / Type FbEq 16b / 32b
14.41	AI2 actual value	(Visible when 14.01 Module 1 type = FAIO-01) Displays the value of analog input AI2 in mA or V (depending on whether the input is set to current or voltage). This parameter is read-only.	- / real32
	-22.000 ... 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 = FAIO-01) Displays the value of analog input AI2 after scaling. See parameter 14.50 AI2 scaled at AI2 min . This parameter is read-only.	- / 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 = FAIO-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 = FAIO-01) Shows the position of the hardware current/voltage selector on the I/O extension module. Note: The setting of the current/voltage selector must match the unit selection made in parameter 14.45 AI2 unit selection . I/O module reboot either by cycling the power or through parameter 96.08 Control board boot is required to validate any changes in the hardware settings.	mA / uint16
	mA	Milliamperes.	10
	V	Volts.	2
14.45	AI2 unit selection	(Visible when 14.01 Module 1 type = FAIO-01) Selects the unit for readings and settings related to analog input AI2. Note: This setting must match the corresponding hardware setting on the I/O extension module (see the manual of the I/O extension module). The hardware setting is shown by parameter 14.44 AI2 HW switch 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 = FAIO-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 = FAIO-01) Defines the filter time constant for analog input AI2.  $O = I \times (1 - e^{-t/T})$ I = filter input (step) O = filter output t = time T = filter time constant Note: The signal is also filtered due to the signal interface hardware. See parameter 14.46 AI2 filter gain.	0.100 s / 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 = FAIO-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 = FAIO-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 = FAIO-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 = FAIO-01) Defines the real value that corresponds to the maximum analog input AI2 value defined by parameter 14.49 AI2 max. See the drawing at parameter 14.50 AI2 scaled at AI2 min.	100.000 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

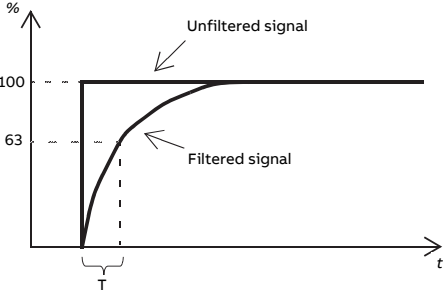
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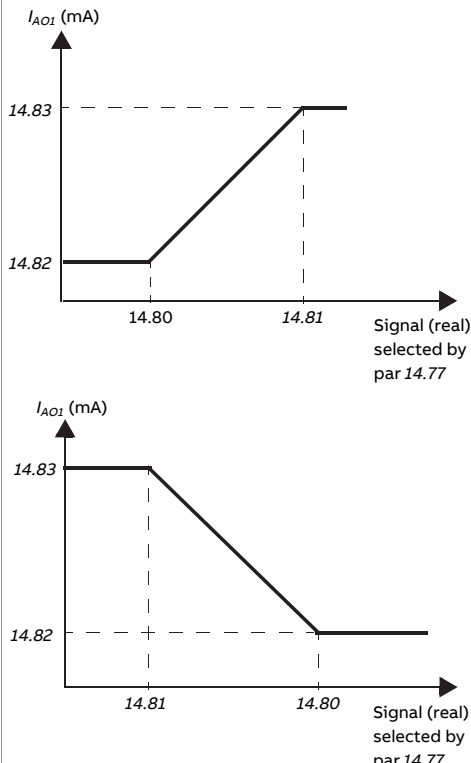
No.	Name / Range / Selection	Description	Def / Type FbEq 16b / 32b
14.62	AI3 filter time	(Visible when 14.01 Module 1 type = FIO-11) Defines the filter time constant for analog input AI3.  $O = I \times (1 - e^{-t/T})$ I = filter input (step) O = filter output t = time T = filter time constant Note: The signal is also filtered due to the signal interface hardware. See parameter 14.61 AI3 filter gain.	0.100 s / 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 = FAIO-01) The value of the analog output can be overridden for eg. testing purposes. A forced value parameter (14.78 AO1 force data) is provided for the analog output, and its value is applied whenever the corresponding bit in this parameter is 1.	- / 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 .	

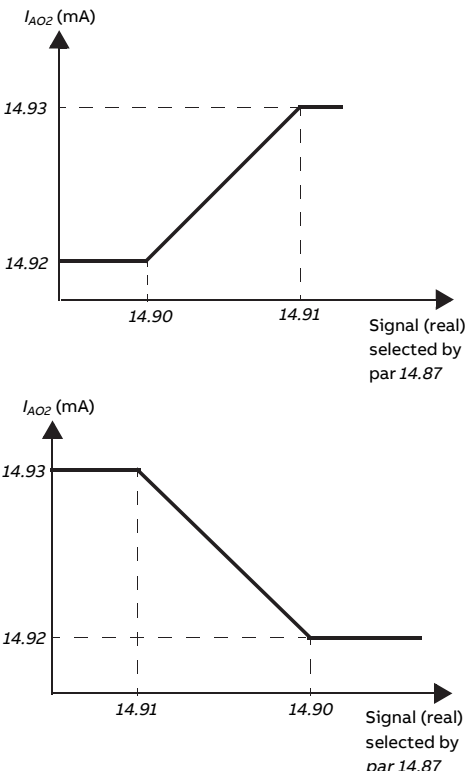
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No.	Name / Range / Selection	Description	Def / Type FbEq 16b / 32b
b1...15	Reserved		
	0000h...FFFFh		1 = 1 / 1 = 1
14.76	AO1 actual value	(Visible when 14.01 Module 1 type = FAIO-01) Displays the value of AO1 in mA. This parameter is read-only.	- / 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 = FAIO-01) Selects a signal to be connected to analog output AO1. Alternatively, sets the output to excitation mode to feed a constant current to a temperature sensor.	Zero / uint32
	Zero	None	0
	Motor speed used	01.01 Motor speed used (page 212).	1
	Output frequency	01.06 Output frequency (page 212).	3
	Motor current	01.07 Motor current (page 212).	4
	Motor torque	01.10 Motor torque (page 212).	6
	DC voltage	01.11 DC voltage (page 213).	7
	Power inu out	01.14 Output power (page 213).	8
	Speed ref ramp in	23.01 Speed ref ramp input (page 369).	10
	Speed ref ramp out	23.02 Speed ref ramp output (page 369).	11
	Speed ref used	24.01 Used speed reference (page 378).	12
	Torq ref used	26.02 Torque reference used (page 396).	13
	Freq ref used	28.02 Frequency ref ramp output (page 405).	14
	Other [bit]	Source selection. See Terms and abbreviations (page 207) .	-
	Force Pt100 excitation	The output is used to feed an excitation current to 1...3 Pt100 sensors. Refer section Motor thermal protection (page 185) .	20
	Force KTY84 excitation	The output is used to feed an excitation current to a KTY84 sensor. Refer section Motor thermal protection (page 185) .	21
	Force PTC excitation	The output is used to feed an excitation current to 1...3 PTC sensors. Refer section Motor thermal protection (page 185) .	22
	Force Pt1000 excitation	The output is used to feed an excitation current to 1...3 Pt1000 sensors. Refer section Motor thermal protection (page 185) .	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 = FAIO-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 = FAIO-01) Defines the filtering time constant for analog output AO1.  $O = I \times (1 - e^{-t/T})$ I = filter input (step) O = filter output t = time T = filter time constant	0.100 s / 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 = FAIO-01) Defines the real value of the signal (selected by parameter 14.77 AO1 source) that corresponds to the minimum AO1 output value (defined by parameter 14.82 AO1 out at AO1 src min).  The top graph shows a signal (real) selected by par 14.77 on the x-axis. The y-axis is I_{AO1} (mA). The signal starts at 14.80, where the output is 14.82 mA. As the signal increases to 14.81, the output increases linearly to 14.83 mA and then remains constant. The bottom graph shows a signal (real) selected by par 14.77 on the x-axis. The y-axis is I_{AO1} (mA). The signal starts at 14.81, where the output is 14.83 mA. As the signal decreases to 14.80, the output decreases linearly to 14.82 mA and then remains constant.	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 = FAIO-01) Defines the real value of the signal (selected by parameter 14.77 AO1 source) that corresponds to the maximum AO1 output value (defined by parameter 14.83 AO1 out at AO1 src max). See parameter 14.80 AO1 source min.	100.0 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 = FAIO-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 = FAIO-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 = FAIO-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 = FAIO-01) Selects a signal to be connected to analog output AO2. Alternatively, sets the output to excitation mode to feed a constant current to a temperature sensor. For the selections, see parameter 14.77 AO1 source .	Zero / uint32
14.88	AO2 force data	(Visible when 14.01 Module 1 type = FAIO-01) Forced value that can be used instead of the selected output signal. See parameter 14.71 AO force selection .	0.000 mA / 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 = FAIO-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 = FAIO-01) Defines the real value of the signal (selected by parameter 14.87 AO2 source) that corresponds to the minimum AO2 output value (defined by parameter 14.92 AO2 out at AO2 src min).  The top graph shows the output current I_{AO2} (mA) on the y-axis and the real signal on the x-axis. The signal increases from 14.90 to 14.91, and the output current increases from 14.92 mA to 14.93 mA. The bottom graph shows the output current I_{AO2} (mA) on the y-axis and the real signal on the x-axis. The signal decreases from 14.91 to 14.90, and the output current decreases from 14.93 mA to 14.92 mA.	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 = FAIO-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 = FAIO-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 = FAIO-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

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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 140) . Note: The contents of the parameter group vary according to the selected I/O extension module type.	
15.01	Module 2 type	See parameter 14.01 Module 1 type .	None / uint16
	None	Inactive.	0
	FIO-01	FIO-01.	1
	FIO-11	FIO-11.	2
	FAIO-01	FAIO-01.	4
	FDIO-01	FDIO-01.	3
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
15.05	DI status	(Visible when 15.01 Module 2 type = FDIO-01) See parameter 14.05 DI status .	- / uint16
15.05	DIO status	(Visible when 15.01 Module 2 type = FIO-11) See parameter 14.05 DIO status .	- / uint16
15.05	DIO status	(Visible when 15.01 Module 2 type = FIO-01) See parameter 14.05 DIO status .	- / uint16
15.06	DI delayed status	(Visible when 15.01 Module 2 type = FDIO-01) See parameter 14.06 DI delayed status .	- / uint16
15.06	DIO delayed status	(Visible when 15.01 Module 2 type = FIO-11) See parameter 14.06 DIO delayed status .	- / uint16
15.06	DIO delayed status	(Visible when 15.01 Module 2 type = FIO-01) See parameter 14.06 DIO delayed status .	- / uint16
15.08	DI filter time	(Visible when 15.01 Module 2 type = FDIO-01) See parameter 14.08 DI filter time .	- / real32
15.08	DIO filter time	(Visible when 15.01 Module 2 type = FIO-11) See parameter 14.08 DIO filter time .	- / real32
15.08	DIO filter time	(Visible when 15.01 Module 2 type = FIO-01) See parameter 14.08 DIO filter time .	- / real32
15.09	DIO1 function	(Visible when 15.01 Module 2 type = FIO-11) See parameter 14.09 DIO1 function .	Input / uint16
15.09	DIO1 function	(Visible when 15.01 Module 2 type = FIO-01) See parameter 14.09 DIO1 function .	Input / uint16
15.11	DIO1 output source	(Visible when 15.01 Module 2 type = FIO-11) See parameter 14.11 DIO1 output source .	Not energized / uint32
15.11	DIO1 output source	(Visible when 15.01 Module 2 type = FIO-01) See parameter 14.11 DIO1 output source .	Not energized / uint32
15.12	DI1 ON delay	(Visible when 15.01 Module 2 type = FDIO-01) See parameter 14.12 DI1 ON delay .	- / real32

No.	Name / Range / Selection	Description	Def / Type FbEq 16b / 32b
15.12	DIO1 ON delay	(Visible when 15.01 Module 2 type = FIO-11) See parameter 14.12 DIO1 ON delay.	- / real32
15.12	DIO1 ON delay	(Visible when 15.01 Module 2 type = FIO-01) See parameter 14.12 DIO1 ON delay.	- / real32
15.13	DI1 OFF delay	(Visible when 15.01 Module 2 type = FDIO-01) See parameter 14.13 DI1 OFF delay.	- / real32
15.13	DIO1 OFF delay	(Visible when 15.01 Module 2 type = FIO-11) See parameter 14.13 DIO1 OFF delay.	- / real32
15.13	DIO1 OFF delay	(Visible when 15.01 Module 2 type = FIO-01) See parameter 14.13 DIO1 OFF delay.	- / real32
15.14	DIO2 function	(Visible when 15.01 Module 2 type = FIO-11) See parameter 14.14 DIO2 function.	- / uint16
15.14	DIO2 function	(Visible when 15.01 Module 2 type = FIO-01) See parameter 14.14 DIO2 function.	- / uint16
15.16	DIO2 output source	(Visible when 15.01 Module 2 type = FIO-11) See parameter 14.16 DIO2 output source.	- / uint32
15.16	DIO2 output source	(Visible when 15.01 Module 2 type = FIO-01) See parameter 14.16 DIO2 output source.	- / uint32
15.17	DI2 ON delay	(Visible when 15.01 Module 2 type = FDIO-01) See parameter 14.17 DI2 ON delay.	- / real32
15.17	DIO2 ON delay	(Visible when 15.01 Module 2 type = FIO-11) See parameter 14.17 DIO2 ON delay.	- / real32
15.17	DIO2 ON delay	(Visible when 15.01 Module 2 type = FIO-01) See parameter 14.17 DIO2 ON delay.	- / real32
15.18	DI2 OFF delay	(Visible when 15.01 Module 2 type = FDIO-01) See parameter 14.18 DI2 OFF delay.	- / real32
15.18	DIO2 OFF delay	(Visible when 15.01 Module 2 type = FIO-11) See parameter 14.18 DIO2 OFF delay.	- / real32
15.18	DIO2 OFF delay	(Visible when 15.01 Module 2 type = FIO-01) See parameter 14.18 DIO2 OFF delay.	- / real32
15.19	DIO3 function	(Visible when 15.01 Module 2 type = FIO-01) See parameter 14.19 DIO3 function.	Input / uint16
15.19	AI supervision function	(Visible when 15.01 Module 2 type = FAIO-01) See parameter 14.19 AI supervision function.	No action / uint16
15.20	AI supervision selection	(Visible when 15.01 Module 2 type = FAIO-01) See parameter 14.20 AI supervision selection.	- / uint16
15.20	AI supervision selection	(Visible when 15.01 Module 2 type = FIO-11) See parameter 14.20 AI supervision selection.	- / uint16
15.21	DIO3 output source	(Visible when 15.01 Module 2 type = FIO-01) See parameter 14.21 DIO3 output source.	Not energized / uint32
15.21	AI tune	(Visible when 15.01 Module 2 type = FAIO-01) See parameter 14.21 AI tune.	No action / uint16
15.21	AI tune	(Visible when 15.01 Module 2 type = FIO-11) See parameter 14.21 AI tune.	No action / uint16

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No.	Name / Range / Selection	Description	Def / Type FbEq 16b / 32b
15.22	DI3 ON delay	(Visible when 15.01 Module 2 type = FDIO-01) See parameter 14.22 DI3 ON delay.	- / real32
15.22	DIO3 ON delay	(Visible when 15.01 Module 2 type = FIO-01) See parameter 14.22 DIO3 ON delay.	- / real32
15.22	AI force selection	(Visible when 15.01 Module 2 type = FAIO-01) See parameter 14.22 AI force selection.	- / uint16
15.22	AI force selection	(Visible when 15.01 Module 2 type = FIO-11) See parameter 14.22 AI force selection.	- / uint16
15.23	DI3 OFF delay	(Visible when 15.01 Module 2 type = FDIO-01) See parameter 14.23 DI3 OFF delay.	- / real32
15.23	DIO3 OFF delay	(Visible when 15.01 Module 2 type = FIO-01) See parameter 14.23 DIO3 OFF delay.	- / real32
15.24	DIO4 function	(Visible when 15.01 Module 2 type = FIO-01) See parameter 14.24 DIO4 function.	Input / uint16
15.26	DIO4 output source	(Visible when 15.01 Module 2 type = FIO-01) See parameter 14.26 DIO4 output source.	- / uint32
15.26	AI1 actual value	(Visible when 15.01 Module 2 type = FAIO-01) See parameter 14.26 AI1 actual value.	- / real32
15.27	DIO4 ON delay	(Visible when 15.01 Module 2 type = FIO-01) See parameter 14.27 DIO4 ON delay.	- / real32
15.27	AI1 scaled value	(Visible when 15.01 Module 2 type = FAIO-01) See parameter 14.27 AI1 scaled value.	- / real32
15.28	DIO4 OFF delay	(Visible when 15.01 Module 2 type = FIO-01) See parameter 14.28 DIO4 OFF delay.	- / real32
15.28	AI1 force data	(Visible when 15.01 Module 2 type = FAIO-01) See parameter 14.28 AI1 force data.	- / real32
15.29	AI1 HW switch position	(Visible when 15.01 Module 2 type = FAIO-01) See parameter 14.29 AI1 HW switch position.	mA / uint16
15.30	AI1 unit selection	(Visible when 15.01 Module 2 type = FAIO-01) See parameter 14.30 AI1 unit selection.	mA / uint16
15.31	RO status	(Visible when 15.01 Module 2 type = FDIO-01) See parameter 14.31 RO status.	- / uint16
15.31	RO status	(Visible when 15.01 Module 2 type = FIO-01) See parameter 14.31 RO status.	- / uint16
15.31	AI1 filter gain	(Visible when 15.01 Module 2 type = FAIO-01) See parameter 14.31 AI1 filter gain.	1 ms / uint16
15.32	AI1 filter time	(Visible when 15.01 Module 2 type = FAIO-01) See parameter 14.32 AI1 filter time.	- / real32
15.33	AI1 min	(Visible when 15.01 Module 2 type = FAIO-01) See parameter 14.33 AI1 min.	- / real32
15.34	RO1 source	(Visible when 15.01 Module 2 type = FDIO-01) See parameter 14.34 RO1 source.	Not energized / uint32
15.34	RO1 source	(Visible when 15.01 Module 2 type = FIO-01) See parameter 14.34 RO1 source.	Not energized / uint32

No.	Name / Range / Selection	Description	Def / Type FbEq 16b / 32b
15.34	AI1 max	(Visible when 15.01 Module 2 type = FAIO-01) See parameter 14.34 AI1 max.	- / real32
15.35	RO1 ON delay	(Visible when 15.01 Module 2 type = FDIO-01) See parameter 14.35 RO1 ON delay.	- / real32
15.35	RO1 ON delay	(Visible when 15.01 Module 2 type = FIO-01) See parameter 14.35 RO1 ON delay.	- / real32
15.35	AI1 scaled at AI1 min	(Visible when 15.01 Module 2 type = FAIO-01) See parameter 14.35 AI1 scaled at AI1 min.	- / real32
15.36	RO1 OFF delay	(Visible when 15.01 Module 2 type = FDIO-01) See parameter 14.36 RO1 OFF delay.	- / real32
15.36	RO1 OFF delay	(Visible when 15.01 Module 2 type = FIO-01) See parameter 14.36 RO1 OFF delay.	- / real32
15.36	AI1 scaled at AI1 max	(Visible when 15.01 Module 2 type = FAIO-01) See parameter 14.36 AI1 scaled at AI1 max.	- / real32
15.37	RO2 source	(Visible when 15.01 Module 2 type = FDIO-01) See parameter 14.37 RO2 source.	Not energized / uint32
15.37	RO2 source	(Visible when 15.01 Module 2 type = FIO-01) See parameter 14.37 RO2 source.	Not energized / uint32
15.38	RO2 ON delay	(Visible when 15.01 Module 2 type = FDIO-01) See parameter 14.38 RO2 ON delay.	- / real32
15.38	RO2 ON delay	(Visible when 15.01 Module 2 type = FIO-01) See parameter 14.38 RO2 ON delay.	- / real32
15.39	RO2 OFF delay	(Visible when 15.01 Module 2 type = FDIO-01) See parameter 14.39 RO2 OFF delay.	- / real32
15.39	RO2 OFF delay	(Visible when 15.01 Module 2 type = FIO-01) See parameter 14.39 RO2 OFF delay.	- / real32
15.41	AI2 actual value	(Visible when 15.01 Module 2 type = FAIO-01) See parameter 14.41 AI2 actual value.	- / real32
15.42	AI2 scaled value	(Visible when 15.01 Module 2 type = FAIO-01) See parameter 14.42 AI2 scaled value.	- / real32
15.43	AI2 force data	(Visible when 15.01 Module 2 type = FAIO-01) See parameter 14.43 AI2 force data.	- / real32
15.44	AI2 HW switch position	(Visible when 15.01 Module 2 type = FAIO-01) See parameter 14.44 AI2 HW switch position.	mA / uint16
15.45	AI2 unit selection	(Visible when 15.01 Module 2 type = FAIO-01) See parameter 14.45 AI2 unit selection.	mA / uint16
15.46	AI2 filter gain	(Visible when 15.01 Module 2 type = FAIO-01) See parameter 14.46 AI2 filter gain.	1 ms / uint16
15.47	AI2 filter time	(Visible when 15.01 Module 2 type = FAIO-01) See parameter 14.47 AI2 filter time.	- / real32
15.48	AI2 min	(Visible when 15.01 Module 2 type = FAIO-01) See parameter 14.48 AI2 min.	- / real32
15.49	AI2 max	(Visible when 15.01 Module 2 type = FAIO-01) See parameter 14.49 AI2 max.	- / real32

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No.	Name / Range / Selection	Description	Def / Type FbEq 16b / 32b
15.50	AI2 scaled at AI2 min	(Visible when 15.01 Module 2 type = FAIO-01) See parameter 14.50 AI2 scaled at AI2 min.	- / real32
15.51	AI2 scaled at AI2 max	(Visible when 15.01 Module 2 type = FAIO-01) See parameter 14.51 AI2 scaled at AI2 max.	- / real32
15.56	AI3 actual value	(Visible when 15.01 Module 2 type = FIO-11) See parameter 14.56 AI3 actual value.	- / real32
15.57	AI3 scaled value	(Visible when 15.01 Module 2 type = FIO-11) See parameter 14.57 AI3 scaled value.	- / real32
15.58	AI3 force data	(Visible when 15.01 Module 2 type = FIO-11) See parameter 14.58 AI3 force data.	- / real32
15.59	AI3 HW switch position	(Visible when 15.01 Module 2 type = FIO-11) See parameter 14.59 AI3 HW switch position.	mA / uint16
15.60	AI3 unit selection	(Visible when 15.01 Module 2 type = FIO-11) See parameter 14.60 AI3 unit selection.	mA / uint16
15.61	AI3 filter gain	(Visible when 15.01 Module 2 type = FIO-11) See parameter 14.61 AI3 filter gain.	1 ms / uint16
15.62	AI3 filter time	(Visible when 15.01 Module 2 type = FIO-11) See parameter 14.62 AI3 filter time.	- / real32
15.63	AI3 min	(Visible when 15.01 Module 2 type = FIO-11) See parameter 14.63 AI3 min.	- / real32
15.64	AI3 max	(Visible when 15.01 Module 2 type = FIO-11) See parameter 14.64 AI3 max.	- / real32
15.65	AI3 scaled at AI3 min	(Visible when 15.01 Module 2 type = FIO-11) See parameter 14.65 AI3 scaled at AI3 min.	- / real32
15.66	AI3 scaled at AI3 max	(Visible when 15.01 Module 2 type = FIO-11) See parameter 14.66 AI3 scaled at AI3 max.	- / real32
15.71	AO force selection	(Visible when 15.01 Module 2 type = FAIO-01) See parameter 14.71 AO force selection.	- / uint16
15.71	AO force selection	(Visible when 15.01 Module 2 type = FIO-11) See parameter 14.71 AO force selection.	- / uint16
15.76	AO1 actual value	(Visible when 15.01 Module 2 type = FAIO-01) See parameter 14.76 AO1 actual value.	- / real32
15.77	AO1 source	(Visible when 15.01 Module 2 type = FAIO-01) See parameter 14.77 AO1 source.	Zero / uint32
15.78	AO1 force data	(Visible when 15.01 Module 2 type = FIO-11) See parameter 14.78 AO1 force data.	- / real32
15.78	AO1 force data	(Visible when 15.01 Module 2 type = FAIO-01) See parameter 14.78 AO1 force data.	- / real32
15.79	AO1 filter time	(Visible when 15.01 Module 2 type = FAIO-01) See parameter 14.79 AO1 filter time.	- / real32
15.80	AO1 source min	(Visible when 15.01 Module 2 type = FAIO-01) See parameter 14.80 AO1 source min.	- / real32
15.81	AO1 source max	(Visible when 15.01 Module 2 type = FAIO-01) See parameter 14.81 AO1 source max.	- / real32

No.	Name / Range / Selection	Description	Def / Type FbEq 16b / 32b
15.82	AO1 out at AO1 src min	(Visible when 15.01 Module 2 type = FIO-11) See parameter 14.82 AO1 out at AO1 src min.	- / real32
15.82	AO1 out at AO1 src min	(Visible when 15.01 Module 2 type = FAIO-01) See parameter 14.82 AO1 out at AO1 src min.	- / real32
15.83	AO1 out at AO1 src max	(Visible when 15.01 Module 2 type = FIO-11) See parameter 14.83 AO1 out at AO1 src max.	- / real32
15.83	AO1 out at AO1 src max	(Visible when 15.01 Module 2 type = FAIO-01) See parameter 14.83 AO1 out at AO1 src max.	- / real32
15.86	AO2 actual value	(Visible when 15.01 Module 2 type = FAIO-01) See parameter 14.86 AO2 actual value.	- / real32
15.87	AO2 source	(Visible when 15.01 Module 2 type = FAIO-01) See parameter 14.87 AO2 source.	Zero / uint32
15.88	AO2 force data	(Visible when 15.01 Module 2 type = FAIO-01) See parameter 14.88 AO2 force data.	- / real32
15.89	AO2 filter time	(Visible when 15.01 Module 2 type = FAIO-01) See parameter 14.89 AO2 filter time.	- / real32
15.90	AO2 source min	(Visible when 15.01 Module 2 type = FAIO-01) See parameter 14.90 AO2 source min.	- / real32
15.91	AO2 source max	(Visible when 15.01 Module 2 type = FAIO-01) See parameter 14.91 AO2 source max.	- / real32
15.92	AO2 out at AO2 src min	(Visible when 15.01 Module 2 type = FAIO-01) See parameter 14.92 AO2 out at AO2 src min.	- / real32
15.93	AO2 out at AO2 src max	(Visible when 15.01 Module 2 type = FAIO-01) See parameter 14.93 AO2 out at AO2 src max.	- / real32

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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 140) . 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
	None	Inactive.	0
	FIO-01	FIO-01.	1
	FIO-11	FIO-11.	2
	FAIO-01	FAIO-01.	4
	FDIO-01	FDIO-01.	3
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
16.05	DI status	(Visible when 16.01 Module 3 type = FDIO-01) See parameter 14.05 DI status .	- / uint16
16.05	DIO status	(Visible when 16.01 Module 3 type = FIO-11) See parameter 14.05 DIO status .	- / uint16
16.05	DIO status	(Visible when 16.01 Module 3 type = FIO-01) See parameter 14.05 DIO status .	- / uint16
16.06	DI delayed status	(Visible when 16.01 Module 3 type = FDIO-01) See parameter 14.06 DI delayed status .	- / uint16
16.06	DIO delayed status	(Visible when 16.01 Module 3 type = FIO-11) See parameter 14.06 DIO delayed status .	- / uint16
16.06	DIO delayed status	(Visible when 16.01 Module 3 type = FIO-01) See parameter 14.06 DIO delayed status .	- / uint16
16.08	DI filter time	(Visible when 16.01 Module 3 type = FDIO-01) See parameter 14.08 DI filter time .	10.0 ms / real32
	0.8 ... 100.0 ms		10 = 1 ms / 1 = 1 ms
16.08	DIO filter time	(Visible when 16.01 Module 3 type = FIO-11) See parameter 14.08 DIO filter time .	- / real32
16.08	DIO filter time	(Visible when 16.01 Module 3 type = FIO-01) See parameter 14.08 DIO filter time .	- / real32
16.09	DIO1 function	(Visible when 16.01 Module 3 type = FIO-11) See parameter 14.09 DIO1 function .	Input / uint16
16.09	DIO1 function	(Visible when 16.01 Module 3 type = FIO-01) See parameter 14.09 DIO1 function .	Input / uint16
16.11	DIO1 output source	(Visible when 16.01 Module 3 type = FIO-11) See parameter 14.11 DIO1 output source .	Not energized / uint32
16.11	DIO1 output source	(Visible when 16.01 Module 3 type = FIO-01) See parameter 14.11 DIO1 output source .	Not energized / uint32
16.12	DI1 ON delay	(Visible when 16.01 Module 3 type = FDIO-01) See parameter 14.12 DI1 ON delay .	- / real32

No.	Name / Range / Selection	Description	Def / Type FbEq 16b / 32b
16.12	DIO1 ON delay	(Visible when 16.01 Module 3 type = FIO-11) See parameter 14.12 DIO1 ON delay.	- / real32
16.12	DIO1 ON delay	(Visible when 16.01 Module 3 type = FIO-01) See parameter 14.12 DIO1 ON delay.	- / real32
16.13	DI1 OFF delay	(Visible when 16.01 Module 3 type = FDIO-01) See parameter 14.13 DI1 OFF delay.	- / real32
16.13	DIO1 OFF delay	(Visible when 16.01 Module 3 type = FIO-11) See parameter 14.13 DIO1 OFF delay.	- / real32
16.13	DIO1 OFF delay	(Visible when 16.01 Module 3 type = FIO-01) See parameter 14.13 DIO1 OFF delay.	- / real32
16.14	DIO2 function	(Visible when 16.01 Module 3 type = FIO-11) See parameter 14.14 DIO2 function.	Input / uint16
16.14	DIO2 function	(Visible when 16.01 Module 3 type = FIO-01) See parameter 14.14 DIO2 function.	Input / uint16
16.16	DIO2 output source	(Visible when 16.01 Module 3 type = FIO-11) See parameter 14.16 DIO2 output source.	Not energized / uint32
16.16	DIO2 output source	(Visible when 16.01 Module 3 type = FIO-01) See parameter 14.16 DIO2 output source.	Not energized / uint32
16.17	DI2 ON delay	(Visible when 16.01 Module 3 type = FDIO-01) See parameter 14.17 DI2 ON delay.	- / real32
16.17	DIO2 ON delay	(Visible when 16.01 Module 3 type = FIO-11) See parameter 14.17 DIO2 ON delay.	- / real32
16.17	DIO2 ON delay	(Visible when 16.01 Module 3 type = FIO-01) See parameter 14.17 DIO2 ON delay.	- / real32
16.18	DI2 OFF delay	(Visible when 16.01 Module 3 type = FDIO-01) See parameter 14.18 DI2 OFF delay.	- / real32
16.18	DIO2 OFF delay	(Visible when 16.01 Module 3 type = FIO-11) See parameter 14.18 DIO2 OFF delay.	- / real32
16.18	DIO2 OFF delay	(Visible when 16.01 Module 3 type = FIO-01) See parameter 14.18 DIO2 OFF delay.	- / real32
16.19	AI supervision function	(Visible when 16.01 Module 3 type = FAIO-01) See parameter 14.19 AI supervision function.	No action / uint16
16.19	DIO3 function	(Visible when 16.01 Module 3 type = FIO-01) See parameter 14.19 DIO3 function.	Input / uint16
16.20	AI supervision selection	(Visible when 16.01 Module 3 type = FAIO-01) See parameter 14.20 AI supervision selection.	- / uint16
16.20	AI supervision selection	(Visible when 16.01 Module 3 type = FIO-11) See parameter 14.20 AI supervision selection.	- / uint16
16.21	AI tune	(Visible when 16.01 Module 3 type = FAIO-01) See parameter 14.21 AI tune.	No action / uint16
16.21	AI tune	(Visible when 16.01 Module 3 type = FIO-11) See parameter 14.21 AI tune.	No action / uint16
16.21	DIO3 output source	(Visible when 16.01 Module 3 type = FIO-01) See parameter 14.21 DIO3 output source.	Not energized / uint32

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No.	Name / Range / Selection	Description	Def / Type FbEq 16b / 32b
16.22	AI force selection	(Visible when 16.01 Module 3 type = FAIO-01) See parameter 14.22 AI force selection.	- / uint16
16.22	AI force selection	(Visible when 16.01 Module 3 type = FIO-11) See parameter 14.22 AI force selection.	- / uint16
16.22	DI3 ON delay	(Visible when 16.01 Module 3 type = FDIO-01) See parameter 14.22 DI3 ON delay.	- / real32
16.22	DIO3 ON delay	(Visible when 16.01 Module 3 type = FIO-01) See parameter 14.22 DIO3 ON delay.	- / real32
16.23	DI3 OFF delay	(Visible when 16.01 Module 3 type = FDIO-01) See parameter 14.23 DI3 OFF delay.	- / real32
16.23	DIO3 OFF delay	(Visible when 16.01 Module 3 type = FIO-01) See parameter 14.23 DIO3 OFF delay.	- / real32
16.24	DIO4 function	(Visible when 16.01 Module 3 type = FIO-01) See parameter 14.24 DIO4 function.	Input / uint16
16.26	AI1 actual value	(Visible when 16.01 Module 3 type = FAIO-01) See parameter 14.26 AI1 actual value.	- / real32
16.26	DIO4 output source	(Visible when 16.01 Module 3 type = FIO-01) See parameter 14.26 DIO4 output source.	Not energized / uint32
16.27	AI1 scaled value	(Visible when 16.01 Module 3 type = FAIO-01) See parameter 14.27 AI1 scaled value.	- / real32
16.27	DIO4 ON delay	(Visible when 16.01 Module 3 type = FIO-01) See parameter 14.27 DIO4 ON delay.	- / real32
16.28	AI1 force data	(Visible when 16.01 Module 3 type = FAIO-01) See parameter 14.28 AI1 force data.	- / real32
16.28	DIO4 OFF delay	(Visible when 16.01 Module 3 type = FIO-01) See parameter 14.28 DIO4 OFF delay.	- / real32
16.29	AI1 HW switch position	(Visible when 16.01 Module 3 type = FAIO-01) See parameter 14.29 AI1 HW switch position.	mA / uint16
16.30	AI1 unit selection	(Visible when 16.01 Module 3 type = FAIO-01) See parameter 14.30 AI1 unit selection.	mA / uint16
16.31	RO status	(Visible when 16.01 Module 3 type = FDIO-01) See parameter 14.31 RO status.	- / uint16
16.31	RO status	(Visible when 16.01 Module 3 type = FIO-01) See parameter 14.31 RO status.	- / uint16
16.31	AI1 filter gain	(Visible when 16.01 Module 3 type = FAIO-01) See parameter 14.31 AI1 filter gain.	1 ms / uint16
16.32	AI1 filter time	(Visible when 16.01 Module 3 type = FAIO-01) See parameter 14.32 AI1 filter time.	- / real32
16.33	AI1 min	(Visible when 16.01 Module 3 type = FAIO-01) See parameter 14.33 AI1 min.	- / real32
16.34	RO1 source	(Visible when 16.01 Module 3 type = FDIO-01) See parameter 14.34 RO1 source.	Not energized / uint32
16.34	RO1 source	(Visible when 16.01 Module 3 type = FIO-01) See parameter 14.34 RO1 source.	Not energized / uint32

No.	Name / Range / Selection	Description	Def / Type FbEq 16b / 32b
16.34	AI1 max	(Visible when 16.01 Module 3 type = FAIO-01) See parameter 14.34 AI1 max.	- / real32
16.35	RO1 ON delay	(Visible when 16.01 Module 3 type = FDIO-01) See parameter 14.35 RO1 ON delay.	- / real32
16.35	RO1 ON delay	(Visible when 16.01 Module 3 type = FIO-01) See parameter 14.35 RO1 ON delay.	- / real32
16.35	AI1 scaled at AI1 min	(Visible when 16.01 Module 3 type = FAIO-01) See parameter 14.35 AI1 scaled at AI1 min.	- / real32
16.36	RO1 OFF delay	(Visible when 16.01 Module 3 type = FDIO-01) See parameter 14.36 RO1 OFF delay.	- / real32
16.36	RO1 OFF delay	(Visible when 16.01 Module 3 type = FIO-01) See parameter 14.36 RO1 OFF delay.	- / real32
16.36	AI1 scaled at AI1 max	(Visible when 16.01 Module 3 type = FAIO-01) See parameter 14.36 AI1 scaled at AI1 max.	- / real32
16.37	RO2 source	(Visible when 16.01 Module 3 type = FDIO-01) See parameter 14.37 RO2 source.	Not energized / uint32
16.37	RO2 source	(Visible when 16.01 Module 3 type = FIO-01) See parameter 14.37 RO2 source.	Not energized / uint32
16.38	RO2 ON delay	(Visible when 16.01 Module 3 type = FDIO-01) See parameter 14.38 RO2 ON delay.	- / real32
16.38	RO2 ON delay	(Visible when 16.01 Module 3 type = FIO-01) See parameter 14.38 RO2 ON delay.	- / real32
16.39	RO2 OFF delay	(Visible when 16.01 Module 3 type = FDIO-01) See parameter 14.39 RO2 OFF delay.	- / real32
16.39	RO2 OFF delay	(Visible when 16.01 Module 3 type = FIO-01) See parameter 14.39 RO2 OFF delay.	- / real32
16.41	AI2 actual value	(Visible when 16.01 Module 3 type = FAIO-01) See parameter 14.41 AI2 actual value.	- / real32
16.42	AI2 scaled value	(Visible when 16.01 Module 3 type = FAIO-01) See parameter 14.42 AI2 scaled value.	- / real32
16.43	AI2 force data	(Visible when 16.01 Module 3 type = FAIO-01) See parameter 14.43 AI2 force data.	- / real32
16.44	AI2 HW switch position	(Visible when 16.01 Module 3 type = FAIO-01) See parameter 14.44 AI2 HW switch position.	mA / uint16
16.45	AI2 unit selection	(Visible when 16.01 Module 3 type = FAIO-01) See parameter 14.45 AI2 unit selection.	mA / uint16
16.46	AI2 filter gain	(Visible when 16.01 Module 3 type = FAIO-01) See parameter 14.46 AI2 filter gain.	1 ms / uint16
16.47	AI2 filter time	(Visible when 16.01 Module 3 type = FAIO-01) See parameter 14.47 AI2 filter time.	- / real32
16.48	AI2 min	(Visible when 16.01 Module 3 type = FAIO-01) See parameter 14.48 AI2 min.	- / real32
16.49	AI2 max	(Visible when 16.01 Module 3 type = FAIO-01) See parameter 14.49 AI2 max.	- / real32

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No.	Name / Range / Selection	Description	Def / Type FbEq 16b / 32b
16.50	AI2 scaled at AI2 min	(Visible when 16.01 Module 3 type = FAIO-01) See parameter 14.50 AI2 scaled at AI2 min.	- / real32
16.51	AI2 scaled at AI2 max	(Visible when 16.01 Module 3 type = FAIO-01) See parameter 14.51 AI2 scaled at AI2 max.	- / real32
16.56	AI3 actual value	(Visible when 16.01 Module 3 type = FIO-11) See parameter 14.56 AI3 actual value.	- / real32
16.57	AI3 scaled value	(Visible when 16.01 Module 3 type = FIO-11) See parameter 14.57 AI3 scaled value.	- / real32
16.58	AI3 force data	(Visible when 16.01 Module 3 type = FIO-11) See parameter 14.58 AI3 force data.	- / real32
16.59	AI3 HW switch position	(Visible when 16.01 Module 3 type = FIO-11) See parameter 14.59 AI3 HW switch position.	mA / uint16
16.60	AI3 unit selection	(Visible when 16.01 Module 3 type = FIO-11) See parameter 14.60 AI3 unit selection.	mA / uint16
16.61	AI3 filter gain	(Visible when 16.01 Module 3 type = FIO-11) See parameter 14.61 AI3 filter gain.	1 ms / uint16
16.62	AI3 filter time	(Visible when 16.01 Module 3 type = FIO-11) See parameter 14.62 AI3 filter time.	- / real32
16.63	AI3 min	(Visible when 16.01 Module 3 type = FIO-11) See parameter 14.63 AI3 min.	- / real32
16.64	AI3 max	(Visible when 16.01 Module 3 type = FIO-11) See parameter 14.64 AI3 max.	- / real32
16.65	AI3 scaled at AI3 min	(Visible when 16.01 Module 3 type = FIO-11) See parameter 14.65 AI3 scaled at AI3 min.	- / real32
16.66	AI3 scaled at AI3 max	(Visible when 16.01 Module 3 type = FIO-11) See parameter 14.66 AI3 scaled at AI3 max.	- / real32
16.71	AO force selection	(Visible when 16.01 Module 3 type = FAIO-01) See parameter 14.71 AO force selection.	- / uint16
16.71	AO force selection	(Visible when 16.01 Module 3 type = FIO-11) See parameter 14.71 AO force selection.	- / uint16
16.76	AO1 actual value	(Visible when 16.01 Module 3 type = FAIO-01) See parameter 14.76 AO1 actual value.	- / real32
16.77	AO1 source	(Visible when 16.01 Module 3 type = FAIO-01) See parameter 14.77 AO1 source.	Zero / uint32
16.78	AO1 force data	(Visible when 16.01 Module 3 type = FIO-11) See parameter 14.78 AO1 force data.	- / real32
16.78	AO1 force data	(Visible when 16.01 Module 3 type = FAIO-01) See parameter 14.78 AO1 force data.	- / real32
16.79	AO1 filter time	(Visible when 16.01 Module 3 type = FAIO-01) See parameter 14.79 AO1 filter time.	- / real32
16.80	AO1 source min	(Visible when 16.01 Module 3 type = FAIO-01) See parameter 14.80 AO1 source min.	- / real32
16.81	AO1 source max	(Visible when 16.01 Module 3 type = FAIO-01) See parameter 14.81 AO1 source max.	- / real32

No.	Name / Range / Selection	Description	Def / Type FbEq 16b / 32b
16.82	AO1 out at AO1 src min	(Visible when 16.01 Module 3 type = FIO-11) See parameter 14.82 AO1 out at AO1 src min.	- / real32
16.82	AO1 out at AO1 src min	(Visible when 16.01 Module 3 type = FAIO-01) See parameter 14.82 AO1 out at AO1 src min.	- / real32
16.83	AO1 out at AO1 src max	(Visible when 16.01 Module 3 type = FIO-11) See parameter 14.83 AO1 out at AO1 src max.	- / real32
16.83	AO1 out at AO1 src max	(Visible when 16.01 Module 3 type = FAIO-01) See parameter 14.83 AO1 out at AO1 src max.	- / real32
16.86	AO2 actual value	(Visible when 16.01 Module 3 type = FAIO-01) See parameter 14.86 AO2 actual value.	- / real32
16.87	AO2 source	(Visible when 16.01 Module 3 type = FAIO-01) See parameter 14.87 AO2 source.	Zero / uint32
16.88	AO2 force data	(Visible when 16.01 Module 3 type = FAIO-01) See parameter 14.88 AO2 force data.	- / real32
16.89	AO2 filter time	(Visible when 16.01 Module 3 type = FAIO-01) See parameter 14.89 AO2 filter time.	- / real32
16.90	AO2 source min	(Visible when 16.01 Module 3 type = FAIO-01) See parameter 14.90 AO2 source min.	- / real32
16.91	AO2 source max	(Visible when 16.01 Module 3 type = FAIO-01) See parameter 14.91 AO2 source max.	- / real32
16.92	AO2 out at AO2 src min	(Visible when 16.01 Module 3 type = FAIO-01) See parameter 14.92 AO2 out at AO2 src min.	- / real32
16.93	AO2 out at AO2 src max	(Visible when 16.01 Module 3 type = FAIO-01) See parameter 14.93 AO2 out at AO2 src max.	- / real32

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 133) .	
19.01	Actual operation mode	Displays the operating mode currently used. See parameters 19.11...19.14 . This parameter is read-only.	Zero / 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 207).	-
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
	Torque	Torque control. The torque reference used is 26.74 Torque ref ramp out (output of the torque reference chain).	3
	Minimum	Combination of selections Speed and Torque : the torque selector compares the speed controller output (25.01 Torque reference speed control) and the torque reference (26.74 Torque ref ramp out) and selects the smaller of the two. If speed error becomes negative, the drive follows the speed controller output until speed error becomes positive again. This prevents the drive from accelerating uncontrollably if the load is lost in torque control.	4
	Maximum	Combination of selections Speed and Torque : the torque selector compares the speed controller output (25.01 Torque reference speed control) and the torque reference (26.74 Torque ref ramp out) and selects the greater of the two. If speed error becomes positive, the drive follows the speed controller output until speed error becomes negative again. This prevents the drive from accelerating uncontrollably if the load is lost in torque control.	5
	Add	Combination of selections Speed and Torque : Torque selector adds the speed reference chain output to the torque reference chain output.	6
	Voltage	Reserved (Type BCU control units only) DC voltage control. DC voltage control.	7
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

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No.	Name / Range / Selection	Description	Def / Type FbEq 16b / 32b
	Speed	Speed control. The torque reference used is 25.01 Torque reference speed control (output of the speed reference chain).	0
	Torque	Torque control. The torque reference used is 26.74 Torque ref ramp out (output of the torque reference chain).	1
19.17	Local control disable	Enables/disables local control (start and stop buttons on the control panel, and the local controls on the PC tool).  WARNING! Before disabling local control, ensure that the control panel is not needed for stopping the drive.	No / 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 133), and parameter 99.04 Motor control mode (page 705). 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

No.	Name / Range / Selection	Description	Def / Type FbEq 16b / 32b																					
20	Start/stop/direction	Start/stop/direction and run/start/jog enable signal source selection; positive/negative reference enable signal source selection. For information on control locations, refer section Local control vs. external control (page 132) .																						
20.01	Ext1 commands	Selects the source of start, stop and direction commands for external control location 1 (EXT1). See also parameters 20.02...20.05 .	In1 Start; In2 Dir / uint16																					
	Not selected	No start or stop command sources selected.	0																					
	In1 Start	The source of the start and stop commands is selected by parameter 20.03 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 = <i>Edge</i>)</td><td>Start</td></tr><tr><td>1 (20.02 = <i>Level</i>)</td><td></td></tr><tr><td>0</td><td>Stop</td></tr></table>	State of source 1 (20.03)	Command	0→1 (20.02 = <i>Edge</i>)	Start	1 (20.02 = <i>Level</i>)		0	Stop	1													
State of source 1 (20.03)	Command																							
0→1 (20.02 = <i>Edge</i>)	Start																							
1 (20.02 = <i>Level</i>)																								
0	Stop																							
	In1 Start; In2 Dir	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>0→1 (20.02 = <i>Edge</i>)</td><td>0</td><td>Start forward</td></tr><tr><td>1 (20.02 = <i>Level</i>)</td><td>1</td><td>Start reverse</td></tr></table>	State of source 1 (20.03)	State of source 2 (20.04)	Command	0	Any	Stop	0→1 (20.02 = <i>Edge</i>)	0	Start forward	1 (20.02 = <i>Level</i>)	1	Start reverse	2									
State of source 1 (20.03)	State of source 2 (20.04)	Command																						
0	Any	Stop																						
0→1 (20.02 = <i>Edge</i>)	0	Start forward																						
1 (20.02 = <i>Level</i>)	1	Start reverse																						
	In1 Start fwd; In2 Start rev	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 = <i>Edge</i>)</td><td>0</td><td>Start forward</td></tr><tr><td>1 (20.02 = <i>Level</i>)</td><td></td><td></td></tr><tr><td>0</td><td>0→1 (20.02 = <i>Edge</i>)</td><td>Start reverse</td></tr><tr><td></td><td>1 (20.02 = <i>Level</i>)</td><td></td></tr><tr><td>1</td><td>1</td><td>Stop</td></tr></table>	State of source 1 (20.03)	State of source 2 (20.04)	Command	0	0	Stop	0→1 (20.02 = <i>Edge</i>)	0	Start forward	1 (20.02 = <i>Level</i>)			0	0→1 (20.02 = <i>Edge</i>)	Start reverse		1 (20.02 = <i>Level</i>)		1	1	Stop	3
State of source 1 (20.03)	State of source 2 (20.04)	Command																						
0	0	Stop																						
0→1 (20.02 = <i>Edge</i>)	0	Start forward																						
1 (20.02 = <i>Level</i>)																								
0	0→1 (20.02 = <i>Edge</i>)	Start reverse																						
	1 (20.02 = <i>Level</i>)																							
1	1	Stop																						

No.	Name / Range / Selection	Description	Def / Type FbEq 16b / 32b																
	In1P Start; In2 Stop	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.	State of source 1 (20.03)	State of source 2 (20.04)	Command	0→1	1	Start	Any	0	Stop	4							
State of source 1 (20.03)	State of source 2 (20.04)	Command																	
0→1	1	Start																	
Any	0	Stop																	
	In1P Start; In2 Stop; In3 Dir	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.	State of source 1 (20.03)	State of source 2 (20.04)	State of source 3 (20.05)	Command	0→1	1	0	Start forward	0→1	1	1	Start reverse	Any	0	Any	Stop	5
State of source 1 (20.03)	State of source 2 (20.04)	State of source 3 (20.05)	Command																
0→1	1	0	Start forward																
0→1	1	1	Start reverse																
Any	0	Any	Stop																

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 20.03 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 border="1"> <thead> <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> </thead> <tbody> <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> </tbody> </table> Note: The start signal is always edge-triggered with this setting regardless of parameter 20.02 Ext1 start trigger type.	State of source 1 (20.03)	State of source 2 (20.04)	State of source 3 (20.05)	Command	0→1	Any	1	Start forward	Any	0→1	1	Start reverse	Any	Any	0	Stop	6
State of source 1 (20.03)	State of source 2 (20.04)	State of source 3 (20.05)	Command																
0→1	Any	1	Start forward																
Any	0→1	1	Start reverse																
Any	Any	0	Stop																
	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 A. Note: The start signal is always level-triggered with this setting regardless of parameter 20.02 Ext1 start trigger type.	12																
	Embedded fieldbus	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.	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 level-triggered with this setting regardless of parameter 20.02 Ext1 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 level-triggered with this setting regardless of parameter 20.02 Ext1 start trigger type.	21																
	ATF	Reserved.	22																

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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 207) .	-
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 .	Not selected / uint16
	Not selected	No start or stop command sources selected.	0

No.	Name / Range / Selection	Description	Def / Type FbEq 16b / 32b														
	In1 Start	The source of the start and stop commands is selected by parameter 20.08 Ext2 in1 source. The state transitions of the source bits are interpreted as follows: <table><tr><th>State of source 1 (20.08)</th><th>Command</th></tr><tr><td>0→1 (20.07 = <i>Edge</i>) 1 (20.07 = <i>Level</i>)</td><td>Start</td></tr><tr><td>0</td><td>Stop</td></tr></table>	State of source 1 (20.08)	Command	0→1 (20.07 = <i>Edge</i>) 1 (20.07 = <i>Level</i>)	Start	0	Stop	1								
State of source 1 (20.08)	Command																
0→1 (20.07 = <i>Edge</i>) 1 (20.07 = <i>Level</i>)	Start																
0	Stop																
	In1 Start; In2 Dir	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 = <i>Edge</i>) 1 (20.07 = <i>Level</i>)</td><td>0</td><td>Start forward</td></tr><tr><td>1</td><td>Start reverse</td></tr></table>	State of source 1 (20.08)	State of source 2 (20.09)	Command	0	Any	Stop	0→1 (20.07 = <i>Edge</i>) 1 (20.07 = <i>Level</i>)	0	Start forward	1	Start reverse	2			
State of source 1 (20.08)	State of source 2 (20.09)	Command															
0	Any	Stop															
0→1 (20.07 = <i>Edge</i>) 1 (20.07 = <i>Level</i>)	0	Start forward															
	1	Start reverse															
	In1 Start fwd; In2 Start rev	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 rowspan="2">0→1 (20.07 = <i>Edge</i>) 1 (20.07 = <i>Level</i>)</td><td>0</td><td>Start forward</td></tr><tr><td>0→1 (20.07 = <i>Edge</i>) 1 (20.07 = <i>Level</i>)</td><td>Start reverse</td></tr><tr><td>1</td><td>1</td><td>Stop</td></tr></table>	State of source 1 (20.08)	State of source 2 (20.09)	Command	0	0	Stop	0→1 (20.07 = <i>Edge</i>) 1 (20.07 = <i>Level</i>)	0	Start forward	0→1 (20.07 = <i>Edge</i>) 1 (20.07 = <i>Level</i>)	Start reverse	1	1	Stop	3
State of source 1 (20.08)	State of source 2 (20.09)	Command															
0	0	Stop															
0→1 (20.07 = <i>Edge</i>) 1 (20.07 = <i>Level</i>)	0	Start forward															
	0→1 (20.07 = <i>Edge</i>) 1 (20.07 = <i>Level</i>)	Start reverse															
1	1	Stop															

No.	Name / Range / Selection	Description	Def / Type FbEq 16b / 32b																
	In1P Start; In2 Stop	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.	State of source 1 (20.08)	State of source 2 (20.09)	Command	0→1	1	Start	Any	0	Stop	4							
State of source 1 (20.08)	State of source 2 (20.09)	Command																	
0→1	1	Start																	
Any	0	Stop																	
	In1P Start; In2 Stop; In3 Dir	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.	State of source 1 (20.08)	State of source 2 (20.09)	State of source 3 (20.10)	Command	0→1	1	0	Start forward	0→1	1	1	Start reverse	Any	0	Any	Stop	5
State of source 1 (20.08)	State of source 2 (20.09)	State of source 3 (20.10)	Command																
0→1	1	0	Start forward																
0→1	1	1	Start reverse																
Any	0	Any	Stop																

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: <table border="1"> <thead> <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> </thead> <tbody> <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> </tbody> </table> Note: The start signal is always edge-triggered with this setting regardless of parameter 20.07 Ext2 start trigger type.	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	6
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																
	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																

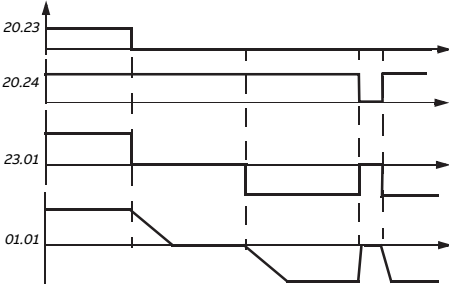
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No.	Name / Range / Selection	Description	Def / Type FbEq 16b / 32b
	DDCS controller	The start and stop commands are taken from an external (DDCS) controller. Note: The start signal is always edge-triggered with this setting regardless of parameter 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 .	Edge / 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 369) .	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 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 207) .	-

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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 DIO2 (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 207) .	-

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 207).	-
20.24	Negative speed enable	Selects the source of the negative speed reference enable command. See parameter 20.23 Positive speed enable .	Selected / uint32

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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). Refer section Jogging (page 167).	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 207) .	-
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 DIO2 (11.02 DIO delayed status, bit 1).	11
	Other [bit]	See Terms and abbreviations (page 207) .	-
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
20.200	Power on acknowledge	Selects the source for activating the Power on acknowledgment signal. 0 = Power on acknowledgement signal is inactive. 1 = Power on acknowledgement signal is active.	DIIL / int32
	FALSE	0	0
	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

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No.	Name / Range / Selection	Description	Def / Type FbEq 16b / 32b
	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
	STO inverted	Safe torque off inverted	9
	Other [bit]	See Terms and abbreviations (page 207) .	-
20.201	Power on ackn reset delay	Defines the time delay for a fault reset after the Power on acknowledgment signal is activated.	1000 ms / int16
	0...30000 ms	Time delay	1 = 1 ms / 1 = 1 ms

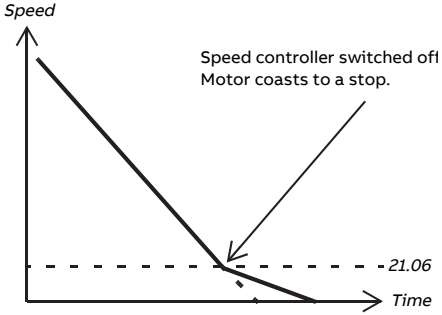
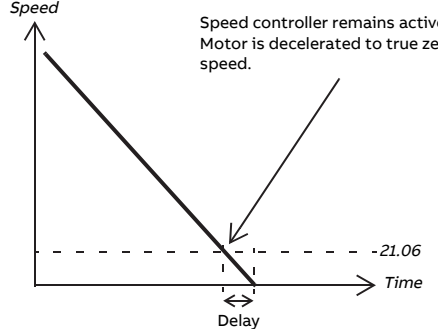
No.	Name / Range / Selection	Description	Def / Type FbEq 16b / 32b
21	Start/stop mode	Start and stop modes; emergency stop mode and signal source selection; DC magnetization settings; autophasing mode selection.	
21.01	Start mode	Selects the motor start function for the DTC motor control mode, ie. when 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 175).	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

No.	Name / Range / Selection	Description	Def / Type FbEq 16b / 32b										
21.02	Magnetization time	Defines the pre-magnetization time when - parameter 21.01 Start mode is set to Constant time (in DTC motor control mode), or - parameter 21.19 Scalar start mode is set to Constant 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.	Motor rated power	Constant magnetizing time	< 1 kW	≥ 50 to 100 ms	1 to 10 kW	≥ 100 to 200 ms	10 to 200 kW	≥ 200 to 1000 ms	200 to 1000 kW	≥ 1000 to 2000 ms	500 ms / uint16
Motor rated power	Constant magnetizing time												
< 1 kW	≥ 50 to 100 ms												
1 to 10 kW	≥ 100 to 200 ms												
10 to 200 kW	≥ 200 to 1000 ms												
200 to 1000 kW	≥ 1000 to 2000 ms												
	0...10000 ms	Constant DC magnetizing time.	1 = 1 ms / 1 = 1 ms										
21.03	Stop mode	Selects the way the motor is stopped when a stop command is received. Additional braking is possible by selecting flux braking (see parameter 97.05 Flux braking). Note: This parameter has no effect in a follower drive in a master/follower configuration.	Coast / 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 369).	1										
	Torque limit	Stop according to torque limits (parameters 30.19 and 30.20).	2										
21.04	Emergency stop mode	Selects the way the motor is stopped when an emergency stop command is received. The source of the emergency stop signal is selected by parameter 21.05 Emergency stop source.	Ramp stop (Off1); Coast stop (Off2) (95.20 b1); Eme ramp stop (Off3) (95.20 b2) / uint16										

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 (refer section Reference ramping (page 153)). 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

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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 207) .	-
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

No.	Name / Range / Selection	Description	Def / Type FbEq 16b / 32b
21.07	Zero speed delay	Defines the delay for the zero speed delay function. The function is useful in applications where a smooth and quick restarting is essential. During the delay, the drive knows the rotor position accurately. <u>Without zero speed delay:</u> The drive receives a stop command and decelerates along a ramp. When actual motor speed falls below the value of parameter 21.06 Zero speed limit, inverter modulation is stopped and the motor coasts to a standstill.  <u>With zero speed delay:</u> The drive receives a stop command and decelerates along a ramp. When actual motor speed falls below the value of parameter 21.06 Zero speed limit, the zero speed delay function activates. During the delay the function keeps the speed controller live: the inverter modulates, motor is magnetized and the drive is ready for a quick restart. Zero speed delay can be used e.g. with the jogging function. 	0 ms / real32
	0...30000 ms	Zero speed delay.	1 = 1 ms / 1 = 1 ms

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No.	Name / Range / Selection	Description	Def / Type FbEq 16b / 32b
21.08	DC current control	Activates/deactivates the DC hold and post-magnetization functions. Refer section DC magnetization (page 175). Note: - DC hold is only available with speed control in DTC motor control mode (see page 133). - 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. Refer section DC hold (page 176). Note: The DC hold function has no effect if the start signal is switched off.	
b1	Post magnetization	1 = Enable post-magnetization. Refer section Post-magnetization (page 176). 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 176).	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 175).	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
21.13	Autophasing mode	Selects the way autophasing is performed. Refer section Autophasing (page 171). Note: This parameter cannot be changed while the drive is running.	Turning / uint16

No.	Name / Range / Selection	Description	Def / Type FbEq 16b / 32b
	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
	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. Refer section Pre-heating (page 175) . 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

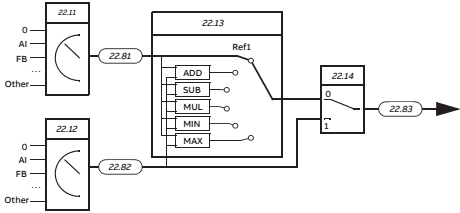
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No.	Name / Range / Selection	Description	Def / Type FbEq 16b / 32b
	Supervision 1	Supervision 1 active (32.01 Supervision status, bit 0).	8
	Supervision 2	Supervision 2 active (32.01 Supervision status, bit 1).	9
	Supervision 3	Supervision 3 active (32.01 Supervision status, bit 2).	10
	Other [bit]	See Terms and abbreviations (page 207) .	-
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 %
21.18	Auto restart time	The motor can be automatically started after a short supply power failure using the automatic restart function. Refer section Automatic restart (page 180). 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, i.e. when 99.04 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 175).	Normal / uint16
	Normal	Immediate start from zero speed.	0

No.	Name / Range / Selection	Description	Def / Type FbEq 16b / 32b
	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
21.37	Motor temperature estimation	Selects the source of the motor temperature estimation on/off command. See section Motor temperature estimation (page 177). 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

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No.	Name / Range / Selection	Description	Def / Type FbEq 16b / 32b
	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 820...822.	
22.01	Speed ref unlimited	Displays the output of the speed reference selection block. See the control chain diagram on page 821. 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
22.11	Speed ref1 source	Selects speed reference source 1. Two signal sources can be defined by this parameter and 22.12 Speed ref2 source. A digital source selected by 22.14 Speed ref1/2 selection can be used to switch between the two sources, or a mathematical function (22.13 Speed ref1 function) applied to the two signals to create the reference. 	AI1 scaled / uint32
	Zero	None.	0
	AI1 scaled	12.12 AI1 scaled value (page 282).	1
	AI2 scaled	12.22 AI2 scaled value (page 283).	2
	FB A ref1	03.05 FB A reference 1 (page 217).	4
	FB A ref2	03.06 FB A reference 2 (page 217).	5
	EFB ref1	03.09 EFB reference 1 (page 217).	8
	EFB ref2	03.10 EFB reference 2 (page 217).	9
	DDCS ctrl ref1	03.11 DDCS controller ref 1 (page 217).	10
	DDCS ctrl ref2	03.12 DDCS controller ref 2 (page 218).	11
	M/F reference 1	03.13 M/F or D2D ref1 (page 218).	12
	M/F reference 2	03.14 M/F or D2D ref2 (page 218).	13
	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. Refer section Using the control panel as an external control source (page 133).	18
	Control panel (ref copied)	Control panel reference, with initial value from previous source or actual value. Refer section Using the control panel as an external control source (page 133).	19

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No.	Name / Range / Selection	Description	Def / Type FbEq 16b / 32b
	Other [bit]	Source selection. See Terms and abbreviations (page 207) .	-
22.12	Speed ref2 source	Selects speed reference source 2. For the selections, and a diagram of reference source selection, see parameter 22.11 Speed ref1 source .	Zero / uint32
22.13	Speed ref1 function	Selects a mathematical function between the reference sources selected by parameters 22.11 Speed ref1 source and 22.12 Speed ref2 source . See diagram at 22.11 Speed ref1 source .	Ref1 / uint16
	Ref1	Signal selected by 22.11 Speed ref1 source is used as speed reference 1 as such (no function applied).	0
	Add (ref1 + ref2)	The sum of the reference sources is used as speed reference 1.	1
	Sub (ref1 - ref2)	The subtraction (22.11 Speed ref1 source - 22.12 Speed ref2 source) of the reference sources is used as speed reference 1.	2
	Mul (ref1 x ref2)	The multiplication of the reference sources is used as speed reference 1.	3
	Min (ref1, ref2)	The smaller of the reference sources is used as speed reference 1.	4
	Max (ref1, ref2)	The greater of the reference sources is used as speed reference 1.	5
22.14	Speed ref1/2 selection	Configures the selection between speed references 1 and 2. See diagram at 22.11 Speed ref1 source . 0 = Speed reference 1 1 = Speed reference 2	Follow Ext1/Ext2 selection / uint32
	Speed reference 1	0.	0
	Speed reference 2	1.	1
	Follow Ext1/Ext2 selection	Speed reference 1 is used when external control location EXT1 is active. Speed reference 2 is used when external control location EXT2 is active. See also parameter 19.11 Ext1/Ext2 selection .	2
	DI1	Digital input DI1 (10.02 DI delayed status , bit 0).	3
	DI2	Digital input DI2 (10.02 DI delayed status , bit 1).	4
	DI3	Digital input DI3 (10.02 DI delayed status , bit 2).	5
	DI4	Digital input DI4 (10.02 DI delayed status , bit 3).	6
	DI5	Digital input DI5 (10.02 DI delayed status , bit 4).	7
	DI6	Digital input DI6 (10.02 DI delayed status , bit 5).	8
	DIO1	Digital input/output DIO1 (11.02 DIO delayed status , bit 0).	11
	DIO2	Digital input/output DIO2 (11.02 DIO delayed status , bit 1).	12

No.	Name / Range / Selection	Description	Def / Type FbEq 16b / 32b
	Other [bit]	See Terms and abbreviations (page 207) .	-
22.15	Speed additive 1 source	Defines a reference to be added to the speed reference after reference selection (see page 820). For the selections, see parameter 22.11 Speed ref1 source . Note: For safety reasons, the additive is not applied when any of the stop functions are active.	Zero / uint32
22.16	Speed share	Defines a scaling factor for the selected speed reference (speed reference 1 or 2, multiplied by the defined value). Speed reference 1 or 2 is selected by parameter 22.14 Speed ref1/2 selection .	1.000 NoUnit / real32
	-8.000 ... 8.000	Speed reference scaling factor.	1000 = 1 / 1000 = 1
22.17	Speed additive 2 source	Defines a reference to be added to the speed reference after the speed share function (see page 820). For the selections, see parameter 22.11 Speed ref1 source . Note: For safety reasons, the additive is not applied when any of the stop functions are active.	Zero / uint32
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

No.	Name / Range / Selection	Description	Def / Type FbEq 16b / 32b																																				
22.22	Constant speed sel1	When bit 0 of parameter 22.21 Constant speed function is 0 (Separate), selects a source that activates constant speed 1. When bit 0 of parameter 22.21 Constant speed function is 1 (Packed), this parameter and parameters 22.23 Constant speed sel2 and 22.24 Constant speed sel3 select three sources whose states activate constant speeds as follows: <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>	Source defined by par. 22.22	Source defined by par. 22.23	Source defined by par. 22.24	Constant speed active	0	0	0	None	1	0	0	Constant speed 1	0	1	0	Constant speed 2	1	1	0	Constant speed 3	0	0	1	Constant speed 4	1	0	1	Constant speed 5	0	1	1	Constant speed 6	1	1	1	Constant speed 7	DI5 / uint32
Source defined by par. 22.22	Source defined by par. 22.23	Source defined by par. 22.24	Constant speed active																																				
0	0	0	None																																				
1	0	0	Constant speed 1																																				
0	1	0	Constant speed 2																																				
1	1	0	Constant speed 3																																				
0	0	1	Constant speed 4																																				
1	0	1	Constant speed 5																																				
0	1	1	Constant speed 6																																				
1	1	1	Constant speed 7																																				
	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 207).	-																																				

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

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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 167.	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 167.	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 (page 155) .	- / 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. Refer section Motor potentiometer (page 178)	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

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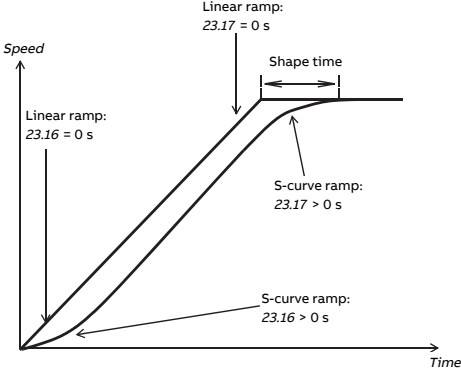
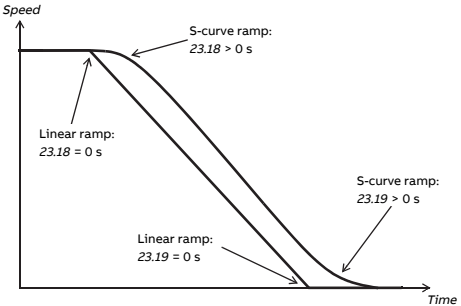
No.	Name / Range / Selection	Description	Def / Type FbEq 16b / 32b
22.73	Motor potentiometer up source	Selects the source of motor potentiometer up signal. 0 = No change 1 = Increase motor potentiometer value. (If both the up and down sources are on, the potentiometer value will not change.)	Not selected / 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 207) .	-
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 (selected by parameter 22.11 Speed ref1 source). See the control chain diagram on page 820. 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 (selected by parameter 22.12 Speed ref2 source). See the control chain diagram on page 820. 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 after the mathematical function applied by parameter 22.13 Speed ref1 function and reference 1/2 selection (22.14 Speed ref1/2 selection). See the control chain diagram on page 820. 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 (22.15 Speed additive 1 source). See the control chain diagram on page 820. 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 (22.16 Speed share). See the control chain diagram on page 820. 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 (22.17 Speed additive 2 source). See the control chain diagram on page 820. 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

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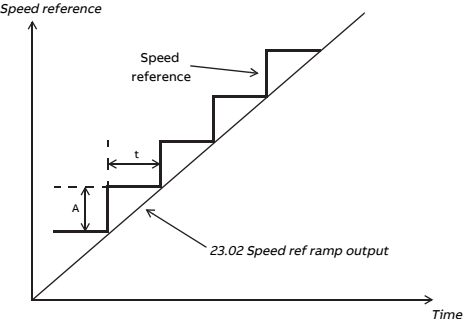
No.	Name / Range / Selection	Description	Def / Type FbEq 16b / 32b
22.87	Speed reference act 7	Displays the value of speed reference before application of critical speeds. See the control chain diagram on page 821. The value is received from 22.86 Speed reference act 6 unless overridden by • any constant speed • a jogging reference • network control reference (see Terms and abbreviations (page 22)) • 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 822.	
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 822. 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 822. 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

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:  0.000 ... 1800.000 s Ramp shape at start of acceleration.	- / 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 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 . Refer section Jogging (page 167) .	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. Refer section Jogging (page 167) .	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 23.200 ... 23.205 (speed and torque control) 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

No.	Name / Range / Selection	Description	Def / Type FbEq 16b / 32b
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. See also parameter 23.27 Ramp out balancing ref. 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 207) .	-
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
	-30000.00 ... 30000.00 rpm	Speed ramp balancing reference. For 16-bit scaling, see parameter 46.01 .	- / 100 = 1 rpm

No.	Name / Range / Selection	Description	Def / Type FbEq 16b / 32b
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 207) .	-
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. Refer section Load share function with a speed-controlled follower (page 143). 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. Refer section Load share function with a speed-controlled follower (page 143) . 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 207) .	-
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. Refer section Load share function with a speed-controlled follower (page 143) .	1.00 percent / real32
	0.00 ... 100.00 %	Speed correction term adjustment.	1 = 1 % / 100 = 1 %
23.42	Follower speed correction source	Selects the source of the torque reference for the load share function. Refer section Load share function with a speed-controlled follower (page 143) .	MF ref 2 / uint32
	NULL	None.	0
	MF ref 2	03.14 M/F or D2D ref2 (page 218) .	1
	Other [bit]	Source selection. See Terms and abbreviations (page 207) .	-
23.200	Ramp set selection	Selects the source to switch between the two sets of acceleration/deceleration ramp times defined in parameters 23.202 Acceleration time 1 to 23.205 Deceleration time 2 . 0 = Acceleration time 1 and deceleration time 1 are active. 1 = Acceleration time 2 and deceleration time 2 are active.	Set 1 / int32
	Set 1	0. Acceleration time1 and deceleration time1.	0

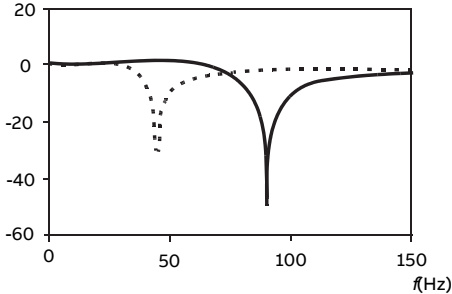
No.	Name / Range / Selection	Description	Def / Type FbEq 16b / 32b
	Set 2	1. Acceleration time2 and deceleration time2.	1
	By direction	Acceleration time1 and deceleration time1 during forward run and acceleration time2 and deceleration time2 during reverse run.	2
	DI1	Digital input DI1 (10.02 DI delayed 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).	9
	DIO2	Digital input/output DIO2 (11.02 DIO delayed status, bit 1).	10
	DI1 inverted	Digital input DI1 inverted	11
	DI2 inverted	Digital input DI2 inverted	12
	DI3 inverted	Digital input DI3 inverted	13
	DI4 inverted	Digital input DI4 inverted	14
	DI5 inverted	Digital input DI5 inverted	15
	DI6 inverted	Digital input DI6 inverted	16
	DIO1 inverted	Digital input/output DIO1 inverted	17
	DIO2 inverted	Digital input/output DIO2 inverted	18
	Other [bit]	See Terms and abbreviations (page 207) .	-
23.201	Enable winch ramps	Selects the source to switch between primary ramps defined in parameters 23.202 Acceleration time 1 to 23.205 Deceleration time 2 and winch ramps defined in parameters group 74 Winch general .	Winch ramps included / int32
	Primary ramps only	Used ramp times are selected by parameter 23.200 Ramp set selection . No winch mode ramp times are used.	0
	Winch ramps included	When a winch mode is active, the corresponding winch mode ramp times defined in group 74 Winch general are used. Otherwise the ramp times selected by parameter 23.200 Ramp set selection are used.	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

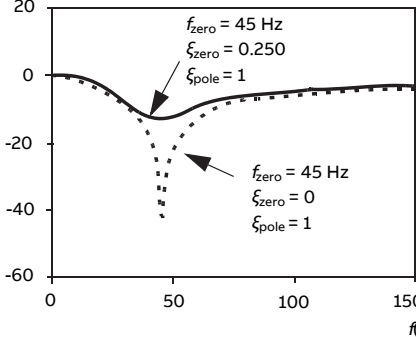
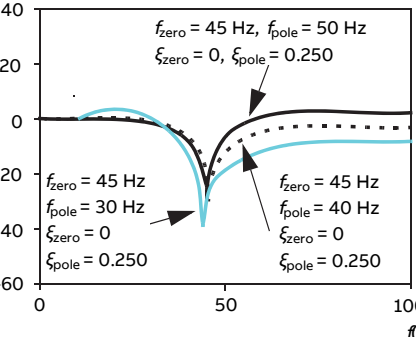
No.	Name / Range / Selection	Description	Def / Type FbEq 16b / 32b
	DIO1	Digital input/output DIO1 (11.02 DIO delayed status , bit 0).	8
	DIO2	Digital input/output DIO2 (11.02 DIO delayed status , bit 1).	9
	DI1 inverted	Digital input DI1 inverted	10
	DI2 inverted	Digital input DI2 inverted	11
	DI3 inverted	Digital input DI3 inverted	12
	DI4 inverted	Digital input DI4 inverted	13
	DI5 inverted	Digital input DI5 inverted	14
	DI6 inverted	Digital input DI6 inverted	15
	DIO1 inverted	Digital input/output DIO1 inverted	16
	DIO2 inverted	Digital input/output DIO2 inverted	17
	Other [bit]	See Terms and abbreviations (page 207) .	-
23.202	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 follows the acceleration rate. If speed reference increases slower than the set acceleration rate, motor speed follows the reference. If the acceleration time is set too short, the drive automatically prolongs the acceleration to maintain speed within the drive torque limits.	3.00 s / real32
	0.00 ... 1800.00 s	Acceleration time 1.	10 = 1 s / 1 = 1 s
23.203	Deceleration time 1	Defines deceleration time 1 required for the speed to change from the speed defined in parameter 46.01 Speed scaling (not from parameter 30.12 Maximum speed) to zero. If the speed reference decreases 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 follows the deceleration rate. If the deceleration rate is set too short, the drive automatically prolongs the deceleration to maintain speed within the 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.	3.00 s / real32
	0.00 ... 1800.00 s	Deceleration time 1.	10 = 1 s / 1 = 1 s

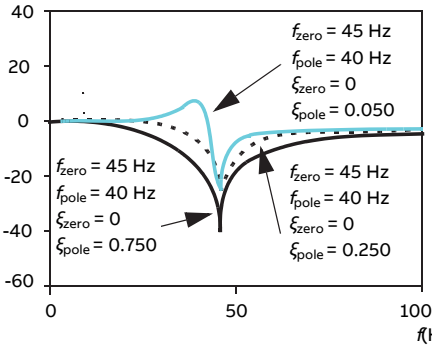
No.	Name / Range / Selection	Description	Def / Type FbEq 16b / 32b
23.204	Acceleration time 2	Defines acceleration time 2. See parameter 23.202 Acceleration time 1 .	3.00 s / real32
	0.00 ... 1800.00 s	Acceleration time 2.	10 = 1 s / 1 = 1 s
23.205	Deceleration time 2	Defines deceleration time 2. See parameter 23.203 Deceleration time 1 .	3.00 s / real32
	0.00 ... 1800.00 s	Deceleration time 2.	10 = 1 s / 1 = 1 s

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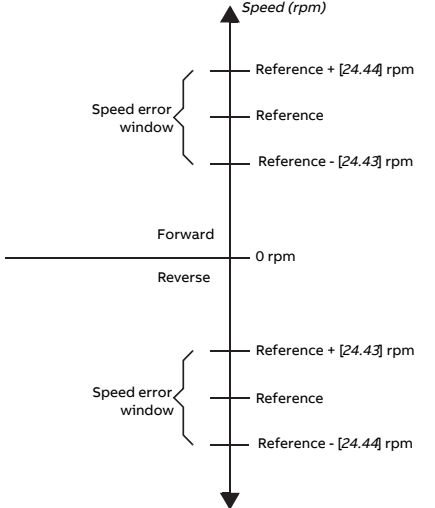
No.	Name / Range / Selection	Description	Def / Type FbEq 16b / 32b
24	Speed reference conditioning	Speed error calculation; speed error window control configuration; speed error step. See the control chain diagrams on pages 825 and 826 .	
24.01	Used speed reference	Displays the ramped and corrected speed reference (before speed error calculation). See the control chain diagram on page 825 . 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 825 . 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 825 . 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 825 . 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
24.12	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

No.	Name / Range / Selection	Description	Def / Type FbEq 16b / 32b
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. $20\log_{10} H(\omega)$ 	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. $20\log_{10} H(\omega)$  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. $20\log_{10} H(\omega)$  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

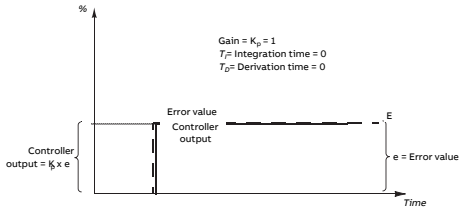
No.	Name / Range / Selection	Description	Def / Type FbEq 16b / 32b
24.17	Damping of pole	Defines the damping coefficient for parameter 24.16. The coefficient shapes the frequency response of the resonance frequency filter. A narrower bandwidth results in better dynamic properties. By setting this parameter to 1, the effect of the pole is eliminated. $20\log_{10} H(\omega)$  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

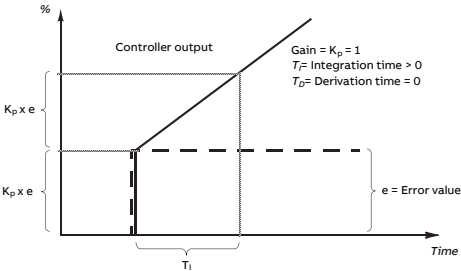
No.	Name / Range / Selection	Description	Def / Type FbEq 16b / 32b
24.41	Speed error window control enable	Enables/disables (or selects a source that enables/disables) speed error window control, sometimes also referred to as deadband control or strip break protection. It forms a speed supervision function 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 Add operating mode is active (see parameters 19.12 and 19.14), or when the drive is a speed-controlled follower (see page 143). 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

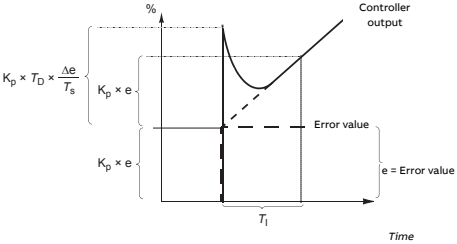
No.	Name / Range / Selection	Description	Def / Type FbEq 16b / 32b
		The window boundaries are defined by 24.43 Speed error window high and 24.44 Speed error window low as follows:  Note that it is parameter 24.44 (rather than 24.43) that defines the overspeed limit in both directions of rotation. This 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 207) .	-
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

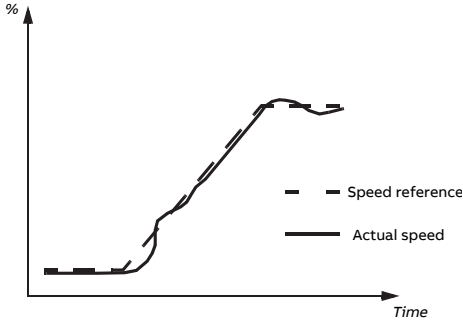
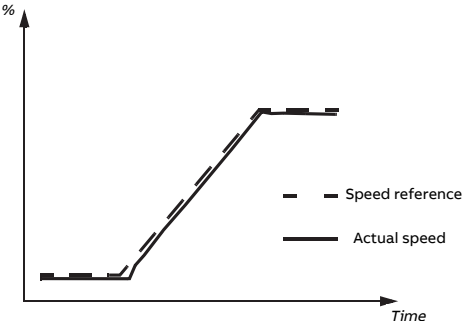
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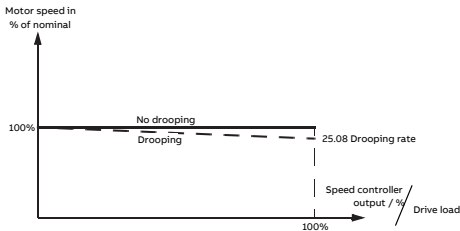
No.	Name / Range / Selection	Description	Def / Type FbEq 16b / 32b
	P-control	Only the proportional term (25.02) is observed by the speed controller. The integral and derivative terms are internally forced to zero.	1
24.43	Speed error window high	Defines the upper boundary of the speed error window. 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
24.200	Speed correction	<i>(Visible only after entering access level pass code 584. See parameter 96.02 Pass code.)</i> Defines a speed reference correction, i.e. 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.	0.00 rpm / real32
	-30000.00 ... 30000.00 rpm	Speed reference correction.	1 = 1 rpm / 1 = 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 825 and 826.	
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 826. 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. Refer section Speed controller autotune (page 156).	10.00; 5.00 (95.21 b1/b2) NoUnit / real32
	0.00 ... 250.00	Proportional gain for speed controller.	100 = 1 / 100 = 1

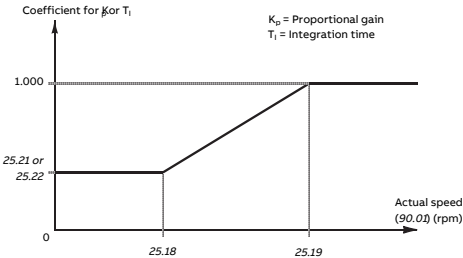
No.	Name / Range / Selection	Description	Def / Type FbEq 16b / 32b
25.03	Speed integration time	Defines the integration time of the speed controller. The integration time defines the rate at which the controller output changes when the error value is constant and the proportional gain of the speed controller 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. Refer section Speed controller autotune (page 156).	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

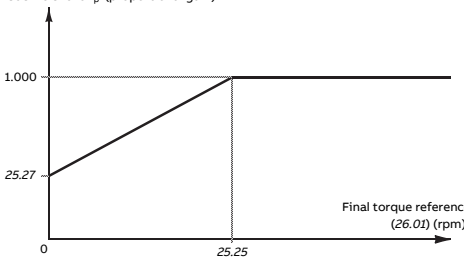
No.	Name / Range / Selection	Description	Def / Type FbEq 16b / 32b
25.04	Speed derivation time	Defines the derivation time of the speed controller. Derivative action boosts the controller output if the error value changes. The longer the derivation time, the more the speed controller output is boosted 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 deriva- tion time	Defines the derivation time for acceleration(/deceleration) compensation. In order to compensate for a high inertia load during acceleration, a derivative of the reference is added to the output of the speed controller. The principle of a derivative action is described under parameter 25.04 Speed derivation time. Note: As a general rule, set this parameter to the value between 50 and 100% of the sum of the mechanical time constants of the motor and the driven machine. The figure below shows the speed responses when a high inertia load is accelerated along a ramp. No acceleration compensation:  Acceleration compensation:  0.00 ... 1000.00 s Acceleration compensation derivation time. 10 = 1 s / 100 = 1 s	- / real32
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. 0.0 ... 1000.0 ms Acceleration/deceleration compensation filter time.	8.0 ms / real32
			1 = 1 ms / 10 = 1 ms

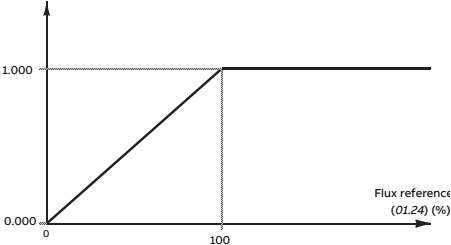
No.	Name / Range / Selection	Description	Def / Type FbEq 16b / 32b
25.08	Drooping rate	Defines the droop rate in percent of the nominal motor speed. Drooping decreases the drive speed slightly as the drive load increases. The actual speed decrease at a certain operating point depends on the droop rate 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 = $0.50 \times 0.01 \times 1500 \text{ rpm} = 7.5 \text{ rpm}$. 	- / real32
	0.00 ... 100.00 %	Droop rate.	$100 = 1\% / 100 = 1\%$
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

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No.	Name / Range / Selection	Description	Def / Type FbEq 16b / 32b
	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
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 826. 	- / 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

No.	Name / Range / Selection	Description	Def / Type FbEq 16b / 32b
	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
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 826. Coefficient for k_p (proportional gain) 	- / 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

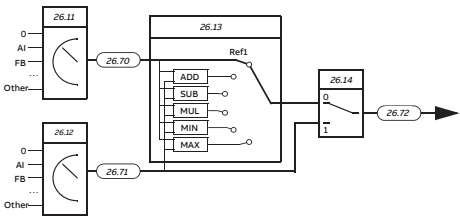
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No.	Name / Range / Selection	Description	Def / Type FbEq 16b / 32b
	0.000 ... 10.000	Proportional gain coefficient at 0% torque reference.	1000 = 1 / 1000 = 1
25.30	Flux adaptation enable	Enables/disables speed controller adaptation based on motor flux reference (01.24 Flux actual %). The proportional gain of the speed controller is multiplied by a coefficient of 0...1 between 0...100% flux reference respectively. See also the block diagram on page 826. Coefficient for k_p (proportional gain)  Flux reference (01.24) (%)	Enable / uint16
	Disable	Speed controller adaptation based on flux reference disabled	0
	Enable	Speed controller adaptation based on flux reference enabled.	1

No.	Name / Range / Selection	Description	Def / Type FbEq 16b / 32b
25.33	Speed controller autotune	Activates (or selects a source that activates) the speed controller autotune function. Refer section Speed controller autotune (page 156). The autotune will automatically set parameters 25.02 Speed proportional gain, 25.03 Speed integration time and 25.37 Mechanical time constant. The prerequisites for performing the autotune routine are: - the motor identification run (ID run) has been successfully completed - the speed and torque limits (parameter group 30 Limits) have been set - speed feedback filtering (parameter group 90 Feedback selection), speed error filtering (24 Speed reference conditioning) and zero speed (21 Start/stop mode) have been set, and - the drive has been started and is running in speed control mode.  WARNING! The motor and machinery will run against the torque and speed limits during the autotune routine. MAKE SURE IT IS SAFE TO ACTIVATE THE AUTOTUNE FUNCTION! The autotune routine can be aborted by stopping the drive. 0→1 = Activate speed controller autotune Note: The value does not revert to 0 automatically.	Off / uint32
	Off	0.	0
	On	1.	1
	Other [bit]	See Terms and abbreviations (page 207) .	-
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

No.	Name / Range / Selection	Description	Def / Type FbEq 16b / 32b
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
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 207) .	-

No.	Name / Range / Selection	Description	Def / Type FbEq 16b / 32b
25.53	Torque prop reference	Displays the output of the proportional (P) part of the speed controller. See the control chain diagram on page 826. 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 826. 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 826. 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 826. 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 %
25.57	Torque reference unbalanced	Displays the acceleration-compensated output of the speed controller. See the control chain diagram on page 826. 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 827 and 830	
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 830 and 831 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. See the control chain diagram on page 831. 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 %
26.08	Minimum torque ref	Defines the minimum torque reference. Allows for local limiting of the torque reference before it is passed on to the torque ramp controller. For absolute torque limiting, refer to parameter 30.19 Minimum torque 1.	-300.0 percent / real32
	-1000.0 ... 0.0 %	Minimum torque reference. For 16-bit scaling, see parameter 46.03.	- / 10 = 1 %
26.09	Maximum torque ref	Defines the maximum torque reference. Allows for local limiting of the torque reference before it is passed on to the torque ramp controller. For absolute torque limiting, refer to parameter 30.20 Maximum torque 1.	300.0 percent / real32
	0.0 ... 1000.0 %	Maximum torque reference. For 16-bit scaling, see parameter 46.03.	- / 10 = 1 %
26.11	Torque ref1 source	Selects torque reference source 1. Two signal sources can be defined by this parameter and 26.12 Torque ref2 source. A digital source selected by 26.14 Torque ref1/2 selection can be used to switch between the two sources, or a mathematical function (26.13 Torque ref1 function) applied to the two signals to create the reference. 	Zero / uint32

No.	Name / Range / Selection	Description	Def / Type FbEq 16b / 32b
	Zero	None.	0
	AI1 scaled	12.12 AI1 scaled value (page 282).	1
	AI2 scaled	12.22 AI2 scaled value (page 283).	2
	FB A ref1	03.05 FB A reference 1 (page 217).	4
	FB A ref2	03.06 FB A reference 2 (page 217).	5
	EFB ref1	03.09 EFB reference 1 (page 217).	8
	EFB ref2	03.10 EFB reference 2 (page 217).	9
	DDCS ctrl ref1	03.11 DDCS controller ref 1 (page 217).	10
	DDCS ctrl ref2	03.12 DDCS controller ref 2 (page 218).	11
	M/F reference 1	03.13 M/F or D2D ref1 (page 218).	12
	M/F reference 2	03.14 M/F or D2D ref2 (page 218).	13
	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. Refer section Using the control panel as an external control source (page 133) .	18
	Control panel (ref copied)	Control panel reference, with initial value from previous source or actual value. Refer section Using the control panel as an external control source (page 133) .	19
	Other [bit]	Source selection. See Terms and abbreviations (page 207) .	-
26.12	Torque ref2 source	Selects torque reference source 2. For the selections, and a diagram of reference source selection, see parameter 26.11 Torque ref1 source .	Zero / uint32
26.13	Torque ref1 function	Selects a mathematical function between the reference sources selected by parameters 26.11 Torque ref1 source and 26.12 Torque ref2 source . See diagram at 26.11 Torque ref1 source .	Ref1 / uint16
	Ref1	Signal selected by 26.11 Torque ref1 source is used as torque reference 1 as such (no function applied).	0
	Add (ref1 + ref2)	The sum of the reference sources is used as torque reference 1.	1
	Sub (ref1 - ref2)	The subtraction ([26.11 Torque ref1 source] - [26.12 Torque ref2 source]) of the reference sources is used as torque reference 1.	2
	Mul (ref1 x ref2)	The multiplication of the reference sources is used as torque reference 1.	3
	Min (ref1, ref2)	The smaller of the reference sources is used as torque reference 1.	4
	Max (ref1, ref2)	The greater of the reference sources is used as torque reference 1.	5

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No.	Name / Range / Selection	Description	Def / Type FbEq 16b / 32b
26.14	Torque ref1/2 selection	Configures the selection between torque references 1 and 2. See diagram at 26.11 Torque ref1 source . 0 = Torque reference 1 1 = Torque reference 2	Torque reference 1 / uint32
	Torque reference 1	0.	0
	Torque reference 2	1.	1
	Follow Ext1/Ext2 selection	Torque reference 1 is used when external control location EXT1 is active. Torque 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 207).	-
26.15	Load share	Defines the scaling factor for the torque reference (the torque reference is multiplied by the value). This allows drives sharing the load between two motors on the same mechanical plant to be tailored to share the correct amount each, yet use the same master torque reference.	1.000 NoUnit / real32
	-8.000 ... 8.000	Torque reference scaling factor.	1000 = 1 / 1000 = 1
26.16	Torque additive 1 source	Selects the source of torque reference additive 1. Note: For safety reasons, the additive is not applied when an emergency stop is active. See the control chain diagram on page 827 . For the selections, see parameter 26.11 Torque ref1 source .	Zero / uint32
26.17	Torque ref filter time	Defines a low-pass filter time constant for the torque reference.	0.000 s / real32
	0.000 ... 30.000 s	Filter time constant for torque reference.	1000 = 1 s / 1000 = 1 s
26.18	Torque ramp up time	Defines the torque reference ramp-up time, ie. the time for the reference to increase from zero to nominal motor torque.	0.000 s / real32
	0.000 ... 60.000 s	Torque reference ramp-up time.	100 = 1 s / 1000 = 1 s
26.19	Torque ramp down time	Defines the torque reference ramp-down time, ie. the time for the reference to decrease from nominal motor torque to zero.	0.000 s / real32

No.	Name / Range / Selection	Description	Def / Type FbEq 16b / 32b
	0.000 ... 60.000 s	Torque reference ramp-down time.	100 = 1 s / 1000 = 1 s
26.25	Torque additive 2 source	Selects the source of torque reference additive 2. The value received from the selected source is added to the torque reference after operating mode selection. Because of this, the additive can be used in speed and torque modes. Note: For safety reasons, the additive is not applied when an emergency stop is active.  WARNING! Make sure the additive is reduced or removed when a ramp stop is required eg. by using parameter 26.26 Force torque ref add 2 zero. See the control chain diagram on page 830. For the selections, see parameter 26.11 Torque ref1 source.	Zero / uint32
26.26	Force torque ref add 2 zero	Selects a source that forces torque reference additive 2 (see parameter 26.25 Torque additive 2 source) to zero. 0 = Normal operation 1 = Force torque reference additive 2 to zero.	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 207) .	-
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

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No.	Name / Range / Selection	Description	Def / Type FbEq 16b / 32b
26.41	Torque step	When enabled by parameter 26.42 Torque step enable, adds an additional step to the torque reference. A second torque step can be added using pointer parameters 26.43 Torque step pointer enable and 26.44 Torque step source. The two torque steps work independently of each other, and are summed up to calculate the total torque step. Note: For safety reasons, the torque steps are not applied when an emergency stop is active.  WARNING! If the total torque step exceeds the limits set by parameters 25.11 Speed control min torque and 25.12 Speed control max torque, a ramp stop may be impossible. Make sure the torque step is reduced or disabled when a ramp stop is required.	0.0 percent / real32
	-300.0 ... 300.0 %	Torque step. For 16-bit scaling, see parameter 46.03 .	- / 10 = 1 %
26.42	Torque step enable	Enables/disables the torque step defined by parameter 26.41 Torque step .	Disable / uint32
	Disable	Torque step disabled.	0
	Enable	Torque step enabled.	1
26.43	Torque step pointer enable	Selects a source that enables/disables the torque step defined by parameter 26.44 Torque step source. See also parameter 26.41 Torque step. 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 207) .	-
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 282) .	1

No.	Name / Range / Selection	Description	Def / Type FbEq 16b / 32b
	AI2 scaled	12.22 AI2 scaled value (page 283).	2
	FB A ref1	03.05 FB A reference 1 (page 217).	4
	FB A ref2	03.06 FB A reference 2 (page 217).	5
	EFB ref1	03.09 EFB reference 1 (page 217).	8
	EFB ref2	03.10 EFB reference 2 (page 217).	9
	DDCS ctrl ref1	03.11 DDCS controller ref 1 (page 217).	10
	DDCS ctrl ref2	03.12 DDCS controller ref 2 (page 218).	11
	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 133).	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 133).	19
	Other [bit]	Source selection. See Terms and abbreviations (page 207).	-
26.51	Oscillation damping	Parameters 26.51...26.58 configure the oscillation damping function. Refer section Oscillation damping (page 159) , and the block diagram on page 830. 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 207).	-

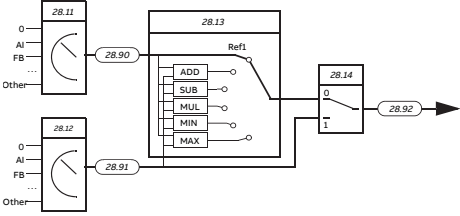
402 Parameters

No.	Name / Range / Selection	Description	Def / Type FbEq 16b / 32b
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
	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 207).	-
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

No.	Name / Range / Selection	Description	Def / Type FbEq 16b / 32b
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
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 %
26.70	Torque reference act 1	Displays the value of torque reference source 1 (selected by parameter 26.11 Torque ref1 source). See the control chain diagram on page 827. This parameter is read-only.	- / real32
	-1600.0 ... 1600.0 %	Value of torque reference source 1. For 16-bit scaling, see parameter 46.03.	- / 10 = 1 %
26.71	Torque reference act 2	Displays the value of torque reference source 2 (selected by parameter 26.12 Torque ref2 source). See the control chain diagram on page 827. This parameter is read-only.	- / real32
	-1600.0 ... 1600.0 %	Value of torque reference source 2. For 16-bit scaling, see parameter 46.03.	- / 10 = 1 %
26.72	Torque reference act 3	Displays the torque reference after the function applied by parameter 26.13 Torque ref1 function (if any), and after selection (26.14 Torque ref1/2 selection). See the control chain diagram on page 827. This parameter is read-only.	- / real32
	-1600.0 ... 1600.0 %	Torque reference after selection. For 16-bit scaling, see parameter 46.03.	- / 10 = 1 %

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No.	Name / Range / Selection	Description	Def / Type FbEq 16b / 32b
26.73	Torque reference act 4	Displays the torque reference after application of reference additive 1. See the control chain diagram on page 827. This parameter is read-only.	- / real32
	-1600.0 ... 1600.0 %	Torque reference after application of reference additive 1. For 16-bit scaling, see parameter 46.03.	- / 10 = 1 %
26.74	Torque ref ramp out	Displays the torque reference after limiting and ramping. See the control chain diagram on page 827. This parameter is read-only.	- / real32
	-1600.0 ... 1600.0 %	Torque reference after limiting and ramping. For 16-bit scaling, see parameter 46.03.	- / 10 = 1 %
26.75	Torque reference act 5	Displays the torque reference after control mode selection. See the control chain diagram on page 830. This parameter is read-only.	- / real32
	-1600.0 ... 1600.0 %	Torque reference after control mode selection. For 16-bit scaling, see parameter 46.03.	- / 10 = 1 %
26.76	Torque reference act 6	Displays the torque reference after application of reference additive 2. See the control chain diagram on page 830. This parameter is read-only.	- / real32
	-1600.0 ... 1600.0 %	Torque reference after application of reference additive 2. For 16-bit scaling, see parameter 46.03.	- / 10 = 1 %
26.77	Torque ref add A actual	Displays the value of the source of torque reference additive 2. See the control chain diagram on page 830. This parameter is read-only.	- / real32
	-1600.0 ... 1600.0 %	Torque reference additive 2. For 16-bit scaling, see parameter 46.03.	- / 10 = 1 %
26.78	Torque ref add B actual	Displays the value of torque reference additive 2 before it is added to torque reference. See the control chain diagram on page 830. This parameter is read-only.	- / real32
	-1600.0 ... 1600.0 %	Torque reference additive 2. For 16-bit scaling, see parameter 46.03.	- / 10 = 1 %
26.81	Rush control gain	Rush controller gain term. Refer section Rush control (page 161) .	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 833 and 834 .	
28.01	Frequency ref ramp input	Displays the used frequency reference before ramping. See the control chain diagram on page 834 . 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 834 . 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 282).	1
	AI2 scaled	12.22 AI2 scaled value (page 283).	2
	FB A ref1	03.05 FB A reference 1 (page 217).	4
	FB A ref2	03.06 FB A reference 2 (page 217).	5
	EFB ref1	03.09 EFB reference 1 (page 217).	8
	EFB ref2	03.10 EFB reference 2 (page 217).	9
	DDCS ctrl ref1	03.11 DDCS controller ref 1 (page 217).	10
	DDCS ctrl ref2	03.12 DDCS controller ref 2 (page 218).	11
	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 133).	18

No.	Name / Range / Selection	Description	Def / Type FbEq 16b / 32b
	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 133).	19
	Other [bit]	Source selection. See Terms and abbreviations (page 207).	-
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

No.	Name / Range / Selection	Description	Def / Type FbEq 16b / 32b
	Other [bit]	See Terms and abbreviations (page 207) .	-
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

No.	Name / Range / Selection	Description	Def / Type FbEq 16b / 32b																																				
28.22	Constant frequency sel1	When bit 0 of parameter 28.21 Constant frequency function is 0 (Separate), selects a source that activates constant frequency 1. When bit 0 of parameter 28.21 Constant frequency function is 1 (Packed), this parameter and parameters 28.23 Constant frequency sel2 and 28.24 Constant frequency sel3 select three sources whose states activate constant frequencies as follows: <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>	Source defined by par. 28.22	Source defined by par. 28.23	Source defined by par. 28.24	Constant frequency active	0	0	0	None	1	0	0	Constant frequency 1	0	1	0	Constant frequency 2	1	1	0	Constant frequency 3	0	0	1	Constant frequency 4	1	0	1	Constant frequency 5	0	1	1	Constant frequency 6	1	1	1	Constant frequency 7	Not selected / uint32
Source defined by par. 28.22	Source defined by par. 28.23	Source defined by par. 28.24	Constant frequency active																																				
0	0	0	None																																				
1	0	0	Constant frequency 1																																				
0	1	0	Constant frequency 2																																				
1	1	0	Constant frequency 3																																				
0	0	1	Constant frequency 4																																				
1	0	1	Constant frequency 5																																				
0	1	1	Constant frequency 6																																				
1	1	1	Constant frequency 7																																				
	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 207).	-																																				

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

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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 154) .	- / 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 207) .	-

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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 207) .	-
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 207) .	-
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 207).	-
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 833. 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 833. 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 833. 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 833. 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 834. 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 . See diagram on page 831.	
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 . See diagram on page 831.	
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 ATEX-related protections)	

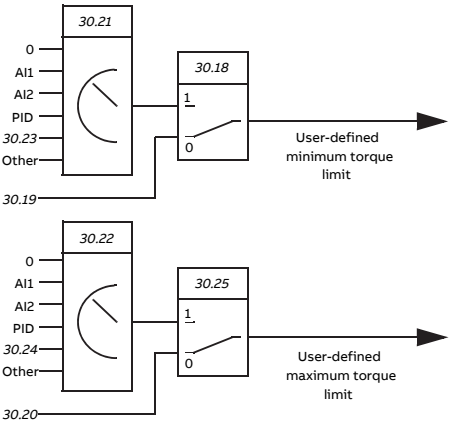
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No.	Name / Range / Selection	Description	Def / Type FbEq 16b / 32b
b13	Load angle lim	(With permanent magnet motors and synchronous reluctance motors, and externally-excited synchronous motors in steady state) 1 = Maximum load angle is being limited, 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 limited by undervoltage controller	
b1	Overvoltage	*1 = Torque is 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 . See diagram on page 831.	
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 . See diagram on page 831.	
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 = Main circuit thermal protection is limiting output power (input current), or continuous output current limit is being reached	
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	

No.	Name / Range / Selection	Description	Def / Type FbEq 16b / 32b
b12	IGBT overtemperature	*1 = Output current is being limited because of estimated IGBT temperature	
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.  WARNING! In a master/follower configuration, do not set maximum and minimum speed limits with the same sign on a follower drive. Refer section Master/follower functionality.	-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.  WARNING! In a master/follower configuration, do not set maximum and minimum speed limits with the same sign on a follower drive. Refer section Master/follower functionality.	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

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No.	Name / Range / Selection	Description	Def / Type FbEq 16b / 32b
	-598.00 ... 598.00 Hz	Minimum frequency. For 16-bit scaling, see parameter 46.02 .	- / 100 = 1 Hz
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 .	0.00 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.	0.00 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). Refer to the block diagram on page 831.	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

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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 207) .	-
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 282) .	1
	AI2 scaled	12.22 AI2 scaled value (page 283) .	2
	PID	40.01 Process PID output actual (output of the process PID controller).	5
	Minimum torque 2	30.23 Minimum torque 2 .	6
	Other [bit]	Source selection. See Terms and abbreviations (page 207) .	-

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 282).	1
	AI2 scaled	12.22 AI2 scaled value (page 283).	2
	PID	40.01 Process PID output actual (output of the process PID controller).	5
	Maximum torque 2	30.24 Maximum torque 2 .	6
	Other [bit]	Source selection. See Terms and abbreviations (page 207).	-
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 PID. 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

No.	Name / Range / Selection	Description	Def / Type FbEq 16b / 32b
	Maximum torque 2 source	1.	1
	DI1	Digital input DI1 (10.02 DI delayed status, bit 0).	2
	DI2	Digital input DI2 (10.02 DI delayed status, bit 1).	3
	DI3	Digital input DI3 (10.02 DI delayed status, bit 2).	4
	DI4	Digital input DI4 (10.02 DI delayed status, bit 3).	5
	DI5	Digital input DI5 (10.02 DI delayed status, bit 4).	6
	DI6	Digital input DI6 (10.02 DI delayed status, bit 5).	7
	DIO1	Digital input/output DIO1 (11.02 DIO delayed status, bit 0).	10
	DIO2	Digital input/output DIO2 (11.02 DIO delayed status, bit 1).	11
	Other [bit]	Source selection. See Terms and abbreviations (page 207) .	-
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
30.35	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
30.101	LSU limit word 1	<i>(Only visible when IGBT supply unit control activated by 95.20)</i> Displays limit word 1 of the supply unit. This parameter is read-only.	- / uint16
b0	P user ref max	1 = Power reference is being limited by supply control program parameters	
b1	P user ref min	1 = Power reference is being limited by supply control program parameters	
b2	P user max	1 = Power is being limited by parameter 30.149	
b3	P user min	1 = Power is being limited by parameter 30.148	
b4	P cooling overtemp	1 = Power reference is being limited because of coolant overtemperature	

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No.	Name / Range / Selection	Description	Def / Type FbEq 16b / 32b
b5	P power unit over-temp	1 = Power reference is being limited because of supply unit overtemperature	
b6...15	Reserved		
	0000h...FFFFh		1 = 1 / 1 = 1
30.148	LSU minimum power limit	<i>(Only visible when IGBT supply unit control activated by 95.20)</i> Defines a minimum power limit for the supply unit. Negative values refer to regenerating, ie. feeding power into the supply network.	-200.0 percent / real32
	-200.0 ... 0.0 %	Minimum power limit for supply unit.	1 = 1 % / 10 = 1 %
30.149	LSU maximum power limit	<i>(Only visible when IGBT supply unit control activated by 95.20)</i> Defines a maximum power limit for the supply unit.	200.0 percent / real32
	0.0 ... 200.0 %	Maximum power limit for supply unit.	1 = 1 % / 10 = 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 207) .	-
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

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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	DI3 / 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 207).	-
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; refer section Local control vs. external control (page 132). - 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		
	b5...7 Reserved		

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

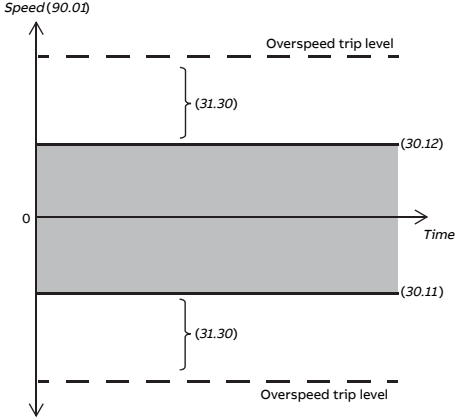
No.	Name / Range / Selection	Description	Def / Type FbEq 16b / 32b
31.19	Motor phase loss	Selects how the drive reacts when a motor phase loss is detected. Note: The drive may not be able to reliably detect a phase loss in a multimotor application: a separate protection method (eg. a motor protection 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 194).	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, the drive can start without a new 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

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No.	Name / Range / Selection	Description			Def / Type FbEq 16b / 32b	
	Fault/Fault	Inputs		Indication (running or stopped)	0	
		IN1	IN2			
		0	0	Fault 5091 Safe torque off		
		0	1	Faults 5091 Safe torque off and FA81 Safe torque off 1 loss		
		1	0	Faults 5091 Safe torque off and FA82 Safe torque off 2 loss		
		1	1	(Normal operation)		
	Fault/Warning	Inputs		Indication		1
		IN1	IN2	Running	Stopped	
		0	0	Fault 5091 Safe torque off5091 Safe torque off	Warning A5A0 Safe torque off	
		0	1	Faults 5091 Safe torque off and FA81 Safe torque off 1 loss	Warning A5A0 Safe torque off and fault FA81 Safe torque off 1 loss	
		1	0	Faults 5091 Safe torque off and FA82 Safe torque off 2 loss	Warning A5A0 Safe torque off and fault FA82 Safe torque off 2 loss	
		1	1	(Normal operation)		

No.	Name / Range / Selection	Description				Def / Type FbEq 16b / 32b
	Fault/Event	Inputs		Indication		2
		IN1	IN2	Running	Stopped	
		0	0	Fault 5091 Safe torque off	Event B5A0 STO event	
		0	1	Faults 5091 Safe torque off and FA81 Safe torque off 1 loss	Event B5A0 STO event and fault FA81 Safe torque off 1 loss	
		1	0	Faults 5091 Safe torque off and FA82 Safe torque off 2 loss	Event B5A0 STO event and fault FA82 Safe torque off 2 loss	
		1	1	(Normal operation)		
	Warning/Warning	Inputs		Indication (running or stopped)		3
		IN1	IN2			
		0	0	Warning A5A0 Safe torque off		
		0	1	Warning A5A0 Safe torque off and fault FA81 Safe torque off 1 loss		
		1	0	Warning A5A0 Safe torque off and fault FA82 Safe torque off 2 loss		
		1	1	(Normal operation)		

No.	Name / Range / Selection	Description	Def / Type FbEq 16b / 32b																	
	Event/Event	<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>	Inputs		Indication (running or stopped)	IN1	IN2	0	0	Event B5A0 STO event	0	1	Event B5A0 STO event and fault FA81 Safe torque off 1 loss	1	0	Event B5A0 STO event and fault FA82 Safe torque off 2 loss	1	1	(Normal operation)	4
Inputs		Indication (running or stopped)																		
IN1	IN2																			
0	0	Event B5A0 STO event																		
0	1	Event B5A0 STO event and fault FA81 Safe torque off 1 loss																		
1	0	Event B5A0 STO event and fault FA82 Safe torque off 2 loss																		
1	1	(Normal operation)																		
	No indication/No indication	<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>	Inputs		Indication (running or stopped)	IN1	IN2	0	0	None	0	1	Fault FA81 Safe torque off 1 loss	1	0	Fault FA82 Safe torque off 2 loss	1	1	(Normal operation)	5
Inputs		Indication (running or stopped)																		
IN1	IN2																			
0	0	None																		
0	1	Fault FA81 Safe torque off 1 loss																		
1	0	Fault FA82 Safe torque off 2 loss																		
1	1	(Normal operation)																		
31.23	Wiring or earth fault	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.	Fault; No action (95.20 b15) / uint16																	
	No action	No action taken (protection disabled).	0																	
	Fault	The drive trips on fault 3181 Wiring or earth fault .	1																	
31.24	Stall function	Selects how the drive reacts to a motor stall condition. A stall condition is defined as follows: • The drive exceeds the stall current limit (31.25 Stall current limit), and • the output frequency is below the level set by parameter 31.27 Stall frequency limit or the motor speed is below the level set by parameter 31.26 Stall speed limit, and • the conditions above have been true longer than the time set by parameter 31.28 Stall time.	Fault / uint16																	
	No action	None (stall supervision disabled).	0																	
	Warning	The drive generates an A780 Motor stall .	1																	

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

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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 23.200...23.205 (Off1) or 23.23 Emergency stop time (Off3). If the actual deceleration rate (01.29) deviates too much from the expected rate, the drive trips on 73B0 Emergency ramp failed, sets bit 8 of 06.17 Drive status word 2, and coasts to a stop. If 31.32 is set to 0% and 31.33 is set to 0 s, the emergency stop ramp supervision is disabled.	- / 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

No.	Name / Range / Selection	Description	Def / Type FbEq 16b / 32b
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
	Warning	The drive generates an A581 Fan .	1
	No action	No action taken.	2
31.36	Aux fan fault function	<i>(Only visible with a ZCU control unit)</i> 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

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No.	Name / Range / Selection	Description	Def / Type FbEq 16b / 32b
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 23.19, 23.200. 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
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)	

No.	Name / Range / Selection	Description	Def / Type FbEq 16b / 32b
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 Ext I/O comm loss .	1
	Fault	The drive trips on a fault, 7082 Ext I/O comm loss .	2
31.120	LSU earth fault	<i>(Only visible when IGBT supply unit control activated by 95.20)</i> Selects how the supply unit reacts when an earth fault or current unbalance is detected.	Fault / uint16
	No action	No action taken.	0
	Warning	The supply unit generates a warning AE02 Earth leakage .	1
	Fault	The supply unit trips on a fault, 2E01 Earth leakage .	2
31.121	LSU supply phase loss	<i>(Only visible when IGBT supply unit control activated by 95.20)</i> Selects how the supply unit reacts when a supply phase loss is detected.	Fault / uint16
	No action	No action taken.	0
	Fault	The supply unit trips on a fault, 3E00 Input phase loss .	1

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No.	Name / Range / Selection	Description	Def / Type FbEq 16b / 32b
31.202	Inverter overload selection	Selects the bits to be monitored by the Inverter overload detection function. When a bit value = 1, the corresponding bits in parameter 30.02 Torque limit status are used for generating fault D106 Inverter overload . You can also select to monitor a bit of your own selection.	0000 0000 0000 0000 / uint16
b0	In motor mode	1 = When the drive is motoring, i.e. output power percentage > 10%.	
b1	In generator mode	1 = When the drive is generating i.e. output power percentage < -10%.	
b2	Minimum torque	See parameter 30.02 Torque limit status .	
b3	Maximum torque	See parameter 30.02 Torque limit status .	
b4	Maximum current	See parameter 30.02 Torque limit status .	
b5	Load angle	See parameter 30.02 Torque limit status .	
b6	Motor pullout	See parameter 30.02 Torque limit status .	
b7	User bit	A bit of your own selection.	
b8...15	Reserved		
	0000h...FFFFh		1 / 1
31.203	User limit bit selection	Selects the source for disabling or enabling the user selectable limit bit for the Inverter overload function. 0 = User-selectable limit bit is disabled. 1 = User-selectable limit bit is enabled.	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).	8
	DIO2	Digital input/output DIO2 (11.02 DIO delayed status , bit 1).	9
	DI1 inverted	Digital input DI1 inverted	10
	DI2 inverted	Digital input DI2 inverted	11
	DI3 inverted	Digital input DI3 inverted	12
	DI4 inverted	Digital input DI4 inverted	13
	DI5 inverted	Digital input DI5 inverted	14
	DI6 inverted	Digital input DI6 inverted	15

No.	Name / Range / Selection	Description	Def / Type FbEq 16b / 32b
	DIO1 inverted	Digital input/output DIO1 inverted	16
	DIO2 inverted	Digital input/output DIO2 inverted	17
	Other [bit]	See Terms and abbreviations (page 207) .	-
31.204	Inverter overload delay	Defines the time delay for generating fault D106 Inverter overload after the drive has exceeded any of the inverter current and torque limits defined with parameter 31.202 Inverter overload selection .	500 ms / int16
	0...30000 ms	Inverter overload delay in ms.	1 = 1 ms / 1 = 1 ms

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 195) .	
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 283) .	10
	Speed ref ramp in	23.01 Speed ref ramp input (page 369) .	18
	Speed ref ramp out	23.02 Speed ref ramp output (page 369) .	19
	Speed ref used	24.01 Used speed reference (page 378) .	20
	Torque ref used	26.02 Torque reference used (page 396) .	21
	Freq ref used	28.02 Frequency ref ramp output (page 405) .	22
	Other [bit]	Source selection. See Terms and abbreviations (page 207) .	-
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

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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

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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 196) .	
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 267) .	2
	Other [bit]	See Terms and abbreviations (page 207) .	-
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

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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 267) .	2
	Other [bit]	See Terms and abbreviations (page 207) .	-
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

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No.	Name / Range / Selection	Description	Def / Type FbEq 16b / 32b
	RO1	Bit 0 of 10.21 RO status (page 267) .	2
	Other [bit]	See Terms and abbreviations (page 207) .	-
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 267) .	2
	Other [bit]	See Terms and abbreviations (page 207) .	-
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

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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 207) .	-
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	A88O 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

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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 207) .	-
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
33.200	Reset winch counters	Selects the command to reset the current values of the winch counters. See parameters 09.40 Winch operating time (page 261)...09.42 Number of brake open (page 262).	Done / uint16
	Done	Reset done.	0
	Reset winch operating time	Winch operating time is reset to zero. See parameter 09.40 Winch operating time (page 261).	1
	Reset number of power on	Number of power on is reset to zero. See parameter 09.41 Number of power on (page 261).	2
	Reset number of brake open	Number of brake open is reset to zero. See parameter 09.42 Number of brake open (page 262).	3

No.	Name / Range / Selection	Description	Def / Type FbEq 16b / 32b
	Set winch operating time	Winch operating time is initialized to the value set in parameter 33.201 Winch operating time preset value (page 453).	4
	Set number of power on	Number of power on is initialized to the value set in parameter 33.202 Number of power on preset value (page 453).	5
	Set number of brake open	Number of brake open is initialized to the value set in parameter 33.203 Number of brake open preset value (page 453).	6
33.201	Winch operating time preset value	Defines the value to which current winch operation time is initialized upon activation of corresponding command set in parameter 33.200 to Set winch operating time . This parameter can be used to initialize the winch operation counter to the previous value after replacing the control board or after doing a firmware upgrade.	0 hours / uint32
	0...1100000 hours	Winch operating time preset value	1 = 1 hours / 1 = 1 hours
33.202	Number of power on preset value	Defines the value to which the power on counter is initialized upon activation of corresponding command set in parameter 33.200 to Set number of brake open . This parameter can be used to initialize the power on counter to the previous value after replacing the control board or after doing a firmware upgrade.	0 NoUnit / uint16
	0...65535	Number of power on preset value.	1 = 1 / 1 = 1
33.203	Number of brake open preset value	Defines the value to which the brake operation counter is initialized upon activation of corresponding command set in parameter 33.200 is set to Set number of brake open . This parameter can be used to initialize the brake operation counter to the previous value after replacing the control board or after doing a firmware upgrade.	0 NoUnit / uint32
	0...2147483647	Number of brake open preset value.	1 = 1 / 1 = 1

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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 185) .	
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 and section Motor overload protection (page 191) .	- / 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 22)) 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 187). 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

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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 <i>Other</i> 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 207) .	-
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 °

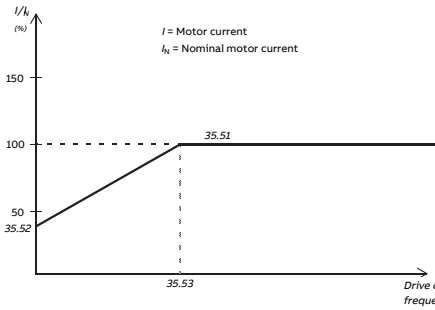
No.	Name / Range / Selection	Description	Def / Type FbEq 16b / 32b
35.21	Temperature 2 source	Selects the source from which measured temperature 2 is read. For wiring examples, see the hardware manual of the drive. Usually this source is from a sensor connected to the motor controlled by the drive, but 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 22)) 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

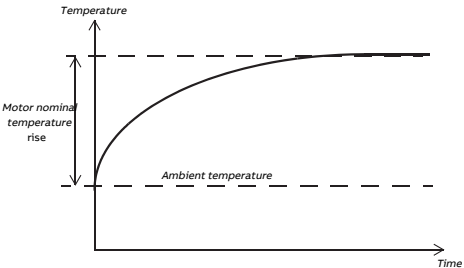
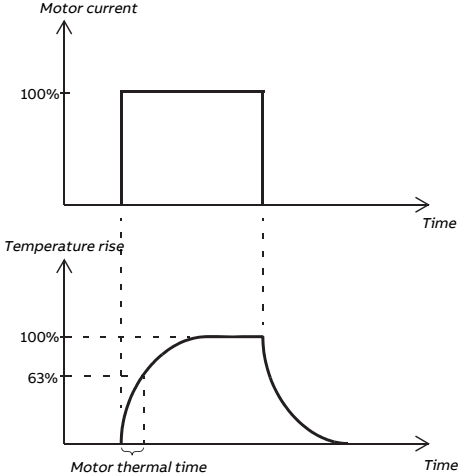
No.	Name / Range / Selection	Description	Def / Type FbEq 16b / 32b
	1 x Pt100 analog I/O	Pt100 sensor connected to a standard analog input selected by parameter 35.24 Temperature 2 AI source and an analog output. The input and output can be on the drive control unit or on an extension module. The required 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 187). 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 207) .	-

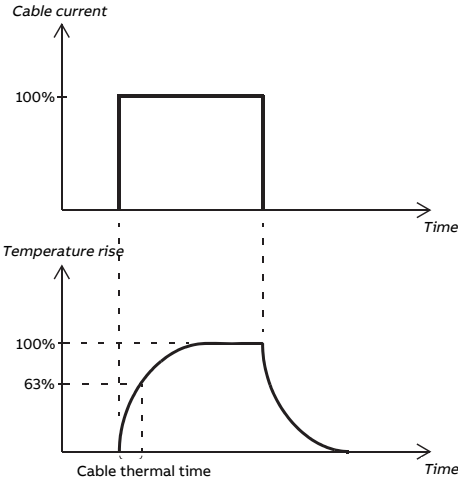
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No.	Name / Range / Selection	Description	Def / Type FbEq 16b / 32b
35.27	Temperature 2 calibration	Defines the calibration of temperature 2. See parameter 35.17 Temperature 1 calibration .	0 ° / real32
	-30...1000 °	Calibration of temperature 2 in 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.  I = Motor current I_n = Nominal motor current	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. Refer section Motor overload protection (page 191).	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. Refer section Motor overload protection (page 191) .	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. Refer section Thermal protection of motor cable (page 192) . 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.	10000.00 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 234).	2

No.	Name / Range / Selection	Description	Def / Type FbEq 16b / 32b
	Other [bit]	See Terms and abbreviations (page 207) .	-
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 207) .	-
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

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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
35.200	Internal fan extended run time	Defines the time duration for which the drive internal fan continues to run at full speed even after the drive is stopped.	0.0 min / real32
	0.0 ... 3600.0 min	Internal fan extended run time.	1 = 1 min / 1 = 1 min

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 197) .	
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 212) .	1
	Output frequency	01.06 Output frequency (page 212) .	3
	Motor current	01.07 Motor current (page 212) .	4
	Motor torque	01.10 Motor torque (page 212) .	6
	DC voltage	01.11 DC voltage (page 213) .	7
	Power inu out	01.14 Output power (page 213) .	8
	Speed ref ramp in	23.01 Speed ref ramp input (page 369) .	10
	Speed ref ramp out	23.02 Speed ref ramp output (page 369) .	11
	Speed ref used	24.01 Used speed reference (page 378) .	12
	Torq ref used	26.02 Torque reference used (page 396) .	13
	Freq ref used	28.02 Frequency ref ramp output (page 405) .	14
	Other [bit]	Source selection. See Terms and abbreviations (page 207) .	-
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

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No.	Name / Range / Selection	Description	Def / Type FbEq 16b / 32b
	Motor speed used	01.01 Motor speed used (page 212).	1
	Output frequency	01.06 Output frequency (page 212).	3
	Motor current	01.07 Motor current (page 212).	4
	Motor torque	01.10 Motor torque (page 212).	6
	DC voltage	01.11 DC voltage (page 213).	7
	Power inu out	01.14 Output power (page 213).	8
	Speed ref ramp in	23.01 Speed ref ramp input (page 369).	10
	Speed ref ramp out	23.02 Speed ref ramp output (page 369).	11
	Speed ref used	24.01 Used speed reference (page 378).	12
	Torq ref used	26.02 Torque reference used (page 396).	13
	Freq ref used	28.02 Frequency ref ramp output (page 405).	14
	Other [bit]	Source selection. See Terms and abbreviations (page 207) .	-
	Ambient temperature	01.70 Ambient temperature % (page 216). 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

No.	Name / Range / Selection	Description	Def / Type FbEq 16b / 32b
	-32768.00 ... 32767.00	Peak value.	1 = 1 / 100 = 1
36.11	PVL peak date	Displays the date on which the peak value was recorded.	- / uint16
36.12	PVL peak time	Displays the time at which the peak value was recorded.	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.	0 / 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

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No.	Name / Range / Selection	Description	Def / Type FbEq 16b / 32b
	0.00 ... 100.00 %	Amplitude logger 1 samples between 50 and 60 %.	1 = 1 % / 100 = 1 %
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.	0 / 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

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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 212) .	2
	Motor torque %	01.10 Motor torque (page 212) .	3
	Output power % of motor nominal	01.15 Output power % of motor nom (page 213) .	4
	Other [bit]	Source selection. See Terms and abbreviations (page 207) .	-
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

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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

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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 179) .	
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 207) .	-
43.08	Brake resistor thermal tc	Defines the thermal time constant for the brake resistor or 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

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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
44	Mechanical brake control	Configuration of mechanical brake control. See also section Mechanical brake control (page 108)	
44.01	Brake control status	Displays the mechanical brake control status word. This parameter is read-only.	- / uint16
b0	Open command	Close/open command to brake actuator (0 = close, 1 = open). Connect this bit to desired output.	
b1	Opening torque request	1 = Opening torque requested from drive logic	
b2	Hold stopped request	1 = Hold requested from drive logic	
b3	Ramp to stopped	1 = Ramping down to zero speed requested from drive logic	
b4	Enabled	1 = Brake control is enabled	
b5	Closed	1 = Brake control logic in <i>BRAKE CLOSED</i> state. See also section Mechanical brake control (page 108)	
b6	Opening	1 = Brake control logic in <i>BRAKE OPENING</i> state.	
b7	Open	1 = Brake control logic in <i>BRAKE OPEN</i> state.	
b8	Closing	1 = Brake control logic in <i>BRAKE CLOSING</i> state.	
b9...15	Reserved		
	0000h...FFFFh		1 = 1 / 1 = 1
44.02	Brake torque memory	Displays the torque (in percent) at the instant of the previous brake close command. This value can be used as a reference for the brake open torque. See parameters 44.09 Brake open torque source and 44.10 Brake open torque . A filtering time for this value can be defined using 44.21 Filter time brake torque memory .	- / real32
	-1600.0 ... 1600.0 %	Torque at brake closure. For 16-bit scaling, see parameter 46.03 .	- / 10 = 1 %
44.03	Brake open torque reference	Displays the currently active brake open torque. See parameters 44.09 Brake open torque source and 44.10 Brake open torque . This parameter is read-only.	- / real32
	-1600.0 ... 1600.0 %	Currently active brake open torque. For 16-bit scaling, see parameter 46.03 .	- / 10 = 1 %

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No.	Name / Range / Selection	Description	Def / Type FbEq 16b / 32b
44.06	Brake control enable	Activates/deactivates (or selects a source that activates/deactivates) the mechanical brake control logic. 0 = Brake control inactive 1 = Brake control active Note: This parameter cannot be changed while the drive is running.	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 207) .	-
44.07	Brake acknowledge selection	Activates/deactivates (and selects the source for) brake open/close status (acknowledgement) supervision. When a brake control error (unexpected state of the acknowledgement signal) is detected, the drive reacts as defined by parameter 44.17 Brake fault function. 0 = Brake closed 1 = Brake open	No acknowledge / uint32
	Off	0.	0
	On	1.	1
	No acknowledge	Brake open/closed supervision disabled.	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

No.	Name / Range / Selection	Description	Def / Type FbEq 16b / 32b
	Other [bit]	See Terms and abbreviations (page 207) .	-
44.08	Brake open delay	Defines the brake open delay, ie. the delay between the internal open brake command and the release of motor speed control. The delay timer starts when the drive has magnetized the motor and increased the motor torque to the level required for brake release (parameter 44.03 Brake open torque reference). Simultaneously with the timer start, the brake control logic energizes the brake control output and the brake starts to open. Set this parameter to the value of mechanical opening delay specified by the brake manufacturer.	0.00 s / real32
	0.00 ... 5.00 s	Brake open delay.	100 = 1 s / 100 = 1 s
44.09	Brake open torque source	Defines a source that is used as a brake opening torque reference if - its absolute value is greater than the setting of parameter 44.10 Brake open torque, and - its sign is the same as the setting of 44.10 Brake open torque. See parameter 44.10 Brake open torque.	Brake open torque / uint32
	Zero	Zero.	0
	AI1 scaled	12.12 AI1 scaled value (page 282) .	1
	AI2 scaled	12.22 AI2 scaled value (page 283) .	2
	FBA ref1	03.05 FB A reference 1 (page 217) .	3
	FBA ref2	03.06 FB A reference 2 (page 217) .	4
	Brake torque memory	Parameter 44.02 Brake torque memory .	7
	Brake open torque	Parameter 44.10 Brake open torque .	8
	Other [bit]	Source selection. See Terms and abbreviations (page 207) .	-
44.10	Brake open torque	Defines the sign (ie. direction of rotation) and minimum absolute value of the brake open torque (motor torque requested at brake release in percent of motor nominal torque). The value of the source selected by parameter 44.09 Brake open torque source is used as the brake open torque only if it has the same sign as this parameter and has a greater absolute value. Note: This parameter is not effective in scalar motor control mode.	0.0 percent / real32
	-1600.0 ... 1600.0 %	Minimum torque at brake release. For 16-bit scaling, see parameter 46.03 .	- / 10 = 1 %

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No.	Name / Range / Selection	Description	Def / Type FbEq 16b / 32b
44.11	Keep brake closed	Selects a source that prevents the brake from opening. 0 = Normal brake operation 1 = Keep brake closed Note: This parameter cannot be changed while the drive is running.	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 207) .	-
44.12	Brake close request	Selects the source of an external brake close request signal. When on, the signal overrides the internal logic and closes the brake. 0 = Normal operation/No external close signal connected 1 = Close brake Note: - In an open-loop (encoderless) application, if the brake is kept closed by a brake close request against a modulating drive for longer than 5 seconds, the brake is forced to close and the drive trips on a fault, 71A5 Mech brk opening not allowed. - This parameter cannot be changed while the drive is running.	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 207) .	-
44.13	Brake close delay	Defines a delay between a close command (that is, when the brake control output is de-energized) and when the drive stops modulating. This is to keep the motor live and under control until the brake actually closes. Set this parameter equal to the value specified by the brake manufacturer as the mechanical make-up time of the brake.	0.00 s / real32
	0.00 ... 60.00 s	Brake close delay.	100 = 1 s / 100 = 1 s
44.14	Brake close level	Defines the brake close speed as an absolute value. After motor speed remains below this level for the duration of the brake close level delay (44.15 Brake close level delay), a close command is given. Note: Check the compatibility of this setting with 21.03 Stop mode (and the applicable deceleration time).	10.00 rpm / real32
	0.00 ... 1000.00 rpm	Brake close speed. For 16-bit scaling, see parameter 46.01 .	- / 100 = 1 rpm
44.15	Brake close level delay	Defines a brake close level delay. See parameter 44.14 Brake close level .	0.00 s / real32
	0.00 ... 10.00 s	Brake close level delay.	100 = 1 s / 100 = 1 s
44.16	Brake reopen delay	Defines a minimum time between brake closure and a subsequent open command.	0.00 s / real32
	0.00 ... 10.00 s	Brake reopen delay.	100 = 1 s / 100 = 1 s
44.17	Brake fault function	Determines how the drive reacts upon a mechanical brake control error. Note: If parameter 44.07 Brake acknowledge selection is set to No acknowledge , acknowledgement status supervision is disabled altogether and will generate no warnings or faults. However, the brake open conditions are always supervised.	Fault / uint16
	Fault	The drive trips on a 71A2 Mech brake closing failed / 71A3 Mech brake opening failed fault if the status of the acknowledgement does not match the status presumed by the brake control logic. The drive trips on a 71A5 Mech brk opening not allowed fault if the brake open conditions cannot be fulfilled (for example, the required motor starting torque is not achieved).	0

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No.	Name / Range / Selection	Description	Def / Type FbEq 16b / 32b
	Warning	The drive generates a A7A1 Mechanical brake closing failed / A7A2 Mechanical brake opening failed warning if the status of the acknowledgement does not match the status presumed by the brake control logic. The drive generates a A7A5 Mechanical brake opening not allowed warning if the brake open conditions cannot be fulfilled (for example, the required motor starting torque is not achieved).	1
	Open fault	Upon closing the brake, the drive generates a A7A1 Mechanical brake closing failed warning if the status of the acknowledgement does not match the status presumed by the brake control logic. Upon opening the brake, the drive trips on a 71A3 Mech brake opening failed fault if the status of the acknowledgement does not match the status presumed by the brake control logic. The drive trips on a 71A5 Mech brk opening not allowed fault if the brake open conditions cannot be fulfilled (for example, the required motor starting torque is not achieved).	2
44.18	Brake fault delay	Defines a close fault delay, ie. time between brake closure and brake close fault trip.	0.00 s / real32
	0.00 ... 60.00 s	Brake close fault delay.	100 = 1 s / 100 = 1 s
44.21	Filter time brake torque memory	Defines a filtering time for parameter 44.02 Brake torque memory (actual torque value used as open torque reference).	100 ms / real32
	0...100 ms	Filtering time.	100 = 1 ms / 1 = 1 ms
44.200	Brake open torque source	Defines a source that is used as a brake opening torque reference if, - its absolute value is greater than the setting of parameter 44.201 Brake open torque, and - its sign is the same as the setting of parameter 44.201 Brake open torque. See parameter 44.201 Brake open torque.	Brake open torque / uint32
	Zero	Zero	0
	AI1 scaled	12.12 AI1 scaled value .	1
	AI2 scaled	12.22 AI2 scaled value	2
	Brake torque memory	Parameter 44.02 Brake torque memory	3
	Brake open torque	Parameter 44.201 Brake open torque .	4
	Other [bit]	See Terms and abbreviations (page 207) .	-

No.	Name / Range / Selection	Description	Def / Type FbEq 16b / 32b
44.201	Brake open torque	Defines the sign (i.e. direction of rotation) and minimum absolute value of the brake open torque (motor torque requested at brake release in percent of motor nominal torque). The value of the source selected by parameter 44.200 Brake open torque source is used as the brake open torque only if it has the same sign as this parameter and has a greater absolute value. Note: This parameter is not effective in scalar motor control mode.	30.0 % / real32
	-1600.0 ... 1600.0%	Minimum torque at brake release.	10 = 1% / 1 = 1%
44.202	Extended runtime	Defines the time period during which drive keeps the motor magnetized after the brake is closed. The Extended run time function is enabled if this value is less than 3600 seconds or greater than 0 seconds. See also, section Extended run time (page 117). Note: The extended run time function is active only when all these conditions are satisfied: - the drive is set to DTC motor control mode, see Operating modes of the drive (page 133) - the drive is in Remote control  WARNING! Extended runtime causes the motor to heat up. In cases where long magnetization time is required, make sure to use motors with external ventilation.	5.0 s / real32
	0.0 ... 3600.0 s	Time period.	1 = 1 s / 1 = 1 s
44.203	Extended runtime sw	Displays the status of the Extended runtime function. This parameter is read-only.	0000 0000 0000 0000 / uint16
b0	Extended run in operation	0 = Extended run time not active. 1 = Extended run time is active after brake is closed.	
b1	Extended run enabled	0 = Extended run time is set to 0. 1 = Extended run time is set to > 0.	
b2...15	Reserved		
	0000h...FFFFh		1 / 1
44.204	Winch brake status	Displays the status of the brake.	0000 0000 0000 0000 / uint16
b0	Winch brake open command	0 = Brake is closed. 1 = Brake is open. Note: This bit is used to control the mechanical brake through a relay output in the winch control program.	
b1...15	Reserved		

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No.	Name / Range / Selection	Description	Def / Type FbEq 16b / 32b
	0000h...FFFFh		1 / 1
44.209	Analogue input as digital status	Displays the analogue input level as digital status.	0000 0000 0000 0000 / uint16
b0	AI1 level status	Analogue input 1 level status.	
b1	AI2 level status	Analogue input 2 level status.	
b2...15	Reserved		
	0000h...FFFFh		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 196) .	
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

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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 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

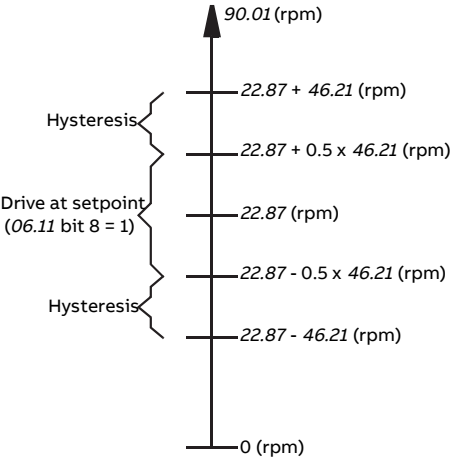
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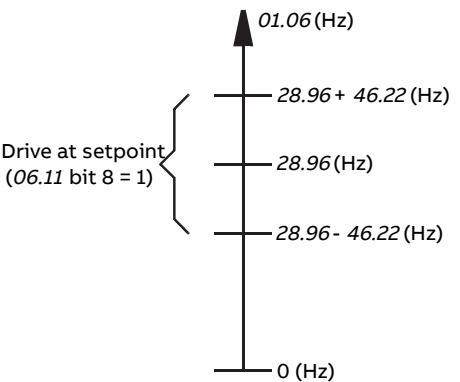
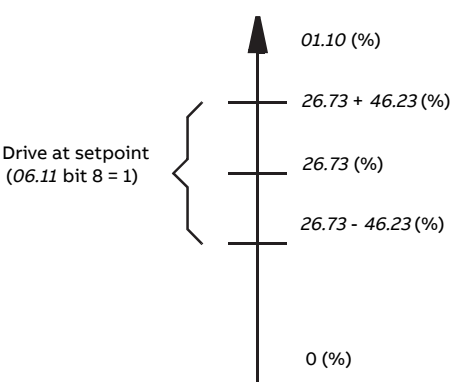
No.	Name / Range / Selection	Description	Def / Type FbEq 16b / 32b
	DI3	Digital input DI3 (10.02 DI delayed status , bit 2).	4
	DI4	Digital input DI4 (10.02 DI delayed status , bit 3).	5
	DI5	Digital input DI5 (10.02 DI delayed status , bit 4).	6
	DI6	Digital input DI6 (10.02 DI delayed status , bit 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 207) .	-
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 name-plate 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. 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

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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 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 (26.73 Torque reference act 4) 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
	0.0 ... 300.0 %	Limit for “at setpoint” indication in torque control. For 16-bit scaling, see parameter 46.03 .	- / 1 = 1 %

No.	Name / Range / Selection	Description	Def / Type FbEq 16b / 32b
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	Speed scaling stand alone	Defines the speed scaling for EXT1 mode. See parameter 12.200 and 12.201 . In EXT1 mode the value in this parameter is written into parameter 46.01 Speed scaling.	1500.00 rpm / real32
	0.10 ... 30000.00 rpm	Acceleration/deceleration terminal/initial speed.	1 = 1 rpm / 1 = 1 rpm

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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 200).	
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 (parameter group 62 D2D and DDCS receive data) or the source of transmitted 16-bit data (parameter group 61 D2D and DDCS transmit 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

No.	Name / Range / Selection	Description	Def / Type FbEq 16b / 32b
47.08	DataStorage 8 real32	Data storage parameter 8. 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 47.38 .	- / 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

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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 (defined in parameter group 62 D2D and DDCS receive data), or when the data storage parameter is the source of transmitted 16-bit data (defined in parameter group 61 D2D and DDCS transmit 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

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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 (refer section Local control vs. external control (page 132)). 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
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.	Name / Range / Selection	Description	Def / Type FbEq 16b / 32b
	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. Refer section Local control vs. external control (page 132).	-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. Refer section Local control vs. external control (page 132).	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. Refer section Local control vs. external control (page 132).	-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 132).	500.00 Hz / real32
	-598.00 ... 598.00 Hz	Maximum frequency reference. For 16-bit scaling, see parameter 46.02 .	- / 100 = 1 Hz
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
	Other [bit]	Source selection. See Terms and abbreviations (page 207).	-

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No.	Name / Range / Selection	Description	Def / Type FbEq 16b / 32b
50	Fieldbus adapter (FBA)	Fieldbus communication configuration. Refer also chapter Fieldbus control through a fieldbus adapter.	
50.01	FBA A enable	Enables/disables communication between the drive and fieldbus FBA A interface, and specifies the physical connector location for the fieldbus cable. Note: This parameter cannot be changed while the drive is running.	Disable / uint16
	Disable	Communication between drive and fieldbus FBA A interface disabled.	0
	Option slot 1	Communication between drive and fieldbus FBA A interface enabled. The fieldbus cable is connected to an fieldbus FBA A interface in slot 1.	1
	Option slot 2	Communication between drive and fieldbus FBA A interface enabled. The fieldbus cable is connected to an fieldbus FBA A interface in slot 2.	2
	Option slot 3	Communication between drive and fieldbus FBA A interface enabled. The fieldbus cable is connected to an fieldbus FBA A interface 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	The drive generates an A7C1 FBA A communication warning and sets the speed to the value defined by parameter 49.05 Communication loss action (page 501). Speed ref safe (when speed reference is being used). This occurs if control is expected from the FBA A interface, or if supervision is forced using parameter 50.26 FBA A comm supervision force. 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 FBA A interface. 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

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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 FBA A interface. 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 FBA A interface. 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 FBA A interface. 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 FBA A interface 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 207) .	-

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 FBA A interface.	Not selected / uint32
	Not selected	No source selected.	0
	Other [bit]	Source selection. See Terms and abbreviations (page 207) .	-
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 FBA A interface.	Not selected / uint32
	Not selected	No source selected.	0
	Other [bit]	Source selection. See Terms and abbreviations (page 207) .	-
50.12	FBA A debug mode	Enables the display of raw (unmodified) data received from and sent to fieldbus FBA A interface 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.	Disable / uint16
	Disable	Display of raw data from fieldbus FBA A interface disabled.	0
	Fast	Display of raw data from fieldbus FBA A interface enabled.	1
50.13	FBA A control word	Displays the raw (unmodified) control word sent by the master (PLC) to fieldbus FBA A interface 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 FBA A interface.	1 = 1
50.14	FBA A reference 1	Displays raw (unmodified) reference REF1 sent by the master (PLC) to fieldbus FBA A interface 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 FBA A interface 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 FBA A interface 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 FBA A interface to master.	1 = 1

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No.	Name / Range / Selection	Description	Def / Type FbEq 16b / 32b															
50.17	FBA A actual value 1	Displays raw (unmodified) actual value ACT1 sent by fieldbus FBA A interface to the master (PLC) if debugging is enabled by parameter 50.12 FBA A debug mode . This parameter is read-only.	- / int32															
50.18	FBA A actual value 2	Displays raw (unmodified) actual value ACT2 sent by fieldbus FBA A interface to the master (PLC) if debugging is enabled by parameter 50.12 FBA A debug mode . This parameter is read-only.	- / int32															
50.21	FBA A timelevel sel	Selects the communication time levels. In general, lower time levels of read/write services reduce CPU load. The table below shows the time levels of the read/write services for cyclic high and cyclic low data with each parameter setting. <table><thead><tr><th>Selection</th><th>Cyclic high *</th><th>Cyclic low **</th></tr></thead><tbody><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></tbody></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.	Selection	Cyclic high *	Cyclic low **	Monitoring	10 ms	2 ms	Normal	2 ms	10 ms	Fast	500 µs	2 ms	Very fast	250 µs	2 ms	Normal / uint16
Selection	Cyclic high *	Cyclic low **																
Monitoring	10 ms	2 ms																
Normal	2 ms	10 ms																
Fast	500 µs	2 ms																
Very fast	250 µs	2 ms																
	Normal	Normal speed.	0															
	Fast	Fast speed.	1															
	Very fast	Very fast speed.	2															
	Monitoring	Low speed. Optimized for PC tool communication and monitoring usage.	3															
50.26	FBA A comm supervision force	Activates fieldbus communication monitoring separately for each control location (refer section Local control vs. external control (page 132)). 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.	- / 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.																

No.	Name / Range / Selection	Description	Def / Type FbEq 16b / 32b
b2	Local	1 = Communication monitoring active when local control is being used.	
b3...15	Reserved		
	0000h...FFFFh		1 = 1 / 1 = 1
50.31	FBA B enable	Enables/disables communication between the drive and fieldbus FBA B interface and defines the physical connector location for the fieldbus cable. Note: This parameter cannot be changed while the drive is running.	Disable / uint16
	Disable	Communication between drive and fieldbus FBA B interface disabled.	0
	Option slot 1	Communication between drive and fieldbus FBA B interface enabled. The adapter is in slot 1.	1
	Option slot 2	Communication between drive and fieldbus FBA B interface enabled. The adapter is in slot 2.	2
	Option slot 3	Communication between drive and fieldbus FBA B interface 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	The drive generates an A7C2 FBA B communication warning and sets the speed to the value defined by parameter 49.05 Communication loss action (page 501) Speed ref safe. 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. 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 FBA B interface. 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 FBA B interface. 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 FBA B interface. 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 FBA B interface. 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 FBA B interface 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 207) .	-
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 FBA B interface.	Not selected / uint32
	Not selected	No source selected.	0
	Other [bit]	Source selection. See Terms and abbreviations (page 207) .	-
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 FBA B interface.	Not selected / uint32
	Not selected	No source selected.	0
	Other [bit]	Source selection. See Terms and abbreviations (page 207) .	-
50.42	FBA B debug mode	Enables the display of raw (unmodified) data received from and sent to fieldbus FBA B interface 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 FBA B interface disabled.	0
	Fast	Display of raw data from fieldbus FBA B interface enabled.	1
50.43	FBA B control word	Displays the raw (unmodified) control word sent by the master (PLC) to fieldbus FBA B interface 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 FBA B interface.	1 = 1
50.44	FBA B reference 1	Displays raw (unmodified) reference REF1 sent by the master (PLC) to fieldbus FBA B interface if debugging is enabled by parameter 50.42 FBA B debug mode . This parameter is read-only.	- / int32

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No.	Name / Range / Selection	Description	Def / Type FbEq 16b / 32b															
50.45	FBA B reference 2	Displays raw (unmodified) reference REF2 sent by the master (PLC) to fieldbus FBA B interface if debugging is enabled by parameter 50.42 FBA B debug mode . This parameter is read-only.	- / int32															
50.46	FBA B status word	Displays the raw (unmodified) status word sent by fieldbus FBA B interface to the master (PLC) if debugging is enabled by parameter 50.42 FBA B debug mode . This parameter is read-only.	0 / uint32															
	00000000...FFFFFFFFh	Status word sent by fieldbus FBA B interface to master.	1 = 1															
50.47	FBA B actual value 1	Displays raw (unmodified) actual value ACT1 sent by fieldbus FBA B interface to the master (PLC) if debugging is enabled by parameter 50.42 FBA B debug mode . This parameter is read-only.	- / int32															
50.48	FBA B actual value 2	Displays raw (unmodified) actual value ACT2 sent by fieldbus FBA B interface to the master (PLC) if debugging is enabled by parameter 50.42 FBA B debug mode . This parameter is read-only.	- / int32															
50.51	FBA B timelevel sel	Selects the communication time levels. In general, lower time levels of read/write services reduce CPU load. The table below shows the time levels of the read/write services for cyclic high and cyclic low data with each parameter setting. <table><tr><th>Selection</th><th>Cyclic high *</th><th>Cyclic low **</th></tr><tr><td>Monitoring</td><td>10 ms</td><td>2 ms</td></tr><tr><td>Normal</td><td>2 ms</td><td>10 ms</td></tr><tr><td>Fast</td><td>500 μs</td><td>2 ms</td></tr><tr><td>Very fast</td><td>250 μs</td><td>2 ms</td></tr></table> * Cyclic high data consists of fieldbus Status word, Act1 and Act2. ** Cyclic low data consists of the parameter data mapped to parameter groups 55 FBA B data in and 56 FBA B data out, and acyclic data. Control word, Ref1 and Ref2 are handled as interrupts generated on receipt of cyclic high messages. Note: This parameter cannot be changed while the drive is running.	Selection	Cyclic high *	Cyclic low **	Monitoring	10 ms	2 ms	Normal	2 ms	10 ms	Fast	500 μs	2 ms	Very fast	250 μs	2 ms	Normal / uint16
Selection	Cyclic high *	Cyclic low **																
Monitoring	10 ms	2 ms																
Normal	2 ms	10 ms																
Fast	500 μs	2 ms																
Very fast	250 μs	2 ms																
	Normal	Normal speed.	0															
	Fast	Fast speed.	1															
	Very fast	Very fast speed.	2															
	Monitoring	Low speed. Optimized for PC tool communication and monitoring usage.	3															

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 (refer section Local control vs. external control (page 132)). The parameter is primarily intended for monitoring the communication with FBA B interface 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 interface, FBA A or FBA B only.	Enable / uint16
	Disable	FBA automatic detection is disabled.	0
	Enable	FBA automatic detection is enabled.	1

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No.	Name / Range / Selection	Description	Def / Type FbEq 16b / 32b
51	FBA A settings	Fieldbus FBA A interface configuration.	
51.01	FBA A type	Displays the type of the fieldbus connected to fieldbus interface FBA A. 0 = Fieldbus 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; 132 = PROFINET IO; 135 = FECA; 136 = FEPL; 485 = FSCA. This parameter is read-only.	None / uint16
51.02	FBA A Par2	Parameters 51.02 ... 51.26 are fieldbus 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 configuration parameter.	1 = 1 / 1 = 1
...	...	...	...
51.26	FBA A Par26	See parameter 51.02 FBA A Par2 .	- / uint16
	0...65535	Fieldbus configuration parameter.	1 = 1 / 1 = 1
51.27	FBA A par refresh	Validates any changed fieldbus 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 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 fieldbus.	1 = 1
51.29	FBA A drive type code	Displays the drive type code in the fieldbus 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 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 communication.	Not configured / uint16
	Not configured	Fieldbus is not configured.	0
	Initializing	Fieldbus is initializing.	1

No.	Name / Range / Selection	Description	Def / Type FbEq 16b / 32b
	Time out	A timeout has occurred in the communication between the fieldbus and the drive.	2
	Configuration error	Fieldbus 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 has been configured not to detect a communication break. For more information, see the documentation of the fieldbus adapter.	5
	Reset	Fieldbus is performing a hardware reset.	6
51.32	FBA A comm SW ver	Displays the patch and build versions of the fieldbus 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 fieldbus firmware.	1 = 1
51.33	FBA A appl SW ver	Displays the major and minor versions of the fieldbus 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 fieldbus firmware.	1 = 1

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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 FBA A interface. 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 FBA A data in1 ... 52.12 FBA A data in12 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 207) .	-
...	...	...	...
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 FBA A interface. 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 FBA A interface.	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 207) .	-
53.02	FBA data out2	Parameters 53.01 ... 53.12 select data to be transferred from the fieldbus controller to the drive through fieldbus FBA A interface.	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 207) .	-
53.03	FBA data out3	Parameters 53.01 FBA data out1 ... 53.12 FBA data out12 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

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No.	Name / Range / Selection	Description	Def / Type FbEq 16b / 32b
	Ref2 32bit	Reference REF2 (32 bits)	13
	CW2 16bit	Control Word 2 (16 bits)	21
	Other [bit]	Source selection. See Terms and abbreviations (page 207) .	-
...	...	...	...
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 FBA B interface configuration.	
54.01	FBA B type	Displays the type of the fieldbus connected to fieldbus interface FBA B. 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 fieldbus FBA B interface 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 configuration parameter.	1 = 1 / 1 = 1
...	...	...	...
54.26	FBA B Par26	See parameter 54.02 FBA B Par2 .	- / uint16
	0.0 ... 65535.0	Fieldbus configuration parameter.	1 = 1 / 1 = 1
54.27	FBA B par refresh	Validates any changed fieldbus FBA B interface 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 FBA B interface 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 fieldbus FBA B interface.	1 = 1
54.29	FBA B drive type code	Displays the drive type code in the fieldbus FBA B interface 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 FBA B interface 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 FBA B interface communication.	Not configured / uint16
	Not configured	Adapter is not configured.	0
	Initializing	Fieldbus is initializing.	1

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No.	Name / Range / Selection	Description	Def / Type FbEq 16b / 32b
	Time out	A timeout has occurred in the communication between the fieldbus and the drive.	2
	Configuration error	Fieldbus 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 FBA B interface has been configured not to detect a communication break. For more information, see the documentation of the fieldbus adapter.	5
	Reset	Fieldbus is performing a hardware reset.	6
54.32	FBA B comm SW ver	Displays the patch and build versions of the FBA B interface 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 fieldbus FBA B interface firmware.	1 = 1
54.33	FBA B appl SW ver	Displays the major and minor versions of the FBA B interface 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 fieldbus FBA B interface 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 FBA B interface.	
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 FBA B interface.	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 207) .	-
...	...	...	...
55.12	FBA B data in12	See parameter 55.01 FBA B data in1 .	None / uint32

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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 FBA B interface.	
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 FBA B interface.	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 207) .	-
...	...	...	...
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

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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 49.05 Communication loss action (page 501) Speed ref safe. 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

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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 207) .	-
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 207) .	-
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 207) .	-
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

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No.	Name / Range / Selection	Description	Def / Type FbEq 16b / 32b
	Mode 2	<u>32-bit values (groups 1...127, indexes 1...255):</u> 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 (refer section Local control vs. external control (page 132)). 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
	Other [bit]	Source selection. See Terms and abbreviations (page 207) .	-
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
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

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No.	Name / Range / Selection	Description	Def / Type FbEq 16b / 32b
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
60	DDCS communication	DDCS communication configuration. The DDCS protocol is used in the communication between - drives in a master/follower configuration (see page 141), - the drive and an external controller such as the AC 800M (see page 149), or - the drive (or more precisely, an inverter unit) and the supply unit of the drive system (see page 151). All of the above utilize a fiber optic link which also requires an FDCO module (typically with ZCU control units) or an RDCO module (with BCU control units). Master/follower and external controller communication can also be implemented through shielded twisted-pair cable connected to the XD2D connector of the drive. This group also contains parameters for drive-to-drive (D2D) communication supervision.	
60.01	M/F communication port	Selects the connection used by the master/follower functionality.	Not in use / uint16
	Not in use	None (communication disabled).	0
	Slot 1A	Channel A on FDCO module in slot 1 (with ZCU control unit only).	1
	Slot 2A	Channel A on FDCO module in slot 2 (with ZCU control unit only).	2
	Slot 3A	Channel A on FDCO module in slot 3 (with ZCU control unit only).	3
	Slot 1B	Channel B on FDCO module in slot 1 (with ZCU control unit only).	4
	Slot 2B	Channel B on FDCO module in slot 2 (with ZCU control unit only).	5
	Slot 3B	Channel B on FDCO module in slot 3 (with ZCU control unit only).	6
	RDCO CH 2	Channel 2 on RDCO module (with BCU control unit only).	12
	XD2D	Connector XD2D. Note: This connection cannot co-exist, and is not to be confused with, drive-to-drive (D2D) communication implemented by application programming (detailed in <i>Drive application programming manual (IEC 61131-3)</i>, 3AUA0000127808 [English]).	7
60.02	M/F node address	Selects the node address of the drive for master/follower communication. No two nodes on-line may have the same address. Note: The allowable addresses for the master are 0 and 1. The allowable addresses for followers are 2...60.	1 NoUnit / uint16

No.	Name / Range / Selection	Description	Def / Type FbEq 16b / 32b
	1...254	Node address.	- / -
60.03	M/F mode	Defines the role of the drive on the master/follower or drive-to-drive link.	Not in use / uint16
	Not in use	Master/follower functionality not active.	0
	DDCS master	The drive is the master on the master/follower (DDCS) link.	1
	DDCS follower	The drive is a follower on the master/follower (DDCS) link.	2
	D2D master	The drive is the master on the master/follower (D2D) link. Note: This setting is only to be used with D2D communication implemented by application programming. If you are using the master/follower functionality (see page 141) through the XD2D connector, select DDCS master instead.	3
	D2D follower	The drive is a follower on the master/follower (D2D) link. Note: This setting is only to be used with D2D communication implemented by application programming. If you are using the master/follower functionality (see page 141) through the XD2D connector, select DDCS follower instead.	4
	DDCS forcing	The role of the drive on the master/follower (DDCS) link is defined by parameters 60.15 Force master and 60.16 Force follower .	5
	D2D forcing	The role of the drive on the master/follower (D2D) link is defined by parameters 60.15 Force master and 60.16 Force follower . Note: This setting is only to be used with D2D communication implemented by application programming. If you are using the master/follower functionality (see page 141) through the XD2D connector, select DDCS forcing instead.	6
60.05	M/F HW connection	Selects the topology of the master/follower link. Note: Use the setting Star if using the master/follower functionality (see page 141) through the XD2D connector (as opposed to a fiber optic link).	Ring / uint16
	Ring	The devices are connected in a ring topology. Forwarding of messages is enabled.	0
	Star	The devices are connected in a star topology (for example, through a branching unit). Forwarding of messages is disabled.	1

No.	Name / Range / Selection	Description	Def / Type FbEq 16b / 32b
60.07	M/F link control	Defines the light intensity of the transmission LED of RDCO module channel CH2. (This parameter is effective only when parameter 60.01 M/F communication port is set to RDCO CH 2. FDCO modules have a hardware transmitter current selector.) In general, use higher values with longer fiber optic cables. The maximum setting is applicable to the maximum length of the fiber optic link. See Specifications of the fiber optic master/follower link (page 148).	10 NoUnit / uint16
	1...15	Light intensity.	- / -
60.08	M/F comm loss timeout	Sets a timeout for master/follower (DACS) communication. If a communication break lasts longer than the timeout, the action specified by parameter 60.09 M/F comm loss function is taken. As a rule of thumb, this parameter should be set to at least 3 times the transmit interval of the master.	100 ms / uint16
	0...65535 ms	Master/follower communication timeout.	- / -
60.09	M/F comm loss function	Selects how the drive reacts to a master/follower communication break.	Fault / uint16
	NoAction	No action taken.	0
	Warning	The drive generates an A7CB M/F comm loss warning. This only occurs if control is expected from the master/follower link, or if supervision is forced using parameter 60.32 M/F comm supervision force.  WARNING! Make sure that it is safe to continue operation in case of a communication break.	1
	Fault	Drive trips on 7582 M/F comm loss . This only occurs if control is expected from the master/follower link, or if supervision is forced using parameter 60.32 M/F comm supervision force .	2
	Fault always	Drive trips on 7582 M/F comm loss . This occurs even though no control is expected from the master/follower link.	3
60.10	M/F ref1 type	Selects the type and scaling of reference 1 received from the master/follower link. The resulting value is shown by 03.13 M/F or D2D ref1 .	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
	General	Generic reference with a scaling of 100 = 1 (ie. integer and two decimals).	2

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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
60.11	M/F ref2 type	Selects the type and scaling of reference 2 received from the master/follower link. The resulting value is shown by 03.14 M/F or D2D ref2 . For the selections, see parameter 60.10 M/F ref1 type .	Torque / uint16
60.12	M/F act1 type	Selects the type/source and scaling of actual value ACT1 transmitted to the master/follower link.	Auto / uint16
	Auto	Type/source and scaling follow the type of reference 1 selected by parameter 60.10 M/F ref1 type . See the individual settings below for the sources and scalings.	0
	Transparent	Reserved	1
	General	Reserved	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
60.13	M/F act2 type	Selects the type/source and scaling of actual value ACT2 transmitted to the master/follower link.	Auto / uint16
	Auto	Type/source and scaling follow the type of reference 2 selected by parameter 60.11 M/F ref2 type . See the individual settings below for the sources and scalings.	0
	Transparent	Reserved	1
	General	Reserved	2
	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
60.14	M/F follower selection	(Effective in the master only.) Defines the followers from which data is read. See also parameters 62.28...62.33 .	None / uint32
	Follower node 2	Data is read from the follower with node address 2.	2
	Follower node 3	Data is read from the follower with node address 3.	4
	Follower node 4	Data is read from the follower with node address 4.	8

No.	Name / Range / Selection	Description	Def / Type FbEq 16b / 32b
	Follower nodes 2+3	Data is read from the followers with node addresses 2 and 3.	6
	Follower nodes 2+4	Data is read from the followers with node addresses 2 and 4.	10
	Follower nodes 3+4	Data is read from the followers with node addresses 3 and 4.	12
	Follower nodes 2+3+4	Data is read from the followers with node addresses 2, 3 and 4.	14
	None	None.	0
60.15	Force master	When parameter 60.03 M/F mode is set to DDCS forcing or D2D forcing , this parameter selects a source that forces the drive to be the master on the master/follower link. 1 = Drive is master on the master/follower link	FALSE / uint32
	FALSE	0.	0
	TRUE	1.	1
	Other [bit]	See Terms and abbreviations (page 207) .	-
60.16	Force follower	When parameter 60.03 M/F mode is set to DDCS forcing or D2D forcing , this parameter selects a source that forces the drive to be a follower on the master/follower link. 1 = Drive is follower on the master/follower link	FALSE / uint32
	FALSE	0.	0
	TRUE	1.	1
	Other [bit]	See Terms and abbreviations (page 207) .	-
60.17	Follower fault action	(Effective in the master only.) Selects how the drive reacts to a fault in a follower. See also parameter 60.23 M/F status supervision sel 1 . Note: Each follower must be configured to transmit its status word as one of the three data words in parameters 60.01...60.03 . In the master, the corresponding target parameter (62.04...62.12) must be set to Follower SW .	Fault / uint16
	No action	No action taken. Unaffected drives on the master/follower link will continue running.	0
	Warning	The drive generates a warning (AFE7 Follower).	1
	Fault	Drive trips on FF7E Follower . All followers will be stopped.	2

No.	Name / Range / Selection	Description	Def / Type FbEq 16b / 32b
60.18	Follower enable	Interlocks the starting of the master to the status of the followers. See also parameter 60.23 M/F status supervision sel 1 . Note: Each follower must be configured to transmit its status word as one of the three data words in parameters 60.01...60.03 . In the master, the corresponding target parameter (62.04...62.12) must be set to Follower SW .	Always / uint16
	MSW bit 0	The master can only be started if all followers are ready to switch on (bit 0 of 06.11 Main status word in each follower is on).	0
	MSW bit 1	The master can only be started if all followers are ready to operate (bit 1 of 06.11 Main status word in each follower is on).	1
	MSW bits 0 + 1	The master can only be started if all followers are ready to switch on and ready to operate (bits 0 and 1 of 06.11 Main status word in each follower are on).	2
	Always	The starting of the master is not interlocked to the status of the followers.	3
	MSW bit 12	The master can only be started if user-definable bit 12 of 06.11 Main status word in each follower is on. See parameter 06.31 MSW bit 12 sel .	4
	MSW bits 0 + 12	The master can only be started if both bit 0 and bit 12 of 06.11 Main status word in each follower are on.	5
	MSW bits 1 + 12	The master can only be started if both bit 1 and bit 12 of 06.11 Main status word in each follower are on.	6
60.19	M/F comm supervision sel 1	Parameters 60.19...60.28 are only effective when the drive is the master on a D2D (drive-to-drive) link, implemented by application programming. See parameters 60.01 M/F communication port and 60.03 M/F mode , and <i>Drive (IEC 61131-3) application programming manual</i> (3AUA0000127808 [English]). In the master, parameters 60.19 M/F comm supervision sel 1 and 60.20 M/F comm supervision sel 2 specify the followers that are monitored for loss of communication. This parameter selects which followers (out of followers 1...16) are monitored. Each of the selected followers is polled by the master. If no reply is received, the action specified in 60.09 M/F comm loss function is taken. The status of communication is shown by 62.37 M/F communication status 1 and 62.38 M/F communication status 2 .	- / uint16
b0	Follower 1	1 = Follower 1 is polled by the master.	
b1	Follower 2	1 = Follower 2 is polled by the master.	

No.	Name / Range / Selection	Description	Def / Type FbEq 16b / 32b
b2	Follower 3	1 = Follower 3 is polled by the master.	
b3	Follower 4	1 = Follower 4 is polled by the master.	
b4	Follower 5	1 = Follower 5 is polled by the master.	
b5	Follower 6	1 = Follower 6 is polled by the master.	
b6	Follower 7	1 = Follower 7 is polled by the master.	
b7	Follower 8	1 = Follower 8 is polled by the master.	
b8	Follower 9	1 = Follower 9 is polled by the master.	
b9	Follower 10	1 = Follower 10 is polled by the master.	
b10	Follower 11	1 = Follower 11 is polled by the master.	
b11	Follower 12	1 = Follower 12 is polled by the master.	
b12	Follower 13	1 = Follower 13 is polled by the master.	
b13	Follower 14	1 = Follower 14 is polled by the master.	
b14	Follower 15	1 = Follower 15 is polled by the master.	
b15	Follower 16	1 = Follower 16 is polled by the master.	
	0000h...FFFFh		1 = 1 / 1 = 1
60.20	M/F comm supervision sel 2	Selects which followers (out of followers 17...32) are monitored for loss of communication. See parameter 60.19 M/F comm supervision sel 1 .	- / uint16
b0	Follower 17	1 = Follower 17 is polled by the master.	
b1	Follower 18	1 = Follower 18 is polled by the master.	
b2	Follower 19	1 = Follower 19 is polled by the master.	
b3	Follower 20	1 = Follower 20 is polled by the master.	
b4	Follower 21	1 = Follower 21 is polled by the master.	
b5	Follower 22	1 = Follower 22 is polled by the master.	
b6	Follower 23	1 = Follower 23 is polled by the master.	
b7	Follower 24	1 = Follower 24 is polled by the master.	
b8	Follower 25	1 = Follower 25 is polled by the master.	
b9	Follower 26	1 = Follower 26 is polled by the master.	
b10	Follower 27	1 = Follower 27 is polled by the master.	
b11	Follower 28	1 = Follower 28 is polled by the master.	
b12	Follower 29	1 = Follower 29 is polled by the master.	
b13	Follower 30	1 = Follower 30 is polled by the master.	
b14	Follower 31	1 = Follower 31 is polled by the master.	
b15	Follower 32	1 = Follower 32 is polled by the master.	
	0000h...FFFFh		1 = 1 / 1 = 1

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No.	Name / Range / Selection	Description	Def / Type FbEq 16b / 32b
60.23	M/F status supervision sel 1	(This parameter is only effective when the drive is the master on a D2D link. See parameters 60.01 M/F communication port and 60.03 M/F mode.) In the master, parameters 60.23 M/F status supervision sel 1 and 60.24 M/F status supervision sel 2 specify the followers whose status word is monitored by the master. This parameter selects the followers (out of followers 1...16) whose status words are monitored by the master. If a follower reports a fault (bit 3 of the status word is on), the action specified in 60.17 Follower fault action is taken. Bits 0 and 1 of the status word (ready states) are handled as defined by 60.18 Follower enable. Using 60.27 M/F status suprv mode sel 1 and 60.28 M/F status suprv mode sel 2, it is possible to define whether any given follower is only monitored when it is stopped. Note: Also activate communication supervision for the same followers in parameter 60.19 M/F comm supervision sel 1. The status of communication is shown by 62.37 M/F communication status 1 and 62.38 M/F communication status 2.	- / uint16
b0	Follower 1	Status of follower 1 is monitored.	
b1	Follower 2	Status of follower 2 is monitored.	
b2	Follower 3	Status of follower 3 is monitored.	
b3	Follower 4	Status of follower 4 is monitored.	
b4	Follower 5	Status of follower 5 is monitored.	
b5	Follower 6	Status of follower 6 is monitored.	
b6	Follower 7	Status of follower 7 is monitored.	
b7	Follower 8	Status of follower 8 is monitored.	
b8	Follower 9	Status of follower 9 is monitored.	
b9	Follower 10	Status of follower 10 is monitored.	
b10	Follower 11	Status of follower 11 is monitored.	
b11	Follower 12	Status of follower 12 is monitored.	
b12	Follower 13	Status of follower 13 is monitored.	
b13	Follower 14	Status of follower 14 is monitored.	
b14	Follower 15	Status of follower 15 is monitored.	
b15	Follower 16	Status of follower 16 is monitored.	
	0000h...FFFFh		1 = 1 / 1 = 1

No.	Name / Range / Selection	Description	Def / Type FbEq 16b / 32b
60.24	M/F status supervision sel 2	Selects the followers (out of followers 17...32) whose status words are monitored by the D2D master. Note: Also activate communication supervision for the same followers in parameter 60.20 M/F comm supervision sel 2. See parameter 60.23 M/F status supervision sel 1.	- / uint16
b0	Follower 17	1 = Status of follower 17 is monitored.	
b1	Follower 18	1 = Status of follower 18 is monitored.	
b2	Follower 19	1 = Status of follower 19 is monitored.	
b3	Follower 20	1 = Status of follower 20 is monitored.	
b4	Follower 21	1 = Status of follower 21 is monitored.	
b5	Follower 22	1 = Status of follower 22 is monitored.	
b6	Follower 23	1 = Status of follower 23 is monitored.	
b7	Follower 24	1 = Status of follower 24 is monitored.	
b8	Follower 25	1 = Status of follower 25 is monitored.	
b9	Follower 26	1 = Status of follower 26 is monitored.	
b10	Follower 27	1 = Status of follower 27 is monitored.	
b11	Follower 28	1 = Status of follower 28 is monitored.	
b12	Follower 29	1 = Status of follower 29 is monitored.	
b13	Follower 30	1 = Status of follower 30 is monitored.	
b14	Follower 31	1 = Status of follower 31 is monitored.	
b15	Follower 32	1 = Status of follower 32 is monitored.	
	0000h...FFFFh		1 = 1 / 1 = 1
60.27	M/F status supv mode sel 1	In the D2D master, parameters 60.27 M/F status supv mode sel 1 and 60.28 M/F status supv mode sel 2 specify the mode of follower status word monitoring. Each follower can individually be set to be monitored continuously, or only when it is in stopped state. This parameter selects the mode of status word monitoring of followers 1...16.	- / uint16
b0	Follower 1	0 = Status of follower 1 is monitored continuously. 1 = Status of follower 1 is monitored only when it is in stopped state.	
b1	Follower 2	0 = Status of follower 2 is monitored continuously. 1 = Status of follower 2 is monitored only when it is in stopped state.	
b2	Follower 3	0 = Status of follower 3 is monitored continuously. 1 = Status of follower 3 is monitored only when it is in stopped state.	

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No.	Name / Range / Selection	Description	Def / Type FbEq 16b / 32b
b3	Follower 4	0 = Status of follower 4 is monitored continuously. 1 = Status of follower 4 is monitored only when it is in stopped state.	
b4	Follower 5	0 = Status of follower 5 is monitored continuously. 1 = Status of follower 5 is monitored only when it is in stopped state.	
b5	Follower 6	0 = Status of follower 6 is monitored continuously. 1 = Status of follower 6 is monitored only when it is in stopped state.	
b6	Follower 7	0 = Status of follower 7 is monitored continuously. 1 = Status of follower 7 is monitored only when it is in stopped state.	
b7	Follower 8	0 = Status of follower 8 is monitored continuously. 1 = Status of follower 8 is monitored only when it is in stopped state.	
b8	Follower 9	0 = Status of follower 9 is monitored continuously. 1 = Status of follower 9 is monitored only when it is in stopped state.	
b9	Follower 10	0 = Status of follower 10 is monitored continuously. 1 = Status of follower 10 is monitored only when it is in stopped state.	
b10	Follower 11	0 = Status of follower 11 is monitored continuously. 1 = Status of follower 11 is monitored only when it is in stopped state.	
b11	Follower 12	0 = Status of follower 12 is monitored continuously. 1 = Status of follower 12 is monitored only when it is in stopped state.	
b12	Follower 13	0 = Status of follower 13 is monitored continuously. 1 = Status of follower 13 is monitored only when it is in stopped state.	
b13	Follower 14	0 = Status of follower 14 is monitored continuously. 1 = Status of follower 14 is monitored only when it is in stopped state.	
b14	Follower 15	0 = Status of follower 15 is monitored continuously. 1 = Status of follower 15 is monitored only when it is in stopped state.	
b15	Follower 16	0 = Status of follower 16 is monitored continuously. 1 = Status of follower 16 is monitored only when it is in stopped state.	
	0000h...FFFFh		1 = 1 / 1 = 1
60.28	M/F status supv mode sel 2	Selects the mode of status word monitoring of followers 17...32.	- / uint16

No.	Name / Range / Selection	Description	Def / Type FbEq 16b / 32b
b0	Follower 17	0 = Status of follower 17 is monitored continuously. 1 = Status of follower 17 is monitored only when it is in stopped state.	
b1	Follower 18	0 = Status of follower 18 is monitored continuously. 1 = Status of follower 18 is monitored only when it is in stopped state.	
b2	Follower 19	0 = Status of follower 19 is monitored continuously. 1 = Status of follower 19 is monitored only when it is in stopped state.	
b3	Follower 20	0 = Status of follower 20 is monitored continuously. 1 = Status of follower 20 is monitored only when it is in stopped state.	
b4	Follower 21	0 = Status of follower 21 is monitored continuously. 1 = Status of follower 21 is monitored only when it is in stopped state.	
b5	Follower 22	0 = Status of follower 22 is monitored continuously. 1 = Status of follower 22 is monitored only when it is in stopped state.	
b6	Follower 23	0 = Status of follower 23 is monitored continuously. 1 = Status of follower 23 is monitored only when it is in stopped state.	
b7	Follower 24	0 = Status of follower 24 is monitored continuously. 1 = Status of follower 24 is monitored only when it is in stopped state.	
b8	Follower 25	0 = Status of follower 25 is monitored continuously. 1 = Status of follower 25 is monitored only when it is in stopped state.	
b9	Follower 26	0 = Status of follower 26 is monitored continuously. 1 = Status of follower 26 is monitored only when it is in stopped state.	
b10	Follower 27	0 = Status of follower 27 is monitored continuously. 1 = Status of follower 27 is monitored only when it is in stopped state.	
b11	Follower 28	0 = Status of follower 28 is monitored continuously. 1 = Status of follower 28 is monitored only when it is in stopped state.	
b12	Follower 29	0 = Status of follower 29 is monitored continuously. 1 = Status of follower 29 is monitored only when it is in stopped state.	
b13	Follower 30	0 = Status of follower 30 is monitored continuously. 1 = Status of follower 30 is monitored only when it is in stopped state.	

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No.	Name / Range / Selection	Description	Def / Type FbEq 16b / 32b
b14	Follower 31	0 = Status of follower 31 is monitored continuously. 1 = Status of follower 31 is monitored only when it is in stopped state.	
b15	Follower 32	0 = Status of follower 32 is monitored continuously. 1 = Status of follower 32 is monitored only when it is in stopped state.	
	0000h...FFFFh		1 = 1 / 1 = 1
60.31	M/F wake up delay	Defines a wake-up delay during which no master/follower communication faults or warnings are generated. This is to allow all drives on the master/follower link to power up. The master cannot be started until the delay elapses or all monitored followers are found to be ready.	60.0 s / uint16
	0.0 ... 180.0 s	Master/follower wake-up delay.	10 = 1 s / 10 = 1 s
60.32	M/F comm supervision force	Activates master/follower communication monitoring separately for each control location (refer section Local control vs. external control (page 132)). The parameter is primarily intended for monitoring the communication with master or follower 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
60.41	Extension adapter com port	Selects the channel used for connecting an optional FEA-xx extension adapter.	Not in use / uint16
	Not in use	None (communication disabled).	0
	Slot 1A	Channel A on FDCO module in slot 1.	1
	Slot 2A	Channel A on FDCO module in slot 2.	2
	Slot 3A	Channel A on FDCO module in slot 3.	3
	Slot 1B	Channel B on FDCO module in slot 1.	4
	Slot 2B	Channel B on FDCO module in slot 2.	5
	Slot 3B	Channel B on FDCO module in slot 3.	6
	RDCO CH 3	Channel CH 3 on RDCO module (with BCU control unit only).	13

No.	Name / Range / Selection	Description	Def / Type FbEq 16b / 32b
60.50	DDCS controller drive type	In ModuleBus communication, defines whether the drive is of the “engineered” or “standard” type. Note: This parameter cannot be changed while the drive is running.	ABB engineered drive / uint16
	ABB engineered drive	The drive is an “engineered drive” (data sets 10...25 are used).	0
	ABB standard drive	The drive is a “standard drive” (data sets 1...4 are used).	1
60.51	DDCS controller comm port	Selects the DDCS channel used for connecting an external controller (such as an AC 800M).	Not in use / uint16
	Not in use	None (communication disabled).	0
	Slot 1A	Channel A on FDCO module in slot 1.	1
	Slot 2A	Channel A on FDCO module in slot 2.	2
	Slot 3A	Channel A on FDCO module in slot 3.	3
	Slot 1B	Channel B on FDCO module in slot 1.	4
	Slot 2B	Channel B on FDCO module in slot 2.	5
	Slot 3B	Channel B on FDCO module in slot 3.	6
	RDCO CH 0	Channel 0 on RDCO module (with BCU control unit only).	10
	XD2D	Connector XD2D.	7
60.52	DDCS controller node address	Selects the node address of the drive for communication with the external controller. No two nodes on-line may have the same address. With an AC 800M (CI858) DriveBus connection, drives must be addressed 1...24; with an AC 80 DriveBus connection, drives must be addressed 1...12. Note that the BusManager function must be disabled in the DriveBus controller. With optical ModuleBus, the drive address is set according to the position value as follows: 1. Multiply the hundreds of the position value by 16. 2. Add the tens and ones of the position value to the result. For example, if the position value is 101, this parameter must be set to $1 \times 16 + 1 = 17$.	1 NoUnit / uint16
	1...254	Node address.	- / -
60.55	DDCS controller HW connection	Selects the topology of the fiber optic link with an external controller.	Star / uint16
	Ring	The devices are connected in a ring topology. Forwarding of messages is enabled.	0
	Star	The devices are connected in a star topology (for example, through a branching unit). Forwarding of messages is disabled.	1

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No.	Name / Range / Selection	Description	Def / Type FbEq 16b / 32b
60.56	DDCS controller baud rate	Selects the communication speed of the channel selected by parameter 60.51 DDCS controller comm port .	4 mbps / uint16
	1 mbps	1 megabit/second.	1
	2 mbps	2 megabit/second.	2
	4 mbps	4 megabit/second.	4
	8 mbps	8 megabit/second.	8
60.57	DDCS controller link control	Defines the light intensity of the transmission LED of RDCO module channel CH0. (This parameter is effective only when parameter 60.51 DDCS controller comm port is set to RDCO CH 0. FDCO modules have a hardware transmitter current selector.) In general, use higher values with longer fiber optic cables. The maximum setting is applicable to the maximum length of the fiber optic link. See Specifications of the fiber optic master/follower link (page 148).	10 NoUnit / uint16
	1...15	Light intensity.	- / -
60.58	DDCS controller comm loss time	Sets a timeout for communication with the external controller. If a communication break lasts longer than the timeout, the action specified by parameter 60.59 DDCS controller comm loss function is taken. As a rule of thumb, this parameter should be set to at least 3 times the transmit interval of the controller. 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). - With an AC 800M controller, the controller detects a communication break immediately but re-establishing the communication is done at 9-second idle intervals. Also note that the sending interval of a data set is not the same as the execution interval of the application task. On ModuleBus, the sending interval is defined by controller parameter Scan Cycle Time (by default, 100 ms).	100 ms / uint16
	0...60000 ms	Timeout for communication with external controller.	- / -
60.59	DDCS controller comm loss function	Selects how the drive reacts to a communication break between the drive and the external controller.	Fault / uint16
	No action	No action taken (monitoring disabled).	0
	Fault	Drive trips on 7581 DDCS controller comm loss . This only occurs if control is expected from the external controller, or if supervision is forced using parameter 60.65 DDCS controller comm supervision force .	1

No.	Name / Range / Selection	Description	Def / Type FbEq 16b / 32b
	Last speed	Drive generates an A7CA DDCS controller comm loss warning and freezes the speed to the level the drive was operating at. This only occurs if control is expected from the external controller, or if supervision is forced using parameter 60.65 DDCS controller 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 A7CA DDCS controller comm loss warning and sets the speed to the speed defined by parameter 49.05 Communication loss action (page 501) Speed ref safe. This only occurs if control is expected from the external controller or if supervision is forced using parameter 60.65 DDCS controller 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 7581 DDCS controller comm loss . This occurs even though no control is expected from the external controller.	4
	Warning	Drive generates an A7CA DDCS controller comm loss warning. This only occurs if control is expected from the external controller, or if supervision is forced using parameter 60.65 DDCS controller comm supervision force.  WARNING! Make sure that it is safe to continue operation in case of a communication break.	5
60.60	DDCS controller ref1 type	Selects the type and scaling of reference 1 received from the external controller. The resulting value is shown by 03.11 DDCS controller ref 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
	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

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No.	Name / Range / Selection	Description	Def / Type FbEq 16b / 32b
60.61	DDCS controller ref2 type	Selects the type and scaling of reference 2 received from the external controller. The resulting value is shown by 03.12 DDCS controller ref 2 . For the selections, see parameter 60.60 DDCS controller ref1 type .	Auto / uint16
60.62	DDCS controller act1 type	Selects the type/source and scaling of actual value ACT1 transmitted to the external controller.	Auto / uint16
	Auto	Type/source and scaling follow the type of reference 1 selected by parameter 60.60 DDCS controller ref1 type . See the individual settings below for the sources and scalings.	0
	Transparent	Reserved.	1
	General	Reserved.	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
60.63	DDCS controller act2 type	Selects the type/source and scaling of actual value ACT2 transmitted to the external controller.	Auto / uint16
	Auto	Type/source and scaling follow the type of reference 2 selected by parameter 60.61 DDCS controller ref2 type . See the individual settings below for the sources and scalings.	0
	Transparent	Reserved.	1
	General	Reserved.	2
	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
60.64	Mailbox dataset selection	Selects the pair of data sets used by the mailbox service in the drive/controller communication. Refer section External ABB controller interface (page 149) .	0 NoUnit / uint16
	0...1	Data sets 32 and 33.	- / -

No.	Name / Range / Selection	Description	Def / Type FbEq 16b / 32b
60.65	DDCS controller comm supervision force	Activates DDCS controller communication monitoring separately for each control location (refer section Local control vs. external control (page 132)). The parameter is primarily intended for monitoring the communication with the controller 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
60.200	Winch drive type	Selects the crane drive type for M/F communication in the D2D-link. All drives in the D2D-link should have individual values of this parameter. After setting this parameter, the application automatically sets the D2D-link communication parameters. For example, parameters 60.01 M/F communication port...60.03 . These parameters are not allowed to change manually.	Not selected / uint16
	Not selected	Winch drive type is not selected/ not used in D2D communication.	0
	Main master winch	Winch master drive.	1
	Winch follower 1 / sub master winch	Drive can be used as a follower or as a sub-system master. Drive definition depends on settings in Main master (D2D master) drive parameter 60.201 Winch drive structure 1 .	2
	Winch follower 2	Drive defined as winch follower 2.	3
	Winch follower 3	Drive defined as winch follower 3.	4
	Winch follower 4	Drive defined as winch follower 4.	5
	Winch follower 5	Drive defined as winch follower 5.	6
	Winch follower 6	Drive defined as winch follower 6.	7
	Winch follower 7	Drive defined as winch follower 7.	8
	Winch follower 8	Drive defined as winch follower 8.	9
	Winch follower 9	Drive defined as winch follower 9.	10
	Winch follower 10	Drive defined as winch follower 10.	11
	Winch follower 11	Drive defined as winch follower 11.	12
	Free follower for main master winch	Drive defined as free follower for main master winch. The free follower drive only follows the master commands, however the master drive ignores the status of the free follower drive (no winch interlocks in use).	17

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No.	Name / Range / Selection	Description	Def / Type FbEq 16b / 32b															
	Free follower for sub master winch	Drive defined as free follower for sub-master winch. The free follower drive only follows the sub-master commands, however the sub-master drive ignores the status of free follower drive (no winch interlocks in use).	18															
	Spare drive	Drive defined as spare drive. Activates the drive logic that allows automatic replacement of the faulted or malfunctioned drive. (not available)	63															
60.201	Winch drive structure 1	Defines the dependency of drives in the M/F link. Activates communication supervision. Setting the bit from 0 to 1 activates the dedicated drive as a follower. Bit 14 and 15 automatically sets the following control modes in follower drives.: <table><tr><th>Bit 14</th><th>Bit 15</th><th>Description</th></tr><tr><td>0</td><td>0</td><td>Manual setup</td></tr><tr><td>1</td><td>0</td><td>All speed control mode</td></tr><tr><td>0</td><td>1</td><td>All torque control mode</td></tr><tr><td>1</td><td>1</td><td>Manual setup</td></tr></table> Note: - This parameter is effective only in the Main master or sub-master drives, based on the selection in parameter 60.200 Winch drive type. - In the Main master drive, if bit 1 Winch follower 1/Sub master = 1, then Winch follower 1/Sub-master acts as a Winch follower 1.	Bit 14	Bit 15	Description	0	0	Manual setup	1	0	All speed control mode	0	1	All torque control mode	1	1	Manual setup	0000 0000 0000 0000 / uint16
Bit 14	Bit 15	Description																
0	0	Manual setup																
1	0	All speed control mode																
0	1	All torque control mode																
1	1	Manual setup																
b0	Reserved																	
b1	Winch follower 1	0 = Used as Sub master drive, if available. 1 = Used as Follower of Main master drive.																
b2	Winch follower 2	0 = Drive is not defined in the D2D network. 1 = User as Follower of Main master or Sub master drive based on the selection in parameter 60.200 Winch drive type .																
b3...10	...	...																
b11	Winch follower 11	0 = Drive is not defined in the D2D network. 1 = User as Follower of Main master or Sub master drive based on the selection in parameter 60.200 Winch drive type .																
b12...13	Reserved																	
b14	All speed control mode	1 = Automatically sets the control mode to Speed in the selected follower drives, if bit 15 = 0. 0 = Control mode can be set manually, if bit 15 = 0.																

No.	Name / Range / Selection	Description	Def / Type FbEq 16b / 32b
b15	All torque control mode	1 = Automatically sets the control mode to Torque in the selected follower drives, if bit 14 = 0. 0 = Control mode can be set manually, if bit 14 = 0.	
	0000h...FFFFh		1 / 1
60.202	Winch drive structure 2	Define the alternative dependency of drives in the M/F D2D-link. Activates communication supervision. Setting the bit from 0 to 1 activates the dedicated drive as a follower. This method activates a number of followers at a time. See bit description in parameter of 60.201 Winch drive structure 1 .	0000 0000 0000 0000 / uint16
b0	Reserved		
b1	Winch follower 1	0 = Used as Sub master drive, if available. 1 = Used as Follower of Main master drive.	
b2	Winch follower 2	0 = Drive is not defined in the D2D network. 1 = User as Follower of Main master or Sub master drive based on the selection in parameter 60.200 Winch drive type .	
b...	...	...	
b11	Winch follower 11	0 = Drive is not defined in the D2D network. 1 = User as Follower of Main master or Sub master drive based on the selection in parameter 60.200 Winch drive type .	
b12...13	Reserved		
b14	All speed control mode	1 = Automatically sets the control mode to Speed in the selected follower drives, if bit 15 = 0. 0 = Control mode can be set manually, if bit 15 = 0.	
b15	All torque control mode	1 = Automatically sets the control mode to Torque in the selected follower drives, if bit 14 = 0. 0 = Control mode can be set manually, if bit 14 = 0.	
	0000h...FFFFh		1 / 1
60.205	Winch drive structure sel	Selects the Winch drive structure. Note: The selection is effective only when drive is not modulating (stopped).	Structure 1 / int32
	Structure 1	Drive can be used as a follower or as a sub system master. Drive definition depends on the settings in Main master (D2D master) drive selected with parameter 60.201 Winch drive structure 1 .	0
	Structure 2	Drive can be used as a follower or as a sub system master. Drive definition depends on settings in Main master (D2D master) drive parameter 60.202 Winch drive structure 2 .	1

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No.	Name / Range / Selection	Description	Def / Type FbEq 16b / 32b
60.208	Winch M/F enable	Enable master follower communication and configuration.	Disabled / int32
	Disabled	Winch master follower communication disabled.	0
	Enabled	Winch master follower communication disabled.	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
	DI1 inverted	Digital input DI1 inverted	10
	DI2 inverted	Digital input DI2 inverted	11
	DI3 inverted	Digital input DI3 inverted	12
	DI4 inverted	Digital input DI4 inverted	13
	DI5 inverted	Digital input DI5 inverted	14
	DI6 inverted	Digital input DI6 inverted	15
	DIO1 inverted	Digital input/output DIO1 inverted	16
	DIO2 inverted	Digital input/output DIO2 inverted	17
	Other [bit]	See Terms and abbreviations (page 207) .	-
60.210	Winch drive type actual	Displays the actual role of the drive defined in the D2Dlink. This parameter is read-only.	None / int16
	None	Drive not defined in D2D-link.	0
	Master	Drive acts as Master in D2D-link.	1
	Follower	Drive acts as Follower in D2D-link.	2
	Free follower	Drive acts as Free follower in D2D-link.	3
60.211	Master reference 1	Displays the speed reference from master drive. This parameter is read-only.	0 NoUnit / real32
	-15000...15000	Master drive speed reference.	1 = 1 / 1 = 1
60.212	Master reference 2	Displays the torque reference from master drive. This parameter is read-only.	0 NoUnit / real32
	-1600...1600	Master drive torque reference.	1 = 1 / 1 = 1
60.213	Master control word	Displays the control word data from master drive. This parameter is read-only.	0000 0000 0000 0000 / uint16

No.	Name / Range / Selection	Description	Def / Type FbEq 16b / 32b
b0	Start	1 = Start command from master to follower	
b1	Modulating	1 = Master drive is modulating	
b2	Brake closed	1 = Master drive brake is closed	
b3	Start cmd	1 = Master drive start command status	
b4...6	Reserved		
b7	Reset	1 = Master drive reset command (to do:new)	
b8...11	Reserved		
b12	Anchor invert direction	1 = Anchor invert direction	
b13	Fault reset	1 = Fault reset command	
b14	Brake closed this drive	1 = Brake closed in this drive	
b15	Reserved		
	0000h...FFFFh		1 / 1
60.214	Master status word	This status word is updated only in the master drive. This parameter is read-only.	0000 0000 0000 0000 / uint16
b0	Drive ready	1 = All drives in the M/F D2D-link are ready.	
b1	Drive fault	1 = At least one drive in the M/F D2D-link is faulty.	
b2	Torque prove ok	1 = Torque proving is ok for all drives in the M/F D2D-link.	
b3	Drive running	1 = All drives in the M/F D2D-link are in running state.	
b4	Emergency off1 inactive	1 = Emergency stop signal is not active (mode off1) for at least one drive in the M/F D2D-link.	
b5	Emergency off2 inactive	1 = Emergency stop signal is not active (mode off2) for at least one drive in the M/F D2D-link.	
b6	Emergency off3 inactive	1 = Emergency stop signal is not active (mode off3) for at least one drive in the M/F D2D-link.	
b7...9	Reserved		
b10	Run enable Lost	1 = Run enable missing for at least one drive in the M/F D2D-link.	
b11	Start inhibit	1 = Start inhibit active in at least one drive in the M/F D2D-link.	
b12	Control location changed	1 = Control location changed in at least one drive in the M/F D2D link.	
b13	Master faulted	1 = Master drive in the M/F D2D-link is faulty.	
b14	Ext2 active	1 = Control location EXT2 active for all drives in the M/f D2D-link.	
b15	Toggle bit	1 = Master communication toggle bit status.	
	0000h...FFFFh		1 / 1

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No.	Name / Range / Selection	Description	Def / Type FbEq 16b / 32b
60.215	Reference from master 1	Shows the speed reference from the master drive with a fast update rate. This parameter is read-only.	0.00 NoUnit / real32
	-15000.00 ... 15000.00	Speed reference from master 1.	100 = 1 / 1 = 1
60.216	Reference from master 2	Shows the torque reference from the master drive with a fast update rate. This parameter is read-only.	0.0 NoUnit / real32
	-1600.0 ... 1600.0	Speed reference from master 2.	10 = 1 / 1 = 1
60.221	Follower 1 status word	Status data transferred from winch follower 1 drive. This parameter is read-only.	0000 0000 0000 0000 / uint16
b0	Drive ready	1 = Follower 1 drive ready status.	
b1	Drive fault	1 = Follower 1 drive is faulty.	
b2	Torque prove ok	1 = Torque proving is ok in Follower 1 drive.	
b3	Drive running	1 = Follower 1 drive in running state.	
b4	Emergency off1 inactive	1 = Emergency stop signal is not active (mode off1) in Follower 1.	
b5	Emergency off2 inactive	1 = Emergency stop signal is not active (mode off2) in Follower 1.	
b6	Emergency off3 inactive	1 = Emergency stop signal is not active (mode off3) in Follower 1.	
b7...9	Reserved		
b10	Run enable lost	1 = Run enable missing in Follower 1.	
b11	Start inhibit	1 = Start inhibit active in Follower 1.	
b12	Control location changed	1 = Control location changed in Follower 1.	
b13	Master faulted	1 = Follower 1 detection that Master is faulty.	
b14	Ext2 Active	1 = Control location EXT2 active in Follower 1.	
b15	Toggle bit	1 = Follower 1 communication toggle bit status.	
	0000h...FFFFh		1 / 1
60.222	Follower 2 status word	Status data transferred from winch follower 2 drive. See parameter 60.221 Follower 1 status word (page 554) . This parameter is read-only.	0000 0000 0000 0000 / uint16
	0000h...FFFFh		1 / 1
60.223	Follower 3 status word	Status data transferred from winch follower 3 drive. See parameter 60.221 Follower 1 status word (page 554) . This parameter is read-only.	0000 0000 0000 0000 / uint16
	0000h...FFFFh		1 / 1
60.224	Follower 4 status word	Status data transferred from winch follower 4 drive. See parameter 60.221 Follower 1 status word (page 554) . This parameter is read-only.	0000 0000 0000 0000 / uint16

No.	Name / Range / Selection	Description	Def / Type FbEq 16b / 32b
	0000h...FFFFh		1 / 1
60.225	Follower 5 status word	Status data transferred from winch follower 5 drive. See parameter 60.221 Follower 1 status word (page 554) . This parameter is read-only.	0000 0000 0000 0000 / uint16
	0000h...FFFFh		1 / 1
60.226	Follower 6 status word	Status data transferred from winch follower 6 drive. See parameter 60.221 Follower 1 status word (page 554) . This parameter is read-only.	0000 0000 0000 0000 / uint16
	0000h...FFFFh		1 / 1
60.227	Follower 7 status word	Status data transferred from winch follower 7 drive. See parameter 60.221 Follower 1 status word (page 554) . This parameter is read-only.	0000 0000 0000 0000 / uint16
	0000h...FFFFh		1 / 1
60.228	Follower 8 status word	Status data transferred from winch follower 8 drive. See parameter 60.221 Follower 1 status word (page 554) . This parameter is read-only.	0000 0000 0000 0000 / uint16
	0000h...FFFFh		1 / 1
60.229	Follower 9 status word	Status data transferred from winch follower 9 drive. See parameter 60.221 Follower 1 status word (page 554) . This parameter is read-only.	0000 0000 0000 0000 / uint16
	0000h...FFFFh		1 / 1
60.230	Follower 10 status word	Status data transferred from winch follower 10 drive. See parameter 60.221 Follower 1 status word (page 554) . This parameter is read-only.	0000 0000 0000 0000 / uint16
	0000h...FFFFh		1 / 1
60.231	Follower 11 status word	Status data transferred from winch follower 11 drive. See parameter 60.221 Follower 1 status word (page 554) . This parameter is read-only.	0000 0000 0000 0000 / uint16
	0000h...FFFFh		1 / 1
60.237	Comm loss delay	Defines the D2D-link communication supervision delay. - D2D-link Master drive: When toggle bit from defined followers is not changing status during the time defined in this parameter, then M/F communication loss condition appears and notifies warning/fault, based on the selection in parameter 60.09 M/F comm loss function. - D2D-link Follower drive: When toggle bit from defined master drive is not changing status during the time defined in this parameter, then M/F comm loss condition appears and notifies warning/fault, based on the selection in parameter 60.09 M/F comm loss function.	120 ms / int16
	0...32000 ms	D2D-link communication delay.	1 = 1 ms / 1 = 1 ms

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No.	Name / Range / Selection	Description	Def / Type FbEq 16b / 32b
60.238	Communication lost status	Displays the drive status for which toggle bit was not updated at the time defined in parameter 60.237 Comm loss delay . This parameter is read-only.	0000 0000 0000 0000 / uint16
b0	Master com lost	1 = Communication with Master lost.	
b1...11	Follower 1...11 com lost	1 = Communication with Follower 1...11 lost.	
b12...15	Reserved		
	0000h...FFFFh		1 / 1

No.	Name / Range / Selection	Description	Def / Type FbEq 16b / 32b
61	D2D and DDCS transmit data	Defines the data sent to the DDCS link. See also parameter group 60 DDCS communication .	
61.01	M/F data 1 selection	Preselects the data to be sent as word 1 onto the master/follower link. See also parameter 61.25 M/F data 1 value , and section Master/follower functionality (page 141) .	Follower CW / uint32
	None	None.	0
	CW 16bit	Control Word (16 bits)	1
	SW 16bit	Status Word (16 bits)	4
	Act1 16bit	Actual value ACT1 (16 bits) Note: Using this setting to send a reference to the follower is not recommended as the source signal is filtered. Use the “reference” selections instead.	5
	Act2 16bit	Actual value ACT2 (16 bits) Note: Using this setting to send a reference to the follower is not recommended as the source signal is filtered. Use the “reference” selections instead.	6
	Follower CW	A word consisting of bits 0...11 of 06.01 Main control word and the bits selected by parameters 06.45...06.48 . Note: Bit 3 of the follower control word is kept on as long as the master is modulating, and when it switches to 0, the follower coasts to a stop.	27
	Used speed reference	24.01 Used speed reference (page 378) .	6145
	Torque reference act 5	26.75 Torque reference act 5 (page 404) .	6731
	Torque reference used	26.02 Torque reference used (page 396) .	6658
	ACS800 System ctrl SW	A follower status word compatible with an ACS800 (System Control Program) master. With this setting, status word bit 0 is cleared whenever the run enable signal is missing.	28
	Follower CW B6 high	Otherwise identical to selection Follower CW , but bit 6 of the follower control word is also kept on as long as the master is modulating. This will allow the follower to stop along the stop ramp of the master.	29
	D2D position	Virtual address for Control word for the follower units, bit 6 high as long as the drive modulates Note: This setting cannot be used in 61.03 M/F data 3 selection because the 32-bit value requires two consecutive words.	809013

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No.	Name / Range / Selection	Description	Def / Type FbEq 16b / 32b
	D2D velocity	Scaled velocity value as displayed by 88.54 D2D velocity send. Note: Occasionally, below data are also sent to the follower: 32768-Position initialization or position send type changed. 32767-Latch 1 triggered in master.	22582
	Other [bit]	Source selection. See Terms and abbreviations (page 207) .	-
61.02	M/F data 2 selection	Preselects the data to be sent as word 2 onto the master/follower link. See also parameter 61.26 M/F data 2 value. For the selections, see parameter 61.01 M/F data 1 selection. Note: If the parameters 61.02 is set to the value other than <i>Used speed reference</i> and 60.10 to <i>Auto</i>, the follower drive do not follow master drive.	Used speed reference / uint32
61.03	M/F data 3 selection	Preselects the data to be sent as word 3 onto the master/follower link. See also parameter 61.27 M/F data 3 value. For the selections, see parameter 61.01 M/F data 1 selection.	Torque reference act 5 / uint32
61.25	M/F data 1 value	Displays the data to be sent onto the master/follower link as word 1 as an integer. If no data has been preselected by 61.01 M/F data 1 selection, the value to be sent can be written directly into this parameter.	- / uint16
	0...65535	Data to be sent as word 1 in master/follower communication.	- / -
61.26	M/F data 2 value	Displays the data to be sent onto the master/follower link as word 2 as an integer. If no data has been preselected by 61.02 M/F data 2 selection, the value to be sent can be written directly into this parameter.	- / uint16
	0...65535	Data to be sent as word 2 in master/follower communication.	- / -
61.27	M/F data 3 value	Displays the data to be sent onto the master/follower link as word 3 as an integer. If no data has been preselected by 61.03 M/F data 3 selection, the value to be sent can be written directly into this parameter.	- / uint16
	0...65535	Data to be sent as word 3 in master/follower communication.	- / -

No.	Name / Range / Selection	Description	Def / Type FbEq 16b / 32b
61.45	Data set 2 data 1 selection	Parameters 61.45...61.50 preselect data to be sent in data sets 2 and 4 to the external controller. These data sets are used in ModuleBus communication with a "standard drive" (60.50 DDCS controller drive type = ABB standard drive). Parameters 61.95...61.100 display the data to be sent to the external controller. If no data has been preselected, the value to be sent can be written directly into these parameters. For example, this parameter preselects the data for word 1 of data set 2. Parameter 61.95 Data set 2 data 1 value displays the selected data in integer format. If no data is preselected, the value to be sent can be written directly into parameter 61.95 .	None / uint32
	None	None.	0
	CW 16bit	Control Word (16 bits)	1
	SW 16bit	Status Word (16 bits)	4
	Act1 16bit	Actual value ACT1 (16 bits)	5
	Act2 16bit	Actual value ACT2 (16 bits)	6
	Other [bit]	Source selection. See Terms and abbreviations (page 207) .	-
61.46	Data set 2 data 2 selection	Preselects the data to be sent as word 2 of data set 2 to the external controller. See also parameter 61.96 Data set 2 data 2 value . For the selections, see parameter 61.45 Data set 2 data 1 selection .	None / uint32
61.47	Data set 2 data 3 selection	See parameter 61.45 Data set 2 data 1 selection .	None / uint32
...	...	...	...
61.50	Data set 4 data 3 selection	See parameter 61.45 Data set 2 data 1 selection .	None / uint32
61.51	Data set 11 data 1 selection	Parameters 61.51...61.74 preselect data to be sent in data sets 11, 13, 15, 17, 19, 21, 23 and 25 to the external controller. Parameters 61.101...61.124 display the data to be sent to the external controller. If no data has been preselected, the value to be sent can be written directly into these parameters. For example, this parameter preselects the data for word 1 of data set 11. Parameter 61.101 Data set 11 data 1 value displays the selected data in integer format. If no data is preselected, the value to be sent can be written directly into parameter 61.101 .	None / uint32
	None	None.	0
	CW 16bit	Control Word (16 bits)	1
	SW 16bit	Status Word (16 bits)	4
	Act1 16bit	Actual value ACT1 (16 bits)	5

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No.	Name / Range / Selection	Description	Def / Type FbEq 16b / 32b
	Act2 16bit	Actual value ACT2 (16 bits)	6
	Other [bit]	Source selection. See Terms and abbreviations (page 207) .	-
61.52	Data set 11 data 2 selection	Preselects the data to be sent as word 2 of data set 11 to the external controller. See also parameter 61.102 Data set 11 data 2 value . For the selections, see parameter 61.51 Data set 11 data 1 selection .	None / uint32
61.53	Data set 11 data 3 selection	Preselects the data to be sent as word 3 of data set 11 to the external controller. See also parameter 61.103 Data set 11 data 3 value . For the selections, see parameter 61.51 Data set 11 data 1 selection .	None / uint32
61.54	Data set 13 data 1 selection	See parameter 61.51 Data set 11 data 1 selection .	None / uint32
...	...	...	...
61.74	Data set 25 data 3 selection	See parameter 61.51 Data set 11 data 1 selection .	None / uint32
61.95	Data set 2 data 1 value	Displays (in integer format) the data to be sent to the external controller as word 1 of data set 2. If no data has been preselected by 61.45 Data set 2 data 1 selection , the value to be sent can be written directly into this parameter.	0 null / uint16
	0...65535	Data to be sent as word 1 of data set 2.	- / -
61.96	Data set 2 data 2 value	Displays (in integer format) the data to be sent to the external controller as word 2 of data set 2. If no data has been preselected by 61.46 Data set 2 data 2 selection , the value to be sent can be written directly into this parameter.	0 null / uint16
	0...65535	Data to be sent as word 2 of data set 2.	- / -
61.97	Data set 2 data 3 value	Displays (in integer format) the data to be sent to the external controller as word 3 of data set 2. If no data has been preselected by 61.47 Data set 2 data 3 selection , the value to be sent can be written directly into this parameter.	0 null / uint16
	0...65535	Data to be sent as word 3 of data set 2.	- / -
...	...	...	...
61.100	Data set 4 data 3 value	Displays (in integer format) the data to be sent to the external controller as word 3 of data set 4. If no data has been selected by 61.50 Data set 4 data 3 selection , the value to be sent can be written directly into this parameter.	0 null / uint16
	0...65535	Data to be sent as word 3 of data set 4.	- / -

No.	Name / Range / Selection	Description	Def / Type FbEq 16b / 32b
61.101	Data set 11 data 1 value	Displays (in integer format) the data to be sent to the external controller as word 1 of data set 11. If no data has been preselected by 61.51 Data set 11 data 1 selection , the value to be sent can be written directly into this parameter.	- / uint16
	0...65535	Data to be sent as word 1 of data set 11.	- / -
61.102	Data set 11 data 2 value	Displays (in integer format) the data to be sent to the external controller as word 2 of data set 11. If no data has been preselected by 61.52 Data set 11 data 2 selection , the value to be sent can be written directly into this parameter.	- / uint16
	0...65535	Data to be sent as word 2 of data set 11.	- / -
61.103	Data set 11 data 3 value	Displays (in integer format) the data to be sent to the external controller as word 3 of data set 11. If no data has been selected by 61.53 Data set 11 data 3 selection , the value to be sent can be written directly into this parameter.	- / uint16
	0...65535	Data to be sent as word 3 of data set 11.	- / -
61.104	Data set 13 data 1 value	Displays (in integer format) the data to be sent to the external controller as word 1 of data set 13. If no data has been selected by 61.54 Data set 13 data 1 selection , the value to be sent can be written directly into this parameter.	- / uint16
	0...65535	Data to be sent as word 1 of data set 13.	- / -
...	...	...	...
61.124	Data set 25 data 3 value	Displays (in integer format) the data to be sent to the external controller as word 3 of data set 25. If no data has been selected by 61.74 Data set 25 data 3 selection , the value to be sent can be written directly into this parameter.	- / uint16
	0...65535	Data to be sent as word 3 of data set 25.	- / -

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No.	Name / Range / Selection	Description	Def / Type FbEq 16b / 32b
62	D2D and DDCS receive data	Mapping of data received through the DDCS link. See also parameter group 60 DDCS communication .	
62.01	M/F data 1 selection	(Follower only) Defines a target for the data received as word 1 from the master through the master/follower link. See also parameter 62.25 M/F data 1 value .	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
	M/F velocity	Scaled velocity value. Note: This selection should be chosen for the same data word as was set to D2D velocity in the master.	4
	M/F position	32-bit position value. Note: This selection should be chosen for the same data word as was set to D2D position in the master. (The setting will automatically reserve two consecutive data words.)	30
	Other [bit]	Source selection. See Terms and abbreviations (page 207) .	-
62.02	M/F data 2 selection	(Follower only) Defines a target for the data received as word 2 from the master through the master/follower link. See also parameter 62.26 M/F data 2 value . For the selections, see parameter 62.01 M/F data 1 selection .	None / uint32
62.03	M/F data 3 selection	(Follower only) Defines a target for the data received as word 3 from the master through the master/follower link. See also parameter 62.27 M/F data 3 value . For the selections, see parameter 62.01 M/F data 1 selection .	None / uint32
62.04	Follower node 2 data 1 sel	Defines a target for the data received as word 1 from the first follower (ie. the follower with node address 2) through the master/follower link. See also parameter 62.28 Follower node 2 data 1 value .	Follower SW / uint32
	None	None.	0
	Follower SW	Status word of the follower. See also parameter 60.18 Follower enable .	26
	Other [bit]	Source selection. See Terms and abbreviations (page 207) .	-

No.	Name / Range / Selection	Description	Def / Type FbEq 16b / 32b
62.05	Follower node 2 data 2 sel	Defines a target for the data received as word 2 from the first follower (ie. the follower with node address 2) through the master/follower link. See also parameter 62.29 Follower node 2 data 2 value . For the selections, see parameter 62.04 Follower node 2 data 1 sel .	None / uint32
62.06	Follower node 2 data 3 sel	Defines a target for the data received as word 3 from the first follower (ie. the follower with node address 2) through the master/follower link. See also parameter 62.30 Follower node 2 data 3 value . For the selections, see parameter 62.04 Follower node 2 data 1 sel .	None / uint32
62.07	Follower node 3 data 1 sel	Defines a target for the data received as word 1 from the second follower (ie. the follower with node address 3) through the master/follower link. See also parameter 62.31 Follower node 3 data 1 value . For the selections, see parameter 62.04 Follower node 2 data 1 sel .	Follower SW / uint32
62.08	Follower node 3 data 2 sel	Defines a target for the data received as word 2 from the second follower (ie. the follower with node address 3) through the master/follower link. See also parameter 62.32 Follower node 3 data 2 value . For the selections, see parameter 62.04 Follower node 2 data 1 sel .	None / uint32
62.09	Follower node 3 data 3 sel	Defines a target for the data received as word 3 from the second follower (ie. the follower with node address 3) through the master/follower link. See also parameter 62.33 Follower node 3 data 3 value . For the selections, see parameter 62.04 Follower node 2 data 1 sel .	None / uint32
62.10	Follower node 4 data 1 sel	Defines a target for the data received as word 1 from the third follower (ie. the follower with node address 4) through the master/follower link. See also parameter 62.34 Follower node 4 data 1 value . For the selections, see parameter 62.04 Follower node 2 data 1 sel .	Follower SW / uint32
62.11	Follower node 4 data 2 sel	Defines a target for the data received as word 2 from the third follower (ie. the follower with node address 4) through the master/follower link. See also parameter 62.35 Follower node 4 data 2 value . For the selections, see parameter 62.04 Follower node 2 data 1 sel .	None / uint32

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No.	Name / Range / Selection	Description	Def / Type FbEq 16b / 32b
62.12	Follower node 4 data 3 sel	Defines a target for the data received as word 3 from the third follower (ie. the follower with node address 4) through the master/follower link. See also parameter 62.36 Follower node 4 data 3 value . For the selections, see parameter 62.04 Follower node 2 data 1 sel .	None / uint32
62.25	M/F data 1 value	(Follower only) Displays, in integer format, the data received from the master as word 1. Parameter 62.01 M/F data 1 selection can be used to select a target for the received data. This parameter can also be used as a signal source by other parameters.	- / uint16
	0...65535	Data received as word 1 in master/follower communication.	- / -
62.26	M/F data 2 value	(Follower only) Displays, in integer format, the data received from the master as word 2. Parameter 62.02 M/F data 2 selection can be used to select a target for the received data. This parameter can also be used as a signal source by other parameters.	- / uint16
	0...65535	Data received as word 2 in master/follower communication.	- / -
62.27	M/F data 3 value	(Follower only) Displays, in integer format, the data received from the master as word 3. Parameter 62.03 M/F data 3 selection can be used to select a target for the received data. This parameter can also be used as a signal source by other parameters.	- / uint16
	0...65535	Data received as word 3 in master/follower communication.	- / -
62.28	Follower node 2 data 1 value	Displays, in integer format, the data received from the first follower (ie. follower with node address 2) as word 1. Parameter 62.04 Follower node 2 data 1 sel can be used to select a target for the received data. This parameter can also be used as a signal source by other parameters.	- / uint16
	0...65535	Data received as word 1 from follower with node address 2.	- / -
62.29	Follower node 2 data 2 value	Displays, in integer format, the data received from the first follower (ie. follower with node address 2) as word 2. Parameter 62.05 Follower node 2 data 2 sel can be used to select a target for the received data. This parameter can also be used as a signal source by other parameters.	- / uint16

No.	Name / Range / Selection	Description	Def / Type FbEq 16b / 32b
	0...65535	Data received as word 2 from follower with node address 2.	- / -
62.30	Follower node 2 data 3 value	Displays, in integer format, the data received from the first follower (ie. follower with node address 2) as word 3. Parameter 62.06 Follower node 2 data 3 sel can be used to select a target for the received data. This parameter can also be used as a signal source by other parameters.	- / uint16
	0...65535	Data received as word 3 from follower with node address 2.	- / -
62.31	Follower node 3 data 1 value	Displays, in integer format, the data received from the second follower (ie. follower with node address 3) as word 1. Parameter 62.07 Follower node 3 data 1 sel can be used to select a target for the received data. This parameter can also be used as a signal source by other parameters.	- / uint16
	0...65535	Data received as word 1 from follower with node address 3.	- / -
62.32	Follower node 3 data 2 value	Displays, in integer format, the data received from the second follower (ie. follower with node address 3) as word 2. Parameter 62.08 Follower node 3 data 2 sel can be used to select a target for the received data. This parameter can also be used as a signal source by other parameters.	- / uint16
	0...65535	Data received as word 2 from follower with node address 3.	- / -
62.33	Follower node 3 data 3 value	Displays, in integer format, the data received from the second follower (ie. follower with node address 3) as word 3. Parameter 62.09 Follower node 3 data 3 sel can be used to select a target for the received data. This parameter can also be used as a signal source by other parameters.	- / uint16
	0...65535	Data received as word 3 from follower with node address 3.	- / -
62.34	Follower node 4 data 1 value	Displays, in integer format, the data received from the third follower (ie. follower with node address 4) as word 1. Parameter 62.10 Follower node 4 data 1 sel can be used to select a target for the received data. This parameter can also be used as a signal source by other parameters.	- / uint16
	0...65535	Data received as word 1 from follower with node address 4.	- / -

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No.	Name / Range / Selection	Description	Def / Type FbEq 16b / 32b
62.35	Follower node 4 data 2 value	Displays, in integer format, the data received from the third follower (ie. follower with node address 4) as word 2. Parameter 62.11 Follower node 4 data 2 sel can be used to select a target for the received data. This parameter can also be used as a signal source by other parameters.	- / uint16
	0...65535	Data received as word 2 from follower with node address 4.	- / -
62.36	Follower node 4 data 3 value	Displays, in integer format, the data received from the third follower (ie. follower with node address 4) as word 3. Parameter 62.12 Follower node 4 data 3 sel can be used to select a target for the received data. This parameter can also be used as a signal source by other parameters.	- / uint16
	0...65535	Data received as word 3 from follower with node address 4.	- / -
62.37	M/F communication status 1	In the master, displays the status of the communication with followers specified by parameter 60.19 M/F comm supervision sel 1 . In a follower, bit 0 indicates the status of the communication with the master.	- / uint16
b0	Follower 1 / Foll	1 (in the master) = Communication with follower 1 OK. 1 (in a follower) = Communication with master OK.	
b1	Follower 2	1 = Communication with follower 2 OK.	
b2	Follower 3	1 = Communication with follower 3 OK.	
b3	Follower 4	1 = Communication with follower 4 OK.	
b4	Follower 5	1 = Communication with follower 5 OK.	
b5	Follower 6	1 = Communication with follower 6 OK.	
b6	Follower 7	1 = Communication with follower 7 OK.	
b7	Follower 8	1 = Communication with follower 8 OK.	
b8	Follower 9	1 = Communication with follower 9 OK.	
b9	Follower 10	1 = Communication with follower 10 OK.	
b10	Follower 11	1 = Communication with follower 11 OK.	
b11	Follower 12	1 = Communication with follower 12 OK.	
b12	Follower 13	1 = Communication with follower 13 OK.	
b13	Follower 14	1 = Communication with follower 14 OK.	
b14	Follower 15	1 = Communication with follower 15 OK.	
b15	Follower 16	1 = Communication with follower 16 OK.	
	0000h...FFFFh		1 = 1 / 1 = 1

No.	Name / Range / Selection	Description	Def / Type FbEq 16b / 32b
62.38	M/F communication status 2	In the master, displays the status of the communication with followers specified by parameter 60.20 M/F comm supervision sel 2 .	- / uint16
b0	Follower 17	1 = Communication with follower 17 OK.	
b1	Follower 18	1 = Communication with follower 18 OK.	
b2	Follower 19	1 = Communication with follower 19 OK.	
b3	Follower 20	1 = Communication with follower 20 OK.	
b4	Follower 21	1 = Communication with follower 21 OK.	
b5	Follower 22	1 = Communication with follower 22 OK.	
b6	Follower 23	1 = Communication with follower 23 OK.	
b7	Follower 24	1 = Communication with follower 24 OK.	
b8	Follower 25	1 = Communication with follower 25 OK.	
b9	Follower 26	1 = Communication with follower 26 OK.	
b10	Follower 27	1 = Communication with follower 27 OK.	
b11	Follower 28	1 = Communication with follower 28 OK.	
b12	Follower 29	1 = Communication with follower 29 OK.	
b13	Follower 30	1 = Communication with follower 30 OK.	
b14	Follower 31	1 = Communication with follower 31 OK.	
b15	Follower 32	1 = Communication with follower 32 OK.	
	0000h...FFFFh		1 = 1 / 1 = 1
62.41	M/F follower ready status 1	In the master, displays the ready status of the communication with followers specified by parameter 60.23 M/F status supervision sel 1 .	- / uint16
b0	Follower 1	1 = Follower 1 ready.	
b1	Follower 2	1 = Follower 2 ready.	
b2	Follower 3	1 = Follower 3 ready.	
b3	Follower 4	1 = Follower 4 ready.	
b4	Follower 5	1 = Follower 5 ready.	
b5	Follower 6	1 = Follower 6 ready.	
b6	Follower 7	1 = Follower 7 ready.	
b7	Follower 8	1 = Follower 8 ready.	
b8	Follower 9	1 = Follower 9 ready.	
b9	Follower 10	1 = Follower 10 ready.	
b10	Follower 11	1 = Follower 11 ready.	
b11	Follower 12	1 = Follower 12 ready.	
b12	Follower 13	1 = Follower 13 ready.	

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No.	Name / Range / Selection	Description	Def / Type FbEq 16b / 32b
b13	Follower 14	1 = Follower 14 ready.	
b14	Follower 15	1 = Follower 15 ready.	
b15	Follower 16	1 = Follower 16 ready.	
	0000h...FFFFh		1 = 1 / 1 = 1
62.42	M/F follower ready status 2	In the master, displays the ready status of the communication with followers specified by parameter 60.24 M/F status supervision sel 2 .	- / uint16
b0	Follower 17	1 = Follower 17 ready.	
b1	Follower 18	1 = Follower 18 ready.	
b2	Follower 19	1 = Follower 19 ready.	
b3	Follower 20	1 = Follower 20 ready.	
b4	Follower 21	1 = Follower 21 ready.	
b5	Follower 22	1 = Follower 22 ready.	
b6	Follower 23	1 = Follower 23 ready.	
b7	Follower 24	1 = Follower 24 ready.	
b8	Follower 25	1 = Follower 25 ready.	
b9	Follower 26	1 = Follower 26 ready.	
b10	Follower 27	1 = Follower 27 ready.	
b11	Follower 28	1 = Follower 28 ready.	
b12	Follower 29	1 = Follower 29 ready.	
b13	Follower 30	1 = Follower 30 ready.	
b14	Follower 31	1 = Follower 31 ready.	
b15	Follower 32	1 = Follower 32 ready.	
	0000h...FFFFh		1 = 1 / 1 = 1
62.45	Data set 1 data 1 selection	Parameters 62.45...62.50 define a target for the data received in data sets 1 and 3 from the external controller. These data sets are used in ModuleBus communication with a "standard drive" (60.50 DDCS controller drive type = ABB standard drive). Parameters 62.95...62.100 display the data received from the external controller in integer format, and can be used as sources by other parameters. For example, this parameter selects a target for word 1 of data set 1. Parameter 62.95 Data set 1 data 1 value displays the received data in integer format, and can also be used as a source by other parameters.	None / uint32
	None	None.	0
	CW 16bit	Control Word (16 bits)	1
	Ref1 16bit	Reference REF1 (16 bits)	2

No.	Name / Range / Selection	Description	Def / Type FbEq 16b / 32b
	Ref2 16bit	Reference REF2 (16 bits)	3
	Other [bit]	Source selection. See Terms and abbreviations (page 207) .	-
62.46	Data set 1 data 2 selection	Defines a target for the data received as word 2 of data set 1. See also parameter 62.96 Data set 1 data 2 value . For the selections, see parameter 62.45 Data set 1 data 1 selection .	None / uint32
62.47	Data set 1 data 3 selection	See parameter 62.45 Data set 1 data 1 selection .	None / uint32
...	...	...	...
62.50	Data set 3 data 3 selection	See parameter 62.45 Data set 1 data 1 selection .	None / uint32
62.51	Data set 10 data 1 selection	Parameters 62.51...62.74 define a target for the data received in data sets 10, 12, 14, 16, 18, 20, 22 and 24 from the external controller. Parameters 62.101...62.124 display the data received from the external controller in integer format, and can be used as sources by other parameters. For example, this parameter selects a target for word 1 of data set 10. Parameter 62.101 Data set 10 data 1 value displays the received data in integer format, and can also be used as a source by other parameters.	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
	Other [bit]	Source selection. See Terms and abbreviations (page 207) .	-
62.52	Data set 10 data 2 selection	Defines a target for the data received as word 2 of data set 10. See also parameter 62.102 Data set 10 data 2 value . For the selections, see parameter 62.51 Data set 10 data 1 selection .	None / uint32
62.53	Data set 10 data 3 selection	Defines a target for the data received as word 3 of data set 10. See also parameter 62.103 Data set 10 data 3 value . For the selections, see parameter 62.51 Data set 10 data 1 selection .	None / uint32
62.54	Data set 12 data 1 selection	See parameter 62.51 Data set 10 data 1 selection .	None / uint32
...	...	...	...

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No.	Name / Range / Selection	Description	Def / Type FbEq 16b / 32b
62.74	Data set 24 data 3 selection	See parameter 62.51 Data set 10 data 1 selection .	None / uint32
62.95	Data set 1 data 1 value	Displays (in integer format) the data received from the external controller as word 1 of data set 1. A target for this data can be selected by parameter 62.45 Data set 1 data 1 selection . The value can also be used as a source by another parameter.	0 null / uint16
	0...65535	Data received as word 1 of data set 1.	- / -
62.96	Data set 1 data 2 value	Displays (in integer format) the data received from the external controller as word 2 of data set 1. A target for this data can be selected by parameter 62.46 Data set 1 data 2 selection . The value can also be used as a source by another parameter.	0 null / uint16
	0...65535	Data received as word 2 of data set 1.	- / -
62.97	Data set 1 data 3 value	Displays (in integer format) the data received from the external controller as word 3 of data set 1. A target for this data can be selected by parameter 62.47 Data set 1 data 3 selection . The value can also be used as a source by another parameter.	0 null / uint16
	0...65535	Data received as word 3 of data set 1.	- / -
...	...	...	...
62.100	Data set 3 data 3 value	Displays (in integer format) the data received from the external controller as word 3 of data set 3. A target for this data can be selected by parameter 62.50 Data set 3 data 3 selection . The value can also be used as a source by another parameter.	0 null / uint16
	0...65535	Data received as word 3 of data set 3.	- / -
62.101	Data set 10 data 1 value	Displays (in integer format) the data received from the external controller as word 1 of data set 10. A target for this data can be selected by parameter 62.51 Data set 10 data 1 selection . The value can also be used as a source by another parameter.	- / uint16
	0...65535	Data received as word 1 of data set 10.	- / -
62.102	Data set 10 data 2 value	Displays (in integer format) the data received from the external controller as word 2 of data set 10. A target for this data can be selected by parameter 62.52 Data set 10 data 2 selection . The value can also be used as a source by another parameter.	- / uint16
	0...65535	Data received as word 2 of data set 10.	- / -
62.103	Data set 10 data 3 value	Displays (in integer format) the data received from the external controller as word 3 of data set 10. A target for this data can be selected by parameter 62.53 Data set 10 data 3 selection . The value can also be used as a source by another parameter.	- / uint16
	0...65535	Data received as word 3 of data set 10.	- / -

No.	Name / Range / Selection	Description	Def / Type FbEq 16b / 32b
62.104	Data set 12 data 1 value	Displays (in integer format) the data received from the external controller as word 1 of data set 12. A target for this data can be selected by parameter 62.54 Data set 12 data 1 selection . The value can also be used as a source by another parameter.	- / uint16
	0...65535	Data received as word 1 of data set 12.	- / -
...	...	...	...
62.124	Data set 24 data 3 value	Displays (in integer format) the data received from the external controller as word 3 of data set 24. A target for this data can be selected by parameter 62.74 Data set 24 data 3 selection . The value can also be used as a source by another parameter.	- / uint16
	0...65535	Data received as word 3 of data set 24.	- / -
62.151	INU-LSU data set 11 data 1 sel	(Parameters 62.151 ... 62.203 only visible when supply unit control activated by 95.20) Parameters 62.151 ... 62.153 define a target for the data received in data set 11 from another converter (typically the supply unit of the drive). Parameters 62.201 ... 62.203 display the data received from the other converter in integer format, and can be used as sources by other parameters. For example, this parameter selects a target for word 1 of data set 11. Parameter 62.201 INU-LSU data set 11 data 1 value displays the received data in integer format, and can also be used as a source by other parameters.	LSU SW / uint32
	None	None.	0
	LSU SW	Status word of the supply unit.	4
	Other [bit]	Source selection. See Terms and abbreviations (page 207) .	-
62.152	INU-LSU data set 11 data 2 sel	Defines a target for the data received as word 2 of data set 11. See also parameter 62.202 INU-LSU data set 11 data 2 value . For the selections, see parameter 62.151 INU-LSU data set 11 data 1 sel .	None / uint32
62.153	INU-LSU data set 11 data 3 sel	Defines a target for the data received as word 3 of data set 11. See also parameter 62.203 INU-LSU data set 11 data 3 value . For the selections, see parameter 62.151 INU-LSU data set 11 data 1 sel .	None / uint32

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No.	Name / Range / Selection	Description	Def / Type FbEq 16b / 32b
62.201	INU-LSU data set 11 data 1 value	Displays (in integer format) the data received from the other converter as word 1 of data set 11. A target for this data can be selected by parameter 62.151 INU-LSU data set 11 data 1 sel . The value can also be used as a source by another parameter.	- / uint16
	0...65535	Data received as word 1 of data set 11.	- / -
62.202	INU-LSU data set 11 data 2 value	Displays (in integer format) the data received from the other converter as word 2 of data set 11. A target for this data can be selected by parameter 62.152 INU-LSU data set 11 data 2 sel . The value can also be used as a source by another parameter.	- / uint16
	0...65535	Data received as word 2 of data set 11.	- / -
62.203	INU-LSU data set 11 data 3 value	Displays (in integer format) the data received from the other converter as word 3 of data set 11. A target for this data can be selected by parameter 62.153 INU-LSU data set 11 data 3 sel . The value can also be used as a source by another parameter.	- / uint16
	0...65535	Data received as word 3 of data set 11.	- / -

No.	Name / Range / Selection	Description	Def / Type FbEq 16b / 32b
74	Winch general	General settings for winch. Refer section, Anchor control (page 52) .	
74.01	Anchor mode enable	Enables/disables the Anchoring mode. Typically used for heaving or lowering an anchor. When the source selected with this parameter is ON, and EXT2 is selected as control location, the Anchoring mode is active. It is also possible to use the additional protective functions provided with parameter groups 77 Anchor stowing protection and 78 Slip detection . The current mode is displayed by winch actual signal 09.01 Winch status word 1 , bit 0. Parameter 74.01 Anchor mode enable has priority over 74.02 Handmooring mode enable and 74.03 Automoor mode enable .	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).	8
	DIO2	Digital input/output DIO2 (11.02 DIO delayed status , bit 1).	9
	DI1 inverted	Digital input DI1 inverted	10
	DI2 inverted	Digital input DI2 inverted	11
	DI3 inverted	Digital input DI3 inverted	12
	DI4 inverted	Digital input DI4 inverted	13
	DI5 inverted	Digital input DI5 inverted	14
	DI6 inverted	Digital input DI6 inverted	15
	DIO1 inverted	Digital input/output DIO1 inverted	16
	DIO2 inverted	Digital input/output DIO2 inverted	17
	Other [bit]	See Terms and abbreviations (page 207) .	-

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No.	Name / Range / Selection	Description	Def / Type FbEq 16b / 32b
74.02	Handmooring mode enable	Enables/disables the Anchoring mode. Typically used for heaving or lowering an anchor. When the source selected with this parameter is ON, and EXT2 is selected as control location, the Anchoring mode is active. It is also possible to use the additional protective functions provided with parameter groups 77 Anchor stowing protection and 78 Slip detection . The current mode is displayed by winch actual signal 09.01 Winch status word 1 , bit 0. Parameter 74.01 Anchor mode enable has priority over 74.02 Handmooring mode enable and 74.03 Automoor mode enable .	FALSE / int32
	FALSE	0	0
	TRUE	1	1
	AM setpoint switch inverted	It is the inverted value of 09.03 Winch status word 3 , bit 11. See parameter group 76 Automoor mode for configuration of setpoint selector switches.	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).	9
	DIO2	Digital input/output DIO2 (11.02 DIO delayed status , bit 1).	10
	DI1 inverted	Digital input DI1 inverted	11
	DI2 inverted	Digital input DI2 inverted	12
	DI3 inverted	Digital input DI3 inverted	13
	DI4 inverted	Digital input DI4 inverted	14
	DI5 inverted	Digital input DI5 inverted	15
	DI6 inverted	Digital input DI6 inverted	16
	DIO1 inverted	Digital input/output DIO1 inverted	17
	DIO2 inverted	Digital input/output DIO2 inverted	18
	Other [bit]	See Terms and abbreviations (page 207) .	-

No.	Name / Range / Selection	Description	Def / Type FbEq 16b / 32b
74.03	Automoor- ing mode enable	Enables/disables the Automoor- ing mode. When the source selected with this parameter is ON, and EXT2 is selected as control location, the Automoor- ing mode is active. It is also possible to use the additional protective functions provided with parameter group 79 Peak torque protection. It is possible to select enable source as AM setpoint switch. See parameter group 76 Automoor- ing for configuration of setpoint selector switches. Parameters 74.01 Anchor mode enable and 74.02 Handmooring mode enable has priority over this parameter.	FALSE / int32
	FALSE	0	0
	TRUE	1	1
	AM setpoint switch	It is the value of parameter 09.03 Winch status word 3 , bit 11. See parameter group 76 Automoor- ing for configuring setpoint selector switches.	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).	9
	DIO2	Digital input/output DIO2 (11.02 DIO delayed status , bit 1).	10
	DI1 inverted	Digital input DI1 inverted	11
	DI2 inverted	Digital input DI2 inverted	12
	DI3 inverted	Digital input DI3 inverted	13
	DI4 inverted	Digital input DI4 inverted	14
	DI5 inverted	Digital input DI5 inverted	15
	DI6 inverted	Digital input DI6 inverted	16
	DIO1 inverted	Digital input/output DIO1 inverted	17
	DIO2 inverted	Digital input/output DIO2 inverted	18
	Other [bit]	See Terms and abbreviations (page 207) .	-
74.04	Automoor- ing trig- gering type	Defines the type of signal required for enabling/dis- abling the Automoor- ing mode.	Switch / int16
	Switch	Automoor- ing is enabled when the DI is ON, and dis- abled when the input is OFF.	0
	Pulse	The enable/disable state changes every time the DI is switched ON.	1

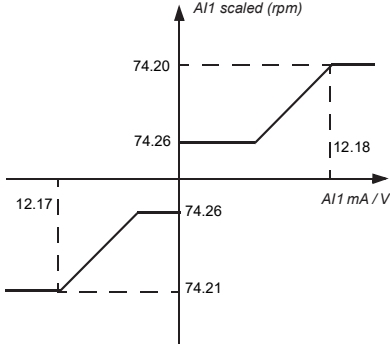
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No.	Name / Range / Selection	Description	Def / Type FbEq 16b / 32b
74.09	Winch configuration word	Specifies winch software related options for certain features that are required to operate differently from their default behavior.	0001 0011 1010 1000 / uint16
b0	Control stand disable at fault	0 = A control stand remains enabled when the drive is tripped. That is, a rising edge on control stand enable input is not required after a fault reset. 1 = A control stand gets disabled when the drive is tripped. When enable mode is set to pulse, a new rising edge is needed on the enable input after a fault reset.	
b1	Rope tens mem zero at lower	0 = The rope tension is always shown in parameter 09.24 , both on forward and reverse rotation of the motor during mooring operation. 1 = When lowering and stopping the drive, the parameter 09.24 Displays 0, as the memorized value do not represent the actual tension if the lowering action is very quick which depends on the used setup.	
b2	Disable anchor overload	0 = The anchor overload feature is enabled. See parameters 74.28 and 74.29 . 1 = The anchor overload function is disabled. See parameters 74.28 and 74.29 . The parameter 74.24 is used as the torque limit in Anchor mode.	
b3	Mooring heaving block	0 = Blocks the start command during mooring operation is disabled. 1 = Start command is blocked in heave direction during mooring operation, if the load cell tension is greater than the load cell high start limit. See parameter 76.65 .	
b4	ID run in ext blocked	0 = ID run start is disabled in EXT2 mode. 1 = ID run start is given from control stands in EXT2 mode. See parameter 99.13 ID run requested .	
b5	Rope tens mem zero HM stop	0 = Rope tension memorized (parameter 09.24), retains its value when the drive is stopped in Handmooring mode. 1 = Value of rope tension memorized becomes zero, when drive is stopped in Handmooring mode.	
b6	Rope tens mem zero AM stop	0 = Rope tension memorized retains its value when the drive is stopped in Automoorings mode. 1 = Value of rope tension memorized becomes zero, when the drive is stopped in Automoorings mode.	
b7	Stop at EXT1 EXT2 change	0 = Possible to switch from EXT1 to EXT2 mode or vice versa without stopping the drive. Note that the start trigger type (parameters 20.02 and 20.07) need to be set to Level. 1 = Drive stops when the control location (EXT1 to EXT2 or vice versa) is changed while the drive is running.	

No.	Name / Range / Selection	Description	Def / Type FbEq 16b / 32b
b8	Stop at HM AM change	0 = Possible to switch from Handmooring mode to Automoor mode or vice versa without stopping the drive. 1 = Drive stop when Mooring mode (Handmooring to Automoor or vice versa) is changed while the drive is running.	
b9	Rope tension zero in Anchor load cell	0 = Rope actual tension (parameter 09.24) shows the value from the Load cell in Anchor mode. 1 = Rope actual tension (parameter 09.24) shows zero in Anchor mode.	
b10...11	Reserved		
b12	Disable handmooring overload	0 = The handmooring overload feature is enabled. Refer parameters 74.30 and 74.31. 1 = The handmooring overload function is disabled. Refer parameters 74.30 and 74.31. The parameter 74.34 Handmooring max torque is used as the torque limit in Handmooring mode.	
b13...15	Reserved		
	0000h...FFFFh		1 / 1
74.10	Chain length calc enable	Enables/disables the chain length calculation. See parameters 74.01 Anchor mode enable and 09.01 Winch status word 1 , bit 0.	Disabled / int32
	Disabled	0	0
	Enabled	1	1
	In anchor mode	Enables the chain length when anchor mode is active. See parameters 74.01 Anchor mode enable and 09.01 Winch status word 1 , bit 0.	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).	9
	DIO2	Digital input/output DIO2 (11.02 DIO delayed status , bit 1).	10
	DI1 inverted	Digital input DI1 inverted	11
	DI2 inverted	Digital input DI2 inverted	12
	DI3 inverted	Digital input DI3 inverted	13
	DI4 inverted	Digital input DI4 inverted	14
	DI5 inverted	Digital input DI5 inverted	15

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No.	Name / Range / Selection	Description	Def / Type FbEq 16b / 32b
	DI6 inverted	Digital input DI6 inverted	16
	DIO1 inverted	Digital input/output DIO1 inverted	17
	DIO2 inverted	Digital input/output DIO2 inverted	18
	Parking mode	Reserved	19
	Other [bit]	See Terms and abbreviations (page 207) .	-
74.11	Chain length source	Selects the method of measuring the length of the chain/rope.	Not selected / uint32
	Not selected	No source is selected.	0
	Load position scaled	The chain/rope length and speed are measured by a pulse or absolute encoder. See parameter 90.51 Load feedback selection .	1
	AI1 scaled	The chain/rope length and speed are measured by a 0(4)...20mA transducer connected to AI1.	2
	AI2 scaled	The chain/rope length and speed are measured by a 0(4)...20mA transducer connected to AI2.	3
	Proximity switch position scaled	Chain/rope length and speed are measured with the proximity switches mounted close to the load drum. See parameters 90.205 Proximity switch mode to 90.208 Pulses per drum revolution .	4
	Other [bit]	See Terms and abbreviations (page 207) .	-
74.12	Chain absolute length	Absolute total (maximum) length of chain in use. See parameters 09.13 Chain length OUT and 09.14 Chain length IN .	0.000 m / real32
	-2000.000 ... 2000.000 m	Chain absolute length.	100 = 1 m / 1 = 1 m
74.20	Anchor max speed heave	Provides positive speed reference scaling for the anchoring mode. The speed defined with this parameter corresponds to an EXT2 reference of 100% when the anchoring mode is active and heave or forward start command is given. See parameters 74.01 Anchor mode enable and 09.01 Winch status word 1 , bit 0. This parameter also defines the speed limit in anchor heave mode. Speed limits set in parameter group 30 Limits has priority over this parameter.	1500 rpm / real32
	0...18000 rpm	Anchor maximum speed heave.	1 = 1 rpm / 1 = 1 rpm
74.21	Anchor max speed lower	Provides negative speed reference scaling for the anchoring mode. The speed defined with this parameter corresponds to an EXT2 reference of 100% when the anchoring mode is active and lower or reverse start command is given. See parameters 74.01 Anchor mode enable and 09.01 Winch status word 1 , bit 0.	1500 rpm / real32
	0...18000 rpm	Anchor max speed lower.	1 = 1 rpm / 1 = 1 rpm

No.	Name / Range / Selection	Description	Def / Type FbEq 16b / 32b
74.22	Anchor acc time	Acceleration time from zero speed to maximum speed defined with parameters 74.20 Anchor max speed heave or 74.21 Anchor max speed lower . Used when the Anchoring mode is active. See parameters 74.01 Anchor mode enable and 09.01 Winch status word 1 , bit 0.	3.00 s / real32
	0.00 ... 1800.00 s	Anchor acceleration time.	10 = 1 s / 1 = 1 s
74.23	Anchor dec time	Deceleration time from maximum speed defined with parameter 74.20 Anchor max speed heave or 74.21 Anchor max speed lower to zero speed. Used when Anchoring mode is active. See parameters 74.01 Anchor mode enable and 09.01 Winch status word 1 , bit 0.	3.00 s / real32
	0.00 ... 1800.00 s	Anchor deceleration time.	10 = 1 s / 1 = 1 s
74.24	Anchor max torque	Maximum torque used in Anchoring mode. In practice, this torque should be sufficient to heave the anchor to its stowing position. Note: Torque limits set in group 30 Limits has priority over this parameter.	100.0 % / real32
	0.0 ... 600.0%	Anchor maximum torque.	10 = 1% / 1 = 1%
74.25	Anchor motoring power limit	Defines maximum power limit in anchoring mode.	300.0 % / real32
	0.0 ... 600.0%	Anchor motoring power limit.	10 = 1% / 1 = 1%
74.26	Anchor min speed	Defines the minimum speed reference at which the drive starts running when start command is given in Anchor mode and the input speed reference is below anchor minimum speed. When the input speed reference exceeds the value set in this parameter, the output speed reference follows the input speed reference. When this parameter is set to zero, there is no minimum speed limitation. 	0 rpm / real32
	0...18000 rpm	Anchor minimum speed in rpm.	1 = 1 rpm / 1 = 1 rpm

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No.	Name / Range / Selection	Description	Def / Type FbEq 16b / 32b
74.27	Anchor invert direction	Inverts the anchor mode speed reference. That is, when heaving motor speed reference is negative and when lowering motor speed reference is positive.	Disabled / int32
	Disabled	0	0
	Enabled	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).	8
	DIO2	Digital input/output DIO2 (11.02 DIO delayed status, bit 1).	9
	DI1 inverted	Digital input DI1 inverted	10
	DI2 inverted	Digital input DI2 inverted	11
	DI3 inverted	Digital input DI3 inverted	12
	DI4 inverted	Digital input DI4 inverted	13
	DI5 inverted	Digital input DI5 inverted	14
	DI6 inverted	Digital input DI6 inverted	15
	DIO1 inverted	Digital input/output DIO1 inverted	16
	DIO2 inverted	Digital input/output DIO2 inverted	17
	Other [bit]	See Terms and abbreviations (page 207) .	-
74.28	Anchor overload torque limit	Maximum torque limit in anchor mode after start command during 2 min, if speed is below 74.29 Anchor overload speed limit .	150.0 % / real32
	0.0 ... 1600.0%	Anchor overload 2 min.	10 = 1% / 1 = 1%
74.29	Anchor overload speed limit	Speed limit when anchor overload function gets disabled.	150 rpm / real32
	0...30000 rpm	Anchor overload speed limit.	1 = 1 rpm / 1 = 1 rpm
74.30	Handmooring max speed heave	Defines speed reference scaling in Handmooring mode (heave direction). It also defines the speed limit in Handmooring mode. The speed defined with this parameter corresponds to an EXT2 reference of 100% when the Handmooring mode is active. See parameters 74.02 Handmooring mode enable and 09.01 Winch status word 1, bit 1. Note: The speed limits set in parameter group 30 Limits has priority over this parameter.	1500 rpm / real32

No.	Name / Range / Selection	Description	Def / Type FbEq 16b / 32b
	0...18000 rpm	Speed reference in Handmooring mode (heave direction).	1 = 1 rpm / 1 = 1 rpm
74.31	Handmooring max speed lower	Defines speed reference scaling in Handmooring mode (lower direction). It also defines the speed limit in Handmooring mode. The speed defined with this parameter corresponds to an EXT2 reference of 100% when Handmooring mode is active. See parameters 74.02 Handmooring mode enable and 09.01 Winch status word 1 , bit 1. Note: The speed limits set in parameter group 30 Limits has priority over this parameter.	1500 rpm / real32
	0...18000 rpm	Speed reference in Handmooring mode (lower direction).	1 = 1 rpm / 1 = 1 rpm
74.32	Handmooring acc time	Defines acceleration time from zero speed to maximum speed defined with parameter 74.30 Handmooring max speed heave when Handmooring mode is active. See parameters 74.02 Handmooring mode enable and 09.01 Winch status word 1 .	3.00 s / real32
	0.00 ... 1800.00 s	Acceleration time in Handmooring mode.	10 = 1 s / 1 = 1 s
74.33	Handmooring dec time	Defines the deceleration time from maximum speed defined with parameter 74.30 Handmooring max speed heave to zero speed. Used when the Handmooring mode is active. See parameters 74.02 Handmooring mode enable and 09.01 Winch status word 1 , bit 1.	3.00 s / real32
	0.00 ... 1800.00 s	Deceleration time in Handmooring mode.	10 = 1 s / 1 = 1 s
74.34	Handmooring max torque	Defines the maximum torque used in the Handmooring mode. Note: Torque limits set in group 30 Limits has priority over this parameter.	100.0 % / real32
	0.0 ... 600.0%	Maximum mooring torque for Handmooring.	10 = 1% / 1 = 1%
74.35	Handmooring motoring power limit	Defines maximum power limit in handmooring mode.	300.0 % / real32
	0.0 ... 600.0%	Motoring power limit for handmooring.	10 = 1% / 1 = 1%
74.36	Handmooring min speed	Defines the minimum speed reference at which the drive starts running when start command is given in Handmooring mode and the input speed reference is below this minimum speed. When the input speed reference exceeds the value set in this parameter, the output speed reference follows the input speed reference. When this parameter is set to zero, there is no minimum speed limitation.	0 rpm / real32
	0...18000 rpm	Minimum speed in Handmooring mode.	1 = 1 rpm / 1 = 1 rpm
74.38	Handmooring overload torque limit	Maximum torque limit in Handmooring mode after start command during 2 min, if speed is below 74.39 Handmooring overload speed limit .	150.0 % / real32
	0.0 ... 600.0%	Anchor overload 2 min.	10 = 1% / 1 = 1%

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No.	Name / Range / Selection	Description	Def / Type FbEq 16b / 32b
74.39	Handmooring over-load speed limit	Speed limit when Handmooring overload function gets disabled.	150 rpm / real32
	0...18000 rpm	Anchor overload speed limit.	1 = 1 rpm / 1 = 1 rpm
74.40	Automooring speed ref	Defines the maximum reference speed level in Auto-mooring mode.	100 rpm / real32
	0...18000 rpm	Speed level in rpm.	1 = 1 rpm / 1 = 1 rpm
74.42	Automooring acc time	Defines acceleration time from zero speed to maximum speed defined with parameter 74.40 Auto-mooring speed ref when Auto-mooring mode is active. See parameters 74.03 Auto-mooring mode enable and 09.01 Winch status word 1 , bit 2.	3.00 s / real32
	0.00 ... 1800.00 s	Acceleration time in seconds.	10 = 1 s / 1 = 1 s
74.43	Automooring dec time	Defines deceleration time from maximum to zero speed defined with parameter 74.40 Auto-mooring speed ref when Auto-mooring mode is active. See parameters 74.03 Auto-mooring mode enable and 09.01 Winch status word 1 , bit 2.	3.00 s / real32
	0.00 ... 1800.00 s	Deceleration time in seconds.	10 = 1 s / 1 = 1 s
74.44	Automooring max torque	Defines the maximum torque to be used in Auto-mooring mode. Note: Torque limits set in group 30 Limits have priority over this parameter.	100.0 % / real32
	0.0 ... 600.0%	Maximum mooring torque for Auto-mooring.	10 = 1% / 1 = 1%
74.47	Automooring invert direction	Enables/disables the Auto-mooring invert direction. Inverts Auto-mooring mode speed reference.	Disabled / int32
	Disabled	0	0
	Enabled	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).	8
	DIO2	Digital input/output DIO2 (11.02 DIO delayed status , bit 1).	9
	DI1 inverted	Digital input DI1 inverted	10
	DI2 inverted	Digital input DI2 inverted	11
	DI3 inverted	Digital input DI3 inverted	12
	DI4 inverted	Digital input DI4 inverted	13

No.	Name / Range / Selection	Description	Def / Type FbEq 16b / 32b
	DI5 inverted	Digital input DI5 inverted	14
	DI6 inverted	Digital input DI6 inverted	15
	DIO1 inverted	Digital input/output DIO1 inverted	16
	DIO2 inverted	Digital input/output DIO2 inverted	17
	Other [bit]	See Terms and abbreviations (page 207) .	-
74.50	Speed match enable	Enables/disables the speed match protection. Selects the source for speed match protection.	Disabled / int32
	Disabled	0	0
	Enabled	1	1
	In anchor mode	Enables speed match protection when Anchor mode is active. See parameters 74.01 Anchor mode enable and 09.01 Winch status word 1 , bit 0.	2
	In handmooring mode	Enables speed match protection when Handmooring mode is active. See parameter 74.02 Handmooring mode enable and 09.01 Winch status word 1 , bit 1.	3
	In anchor and handmooring mode	Enables peak torque protection when Anchor or Handmooring mode is active.	4
	DI1	Digital input DI1 (10.02 DI delayed status , bit 0).	5
	DI2	Digital input DI2 (10.02 DI delayed status , bit 1).	6
	DI3	Digital input DI3 (10.02 DI delayed status , bit 2).	7
	DI4	Digital input DI4 (10.02 DI delayed status , bit 3).	8
	DI5	Digital input DI5 (10.02 DI delayed status , bit 4).	9
	DI6	Digital input DI6 (10.02 DI delayed status , bit 5).	10
	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
	DI1 inverted	Digital input DI1 inverted	13
	DI2 inverted	Digital input DI2 inverted	14
	DI3 inverted	Digital input DI3 inverted	15
	DI4 inverted	Digital input DI4 inverted	16
	DI5 inverted	Digital input DI5 inverted	17
	DI6 inverted	Digital input DI6 inverted	18
	DIO1 inverted	Digital input/output DIO1 inverted	19
	DIO2 inverted	Digital input/output DIO2 inverted	20
	Other [bit]	See Terms and abbreviations (page 207) .	-
74.51	Speed steady deviation level	Defines the absolute speed deviation level when the motor is running in steady state.	50.00 rpm / real32
	0.00 ... 30000.00 rpm	Speed steady deviation level.	1 = 1 rpm / 1 = 1 rpm

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No.	Name / Range / Selection	Description	Def / Type FbEq 16b / 32b
74.52	Speed ramp deviation level	Defines the absolute speed deviation level for the ramping state (acceleration/deceleration).	50.00 rpm / real32
	0.00 ... 30000.00 rpm	Speed ramp deviation level.	1 = 1 rpm / 1 = 1 rpm
74.53	Speed match action	Determines how the drive reacts upon a speed match error.	Warning / uint16
	Warning	The drive displays speed match warning D20C Speed match .	0
	Fault	The drive trips on a speed match fault D104 Speed match .	1
74.54	Speed match action delay	Defines the time delay for generating speed match fault (D104 Speed match)/warning (D20C Speed match). When the speed error is higher than the value defined in, - parameter 74.51 Speed steady deviation level in a steady state or - parameter 74.52 Speed ramp deviation level in a ramping state, for longer than this delay, the drive trips on the SPEED MATCH fault or generates a warning based on selection in parameter 74.54 Speed match action delay. For further information, refer section Speed matching (page 118) .	1000 ms / int16
	0...30000 ms	Time delay for generating Speed match fault (D104 Speed match on page 671).	1 = 1 ms / 1 = 1 ms
74.60	Winch system ID-run enable	Selects the winch system ID run to be performed at the next start of the drive. During winch ID run, the drive identifies inertia and dynamic friction torque values. After winch ID run, the drive stops and this parameter is automatically set to Done. Refer Winch control start-up .	Done / uint16
	Done	No winch system ID run is requested. The parameter automatically reverts to Done when the winch ID run is complete.	0
	At next start	The winch system ID run is performed at the next start of the drive.	1
74.61	Winch system ID-run configuration	Specifies winch system ID run related settings that can be enabled and disabled by toggling the specific bits.	0000 0000 0000 0011 / uint16
b0	Inertia identification	0 = Winch system ID run procedure does not estimate the system inertia. 1 = Winch system ID run procedure estimates the system inertia and updates the estimated value in parameter 74.65 Winch system inertia .	

No.	Name / Range / Selection	Description	Def / Type FbEq 16b / 32b
b1	Rotation friction identification	0 = Winch system ID run procedure does not estimate the dynamic friction. 1 = Winch system ID run procedure estimates the dynamic friction and updates the estimated friction torque values in parameters 74.66 Winch system speed 1 torque to 74.70 Winch system speed 5 torque .	
b2...15	Reserved		
	0000h...FFFFh		1 / 1
74.62	Rope tension configuration	Specifies rope tension configuration related settings that can be enabled and disabled by toggling the specific bits.	0000 0000 0000 0000 / uint16
b0	Inertia reduction	0 = Actual rope tension displayed in parameters 09.23 and 09.24 is not compensated with the inertia torque. 1 = Actual rope tension displayed in parameters 09.23 and 09.24 is compensated with the inertia torque. Inertia is estimated from the winch system ID run procedure. See parameter 74.65 Winch system inertia .	
b1	Rotation friction reduction	0 = Friction torque is not deducted from actual rope tension displayed in parameters 09.23 and 09.24 . 1 = Friction torque is deducted from actual rope tension displayed in parameters 09.23 and 09.24 . The value of friction torque used for deduction depends upon the speed at which the drive is running. See parameters 74.66 Winch system speed 1 torque to 74.75 Winch system speed 5 .	
b2...15	Reserved		
	0000h...FFFFh		1 / 1
74.63	Rope tension filter number	Defines the rope tension filter number.	10 NoUnit / uint32
	0...10000	Rope tension filter number.	1 = 1 / 1 = 1
74.64	Speed change rate deadband	Defines the speed change rate deadband.	3 NoUnit / real32
	0...10000	Speed change rate deadband.	1 = 1 / 1 = 1
74.65	Winch system inertia	Displays the inertia calculated from the winch system ID run procedure. Alternatively, you can enter the system inertia value in this parameter, if the system inertia is manually calculated.	0.00000 kgm ² / real32
	0.00000 ... 1000.00000 kgm ²	Winch system inertia in kgm ² .	1000 = 1 kgm ² / 1 = 1 kgm ²
74.66	Winch system speed 1 torque	Displays the friction torque estimated at winch system speed 1 from the winch system ID run procedure. See parameter 74.71 Winch system speed 1 . Alternatively you can enter the friction torque value in this parameter, if the friction torque is manually calculated.	0.0 % / real32
	0.0 ... 300.0%	Winch system speed 1 torque.	10 = 1% / 1 = 1%

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No.	Name / Range / Selection	Description	Def / Type FbEq 16b / 32b
74.67	Winch system speed 2 torque	Displays the friction torque estimated at winch system speed 2 from the winch system ID run procedure. See parameter 74.72 Winch system speed 2 . Alternatively you can enter the friction torque value in this parameter, if the friction torque is manually calculated.	0.0 % / real32
	0.0 ... 300.0%	Winch system speed 2 torque.	10 = 1% / 1 = 1%
74.68	Winch system speed 3 torque	Displays the friction torque estimated at winch system speed 3 from the winch system ID run procedure. See parameter 74.73 Winch system speed 3 . Alternatively you can enter the friction torque value in this parameter, if the friction torque is manually calculated.	0.0 % / real32
	0.0 ... 300.0%	Winch system speed 3 torque.	10 = 1% / 1 = 1%
74.69	Winch system speed 4 torque	Displays the friction torque estimated at winch system speed 4 from the winch system ID run procedure. See parameter 74.74 Winch system speed 4 . Alternatively you can enter the friction torque value in this parameter, if the friction torque is manually calculated.	0.0 % / real32
	0.0 ... 300.0%	Winch system speed 4 torque.	10 = 1% / 1 = 1%
74.70	Winch system speed 5 torque	Displays the friction torque estimated at winch system speed 5 from the winch system ID run procedure. See parameter 74.75 Winch system speed 5 . Alternatively you can enter the friction torque value in this parameter, if the friction torque is manually calculated.	0.0 % / real32
	0.0 ... 300.0%	Winch system speed 5 torque.	10 = 1% / 1 = 1%
74.71	Winch system speed 1	Displays the speed at which the winch system speed 1 torque is estimated. See parameter 74.66 Winch system speed 1 torque . Generally, this speed is 100 rpm. Alternatively, the speed can be user defined.	0.0 rpm / real32
	0.0 ... 18000.0 rpm	Winch system speed 1 in rpm.	10 = 1 rpm / 1 = 1 rpm
74.72	Winch system speed 2	Displays the speed at which the winch system speed 2 torque is estimated. See parameter 74.67 Winch system speed 2 torque . Generally, this speed is 200 rpm. Alternatively, the speed can be user defined.	0.0 rpm / real32
	0.0 ... 18000.0 rpm	Winch system speed 2 in rpm.	10 = 1 rpm / 1 = 1 rpm
74.73	Winch system speed 3	Displays the speed at which the winch system speed 3 torque is estimated. See parameter 74.68 Winch system speed 3 torque . Generally, this speed is Mode maximum speed / 3 rpm. Alternatively, the speed can be user defined.	0.0 rpm / real32
	0.0 ... 18000.0 rpm	Winch system speed 3 in rpm.	10 = 1 rpm / 1 = 1 rpm

No.	Name / Range / Selection	Description	Def / Type FbEq 16b / 32b
74.74	Winch system speed 4	Displays the speed at which the winch system speed 4 torque is estimated. See parameter 74.69 Winch system speed 4 torque . Generally, this speed is Mode maximum speed x 2 / 3 rpm. Alternatively, the speed can be user defined.	0.0 rpm / real32
	0.0 ... 18000.0 rpm	Winch system speed 4 in rpm.	1 = 1 rpm / 1 = 1 rpm
74.75	Winch system speed 5	Displays the speed at which the winch system speed 5 torque is estimated. See parameter 74.70 Winch system speed 5 torque . Generally, this speed is mode max speed in rpm. Alternatively, the speed could be user defined.	0.0 rpm / real32
	0.0 ... 18000.0 rpm	Winch system speed 5 in rpm.	10 = 1 rpm / 1 = 1 rpm
74.76	Handmooring switch level	Selects the speed levels for handmooring maximum speed based on the actual motor torque level (01.01). A low torque level is used with higher speed and high torque level is used with lower speed. - Handmooring maximum speed changes to next level when motor actual torque level (01.01) is higher than 74.77 Handmooring switch level torque + 74.78 Handmooring switch level hysteresis, for the defined time interval (74.79). - Change back to the set handmooring maximum speed happens when actual motor torque level (01.01) is less than the 74.77 Handmooring switch level torque - 74.78 Handmooring switch level hysteresis, for the defined time interval (74.79). - Handmooring maximum speed can be switched between two-speed levels based on the status of actual motor torque level. - Low torque is used with high speed and higher torque is used with nominal or lower speed.	Disable / uint32
	Disable	Function disabled	0
	Default and set 1	Change between default Handmooring max speed heave/lower (74.30 / 74.31) and Handmooring max speed heave set 1/lower set 1 (74.83/74.84).	1
	Default and set 2	Change between default Handmooring max speed heave/lower (74.30 / 74.31) and Handmooring max speed heave set 2/lower set 2 (74.85/74.86).	2
	Default and set 3	Change between default Handmooring max speed heave/lower (74.30 / 74.31) and Handmooring max speed heave set 3/lower set 3 (74.87/74.88).	3
	Set 1 and set 2	Change between Handmooring max speed heave set 1/lower set 1 (74.83/74.84) and Handmooring max speed heave set 2/lower set 2 (74.85/74.86).	4
	Set 1 and set 3	Change between Handmooring max speed heave set 1/lower set 1 (74.83/74.84) and Handmooring max speed heave set 3/lower set 3 (74.87/74.88).	5

No.	Name / Range / Selection	Description	Def / Type FbEq 16b / 32b
	Set 2 and set 3	Change between Handmooring max speed heave set 2/lower set 2 (74.85/74.86) and Handmooring max speed heave set 2/lower set 2 (74.85/74.86).	6
74.77	Handmooring switch level torue	Defines torque limit for handmooring switch torque level supervision function. - Handmooring maximum speed can be switched between two-speed levels based on the status of actual motor torque level. - Low torque is used with high speed and higher torque is used with nominal or lower speed. For example: 74.77 = 30% and hysteresis (74.78) = 10% Low or nominal speed (1500 rpm): When actual torque (01.01) is above the value of 74.77 + 74.78 longer than delay (74.79), 74.77 = 30% + 10% = 40%. High speed (3600 rpm): When actual torque (01.01) is less than 74.77 - 74.78 longer than delay (74.79), 74.77 = 30% - 10% = 20%.	30.0 % / real32
	0.0 ... 600.0%	Handmooring switch level torque	10 = 1% / 1 = 1%
74.78	Handmooring switch level hysteresis	Defines hysteresis limit for handmooring switch level supervision function. - Handmooring maximum speed can be switched between two-speed levels based on the status of actual motor torque level. - Low torque is used with high speed and higher torque is used with nominal or lower speed. - See figure in parameter 74.77.	10.0 % / real32
	0.0 ... 100.0%	Handmooring switch level hysteresis	10 = 1% / 1 = 1%
74.79	Handmooring switch level delay	Defines hysteresis limit for handmooring switch level supervision function. - Handmooring maximum speed can be switched between two-speed levels based on the status of actual motor torque level. - Low torque is used with high speed and higher torque is used with nominal or lower speed. - See figure in parameter 74.77.	1.0 s / real32

No.	Name / Range / Selection	Description	Def / Type FbEq 16b / 32b															
	0.0 ... 600.0 s	Handmooring switch level delay time	10 = 1 s / 1 = 1 s															
74.80	Handmooring max speed sel sw	Displays the status of Handmooring maximum speed selections. This parameter is read-only.	0000 0000 0000 0000 / uint16															
b0	Handmooring sel source in 1	1 = Parameter 74.81 Handmooring max speed sel in 1 is selected.																
b1	Handmooring sel source in 2	1 = Parameter 74.82 Handmooring max speed sel in 2 is selected.																
b2...3	Reserved																	
b4	Default set used	1 = Speed reference scaling in Handmooring mode (heave/lower direction) defined with par. 74.30 or par. 74.31 in use.																
b5	Set 1 used	1 = Parameter 74.83 Handmooring max speed heave set 1 or 74.84 Handmooring max speed lower set 1 is selected.																
b6	Set 2 used	1 = Parameter 74.85 Handmooring max speed heave set 2 or 74.86 Handmooring max speed lower set 2 is selected.																
b7	Set 3 used	1 = Parameter 74.87 Handmooring max speed heave set 3 or 74.88 Handmooring max speed lower set 3 is selected.																
b8...15	Reserved																	
	0000h...FFFFh		1 / 1															
74.81	Handmooring max speed sel in 1	Source 1 to select the used Handmooring maximum speed in heave or lower direction. Parameter 74.80 Handmooring max speed sel sw , bit 0 displays the status of this selection. <table><tr><th>In 2 = par. 74.82</th><th>In 2 = par. 74.81</th><th>Description</th></tr><tr><td>0</td><td>0</td><td>Default (par. 74.30/par.74.31)</td></tr><tr><td>0</td><td>1</td><td>Set 1 (par. 74.83/par. 74.84)</td></tr><tr><td>1</td><td>0</td><td>Set 2 (par. 74.85/par. 74.86)</td></tr><tr><td>1</td><td>1</td><td>Set 3 (par. 74.87/par. 74.88)</td></tr></table>	In 2 = par. 74.82	In 2 = par. 74.81	Description	0	0	Default (par. 74.30 /par. 74.31)	0	1	Set 1 (par. 74.83 /par. 74.84)	1	0	Set 2 (par. 74.85 /par. 74.86)	1	1	Set 3 (par. 74.87 /par. 74.88)	FALSE / int32
In 2 = par. 74.82	In 2 = par. 74.81	Description																
0	0	Default (par. 74.30 /par. 74.31)																
0	1	Set 1 (par. 74.83 /par. 74.84)																
1	0	Set 2 (par. 74.85 /par. 74.86)																
1	1	Set 3 (par. 74.87 /par. 74.88)																
	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															

No.	Name / Range / Selection	Description	Def / Type FbEq 16b / 32b															
	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															
	DI1 inverted	Digital input DI1 inverted	10															
	DI2 inverted	Digital input DI2 inverted	11															
	DI3 inverted	Digital input DI3 inverted	12															
	DI4 inverted	Digital input DI4 inverted	13															
	DI5 inverted	Digital input DI5 inverted	14															
	DI6 inverted	Digital input DI6 inverted	15															
	DIO1 inverted	Digital input/output DIO1 inverted	16															
	DIO2 inverted	Digital input/output DIO2 inverted	17															
	Other [bit]	See Terms and abbreviations (page 207) .	-															
74.82	Handmooring max speed sel in 2	Source 2 to select the used Handmooring maximum speed in heave or lower direction. Parameter 74.80 Handmooring max speed sel sw, bit 0 displays the status of this selection. <table><tr><th>In 2 = par. 74.82</th><th>In 2 = par. 74.81</th><th>Description</th></tr><tr><td>0</td><td>0</td><td>Default (par. 74.30/par.74.31)</td></tr><tr><td>0</td><td>1</td><td>Set 1 (par. 74.83/par. 74.84)</td></tr><tr><td>1</td><td>0</td><td>Set 2 (par. 74.85/par. 74.86)</td></tr><tr><td>1</td><td>1</td><td>Set 3 (par. 74.87/par. 74.88)</td></tr></table>	In 2 = par. 74.82	In 2 = par. 74.81	Description	0	0	Default (par. 74.30/par.74.31)	0	1	Set 1 (par. 74.83/par. 74.84)	1	0	Set 2 (par. 74.85/par. 74.86)	1	1	Set 3 (par. 74.87/par. 74.88)	FALSE / int32
In 2 = par. 74.82	In 2 = par. 74.81	Description																
0	0	Default (par. 74.30/par.74.31)																
0	1	Set 1 (par. 74.83/par. 74.84)																
1	0	Set 2 (par. 74.85/par. 74.86)																
1	1	Set 3 (par. 74.87/par. 74.88)																
	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).	8															
	DIO2	Digital input/output DIO2 (11.02 DIO delayed status , bit 1).	9															

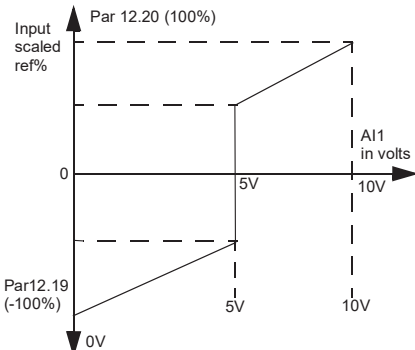
No.	Name / Range / Selection	Description	Def / Type FbEq 16b / 32b
	DI1 inverted	Digital input DI1 inverted	10
	DI2 inverted	Digital input DI2 inverted	11
	DI3 inverted	Digital input DI3 inverted	12
	DI4 inverted	Digital input DI4 inverted	13
	DI5 inverted	Digital input DI5 inverted	14
	DI6 inverted	Digital input DI6 inverted	15
	DIO1 inverted	Digital input/output DIO1 inverted	16
	DIO2 inverted	Digital input/output DIO2 inverted	17
	Other [bit]	See Terms and abbreviations (page 207) .	-
74.83	Handmooring max speed heave set 1	Defines speed reference scaling in Handmooring mode (heave direction) when selected with parameter 74.81 Handmooring max speed sel in 1 in 1 and 74.82 Handmooring max speed sel in 2. It also defines the speed limit in Handmooring mode. The speed defined with this parameter corresponds to an EXT2 reference of 100% when the Handmooring mode is active. See parameters 74.02 Handmooring mode enable and 09.01 Winch status word 1, bit 1. Note: The speed limits set in parameter group 30 Limits has priority over this parameter.	1500 rpm / real32
	0...18000 rpm	Speed reference scaling in Handmooring mode.	1 = 1 rpm / 1 = 1 rpm
74.84	Handmooring max speed lower set 1	Defines speed reference scaling in Handmooring mode (heave direction) when selected with parameter 74.81 Handmooring max speed sel in 1 in 1 and 74.82 Handmooring max speed sel in 2. It also defines the speed limit in Handmooring mode. The speed defined with this parameter corresponds to an EXT2 reference of 100% when the Handmooring mode is active. See parameters 74.02 Handmooring mode enable and 09.01 Winch status word 1, bit 1. Note: The speed limits set in parameter group 30 Limits has priority over this parameter.	1500 rpm / real32
	0...18000 rpm	Speed reference scaling in Handmooring mode.	1 = 1 rpm / 1 = 1 rpm
74.85	Handmooring max speed heave set 2	See description of parameter 74.83 Handmooring max speed heave set 1 in 1.	1500 rpm / real32
	0...18000 rpm	Speed reference scaling in Handmooring mode.	1 = 1 rpm / 1 = 1 rpm
74.86	Handmooring max speed lower set 2	See description of parameter 74.82 Handmooring max speed sel in 2 in 2.	1500 rpm / real32
	0...18000 rpm	Speed reference scaling in Handmooring mode.	1 = 1 rpm / 1 = 1 rpm
74.87	Handmooring max speed heave set 3	See description of parameter 74.83 Handmooring max speed heave set 1 in 1.	1500 rpm / real32
	0...18000 rpm	Speed reference scaling in Handmooring mode.	1 = 1 rpm / 1 = 1 rpm

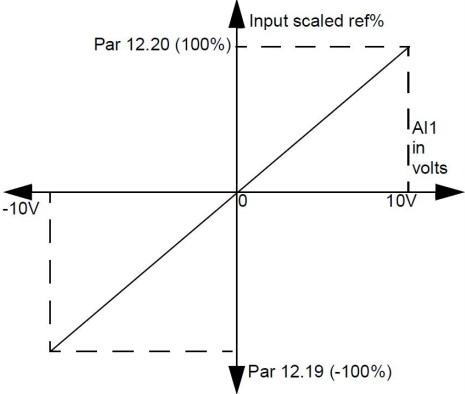
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No.	Name / Range / Selection	Description	Def / Type FbEq 16b / 32b
74.88	Handmooring max speed lower set 3	See description of parameter 74.84 Handmooring max speed lower set 1 .	1500 rpm / real32
	0...18000 rpm	Speed reference scaling in Handmooring mode.	1 = 1 rpm / 1 = 1 rpm
74.89	Torque high status word	Torque high status word. Displays the status of high torque supervision functions for different control modes.	0000 0000 0000 0000 / uint16
b0	Handmooring high torque warning	1 = High torque warning condition detected in Handmooring mode. 0 = No warning condition	
b1	Handmooring high torque fault	1 = High torque active fault in Handmooring mode. 0 = No high torque fault in Handmooring mode.	
b2	Automooring high torque warning	1 = High torque warning condition detected in Auto-mooring mode. 0 = No warning condition	
b3	Automooring high torque fault	1 = High torque active fault in automooring mode. 0 = No high torque fault in automooring mode.	
b4	Anchor mode high torque warning	1 = High torque warning condition detected in anchor mode. 0 = No warning condition	
b5	Anchor mode high torque fault	1 = High torque active fault in anchor mode. 0 = No high torque fault in anchor mode.	
b6...15	Reserved		
	0000h...FFFFh		1 / 1
74.90	Handmooring high torque level supervision	Activates handmooring high torque level supervision function. It also defines the function behavior if supervision conditions are fulfilled. The supervision function monitors the actual torque of motor in handmooring mode and provides a defined reaction if the torque level is higher than the defined Handmooring high torque level limit (74.91) for the defined time interval (74.92 Handmooring high torque level delay).	Not used / uint32
	Not used	Function not used/disabled	0
	Warning	Function triggers the warning D207 High handmooring torque level .	1
	Fault	Function triggers the fault D107 High handmooring torque level	2
74.91	Handmooring high torque level limit	Defines torque level limit for handmooring high torque level supervision function.	150.0 % / real32
	0.0 ... 600.0%	Handmooring high torque level limit	10 = 1% / 1 = 1%
74.92	Handmooring high torque level delay	Defines delay time for handmooring high torque level supervision function.	5.0 s / real32
	0.0 ... 1800.0 s	Handmooring high torque level delay time	10 = 1 s / 1 = 1 s

No.	Name / Range / Selection	Description	Def / Type FbEq 16b / 32b
74.95	Automoorings high torque level supervision	Activates automoorings high torque level supervision function. It also defines the function behavior if supervision conditions are fulfilled. The supervision function monitors actual torque of motor in automoorings mode and defines a reaction if torque level is higher than the Automoorings high torque level limit (74.96) for the defined delay time (74.97).	Not used / uint32
	Not used	Function not used/disabled	0
	Warning	Function triggers the warning D210 high anchor torque level .	1
	Fault	Function triggers the fault D108 High automoorings torque level .	2
74.96	Automoorings high torque level limit	Defines torque level limit for automoorings high torque level supervision function.	150.0 % / real32
	0.0 ... 600.0%	Automoorings high torque level limit	10 = 1% / 1 = 1%
74.97	Automoorings high torque level delay	Defines delay time for automoorings high torque level supervision function.	5.0 s / real32
	0.0 ... 1800.0 s	Automoorings high torque level delay time	10 = 1 s / 1 = 1 s
74.100	Anchor high torque level supervision	Activates anchor high torque level supervision function. It also defines the function behavior if supervision conditions are fulfilled. The function monitors the actual torque of motor in anchor mode and provides a defined reaction if torque level is higher than automoorings high torque level limit (74.101) for the defined delay time (74.102).	Not used / uint32
	Not used	Function not used/disabled	0
	Warning	Function triggers the warning D210 high anchor torque level .	1
	Fault	Function triggers the fault D10A High anchor torque level .	2
74.101	Anchor high torque level limit	Defines torque level limit for anchor high torque level supervision function.	150.0 % / real32
	0.0 ... 600.0%	Anchor high torque level limit	10 = 1% / 1 = 1%
74.102	Anchor high torque level delay	Defines delay time for anchor high torque level supervision function.	5.0 s / real32
	0.0 ... 1880.0 s	Anchor high torque level delay time	10 = 1 s / 1 = 1 s
74.110	Abnormal torque level	Defines abnormal torque level of the motor. It also defines the motor torque limit for indication. When actual motor torque (01.10) is higher than this value, for more than one second, then 09.05 Winch abnormal condition status , bit 0 = Indication signal starts blinking.	100.0 % / real32
	0.0 ... 600.0%	Abnormal torque level	10 = 1% / 1 = 1%

No.	Name / Range / Selection	Description	Def / Type FbEq 16b / 32b
75	Winch interface	Winch control stand configuration. Refer section Winch control interface (page 45) .	
75.01	Control stand fault reset enable	Winch control stand configuration. Refer section Winch control interface (page 45) .	Disable / int32
	Disable	Auto fault reset command is disabled.	0
	Enable	Auto fault reset command is enabled.	1
	Other [bit]	See Terms and abbreviations (page 207) .	-
75.02	Control stand enable mode	To enable the control stands in winch interface, EXT2 shall be active and set parameter 20.06 Ext2 commands = Not selected .	Switch / uint16
	Switch	The control stand is enabled when the digital input is ON and disabled when the input is OFF.	0
	Pulse	The enable/disable state changes every time when the digital input is momentarily switched ON.	1
	No enable signal	The enable signals (75.10 Control stand 1 enable or 75.14 Control stand 2 enable or 75.18 Control stand 3 enable) do not have any effect. The control stand where the joystick start and reference commands are activated has the control. When these control commands are released, the enable signal is also released. Use this selection with control stands which do not have a separate enable signal.	2
75.03	Control stand priority selection	Selects the control stand priority. It defines if the control is taken over by another control stand during run.	Ignore new / uint16
	Override old	No control stand has priority. A control stand can take over control from any other stand during run. In this example, there are two control stands. - The winch is run from control stand 1 (Multi IO1 enable is TRUE and the control stand 1 is heaving/lowering the winch). - At this point, the user enables control stand 2 (Multi IO2 enable is TRUE and the control stand 2 heaves/lowersthe winch). That is, control stand 1 is no longer controlling the winch, because control stand 2 has the priority and has taken over the control of the winch.	0

No.	Name / Range / Selection	Description	Def / Type FbEq 16b / 32b
	Ignore new	Active control stand has the priority and control cannot be taken from that control stand. In this example, there are two control stands. • The winch is running from control stand 1 (control stand 1 enable is TRUE and the control stand 1 is heaving/lowering the winch). • At this point, the user enables control stand 2 (control stand 2 enable is TRUE and the user tries to heave/lower the winch). Control stand 1 is still controlling the winch and has the control till the user disable control stand 1. After disabling control stand 1, the user can enable other control stand and control the winch from it.	1
75.04	Control stand joystick mode	Selects the type of control stand joystick AI signal.	Unipolar / uint16
	Unipolar	Joystick analog input is unipolar. The minimum input signal runs the motor at the maximum reference in the reverse direction and the maximum input at the maximum reference in the forward direction. Here, the voltage is between 0v-5v for negative direction and 5v-10v for positive direction and the direction is given by two DI's assigned to control stand heave and control stand lower parameters. The user scales the AI scaled at AI min to -100% and AI scaled at AI max to 100%. 	0

No.	Name / Range / Selection	Description	Def / Type FbEq 16b / 32b
	Bipolar	Joystick analog input is bipolar. In this case, there is only one DI used for giving start command. The direction is coming from the AI reference sign. Bipolar analog input is -10v to 10 v and the user scales the AI scaled at AI min to -100% and AI scaled at AI max to 100%. 	1
75.05	Joystick zero position source	Selects the source of joystick zero position.	Not selected / int32
	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 207) .	-
75.06	Joystick zero position status word	Shows the status of joystick zero position.	0000 0000 0000 0000 / uint16
	b0 Function active	1 = Joystick zero position status function activated.	
	b1 Joystick in zero position	1 = Joystick is in zero position.	

No.	Name / Range / Selection	Description	Def / Type FbEq 16b / 32b
b2	Start interlock active	1 = Start interlock is active for joystick.	
b3	Warning trigger	1 = D21B joystick zero position error condition warning detected.	
b4	Fault trigger	1 = D11B joystick zero position error condition fault detected.	
b5	Fault reset sequence	1 = Fault reset of joystick not allowed.	
b6...15	Reserved		
	0000h...FFFFh		1 / 1
75.07	Joystick zero position configuration word	Shows the configuration word of joystick zero position function behaviour.	0000 0000 0000 0001 / uint16
b0	Fault or Warning action	1 = D11B joystick zero position error condition fault detected 0 = D21B joystick zero position error condition warning detected.	
b1...2	Reserved		
b3	Hide warning	1 = D21B joystick zero position error warning message hidden/not shown.	
b4...15	Reserved		
	0000h...FFFFh		1 / 1
75.10	Control stand 1 enable	Selects the source for enabling control stand 1.	DI1 / 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).	8
	DIO2	Digital input/output DIO2 (11.02 DIO delayed status, bit 1).	9
	DI1 inverted	Digital input DI1 inverted	10
	DI2 inverted	Digital input DI2 inverted	11
	DI3 inverted	Digital input DI3 inverted	12
	DI4 inverted	Digital input DI4 inverted	13
	DI5 inverted	Digital input DI5 inverted	14

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No.	Name / Range / Selection	Description	Def / Type FbEq 16b / 32b
	DI6 inverted	Digital input DI6 inverted	15
	DIO1 inverted	Digital input/output DIO1 inverted	16
	DIO2 inverted	Digital input/output DIO2 inverted	17
	Other [bit]	See Terms and abbreviations (page 207) .	-
75.11	Control stand 1 reference	Selects the signal source for control stand 1 reference. Usually, this reference is a speed reference in percent of the absolute maximum speed. That is, the analog minimum/maximum values in group 12 Standard AI are set, such that 100% analog scaled value gives the absolute maximum speed.	AI1 scaled / int32
	Not selected	No source is selected.	0
	AI1 scaled	Analog input AI1. Note: If the signal is bipolar (± 10 V DC), use the selection in parameter 75.04 Control stand joystick mode as bipolar.	1
	AI2 scaled	Analog input AI2. Note: If the signal is bipolar (± 10 V DC), use the selection in parameter 75.04 Control stand joystick mode as bipolar.	2
	Step reference	You can select between three step reference speeds. The polarity of the reference depends on the direction in which the end-user gives the start command using digital inputs assigned to parameter 75.12 Control stand 1 heave and 75.13 Control stand 1 lower .	3
	Other [bit]	See Terms and abbreviations (page 207) .	-
75.12	Control stand 1 heave	Defines the source of start, stop and direction (heave) command for control stand 1. Activates step reference speed 1 when parameter 75.11 Control stand 1 reference is set to step reference.	DI2 / 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).	8
	DIO2	Digital input/output DIO2 (11.02 DIO delayed status , bit 1).	9
	DI1 inverted	Digital input DI1 inverted	10

No.	Name / Range / Selection	Description	Def / Type FbEq 16b / 32b
	DI2 inverted	Digital input DI2 inverted	11
	DI3 inverted	Digital input DI3 inverted	12
	DI4 inverted	Digital input DI4 inverted	13
	DI5 inverted	Digital input DI5 inverted	14
	DI6 inverted	Digital input DI6 inverted	15
	DIO1 inverted	Digital input/output DIO1 inverted	16
	DIO2 inverted	Digital input/output DIO2 inverted	17
	Other [bit]	See Terms and abbreviations (page 207) .	-
75.13	Control stand 1 lower	Defines the source of start, stop and direction (lower) command for control stand 1. Activates step reference speed 1 when parameter 75.11 Control stand 1 reference is set to step reference.	DI3 / 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).	8
	DIO2	Digital input/output DIO2 (11.02 DIO delayed status , bit 1).	9
	DI1 inverted	Digital input DI1 inverted	10
	DI2 inverted	Digital input DI2 inverted	11
	DI3 inverted	Digital input DI3 inverted	12
	DI4 inverted	Digital input DI4 inverted	13
	DI5 inverted	Digital input DI5 inverted	14
	DI6 inverted	Digital input DI6 inverted	15
	DIO1 inverted	Digital input/output DIO1 inverted	16
	DIO2 inverted	Digital input/output DIO2 inverted	17
	Other [bit]	See Terms and abbreviations (page 207) .	-
75.14	Control stand 2 enable	See parameter 75.10 Control stand 1 enable .	FALSE / int32
75.15	Control stand 2 reference	See parameter 75.11 Control stand 1 reference .	Not selected / int32
75.16	Control stand 2 heave	See parameter 75.12 Control stand 1 heave .	FALSE / int32

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No.	Name / Range / Selection	Description	Def / Type FbEq 16b / 32b
75.17	Control stand 2 lower	See parameter 75.13 Control stand 1 lower .	FALSE / int32
75.18	Control stand 3 enable	See parameter 75.10 Control stand 1 enable .	FALSE / int32
75.19	Control stand 3 reference	See parameter 75.11 Control stand 1 reference .	Not selected / int32
75.20	Control stand 3 heave	See parameter 75.12 Control stand 1 heave .	FALSE / int32
75.21	Control stand 3 lower	See parameter 75.13 Control stand 1 lower .	FALSE / int32
75.22	Include FB control stand	Enables the fieldbus stand to participate in the control stand logic.	No / int32
	No	Fieldbus control stand is not used.	0
	Yes	Fieldbus control stand is used.	1
	Other [bit]	See Terms and abbreviations (page 207) .	-
75.23	Multi FB stand enable	Enables multiple fieldbus stand to participate in the control stand logic.	Winch FB CW bitEnable / int32
	FALSE	0	0
	TRUE	1	1
	Winch FB CW bitEnable	Parameter 09.09 Winch FB control word , bit 0 activated.	2
	Winch FB CW bitHeave	Parameter 09.09 Winch FB control word , bit 1 activated.	3
	Winch FB CW bitLower	Parameter 09.09 Winch FB control word , bit 2 activated.	4
	Other [bit]	See Terms and abbreviations (page 207) .	-
75.24	Multi FB reference	Selects a multiple fieldbus reference to participate in the control stand logic.	FB A ref 2 / uint32
	Not selected	0	0
	FB A ref 1	Fieldbus adapter A reference 1 type selected.	1
	FB A ref 2	Fieldbus adapter A reference 2 type selected.	2
	FB B ref 1	Fieldbus adapter B reference 1 type selected.	3
	FB B ref 2	Fieldbus adapter B reference 2 type selected.	4
	Other [bit]	See Terms and abbreviations (page 207) .	-
75.25	Multi FB heave	Enables multiple fieldbus stand to participate in the heave logic.	Winch FB CW bitHeave / int32
	FALSE	0	0
	TRUE	1	1
	Winch FB CW bitEnable	Parameter 09.09 Winch FB control word , bit 0 activated.	2
	Winch FB CW bitHeave	Parameter 09.09 Winch FB control word , bit 1 activated.	3

No.	Name / Range / Selection	Description	Def / Type FbEq 16b / 32b
	Winch FB CW bit-Lower	Parameter 09.09 Winch FB control word , bit 2 activated.	4
	Other [bit]	See Terms and abbreviations (page 207) .	-
75.26	Multi FB lower	Enables multiple fieldbus stand to participate in the lower logic.	Winch FB CW bit-Lower / int32
	FALSE	0	0
	TRUE	1	1
	Winch FB CW bit-Enable	Parameter 09.09 Winch FB control word , bit 0 activated.	2
	Winch FB CW bitHeave	Parameter 09.09 Winch FB control word , bit 1 activated.	3
	Winch FB CW bit-Lower	Parameter 09.09 Winch FB control word , bit 2 activated.	4
	Other [bit]	See Terms and abbreviations (page 207) .	-
75.30	Step reference selector 2	Defines the source for selecting the step reference 2. The output can be read from signal 09.35 Step reference output . Refer section Step reference selection (page 49) .	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).	8
	DIO2	Digital input/output DIO2 (11.02 DIO delayed status , bit 1).	9
	DI1 inverted	Digital input DI1 inverted	10
	DI2 inverted	Digital input DI2 inverted	11
	DI3 inverted	Digital input DI3 inverted	12
	DI4 inverted	Digital input DI4 inverted	13
	DI5 inverted	Digital input DI5 inverted	14
	DI6 inverted	Digital input DI6 inverted	15
	DIO1 inverted	Digital input/output DIO1 inverted	16
	DIO2 inverted	Digital input/output DIO2 inverted	17
	Other [bit]	See Terms and abbreviations (page 207) .	-

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No.	Name / Range / Selection	Description	Def / Type FbEq 16b / 32b
75.31	Step reference selector 3	Defines the source for selecting the step reference 3. The output can be read from signal 09.35 Step reference output . For selections, see parameter 75.30 Step reference selector 2 .	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).	8
	DIO2	Digital input/output DIO2 (11.02 DIO delayed status , bit 1).	9
	DI1 inverted	Digital input DI1 inverted	10
	DI2 inverted	Digital input DI2 inverted	11
	DI3 inverted	Digital input DI3 inverted	12
	DI4 inverted	Digital input DI4 inverted	13
	DI5 inverted	Digital input DI5 inverted	14
	DI6 inverted	Digital input DI6 inverted	15
	DIO1 inverted	Digital input/output DIO1 inverted	16
	DIO2 inverted	Digital input/output DIO2 inverted	17
	Other [bit]	See Terms and abbreviations (page 207) .	-
75.34	Step reference 1	Defines the step reference speed 1 in percentage of absolute maximum speed.	50.00 % / real32
	0.00 ... 100.00%	Step reference 1.	100 = 1% / 1 = 1%
75.35	Step reference 2	Defines the step reference speed 2 in percentage of absolute maximum speed.	70.00 % / real32
	0.00 ... 100.00%	Step reference 2	100 = 1% / 1 = 1%
75.36	Step reference 3	Defines the step reference speed 3 in percentage of absolute maximum speed.	100.00 % / real32
	0.00 ... 100.00%	Step reference 3.	100 = 1% / 1 = 1%

No.	Name / Range / Selection	Description	Def / Type FbEq 16b / 32b
76	Automoorring	Settings for Automoorring. Refer section Automoorring (page 64) .	
76.01	Automoorring mode	Selects the Automoorring mode. Refer section Automoorring (page 64) .	Not used / uint16
	Not used	No action is taken.	0
	Time control	It is based on internal torque measurement with DTC, also selected in parameter 76.10 Tension feedback source . It uses torque measurement, and the re-moorring time interval (not specifically time 1).	1
	Load cell	Based on the feedback of an external load sensor defined with parameter 76.10 Tension feedback source .	2
	Continuous	The drive is continuously running in the forward direction and the internal torque limit is set to the current Automoorring setpoint.	3
	Continuous + Time control	The drive initially performs Continuous Automoorring for a predefined time and then internally switches to Time control Automoorring mode. See parameters 76.55 Cont to Time switch src and 76.56 Cont to Time switchover time .	4
76.02	Override control	Override control forces Automoorring On, in continuous Automoorring mode, as a parallel functionality with the time control or load-cell Automoorring mode. In special cases, this can be used as an emergency mode for starting Automoorring.	Disabled / int32
	Disabled	0	0
	Enabled	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).	8
	DIO2	Digital input/output DIO2 (11.02 DIO delayed status , bit 1).	9
	DI1 inverted	Digital input DI1 inverted	10
	DI2 inverted	Digital input DI2 inverted	11
	DI3 inverted	Digital input DI3 inverted	12
	DI4 inverted	Digital input DI4 inverted	13
	DI5 inverted	Digital input DI5 inverted	14
	DI6 inverted	Digital input DI6 inverted	15

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No.	Name / Range / Selection	Description	Def / Type FbEq 16b / 32b
	DIO1 inverted	Digital input/output DIO1 inverted	16
	DIO2 inverted	Digital input/output DIO2 inverted	17
	Other [bit]	See Terms and abbreviations (page 207).	-
76.03	Automooring style	Selects the overall style of Automooring operation. Refer section Automooring (page 64).	AM Style 1 / uint16
	AM Style 1	This is classic ACS800 style of Automooring.	0
	AM Style 2	In this method, the Automooring speed reference is varied linearly inside deadband zone until In zone delay elapses.	1
	AM Style 3	In this method, the Automooring speed reference is varied linearly inside deadband zone, but the reference is held zero at the first crossing of setpoint from either direction.	2
76.04	Automooring config word	Configures the behavior of Automooring on a power cycle.	0000 0000 0111 0110 / uint16
	b0 AM continues after power fail	0 = A new rising edge is required on Automooring enable to resume operation after a power cycle. 1 = Automooring operation resumes automatically on a power cycle, provided the Automooring enable input remains ON.	
	b1 AM continues after power fail Load cell	0 = Rising edge on Automooring enable input is required to restart Automooring after the power failure. 1 = Automooring to continue automatically (no rising edge required) after the power failure, if the load cell tension feedback is within hysteresis limits.	
	b2 AM absolute hysteresis and deadband	0 = Deadband and hysteresis are in percentage of the Automooring setpoint value. 1 = Deadband and Hysteresis are directly added to (in case of upper limit) or subtracted from (in case of lower limits) the Automooring setpoint value.	
	b3 AM flash fast at re-mooring indication	0 = Disables fast flashing of automooring indication bit. Parameter 09.03 , bit 14 is constantly 1 (TRUE). 1 = Enables fast flashing of automooring indication bit. Parameter 09.03 , bit 14 flashes at 0.5 second interval.	
	b4 AM flash medium at minum level not reached	0 = Disables medium flashing of automooring indication bit. Parameter 09.03 , bit 14 is constantly 1 (TRUE). 1 = Enables medium flashing of automooring indication bit. Parameter 09.03 , bit 14 flashes at one second interval.	
	b5 AM flash slow at continue after power fail / outside hysteresis	0 = Disables slow flashing of automooring indication bit. Parameter 09.03 , bit 14 is constantly 1 (TRUE). 1 = Enables slow flashing of automooring indication bit. Parameter 09.03 , bit 14 flashes at two seconds interval.	

No.	Name / Range / Selection	Description	Def / Type FbEq 16b / 32b
b6	AM load cell enable limit check	0 = Automoorings starts when load cell tension is outside hysteresis limits. 1 = Automoorings starts when the drive switches from Handmooring to Automoorings mode and if the load cell tension is within hysteresis limits.	
b7	AM adaptive start torque limit	0 = Brake open torque and torque proving reference are not limited by the active Automoorings setpoint. 1 = Brake open torque and torque proving reference are limited by the active Automoorings setpoint. That is, if the value of brake open torque selected with parameter 44.200 is greater than active Automoorings setpoint, then the brake open torque is limited to Automoorings setpoint. Note: This limitation is valid only in Automoorings mode.	
b8...15	Reserved		
	0000h...FFFFh		1 / 1
76.05	Automoorings min tension	Defines the minimum Automoorings level (%); the rope tension level that must be present before Automoorings starts, usually as a result of Handmooring. If this level is not exceeded, a protective action is taken based on the selections in parameter 76.07 AM min protection action .	20.0 % / real32
	0.0 ... 100.0%	Automoorings minimum start tension.	10 = 1% / 1 = 1%
76.06	AM min protection mode	Selects the mode of Automoorings minimum level protection.	Not used / uint16
	Not used	No action is taken. The protection is disabled and Automoorings started in all conditions.	0
	Always enabled	The protection is enabled in all conditions (after power ON, at start and between re-moorings times).	1
	Only at AM start	The protection is active only at start and not between re-moorings times.	2
	Limited nbr of starts	The protection is enabled and when the protection becomes active, the drive is started again after the re-moorings delay. This restarting is attempted for the number of times defined with parameter 76.85 AM min prot max starts , after which the drive trips on fault if the minimum tension is not reached.	3
76.07	AM min protection action	Selects the protection action when rope tension level is below the value in parameter 76.05 Automoorings min tension .	Warning / uint16
	Warning	The drive generates a warning when the protection becomes active.	0
	Fault	The drive trips on fault when the protection becomes active.	1

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No.	Name / Range / Selection	Description	Def / Type FbEq 16b / 32b
	Stop + Warning	The drive is stopped and the mechanical brake is closed when the protection becomes active. - In time control mode, the drive is started after the remoorin delay. - In load cell mode, the drive remains stopped until the actual rope tension remains below minimum level.	2
76.09	Automoorning winch capacity	Defines the additional scaling for parameter 74.44 Automoorning max torque and for Automoorning set points to align actual motor torque with used mechanics. For example: When this parameter value is set at 50% and the value in parameter 76.14 Automoorning setpoint1 is set to 10%, then the final winch capacity will be 31 Nm for a motor with nominal torque (par. 01.30 Nominal torque scale) = 620 Nm.	100.0 % / real32
	0.1 ... 200.0%	Automoorning winch capacity in percent.	10 = 1% / 1 = 1%
76.10	Tension feedback source	Defines the source for load feedback (rope tension sensor).	Internal DTC / int32
	Not selected	No source is selected.	0
	Internal DTC	The value in parameter 01.10 Motor torque is used as a source for rope tension feedback.	1
	AI1 scaled	The load cell signal connected to AI1 is used as a source for the rope tension feedback.	2
	AI2 scaled	The load cell signal connected to AI2 is used as a source for the rope tension feedback.	3
	Other [bit]	See Terms and abbreviations (page 207) .	-
76.11	Min automoorning setpoint level	Defines the minimum Automoorning set point level (%) that can be used. This parameter is a limitation to the Automoorning set point if an external reference source is used.	0.0 % / real32
	0.0 ... 100.0%	Minimum Automoorning set point level in percent.	10 = 1% / 1 = 1%
76.12	Max automoorning setpoint level	Defines the maximum Automoorning set point level (%) that can be used. This parameter is a limitation to the Automoorning set point if an external reference source is used.	100.0 % / real32
	0.0 ... 300.0%	Maximum Automoorning set point level in percent.	10 = 1% / 1 = 1%
76.13	Automoorning set-point selection	Selects the source for Automoorning set point, that is, the torque limitation of the speed controller. Automoorning set point is the rope tension reference.	Setpoint 1 / int32
	Not selected	No source is selected.	0
	AI1 scaled	The scaled value of external signal connected to AI1 is the source for Automoorning set point.	1
	AI2 scaled	The scaled value of external signal connected to AI2 is the source for Automoorning set point.	2
	Setpoint 1	The value in parameter 76.14 Automoorning setpoint1 is the source for Automoorning set point.	3

No.	Name / Range / Selection	Description	Def / Type FbEq 16b / 32b
	Setpoint 2	The value in parameter 76.15 Automoorring setpoint2 is the source for Automoorring set point.	4
	Setpoint 3	The value in parameter 76.16 Automoorring setpoint3 is the source for Automoorring set point.	5
	Setpoint 4	The value in parameter 76.17 Automoorring setpoint4 is the source for Automoorring set point.	6
	Setpoint 5	The value in parameter 76.18 Automoorring setpoint5 is the source for Automoorring set point.	7
	AM setpoint switch output	The value in parameter 09.30 AM setpoint switch output is the source for Automoorring set point. This is based on the value of DI set in parameters 76.20 AM setpoint selector 1 srcA to 76.28 AM setpoint selector 3 srcC .	8
	Joystick motor potentiometer	Control stand joystick's heave/lower digital signals are used to raise/lower the Automoorring setpoint. The rate of change of setpoint is set by parameter 76.71 AM motpot ramp time .	9
	Other [bit]	See Terms and abbreviations (page 207) .	-
76.14	Automoorring set-point1	Defines the constant value for Automoorring setpoint1, that is, the torque limitation of the speed controller. Automoorring set point is the rope tension reference.	20.0 % / real32
	0.0 ... 300.0%	Automoorring set point in percent.	10 = 1% / 1 = 1%
76.15	Automoorring set-point2	Defines the constant value for Automoorring setpoint2, that is, the torque limitation of the speed controller. Automoorring set point is the rope tension reference.	40.0 % / real32
	0.0 ... 300.0%	Automoorring set point in percent.	10 = 1% / 1 = 1%
76.16	Automoorring set-point3	Defines the constant value for Automoorring setpoint3, that is, the torque limitation of the speed controller. Automoorring set point is the rope tension reference.	60.0 % / real32
	0.0 ... 300.0%	Automoorring set point in percent.	10 = 1% / 1 = 1%
76.17	Automoorring set-point4	Defines the constant value for Automoorring setpoint4, that is, the torque limitation of the speed controller. Automoorring set point is the rope tension reference.	80.0 % / real32
	0.0 ... 300.0%	Automoorring set point in percent.	10 = 1% / 1 = 1%
76.18	Automoorring set-point5	Defines the constant value for Automoorring setpoint5, that is, the torque limitation of the speed controller. Automoorring set point is the rope tension reference.	100.0 % / real32
	0.0 ... 300.0%	Automoorring set point in percent.	10 = 1% / 1 = 1%
76.19	AM setpoint ref ramp	Defines ramp time reference for Automoorring setpoint.	0.00 s / real32
	0.00 ... 30000.00 s	Automoorring setpoint reference ramp time in seconds.	10 = 1 s / 1 = 1 s

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No.	Name / Range / Selection	Description	Def / Type FbEq 16b / 32b																												
76.20	AM setpoint select- or 1 srcA	Selects the source for Automoooring trigger and set point based on the bit combinations defined in table below. <table> <tr> <th></th><th>Source 1A</th><th>Source 1B</th><th>Source 1C</th></tr> <tr> <td>Disabled (0%)</td><td>AM setpoint selector confA bit 0</td><td>AM setpoint selector confB bit 0</td><td>AM setpoint selector confC bit 0</td></tr> <tr> <td>Setpoint1</td><td>AM setpoint selector confA bit 1</td><td>AM setpoint selector confB bit 1</td><td>AM setpoint selector confB bit 1</td></tr> <tr> <td>Setpoint2</td><td>AM setpoint selector confA bit 2</td><td>AM setpoint selector confB bit 2</td><td>AM setpoint selector confB bit 2</td></tr> <tr> <td>Setpoint3</td><td>AM setpoint selector confA bit 3</td><td>AM setpoint selector confB bit 3</td><td>AM setpoint selector confB bit 3</td></tr> <tr> <td>Setpoint4</td><td>AM setpoint selector confA bit 4</td><td>AM setpoint selector confB bit 4</td><td>AM setpoint selector confB bit 4</td></tr> <tr> <td>Setpoint5</td><td>AM setpoint selector confA bit 5</td><td>AM setpoint selector confB bit 5</td><td>AM setpoint selector confB bit 5</td></tr> </table>		Source 1A	Source 1B	Source 1C	Disabled (0%)	AM setpoint selector confA bit 0	AM setpoint selector confB bit 0	AM setpoint selector confC bit 0	Setpoint1	AM setpoint selector confA bit 1	AM setpoint selector confB bit 1	AM setpoint selector confB bit 1	Setpoint2	AM setpoint selector confA bit 2	AM setpoint selector confB bit 2	AM setpoint selector confB bit 2	Setpoint3	AM setpoint selector confA bit 3	AM setpoint selector confB bit 3	AM setpoint selector confB bit 3	Setpoint4	AM setpoint selector confA bit 4	AM setpoint selector confB bit 4	AM setpoint selector confB bit 4	Setpoint5	AM setpoint selector confA bit 5	AM setpoint selector confB bit 5	AM setpoint selector confB bit 5	FALSE / int32
	Source 1A	Source 1B	Source 1C																												
Disabled (0%)	AM setpoint selector confA bit 0	AM setpoint selector confB bit 0	AM setpoint selector confC bit 0																												
Setpoint1	AM setpoint selector confA bit 1	AM setpoint selector confB bit 1	AM setpoint selector confB bit 1																												
Setpoint2	AM setpoint selector confA bit 2	AM setpoint selector confB bit 2	AM setpoint selector confB bit 2																												
Setpoint3	AM setpoint selector confA bit 3	AM setpoint selector confB bit 3	AM setpoint selector confB bit 3																												
Setpoint4	AM setpoint selector confA bit 4	AM setpoint selector confB bit 4	AM setpoint selector confB bit 4																												
Setpoint5	AM setpoint selector confA bit 5	AM setpoint selector confB bit 5	AM setpoint selector confB bit 5																												
	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).	8																												
	DIO2	Digital input/output DIO2 (11.02 DIO delayed status, bit 1).	9																												
	DI1 inverted	Digital input DI1 inverted	10																												
	DI2 inverted	Digital input DI2 inverted	11																												
	DI3 inverted	Digital input DI3 inverted	12																												
	DI4 inverted	Digital input DI4 inverted	13																												
	DI5 inverted	Digital input DI5 inverted	14																												
	DI6 inverted	Digital input DI6 inverted	15																												
	DIO1 inverted	Digital input/output DIO1 inverted	16																												

No.	Name / Range / Selection	Description	Def / Type FbEq 16b / 32b
	DIO2 inverted	Digital input/output DIO2 inverted	17
	Other [bit]	See Terms and abbreviations (page 207).	-
76.21	AM setpoint select- or 1 srcB	See parameter 76.20 AM setpoint selector 1 srcA .	FALSE / int32
76.22	AM setpoint select- or 1 srcC	See parameter 76.20 AM setpoint selector 1 srcA .	FALSE / int32
76.23	AM setpoint select- or 2 srcA	See parameter 76.20 AM setpoint selector 1 srcA .	FALSE / int32
76.24	AM setpoint select- or 2 srcB	See parameter 76.20 AM setpoint selector 1 srcA .	FALSE / int32
76.25	AM setpoint select- or 2 srcC	See parameter 76.20 AM setpoint selector 1 srcA .	FALSE / int32
76.26	AM setpoint select- or 3 srcA	See parameter 76.20 AM setpoint selector 1 srcA .	FALSE / int32
76.27	AM setpoint select- or 3 srcB	See parameter 76.20 AM setpoint selector 1 srcA .	FALSE / int32
76.28	AM setpoint select- or 3 srcC	See parameter 76.20 AM setpoint selector 1 srcA .	FALSE / int32
76.30	Hysteresis high level	Defines the Automoorring hysteresis high; triggering level to start Automoorring after out zone delay (parameter 76.35 Out zone time delay) in case the rope tension is too high (tight rope). This parameter is valid in the time control or load-cell Automoorring mode (parameter 76.01 Automoorring mode). The final calculated value is shown in parameter 09.26 AM hysteresis high used .	20.0 % / real32
	0.0 ... 100.0%	Value of limit in percent of Automoorring set point value.	10 = 1% / 1 = 1%
76.31	Hysteresis low level	Defines the Automoorring hysteresis low; triggering level to start Automoorring after out zone delay (parameter 76.35 Out zone time delay) in case the rope tension is too low (slack rope). This parameter is valid in the time control or load-cell Automoorring mode (parameter 76.01 Automoorring mode). The final calculated value is shown in parameter 09.27 AM hysteresis low used .	20.0 % / real32
	0.0 ... 100.0%	Value of limit in percent of Automoorring set point value.	10 = 1% / 1 = 1%
76.32	Deadband high level	Defines the Automoorring dead band high; triggering level to stop Automoorring after in-zone delay (parameter 76.34 In zone time delay). This parameter is valid in the time-control or load-cell Automoorring mode (parameter 76.01 Automoorring mode). The final calculated value is shown in parameter 09.28 AM deadband high used .	10.0 % / real32
	0.0 ... 100.0%	Deadband high level in percent.	10 = 1% / 1 = 1%

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No.	Name / Range / Selection	Description	Def / Type FbEq 16b / 32b
76.33	Deadband low level	Defines the Automoorng dead band low; triggering level to stop Automoorng after in-zone delay (parameter 76.34 In zone time delay). This parameter is valid in the time-control or load-cell Automoorng mode (parameter 76.01 Automoorng mode). The final calculated value is shown in parameter 09.29 AM deadband low used .	10.0 % / real32
	0.0 ... 100.0%	Deadband low level	10 = 1% / 1 = 1%
76.34	In zone time delay	Defines the time delay before Automoorng is stopped in case the Automoorng dead band level is reached. This parameter is valid in the time-control or load-cell Automoorng mode (parameter 76.01 Automoorng mode).	10 s / real32
	0...3600 s	In zone time delay in seconds.	1 = 1 s / 1 = 1 s
76.35	Out zone time delay	Defines the time delay before Automoorng is started if the actual rope tension is outside the hysteresis high (parameter 76.30 Hysteresis high level) or hysteresis low (parameter 76.31 Hysteresis low level) values. This is valid only in Load cell mode.	5 s / real32
	0...3600 s	Out zone time delay in seconds.	1 = 1 s / 1 = 1 s
76.40	Torque measuring mode	Selects the mode for rope tension measurement in time control Automoorng mode.	Standstill mode / uint16
	Standstill mode	In standstill mode, the torque on the shaft is measured for the torque measuring time (76.41 Torque measuring time) while the speed reference is kept at zero.	0
	Rotating mode	In rotating mode, at first the motor rolls Out the rope (for the time 76.43 Rotating mode time with the speed - 76.42 Rotating mode speed) and measures the torque in the middle of the sequence, and then rolls In the rope (for the time 76.43 Rotating mode time with the speed + 76.42 Rotating mode speed) and measures the torque in the middle of the sequence. The final torque is calculated as the mean value of these two measurements.	1
76.41	Torque measuring time	Defines the actual rope tension when the parameter 76.10 Tension feedback source is set to Internal DTC. During this time, the drive/motor is started and then the mechanical brake is opened. The speed reference is forced to zero and the torque limitation is increased.	5 s / real32
	0...3600 s	Torque measuring time in seconds.	1 = 1 s / 1 = 1 s
76.42	Rotating mode speed	The speed reference is used during the rotating mode time (parameter 76.43 Rotating mode time), when the torque measuring mode (parameter 76.40 Torque measuring mode) is selected as rotating mode.	0 rpm / real32
	0...3000 rpm	Rotating mode speed in rpm.	1 = 1 rpm / 1 = 1 rpm

No.	Name / Range / Selection	Description	Def / Type FbEq 16b / 32b
76.43	Rotating mode time	In rotating mode, at first the motor rolls Out the rope (for the time 76.43 Rotating mode time with the speed - 76.42 Rotating mode speed) and measures the torque in the middle of the sequence, and then rolls In the rope (for the time 76.43 Rotating mode time with the speed + 76.42 Rotating mode speed) and measures the torque in the middle of the sequence. The final torque is calculated as the mean value of these two measurements.	0 s / real32
	0...3600 s	Rotating mode time in rpm.	1 = 1 s / 1 = 1 s
76.44	Rotating mode calculation	Defines the method used for calculating the actual rope tension when the torque measurement mode is set to rotating mode. See parameter 76.40 Torque measuring mode , selection Rotating mode. This selection is measuring the tension at the middle of rolling Out and In, and then calculates the average of these two values.	Average in out torq / uint16
	Average in out torq	The average torque measured during forward and reverse rotating cycle is the actual rope tension.	0
76.50	Re-mooring time interval 1	Defines the Re-mooring time interval 1. This parameter is used in the time control sequence (parameter 76.01 Automoor mode). During this time, the drive/motor is stopped and the mechanical brake is closed.	1.0 min / real32
	0.0 ... 3600.0 min	Re-mooring time interval 1.	1 = 1 min / 1 = 1 min
76.51	Re-mooring time interval 2	Defines the Re-mooring time interval 2. This parameter is used in the time control sequence (parameter 76.01 Automoor mode). During this time, the drive/motor is stopped and the mechanical brake is closed.	3.0 min / real32
	0.0 ... 3600.0 min	Re-mooring time interval 2.	1 = 1 min / 1 = 1 min
76.52	Re-mooring time 1/2 switch src	Defines the source for Re-mooring time interval in time control Automoor mode. False = Re-mooring time 1 True = Re-mooring time 2	Re-mooring time 1 / int32
	Re-mooring time 1	The value in parameter 76.50 Re-mooring time interval 1 is used as final re-mooring time.	0
	Re-mooring time 2	The value in parameter 76.51 Re-mooring time interval 2 is used as re-mooring time.	1
	Switchover timer	The value in parameter 76.50 Re-mooring time interval 1 is used as Re-mooring time for the time interval defined in parameter 76.53 Re-mooring switchover time 1/2 , after which parameter 76.51 Re-mooring time interval 2 is used as Re-mooring time. See parameter 09.03 Winch status word 3 , bit 9.	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

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No.	Name / Range / Selection	Description	Def / Type FbEq 16b / 32b
	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).	9
	DIO2	Digital input/output DIO2 (11.02 DIO delayed status , bit 1).	10
	DI1 inverted	Digital input DI1 inverted	11
	DI2 inverted	Digital input DI2 inverted	12
	DI3 inverted	Digital input DI3 inverted	13
	DI4 inverted	Digital input DI4 inverted	14
	DI5 inverted	Digital input DI5 inverted	15
	DI6 inverted	Digital input DI6 inverted	16
	DIO1 inverted	Digital input/output DIO1 inverted	17
	DIO2 inverted	Digital input/output DIO2 inverted	18
	Other [bit]	See Terms and abbreviations (page 207) .	-
76.53	Re-mooring switchover time 1/2	The time interval that needs to be elapsed for re-mooring time interval 2 to be used as Re-mooring time, when parameter 76.52 Re-mooring time 1/2 switch src is selected as Switchover timer. See parameter 09.03 Winch status word 3 , bit 9.	30.0 min / real32
	0.0 ... 3600.0 min	Re-mooring switchover time 1/2.	1 = 1 min / 1 = 1 min
76.54	Re-mooring wakeup level	Change in Automoorng setpoint is needed to restart the Automoorng during re-mooring time interval. Also, the change in setpoint is required in parameter 09.37 AM combined setpoint/actual to switch temporarily from parameter 09.32 Winch scaled tension to 09.36 AM scaled setpoint .	1.00 % / real32
	0.00 ... 100.00%	Re-mooring wakeup level.	100 = 1% / 1 = 1%
76.55	Cont to Time switch src	Selects the source for switching to Time control mode from Continuous mode when Automoorng mode is set to Continuous + Time control in parameter 76.01 Automoorng mode .	Switchover timer / int32
	FALSE	0	0
	TRUE	1	1
	Switchover timer	Winch internally switches to Time control mode from the Continuous mode when the time defined with parameter 76.56 Cont to Time switchover time is elapsed.	2
	Setpoint switch list	Winch internally switches to Time control mode from the Continues mode when the parameter 09.04 Winch status word 4 is set to bit 5.	3
	DI1	Digital input DI1 (10.02 DI delayed status , bit 0).	4

No.	Name / Range / Selection	Description	Def / Type FbEq 16b / 32b
	DI2	Digital input DI2 (10.02 DI delayed status , bit 1).	5
	DI3	Digital input DI3 (10.02 DI delayed status , bit 2).	6
	DI4	Digital input DI4 (10.02 DI delayed status , bit 3).	7
	DI5	Digital input DI5 (10.02 DI delayed status , bit 4).	8
	DI6	Digital input DI6 (10.02 DI delayed status , bit 5).	9
	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
	DI1 inverted	Digital input DI1 inverted	12
	DI2 inverted	Digital input DI2 inverted	13
	DI3 inverted	Digital input DI3 inverted	14
	DI4 inverted	Digital input DI4 inverted	15
	DI5 inverted	Digital input DI5 inverted	16
	DI6 inverted	Digital input DI6 inverted	17
	DIO1 inverted	Digital input/output DIO1 inverted	18
	DIO2 inverted	Digital input/output DIO2 inverted	19
	Other [bit]	See Terms and abbreviations (page 207) .	-
76.56	Cont to Time switchover time	Defines the time that need to elapse before Automoor-ing switches to Time control mode from the initial Continuous mode. This time is effective only when parameter 76.01 Automoor-ing mode is set to Time control + Continuous.	15.0 min / real32
	0.0 ... 3600.0 min	Continuous mode to Time mode switchover time.	1 = 1 min / 1 = 1 min
76.60	Max AM time	Defines the maximum running time for the drive/mo-tor. The value is used in protection against an abnor-mal Automoor-ing sequence, load loss or broken ropes. If this time is exceeded, protective action is taken based on selection in parameter 76.61 Max AM timeout function .	1.0 min / real32
	0.0 ... 3600.0 min	Max Automoor-ing time.	1 = 1 min / 1 = 1 min
76.61	Max AM timeout function	Selects the protection action when the maximum Automoor-ing time (parameter 76.60 Max AM time) is reached.	Not used / uint16
	Not used	No action is taken.	0
	Stop	Protection is enabled. The drive is stopped and the mechanical brake is closed when the maximum moor-ing time (parameter 76.60 Max AM time) is reached. The drive is started again after the re mooring delay (parameter 76.50 Re-moor-ing time interval 1).	1
	Warning	Protection is enabled but the drive generates a warning when the maximum mooring time (parameter 76.60 Max AM time) is reached.	2

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No.	Name / Range / Selection	Description	Def / Type FbEq 16b / 32b
	Fault	Protection is enabled and drive trips on a fault and the mechanical brake is closed when the maximum mooring time (parameter 76.60 Max AM time) is reached.	3
76.65	Load cell high start limit	Defines the load cell tension limit for the drive to start in the heaving direction during mooring operation. If the actual rope tension is below the value defined in this parameter, the heave start command is blocked.	125.0 % / real32
	0.0 ... 600.0%	Load cell high start limit.	10 = 1% / 1 = 1%
76.70	AM motpot force init	When source selected with this parameter is ON, the Automoorings setpoint is forced to the value in parameter 76.14 Automoorings setpoint1 . This parameter is effective only when 76.13 Automoorings setpoint selection is set to Joystick motpot.	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).	8
	DIO2	Digital input/output DIO2 (11.02 DIO delayed status , bit 1).	9
	DI1 inverted	Digital input DI1 inverted	10
	DI2 inverted	Digital input DI2 inverted	11
	DI3 inverted	Digital input DI3 inverted	12
	DI4 inverted	Digital input DI4 inverted	13
	DI5 inverted	Digital input DI5 inverted	14
	DI6 inverted	Digital input DI6 inverted	15
	DIO1 inverted	Digital input/output DIO1 inverted	16
	DIO2 inverted	Digital input/output DIO2 inverted	17
	Other [bit]	See Terms and abbreviations (page 207) .	-
76.71	AM motpot ramp time	Defines the change rate of the Automoorings setpoint when joystick motpot is used to vary the Automoorings setpoint. This parameter specifies the time required for the setpoint to change from minimum (parameter 76.11 Min automoorings setpoint level) to maximum (76.12 Max automoorings setpoint level). The same change rate applies in both directions.	60.0 s / real32
	0.0 ... 3600.0 s	Automoorings motpot ramp time.	1 = 1 s / 1 = 1 s

No.	Name / Range / Selection	Description	Def / Type FbEq 16b / 32b
76.72	AM motpot init function	Defines an initial value (starting point) for the Automoooring setpoint on a mode change or power cycle. This parameter is effective only when 76.13 Automoooring setpoint selection is set to Joystick motpot.	Min automoooring setpoint / uint16
	Min automoooring setpoint	The initial value is the value set in parameter 76.11 Min automoooring setpoint level .	0
	Current rope tension	The initial value is the value stored in parameter 09.24 Rope tension memorized .	1
	Last automoooring setpoint	The initial value is the Automoooring setpoint used during the previous Automoooring cycle.	2
	Setpoint 1	The initial value is the value set in parameter 76.14 Automoooring setpoint1 .	3
76.75	AM setpoint selector conf A	Specifies the configuration word which allows the truth table in parameter 76.20 AM setpoint selector 1 srcA freely configurable. The bits 0-5 of this word defines whether the entries in Source A column of the truth table takes the value 1 or 0.	0000 0000 0010 0110 / uint16
b0	AM disabled	1 = Source A of the AM setpoint selector must be ON to disable AM. 0 = Source A of the AM setpoint selector must be OFF to disable AM.	
b1	Setpoint 1 conf A	1 = Source A of the AM setpoint selector must be ON for AM setpoint 1 to be active. 0 = Source A of the AM setpoint selector must be OFF for AM setpoint 1 to be active.	
b2	Setpoint 2 conf A	1 = Source A of the AM setpoint selector must be ON for AM setpoint 2 to be active. 0 = Source A of the AM setpoint selector must be OFF for AM setpoint 2 to be active.	
b3	Setpoint 3 conf A	1 = Source A of the AM setpoint selector must be ON for AM setpoint 3 to be active. 0 = Source A of the AM setpoint selector must be OFF for AM setpoint 3 to be active.	
b4	Setpoint 4 conf A	1 = Source A of the AM setpoint selector must be ON for AM setpoint 4 to be active. 0 = Source A of the AM setpoint selector must be OFF for AM setpoint 4 to be active.	
b5	Setpoint 5 conf A	1 = Source A of the AM setpoint selector must be ON for AM setpoint 5 to be active. 0 = Source A of the AM setpoint selector must be OFF for AM setpoint 5 to be active.	
b6...15	Reserved		
	0000h...FFFFh		1 / 1

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No.	Name / Range / Selection	Description	Def / Type FbEq 16b / 32b
76.76	AM setpoint select- or conf B	Specifies the configuration word which allows the truth table in parameter 76.20 AM setpoint selector 1 srcA freely configurable. The bits 0-5 of this word defines whether the entries in Source B column of the truth table takes the value 1 or 0.	0000 0000 0011 1100 / uint16
b0	AM disabled	1 = Source B of the AM setpoint selector must be ON to disable AM. 0 = Source B of the AM setpoint selector must be OFF to disable AM.	
b1	Setpoint 1 conf B	1 = Source B of the AM setpoint selector must be ON for AM setpoint 1 to be active. 0 = Source B of the AM setpoint selector must be OFF for AM setpoint 1 to be active.	
b2	Setpoint 2 conf B	1 = Source B of the AM setpoint selector must be ON for AM setpoint 2 to be active. 0 = Source B of the AM setpoint selector must be OFF for AM setpoint 2 to be active.	
b3	Setpoint 3 conf B	1 = Source B of the AM setpoint selector must be ON for AM setpoint 3 to be active. 0 = Source B of the AM setpoint selector must be OFF for AM setpoint 3 to be active.	
b4	Setpoint 4 conf B	1 = Source B of the AM setpoint selector must be ON for AM setpoint 4 to be active. 0 = Source B of the AM setpoint selector must be OFF for AM setpoint 4 to be active.	
b5	Setpoint 5 conf B	1 = Source B of the AM setpoint selector must be ON for AM setpoint 5 to be active. 0 = Source B of the AM setpoint selector must be OFF for AM setpoint 5 to be active.	
b6...15	Reserved		
	0000h...FFFFh		1 / 1
76.77	AM setpoint select- or conf C	Specifies the configuration word which allows the truth table in parameter 76.20 AM setpoint selector 1 srcA freely configurable. The bits 0-5 of this word defines whether the entries in Source C column of the truth table takes the value 1 or 0.	0000 0000 0011 0000 / uint16
b0	AM disabled	1 = Source C of the AM setpoint selector must be ON to disable AM. 0 = Source C of the AM setpoint selector must be OFF to disable AM.	
b1	Setpoint 1 conf C	1 = Source C of the AM setpoint selector must be ON for AM setpoint 1 to be active. 0 = Source C of the AM setpoint selector must be OFF for AM setpoint 1 to be active.	

No.	Name / Range / Selection	Description	Def / Type FbEq 16b / 32b
b2	Setpoint 2 conf C	1 = Source C of the AM setpoint selector must be ON for AM setpoint 2 to be active. 0 = Source C of the AM setpoint selector must be OFF for AM setpoint 2 to be active.	
b3	Setpoint 3 conf C	1 = Source C of the AM setpoint selector must be ON for AM setpoint 3 to be active. 0 = Source C of the AM setpoint selector must be OFF for AM setpoint 3 to be active.	
b4	Setpoint 4 conf C	1 = Source C of the AM setpoint selector must be ON for AM setpoint 4 to be active. 0 = Source C of the AM setpoint selector must be OFF for AM setpoint 4 to be active.	
b5	Setpoint 5 conf C	1 = Source C of the AM setpoint selector must be ON for AM setpoint 5 to be active. 0 = Source C of the AM setpoint selector must be OFF for AM setpoint 5 to be active.	
b6...15	Reserved		
	0000h...FFFFh		1 / 1
76.81	Frequent start supervision action	Defines action for frequent start/stop supervision for automooring routine in load cell mode that prevents excess starting condition. Every new start increment internal counter by 1, every time period defined by 76.82 Frequent start time window internal counter is decrement by 1. Supervision triggers defined action when the internal counter reaches a fixed value in 30 starts.	No action / uint16
	No action	Supervision not used.	0
	Fault	Supervision triggers fault when condition is detected.	1
76.82	Frequent start time window	Defines time window for supervision function and time period to decrement internal start/stop counter.	60 s / uint16
	0...65535 s	Motoring power limit for handmooring.	1 = 1 s / 1 = 1 s
76.85	AM min prot max starts	Defines the number of trials of minimum tension condition checking before the drive trips on a fault. - The counter is incremented each time the drive starts from remooring and then stops due to actual rope tension below the minimum tension level. - When the counter value exceeds the value set in this parameter, the drive trips on a fault. This parameter is effective only when parameter 76.06 AM min protection mode is set to Limited nbr of starts.	2 NoUnit / uint16
	0...30000	Automooring minimum protection maximum start.	1 = 1 / 1 = 1

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No.	Name / Range / Selection	Description	Def / Type FbEq 16b / 32b
76.90	Automoooring set-point fault reset	Enables/disables automatic fault reset in automoooring mode when the value selected in parameter 76.13 is below the value defined in parameter 76.91 during a time delay defined in parameter 76.92 . Note: The function can generate a fault reset if there is an active fault and the current control mode is set to Automoooring.	Disabled / int32
	Disabled	Automoooring setpoint fault reset function is disabled.	0
	Enabled	Automoooring setpoint fault reset function 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).	8
	DIO2	Digital input/output DIO2 (11.02 DIO delayed status , bit 1).	9
	DI1 inverted	Digital input DI1 inverted	10
	DI2 inverted	Digital input DI2 inverted	11
	DI3 inverted	Digital input DI3 inverted	12
	DI4 inverted	Digital input DI4 inverted	13
	DI5 inverted	Digital input DI5 inverted	14
	DI6 inverted	Digital input DI6 inverted	15
	DIO1 inverted	Digital input/output DIO1 inverted	16
	DIO2 inverted	Digital input/output DIO2 inverted	17
	Other [bit]	See Terms and abbreviations (page 207) .	-
76.91	Automoooring set-point fault reset level	Defines the Automoooring setpoint level below which a fault command will be automatically generated. Note: This function can generate a fault reset only if the current control mode is set to Automoooring.	5.0 % / real32
	0.0 ... 300.0%	Automoooring setpoint fault reset level	10 = 1% / 1 = 1%
76.92	Automoooring set-point fault reset delay	Defines the time delay required to verify that the automoooring setpoint level is below the value defined in parameter 76.91 . Note: The function can generate a fault reset if the current control mode is set to Automoooring.	0.5 s / real32
	0.0 ... 3200.0 s	Automoooring setpoint fault reset delay.	10 = 1 s / 1 = 1 s

No.	Name / Range / Selection	Description	Def / Type FbEq 16b / 32b
77	Anchor stowing protection	Settings for anchor stowing protection. Refer section Anchor stowing protection (page 55) .	
77.01	Anchor protection enable	Reserved	Disabled / int32
	Disabled	0	0
	Enabled	1	1
	In anchor mode	Enables anchor stowing protection when the anchoring mode is active. Refer parameters 74.01 Anchor mode enable and 09.01 Winch status word 1 , bit 0.	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).	9
	DIO2	Digital input/output DIO2 (11.02 DIO delayed status , bit 1).	10
	DI1 inverted	Digital input DI1 inverted	11
	DI2 inverted	Digital input DI2 inverted	12
	DI3 inverted	Digital input DI3 inverted	13
	DI4 inverted	Digital input DI4 inverted	14
	DI5 inverted	Digital input DI5 inverted	15
	DI6 inverted	Digital input DI6 inverted	16
	DIO1 inverted	Digital input/output DIO1 inverted	17
	DIO2 inverted	Digital input/output DIO2 inverted	18
	Parking mode		19
	Other [bit]	See Terms and abbreviations (page 207) .	-
77.02	Disable function	Used to temporarily defeat anchor stowing protection. When the signal specified with this parameter is ON, anchor stowing protection is disabled. After the signal returns to OFF, anchor stowing protection continue to be disabled for the period defined with parameter 77.03 Disable time , to be re-enabled after the delay.	Disabled / int32
	Disabled	0	0
	Enabled	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

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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).	8
	DIO2	Digital input/output DIO2 (11.02 DIO delayed status , bit 1).	9
	DI1 inverted	Digital input DI1 inverted	10
	DI2 inverted	Digital input DI2 inverted	11
	DI3 inverted	Digital input DI3 inverted	12
	DI4 inverted	Digital input DI4 inverted	13
	DI5 inverted	Digital input DI5 inverted	14
	DI6 inverted	Digital input DI6 inverted	15
	DIO1 inverted	Digital input/output DIO1 inverted	16
	DIO2 inverted	Digital input/output DIO2 inverted	17
	Other [bit]	See Terms and abbreviations (page 207) .	-
77.03	Disable time	See parameter 77.02 Disable function.	0.0 s / real32
	0.0 ... 3600.0 s	Disable time.	1 = 1 s / 1 = 1 s
77.04	Protection mode	Selects whether the anchor stowing protection is active before or after the chain/rope length limit (specified with parameter 77.06 Activation chain length) is reached.	Act > Lim / uint16
	Act > Lim	Anchor stowing protection is active when chain/rope length (09.13 Chain length OUT) is above the value of parameter 77.06 Activation chain length.	0
	Act < Lim	Anchor stowing protection is active when chain/rope length (09.13 Chain length OUT) is below the value of parameter 77.06 Activation chain length .	1
77.05	Activation speed direction	Selects the running direction in which anchor stowing protection is active.	Heave / uint16
	Heave	Anchor stowing protection is active only in the heave direction.	0
	Lower	Anchor stowing protection is active only in the lower direction.	1
	Both	Anchor stowing protection is active in both running directions.	2
77.06	Activation chain length	Defines the chain/rope length at which the anchor stowing protection is activated. This setting works in parallel with parameter 77.11 Anchor external detection .	4.000 m / real32
	-2000.000 ... 2000.000 m	Protection activation chain length.	100 = 1 m / 1 = 1 m

No.	Name / Range / Selection	Description	Def / Type FbEq 16b / 32b
77.07	Limited max torque	Defines the maximum torque applied by the drive when anchor stowing protection is active. Note: Minimum/maximum torque limit set in group 30 Limits (page 415) has priority over this parameter.	100.0 % / real32
	0.0 ... 300.0%	Limited maximum torque.	10 = 1% / 1 = 1%
77.08	Limited max speed	Defines limited maximum speed. Speed reference multiplier applied by the drive when anchor stowing protection is active. The multiplier is given in percentage of the existing running winch EXT2 reference.	25.0 % / real32
	0.0 ... 300.0%	Limited maximum speed	10 = 1% / 1 = 1%
77.09	Acc time in protection	Acceleration time from zero speed to anchor maximum speed defined with parameter 74.20 Anchor max speed heave or 74.21 Anchor max speed lower used when anchor stowing protection is active.	1.00 s / real32
	0.00 ... 1800.00 s	Acceleration time in protection.	10 = 1 s / 1 = 1 s
77.10	Dec time in protection	Deceleration time from anchor maximum speed defined with parameter 74.20 Anchor max speed heave or 74.21 Anchor max speed lower to zero speed used when anchor stowing protection is active.	1.00 s / real32
	0.00 ... 1800.00 s	Deceleration time in protection.	10 = 1 s / 1 = 1 s
77.11	Anchor external detection	Selects an alternative source for a chain/rope length limit signal. The signal works in parallel with parameter 77.06 Activation chain length .	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).	8
	DIO2	Digital input/output DIO2 (11.02 DIO delayed status , bit 1).	9
	DI1 inverted	Digital input DI1 inverted	10
	DI2 inverted	Digital input DI2 inverted	11
	DI3 inverted	Digital input DI3 inverted	12
	DI4 inverted	Digital input DI4 inverted	13
	DI5 inverted	Digital input DI5 inverted	14
	DI6 inverted	Digital input DI6 inverted	15
	DIO1 inverted	Digital input/output DIO1 inverted	16

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No.	Name / Range / Selection	Description	Def / Type FbEq 16b / 32b
	DIO2 inverted	Digital input/output DIO2 inverted	17
	Other [bit]	See Terms and abbreviations (page 207) .	-
77.12	Anchor parking enable time	Defines the time required to verify the control stand enable command for activating the anchor parking mode.	5.0 s / real32
	0.0 ... 3600.0 s	Anchor parking enable time.	10 = 1 s / 1 = 1 s

No.	Name / Range / Selection	Description	Def / Type FbEq 16b / 32b
78	Slip detection	Settings for slip detection. Refer section, Slip detection (page 81) .	
78.01	Slip detection enable	Enables/disables the slip detection. The function is used to decrease the winch speed whenever slippage is detected in a torque limiter, for example, a slip clutch. Slip detection is based on the external slip sensor, or on calculations made by the drive in which case slipping is determined to occur, if all of the following conditions are true: Actual chain/rope speed on the load side of the torque limiter (09.11 Chain actual speed) is below the value of parameter 78.06 Activation chain speed limit. Actual speed of the drive (01.01 Motor speed used) is above the value of parameter 78.07 Activation drive speed limit. Actual torque of the drive (01.10 Motor torque) is above the value of parameter 78.07 Activation drive speed limit. The running direction is as specified with parameter 78.05 Activation speed direction. After a slip is detected, the delay specified with parameter 78.09 Activation delay time starts. After delay elapses, the drive adopts the speed defined in parameter 78.10 Limited max speed. When the source selected with this parameter is ON, and EXT2 is selected as control location, slip detection is in use.	Disabled / int32
	Disabled	0	0
	Enabled	1	1
	In anchor mode	Enables slip detection when the anchoring mode is active. See parameter 74.01 Anchor mode enable and 09.01 Winch status word 1 , bit 0.	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).	9
	DIO2	Digital input/output DIO2 (11.02 DIO delayed status , bit 1).	10
	DI1 inverted	Digital input DI1 inverted	11

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No.	Name / Range / Selection	Description	Def / Type FbEq 16b / 32b
	DI2 inverted	Digital input DI2 inverted	12
	DI3 inverted	Digital input DI3 inverted	13
	DI4 inverted	Digital input DI4 inverted	14
	DI5 inverted	Digital input DI5 inverted	15
	DI6 inverted	Digital input DI6 inverted	16
	DIO1 inverted	Digital input/output DIO1 inverted	17
	DIO2 inverted	Digital input/output DIO2 inverted	18
	Parking mode	Reserved	19
78.02	Disable function	Enables/disables the temporarily defeat slip detection. When the signal specified with this parameter is ON, slip detection is disabled. After the signal returns to OFF, slip detection continues to be disabled for the period defined with parameter 78.03 Disable time to be enabled after the delay.	Disabled / int32
	Disabled	0	0
	Enabled	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).	8
	DIO2	Digital input/output DIO2 (11.02 DIO delayed status , bit 1).	9
	DI1 inverted	Digital input DI1 inverted	10
	DI2 inverted	Digital input DI2 inverted	11
	DI3 inverted	Digital input DI3 inverted	12
	DI4 inverted	Digital input DI4 inverted	13
	DI5 inverted	Digital input DI5 inverted	14
	DI6 inverted	Digital input DI6 inverted	15
	DIO1 inverted	Digital input/output DIO1 inverted	16
	DIO2 inverted	Digital input/output DIO2 inverted	17
78.03	Disable time	See parameter 78.02 Enabled .	0.0 s / real32
	0.0 ... 3600.0 s	Disable time.	1 = 1 s / 1 = 1 s
78.04	Slip detection mode	Defines the mode of slip detection function.	Internal / uint16
	Internal	Slip detection is based on parameters 78.05 Activation speed direction to 78.07 Activation drive speed limit .	0

No.	Name / Range / Selection	Description	Def / Type FbEq 16b / 32b
	External (78.11)	Slip detection is based on a signal from an external slip sensor. The source of the signal is defined with parameter 78.11 Slip external detection .	1
78.05	Activation speed direction	Selects the running direction in which slip detection is active.	Heave / uint16
	Heave	Slip detection is active in heave direction.	0
	Lower	Slip detection is active in lower direction.	1
	Both	Slip detection is active in both running directions.	2
78.06	Activation chain speed limit	Chain/rope speed limit on load side of the torque limiter. See parameter 78.01 Slip detection enable and 09.11 Chain actual speed .	0.010 m/s / real32
	0.000 ... 2000.000 m/s	Activation chain/rope speed limit.	100 = 1 m/s / 1 = 1 m/s
78.07	Activation drive speed limit	Activates slip detection function if the actual motor speed (parameter 01.01 Motor speed used) is more than the value set in this parameter. See parameter 78.01 Slip detection enable .	100.0 rpm / real32
	0.0 ... 18000.0 rpm	Activation drive speed limit.	1 = 1 rpm / 1 = 1 rpm
78.08	Activation torque limit	Activates slip detection function if the actual motor torque (parameter 01.10 Motor torque) is more than the value set in this parameter. See parameter 78.01 Slip detection enable .	70.0 % / real32
	0.0 ... 300.0%	Activation torque limit.	10 = 1% / 1 = 1%
78.09	Activation delay time	Time delay between slip detection and adoption of speed defined with parameter 78.10 Limited max speed . See parameter 78.01 Slip detection enable .	5.0 s / real32
	0.0 ... 3600.0 s	Activation delay time.	1 = 1 s / 1 = 1 s
78.10	Limited max speed	Speed adopted by the drive after slip is detected and the delay set with parameter 78.09 Activation delay time has passed. The speed reference multiplier is given in percentage of the existing running winch EXT2 reference. See parameter 78.01 Slip detection enable .	0.0 % / real32
	0.0 ... 300.0%	Acceleration time in protection.	10 = 1% / 1 = 1%
78.11	Slip external detection	Selects the source for external detection of slippage.	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

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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).	8
	DIO2	Digital input/output DIO2 (11.02 DIO delayed status, bit 1).	9
	DI1 inverted	Digital input DI1 inverted	10
	DI2 inverted	Digital input DI2 inverted	11
	DI3 inverted	Digital input DI3 inverted	12
	DI4 inverted	Digital input DI4 inverted	13
	DI5 inverted	Digital input DI5 inverted	14
	DI6 inverted	Digital input DI6 inverted	15
	DIO1 inverted	Digital input/output DIO1 inverted	16
	DIO2 inverted	Digital input/output DIO2 inverted	17

No.	Name / Range / Selection	Description	Def / Type FbEq 16b / 32b
79	Peak torque protection	Settings for peak torque protection. Refer section Peak torque protection (page 81) .	
79.01	Peak torque protection enable	Enables/disables the peak torque protection. The function is used to soften the mechanical loads caused by a tightening rope. If the torque and the speed exceed pre-set limits, peak torque protection activates, causing the drive to decelerate down to a (lower) pre-set speed. When the source selected with this parameter is ON, and EXT2 is selected as control location, peak torque protection is in use.	Disabled / int32
	Disabled	0	0
	Enabled	1	1
	In handmooring mode	Enables peak torque protection when Handmooring mode is active. See parameters 74.02 Handmooring mode enable and 09.01 Winch status word 1, bit 1 .	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).	9
	DIO2	Digital input/output DIO2 (11.02 DIO delayed status , bit 1).	10
	DI1 inverted	Digital input DI1 inverted	11
	DI2 inverted	Digital input DI2 inverted	12
	DI3 inverted	Digital input DI3 inverted	13
	DI4 inverted	Digital input DI4 inverted	14
	DI5 inverted	Digital input DI5 inverted	15
	DI6 inverted	Digital input DI6 inverted	16
	DIO1 inverted	Digital input/output DIO1 inverted	17
	DIO2 inverted	Digital input/output DIO2 inverted	18
79.02	Activation speed direction	Selects the running direction in which peak torque protection is active.	Heave / uint16
	Heave	Peak torque protection is active in heave direction.	0
	Lower	Peak torque protection is active in lower direction.	1
	Both	Peak torque protection is active in both forward (heave) and reverse (lower) directions.	2

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No.	Name / Range / Selection	Description	Def / Type FbEq 16b / 32b
79.03	Activation torque limit	Activates peak torque protection when actual signal 01.10 Motor torque exceeds this limit and the absolute value of actual signal 01.01 Motor speed used exceeds the limit set with parameter 79.04 Activation speed limit .	50.0 % / real32
	0.0 ... 300.0%	Activation torque limit.	10 = 1% / 1 = 1%
79.04	Activation speed limit	Activates peak torque protection when the absolute value of actual signal 01.01 Motor speed used exceeds this limit and actual signal 01.10 Motor torque exceeds the limit set with parameter 79.03 Activation torque limit .	100 rpm / real32
	0...18000 rpm	Activation speed limit.	1 = 1 rpm / 1 = 1 rpm
79.05	Dec time to protection speed	Defines the deceleration time to protection speed. When the protection is activated, the drive is decelerated from reference speed down to the speed defined with parameter 79.06 Limited max speed within the time specified with this parameter.	1.00 s / real32
	0.00 ... 3600.00 s	Deceleration time to protection speed.	10 = 1 s / 1 = 1 s
79.06	Limited max speed	Speed reference multiplier applied by the drive when peak torque protection is active.	33.0 % / real32
	0.0 ... 100.0%	Limited maximum speed.	10 = 1% / 1 = 1%
79.07	Dec time to zero	Deceleration time from parameter 79.06 Limited max speed to zero for the peak torque protection function. This deceleration time applies when peak torque protection is active.	1.00 s / real32
	0.00 ... 1800.00 s	Deceleration time to zero.	10 = 1 s / 1 = 1 s

No.	Name / Range / Selection	Description	Def / Type FbEq 16b / 32b
80	Power control	Settings for power control. Refer section Power control (page 84) .	
80.01	Power control enable	Enables/disables power control pointer.	Disabled / int32
	Disabled	0	0
	Enabled	1	1
	In Anchor mode	Enables power control when Anchor mode is active. See parameters 74.01 Anchor mode enable and 09.01 Winch status word 1 , bit 0.	2
	In Anchor or Handmooring mode	Enables power control when Anchor or Handmooring mode is active. See parameter 09.01 Winch status word 1 . • Bit 0 - Anchor mode active = 1 • Bit 1 - Handmooring mode = 1	3
	DI1	Digital input DI1 (10.02 DI delayed status , bit 0).	4
	DI2	Digital input DI2 (10.02 DI delayed status , bit 1).	5
	DI3	Digital input DI3 (10.02 DI delayed status , bit 2).	6
	DI4	Digital input DI4 (10.02 DI delayed status , bit 3).	7
	DI5	Digital input DI5 (10.02 DI delayed status , bit 4).	8
	DI6	Digital input DI6 (10.02 DI delayed status , bit 5).	9
	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
	DI1 inverted	Digital input DI1 inverted	12
	DI2 inverted	Digital input DI2 inverted	13
	DI3 inverted	Digital input DI3 inverted	14
	DI4 inverted	Digital input DI4 inverted	15
	DI5 inverted	Digital input DI5 inverted	16
	DI6 inverted	Digital input DI6 inverted	17
	DIO1 inverted	Digital input/output DIO1 inverted	18
	DIO2 inverted	Digital input/output DIO2 inverted	19
	Other [bit]	See Terms and abbreviations (page 207) .	-
80.02	Set1 torque level1	Torque level for crosspoint 1 in forward operation (heaving the winch). 100% = winch motor nominal torque	0.0 % / real32
	0.0 ... 3000.0%	Level in percentage	10 = 1% / 1 = 1%
80.03	Set1 torque level2	Torque level for crosspoint 2 in forward operation (heaving the winch). 100% = winch motor nominal torque	0.0 % / real32

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No.	Name / Range / Selection	Description	Def / Type FbEq 16b / 32b
	0.0 ... 3000.0%	Level in percentage	10 = 1% / 1 = 1%
80.04	Set1 torque level3	Torque level for crosspoint 3 in forward operation (heaving the winch). 100% = winch motor nominal torque	0.0 % / real32
	0.0 ... 3000.0%	Level in percentage	10 = 1% / 1 = 1%
80.05	Set1 torque level4	Torque level for crosspoint 4 in forward operation (heaving the winch). 100% = winch motor nominal torque	0.0 % / real32
	0.0 ... 3000.0%	Level in percentage	10 = 1% / 1 = 1%
80.06	Set1 torque level5	Torque level for crosspoint 5 in forward operation (heaving the winch). 100% = winch motor nominal torque	0.0 % / real32
	0.0 ... 3000.0%	Level in percentage	10 = 1% / 1 = 1%
80.07	Set1 speed level1	Speed limit for crosspoint 1 in forward operation (heaving the winch).	0.0 rpm / real32
	0.0 ... 18000.0 rpm	Speed	1 = 1 rpm / 1 = 1 rpm
80.08	Set1 speed level2	Speed limit for crosspoint 2 in forward operation (heaving the winch).	0.0 rpm / real32
	0.0 ... 18000.0 rpm	Speed	1 = 1 rpm / 1 = 1 rpm
80.09	Set1 speed level3	Speed limit for crosspoint 3 in forward operation (heaving the winch).	0.0 rpm / real32
	0.0 ... 18000.0 rpm	Speed	1 = 1 rpm / 1 = 1 rpm
80.10	Set1 speed level4	Speed limit for crosspoint 4 in forward operation (heaving the winch).	0.0 rpm / real32
	0.0 ... 18000.0 rpm	Speed	1 = 1 rpm / 1 = 1 rpm
80.11	Set1 speed level5	Speed limit for crosspoint 5 in forward operation (heaving the winch).	0.0 rpm / real32
	0.0 ... 18000.0 rpm	Speed	1 = 1 rpm / 1 = 1 rpm
80.12	Set2 torque level1	Torque level for crosspoint 1 in reverse operation (lowering the winch). 100% = winch motor nominal torque	0.0 % / real32
	0.0 ... 3000.0%	Level in percentage	10 = 1% / 1 = 1%
80.13	Set2 torque level2	Torque level for crosspoint 2 in reverse operation (lowering the winch). 100% = winch motor nominal torque	0.0 % / real32
	0.0 ... 3000.0%	Level in percentage	10 = 1% / 1 = 1%
80.14	Set2 torque level3	Torque level for crosspoint 3 in reverse operation (lowering the winch). 100% = winch motor nominal torque	0.0 % / real32
	0.0 ... 3000.0%	Level in percentage	10 = 1% / 1 = 1%

No.	Name / Range / Selection	Description	Def / Type FbEq 16b / 32b
80.15	Set2 torque level4	Torque level for crosspoint 4 in reverse operation (lowering the winch). 100% = winch motor nominal torque	0.0 % / real32
	0.0 ... 3000.0%	Level in percentage	10 = 1% / 1 = 1%
80.16	Set2 torque level5	Torque level for crosspoint 5 in reverse operation (lowering the winch). 100% = winch motor nominal torque	0.0 % / real32
	0.0 ... 3000.0%	Level in percentage	10 = 1% / 1 = 1%
80.17	Set2 speed level1	Speed limit for crosspoint 1 in reverse operation (lowering the winch).	0.0 rpm / real32
	0.0 ... 18000.0 rpm	Speed	1 = 1 rpm / 1 = 1 rpm
80.18	Set2 speed level2	Speed limit for crosspoint 2 in reverse operation (lowering the winch).	0.0 rpm / real32
	0.0 ... 18000.0 rpm	Speed	1 = 1 rpm / 1 = 1 rpm
80.19	Set2 speed level3	Speed limit for crosspoint 3 in reverse operation (lowering the winch).	0.0 rpm / real32
	0.0 ... 18000.0 rpm	Speed	1 = 1 rpm / 1 = 1 rpm
80.20	Set2 speed level4	Speed limit for crosspoint 4 in reverse operation (lowering the winch).	0.0 rpm / real32
	0.0 ... 18000.0 rpm	Speed	1 = 1 rpm / 1 = 1 rpm
80.21	Set2 speed level5	Speed limit for crosspoint 5 in reverse operation (lowering the winch).	0.0 rpm / real32
	0.0 ... 18000.0 rpm	Speed	1 = 1 rpm / 1 = 1 rpm
80.22	Acc torque buffer	Torque buffer applied until the end of acceleration in reverse operation (lowering the winch). 100% = winch motor nominal torque	0.0 % / real32
	0.0 ... 18000.0%	Percentage	1 = 1% / 1 = 1%
80.23	Dec torque buffer	Torque buffer applied until the start of deceleration in reverse operation (lowering the winch). 100% = winch motor nominal torque	0.0 % / real32
	0.0 ... 18000.0%	Percentage	1 = 1% / 1 = 1%
80.24	Power control filter time	Power control filter for signal 09.21 Power control ref to avoid oscillations between cross points.	0.000 s / real32
	0.000 ... 35.000 s	Filter time for signal 09.21 Power control ref .	100 = 1 s / 1 = 1 s
80.25	Power control hysteresis	Power control hysteresis. If the value of signal 09.21 Power control ref is within this value, there is no change in power control speed reference. This prevents oscillation at speed limitation break points.	2.00 % / real32
	0.00 ... 100.00%	Power control hysteresis	100 = 1% / 1 = 1%
80.26	Torque acc time	Defines torque acceleration time.	10.00 s / real32

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No.	Name / Range / Selection	Description	Def / Type FbEq 16b / 32b
	0.00 ... 30000.00 s	Torque acceleration time in seconds.	10 = 1 s / 1 = 1 s
80.27	Torque dec time	Defines torque deceleration time.	10.00 s / real32
	0.00 ... 30000.00 s	Torque deceleration time in seconds.	10 = 1 s / 1 = 1 s
80.30	Set1/Set2 switch	Selects the source that switches between the two sets of power control crosspoints defined with parameters 80.02...80.21 .	Set1 / int32
	Set1	Set1 cross points defined with parameters 80.02...80.11 are active.	0
	Set2	Set1 cross points defined with parameters 80.02...80.21 are active.	1
	Forward/Reverse	Set1 is used in forward and Set2 is used in reverse directions.	2
	Anchor/Handmooring	Set1 is used in Anchor mode and Set2 is used in Handmooring mode.	3
	DI1	Digital input DI1 (10.02 DI delayed status , bit 0).	4
	DI2	Digital input DI2 (10.02 DI delayed status , bit 1).	5
	DI3	Digital input DI3 (10.02 DI delayed status , bit 2).	6
	DI4	Digital input DI4 (10.02 DI delayed status , bit 3).	7
	DI5	Digital input DI5 (10.02 DI delayed status , bit 4).	8
	DI6	Digital input DI6 (10.02 DI delayed status , bit 5).	9
	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
	DI1 inverted	Digital input DI1 inverted	12
	DI2 inverted	Digital input DI2 inverted	13
	DI3 inverted	Digital input DI3 inverted	14
	DI4 inverted	Digital input DI4 inverted	15
	DI5 inverted	Digital input DI5 inverted	16
	DI6 inverted	Digital input DI6 inverted	17
	DIO1 inverted	Digital input/output DIO1 inverted	18
	DIO2 inverted	Digital input/output DIO2 inverted	19
	Other [bit]	See Terms and abbreviations (page 207) .	-
80.31	Torque source	Selects the source of torque reference used in power control against the crosspoints.	Actual torque / uint32
	Not selected	Torque source not selected	0
	Actual torque	Motor torque is used as power control torque reference for comparing against power control crosspoints. See parameter 01.10 Motor torque .	1

No.	Name / Range / Selection	Description	Def / Type FbEq 16b / 32b
	Rope tension	Inertia compensated rope tension is used as a power control torque reference for comparing against power control crosspoints. See parameter 74.62 Rope tension configuration (page 585).	2
	Other [bit]	See Terms and abbreviations (page 207).	-

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No.	Name / Range / Selection	Description	Def / Type FbEq 16b / 32b
81	Winch system check	Settings for torque proving and brake slip detection. Refer sections Brake opening torque selection (page 117) and Brake system checks – Brake slip (page 116) .	
81.01	Torque proving enable	Selects whether Torque proving (electrical test) is active or not. Note: For scalar motor control, disable Torque proving and Brake open torque. Select the following: 44.200 Brake open torque source = Zero 44.201 Brake open torque = 0% 81.01 Torque proving enable = Disable	Disabled / int32
	Disabled	0	0
	Enabled	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).	8
	DIO2	Digital input/output DIO2 (11.02 DIO delayed status , bit 1).	9
	DI1 inverted	Digital input DI1 inverted	10
	DI2 inverted	Digital input DI2 inverted	11
	DI3 inverted	Digital input DI3 inverted	12
	DI4 inverted	Digital input DI4 inverted	13
	DI5 inverted	Digital input DI5 inverted	14
	DI6 inverted	Digital input DI6 inverted	15
	DIO1 inverted	Digital input/output DIO1 inverted	16
	DIO2 inverted	Digital input/output DIO2 inverted	17
	Other [bit]	See Terms and abbreviations (page 207) .	-
81.02	Torque proving reference	Defines the torque reference during the torque proving test.	30.0 % / real32
	0.0 ... 100.0%	Torque reference proving percentage	10 = 1% / 1 = 1%

No.	Name / Range / Selection	Description	Def / Type FbEq 16b / 32b
81.03	Winch system check time	Defines the time delay during which Torque proving is active and the electrical and mechanical tests of the winch system are done against a closed brake. If the actual torque cannot be reached during this check time, the drive trips on fault D102 Torque prove failed. See parameters 81.01 Torque proving enable, 81.02 Torque proving reference and 81.04 Brake slip speed limit.	0.500 s / real32
	0.000 ... 10.000 s	Winch system check time	1000 = 1 s / 1 = 1 s
81.04	Brake slip speed limit	Defines the motor slip speed allowed during mechanical brake opening. If the motor speed exceeds this level during winch system check time, a motor brake slipping fault D103 Motor brake slipping is generated. This feature is not applicable in scalar mode.	50.0 rpm / real32
	0.0 ... 100.0 rpm	Speed (an absolute value)	10 = 1 rpm / 1 = 1 rpm
81.05	Brake slip fault delay	Defines the motor slip time delay during mechanical brake opening. If the motor speed exceeds slip speed during brake opening, a motor brake slipping fault D103 Motor brake slipping is generated. This feature is not applicable in scalar mode.	0.300 s / real32
	0.000 ... 10.000 s	Time	1000 = 1 s / 1 = 1 s

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No.	Name / Range / Selection	Description	Def / Type FbEq 16b / 32b
82	Clutch control	Settings for clutch control.	
82.01	Clutch control enable	Enables clutch control.	Disabled / int32
	Disabled	Clutch control speeds are not in use.	0
	Enabled always	Clutch control speeds are used whenever enabled with parameter 84.02 Synchro sel or 84.03 Sync corr mode .	1
	Any stand active	A clutch control speed is applied when any control stand is activated, and the source defined with parameter 84.02 Synchro sel or 84.03 Sync corr mode is ON. See parameters in group 75 Winch interface and parameter 09.02 Winch status word 2 , bit0 to bit4.	2
	Stand 1 active	A clutch control speed is applied when control stand 1 is activated, and the source defined with parameter 84.02 Synchro sel or 84.03 Sync corr mode is ON. See parameters in group 75 Winch interface and parameter 09.02 Winch status word 2 bit0.	3
	Stand 2 active	A clutch control speed is applied when control stand 2 is activated, and the source defined with parameter 84.02 Synchro sel or 84.03 Sync corr mode is ON. See parameters in group 75 Winch interface and parameter 09.02 Winch status word 2 , bit 1.	4
	Stand 3 active	A clutch control speed is applied when control stand 3 is activated, and the source defined with parameter 84.02 Synchro sel or 84.03 Sync corr mode is ON. See parameters in group 75 Winch interface and parameter 09.02 Winch status word 2 , bit 2.	5
	FB stand active	A clutch control speed is applied when a fieldbus control stand is activated, and the source defined with parameter 84.03 Sync corr mode is ON. See parameters in group 75 Winch interface and parameter 09.02 Winch status word 2 , bit 3.	6
	AM not active	Clutch control speed is applied whenever Automoorings is inactive. See parameters 74.03 Automoorings mode enable and parameter 09.02 Winch status word 2 , bit 2.	7
82.02	Clutch control 1 selection	Selects the source for activation of clutch control speed 1. When the source signal is ON, clutch control speed 1 is applied and the drive is started if allowed with parameter . Note: This parameter has priority over parameter 84.03 Sync corr mode .	Disabled / int32
	Disabled	0	0
	Enabled	1	1
	DI1	Digital input DI1 (10.02 DI delayed status , bit 0).	2
	DI2	Digital input DI2 (10.02 DI delayed status , bit 1).	3
	DI3	Digital input DI3 (10.02 DI delayed status , bit 2).	4

No.	Name / 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).	8
	DIO2	Digital input/output DIO2 (11.02 DIO delayed status , bit 1).	9
	DI1 inverted	Digital input DI1 inverted	10
	DI2 inverted	Digital input DI2 inverted	11
	DI3 inverted	Digital input DI3 inverted	12
	DI4 inverted	Digital input DI4 inverted	13
	DI5 inverted	Digital input DI5 inverted	14
	DI6 inverted	Digital input DI6 inverted	15
	DIO1 inverted	Digital input/output DIO1 inverted	16
	DIO2 inverted	Digital input/output DIO2 inverted	17
	Other [bit]	See Terms and abbreviations (page 207) .	-
82.03	Clutch control 2 selection	Selects the source for activation of clutch control speed 2. When the source signal is ON, clutch control speed 2 is applied and the drive is started if allowed with parameter . Note: Parameter 84.02 Synchro sel has priority over this parameter.	Disabled / int32
	Disabled	0	0
	Enabled	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).	8
	DIO2	Digital input/output DIO2 (11.02 DIO delayed status , bit 1).	9
	DI1 inverted	Digital input DI1 inverted	10
	DI2 inverted	Digital input DI2 inverted	11
	DI3 inverted	Digital input DI3 inverted	12
	DI4 inverted	Digital input DI4 inverted	13
	DI5 inverted	Digital input DI5 inverted	14

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No.	Name / Range / Selection	Description	Def / Type FbEq 16b / 32b
	DI6 inverted	Digital input DI6 inverted	15
	DIO1 inverted	Digital input/output DIO1 inverted	16
	DIO2 inverted	Digital input/output DIO2 inverted	17
	Other [bit]	See Terms and abbreviations (page 207) .	-
82.04	Clutch control speed 1	Defines the clutch control speed 1. Positive or negative sign defines direction.	150 rpm / real32
	-18000...18000 rpm	Clutch control speed 1	1 = 1 rpm / 1 = 1 rpm
82.05	Clutch control speed 2	Defines the clutch control speed 2. Positive or negative sign defines direction.	-150 rpm / real32
	-18000...18000 rpm	Clutch control speed 2	1 = 1 rpm / 1 = 1 rpm
82.06	Clutch control max torque	Defines the maximum torque used in clutch control mode. Note: Torque limits set in group 30 Limits has priority over this parameter.	50.0 % / real32
	0.0 ... 600.0%	Maximum torque for clutch control.	10 = 1% / 1 = 1%
82.08	Clutch acc time	Defines acceleration time from zero speed to clutch control speed 1 or clutch control speed 2, whichever is active. Used when the clutch control mode is active.	1.00 s / real32
	0.00 ... 1800.00 s	Clutch acceleration time.	10 = 1 s / 1 = 1 s
82.09	Clutch dec time	Defines deceleration time from clutch control speed 1 or clutch control speed 2, whichever is active, to zero speed. Used when the clutch control mode is active.	1.00 s / real32
	0.00 ... 1800.00 s	Clutch deceleration time.	10 = 1 s / 1 = 1 s

No.	Name / Range / Selection	Description	Def / Type FbEq 16b / 32b
84	Synchro control	Settings for synchro control. Refer section Synchro control function - block diagram (page 100) .	
84.01	Synchro control	Enables synchro control function.	Off / int32
	Off	Synchro control function is disabled.	0
	On	Synchro control function is enabled.	1
	Other [bit]	See Terms and abbreviations (page 207) .	-
84.02	Synchro sel	Activates Synchro control and defines the input for the Synchro command. When this command is active and the drive is in Master/Follower mode, the shaft synchronization is enabled. This parameter is active only when the Synchro control function is enabled with parameter .	No / int32
	No	Synchro selection command is not active.	0
	Select	Synchro selection command is active.	1
	Other [bit]	See Terms and abbreviations (page 207) .	-
84.03	Sync corr mode	Defines the synchronization correction mode used in Synchro command activation with parameter 84.02 Synchro sel	Direct / uint32
	Direct	Direct mode of synchronization correction. In this mode, the difference between the Master position and the Follower position at the time of Synchro command activation is taken as position error. No permanent offset is calculated in this mode.	0
	Offset	Offset mode of synchronization correction. In this mode, the difference between the Master position and the Follower position at the time of Synchro command activation is taken as an offset and is not considered as position error.	1
84.04	Synchro corr rate	Defines the rate factor for final speed correction reference in slave speed loop. The rate value corresponds to a correction of speed in rpm for a position error of 1 unit.	1.00 rpm/unit / real32
	0.00 ... 1000.00 rpm/unit	Correction rate	100 = 1 rpm/unit / 1 = 1 rpm/unit

No.	Name / Range / Selection	Description	Def / Type FbEq 16b / 32b
84.05	Synchro corr min speed	Defines the minimum speed below which position correction is not provided (par. 84.23 Correction speed ref = 0). When 84.05 Synchro corr min speed = 0, - start command is activated and synchro correction reference is generated to eliminate the 84.20 Actual position error. - start command is removed and synchro correction reference is generated to eliminate the 84.20 Actual position error to be inside 84.08 Position hysteresis. When 84.05 Synchro corr min speed is not equal to 0, - start command is activated and absolute value of 90.01 Motor speed for control is below this parameter value, then 84.23 Correction speed ref is forced to be 0. - start command is removed and absolute value of 90.01 Motor speed for control is below this parameter value, then whatever the value in parameter 84.20 Actual position error, the drive stops. - start command is activated and absolute value of 90.01 Motor speed for control is above this parameter value, then 84.23 Correction speed ref is generated to eliminate the position error. - start command is removed and absolute value of 90.01 Motor speed for control is above this parameter value then 84.23 Correction speed ref is generated to eliminate the 84.20 Actual position error. The drive stops when whatever stop condition is fulfilled (absolute value of parameter 90.01 Motor speed for control is less than 84.05 Synchro corr min speed or 84.20 Actual position error is less than 84.08 Position hysteresis).	0.00 rpm / real32
	0.00 ... 32000.00 rpm	Minimum speed for synchro correction.	100 = 1 rpm / 1 = 1 rpm
84.06	Synchro err limit	Defines the position synchronization error limit in the drive. If 84.20 Actual position error is greater or equal to this limit for more than the time defined in parameter 84.07 Synchro err fault delay , then drive generates the fault D10B Synchron fault .	10.00 unit / real32
	0.00 ... 1000.00 unit	Position synchronization error limit.	100 = 1 unit / 1 = 1 unit
84.07	Synchro err fault delay	Defines the time delay in generating the fault due to synchronization error. The delay counts as soon as parameter 84.02 Synchro sel is greater or equal to parameter 84.06 Synchro err limit .	2.0 s / real32
	0.0 ... 100.0 s	Synchronization error fault delay.	10 = 1 s / 1 = 1 s

No.	Name / Range / Selection	Description	Def / Type FbEq 16b / 32b
84.08	Position hysteresis	Defines the position hysteresis for stop sequence in synchronization mode. The drive stops only when the absolute synchronization position error is in this range. Note: - When this value = 0, drive stops as soon as the stop command is removed. - This parameter is applicable only for D2D Follower drives or for standalone drive with external PLC master.	5.00 unit / real32
	0.00 ... 1000.00 unit	Position hysteresis.	100 = 1 unit / 1 = 1 unit
84.09	Position hysteresis corr speed limit	Defines the limit for parameter 84.23 Correction speed ref , when start command is removed. Note: When start command is active, par. 84.23 is limited to 5% from parameters 90.01 Motor speed for control or 21.06 Zero speed limit depending on whichever is higher.	30.00 rpm / real32
	0.00 ... 32000.00 rpm	Position hysteresis correction speed limit.	100 = 1 rpm / 1 = 1 rpm
84.11	Synchro sw	Displays the status of synchro control function. This parameter is read only.	0000 0000 0000 0000 / uint16
b0	Synchro on	Synchro control function is On.	
b1	Synchro sel	Synchro control function is selected and position correction logic can modify the speed reference.	
b2	Synchro fault	Fault condition tripped and still presented due to position difference going beyond limits defined in parameter 84.06 Synchro err limit .	
b3...15	Reserved		
	0000h...FFFFh		1 / 1
84.19	Actual position	Displays the actual position of the drive (par. 90.05 Load position scaled). This parameter is read-only.	0.00 unit / real32
	-32000.00 ... 32000.00 unit	Actual position	100 = 1 unit / 1 = 1 unit
84.20	Actual position error	Displays the actual position error of this drive in comparison with the master target position. This parameter is read-only.	0.00 unit / real32
	-32000.00 ... 32000.00 unit	Actual position error	100 = 1 unit / 1 = 1 unit
84.21	Target position	Displays the target position from the master system. The target source is defined by parameter 84.40 Target position source . This parameter is read-only.	0.00 unit / real32
	-32000.00 ... 32000.00 unit	Synchro control target position.	100 = 1 unit / 1 = 1 unit

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No.	Name / Range / Selection	Description	Def / Type FbEq 16b / 32b
84.22	Offset value	Displays the offset value. Note: This value can be adjusted manually, when parameter 84.02 Synchro sel = Select.	0.00 unit / real32
	-32000.00 ... 32000.00 unit	Offset value.	100 = 1 unit / 1 = 1 unit
84.23	Correction speed ref	Displays the currently used additional speed reference to correct the position. This parameter is read-only.	0.00 rpm / real32
	-32000.00 ... 32000.00 rpm	Synchro control speed reference correction.	100 = 1 rpm / 1 = 1 rpm
84.40	Target position source	Selects the source of position reference for the synchro control function.	NULL / uint32
	NULL	None	0
	AI1	12.11 AI1 actual value (page 281).	1
	AI2	12.21 AI2 actual value (page 283).	2
	Position from D2D master	Value comes from parameter 84.50 Position from D2D master .	3
84.50	Position from D2D master	Displays the position reference from currently used D2D master. This parameter is read only.	0.000 unit / real32
	-32000.000 ... 32000.000 unit	Position from D2D master	1000 = 1 unit / 1 = 1 unit

No.	Name / Range / Selection	Description	Def / Type FbEq 16b / 32b
90	Feedback selection	Motor and load feedback configuration. See also section Encoder support (page 161) , and the diagram on page 823.	
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 is a read-only parameter.	- / 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 is a read-only parameter.	- / 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 is a read-only parameter.	- / real32
	-32768.00 ... 32767.00 rpm	Load speed. For 16-bit scaling, see parameter 46.01 .	- / 100 = 1 rpm

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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 is a read-only parameter.	- / 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 is a read-only parameter.	- / 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 is a read-only parameter.	- / 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. Refer section Position counter (page 163), and the block diagram on page 824. Note: This is a read-only parameter.	- / 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 is a read-only parameter.	- / 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 is a read-only parameter.	- / 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 is a read-only parameter.	- / 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 is a read-only parameter.	- / 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 is a read-only parameter.	- / 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 is a read-only parameter.	- / uint32
	0...16777215	Raw encoder 1 revolution count.	- / 1 = 1
90.20	Encoder 2 speed	Displays encoder 2 speed in rpm. Note: This is a read-only parameter.	- / real32

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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 is a read-only parameter.	- / real32
	0.00000000 ... 1.00000000 rev	Encoder 2 position within one revolution.	- / 100000000 = 1 rev
90.22	Encoder 2 multturn revolutions	Displays the revolutions of (multiturn) encoder 2 within its value range (see parameter 93.14 Revolution data width). Note: This is a read-only parameter.	- / 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 is a read-only parameter.	- / 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 is a read-only parameter.	- / 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 is a read-only parameter.	- / 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 is a read-only parameter.	- / 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 is a read-only parameter.	- / int32
	~~2147483648..2147483647~~	Load revolution count extension.	- / 1 = 1
90.35	Pos counter status	Status information related to the position counter function. Refer section Position counter (page 163) . Note: This is a read-only parameter.	- / 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

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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 171) 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 162). Note: You cannot change this parameter when the drive operates.	1 NoUnit / int32
	~~-2147483648~~ 2147483647	Motor gear numerator.	- / 1 = 1
90.44	Motor gear denominator	See parameter 90.43 Motor gear numerator. Note: You cannot change this parameter when the drive operates.	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
90.47	Enable motor encoder drift detection	Enables/disables detection of encoder drift based on the difference between encoder measurements and motor speed estimates.	Yes / uint16
	No	Encoder drift detection disabled.	0
	Yes	Encoder drift detection enabled.	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

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No.	Name / Range / Selection	Description	Def / Type FbEq 16b / 32b
	Estimate	Calculated speed and position estimates are used. The values are scaled from the motor side to the load side using the inverted ratio between 90.61 Gear numerator and 90.62 Gear denominator (ie. 90.62 divided by 90.61).	3
	Motor feedback	The source selected by parameter 90.41 Motor feedback selection for motor feedback is also used for load feedback. Any difference between the motor and load speeds (and positions) can be compensated by using the inverted ratio between 90.61 Gear numerator and 90.62 Gear denominator (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 162) . Note: You cannot change this parameter when the drive operates.	1 NoUnit / int32
	-2147483648..2147483647	Load gear numerator.	- / 1 = 1
90.54	Load gear denominator	See parameter 90.53 Load gear numerator . Note: You cannot change this parameter when the drive operates.	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

No.	Name / Range / Selection	Description	Def / Type FbEq 16b / 32b
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
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 163) .	- / 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 207) .	-
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 162) .	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

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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 207) .	-
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 207).	-
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 207).	-
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 207).	-

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No.	Name / Range / Selection	Description	Def / Type FbEq 16b / 32b
90.200	Proximity switch pulse count	Displays the count of number of pulses from the proximity switch. The pulse count is incremented when load drum is heaving and decremented when the load drum is lowering.	0 null / real32
	-2147483008..2147483008	Pulse count.	1 = 1 / 1 = 1
90.201	Proximity switch load position scaled	Displays the position of the load scaled based on the feed constant ratio (that is, 90.63 Feed constant numerator / 90.64 Feed constant denominator). Proximity switch load position scaled = (Pulse count x Feed constant ration) / Pulse per revolution.	0 null / real32
	-8388610.0 ... 8388610.0	Load position.	10 = 1 / 1 = 1
90.202	Motor speed filter time	Displays the speed of the load drum in RPM calculated by estimating the frequency of pulses from the proximity switch.	0.0 null / real32
	-32768.00 ... 32768.00	Load speed.	100 = 1 / 1 = 1
90.205	Proximity switch mode	Selects the mode for load position measurement when proximity switch is used for chain length measurement.	0000 0000 0000 0000 / uint16
	b0 SrcA & SrcB	Two proximity switches, A and B, which produces quadrature signals.	
	b1 SrcA & rotation dir	A single proximity switch A, whose pulse along with direction of rotation of the motor is used in estimating the load position.	
	0000h...FFFFh		1 / 1
90.206	Prox signal A source	Selects a digital source for pulse signal from proximity switch A.	Acc/Dec 1 / int32
	Acc/Dec 1	0	0
	Acc/Dec 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).	8
	DIO2	Digital input/output DIO2 (11.02 DIO delayed status , bit 1).	9
	DI1	Digital input DI1 inverted.	10
	DI2	Digital input DI2 inverted.	11
	DI3	Digital input DI3 inverted.	12

No.	Name / Range / Selection	Description	Def / Type FbEq 16b / 32b
	DI4	Digital input DI4 inverted.	13
	DI5	Digital input DI5 inverted.	14
	DI6	Digital input DI6 inverted.	15
	DIO1	Digital input/output DIO1 inverted.	16
	DIO2	Digital input/output DIO2 (11.02 DIO delayed status, bit 1).	18
	Other [bit]	See Terms and abbreviations (page 207) .	-
90.207	Prox signal B source	Selects a digital source for pulse signal from proximity switch B.	Acc/Dec 1 / int32
	Acc/Dec 1	0	0
	Acc/Dec 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).	8
	DIO2	Digital input/output DIO2 (11.02 DIO delayed status, bit 1).	9
	DI1	Digital input DI1 inverted.	10
	DI2	Digital input DI2 inverted.	11
	DI3	Digital input DI3 inverted.	12
	DI4	Digital input DI4 inverted.	13
	DI5	Digital input DI5 inverted.	14
	DI6	Digital input DI6 inverted.	15
	DIO1	Digital input/output DIO1 inverted.	16
	DIO2	Digital input/output DIO2 (11.02 DIO delayed status, bit 1).	17
	Other [bit]	See Terms and abbreviations (page 207) .	-
90.208	Pulses per drum revolution	Defines the number of pulses generated per revolution from the proximity switch on the load side.	0 null / real32
	0...65535	Pulses per revolution.	1 = 1 / 1 = 1
90.209	Crane ramp set selection	Selects a digital source for pulse signal from proximity switch B.	Acc/Dec 1 / int32
	Acc/Dec 1	0	0
	Acc/Dec 2	1	1
	DI1	Digital input DI1 (10.02 DI delayed status, bit 0).	2

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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).	8
	DIO2	Digital input/output DIO2 (11.02 DIO delayed status , bit 1).	9
	DI1	Digital input DI1 inverted.	10
	DI2	Digital input DI2 inverted.	11
	DI3	Digital input DI3 inverted.	12
	DI4	Digital input DI4 inverted.	13
	DI5	Digital input DI5 inverted.	14
	DI6	Digital input DI6 inverted.	15
	DIO1	Digital input/output DIO1 inverted.	16
	DIO2	Digital input/output DIO2 (11.02 DIO delayed status , bit 1).	17
	Other [bit]	See Terms and abbreviations (page 207).	-
90.210	Position counter init sw	Status information of rotary supervision function. Refer section Rotary supervision (page 55). This parameter is read-only.	0000 0000 0000 0000 / uint16
	b0 Pos counter init command	This bit is connected as default into parameter 90.67 Pos counter init cmd source .	
	b1 Reset pos counter init ready	This bit is connected as default into a parameter 90.69 Reset pos counter init ready .	
	b2...15 Reserved		
	0000h...FFFFh		1 / 1
90.211	Rotary supervision	Determines how the drive reacts when Rotary supervision function detects an error while supervising the incoming signals from the proximity sensors. See also Rotary supervision (page 55)	0000 0000 0000 0000 / uint16
	b0 Not used	No action is taken. The supervision is disabled.	
	b1 Warning	Supervision triggers a warning D21A Rotary supervision, when error condition is detected.	
	b1 Fault	Supervision triggers a fault D11A Rotary supervision, when error condition is detected.	
	0000h...FFFFh		1 / 1

No.	Name / Range / Selection	Description	Def / Type FbEq 16b / 32b
90.212	Motor speed filter time	Displays the position of the load scaled based on the feed constant ratio (that is, 90.63 Feed constant numerator / 90.64 Feed constant denominator). Proximity switch load position scaled = (Pulse count x Feed constant ration) / Pulse per revolution.	10 null / real32
	0.0 ... 600.0	Rotary supervision delay time.	10 = 1 / 1 = 1

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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 is a read-only parameter.	- / 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 is a read-only parameter.	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 is a read-only parameter.	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 is a read-only parameter.	- / real32

No.	Name / Range / Selection	Description	Def / Type FbEq 16b / 32b
	0...1000C	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 is a read-only parameter.	- / real32
	0...1000C	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 171) 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

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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 161) .	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 161) .	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

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No.	Name / Range / Selection	Description	Def / Type FbEq 16b / 32b
92	Encoder1 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 multi-turn 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 type , this setting acts like setting A all .	0
	A all	Channel A: Rising and falling edges are used for speed calculation. *Channel B: Defines the direction of rotation.	1
	A rising	Channel A: Rising edges are used for speed calculation. *Channel B: Defines the direction of rotation.	2
	A falling	Channel A: Falling edges are used for speed calculation. *Channel B: Defines the direction of rotation.	3

No.	Name / Range / Selection	Description	Def / Type FbEq 16b / 32b								
	Auto rising	One of the above modes is selected automatically depending on the pulse frequency as follows:	4								
		<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>		Pulse frequency of the channel(s)	Used mode	< 2442 Hz	A&B all	2442...4884 Hz	A all	> 4884 Hz	A rising
		Pulse frequency of the channel(s)		Used mode							
		< 2442 Hz		A&B all							
		2442...4884 Hz		A all							
> 4884 Hz	A rising										
	Auto falling	One of the above modes is selected automatically depending on the pulse frequency as follows:	5								
		<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>		Pulse frequency of the channel(s)	Used mode	< 2442 Hz	A&B all	2442...4884 Hz	A all	> 4884 Hz	A falling
		Pulse frequency of the channel(s)		Used mode							
		< 2442 Hz		A&B all							
		2442...4884 Hz		A all							
> 4884 Hz	A falling										
92.12	Zero pulse enable	(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 .	Disable / uint16								
	Disable	Zero pulse disabled.	0								
	Enable	Zero pulse enabled.	1								
92.12	Resolver polepairs	(Visible when 92.01 Encoder 1 type = Resolver) Defines the number of pole pairs of the resolver.	1 NoUnit / uint16								
	1...32	Number of resolver pole pairs.	1 = 1 / 1 = 1								
92.13	Position estimation enable	(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.	Enable / uint16								
	Disable	Measured position used. (The resolution is 4 × pulses per revolution for quadrature encoders, 2 × pulses per revolution for single-track encoders.)	0								
	Enable	Estimated position used. (Uses position interpolation; extrapolated at the time of data request.)	1								

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 VIExx 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 multturn 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 multturn 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

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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 μ s filtering time, the maximum pulse frequency is 200 kHz.	No filtering / uint16
	No filtering	Filtering disabled.	0
	1 μ s	Filtering time: 1 microsecond.	1
	2 μ s	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 calculation 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 incremental 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

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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	Hiperface node address	(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.	4800 bits/s / uint16
	4800 bits/s	1 MHz	0
	9600 bits/s	2 MHz	1
	19200 bits/s	4 MHz	2
	38400 bits/s	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	SSI revolution msb	(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 SSI revolution msb / 92.51 SSI revolution msb . The position delta validation measures the position feedback values in 250 μ s 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 NoUnit / uint16
	0 ... 1000.0	Position delta limit	- / 1 = 1
92.51	SSI revolution msb	(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 SSI revolution msb / 92.51 SSI revolution msb . Refer to parameter 92.50 SSI revolution msb .	2 NoUnit / uint16
	0...3000	Position delta mask time	- / 1 = 1

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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 1 / 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	Hiperface node address	(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.	4800 bits/s / uint16
	4800 bits/s	1 MHz	0
	9600 bits/s	2 MHz	1

No.	Name / Range / Selection	Description	Def / Type FbEq 16b / 32b
	19200 bits/s	4 MHz	2
	38400 bits/s	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	SSI revolution msb	(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 SSI revolution msb / 92.51 SSI revolution msb. 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 NoUnit / uint16
	0 ... 1000.0	Position delta limit	- / 1 = 1
93.51	SSI revolution msb	(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 SSI revolution msb / 92.51 SSI revolution msb. Refer to parameter 92.50 SSI revolution msb.	2 NoUnit / uint16
	0...3000	Position delta mask time	- / 1 = 1

No.	Name / Range / Selection	Description	Def / Type FbEq 16b / 32b
94	LSU control	Control of the supply unit of the drive, such as DC voltage and reactive power reference. Note that the references defined here must also be selected as the reference source in the supply control program to be effective. This group is only visible when supply unit control has been activated by parameter 95.20 HW options word 1. See also section Control of a supply unit (LSU) (page 151).	
94.01	LSU Control	Enables/disables the internal INU-LSU state machine. When the state machine is enabled, the inverter unit (INU) controls the supply unit (LSU) and prevents the inverter unit from starting until the supply unit is ready. When the state machine is disabled, the status of the supply unit is ignored by the inverter unit.	On / uint16
	Off	INU-LSU state machine disabled.	0
	On	INU-LSU state machine enabled.	1
94.02	LSU panel communication	Enables/disables control panel and PC tool access to the supply unit (line-side converter) via the inverter unit (motor-side converter). Note: This feature is only supported by the following drives: • ACS880-11 • ACS880-31 • ACS880-17 based on an integrated drive module • ACS880-37 based on an integrated drive module.	Disable / uint16
	Disable	Control panel and PC tool access to supply unit through inverter unit disabled.	0
	Enable	Control panel and PC tool access to supply unit through inverter unit enabled.	1
94.04	INU-LSU status word profile	<i>(Only visible with certain drive types.)</i> Selects the functionality of bit 1 of 06.11 Main status word.	ABB single drives standard SW / uint16
	ABB single drives standard SW	The drive sets bit 1 of 06.11 Main status word after the DC link is charged.	0
	Backwards compatible SW	The drive sets bit 1 of 06.11 Main status word after the main contactor is closed and the supply unit (line-side converter) is running. This setting can be used eg. when installing the drive into an existing set-up with other ACS880 as well as ACS800 drives.	1

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No.	Name / Range / Selection	Description	Def / Type FbEq 16b / 32b
94.05	LSU external start command	<i>(Only visible when IGBT supply unit control activated by 95.20)</i> Selects the source for LSU external start command. This parameter is visible only if INU-ISU communication is enabled in 95.20 bit 15. Note: If LSU is stopped using parameter 94.05 <i>LSU external start command</i>, LSU continues to run during the time defined by 94.11 <i>LSU stop delay</i>.	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
	DIIL	DIIL input (10.02 DI delayed status, bit 15).	30
94.10	LSU max charging time	Defines the maximum time the supply unit (LSU) is allowed for charging before a fault, 7584 <i>LSU charge failed</i> is generated.	15 s / uint16
	0...65535 s	Maximum charging time.	1 = 1 s / 1 = 1 s
94.11	LSU stop delay	Defines a stop delay for the supply unit. This parameter can be used to delay the opening of the main breaker/contactors when a restart is expected.	600.0 s / uint16
	0.0 ... 3600.0 s	Supply unit stop delay.	10 = 1 s / 10 = 1 s
94.20	DC voltage reference	<i>(Only visible when IGBT supply unit control activated by 95.20)</i> Displays the DC voltage reference sent to the supply unit. Note: This is a read-only parameter.	- / real32
	0.0 ... 2000.0 V	DC voltage reference sent to supply unit.	10 = 1 V / 10 = 1 V
94.21	DC voltage ref source	<i>(Only visible when IGBT supply unit control activated by 95.20)</i> Selects the source of the DC voltage reference to be sent to the supply unit.	User ref / uint32
	Zero	None.	0
	User ref	94.22 <i>User DC voltage reference</i> .	1

No.	Name / Range / Selection	Description	Def / Type FbEq 16b / 32b
	Other [bit]	Source selection. See Terms and abbreviations (page 207) .	-
94.22	User DC voltage reference	<i>(Only visible when IGBT supply unit control activated by 95.20)</i> Defines the DC voltage reference for the supply unit when 94.21 DC voltage ref source is set to User ref .	0.0 V / real32
	0.0 ... 2000.0 V	User DC reference.	10 = 1 V / 10 = 1 V
94.30	Reactive power reference	<i>(Only visible when IGBT supply unit control activated by 95.20)</i> Displays the reactive power reference sent to the supply unit. Note: This is a read-only parameter.	- / real32
	-3276.8 ... 3276.7 kVar	Reactive power reference sent to the supply unit.	10 = 1 kVar / 10 = 1 kVar
94.31	Reactive power ref source	<i>(Only visible when IGBT supply unit control activated by 95.20)</i> Selects the source of the reactive power reference to be sent to the supply unit.	User ref / uint32
	Zero	None.	0
	User ref	94.32 User reactive power reference .	1
	Other [bit]	Source selection. See Terms and abbreviations (page 207) .	-
94.32	User reactive power reference	<i>(Only visible when IGBT supply unit control activated by 95.20)</i> Defines the reactive power reference for the supply unit when 94.31 Reactive power ref source is set to User ref .	0.0 kVar / real32
	-3276.8 ... 3276.7 kVar	User reactive power reference.	10 = 1 kVar / 10 = 1 kVar
94.40	Power mot limit on net loss	Defines the maximum shaft power for motoring mode upon a supply network failure when IGBT supply unit control is active (bit 15 of 95.20 HW options word 1 is on). The value is given in percent of nominal motor power. Note: With a diode supply unit (bit 11 of 95.20 is on), the motoring shaft power is limited to 2% upon a network failure regardless of this parameter.	600.00 percent / real32
	0.00 ... 600.00 %	Maximum shaft power for motoring mode upon a supply network failure.	1 = 1 % / 100 = 1 %

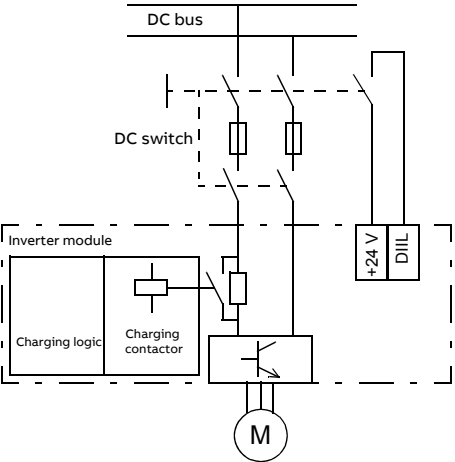
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No.	Name / Range / Selection	Description	Def / Type FbEq 16b / 32b
94.41	Power gen limit on net loss	Defines the maximum shaft power for generating upon a supply network failure when supply unit control is active (bit 15 of 95.20 HW options word 1 is on). The value is given in percent of nominal motor power. Note: With a diode supply unit (bit 11 of 95.20 is on), the motoring shaft power is limited to 2% upon a network failure regardless of this parameter.	-600.00 percent / real32
	-600.00 ... 0.00 %	Maximum shaft power for generating mode upon a supply network failure.	1 = 1 % / 100 = 1 %
94.50	LSU weak grid enable	Enables LSU weak grid detection on ACS880-11/31/14/34/17/37 drives to improve stability in weak grids and when the drive is supplied by a generator. Note: This parameter can be used only with ACS880-11/31/14/34/17/37 frames R3, R6, R8, and R11.	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 207).	-

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: You cannot change this parameter when the drive operates.	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

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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	<i>(Type BCU control units only)</i> 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 monitoring	<i>(Only visible with a ZCU control unit)</i> Enables/disables DC switch monitoring through 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

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No.	Name / Range / Selection	Description	Def / Type FbEq 16b / 32b
95.09	Switch fuse controller	<i>(Only visible with a BCU control unit)</i> 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	<i>(Only visible with a BCU control unit)</i> 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. 0 = Reduced run disabled 1...12 = Number of modules available Note: You cannot change this parameter when the drive operates.	- / uint16
	0...65535	Number of inverter modules available.	- / -
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: You cannot change this parameter when the drive operates.	- / 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 ABB.	
	b1 ABB sine filter	1 = An ABB sine filter is connected to the output of the drive/inverter.	

No.	Name / Range / Selection	Description	Def / Type FbEq 16b / 32b
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
95.20	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: You cannot change this parameter when the drive operates.	- / 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 1, without FSO module. Affects 10.24 , 21.04 , 21.05 , 23.200 .	
b2	Emergency stop Cat 1	1 = Emergency stop, Category 1, without FSO module. Affects 10.24 , 21.04 , 21.05 , 23.200 .	
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 . <i>(Only visible with a ZCU control unit)</i>	
b5	DC supply switch	1 = DC switch monitoring active. Affects 20.12 , 31.03 , 95.08 . <i>(Only visible with a ZCU control unit)</i>	
b6	DOL motor switch	1 = Motor fan control active. Affects 10.24 , 35.100 , 35.103 , 35.104 .	
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 .	
b12	Reserved		

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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 , 60 , 61 , 62 , 94 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: You cannot change this parameter when the drive operates.	- / 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 ABB 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	<i>(Only visible with a BCU control unit)</i> 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: You cannot change this parameter when the drive operates.	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

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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 open or close the Parameter lock (to allow or prevent the parameter editing) - to activate other than "End user" access levels (refer to 96.03) - to open and 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. <u>Store the code in a safe place – the protection cannot be disabled even by ABB if the code is lost.</u> Also, refer section User lock (page 135).	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 is a read-only parameter.	- / uint16
b0	End user	End user. This is the default access level on which the parameters that are described in this manual are visible.	
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

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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: You cannot change this parameter when the drive operates.	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: You cannot change this parameter when the drive operates.	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 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 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 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 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: You cannot change this parameter when the drive operates.	- / 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

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No.	Name / Range / Selection	Description	Def / Type FbEq 16b / 32b
	Other [bit]	See Terms and abbreviations (page 207) .	-
96.10	User set status	Shows the status of the user parameter sets. Note: This is a read-only parameter. See also section User parameter sets (page 198) .	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
	User set 5	User set 5 has been loaded.	8
	User set 6	User set 6 has been loaded.	9
	User set 7	User set 7 has been loaded.	10
	User set 8	User set 8 has been loaded.	11
96.11	User set save/load	Enables the saving and restoring of up to four custom sets of parameter settings. Refer section User parameter sets (page 198) . 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

No.	Name / Range / Selection	Description	Def / Type FbEq 16b / 32b															
	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															
	Save to set 3	Save user parameter set 3.	20															
	Save to set 4	Save user parameter set 4.	21															
96.12	User set I/O mode in1	When parameter 96.11 is set to User set I/O mode (page 688) , selects the user parameter set together with parameter 96.13 as follows:	Not selected / uint32															
		<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>		Status of source defined by 96.12	Status of source defined by 96.13	User parameter set selected	0	0	Set 1	1	0	Set 2	0	1	Set 3	1	1	Set 4
		Status of source defined by 96.12		Status of source defined by 96.13	User parameter set selected													
		0		0	Set 1													
		1		0	Set 2													
		0		1	Set 3													
1	1	Set 4																
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 207) .	-															
96.13	User set I/O mode in2	See parameter 96.12 User set I/O mode in1 .	Not selected / uint32															
96.16	Unit selection	Selects the unit of parameters indicating power, temperature and torque.	- / uint16															
b0	Power unit	0 = kW 1 = hp																
b1	Reserved																	
b2	Temperature unit	0 = C (°C) 1 = F (°F)																

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No.	Name / Range / Selection	Description	Def / Type FbEq 16b / 32b
b3	Reserved		
b4	Torque unit	0 = Nm (N·m) 1 = lbft (lbf·ft)	
b5...15	Reserved		
	0000h...FFFFh		1 = 1 / 1 = 1
96.20	Time sync primary source	Defines the 1st priority external source for synchronization of the drive's time and date.	DDCS Controller / 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
96.23	M/F and D2D clock synchronization	In the master drive, activates clock synchronization for master/follower and drive-to-drive communication.	Inactive / uint16
	Inactive	Clock synchronization not active.	0
	Active	Clock synchronization active.	1
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 through 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 is a read-only parameter.	- / uint16

No.	Name / Range / Selection	Description	Def / Type FbEq 16b / 32b
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.	
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. Refer section Warning/fault history and analysis (page 717) .	- / uint16

No.	Name / Range / Selection	Description	Def / Type FbEq 16b / 32b
	0...65535	00001 = Clear the event logs. (The value will automatically revert to 00000.)	1 = 1 / 1 = 1
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 198).	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 .	

No.	Name / Range / Selection	Description	Def / Type FbEq 16b / 32b
b7	Set approved checksum 4	1 = Set: Copy value of 96.53 into 96.59 .	
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. Refer section Warning/fault history and analysis (page 717) . Note: This is a read-only parameter.	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 207) .	-
	Other [bit]	See Terms and abbreviations (page 207) .	-
96.64	User data logger start	Starts, or selects a source that starts, the user data logger.	Off / uint32
	Off	0.	0

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No.	Name / Range / Selection	Description	Def / Type FbEq 16b / 32b
	On	1.	1
	Other [bit]	See Terms and abbreviations (page 207) .	-
96.65	Factory data logger time level	Selects the sampling interval for the factory data logger. Refer section Warning/fault history and analysis (page 717) .	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 138) . Note: You cannot change this parameter when the drive operates.	No / uint16
	No	Adaptive program enabled.	0
	Yes	Adaptive program disabled.	1
96.100	Change user pass code	<i>(Visible when user lock is open)</i> To change the current user pass code, enter a new code into this parameter as well as 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. Also, refer section User lock (page 135) .	10000000 / uint32
	10000000...99999999	New user pass code.	1 = 1
96.101	Confirm user pass code	<i>(Visible when user lock is open)</i> Confirms the new user pass code entered in 96.100 Change user pass code (page 694) .	10000000 / uint32
	10000000...99999999	Confirmation of new user pass code.	1 = 1
96.102	User lock functionality	<i>(Visible when user lock is open)</i> 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 .	- / 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	

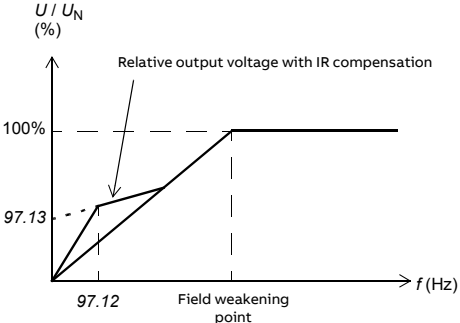
No.	Name / Range / Selection	Description	Def / Type FbEq 16b / 32b
b2	Disable file download	1 = Loading of files to drive prevented. This applies to - firmware upgrades - safety functions module (FSO-xx) configuration - parameter restore - loading an adaptive program - loading and debugging an application 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 write 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		
b9	Enable IEC programming online	1 = Loading and debugging an application with Drive Application Builder is enabled. This bit is functional only with N8010 licence.	
b10	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
96.108	LSU control board boot	<i>(Visible when IGBT supply unit control activated by 95.20)</i> Changing the value of this parameter to 1 reboots the supply control unit (without requiring a power off/on cycle of the drive system). The value reverts to 0 automatically.	0 NoUnit / uint16
	0...1	1 = Reboot the supply control unit.	1 = 1 / 1 = 1

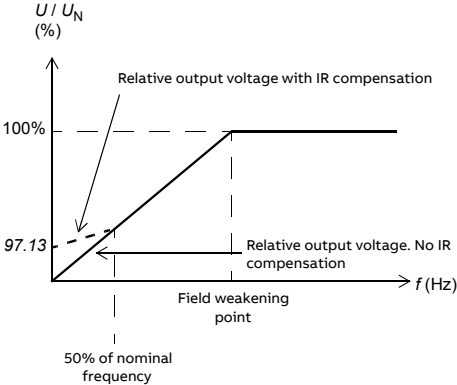
No.	Name / Range / Selection	Description	Def / Type FbEq 16b / 32b
97	Motor control	Motor model settings.	
97.01	Switching frequency reference	When parameter 97.09 Switching freq mode is set to Custom , defines the switching frequency when it is not otherwise being internally limited. Note: Do not adjust this expert-level parameter without the appropriate expertise.	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: Do not adjust this expert-level parameter without the appropriate expertise. 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: Do not adjust this expert-level parameter without the appropriate expertise. 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 $0.95 \times 550 \text{ V} / \sqrt{2} = 369 \text{ V}$ 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). Refer section Flux braking (page 174). Note: Do not adjust this expert-level parameter without the appropriate expertise.	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: Do not adjust this expert-level parameter without the appropriate expertise.	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 207) .	-
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.	$100 = 1 \% / 100 = 1 \%$

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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: Do not adjust this expert-level parameter without the appropriate expertise. 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: Do not adjust this expert-level parameter without the appropriate expertise. 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: Do not adjust this expert-level parameter without the appropriate expertise.	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: You cannot change this parameter when the drive operates.	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 171).	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 177).	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 is a read-only parameter.	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 823.	5.00 ms / real32
	0.00 ... 100.00 ms	Filtering time for estimated speed.	1 = 1 ms / 100 = 1 ms

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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: You cannot change this parameter when the drive operates.	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

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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: You cannot change this parameter when the drive operates.	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: You cannot change this parameter when the drive operates.	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 - if the load is not equally shared between the motors, - if the motors are of different sizes, or - 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 133).	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 170) and section Operating modes of the drive (page 133).	1

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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: You cannot change this parameter when the drive operates.	0.0 A / real32
	0.0 ... 10000.0 A	Nominal current of the motor. The allowable range is $1/6 \dots 2 \times I_N$ (nominal current) of the drive and $0 \dots 2 \times I_N$ 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 $3 \times 60 \text{ V} = 180 \text{ V}$. 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: You cannot change this parameter when the drive operates.	0.0 V / real32
	0.0 ... 1500.0 V	Nominal voltage of the motor. The allowable range is $1/6 \dots 2 \times U_N$ (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: You cannot change this parameter when the drive operates.	50.00 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: You cannot change this parameter when the drive operates. 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: You cannot change this parameter when the drive operates.	- / 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: You cannot change this parameter when the drive operates.	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: You cannot change this parameter when the drive operates.	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

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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 cancelled 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: You cannot change this parameter when the drive operates.	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

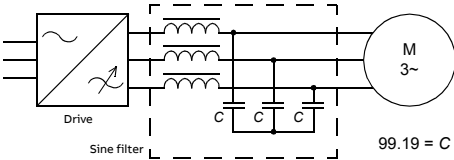
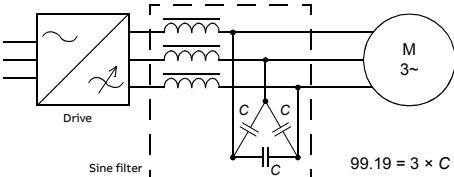
No.	Name / Range / Selection	Description	Def / Type FbEq 16b / 32b
	Normal	Normal ID run: • supports all motor types • load to be decoupled • good performance. Guarantees good control accuracy for all cases. This mode should be selected whenever it is possible. Note: If the load torque will be higher than 20% of motor nominal torque, or if the machinery is not able to withstand the nominal torque transient during the ID run, then the driven machinery must be de-coupled from the motor during a Normal ID run. 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 approximately 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 running (i.e. in case of a motor with an integrated brake supplied from the motor terminals). With this ID run mode, the resultant motor control in the field weakening area or at high torques is not necessarily as accurate as motor control following a Normal ID run. Reduced ID run is completed faster than the Normal ID run (< 90 seconds). Note: Check the direction of rotation of the motor before starting the ID run. During the run, the motor will rotate in the forward direction.  WARNING! The motor will run at up to approximately 50...100% of the nominal speed during the ID run. 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 (refer section Autophasing (page 171)). 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
	Autophasing	Autophasing .	4

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No.	Name / Range / Selection	Description	Def / Type FbEq 16b / 32b
	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: You cannot change this parameter when the drive operates.	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.	0.00 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 safety module 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.	

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 \(page 139\)](#)
- [Programmable relay outputs \(page 140\)](#), and
- [Programmable I/O extensions \(page 140\)](#).

■ 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 \(page 219\)](#). 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	Fault: 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	Fault: 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). Also check parameters 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: V-phase, 4: W-phase, 3/5/6/7: multiple phases).

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Code (hex)	Event name / Aux. code	Cause	What to do
2330	Earth leakage	Fault: 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. (Refer parameter 99.04 Motor control mode.) 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	Fault: 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.

Code (hex)	Event name / Aux. code	Cause	What to do
2381	IGBT overload	Fault: 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	Fault: 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 above). "ZZ" indicates the phase (1: U, 2: V, 3: W).
2392	BU earth leakage	Fault: 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	Fault: 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.
3000	Invalid voltage chain data-points	Fault: Parametrization of the speed/torque limitation curve (in the DC voltage reference chain) are inconsistent.	Check that the speed points of the curve are in increasing order.
3130	Supply phase loss	Fault: 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.

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Code (hex)	Event name / Aux. code	Cause	What to do
3180	Charge relay lost	Fault: No acknowledgement received from charge relay.	Contact your local ABB representative.
3181	Wiring or earth fault	Fault: 1. The drive hardware is supplied from a common DC bus. 2. Incorrect input power and motor cable connection (i.e. input power cable is connected to the motor connection). 3. Drive has detected load unbalance typically due to earth fault in motor or motor cable.	1. Switch off the protection in parameter 31.23. 2. Check the power connections. Check the input fuses. 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 (refer parameter 99.04 Motor control mode).
3210	DC link over-voltage	Fault: Excessive intermediate circuit DC voltage.	Check that overvoltage control is on (parameter 30.30 Overvoltage control). Check that the supply voltage matches the nominal input voltage of the drive. Check the supply line for static or transient overvoltage. Check brake chopper and resistor (if present). Check deceleration time. Use coast-to-stop function (if applicable). Retrofit drive with brake chopper and brake resistor. 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 under-voltage	Fault: 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.

Code (hex)	Event name / Aux. code	Cause	What to do
3280	Standby timeout	Fault: Automatic restart failed (refer section Automatic restart (page 180)).	Check the condition of the supply (voltage, cabling, fuses, switchgear).
3291	DC voltage difference	Fault: 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	Fault: Motor circuit fault due to missing motor connection (all three phases are not connected).	Connect motor cable.
3385	Autophasing	Fault: Autophasing routine (refer section Autophasing (page 171)) 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 .
	0002	Motor is rotating during autophasing.	Check that the load torque is not too high for the Turning mode (must be less than 5%). 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. 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.

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Code (hex)	Event name / Aux. code	Cause	What to do
	0009	(LV-Synchro) Standstill failure.	Contact your local ABB representative.
3E00	Input phase loss	Fault: 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	Fault: 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	Fault: 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 <i>Hardware manual</i>. 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	Fault: Control board temperature is too high.	Check proper cooling of the drive. Check the auxiliary cooling fan.
4210	IGBT overtemperature	Fault: 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	Fault: 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 <i>Hardware manual</i>. Check drive module cooling air flow and fan operation. Check inside of cabinet and heatsink of drive module for dust pick-up. Clean whenever necessary.

Code (hex)	Event name / Aux. code	Cause	What to do
42F1	IGBT temperature	Fault: 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	Fault: Power unit module temperature is excessive.	See A4B0 Excess temperature .
4380	Excess temp difference	Fault: High temperature difference between the IGBTs of different phases.	See A4B1 Excess temperature difference (page 772) .
4981	External temperature 1	Fault: 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	Fault: 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	Fault: 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	Fault: 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	Fault: 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.

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Code (hex)	Event name / Aux. code	Cause	What to do
4993	Safe motor temperature 3	Fault: 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.
5080	Fan	Fault: Cooling fan feedback missing.	See A581 Fan .
5081	Auxiliary fan not running	Fault: 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	Fault: 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	Fault: 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 429) .
5092	PU logic error	Fault: 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.

Code (hex)	Event name / Aux. code	Cause	What to do
5093	Rating ID mismatch	Fault: 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. 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	Fault: Problem with internal temperature measurement of the drive.	See A5EA Measurement circuit temperature (page 772) .

Code (hex)	Event name / Aux. code	Cause	What to do
5681	PU communication	Fault: 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 [x]INT 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	Fault: Connection between the drive control unit and the power unit is lost.	Check the connection between the control unit and the power unit.
5690	PU communication internal	Fault: Internal communication error.	Contact your local ABB representative.
5691	Measurement circuit ADC	Fault: 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	Fault: 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	Fault: Measurement circuit fault.	Contact your local ABB representative, quoting the auxiliary code.
5694	PU communication conf	Fault: 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.	

Code (hex)	Event name / Aux. code	Cause	What to do
	0003	Power unit (xINT) is in the wrong channel.	
	0005	Too many power units (xINTs).	
5695	Reduced run	Fault: Number of inverter modules detected does not match the value of parameter 95.13 <i>Reduced run mode</i> .	Check that the value of 95.13 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 is set to 0 (reduced run function disabled).
5696	PU state feedback	Fault: State feedback from output phases does not match control signals.	Contact your local ABB representative, quoting the auxiliary code.
5697	Charging feedback	Fault: • Incorrect parameter setting. • The charging switch and DC switch were operated out of sequence, or a start command was issued before the unit was ready. • Charging circuit fault. • Brake circuit fault.	• Check the setting of 95.09 Switch fuse controller. The parameter should be enabled only if an xSFC charging controller is installed. • 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. • 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. • Check the wiring and condition of brake resistor.
5698	Unknown PU fault	Fault: Unidentified power unit logic fault.	Check power unit logic and firmware compatibility. Contact your local ABB representative.
6000	Internal SW error	Fault: Internal error.	Contact your local ABB representative, quoting the auxiliary code.

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Code (hex)	Event name / Aux. code	Cause	What to do
6181	FPGA version incompatible	Fault: - Firmware and FPGA file version in the power unit are incompatible. - Update of power unit logic failed.	- Reboot the control unit (using parameter 96.08 Control board boot) or by cycling power. If the problem persists, contact your local ABB representative. - Retry.
6200	Checksum mismatch	Fault: The calculated parameter checksum does not match any enabled reference checksum.	See A686 Checksum mismatch .
6306	FBA A mapping file	Fault: Fieldbus adapter A mapping file read error.	Contact your local ABB representative.
6307	FBA B mapping file	Fault: Fieldbus adapter B mapping file read error.	Contact your local ABB representative.
6481	Task overload	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.
6487	Stack overflow	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.
6488	Restart after firmware malfunction	Fault: 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.
64A1	Internal file load	Fault: 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	Fault: Internal record load error.	Contact your local ABB representative.
64A3	Application loading	Fault: 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.

Code (hex)	Event name / Aux. code	Cause	What to do
	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	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	Fault: Error running the adaptive program.	Check the auxiliary code (format XXXX YYYY). "XXXX" specifies the number of the function block (0000 = generic 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 nonexistent 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.

Code (hex)	Event name / Aux. code	Cause	What to do
64B0	Memory unit detached	Fault: 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	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	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	Fault: Operating system error.	Reboot the control unit (using parameter 96.08 Control board boot) or by cycling power. If the problem persists, contact your local ABB representative.
64FF	Fault reset	Fault: Informative fault.	An active fault has been reset.
6581	Parameters system	Fault: Parameter load or save failed.	Try forcing a save using parameter 96.07 Parameter save manually . Retry.
6591	Backup/Restore Timeout	Fault: 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	FBAA parameter conflict	Fault: 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	Fault: 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	Fault: A reference source is simultaneously connected to multiple parameters with different units.	See A6DA Reference source parametrization (page 772) .
6681	EFB communication loss	Fault: Communication break in embedded fieldbus (EFB) communication.	Check the status of the fieldbus master (online/offline/error etc.). Check cable connections to the XD2D connector on the control unit.

Code (hex)	Event name / Aux. code	Cause	What to do
6682	EFB configuration file	Fault: Embedded fieldbus (EFB) configuration file could not be read.	Contact your local ABB representative.
6683	EFB invalid parameterization	Fault: 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	Fault: • Embedded fieldbus (EFB) protocol firmware could not be loaded. • Version mismatch between EFB protocol firmware and drive firmware.	Contact your local ABB representative.
6881	Text data overflow	Fault: Internal fault.	Reset the fault. Contact your local ABB representative if the fault persists.
6882	Text 32-bit table overflow	Fault: Internal fault.	Reset the fault. Contact your local ABB representative if the fault persists.
6883	Text 64-bit table overflow	Fault: Internal fault.	Reset the fault. Contact your local ABB representative if the fault persists.
6885	Text file overflow	Fault: Internal fault.	Reset the fault. Contact your local ABB representative if the fault persists.
7080	Option module comm loss	Fault: Communication between drive and an option module is lost.	See A798 Encoder option comm loss (page 772) .
7081	Control panel loss	Fault: Control panel (or PC tool) has stopped communicating.	Check PC tool or control panel connection. 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	Fault: The I/O extension module types specified by parameters do not match the detected configuration.	See A799 Ext I/O comm loss (page 772) .
7083	Panel reference conflict	Fault: 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	Fault: 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.

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Code (hex)	Event name / Aux. code	Cause	What to do
7085	Incompatible option module	Fault: Option module not supported. (For example, type Fxxx-xx-M fieldbus 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 unit. Remove FSO-xx module to clear the fault. Connect FSO-xx module to the supported control unit.
7121	Motor stall	Fault: 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	Fault: 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	Fault: 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	Fault: Brake resistor temperature has exceeded fault limit defined by parameter 43.11 Brake resistor fault limit .	Stop drive. Let resistor cool down. Check resistor overload protection function settings (parameter group 43 Brake chopper). Check fault limit setting, parameter 43.11 Brake resistor fault limit. Check that braking cycle meets allowed limits.
7184	Brake resistor wiring	Fault: 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.

Code (hex)	Event name / Aux. code	Cause	What to do
7191	BC short circuit	Fault: Short circuit in brake chopper IGBT.	Ensure brake resistor is connected and not damaged. Check the electrical specifications of the brake resistor against the <i>Hardware manual</i>. 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	Fault: 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.
71A2	Mech brake closing failed	Fault: Mechanical brake control fault. Activated eg. if brake acknowledgement is not as expected during brake closing.	Check mechanical brake connection. Check mechanical brake settings in parameter group 44 Mechanical brake control. Check that acknowledgement signal matches actual status of brake.
71A3	Mech brake opening failed	Fault: Mechanical brake control fault. Activated eg. if brake acknowledgement is not as expected during brake opening.	Check mechanical brake connection. Check mechanical brake settings in parameter group 44 Mechanical brake control. Check that acknowledgement signal matches actual status of brake.
71A5	Mech brk opening not allowed	Fault: Open conditions of mechanical brake cannot be fulfilled (for example, brake has been prevented from opening by parameter 44.11 Keep brake closed). In an encoderless application, the brake is kept closed by a brake close request (either from parameter 44.12 Brake close request or from an FSO-xx safety functions module) against a modulating drive for longer than 5 seconds.	Check mechanical brake settings in parameter group 44 Mechanical brake control (especially 44.11 Keep brake closed). Check that acknowledgement signal (if used) matches actual status of brake. Check the source signal selected by parameter 44.12 Brake close request. Check the safety circuits connected to the FSO-xx safety functions module.

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Code (hex)	Event name / Aux. code	Cause	What to do
71B1	Motor fan	Fault: 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	Fault: No motor speed feedback received.	See A7B0 Motor speed feedback (page 772).
7310	Overspeed	Fault: - 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. - Incorrect estimated speed.	- 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). - 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 708).
7380	Encoder internal	Fault: Internal fault.	Contact your local ABB representative.
7381	Encoder	Fault: Encoder feedback fault.	See A7E1 Encoder (page 772).
73A0	Speed fbk configuration	Fault: Speed feedback configuration incorrect.	See A797 Speed feedback configuration (page 772).
73A1	Load position feedback	Fault: 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).

Code (hex)	Event name / Aux. code	Cause	What to do
	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	Fault: 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 (23.200...23.205 for mode Off1, 23.23 for mode Off3).
73B1	Stop failed	Fault: 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	Fault: 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.
7510	FBA A communication	Fault: Cyclical communication between drive and fieldbus FBA A interface or between PLC and fieldbus FBA A interface 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.

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Code (hex)	Event name / Aux. code	Cause	What to do
7520	FBA B communication	Fault: Cyclical communication between drive and fieldbus FBA B interface or between PLC and fieldbus FBA B interface 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	Fault: 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 settings of parameter group 60 DDCS communication. Check the corresponding settings in the control program of the other converter. Check cable connections. If necessary, replace cables.
7581	DDCS controller comm loss	Fault: DDCS (fiber optic) communication between drive and external controller is lost.	Check status of controller. See user documentation of controller. Check settings of parameter group 60 DDCS communication. Check cable connections. If necessary, replace cables.
7582	M/F comm loss	Fault: Master/follower communication is lost.	See A7CB M/F comm loss (page 772) .
7583	Line side unit faulted	Fault: 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. Refer section Auxiliary codes for line-side converter faults (page 776) .
7584	LSU charge failed	Fault: The supply unit was not ready (ie. the main contactor/breaker could not be closed) within expected time.	Check that communication to the supply unit has been activated by 95.20 HW options word 1. Check that the supply unit is enabled, allowed to start, and can be controlled by the inverter unit (eg. not in local control mode).

Code (hex)	Event name / Aux. code	Cause	What to do
8001	ULC underload	Fault: Selected signal has fallen below the user underload curve.	See A8BF ULC underload (page 772) .
8002	ULC overload	Fault: Selected signal has exceeded the user overload curve.	See A8BE ULC overload (page 772) .
80A0	AI Supervision	Fault: 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: 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: 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: Fault generated by the signal supervision 3 function.	Check the source of the fault (parameter 32.27 Supervision 3 signal).
8E12	Fan speed	Fault: 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	Fault: 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: 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: 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: Fault related to digital input DI8. Some of the bits of the fuse status word are 0.	Check digital input DI8.
9081	External fault 1	Fault: Fault in external device 1.	Check the external device. Check setting of parameter 31.01 External event 1 source .

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Code (hex)	Event name / Aux. code	Cause	What to do
9082	External fault 2	Fault: Fault in external device 2.	Check the external device. Check setting of parameter 31.03 External event 2 source .
9083	External fault 3	Fault: Fault in external device 3.	Check the external device. Check setting of parameter 31.05 External event 3 source .
9084	External fault 4	Fault: Fault in external device 4.	Check the external device. Check setting of parameter 31.07 External event 4 source .
9085	External fault 5	Fault: Fault in external device 5.	Check the external device. Check setting of parameter 31.09 External event 5 source .
A2A1	Current calibration	Warning: Current offset and gain measurement calibration will occur at next start.	Informative warning. (See parameter 99.13 ID run requested .)
A2B3	Earth leakage	Warning: 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 (refer parameter 99.04 Motor control mode). If no earth fault can be detected, contact your local ABB representative.
A2B4	Short circuit	Warning: 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	Warning: 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.

Code (hex)	Event name / Aux. code	Cause	What to do
A3A1	DC link over-voltage	Warning: 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 under-voltage	Warning: 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	Warning: 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 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	Warning: 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	Warning: 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.

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Code (hex)	Event name / Aux. code	Cause	What to do
	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	Warning: 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	Warning: 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 .
A497	Motor temperature 1	Warning: 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	Warning: 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	Warning: 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	Warning: Control unit temperature is excessive.	Check the auxiliary code. See actions for each code below.

Code (hex)	Event name / Aux. code	Cause	What to do
	–	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	Warning: 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	Warning: 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 772) .
A4B1	Excess temperature difference	Warning: 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 : parallel-connected 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	Warning: Drive IGBT temperature is excessive.	Check ambient conditions. Check air flow and fan operation. Check heatsink fins for dust pick-up. Check motor power against drive power.

Code (hex)	Event name / Aux. code	Cause	What to do
A580	PU communication	Warning: 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	Warning: 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. "Z" specifies the index of the fan (1: Main fan 1, 2: Main fan 2, 3: Main fan 3). 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	Warning: 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.

Code (hex)	Event name / Aux. code	Cause	What to do
A5A0	Safe torque off	Warning: 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 429) .
A5EA	Measurement circuit temperature	Warning: 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 "ZZ" specifies the location: <u>With control program version 2.8x and later:</u> 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. <u>With control program version up to and including 2.7x:</u> 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	Warning: Power unit power supply failure.	Contact your local ABB representative.
A5EC	PU communication internal	Warning: 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	Warning: Problem with measurement circuit of power unit (analog to digital converter).	Contact your local ABB representative.
A5EE	Measurement circuit DFF	Warning: Problem with current or voltage measurement of power unit.	Contact your local ABB representative.
A5EF	PU state feedback	Warning: State feedback from output phases does not match control signals.	Contact your local ABB representative.
A5F0	Charging feedback	Warning: 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	Warning: Adequate motor control at requested output frequency cannot be reached because of limited switching frequency (eg. by parameter 95.15).	Informative warning.

Code (hex)	Event name / Aux. code	Cause	What to do
A5F4	Control unit battery	Warning: 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	Warning: 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 YYYY YZZZ). "X" specifies the source of warning (1: generic flash erase supervision). "ZZZ" specifies the flash subsector or number that generated the warning.
A683	Data saving to power unit	Warning: 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	Warning: 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.
	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	Warning: 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.

Code (hex)	Event name / Aux. code	Cause	What to do
A686	Checksum mismatch	Warning: 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 <i>Checksum control word</i> . Check the parameter configuration. Using 96.55 <i>Checksum control word</i> , enable a checksum parameter and copy the actual checksum into that parameter.
A687	Checksum configuration	Warning: 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 <i>Checksum action</i> .
A688	Parameter map configuration	Warning: Too much data in parameter mapping table created in Drive customizer.	See the <i>Drive customizer PC tool user's manual</i> (3AUA0000104167 [English]).
A689	Mapped parameter value cut	Warning: 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 <i>Drive customizer PC tool user's manual</i> (3AUA0000104167 [English]).
A6A4	Motor nominal value	Warning: 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. 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.

Code (hex)	Event name / Aux. code	Cause	What to do
	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	Warning: 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	Warning: The supply voltage has not been defined.	Set supply voltage in parameter 95.01 Supply voltage .
A6B0	User lock open	Warning: 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 . Also, refer section User lock (page 135) .
A6B1	User pass code not confirmed	Warning: 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. Also, refer section User lock (page 135) .
A6D1	FBA A parameter conflict	Warning: 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	FBAB Parameter conflict	Warning: The drive does not have a functionality requested by a PLC, or requested functionality has not been activated.	Check PLC programming. Check settings of parameter groups 50 Fieldbus adapter (FBA) and 54 FBA B settings .

Code (hex)	Event name / Aux. code	Cause	What to do
A6DA	Reference source parametrization	Warning: A reference source is simultaneously connected to multiple parameters with different units.	Check the reference source selection parameters. Check the auxiliary code (format XXYY 00ZZ). "XX" and "YY" specify the two sets of parameters where the source was connected to (01 = speed reference chain [22.11, 22.12, 22.15, 22.17], 02 = frequency reference chain [28.11, 28.12], 03 = torque reference chain [26.11, 26.12, 26.16], 04 = other torque-related parameters [26.25, 30.21, 30.22, 44.09]. "ZZ" indicates the conflicting reference source (01...0E = index in parameter group 3, 33 = process PID control, 3D = motor potentiometer, 65 = AI1, 66 = AI2, 6F = frequency input).
A6E5	AI parametrization	Warning: 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. 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 <i>Control board boot</i>) is required to validate any changes in the hardware settings.
A6E6	ULC configuration	Warning: 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	Warning: 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.

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Code (hex)	Event name / Aux. code	Cause	What to do
A781	Motor fan	Warning: 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	Warning: - Error in temperature measurement when temperature sensor (KTY or PTC) connected to encoder interface FEN-xx is used. - Error in temperature measurement when KTY sensor connected to encoder interface FEN-01 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. - FEN-01 does not support temperature measurement with KTY sensor. Use PTC sensor or other encoder interface module.
A783	Motor overload	Warning: 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 .
A791	Brake resistor	Warning: 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	Warning: 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	Warning: 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 .

Code (hex)	Event name / Aux. code	Cause	What to do
A797	Speed feed-back configuration	Warning: 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).
	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	Warning: 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.

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Code (hex)	Event name / Aux. code	Cause	What to do
	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	Warning: 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, 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. 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.

Code (hex)	Event name / Aux. code	Cause	What to do
	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	Warning: 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	Warning: 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.
A7A1	Mechanical brake closing failed	Warning: Status of mechanical brake acknowledgement is not as expected during brake close.	Check mechanical brake connection. Check mechanical brake settings in parameter group 44 Mechanical brake control. Check that acknowledgement signal matches actual status of brake.
A7A2	Mechanical brake opening failed	Warning: Status of mechanical brake acknowledgement is not as expected during brake open.	Check mechanical brake connection. Check mechanical brake settings in parameter group 44 Mechanical brake control. Check that acknowledgement signal matches actual status of brake.

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Code (hex)	Event name / Aux. code	Cause	What to do
A7A5	Mechanical brake opening not allowed	Warning: Open conditions of mechanical brake cannot be fulfilled (for example, brake has been prevented from opening by parameter 44.11 Keep brake closed).	Check mechanical brake settings in parameter group 44 Mechanical brake control (especially 44.11 Keep brake closed). Check that acknowledgement signal (if used) matches actual status of brake.
A7AA	Extension AI parameterization	Warning: 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 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	Warning: 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 <i>Drive application programming manual (IEC 61131-3)</i> (3AUA0000127808 [English]).
A7B0	Motor speed feedback	Warning: 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).

Code (hex)	Event name / Aux. code	Cause	What to do
	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	Warning: No load speed feedback is received.	Check the auxiliary code (format XXYY ZZZZ). "XX" specifies the number of the encoder interface module (01: 91.11/91.12, 02: 91.13/91.14), "YY" specifies the encoder (01: 92 Encoder 1 configuration, 02: 93 Encoder 2 configuration). "ZZZZ" indicates the problem (see actions for each code below).
	0001	Load gear definition invalid or outside limits.	Check load gear settings (90.53 and 90.54).
	0002	Feed constant definition invalid or outside limits.	Check feed constant settings (90.63 and 90.64).
	0003	Encoder stopped working.	Check encoder status.
	0004	Encoder drift detected.	Check for slippage between encoder and motor.
A7C1	FBA A communication	Warning: Cyclical communication between drive and fieldbus FBA A interface or between PLC and fieldbus FBA A interface 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.

Code (hex)	Event name / Aux. code	Cause	What to do
A7C2	FBA B communication	Warning: Cyclical communication between drive and fieldbus FBA B interface or between PLC and fieldbus FBA B interface 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.
A7CA	DDCS controller comm loss	Warning: DDCS (fiber optic) communication between drive and external controller is lost.	Check status of controller. See user documentation of controller. Check settings of parameter group 60 DDCS communication. Check cable connections. If necessary, replace cables.
A7CB	M/F comm loss	Warning: Master/follower communication is lost.	Check the auxiliary code. The code indicates which node address (defined by parameter 60.02 in each drive) on the master/follower link is affected. Check settings of parameter group 60 DDCS communication. On the FDCO module (if present), check that the DDCS link switch is not set to 0 (OFF). Check cable connections. If necessary, replace cables.
A7CE	EFB comm loss	Warning: 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	Warning: Encoder error.	Check the auxiliary code (format XYY 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).

Code (hex)	Event name / Aux. code	Cause	What to do
	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	Warning: 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: Warning generated by an on-time timer or a value counter.	Check the auxiliary code. Check the source of the warning corresponding to the code: 0: 33.13 On-time 1 source 1: 33.23 On-time 2 source 4: 33.53 Value counter 1 source 5: 33.63 Value counter 2 source .

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Code (hex)	Event name / Aux. code	Cause	What to do
A881	Output relay	Warning: 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: 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: 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 contact-or	Warning: 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: 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: 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: 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: Warning generated by edge counter 1.	Check the source of the warning (parameter 33.33 Edge counter 1 source).
A889	Edge counter 2	Warning: Warning generated by edge counter 2.	Check the source of the warning (parameter 33.43 Edge counter 2 source).
A88A	Value counter 1	Warning: Warning generated by value counter 1.	Check the source of the warning (parameter 33.53 Value counter 1 source).
A88B	Value counter 2	Warning: Warning generated by value counter 2.	Check the source of the warning (parameter 33.63 Value counter 2 source).

Code (hex)	Event name / Aux. code	Cause	What to do
A88C	Device clean	Warning: Warning generated by an on-time timer. Programmable warnings: 33.14 On-time 1 warn message 33.24 On-time 2 warn message	Check the auxiliary code. Check the source of the warning corresponding to the code: 0: 33.13 On-time 1 source 1: 33.23 On-time 2 source 10: 05.04 Main fan on-time counter .
A88D	DC capacitor	Warning: Warning generated by an on-time timer. Programmable warnings: 33.14 On-time 1 warn message 33.24 On-time 2 warn message	Check the auxiliary code. Check the source of the warning corresponding to the code: 0: 33.13 On-time 1 source 1: 33.23 On-time 2 source 10: 05.04 Main fan on-time counter .
A88E	Cabinet fan	Warning: Warning generated by an on-time timer. Programmable warnings: 33.14 On-time 1 warn message 33.24 On-time 2 warn message	Check the auxiliary code. Check the source of the warning corresponding to the code: 0: 33.13 On-time 1 source 1: 33.23 On-time 2 source 10: 05.04 Main fan on-time counter .
A88F	Cooling fan	Warning: Warning generated by an on-time timer. Programmable warnings: 33.14 On-time 1 warn message 33.24 On-time 2 warn message	Check the auxiliary code. Check the source of the warning corresponding to the code: 0: 33.13 On-time 1 source 1: 33.23 On-time 2 source 10: 05.04 Main fan on-time counter .
A890	Additional cooling fan	Warning: Warning generated by an on-time timer. Programmable warnings: 33.14 On-time 1 warn message 33.24 On-time 2 warn message	Check the auxiliary code. Check the source of the warning corresponding to the code: 0: 33.13 On-time 1 source 1: 33.23 On-time 2 source 10: 05.04 Main fan on-time counter .
A8A0	AI Supervised Warning	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 .

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Code (hex)	Event name / Aux. code	Cause	What to do
A8B0	Signal supervision	Warning: 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: 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: Warning generated by the signal supervision 3 function.	Check the source of the warning (parameter 32.27 Supervision 3 signal).
A8BE	ULC overload	Warning: 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	Warning: Selected signal has fallen below the user underload curve.	Check for any operating conditions decreasing the monitored signal (for example, loss of load if the torque or current is being monitored). Check the definition of the load curve (parameter group 37 User load curve).
A8C0	Fan service counter	Warning: 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	Warning: Fault in external device 1.	Check the external device. Check setting of parameter 31.01 External event 1 source .
A982	External warning 2	Warning: Fault in external device 2.	Check the external device. Check setting of parameter 31.03 External event 2 source .
A983	External warning 3	Warning: Fault in external device 3.	Check the external device. Check setting of parameter 31.05 External event 3 source .
A984	External warning 4	Warning: Fault in external device 4.	Check the external device. Check setting of parameter 31.07 External event 4 source .
A985	External warning 5	Warning: Fault in external device 5.	Check the external device. Check setting of parameter 31.09 External event 5 source .

Code (hex)	Event name / Aux. code	Cause	What to do
AE90	I/O bus communication	Warning: 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: 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 through parameter group 207 I/O bus service.
AE92	Fan speed	Warning: 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	Warning: 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. Check fan feedback. Verify the identification run results against the tachometer pulse count of the fan feedback.
AE94	CIO MCB monitoring	Warning: 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: 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: Warning related to digital input DI8. The aux code shows the CIO node address.	Check digital input DI8.
AF80	INU-LSU comm loss	Warning: DDCS (fiber optic) communication between converters (for example, the inverter unit and the supply unit) is lost. Note that the inverter unit will continue operating based on the status information that was last received from the other converter.	Check status of other converter (parameters 06.36 and 06.39 Internal state machine LSU CW). Check settings of parameter group 60 DDCS communication . Check the corresponding settings in the control program of the other converter. Check cable connections. If necessary, replace cables.
AF85	Line side unit warning	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. Refer section Auxiliary codes for line-side converter warnings (page 773).

Code (hex)	Event name / Aux. code	Cause	What to do
AF90	Speed controller autotuning	Warning: 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. Refer section Speed controller autotune (page 156) .
	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	Warning: A fault is about to be autoreset.	Informative warning. See the settings in parameter group 31 Fault functions .
AFE1	Emergency stop (off2)	Warning: - Drive has received an emergency stop (mode selection off2) command. (Follower drive in a master/follower configuration) Drive has received a stop command from the master.	- 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 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)	Warning: 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).

Code (hex)	Event name / Aux. code	Cause	What to do
AFE7	Follower	Warning: 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	Warning: No enable start signal received.	Check the setting of (and the source selected by) parameter 20.19 Enable start command .
AFEB	Run enable missing	Warning: 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	Warning: 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	Warning: Motor ID run will occur at next start, or is in progress.	Informative warning.
AFF7	Autophasing	Warning: Autophasing will occur at next start.	Informative warning.
B5A0	STO event	Pure: 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	Pure: The drive has been powered up.	Informative event.
B5F6	ID run done	Pure: 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
B680	SW internal diagnostics	Pure: 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	Pure: The calculated parameter checksum does not match any enabled reference checksum.	See A686 Checksum mismatch (page 772).

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Code (hex)	Event name / Aux. code	Cause	What to do
B68B	SW internal information	Pure: Software internal data is collected.	If the Drive Composer PC tool is available, send a support package to your local ABB representative.
D100	Automoorng min level not reached	Fault: Actual rope tension is below the Minimum Automoorng level when Automoorng is activated. The ropes are slack when Automoorng is enabled.	Tighten the rope in the Handmooring mode. Check the setting of parameter 76.05 Automoorng min tension .
D101	Automoorng max time reached	Fault: Automoorng maximum running time limit detected. Automoorng mode have been running too long time.	Check for broken ropes in the winch system. Check for incorrect actual rope tension feedback. Check for too high Automoorng set point.
D102	Torque prove failed	Fault: Motor torque did not reach test level within the time defined with parameter 81.03 Winch system check time . This is a function of winch system check time/electrical check.	Check motor and motor cables. Check mechanical brake. Check if setting of parameter 21.02 Magnetization time is too short. Check possible torque and current limits.
D103	Motor brake slipping	Fault: The mechanical brake slipped and the motor speed exceeded the brake slip speed limit (81.04 Brake slip speed limit) for a period of brake slip fault delay (81.05 Brake slip fault delay). This is a function of winch system check time/mechanical check.	Check mechanical brakes. Check parameters for Winch system check time. Check the amount of torque prove reference. Check settings of slip speed limit (81.04 Brake slip speed limit). Open loop motor control speed level must be higher than closed loop motor control level.
D104	Speed match	Fault: The load speed error is higher than parameter 74.51 Speed steady deviation level (page 583) in a steady state or parameter 74.52 Speed ramp deviation level (page 584) in ramping state, for longer than the duration of parameter 74.54 Speed match action delay (page 584) .	Check the motor and load coupling mechanism.
D105	Frequent AM start supervision	Fault: Number of starts in a minute in time window defined by parameter 76.82 Frequent start time window exceeds 30.	Check parameter 76.82 Frequent start time window setting. Start command counter increments by one at every start, and decrements by one at every time period defined by parameter 76.82 Frequent start time window .

Code (hex)	Event name / Aux. code	Cause	What to do
D106	Inverter overload	Fault: Drive has exceeded the inverter current or torque limits, and the delay defined with parameter 31.204 Inverter overload delay has elapsed. The fault condition is checked only when the generating power is more than 10% of the motor nominal power and the actual speed is greater than 5% of the motor synchronous speed.	Check the speed controller torque settings. Check the torque, speed and power limit settings.
D107	High hand-mooring torque level	Fault: Actual torque is higher than value defined in parameter 74.91 Handmooring high torque level limit during the time defined in parameter 74.92 Handmooring high torque level delay .	Check settings of Handmooring high torque level supervision settings with parameters 74.90...74.92 .
D108	High auto-mooring torque level	Fault: Actual torque is higher than value defined in parameter 74.96 Automoor-ing high torque level limit during the time defined in parameter 74.97 Auto-moor-ing high torque level delay .	Check settings of Automoor-ing high torque level supervision settings with parameters 74.95...74.97 .
D109	D2D M/F comm	Master/follower communication is lost.	Check 60.238 Communication lost status to verify the reason. Check 60.237 Comm loss delay settings may be too short.
D10A	High anchor torque level	Fault: Actual torque is higher than value defined in parameter 74.101 Anchor high torque level limit during the time defined in parameter 74.102 Anchor high torque level delay .	Check settings of Anchor high torque level supervision settings with parameters 74.100...74.102 .
D10B	Synchron fault	Fault: Difference in actual position of Master drive and Follower drive. For example, value in parameter 84.20 Actual position error is more than the limit defined in parameter 84.06 Synchro err limit and the condition prevails for more than the delay time set in parameter 84.07 Synchro err fault delay .	Check the limit set for position difference in parameter 84.06 Synchro err limit. Check the delay time set in parameter 84.07 Synchro err fault delay. Check the position correction parameters: 84.06 Synchro err limit and 84.04 Synchro corr rate.
D11A	Rotary supervision	Fault: Rotary supervision functionality has detected an error condition.	Check the auxiliary code
	0003	No incoming signals from sensor A	Check sensor wiring, malfunction.
	0004	No incoming signals from sensor B	Check sensor wiring, malfunction.
	0005	Wrong input data sequence detected. Logic receive signal from different sensor than expected.	Check sensor wiring. Check parametrization (Parameter 74.27 Anchor invert direction has the same source as in parameter 90.206 Prox signal A source and 90.207 Prox signal B source). Add sensors filtering.

Code (hex)	Event name / Aux. code	Cause	What to do
	0006	No incoming signals from sensor in defined time frames.	Check the time settings in 90.212 Motor speed filter time is correct. Check sensor wiring, malfunction.
D11B	Joystic zero position error condition	Fault: Joystick is not in zero position during initialization or fault reset. Zero position signal status is incorrect.	Check parameters 75.05 Joystick zero position source , 75.06 Joystick zero position status word and 75.07 Joystick zero position configuration word .
D200	Anchor protection active	Warning: Measured chain length reached the preset limit (77.06 Activation chain length) and/or an external proximity switch is activated. Anchor approaching stowing position, normal behavior. Anchor is near ship body and triggered by the anchor in sensor system.	During the warning, speed and torque are limited to avoid mechanical damages when anchor hit to the stowing position. Check the anchor in sensor system in case of problem.
D201	Automoorng min level not reached	Warning: Actual rope tension is below the Minimum Automoorng level when Automoorng is activated. The ropes are slack when Automoorng is activated.	Run the motor in the opposite direction and deactivate the Slowdown command, or let the drive run with the limited speed reference.
D202	Automoorng max time reached	Warning: Automoorng maximum running time reached.	Check for broken ropes or improper fixing on harbor side. Check for incorrect actual rope tension feedback/scaling. Check for too high Automoorng set point. Pre-tighten the rope in Handmooring mode to avoid slack in the rope.
D203	Peak torque protection active	Warning: During Handmooring mode, torque and speed exceed preset limits set in parameter group 79 Peak torque protection . Rope tension is raised too fast during fast speed; system protects ropes from high torque spikes.	Check peak torque protection parameters. Check driving methods of operator, too fast speed when rope tension starts rising up.
D204	Slip protection active	Warning: Difference of chain speed on either side of the torque limiter, or an external slip detection switch is activated.	Check slip detection parameters. Check for possible overload on the drum.
D205	Power control configuration error	Warning: Torque and speed values are set in incorrect order in parameter group 80 Power control for forward or reverse curves.	Enter the torque values in increasing order and the speed limit values in decreasing order for both the forward and reverse directions.
D206	M/F control location mismatch	Warning: Master and follower are not in the same control location.	Check that the master and the follower are both in control location EXT2.

Code (hex)	Event name / Aux. code	Cause	What to do
D207	High hand-mooring torque level	Warning: Actual torque is higher than value defined in parameter 74.91 Handmooring high torque level limit during the time defined in parameter 74.92 Handmooring high torque level delay .	Check settings of Handmooring high torque level supervision settings with parameters 74.90...74.92 .
D208	High auto-mooring torque level	Warning: Actual torque is higher than value defined in parameter 74.96 Automooring high torque level limit during the time defined in parameter 74.97 Automooring high torque level delay .	Check settings of Automooring high torque level supervision settings with parameters 74.95...74.97 .
D210	high anchor torque level	Warning: Actual torque is higher than value defined in parameter 74.101 Anchor high torque level limit during the time defined in parameter 74.102 Anchor high torque level delay .	Check settings of Anchor high torque level supervision settings with parameters 74.100...74.102 .
D211	Follower 1 faulted	Warning: Follower drive 1 has tripped on a fault. This fault message is displayed in the master drive only.	See the follower drive 1 for more detailed fault description.
D21A	Rotary supervision	Fault: Rotary supervision functionality has detected an error condition.	Check the auxiliary code
	0003	No incoming signals from sensor A	Check sensor wiring, malfunction.
	0004	No incoming signals from sensor B	Check sensor wiring, malfunction.
	0005	Wrong input data sequence detected. Logic receive signal from different sensor than expected.	Check sensor wiring. Check parametrization (Parameter 74.27 Anchor invert direction has the same source as in parameter 90.206 Prox signal A source and 90.207 Prox signal B source). Add sensors filtering.
	0006	No incoming signals from sensor in defined time frames.	Check the time settings in 90.212 Rotary supervision delay is correct. Check sensor wiring, malfunction.
D21B	Joystic zero position error condition	Warning: Joystick is not in zero position during initialization or fault reset. Zero position signal status is incorrect.	Check parameters 75.05 Joystick zero position source , 75.06 Joystick zero position status word and 75.07 Joystick zero position configuration word .
D20A	Master faulted	Warning: Master drive has tripped on a fault. This fault message is displayed in the follower drives only.	See the master drive for more detailed fault description.

Code (hex)	Event name / Aux. code	Cause	What to do
D20B	Wrong start sequence	Warning: Drive does not accept a start command because - the start signal is active when the drive is powered ON. - the control stand heave/lower signal become active before the enable signal. - the start signal remains ON after a fault.	You must disable and enable the start signal again with the joystick.
D20C	Speed match	Warning: The load speed error is higher than parameter 74.51 Speed steady deviation level (page 583) in a steady state or parameter 74.52 Speed ramp deviation level (page 584) in ramping state, for longer than the duration of parameter 74.54 Speed match action delay (page 584).	Check the motor and load coupling mechanism.
D20E	Winch system ID run active	Warning: Winch system ID run will occur at next start or in progress.	Informative warning.
D20F	Winch system ID run done	Warning: Winch system ID run is completed successfully	Remove the start command.
FA81	Safe torque off 1 loss	Fault: 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 429). 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
FA82	Safe torque off 2 loss	Fault: 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 429). 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)
FA90	STO diagnostics failure	Fault: SW internal malfunction.	Contact your local ABB representative.
FB11	Memory unit missing	Fault: - No memory unit is attached to the control unit. - The memory unit attached to the control unit is empty.	- Power down the control unit. Check that the memory unit is properly inserted into the control unit. - Power down the control unit. Attach a memory unit (with the appropriate firmware) to the control unit.
FB12	Memory unit incompatible	Fault: 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	Fault: The firmware on the attached memory unit is incompatible with the drive.	Power down the control unit. Attach a memory unit with compatible firmware.

Code (hex)	Event name / Aux. code	Cause	What to do
FB14	Memory unit FW load failed	Fault: 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	Fault: 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 • 99.09 Motor nominal speed. Make sure that • $30.12 \text{ Maximum speed} > (0.55 \times 99.09 \text{ Motor nominal speed}) > (0.5 \times \text{synchronous speed})$ • $30.11 \text{ Minimum speed} < 0$, and • $\text{supply voltage} > (0.66 \times 99.07 \text{ Motor nominal voltage})$.
	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.

Code (hex)	Event name / Aux. code	Cause	What to do
	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.
FF7E	Follower	Fault: 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	Fault: A fault trip command has been received through fieldbus FBA A interface.	Check the fault information provided by the PLC.
FF82	FB B force trip	Fault: A fault trip command has been received through fieldbus FBA A interface.	Check the fault information provided by the PLC.

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Code (hex)	Event name / Aux. code	Cause	What to do
FF8E	EFB force trip	Fault: A fault trip command has been received through the embedded field-bus 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	Warning: 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	Warning: 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	Warning: Excessive IGBT junction to case temperature.	Check supply cable.
AE05	BU current difference	Warning: Current difference detected by the branching unit (BU).	Check converter fuses. Check converter(s). Check inverter(s). Check LCL filter.
AE06	BU earth leakage	Warning: 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 over-voltage	Warning: 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 under-voltage	Warning: 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	Warning: 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	Warning: DC link voltage difference detected by the branching unit.	Check DC fuses. Check converter module connections to DC link.
AE0D	BU voltage difference	Warning: Main voltage difference detected by the branching unit.	Check AC fuses. Check supply cable.
AE14	Excess temperature	Warning: 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	Warning: High temperature difference between the IGBTs of different phases.	Check the cabling. Check cooling of power module(s).
AE16	IGBT temperature	Warning: 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	Warning: The supply voltage range has not been defined.	Define the supply voltage range (parameter 95.01 Supply voltage).
AE58	Emergency stop (OFF2)	Warning: 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	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, 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.

Code (hex)	Event name / Aux. code	Cause	What to do
AE73	Fan	Warning: 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.
AE78	Net lost	Warning: Net lost is detected.	Resynchronize the IGBT supply unit to the grid after net lost.
AE85	Charging count	Warning: 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	Fault: 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	Fault: 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	Fault: 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	Fault: Excessive IGBT junction to case temperature.	Check the load.
2E05	BU current difference	Fault: 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.

Code (hex)	Event name / Aux. code	Cause	What to do
2E06	BU earth leakage	Fault: 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.
3E00	Input phase loss	Fault: 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 over-voltage	Fault: Excessive intermediate circuit DC voltage.	Check that parameter 95.01 Supply voltage is set according to the supply voltage in use.
3E05	DC link under-voltage	Fault: 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	Fault: 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	Fault: 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.
4E01	Cooling	Fault: 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.

Code (hex)	Event name / Aux. code	Cause	What to do
4E02	IGBT temperature	Fault: 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	Fault: Power unit module temperature is excessive.	See AE14 Excess temperature (page 775) .
4E04	Excess temperature difference	Fault: 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	Fault: 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	Fault: An auxiliary cooling fan is stuck or disconnected.	Check the fan operation and connection. Replace the fan if faulty.
5E05	Rating ID mismatch	Fault: 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 or by cycling its power. If the problem persists, contact your local ABB representative.
5E06	Main contactor or Fault	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	Fault: Synchronization to supply network has failed.	Monitor possible network transients.
6E1A	Rating ID fault	Fault: Rating ID load error.	Contact your local ABB representative.

Code (hex)	Event name / Aux. code	Cause	What to do
6E1F	Licensing fault	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.
6E21	Macro parameterization error	Fault: 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 0009 000A 000B 000C 000D 001F 0022	Parameter is not accessible from the macro file. Value written is below the parameter minimum limit. Value written is above the parameter maximum limit. Value written is not listed in the parameter selection list. Parameter function prevents to display the value. Parameter does not exist. Parameter in the macro file does not match the parameter in the drive. The unit or display format is different. Pointer parameter is written to target a parameter or bit that does not exist or that is not available to be targeted from macro.	

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Code (hex)	Event name / Aux. code	Cause	What to do
7E01	Panel loss	Fault: 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	Fault: 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

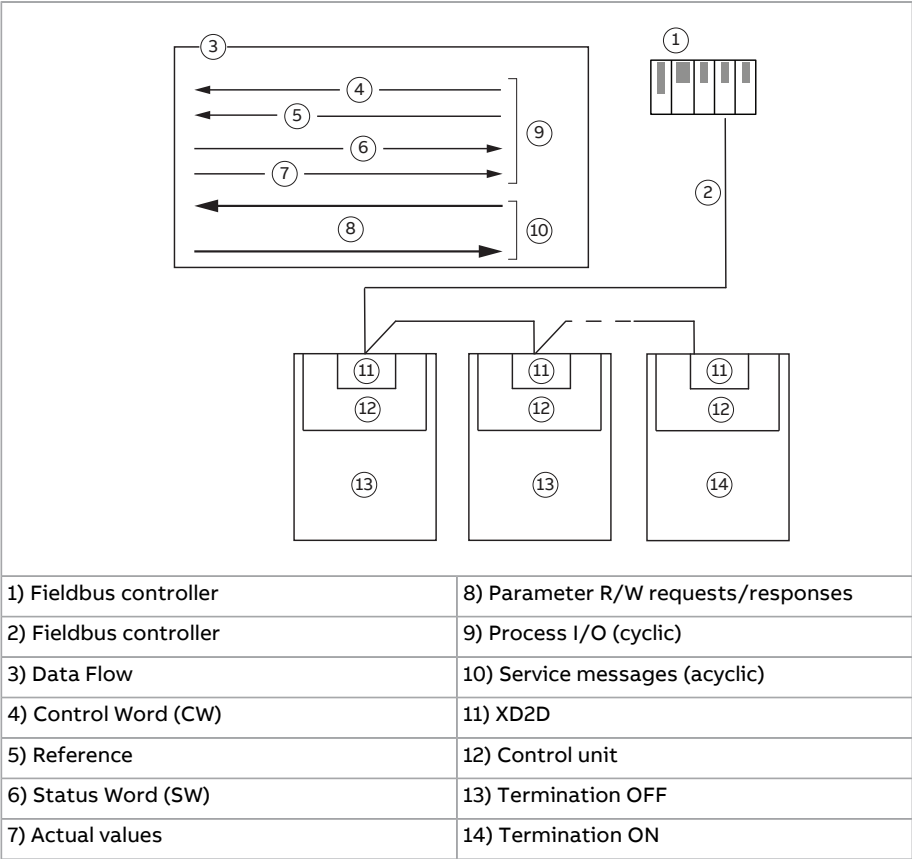
The chapter describes how the drive can be controlled by external devices over a communication network (fieldbus) using the embedded fieldbus interface.

System overview

The drive can be connected to an external control system through a communication link using either a fieldbus or the embedded fieldbus interface.

The embedded fieldbus interface supports the Modbus RTU protocol. The drive control program can handle 10 Modbus registers in a 10-millisecond time level. For example, if the drive receives a request to read 20 registers, it will start its response within 22 ms of receiving the request – 20 ms for processing the request and 2 ms overhead for handling the bus. The actual response time depends on other factors as well, such as the baud rate (a parameter setting in the drive).

The drive can be set to receive all of its control information through the fieldbus interface, or the control can be distributed between the embedded fieldbus interface and other available sources, for example, digital and analog inputs.



Connecting the fieldbus to the drive

Connect the fieldbus to terminal XD2D on the control unit of the drive. See the appropriate *Hardware Manual* for more information on the connection, chaining and termination of the link.

Note: If the XD2D connector is reserved by the embedded fieldbus interface (parameter [58.01 Protocol enable](#) is set to [Modbus RTU](#)), the drive-to-drive link functionality is automatically disabled.

Setting up the embedded fieldbus interface

Set the drive up for the embedded fieldbus communication with the parameters shown in the table below. The **Setting for fieldbus control** column gives either the value to use or the default value. The **Function/Information column** gives a description of the parameter.

Parameter	Setting for fieldbus control	Function/Information
COMMUNICATION INITIALIZATION		
58.01 Protocol enable	Modbus RTU	Initializes embedded fieldbus communication. Drive-to-drive link operation is automatically disabled.
EMBEDDED MODBUS CONFIGURATION		
58.03 Node address	1 (default)	Node address. There must be no two nodes with the same node address online.
58.04 Baud rate	19.2 kbps (default)	Defines the communication speed of the link. Use the same setting as in the master station
58.05 Parity	8 EVEN 1 (default)	Selects the parity and stop bit setting. Use the same setting as in the master station.
58.14 Communication loss action	Fault (default)	Defines the action taken when a communication loss is detected.
58.15 Communication loss mode	Cw / Ref1 / Ref2 (default)	Enables/disables communication loss monitoring and defines the means for resetting the counter of the communication loss delay.
58.16 Communication loss time	3.0 s (default)	Defines the time-out limit for the communication monitoring.
58.17 Transmit delay	0 ms (default)	Defines a response delay for the drive.

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Parameter	Setting for fieldbus control	Function/Information
58.25 Control profile	ABB Drives (default), Transparent	Selects the control profile used by the drive. Refer section Basics of the embedded fieldbus interface (page 786).
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) RO/DIO control word , AO1 data storage , AO2 data storage	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. These settings write the incoming data into storage parameters 10.99 RO/DIO control word , 13.91 AO1 data storage , 13.92 AO2 data storage .
58.06 Communication control	Refresh settings	Validates the settings of the configuration parameters.

The new settings will take effect when the drive is powered up the next time, or when they are validated by parameter [58.06 Communication control](#).

Setting the drive control parameters

After the embedded fieldbus interface has been set up, check and adjust the drive control parameters listed in the table below. The **Setting for fieldbus control** column gives the value or values to use when the embedded fieldbus signal is the desired source or destination for that particular drive control signal. The **Function/Information** column gives a description of the parameter.

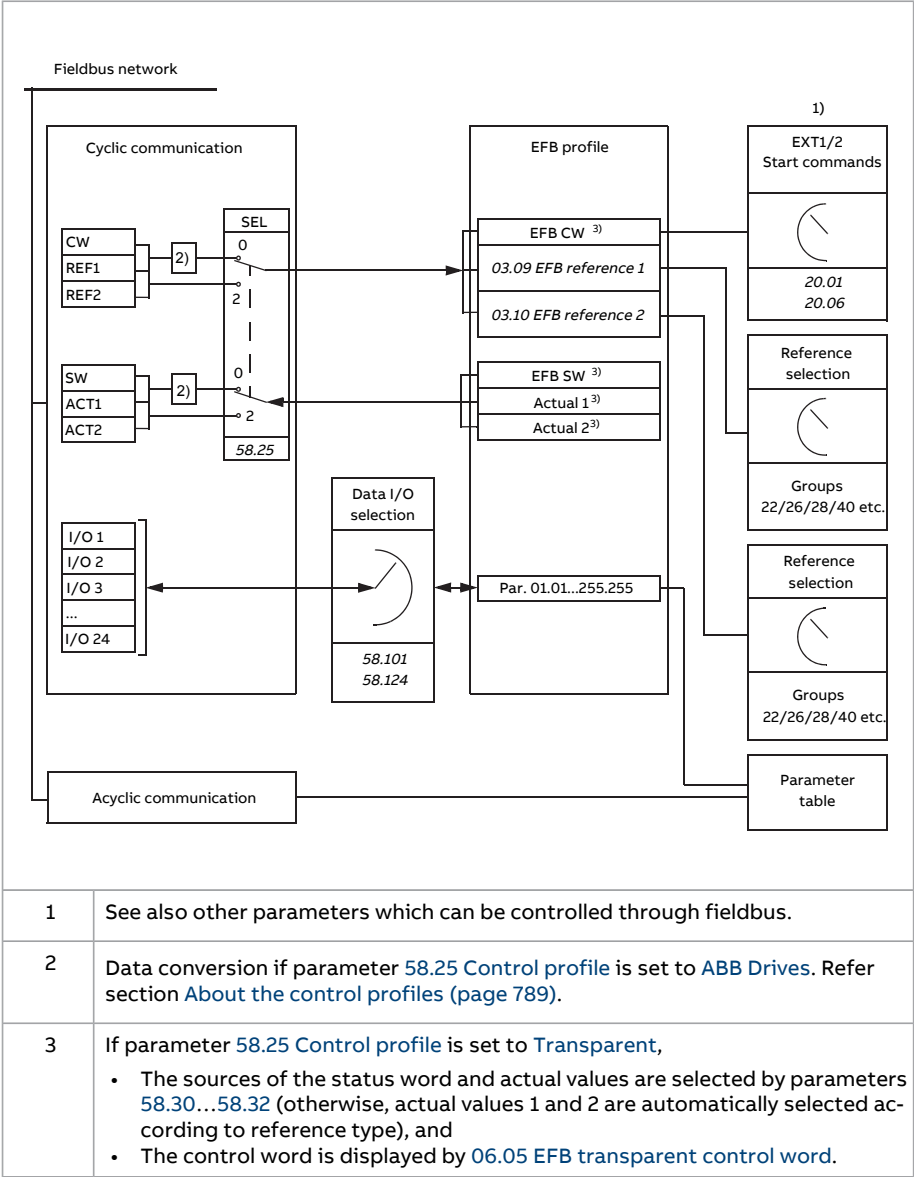
Parameter	Setting for fieldbus control	Function/Information
CONTROL COMMAND SOURCE SELECTION		
20.01 Ext1 commands	Embedded fieldbus	Selects fieldbus as the source for the start and stop commands when EXT1 is selected as the active control location.
20.02 Ext1 start trigger type	Embedded fieldbus	Selects fieldbus as the source for the start and stop commands when EXT2 is selected as the active control location.
SPEED REFERENCE SELECTION		
22.11 Speed ref1 source	EFB ref1 or EFB ref2	Selects a reference received through the embedded fieldbus interface as speed reference 1.
22.12 Speed ref2 source	EFB ref1 or EFB ref2	Selects a reference received through the embedded fieldbus interface as speed reference 2.
TORQUE REFERENCE SELECTION		
26.11 Torque ref1 source	EFB ref1 or EFB ref2	Selects a reference received through the embedded fieldbus interface as torque reference 1.
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.



■ **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. Refer section [About the control profiles \(page 789\)](#).

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. Refer section [About the control profiles \(page 789\)](#).

■ 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](#). Refer section [About the control profiles \(page 789\)](#).

■ 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](#). Refer section [About the control profiles \(page 789\)](#).

■ 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.

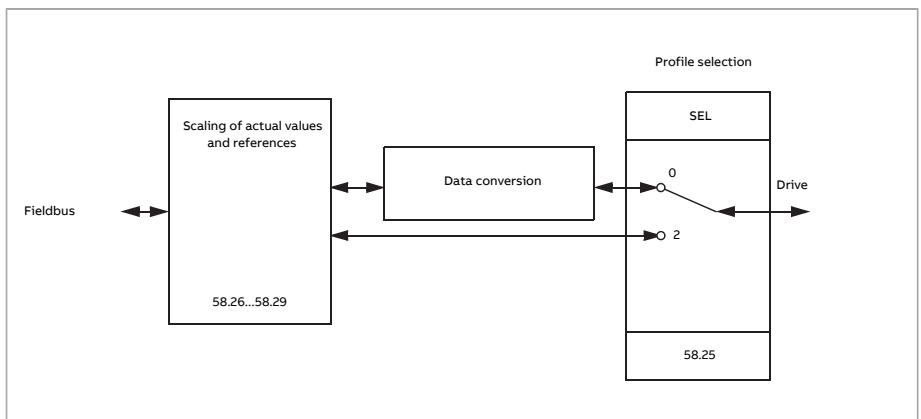
Note: Register addresses of 32-bit parameters cannot be accessed by using 5-digit register numbers.

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 \(page 793\)](#).

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 167) .
		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

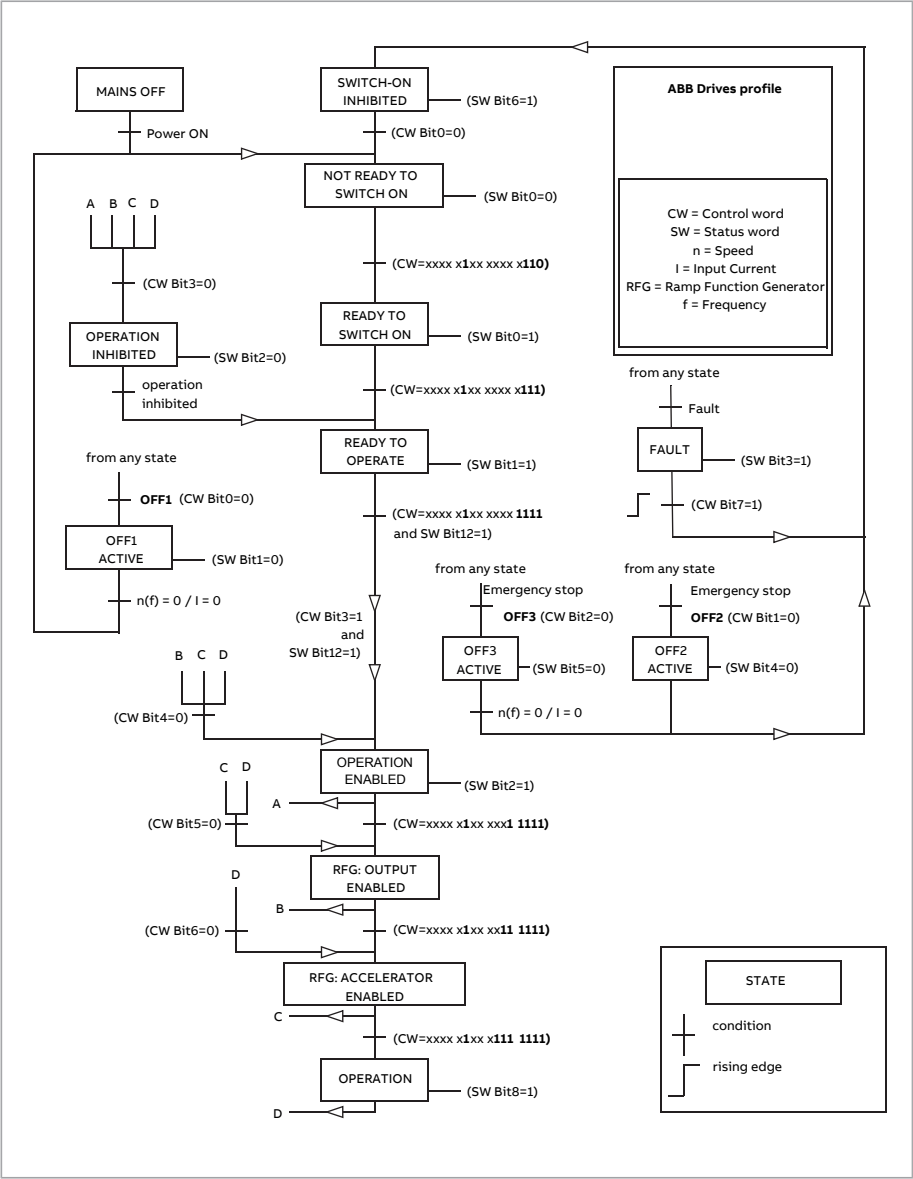
The table below shows the fieldbus Status Word for the ABB Drives control profile. The embedded fieldbus interface converts the drive Status Word into this form for the fieldbus. The upper case boldface text refers to the states shown in [State transition diagram \(page 793\)](#).

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 outside tolerance limits.
9	REMOTE	1	Drive control location: REMOTE (EXT1 or EXT2).
		0	Drive control location: LOCAL.
10	ABOVE_LIMIT	1	Actual frequency or speed equals or exceeds supervision limit (set by drive parameter). Valid in both directions of rotation.
		0	Actual frequency or speed within supervision limit.
11	USER_0		Status bits that can be combined with drive logic for application-specific 12 USER_1 functionality.
12	EXT_RUN_ENABLE	1	External Run enable signal received.
		0	No external Run enable signal received.
13...15	Reserved		

■ State transition diagram

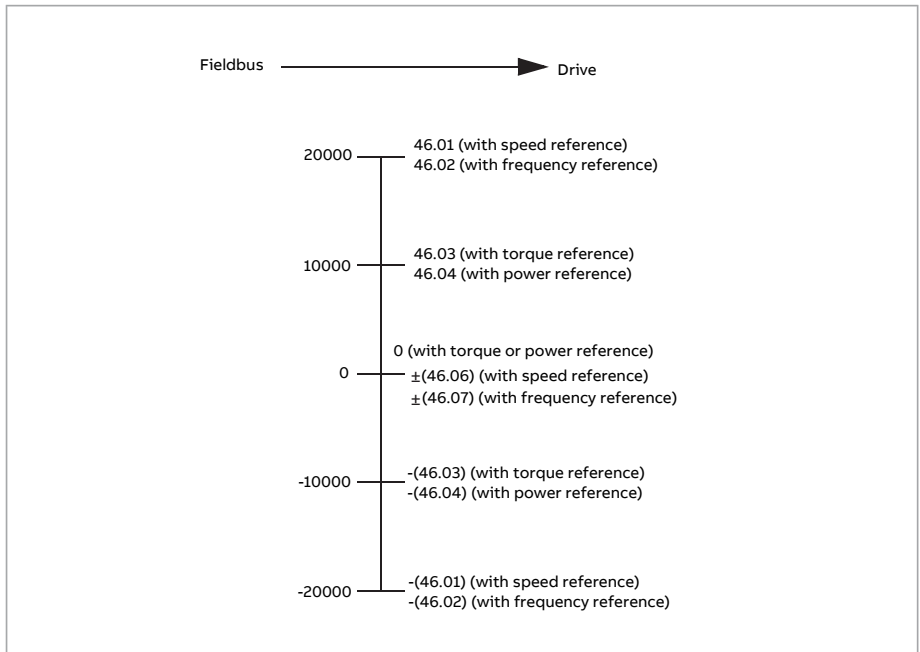
The diagram below shows the state transitions in the drive when the drive is using the ABB Drives profile, and configured to follow the commands of the control word from the embedded fieldbus interface. The upper case texts refer to the states which are used in the tables representing the fieldbus Control and Status words. Refer sections [Control Word \(page 790\)](#) and [Status Word \(page 792\)](#).



■ 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 528).

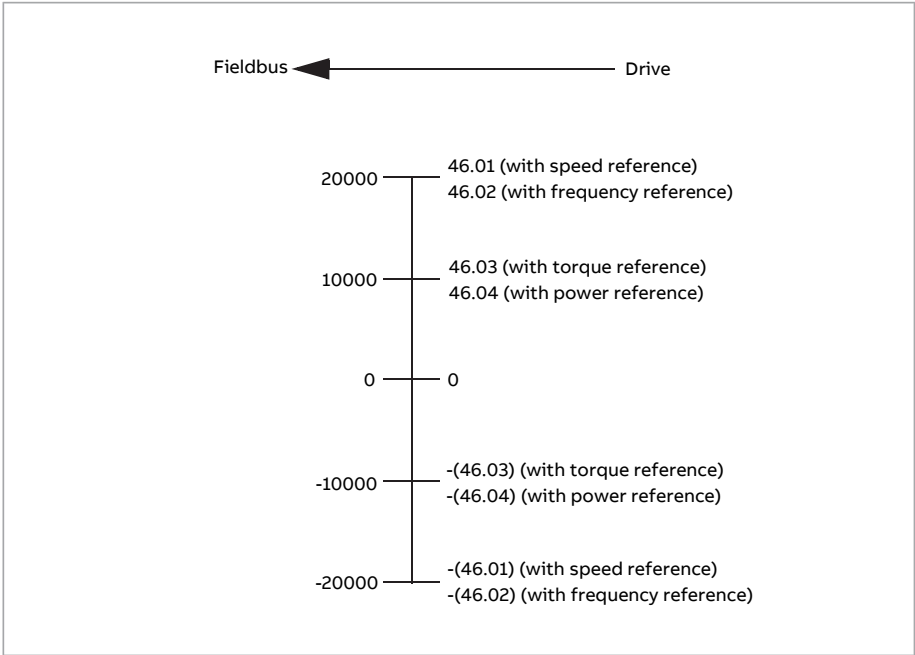


The scaled references are shown by parameters [03.09 EFB reference 1](#) and [03.10 EFB reference 2](#).

■ **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 \(page 528\)](#).



■ 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. Refer section Control Word (page 790) . 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). Refer section Status Word (page 792) . 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. Refer section Error code registers (holding registers 400090...400100) (page 803) .
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 [797](#)).

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 acknowledgement) 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 Trans- port	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. Refer section Error code registers (holding registers 400090...400100) (page 803).
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

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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.

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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 that can use fieldbus adapter connection, called “fieldbus A” (FBA A) and “fieldbus B” (FBA B). The drive can be configured to receive all of its control information through these interface(s), or the control can be distributed between these interface(s) and other available sources such as digital and analog inputs, depending on how control locations EXT1 and EXT2 are configured.

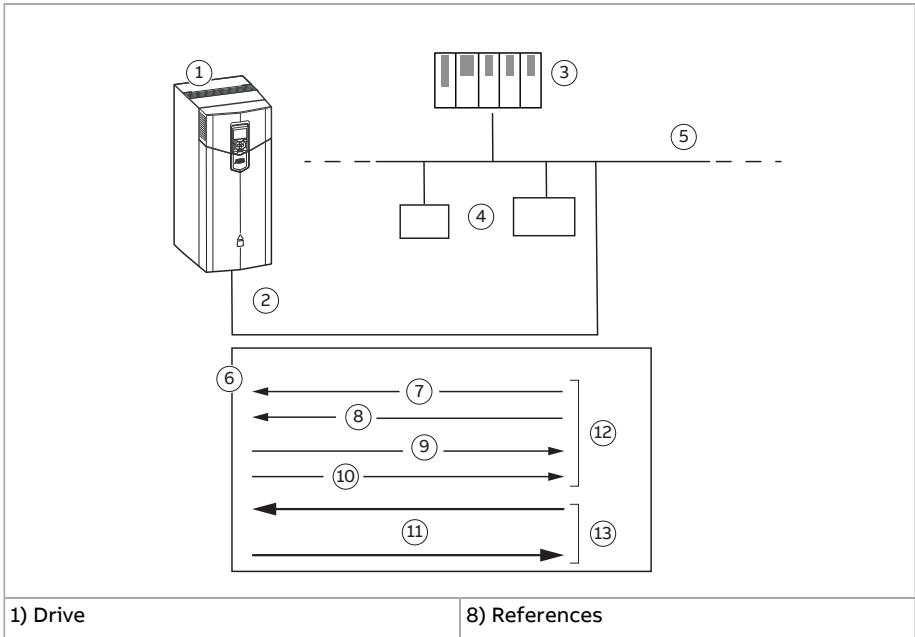
Note: The text and examples in this chapter describe the configuration of FBA A interface by parameters [50.01...50.21](#) and parameter groups 51...53. The FBA B interface, if present, is configured in a similar fashion by parameters [50.31...50.51](#) and parameter groups 54...56. It is recommended that the FBA B interface is only used for monitoring.

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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 or FEIP-21 adapter)
- Modbus/RTU (FSCA-01 adapter)
- Modbus/TCP (FENA-11 or FENA-21, FMBT-21 adapter)
- POWERLINK (FEPL-02 adapter)
- PROFIBUS DP (FPBA-01 adapter)
- PROFINET IO (FENA-11 or FENA-21 or FPNO-21 adapter)
- CIP Safety functions module (FSCS-21 adapter)
- PROFIsafe (FSPS-21 adapter).

Note: Fieldbus adapters with the suffix “M” (eg. FPBA-01-M) are not supported.

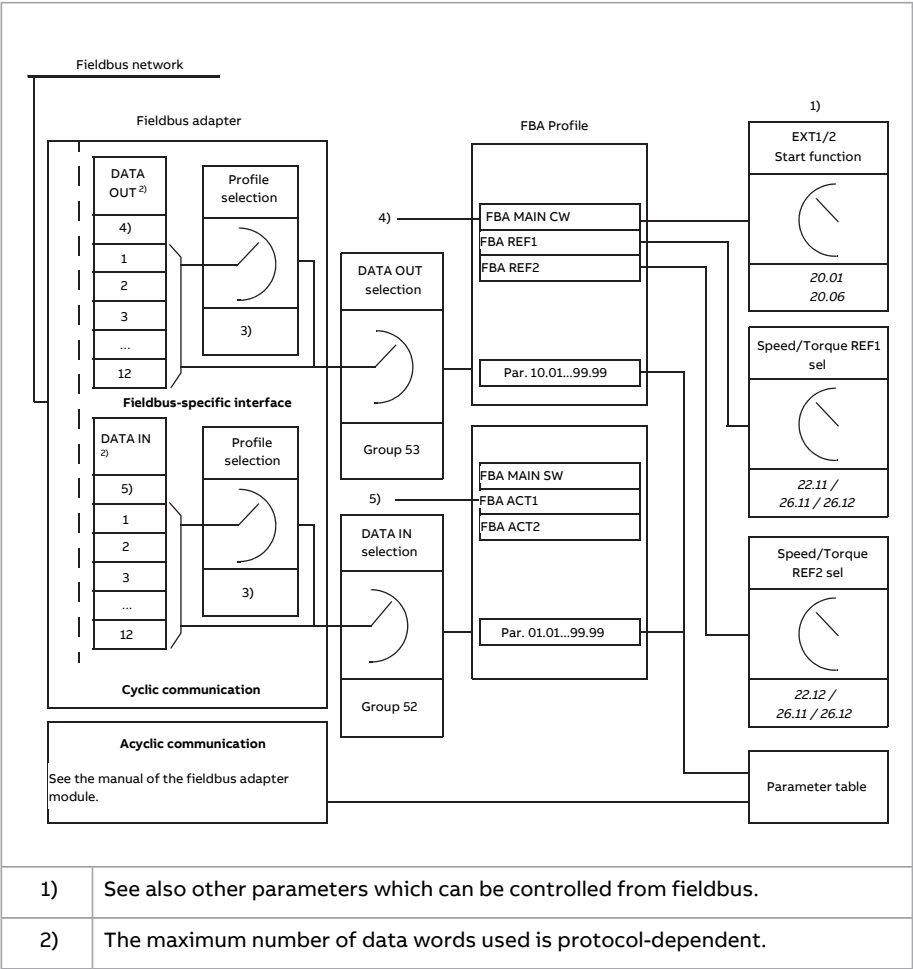


2) Type Fxxx fieldbus adapter installed onto drive control unit (slot 1, 2 or 3)	9) Status word (SW)
3) Fieldbus controller	10) Actual values
4) Other devices	11) Parameter R/W requests/responses
5) Fieldbus	12) Process I/O (cyclic)
6) Data Flow	13) Process I/O (cyclic) or Service messages (acyclic)
7) Control word (CW)	-

Basics of the fieldbus control through an adapter module

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](#).



3)	Profile/instance selection parameters. Fieldbus module specific parameters. For more information, see the <i>User's Manual</i> 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](#), and [26 Torque reference chain](#).

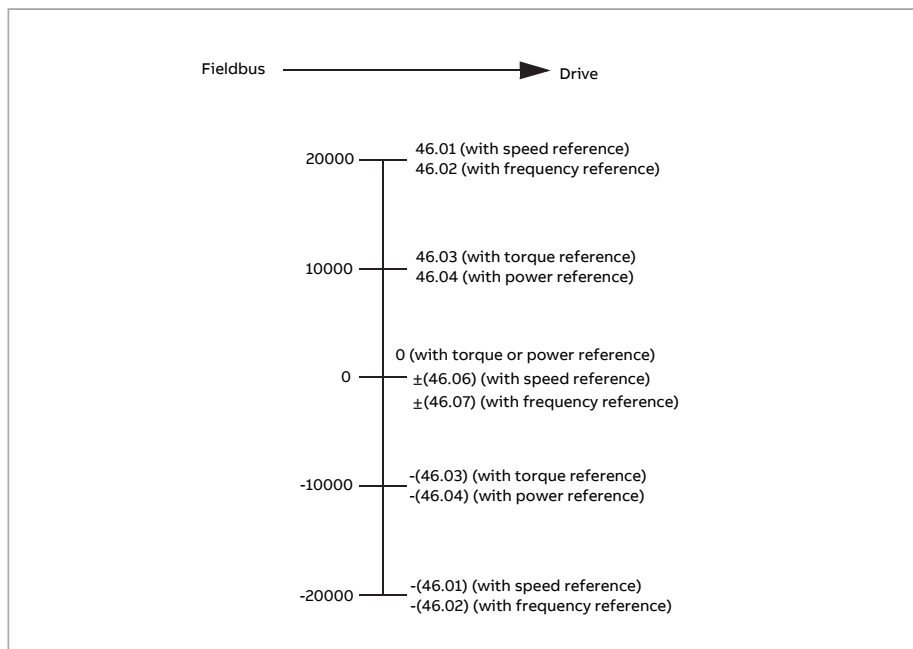
Debugging the network words

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](#).

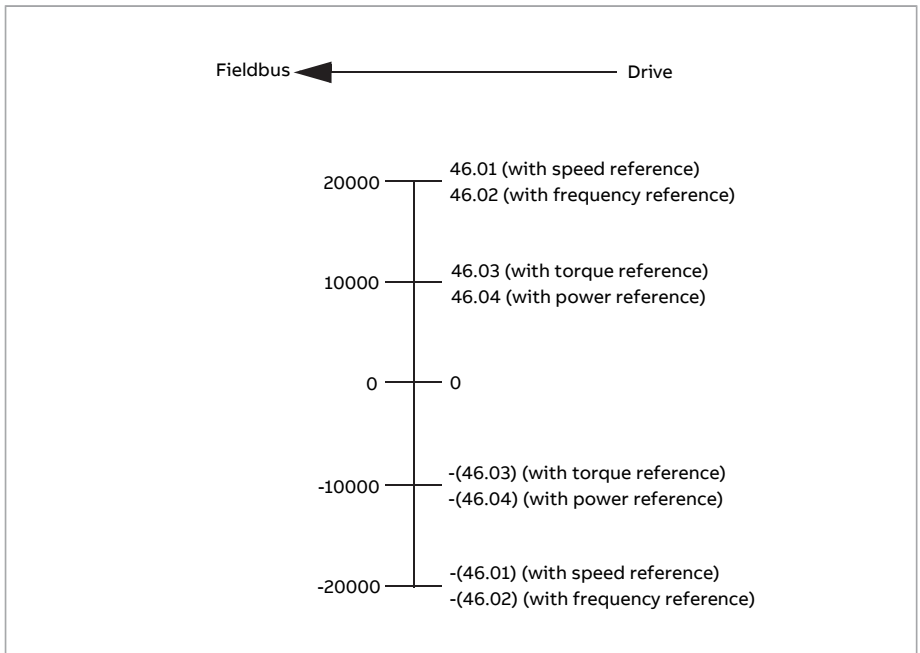
Debugging the network words

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 parameters 06.18 Start inhibit status word and 06.25 Drive inhibit status word 2 .
		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).

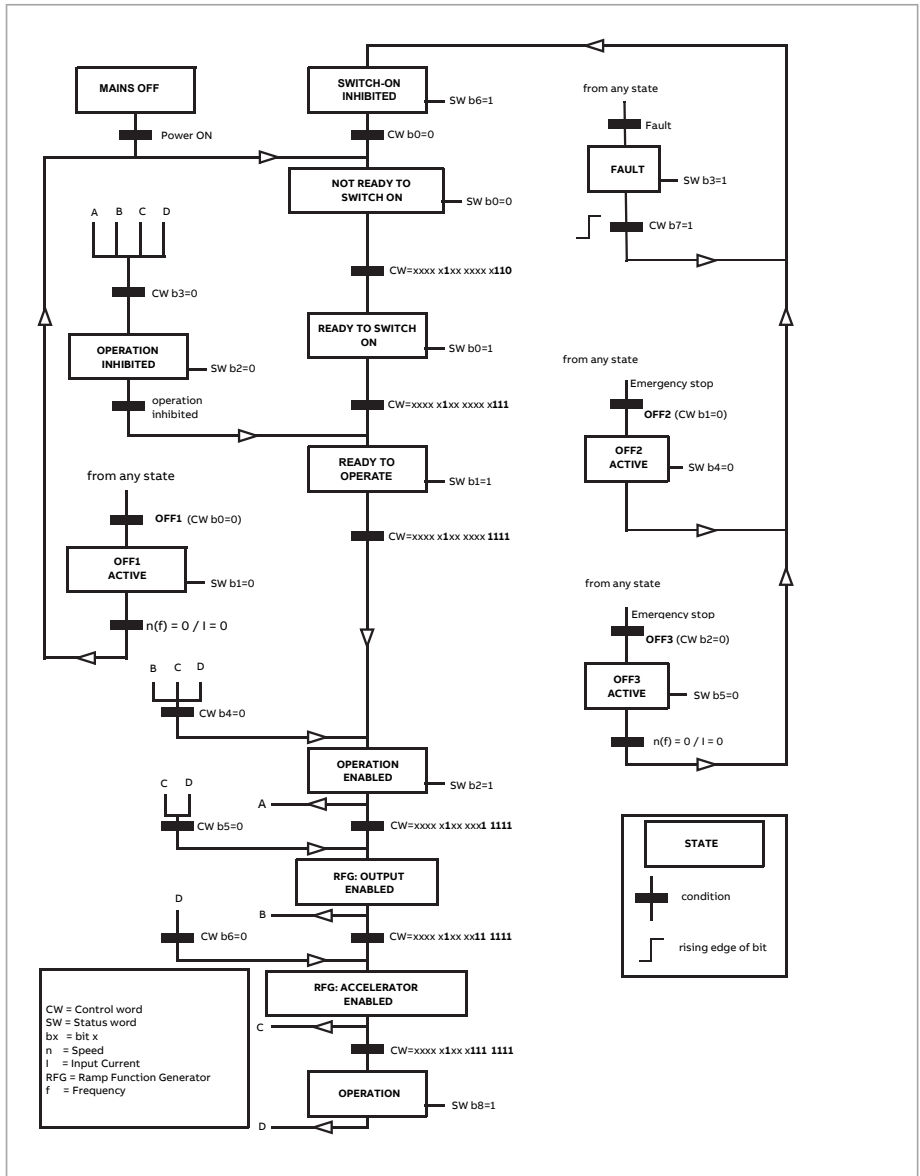
Bit	Name	Value	STATE/Description
6	Ramp in zero	1	Normal operation. Proceed to OPERATING . Note: This bit is effective only if the fieldbus interface is set as the source for this signal by drive parameters.
		0	Force Ramp function generator input to zero.
7	Reset	0=>1	Fault reset if an active fault 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 167).
		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.
22.11 Speed ref1 source	4 = FB A ref1	Selects fieldbus A reference 1 as the source for speed reference 1.

1) Read-only or automatically detected/set

2) Example

The start sequence for the parameter example above is given below.

Control word

- 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

What this chapter contains

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.

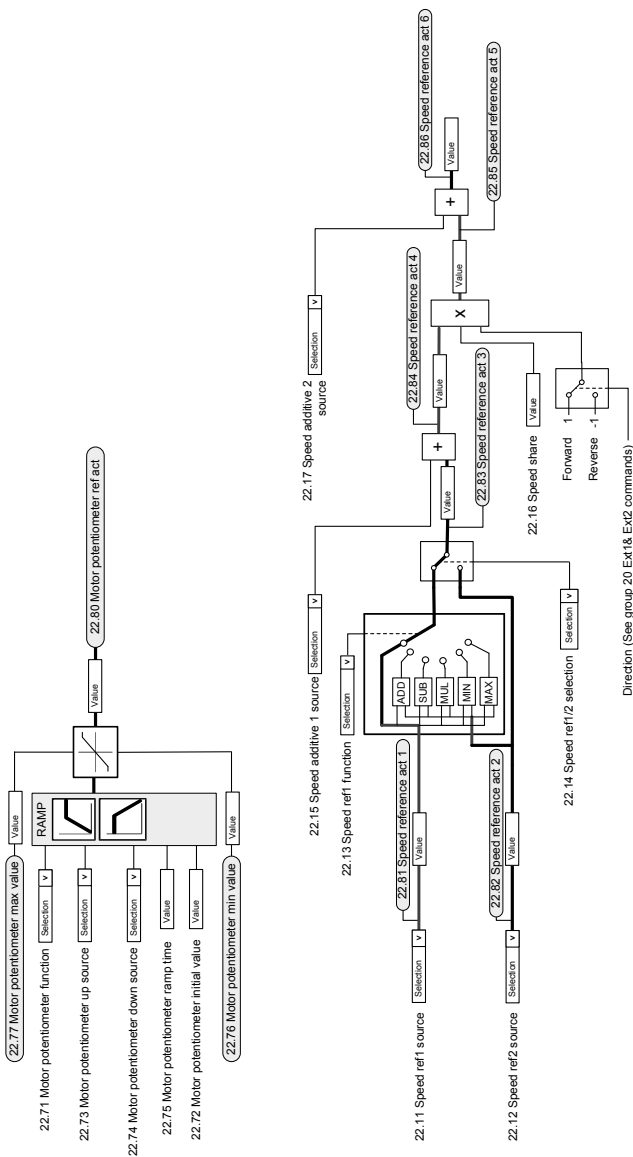
For a more general diagram, refer section [Operating modes of the drive \(page 133\)](#).

- [Drive control diagrams \(page 820\)](#)
- [Winch control diagrams \(page 839\)](#).

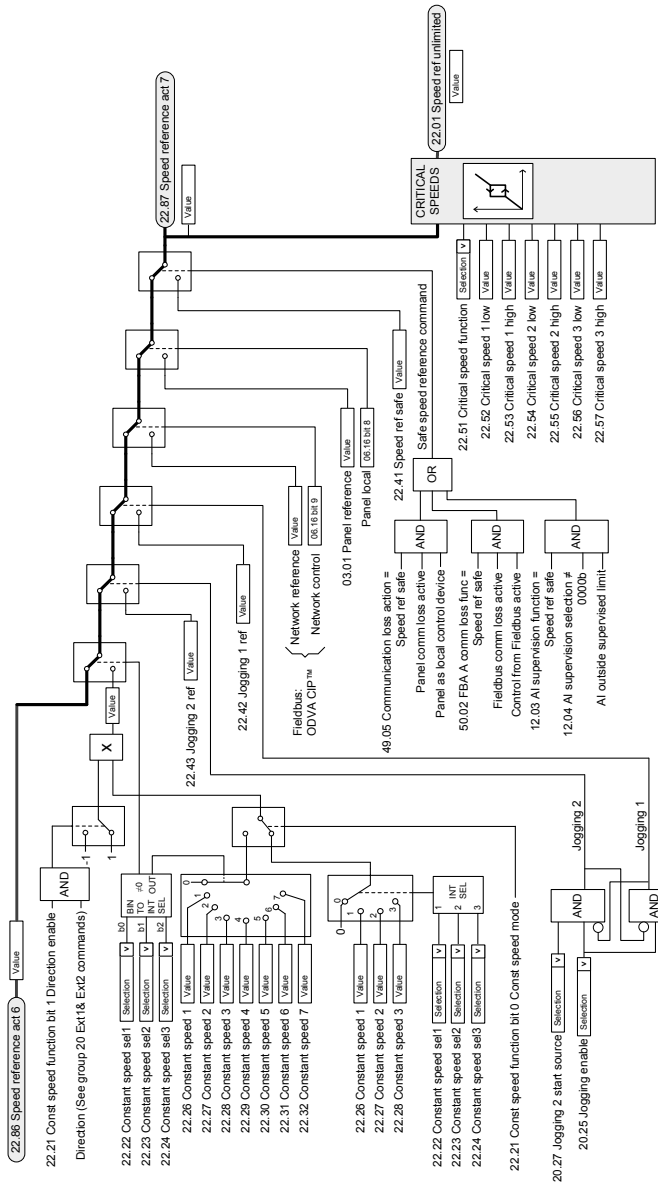
Winch control diagrams are available through Drive Composer (pro) PC tool, when connected to a winch drive.

Drive control diagrams

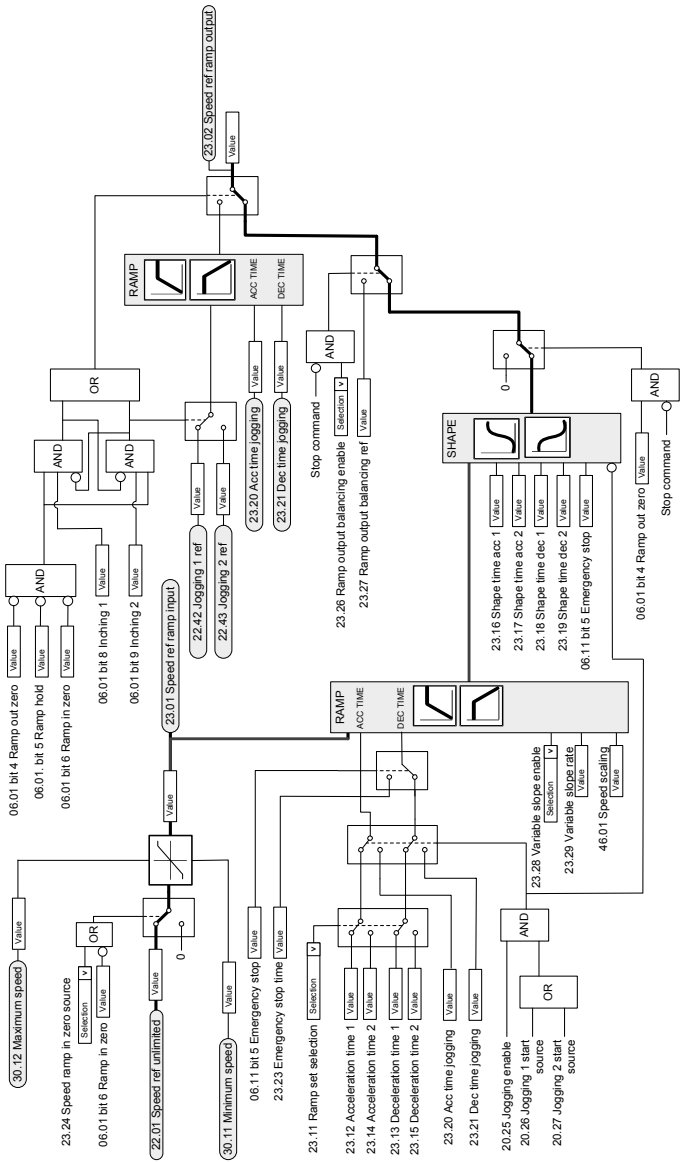
■ Speed reference source selection I



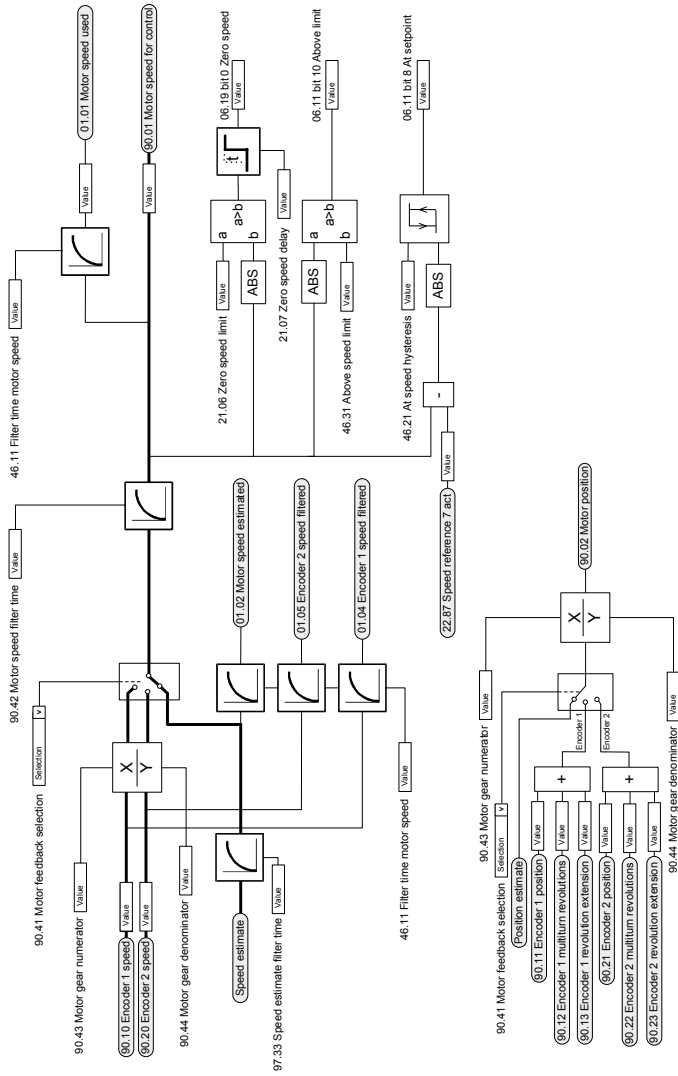
■ Speed reference source selection II



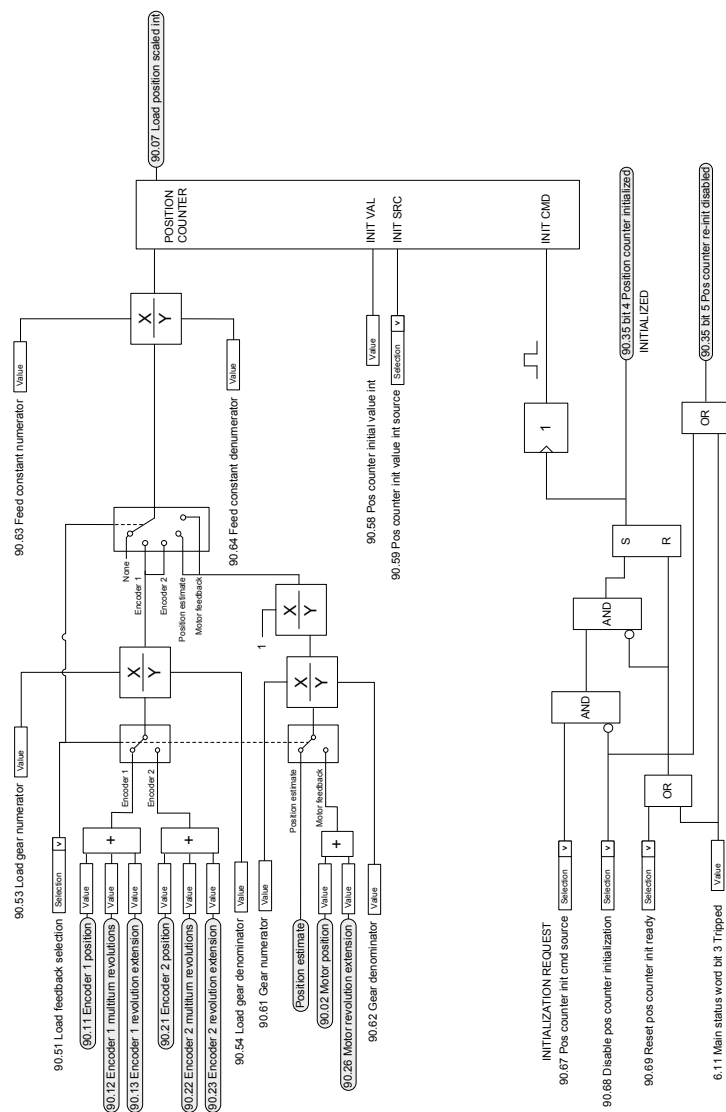
■ Speed reference ramping and shaping



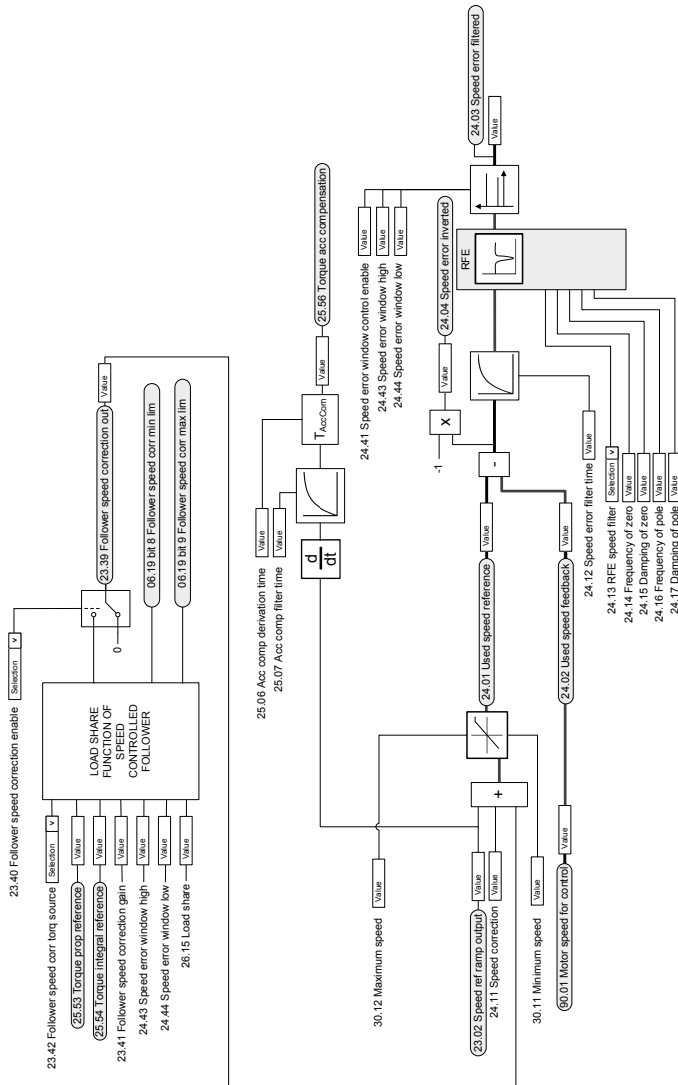
Motor feedback configuration

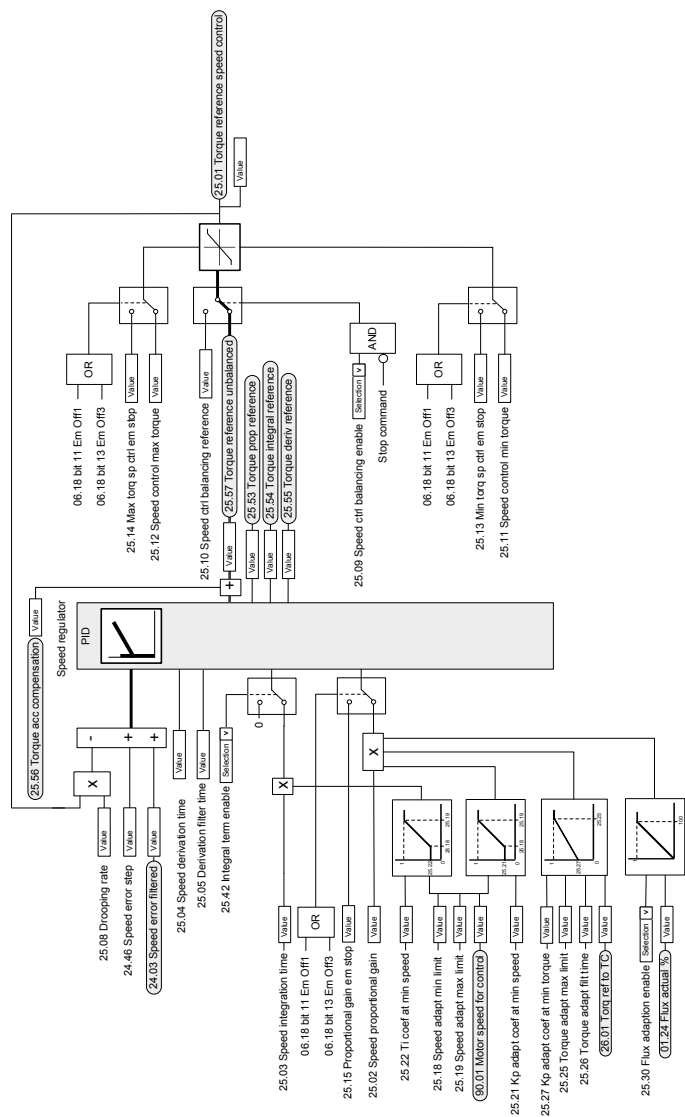


- **Load feedback and position counter configuration**

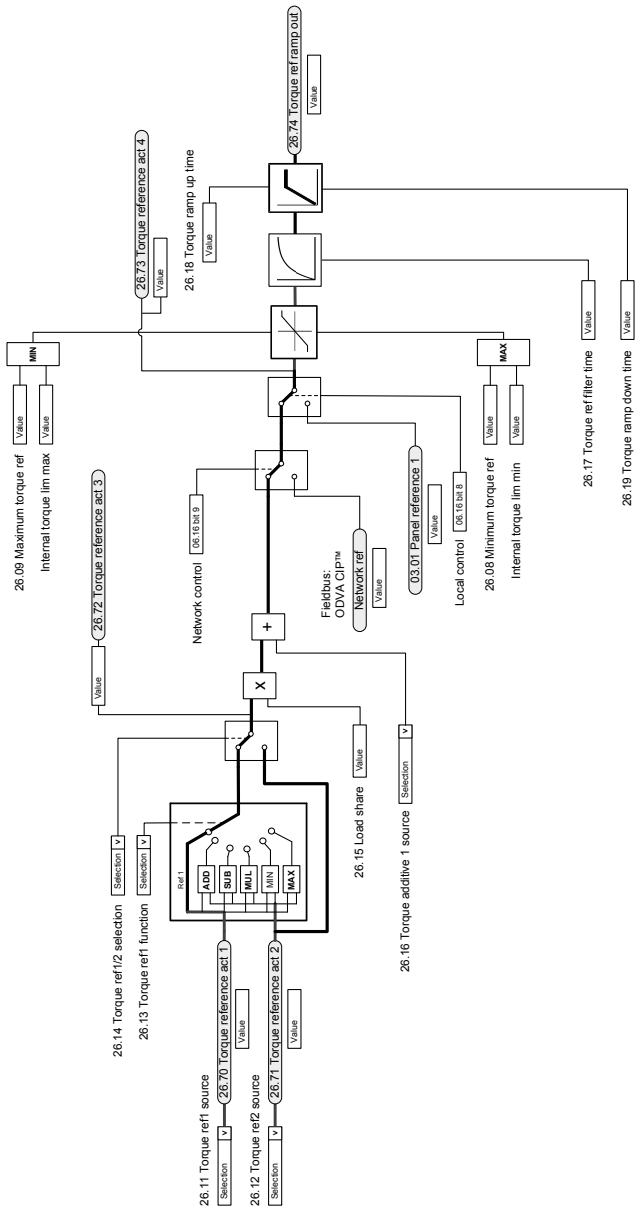


Speed error calculation

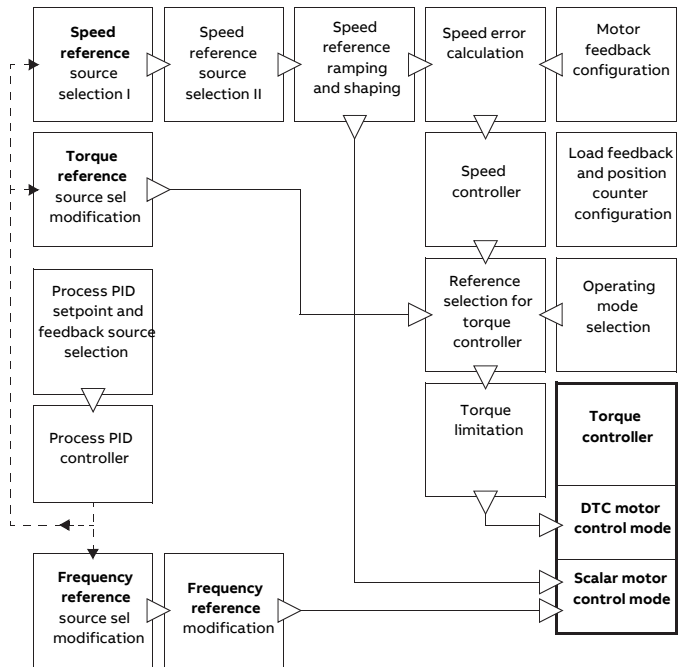




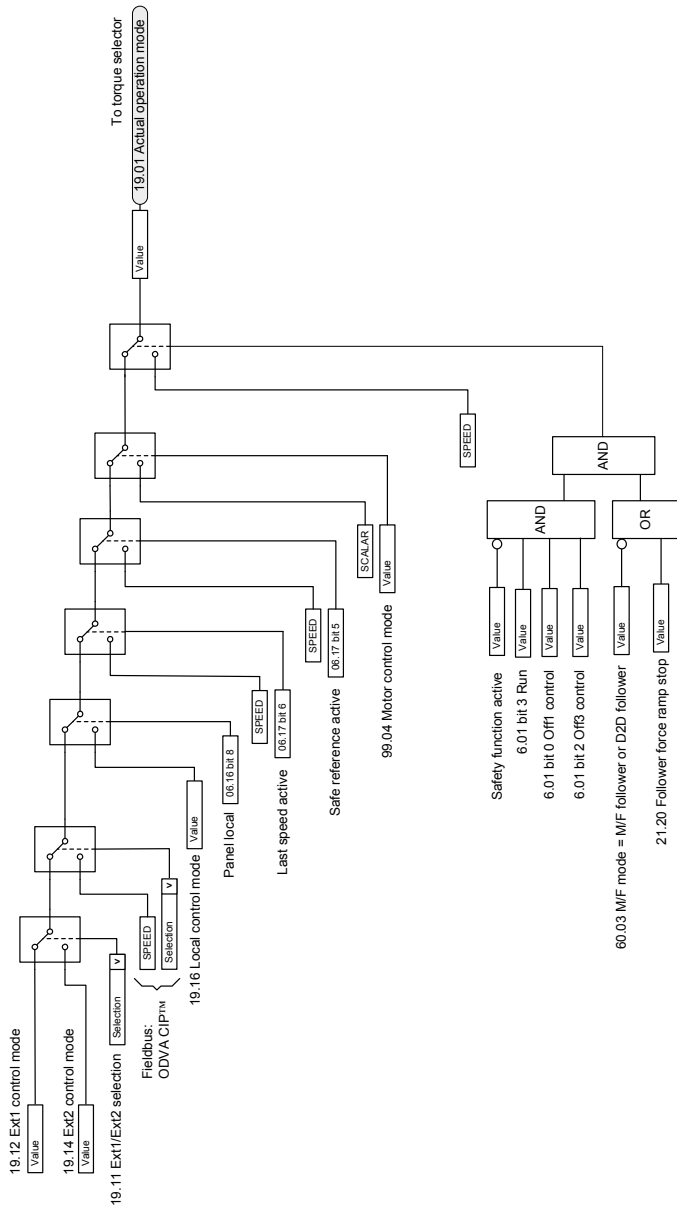
■ Torque reference source selection and modification



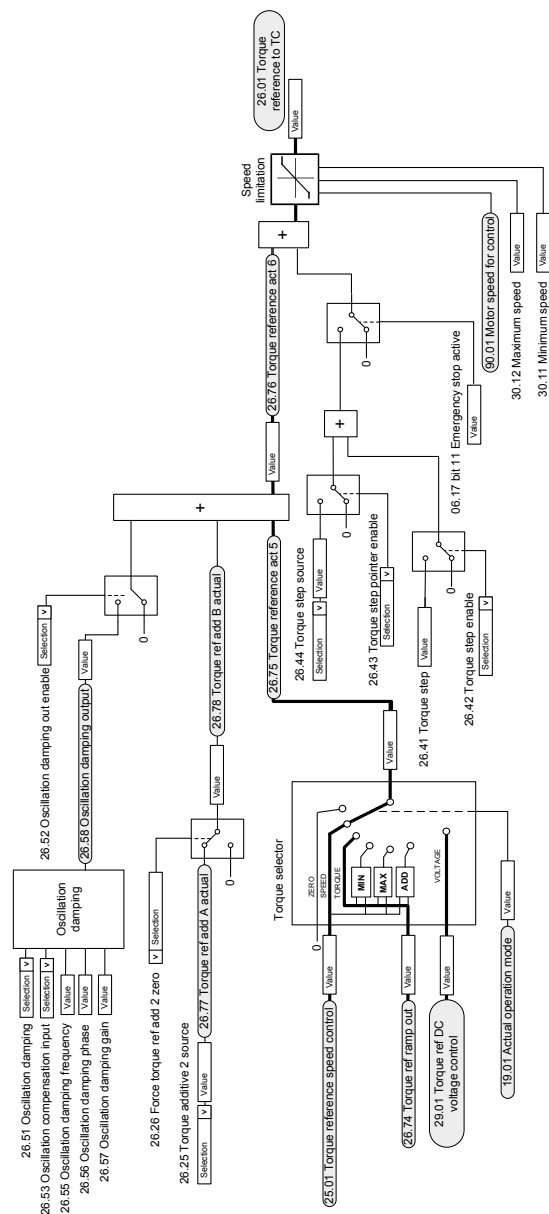
■ Operating modes of the drive



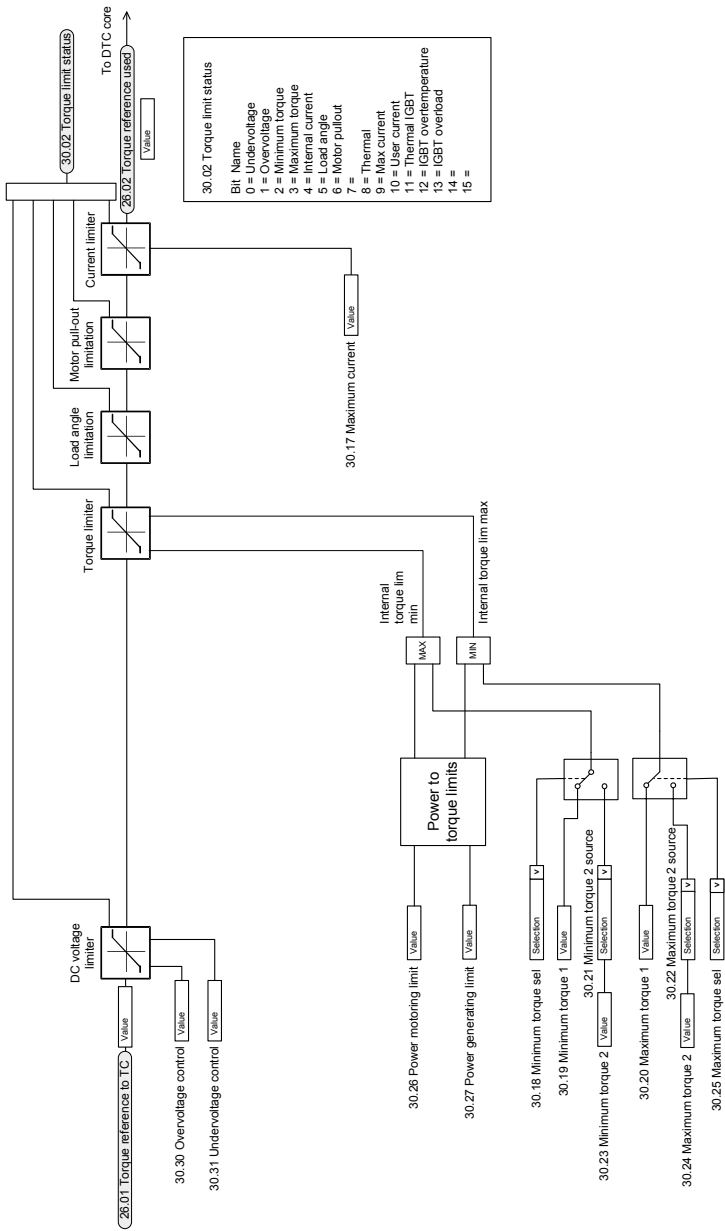
■ Operating mode selection



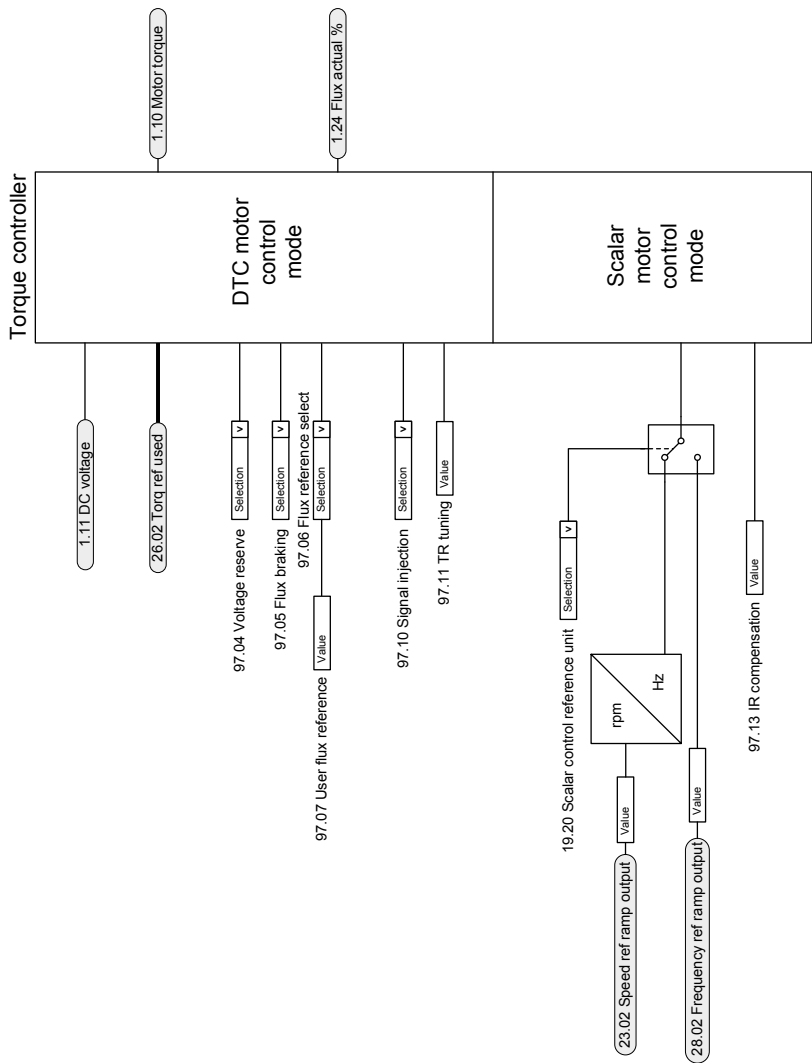
- **Reference selection for torque controller**



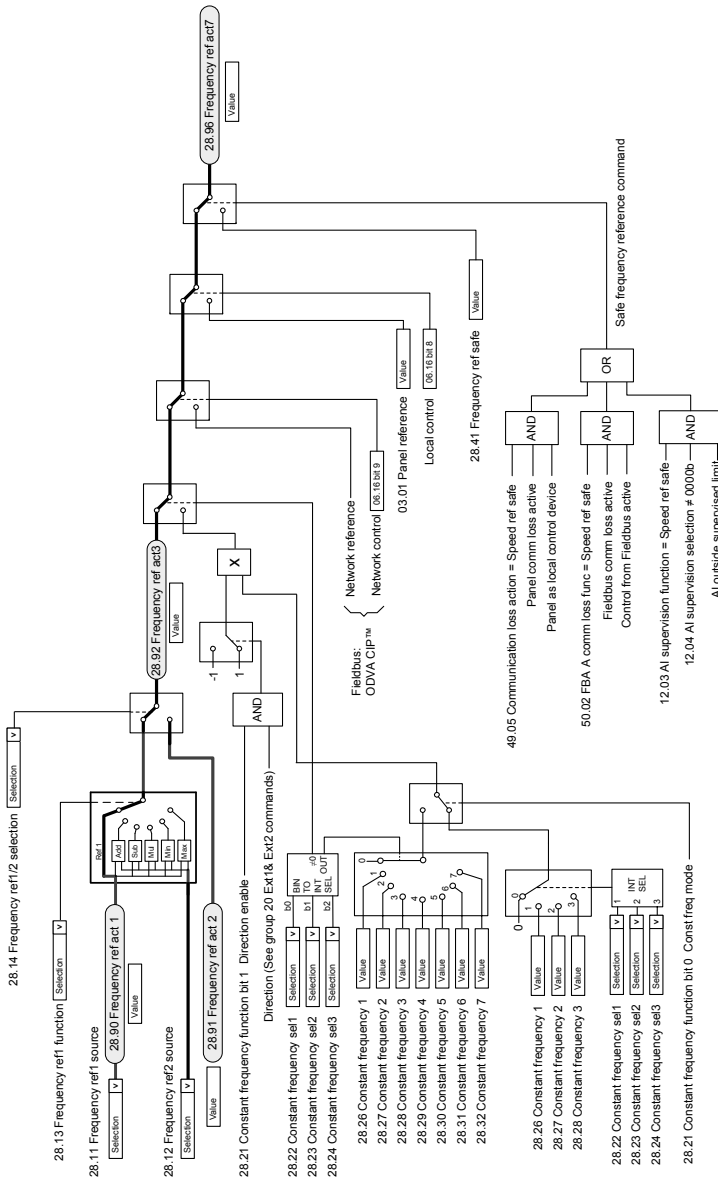
■ Torque limitation



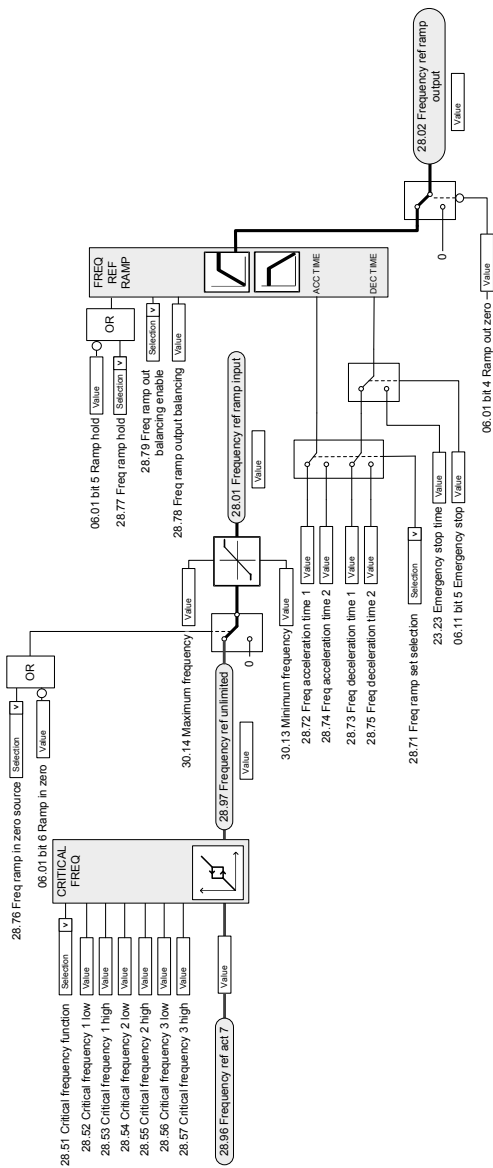
■ Torque controller



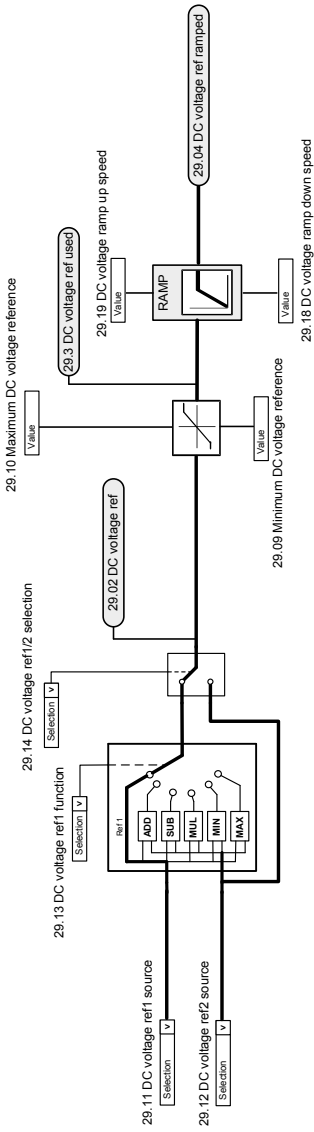
■ Frequency reference selection



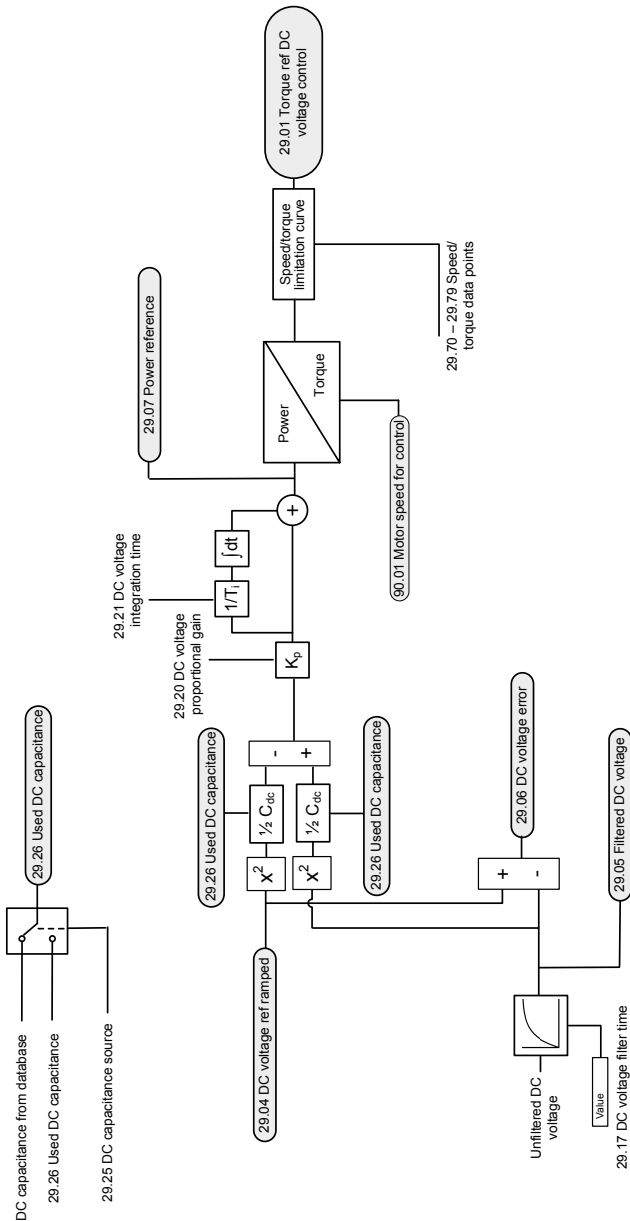
■ Frequency reference modification



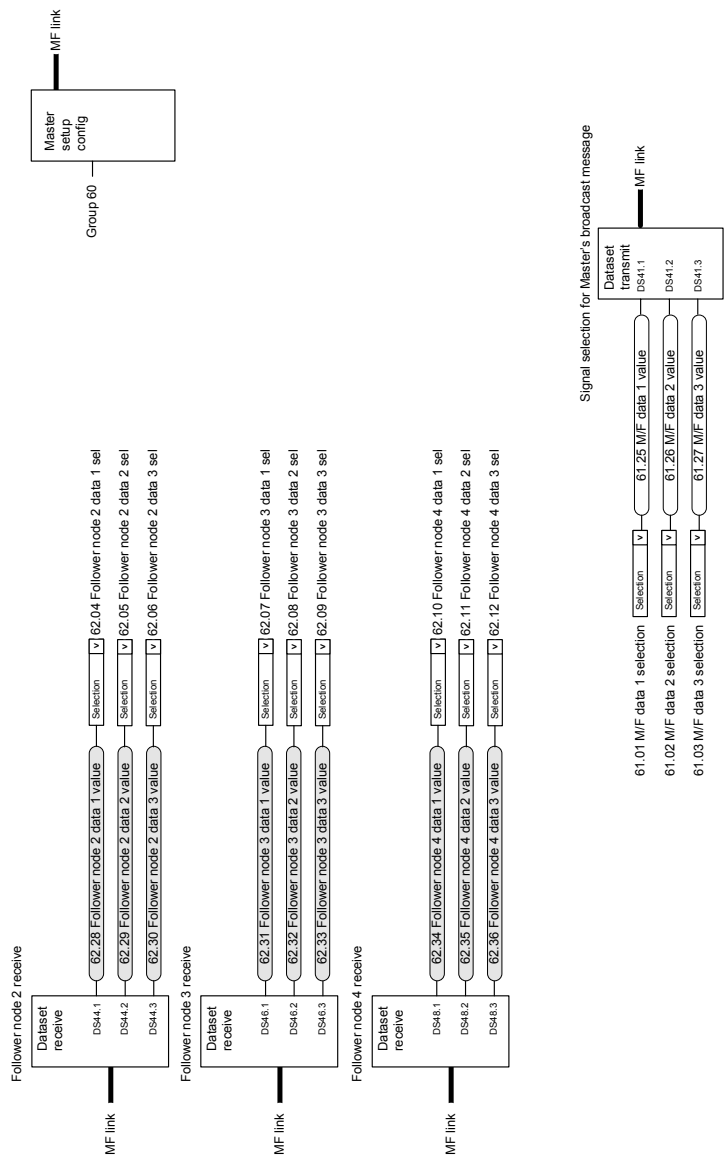
■ DC voltage reference selection



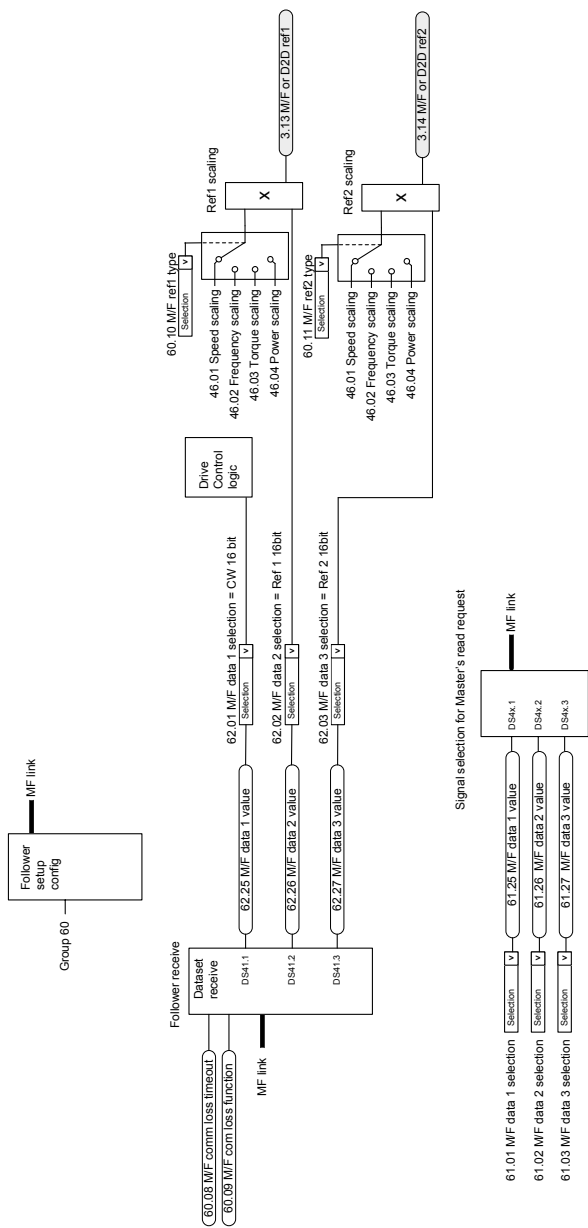
■ DC voltage reference modification



■ Master/Follower communication I (Master)

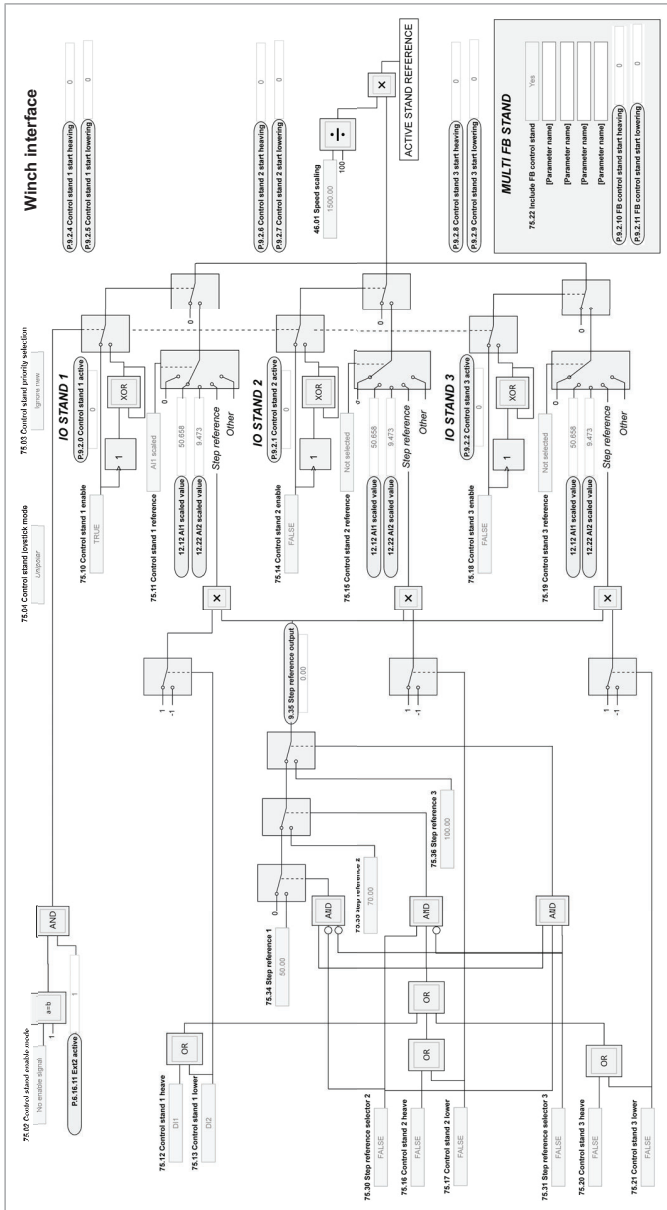


■ Master/Follower communication II (Follower)

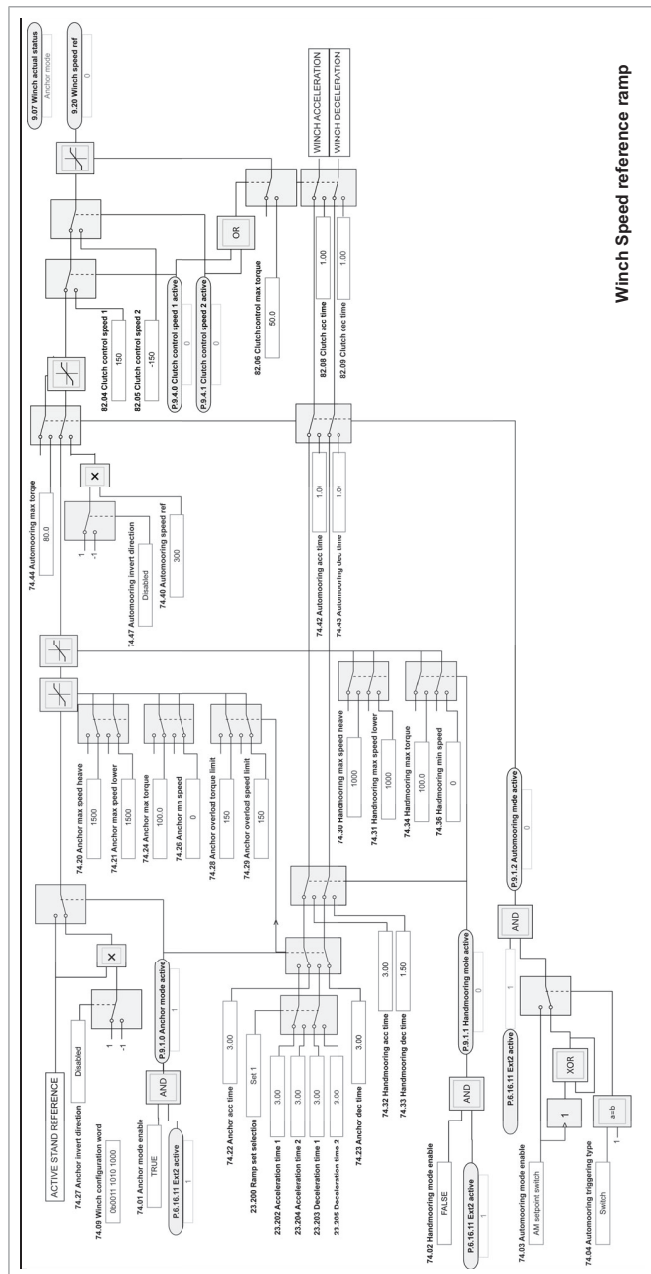


Winch control diagrams

- **Winch interface logic**

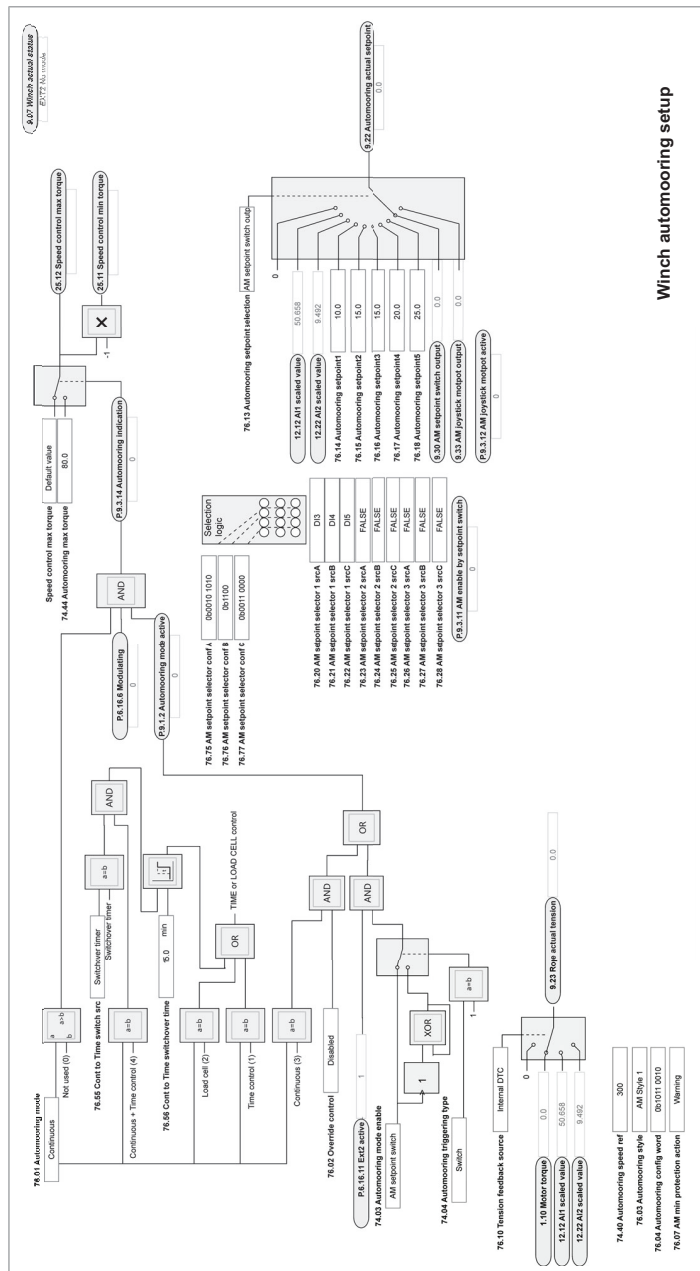


- Winch speed reference ramp

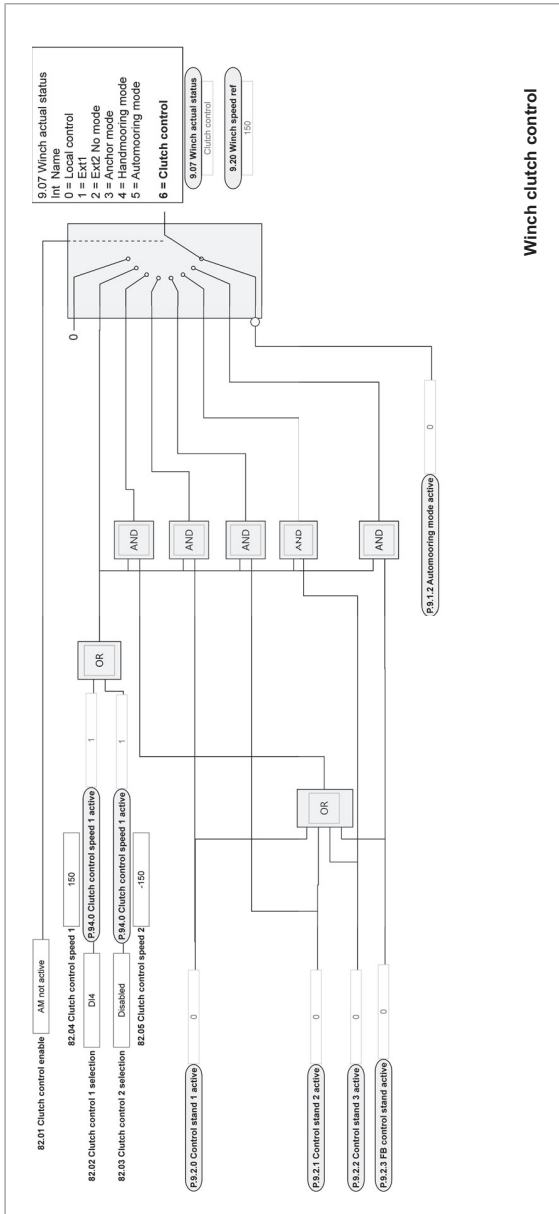


Winch Speed reference ramp

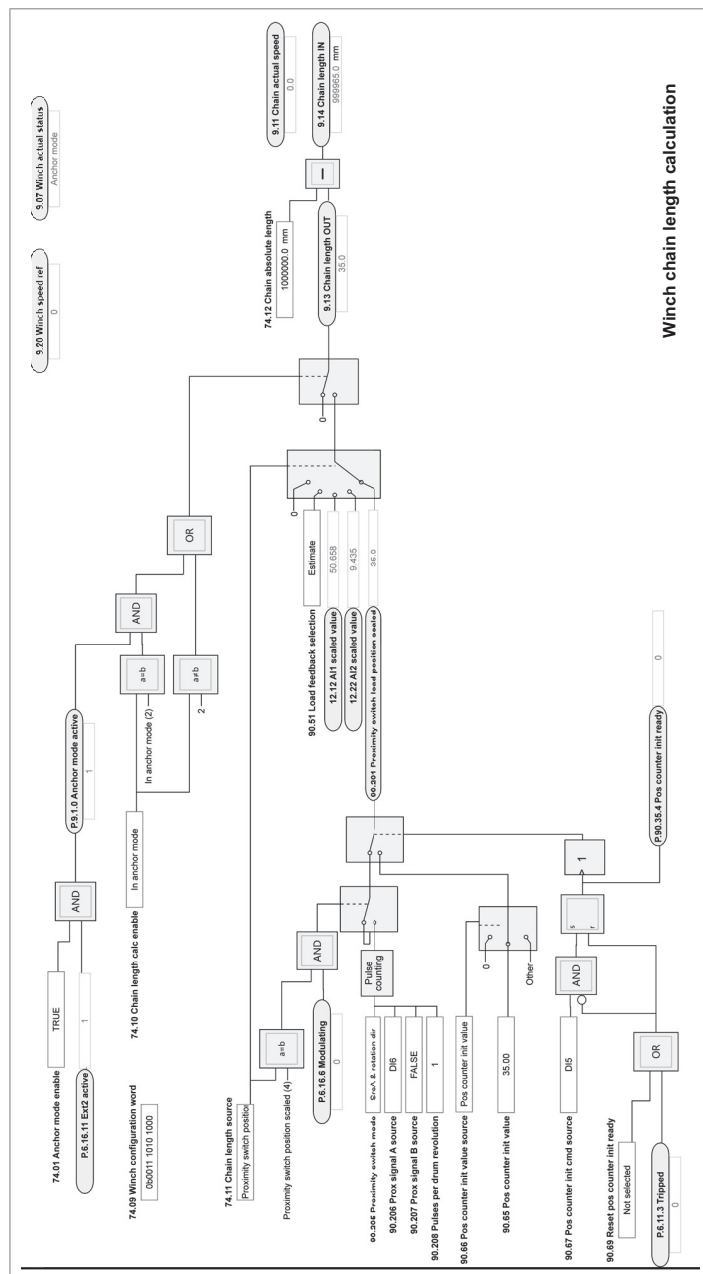
■ Winch automooring setup



- **Winch clutch control**



■ Winch chain length calculation



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 new.abb.com/contact-centers.

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