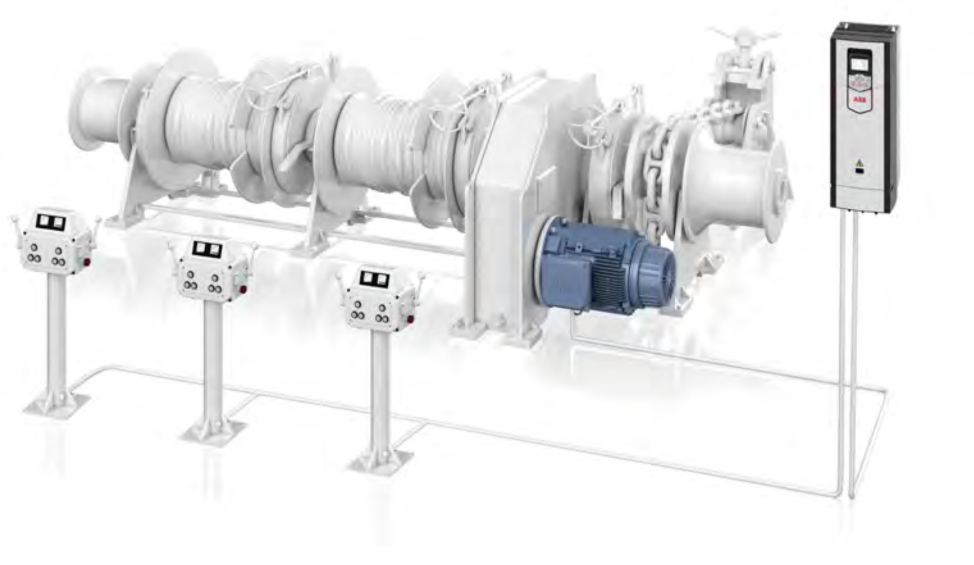
ABB INDUSTRIAL DRIVES

ACS880 winch control program (option +N5100)

Firmware manual



List of related manuals

*List of hyperlinks to product manuals	Code
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) firmware manual	3AXD50000021887
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
Manuals and quick guides for I/O extension modules, fieldbus adapters, encoder interfaces, etc.	

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

*Available in the Document library.

Firmware manual

ACS880 winch control program (option +N5100)

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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 applicability, safety and intended audience.

Applicability

This manual applies to the ACS880 winch control program (option +N5100), winch application version 4.0.0.4 or later, and primary control version 3.4x or later.

You can see firmware and loading package versions in parameters.

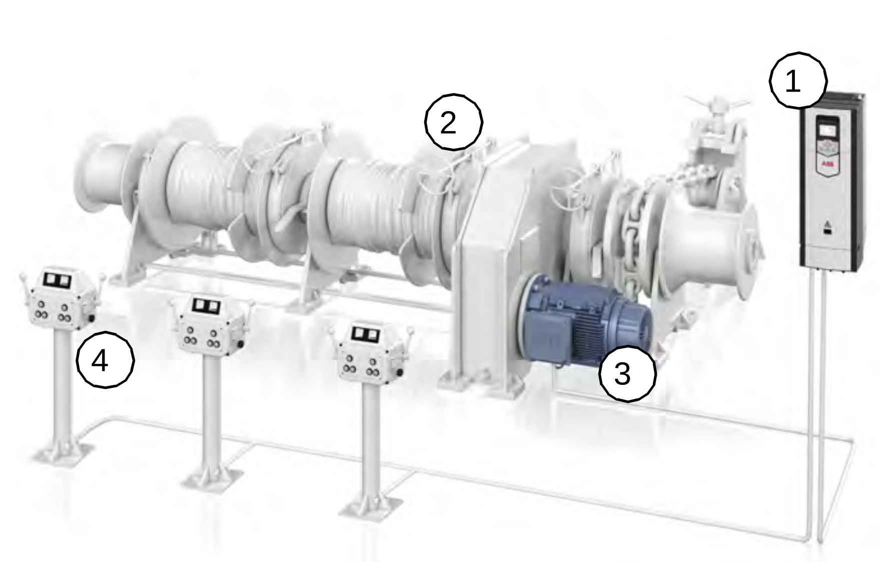
Example:

Parameter	**Loading package version**
07.04 Firmware name	AINFC
07.05 Firmware version	3.40.3.2
07.06 Loading package name	AWCLC
07.07 Loading package version	4.10.0.0

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.

Supported features

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



1	Winch control is included in the drive. It is ready made and fixed (done with IEC61131-1). Includes also, • adaptive block programming (free blocks) for flexibility • Primary control program (platform) • Functional safety modules FSO-21 and FSE-31
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	Multiple control stands connect directly to the drive.

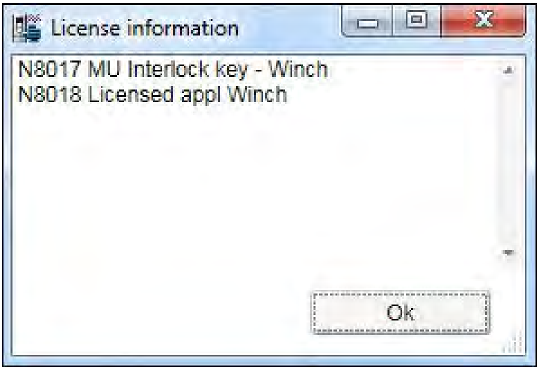
See also this interesting video (click on the below winch image):

Licensing

The Winch control program (+N5100), version AINLC4.00.0.0 or later 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 ACS-APx control panel from **System info** → **Licenses**.



If the program was loaded to a ZMU-02 memory unit without the license key, then the drive indicates a fault *64A5 Licensing fault*. See the auxiliary fault code in the Event logger to know the plus code of the missing license, in this case N8017. For further assistance, contact your local ABB representative.

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*.

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.

See also the short menu parameters list marked in the chapter *Additional parameter data* on page *569*.

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.

Target audience

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

Contents of the manual

This manual contains the following chapters:

- *Quick start-up guide* contains the basic start-up sequence of the drive and additional alternative checklists for starting up the drive with the control program.
- *Using the control panel* provides basic instructions for the use of the control panel.
- *Winch program features* describes the program features specific to the winch application.
- *Standard program features* describes the control locations and operation modes, as well as the program features that are not specific to winch applications.
- *Default control connections* presents the default connection diagram of the winch control application.
- *Parameters* describes the parameters used to program the drive.
- *Additional parameter data* contains further information on the parameters.
- *Fault tracing* lists the warning and fault messages with possible causes and remedies.
- *Fieldbus control through the embedded fieldbus interface (EFB)* describes the communication to and from a fieldbus network using the embedded fieldbus interface of the drive.
- *Fieldbus control through a fieldbus adapter* describes the communication to and from a fieldbus network using an optional fieldbus adapter module.
- *Control chain diagrams* showing the parameter structure within the drive.

Related documents

See the *List of related manuals* on the inside of the front cover.

Terms and abbreviations

Term/abbreviation	Definition
ACS-AP-I	Type of control panel used with ACS880 drives.
ACS-AP-W	
AI	Analog input; interface for analog input signals.
AO	Analog output; interface for analog output signals.
BCU	Type of control unit used in ACS880 drives systems, primarily those with parallel-connected inverter or supply modules.
CIO	I/O module for controlling cabinet fans
D2D	Drive-to-drive; communication link between drives that is implemented by application programming. See *Drive application programming manual (IEC 61131-3)* (3AUA0000127808 [English]).
DC link	DC circuit between rectifier and inverter.
DDCS	Distributed drives communication system; a protocol used in optical fiber communication.
DI	Digital input; interface for digital input signals.
DIO	Digital input/output; interface that can be used as a digital input or output.
DO	Digital output; interface for digital output signals.
Drive	Frequency converter for controlling AC motors. The drive consists of a rectifier and an inverter connected together by the DC link. In drives up to approximately 500 kW, these are integrated into a single module (drive module). Larger drives typically consist of separate supply and inverter units. The ACS880 primary control program is used to control the inverter part of the drive.
DriveBus	A communication link used by, for example, ABB controllers. ACS880 drives can be connected to the DriveBus link of the controller.
DTC	Direct torque control. See page *139*.
EFB	Embedded fieldbus interface. See page *679*.
FAIO-01	Optional analog I/O extension module.
FBA	Fieldbus adapter.
FCAN-01	Optional CANopen adapter.
FCNA-01	Optional ControlNet adapter.
FDCO-0x	Optional DDCS communication module.
FDIO-01	Optional digital I/O extension module.
FDNA-01	Optional DeviceNet™ adapter.
FEA-03	Optional I/O extension adapter.
FECA-01	Optional EtherCAT® adapter.
FEN-01	Optional TTL encoder interface module.

Term/abbreviation	**Definition**
FEN-11	Optional absolute encoder interface module.
FEN-21	Optional resolver interface module.
FEN-31	Optional HTL encoder interface module.
FENA-11	Optional Ethernet/IP, Modbus/TCP and PROFINET IO adapter.
FENA-21	Optional dual-port Ethernet/IP, Modbus/TCP and PROFINET IO adapter.
FEPL-02	Optional POWERLINK adapter.
FIO-01	Optional digital I/O extension module.
FIO-11	Optional analog I/O extension module.
FPBA-01	Optional PROFIBUS DP adapter.
FPTC-01	Optional thermistor protection module.
FPTC-02	Optional ATEX-certified thermistor protection module for potentially explosive atmospheres.
FPTC-01	Optional temperature measurement module. Not released for sales at the time of publication.
FPTC-02	Optional temperature measurement module for potentially explosive atmospheres. Not released for sales at the time of publication.
FSCA-01	Optional Modbus adapter.
FSO-xx	Optional safety functions module.
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; a voltage-controlled semiconductor type widely used in inverters and IGBT supply units due to their easy controllability and high switching frequency
INU-LSU	Type of optical *DDCS* communication link between two converters, for example the *supply unit* and the *inverter unit* of a drive system.
Inverter unit	The part of the drive that converts DC to AC for the motor.
I/O	Input/Output
ISU	An IGBT supply unit; type of supply unit implemented using IGBT switching components, used in regenerative and low-harmonic drives.
Line-side converter	See *supply unit*.
LSU	See *supply unit*.
ModuleBus	A communication link used by, for example, ABB controllers. ACS880 drives can be connected to the optical ModuleBus link of the controller.

Term/abbreviation	Definition
Motor-side converter	See *inverter unit*.
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 Net Ctrl and Net Ref objects of the ODVA AC/DC Drive Profile. For more information, see www.odva.org, and the following manuals: • *FDNA-01 DeviceNet adapter module User's manual* (3AFE68573360 [English]), and • *FENA-01/-11 Ethernet adapter module User's manual* (3AUA0000093568 [English]).
Parameter	User-adjustable operation instruction to the drive, or signal measured or calculated by the drive
PID controller	Proportional–integral–derivative controller. Drive speed control is based on PID algorithm.
PLC	Programmable logic controller
Power unit	Contains the power electronics and power connections of the drive (or inverter module). The drive control unit is connected to the power unit.
PSL2	Protocol used in communication between the drive control unit and the *Power unit*.
PTC	Positive temperature coefficient.
PU	See *Power unit*.
RDCO-0x	DDCS communication module.
RFG	Ramp function generator.
RO	Relay output; interface for a digital output signal. Implemented with a relay.
SSI	Synchronous serial interface.
STO	Safe torque off
Supply unit	The part of the drive that converts AC to DC. An IGBT supply unit (*ISU*) is also capable of feeding regenerative energy back into the supply network.
TTL	Transistor-transistor logic
UPS	Uninterruptible power supply; power supply equipment with battery to maintain output voltage during power failure
ZCU	Type of control unit used in ACS880 drives (primarily in drive modules, or inverter/supply units consisting of a single power module). Consists of a ZCON board built into a plastic housing. Depending on the type of hardware, the control unit may be integrated into or fitted onto the drive/inverter module, or installed separately.

Cybersecurity disclaimer

This product can be connected to and to communicate information and data via a network interface. The HTTP protocol, which is used between the commissioning tool (Drive Composer) and the product, is an unsecured protocol. For independent and continuous operation of product such connection via network to commissioning tool is not necessary. However 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, prevention of physical access, 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.

Notwithstanding any other provision to the contrary and regardless whether the contract is terminated or not, ABB and its affiliates are under no circumstances liable for damages and/or losses related to such security breaches, any unauthorized access, interference, intrusion, leakage and/or theft of data or information.

See also section *User lock* (page *183*).

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*.

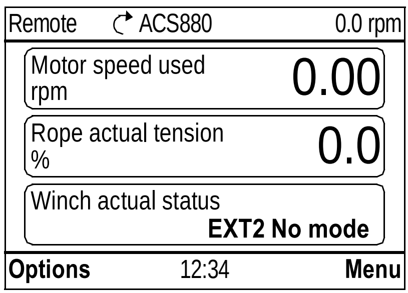
Safety

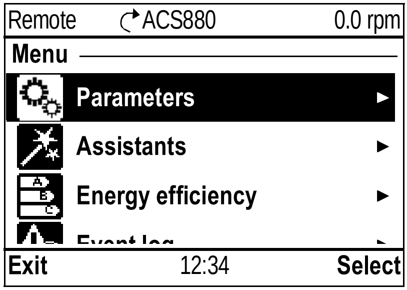
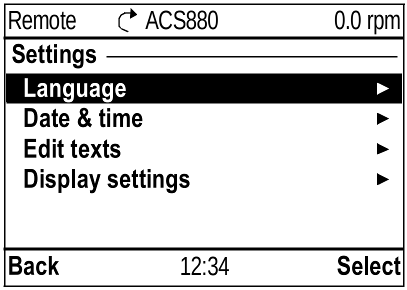
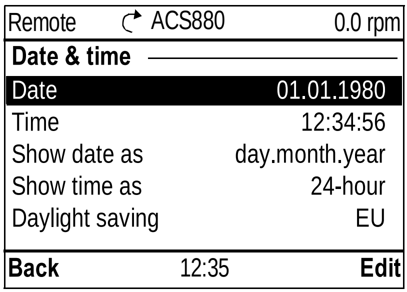
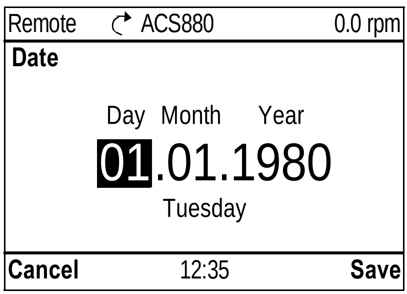
WARNING! All electrical installation and maintenance work on the drive should be carried out by qualified electricians only.

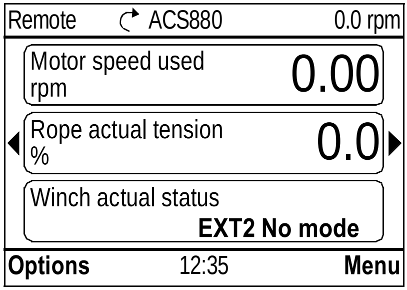
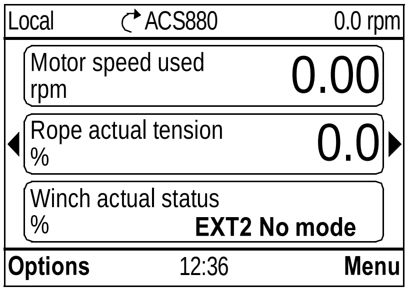
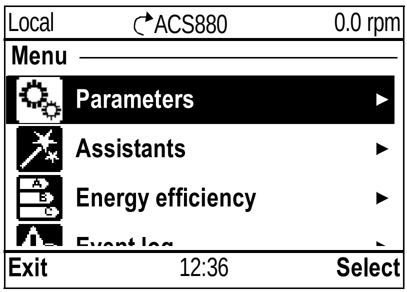
Never work on the drive, the brake chopper circuit, the motor cable or the motor when power is applied to the drive. Always make sure by measuring that no voltage is actually present.

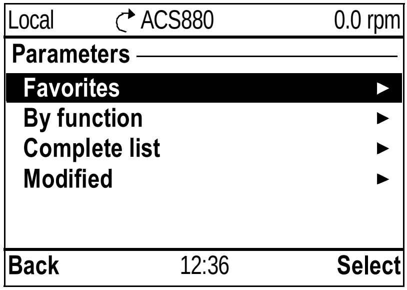
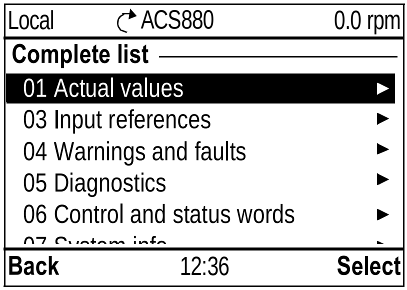
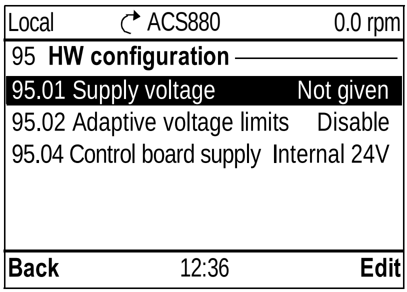
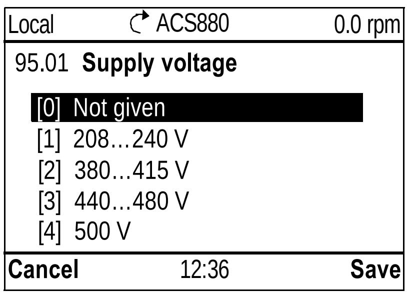
WARNING! Make sure that the machinery into which the drive with brake control function is integrated fulfills the personnel safety regulations. Note that the frequency converter (a Complete Drive Module or a Basic Drive Module, as defined in IEC 61800-2), is not considered as a safety device mentioned 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.

Drive start-up

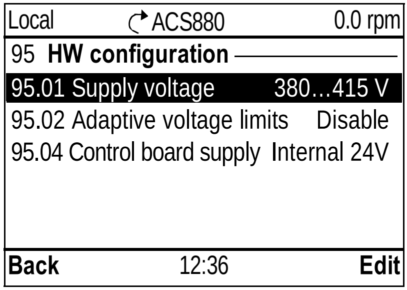
Safety		
	WARNING! Obey all safety instructions for the drive. Only qualified electricians are allowed to start up the drive.	
☐	Check the installation. See the installation checklist in the appropriate *Hardware manual*.	
☐	Check that the starting of the motor does not cause any danger. **De-couple 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 located below the display. The commands assigned to the softkeys vary depending on the context.	

☐	In the **Home** view, press (**Menu**). The main **Menu** (right) appears.	
☐	Highlight **Settings** on the menu using and 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 (**Select**).	

☐	Set the correct date: • Use ◄ and ► to move the cursor left and right. • Use ▲ and ▼ to change the value. • Press (**Save**) to accept the new setting. Check/adjust all the remaining settings in the **Date & time** menu. The **Show clock** setting determines whether the time is shown at all times in the bottom pane of the display. After you have made the settings, press (**Back** or **Exit**) repeatedly until the **Home** view (right) reappears.	
2 – Supply voltage and motor data settings		
☐	Switch to local control to ensure that external control is disabled by pressing the Loc/Rem key. Local control is indicated by the text "Local" in the top pane.	
☐	Open the main **Menu** by pressing (**Menu**).	

<table>
<tr><td>☐</td><td>Highlight Parameters and press (Select).</td><td>
</td></tr>
<tr><td>☐</td><td>Highlight Complete list using and and press (Select).
A listing of parameter groups is displayed.</td><td>
</td></tr>
<tr><td>☐</td><td>Highlight parameter group 95 HW configuration 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.</td><td>
</td></tr>
<tr><td>☐</td><td>Highlight parameter 95.01 Supply voltage (if not already highlighted) and press (Edit).
The available parameter settings are listed.</td><td>
</td></tr>
</table>

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



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

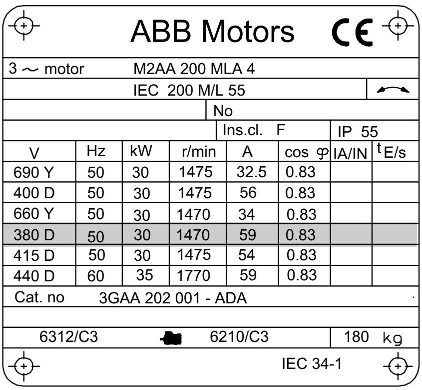
☐ Set parameter *99.04 Motor control mode*.

DTC (Direct torque control); *Scalar*

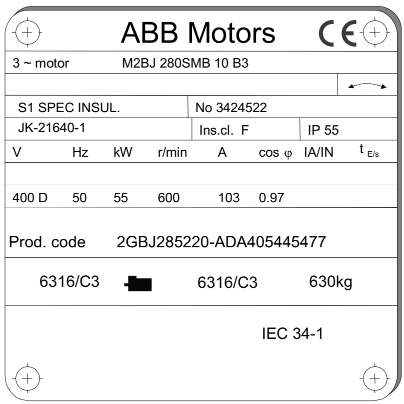
- **DTC** can be used for desk machinery winches (anchor and mooring), in open or closed loop motor control.
- **Scalar** is a test mode and can be used with or without motor.

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:



Example of a nameplate of a permanent magnet motor:



☐ *99.06 Motor nominal current*

The allowable range is

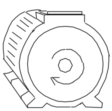
- in DTC mode: $1/6 \times I_{Hd}$ … $2 \times I_{Hd}$ of the drive
- in Scalar mode: 0 … $2 \times I_{Hd}$

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 × U_N … 2 × U_N of the drive. With permanent magnet motors, the nominal voltage is the BackEMF voltage at nominal speed. If the voltage is given in volt/rpm (eg. 60 V per 1000 rpm), the voltage at a nominal speed of 3000 rpm is 3 × 60 V = 180 V. Note that nominal voltage is not the same as equivalent DC motor voltage (EDCM) given by some manufacturers. The nominal voltage can be calculated by dividing the EDCM voltage by 1.7 (or square root of 3).
☐	*99.08 Motor nominal frequency* With permanent magnet motors, if the nominal frequency is not shown on the nameplate, it can be calculated using the following formula: $f = n \times p / 60$ where n = nominal motor speed, p = number of pole pairs.
☐	*99.09 Motor nominal speed*
☐	*99.10 Motor nominal power*
☐	*99.11 Motor nominal cos ?* *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 de-coupled from the motor if • the load torque is higher than 20%, or • the machinery is not able to withstand the nominal torque transient during the identification run. 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. **Notes**: • This mode cannot be used with a permanent magnet motor if the load torque is higher than 20% of nominal. • Mechanical brake is not opened by the logic for the identification run.
☐	Ensure that the Safe torque off and emergency stop circuits (if present) are closed.
☐	Start the identification run by pressing the (Start) button. A warning will indicate that the identification run is in progress.
☐	Check that the motor runs in the correct direction. **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 *None*. 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* = 44.204.0 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*.
☐	Make sure that the brake open torque parameters are set by default. *44.200 Brake open torque source* = *Brake open torque*. *44.201 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 the brake and safety circuits are working.
☐	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*. Enable control stand 1 or control stand 2 or control stand 3. *75.10 Control stand 1 enable* = *DI1* *75.14 Control stand 2 enable* = *FALSE* *75.18 Control stand 3 enable* = *FALSE*
☐	Activate control stand 1 heave or lower. *75.11 Control stand 1 reference* = *AI1 scaled* *75.12 Control stand 1 heave* = *DI2* *75.13 Control stand 1 lower* = *DI3* *75.16 Control stand 2 heave* = *FALSE* *75.17 Control stand 2 lower* = *FALSE* *75.20 Control stand 3 heave* = *FALSE* *75.21 Control stand 3 lower* = *FALSE*

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 *75.13 Control stand 1 lower* = DI3 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 *ACX-AP-x assistant control panels user's manual* (*3AUA0000085685* [English]).

4

Winch program features

Contents of this chapter

This chapter describes some of the important functions within the control program that are specific to winch applications, how to use them and how to program them to operate.

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. See also the overview of winch control in the below *Block diagram*.

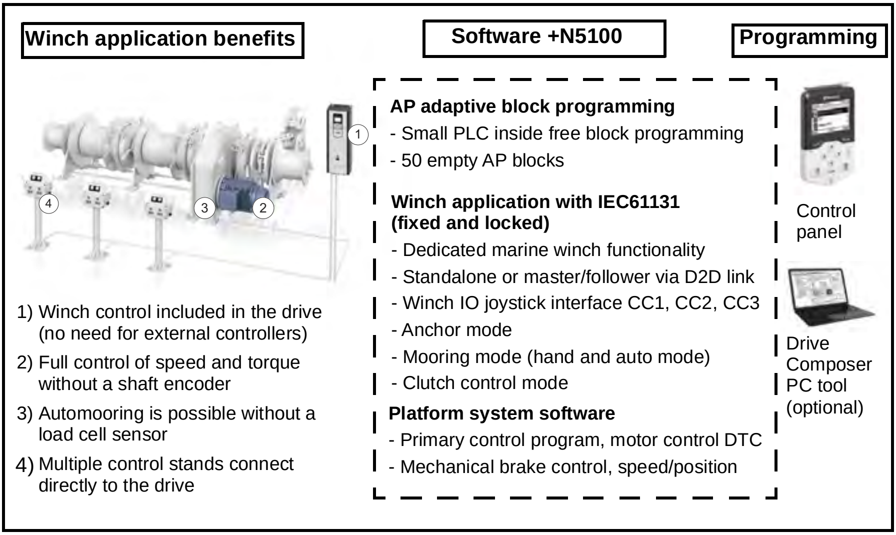
The start, stop and control signals can be analog, digital or fieldbus-based from a programmable logic controller (PLC). The wireless radio controller can be connected through PLC or directly to the drive IO board (D2D link-embedded Modbus).

The control program includes four different user parameter sets for customizing the parameter settings. Each set includes two different control places. For more information, see section *User parameter sets* on page *182*.

The speed match is used to increase the safety with measurement from the anchor chain length on the drum. The winch is in open loop DTC. If the user has an encoder or sensor to measure the chain length, then the encoder feedback can be used for speed match safety.

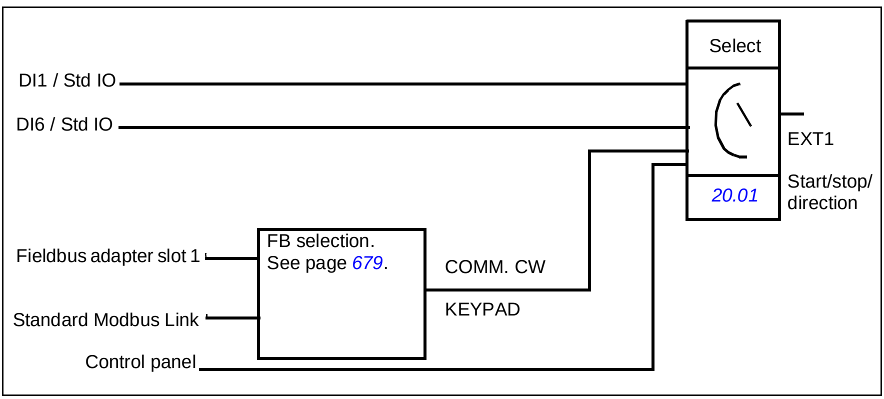
Block diagram

The figure below shows the Winch application benefits and its supported features.

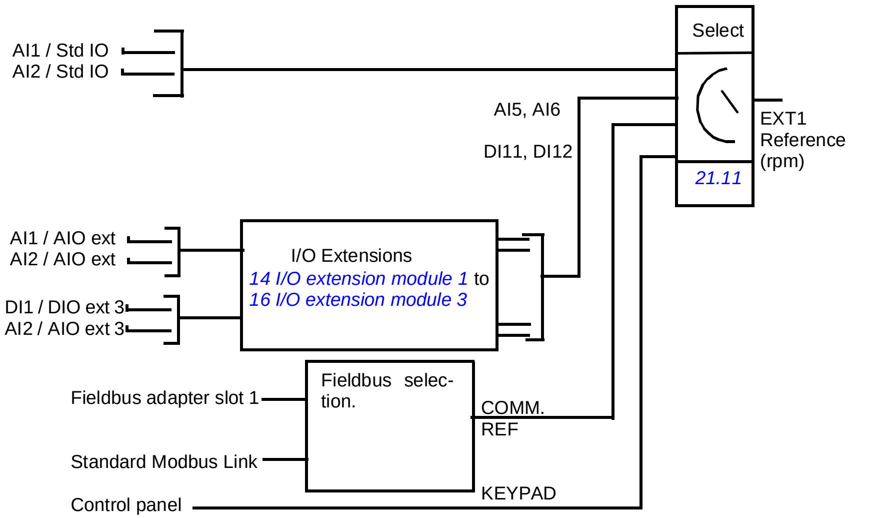


Standalone speed control without winch feature (EXT1)

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.



AI1 / Std IO = Analogue input AI1 on the standard I/O terminal block.

AI1 / AIO ext = Analogue input AI1 on the analogue I/O extension module.

Winch control mode (EXT2)

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

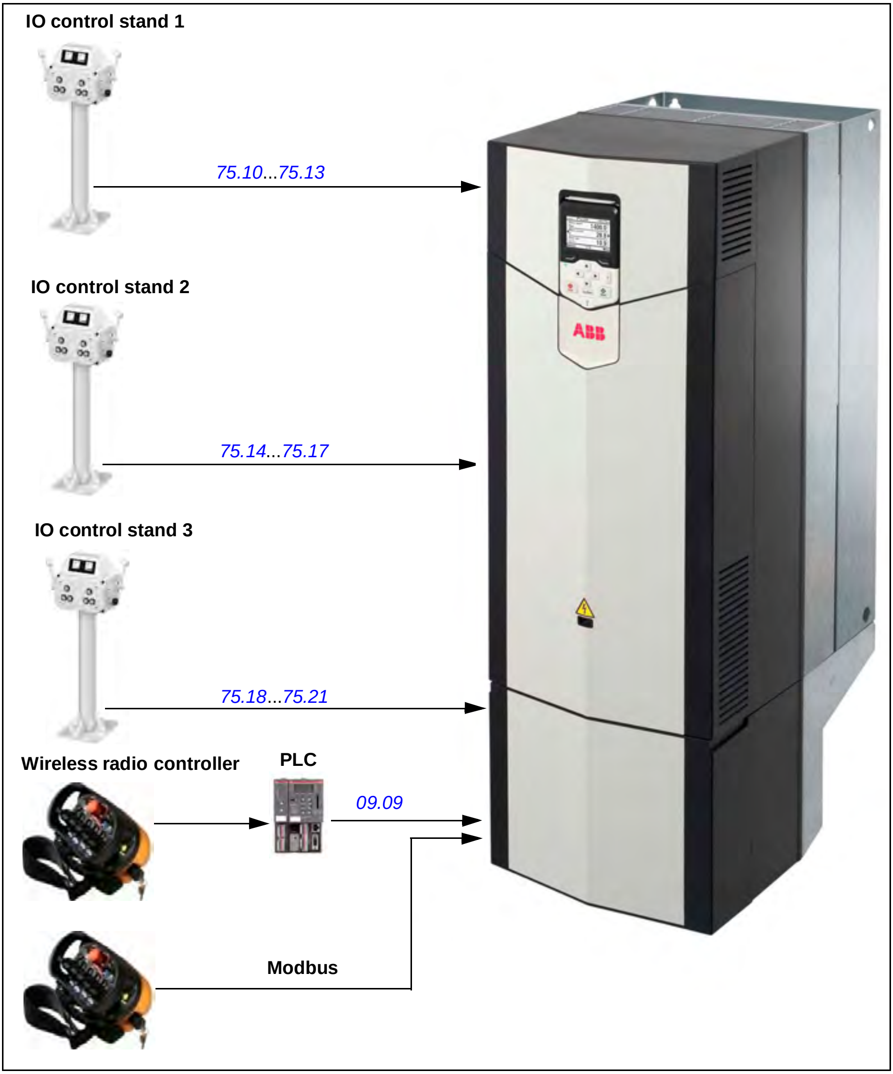
Winch interface EXT2

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 three 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*. See the below connections diagram.



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

Winch control interface

The control program includes external control locations EXT1 and EXT2 for normal operation. For more information on the external control locations, see section *Local control vs. external control* on page *120*.

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* on page *476*.

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 Automooring with a DI input
- Automooring setpoint switch or potentiometer AI input.

Settings and diagnostics

Parameter group: *75 Winch interface* (page *476*).

Parameter: *20.06 Ext2 commands* (page *283*).

Events: -

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, see parameter *75.03 Control stand priority selection* on page *477*.

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.

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*, *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*.

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*).

75.12, *75.16* or *75.20*	*75.13*, *75.17* or *75.21*	*75.30 Step reference selector 2*	*75.31 Step reference selector 3*	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* (-)

See also section *Speed reference priorities* on page *45*.

Settings and diagnostics

Parameters: *75.30 Step reference selector 2*, *75.31 Step reference selector 3*, *75.34 Step reference 1*, *75.35 Step reference 2*, *75.36 Step reference 3*.

Events: -

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, see sections:

- *Speed reference ramping* on page *46*
- *Constant speeds* on page *140*
- *Step reference selection* on page *44*
- *Anchor control* on page *47*
- *Supervision logic* on page *105*

Speed reference ramping

The control program has two user-selectable ramps.

- Acceleration ramp, and
- 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.

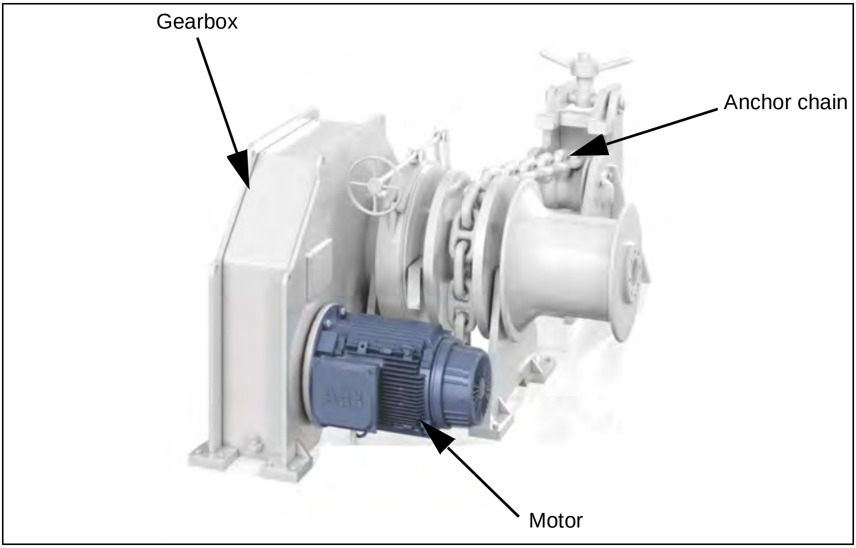
Settings and diagnostics

Parameters: *23.16 Shape time acc 1* … *23.19 Shape time dec 2*, *23.200 Ramp set selection* … *23.205 Deceleration time 2*, and *46.01 Speed scaling*.

Events: -

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.

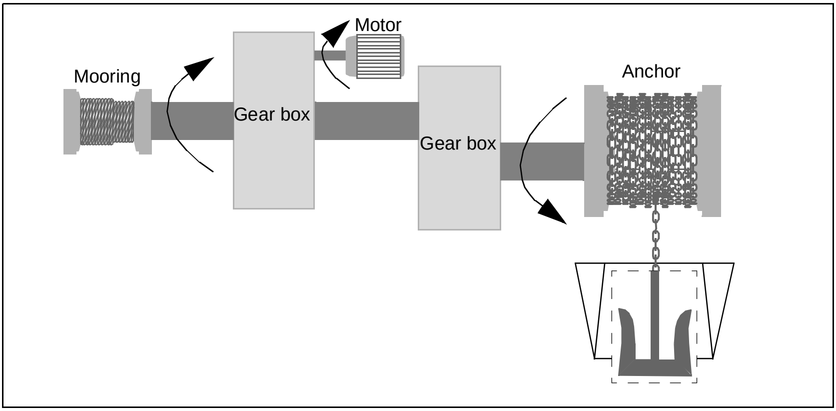


The Anchor mode can be activated with parameter *74.01 Anchor mode enable*.

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 *457*).

Events: -

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.

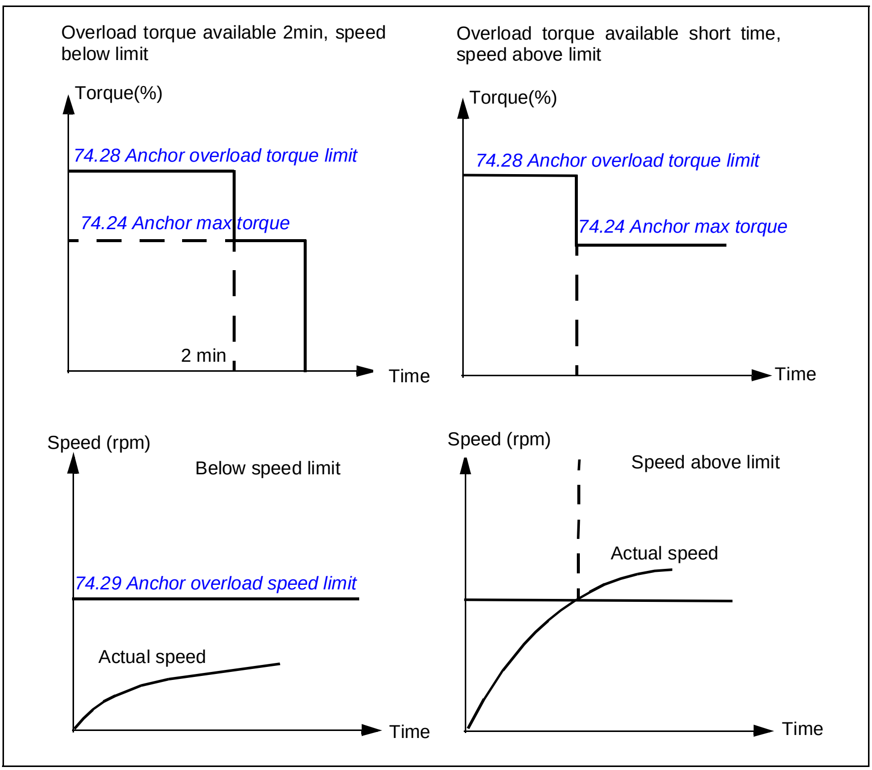
This function is used at start of anchor only in heaving direction. If the anchor is jammed in the sea bottom and not moving, a temporary overload force is needed to heave the anchor. The temporary time for the lifting force is limited to two minutes.

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.

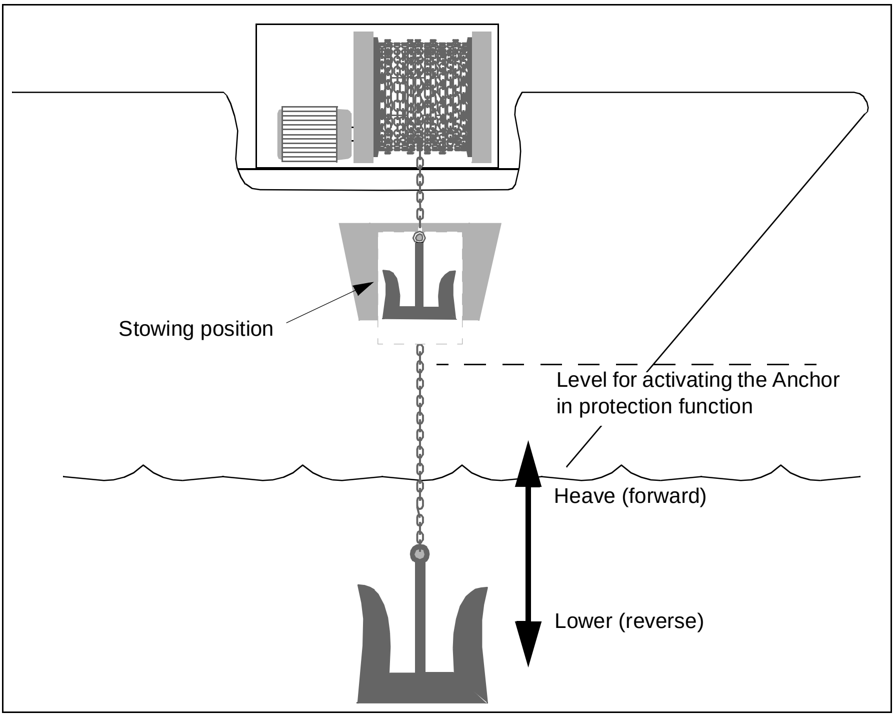
Settings and diagnostics

Parameters: *74.09 Winch configuration word* (page *460*), *74.24 Anchor max torque* (page *462*), *74.27 Anchor invert direction* (page *463*), *74.28 Anchor overload torque limit* (page *464*) and *74.29 Anchor overload speed limit* (page *464*).

Events: -

Anchor stowing protection

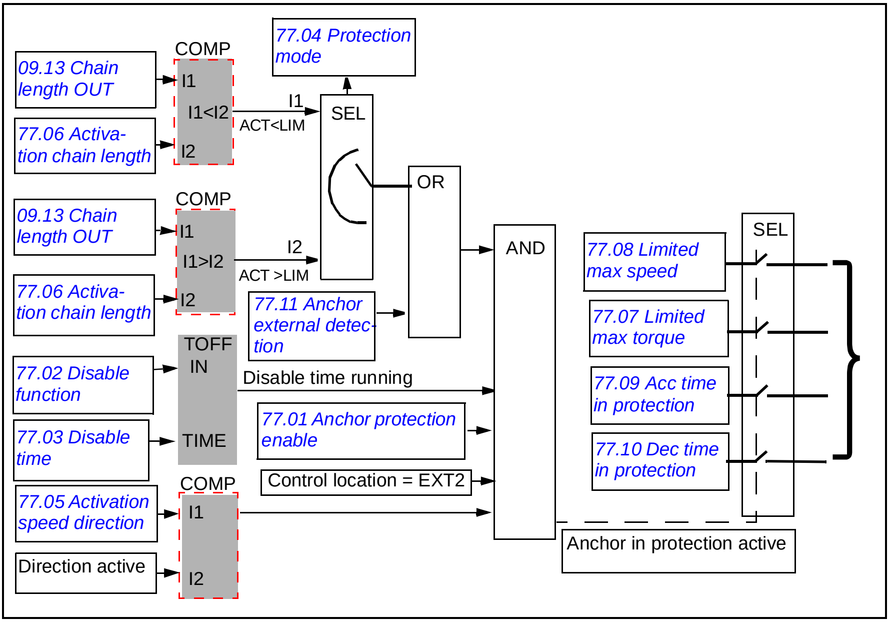
The Anchor stowing protection function can automatically apply a reduced speed reference and a lower torque limit before the anchor reaches its stowing position when an anchor is heaved. The function can be triggered by the measured chain length reaching a preset limit and/or an external proximity switch. 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 (DIx). User can define the source for the signal by a 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 *498*).

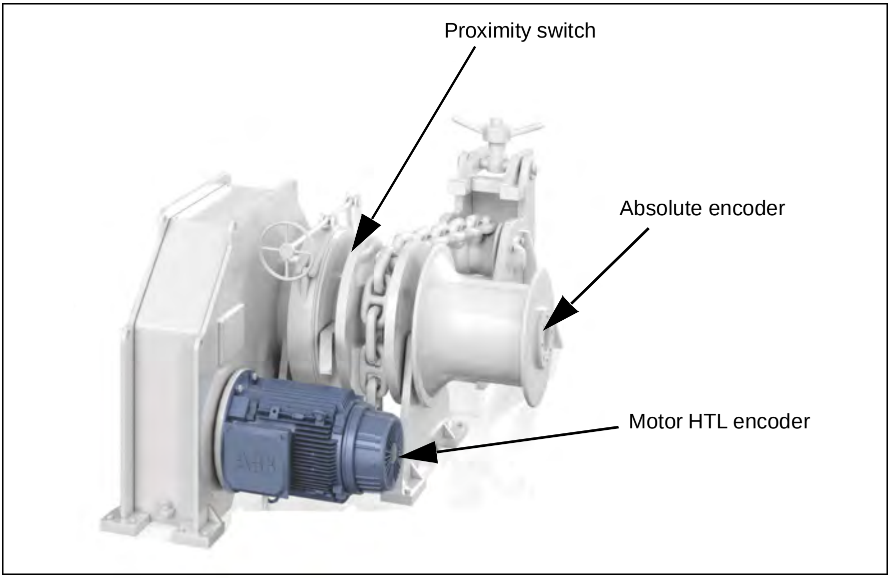
Events: -

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 a absolute encoder
- motor shaft with a 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:

$$\textit{Proximity switch load position scaled (90.201)} = \frac{\textit{Pulse count}}{\textit{Pulses per drum revolution (90.208)}} \times \textit{Feed constant ratio}$$

$$\textit{Feed constant ratio} = \frac{\textit{90.63 Feed constant numerator}}{\textit{90.64 Feed constant denominator}}$$

- 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 Encoder2configuration*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*. See chapter *Position counter* on page *148*.

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*.

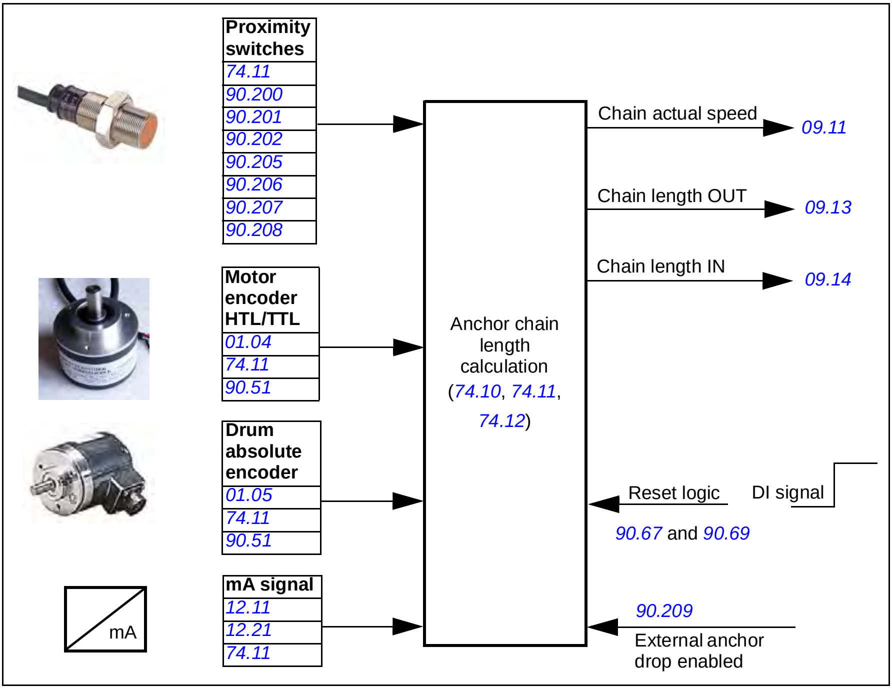
To initiate the position counter, see parameters *90.65 Pos counter init value* to *90.67 Pos counter init cmd source*.

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.

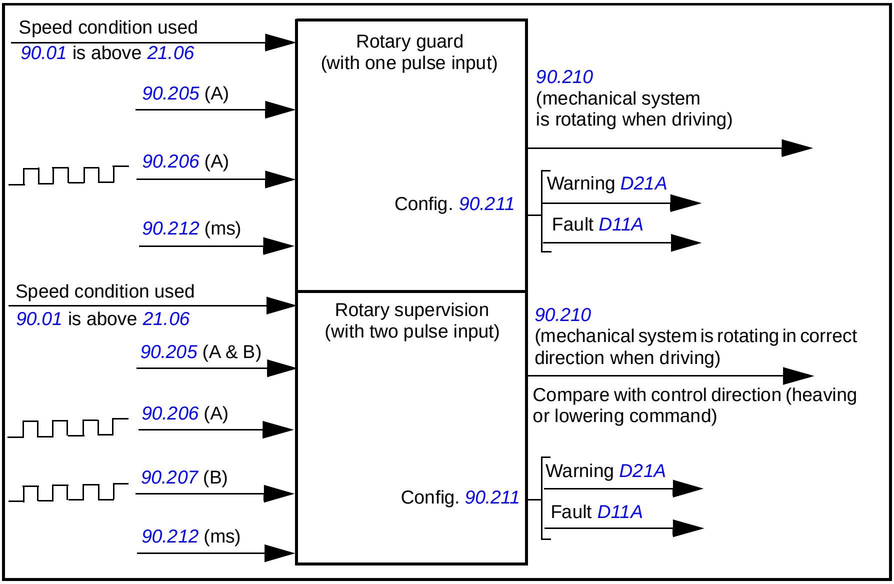


Rotary supervision

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 Rotary supervision delay*) and confirms mechanical system rotation.
- R**otary 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 *192*), *09.11 Chain actual speed* (page *223*), *09.13 Chain length OUT* (page *223*), and *09.14 Chain length IN* (page *224*).

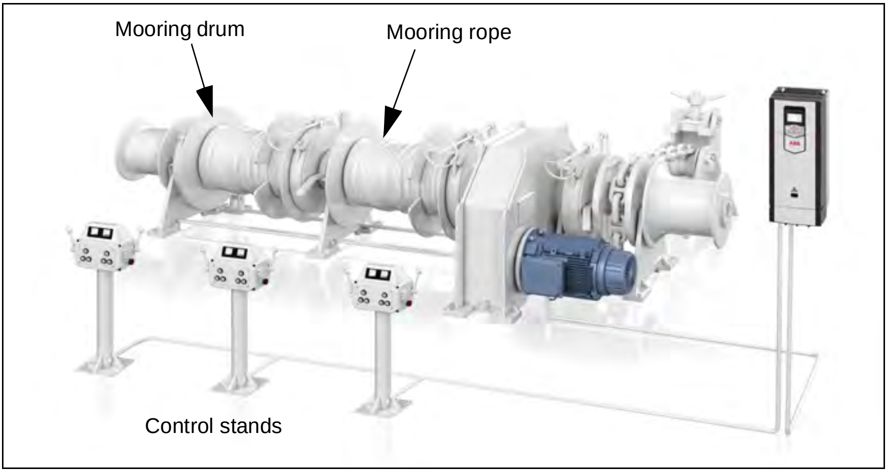
Parameter groups: *12 Standard AI* (page *239*), *74 Winch general* (page *457*) and *90 Feedback selection* (page *515*).

Events: *D21A Rotary supervision* (page *650*), *D11A Rotary supervision* (page *672*).

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*, *74.32 Handmooring acc time*, *74.33 Handmooring dec time* and *74.34 Handmooring max torque* (page *464*).

Events: -

Handmooring application protections

For Handmooring application protections, see *Slip detection* (page *75*) and *Peak torque protection* (page *76*).

Settings and diagnostics

Parameter: *79.01 Peak torque protection enable* (page *504*).

Events: -

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.

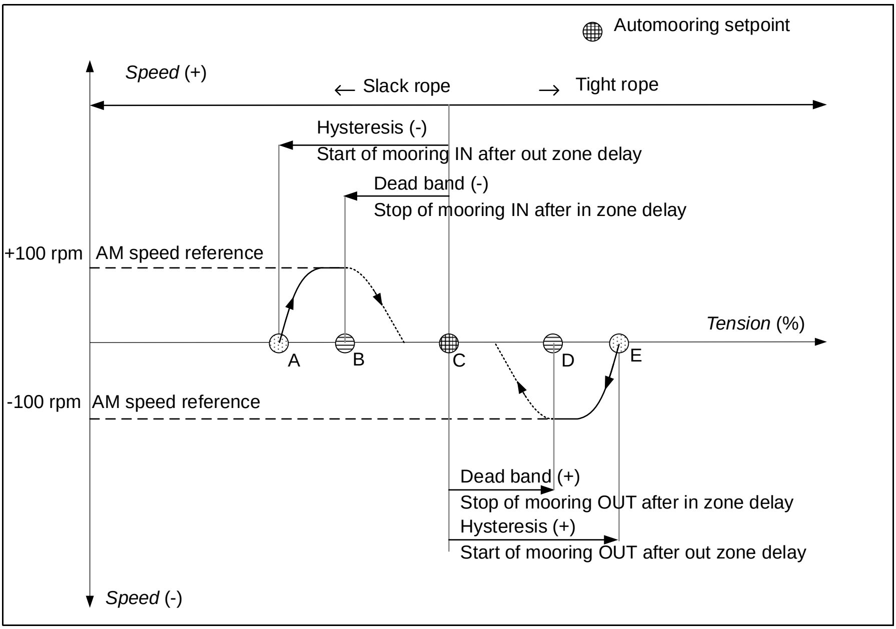
Automooring can be used when Handmooring is completed and required pretension is achieved in the ropes (parameter *76.05 Automooring min tension*). This optional protection prevents starting Automooring with slack ropes.

A speed control reference (parameter *74.40 Automooring 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 Automooring setpoint selection*).

Overview of Automooring mode

The Automooring can be used in different modes. You can select the mode with parameter *76.01 Automooring mode*.

- **Time control in *76.01***- This mode can be used for internal DTC feedback in *76.10*. The tension feedback comes from the internal DTC torque measurement. Automooring is controlled by defined time control sequence where the program waits with closed brake for the Re-mooring time and then checks the tension in the rope. If required, the program corrects the tension in the rope and then waits the Re-mooring time.
- **Load cell in *76.01*** - This mode can be used for external load cell feedback in *76.10*. 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 in *76.01*** - This mode can be used for internal DTC feedback in *76.10*. The program is continuously correcting the tension in the rope according to the desired setpoint value.
- **Continuous + Time control in *76.01*** - This mode can be used for internal DTC feedback in *76.10*. It is a combination of Continuous and Time control modes. The program switches from Continuous to Time control after a predefined time.



Automooring setpoints

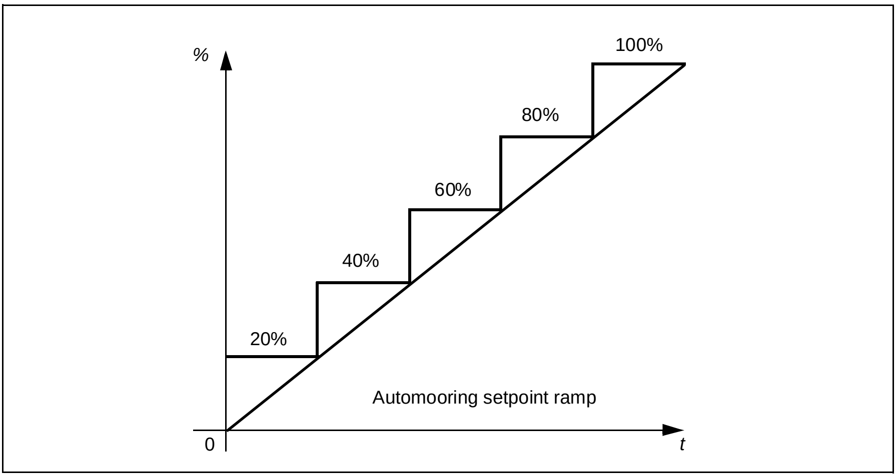
The desired tension in the rope is defined with parameter *76.13 Automooring setpoint selection*. The setpoint can be selected as:

- Analogue inputs
- Constant values
- Automooring setpoint switch output
- Joystick motor potentiometer

Parameter *09.22 Automooring actual setpoint* shows the used setpoint.

Automooring setpoint ramp

The ramp time for Automooring setpoint is defined for Automooring 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 Automooring setpoint reference ramp is 10 seconds and Automooring setpoint switch is changed from 0 to 20%, then it takes 2 seconds to ramp up the Automooring setpoint reference. Parameter *09.22 Automooring actual setpoint* shows the actual Automooring setpoint reference.

Automooring setpoint switches

The Automooring setpoint switch can be selected with parameter *76.13 Automooring 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 Automooring setpoints 1 to 5 (*76.14*...*76.18*).

Automooring 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 Automooring 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, see parameters *76.75 AM setpoint selector conf A* and *76.76 AM setpoint selector conf B* on page *495*.

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* on page *459*.

Automooring setpoint change during re-mooring

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

Settings and diagnostics

Parameter groups: *74 Winch general* (page *457*) and *76 Automooring* (page *484*).

Signals: *09.22 Automooring actual setpoint* (page *224*) and *09.30 AM setpoint switch output* (page *225*).

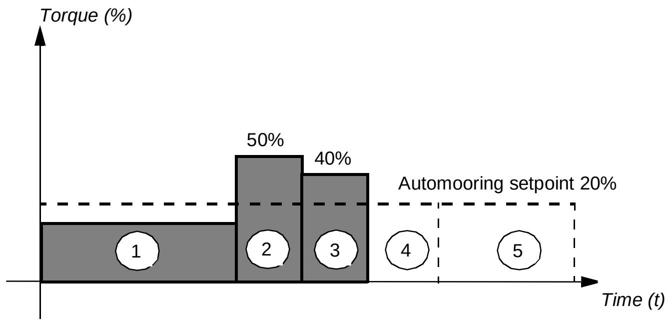
Parameters: *76.13 Automooring setpoint selection* (page *487*), *76.14 Automooring setpoint1*...*76.18 Automooring setpoint5* (page *487*), *76.19 AM setpoint ref ramp* (page *488*), *76.20 AM setpoint selector 1 srcA*...*76.28 AM setpoint selector 3 srcC* (page *488*) and *76.75 AM setpoint selector conf A*...*76.77 AM setpoint selector conf C* (page *495*).

Events: -

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 Automooring setpoint value.

Enable adaptive limits with parameter *76.04 Automooring config word*, bit *7*.



1 Pre-magnetizing, 2 Torque proving, 3 Start torque, 4 TORQ measuring, 5 Automooring

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 *394*), *76.04 Automooring config word* (page *485*), *81.01 Torque proving enable* (page *509*) and *81.02 Torque proving reference* (page *509*).

Events: -

Automooring hysteresis and dead band

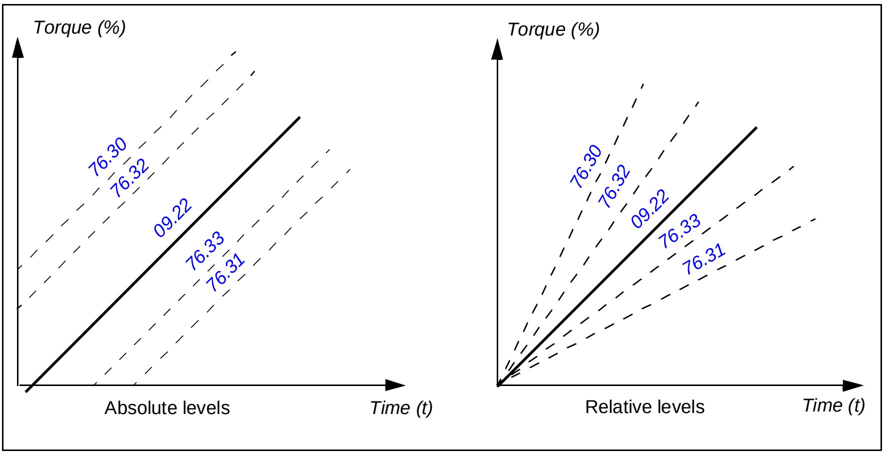
Hysteresis limits define the limits for the rope tension. If the tension exceeds the limits, the Automooring program starts a corrective action to get the tension towards the setpoint. The hysteresis values are defined in parameters *76.30 Hysteresis high level* and *76.31 Hysteresis low level*. They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

The deadband limits define the limits for an acceptable tension value. When the tension is within the deadband, the Automooring 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 Automooring actual setpoint (*09.22 Automooring 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 Automooring config word*, bit 2.



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

Settings and diagnostics

Signal: *09.22 Automooring actual setpoint* (page *224*).

Parameters: *76.04 Automooring config word* (page *485*), *76.30 Hysteresis high level*, *76.31 Hysteresis low level*, *76.32 Deadband high level* and *76.33 Deadband low level* (page *489*).

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*.

Events: -

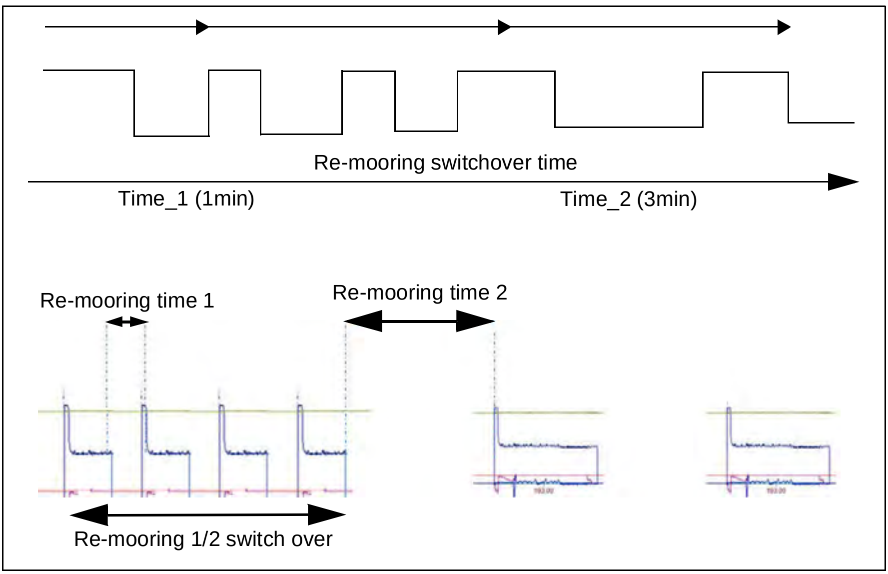
Automooring modes

Time control mode

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

Re-mooring times

With parameter *76.52 Re-mooring time 1/2 switch src*, either *76.50 Re-mooring time interval 1* or *76.51 Re-mooring time interval 2* can be selected. Additionally, a switchover timer can be selected. The time is defined in parameter *76.53 Re-mooring switchover time 1/2*. For the time defined in parameter *76.53 Re-mooring switchover time 1/2,* Re-mooring time interval 1(*76.50 Re-mooring time interval 1)* is used, and after that Re-mooring time interval 2 (*76.51 Re-mooring 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-mooring 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, Automooring 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.

Automooring styles

Automooring styles are applicable in both Time control and Load cell Automooring modes. The Automooring style is selected with parameter *76.03 Automooring style*.

AM Style 1

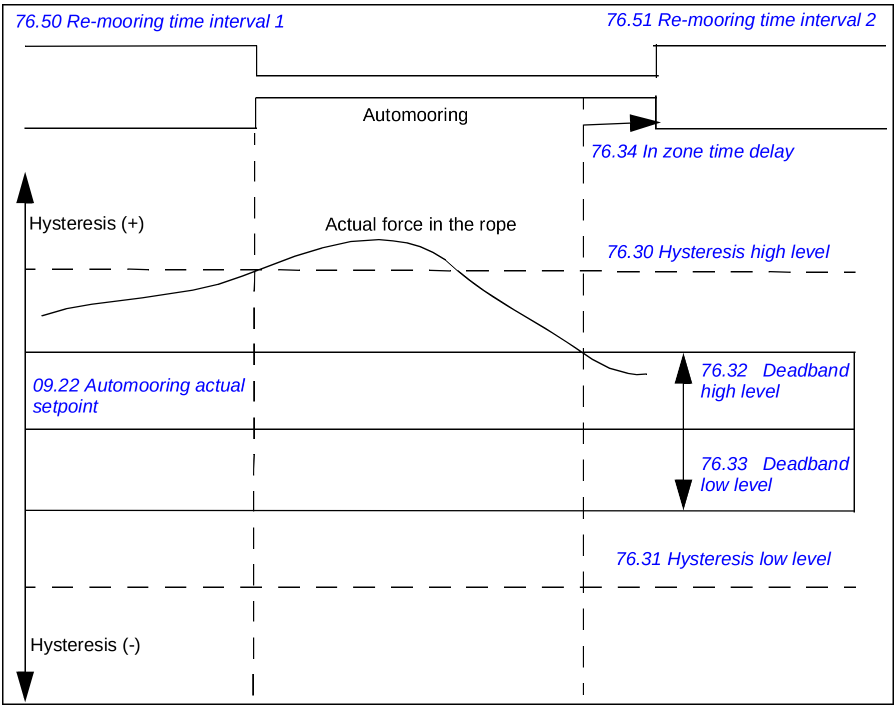
When tension is outside the hysteresis high or low limits during *76.41 Torque measuring time*, the program starts correcting the tension towards the setpoint.

If the tension is too tight, the program uses the parameter *74.40 Automooring 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 Automooring 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 Automooring 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-mooring time again.

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



AM Style 2

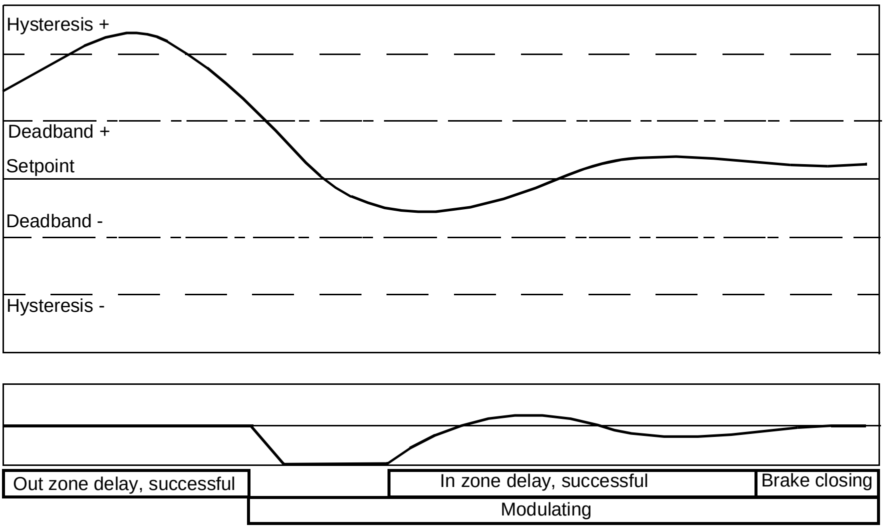
When the tension is within the deadband limits, the speed reference is proportional to the tension deviation.

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

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%).

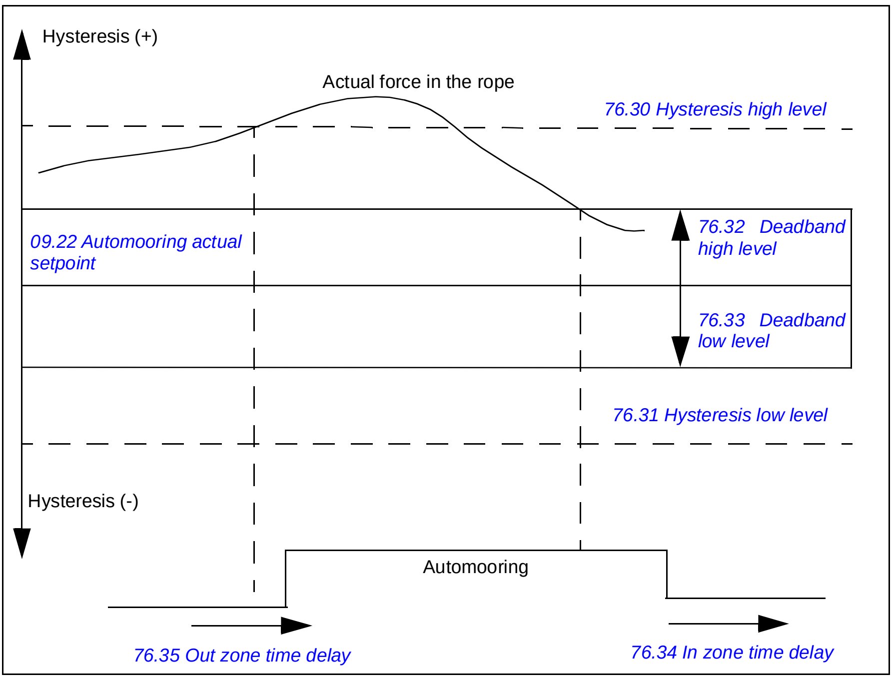
Comparison table

	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 setpoint when inside the dead-band area	Linearly decrease than closer to setpoint when inside the dead-band area, preset 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*).



Automooring styles in load cell

Automooring styles are applicable in both Time control and Load cell Automooring modes. The Automooring style can be selected in parameter *76.03 Automooring style*.

Scaling of external load cell sensor

The parameter *09.22 Automooring 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 N-m
- 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% Automooring set point (parameters *76.14 Automooring setpoint1*...*76.18 Automooring 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.

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

where:

- x is the scaling constant in parameter *12.20* for AI1 in this example
- $T_{\text{LOAD CELL MAX}}$ is the maximum measuring range of the load cell sensor
- T_N is the winch motor nominal torque in Newton meters (N·m).

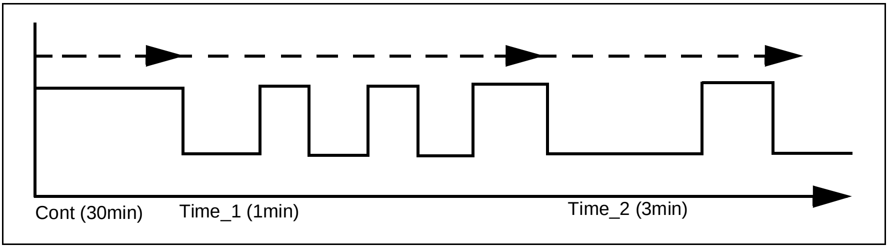
The Automooring set point must be scaled accordingly if it is taken from an analogue input. For-example, *76.13 Automooring setpoint selection* = AI1 scaled.

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

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 Automooring min tension*) must be present in the ropes from the Handmooring sequence before Automooring 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 Automooring after the Handmooring sequence, or in addition should be active also between each Re-mooring time interval and after possible powering cycling of the drive.

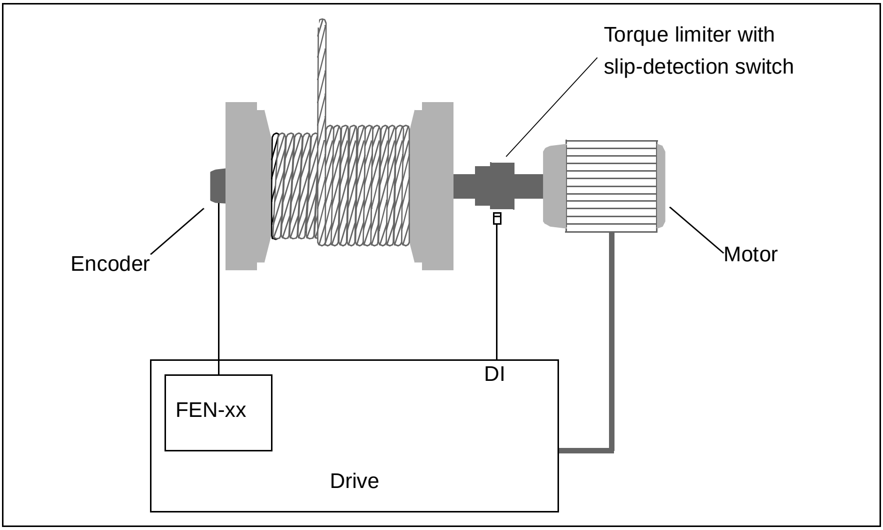
Behavior at power up

After the drive is powered *On* with the Automooring mode, the Automooring sequence can either start automatically (continue from last time) or remain stopped and require a new rising edge of the Automooring mode selection. This is defined in parameter *76.04 Automooring 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* on page *501*.

Events: -

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

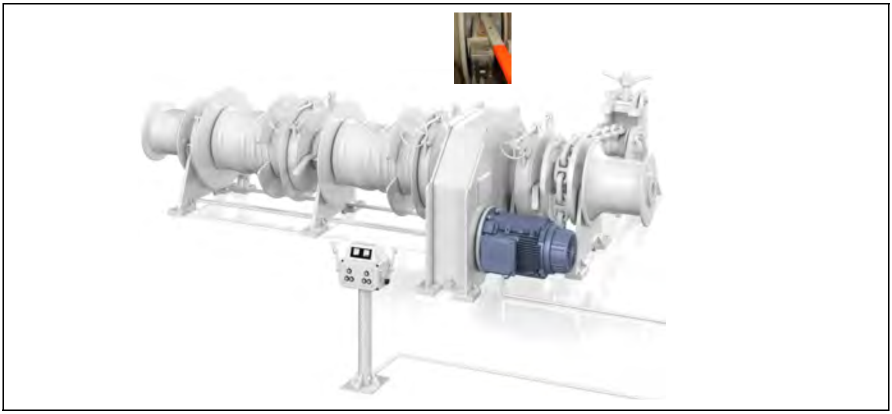
Parameter group: *79 Peak torque protection* (page *504*).

Events: -

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. See parameter *75.22 Include FB control stand* (page *481*).

Settings and diagnostics

Parameter group: *82 Clutch control* (page *512*).

Parameter: *75.22 Include FB control stand* (page *481*).

Events: -

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 Power control* (page *505*).

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.

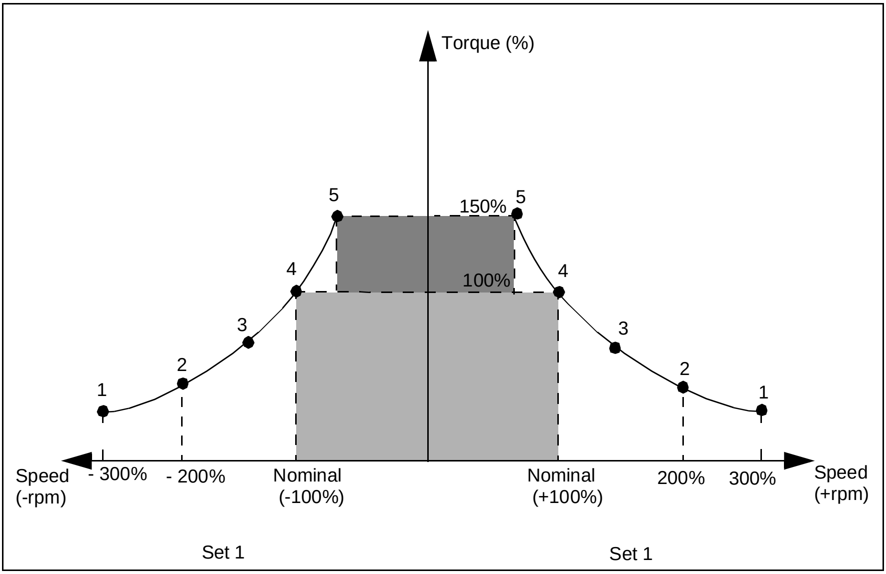
For example,

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*

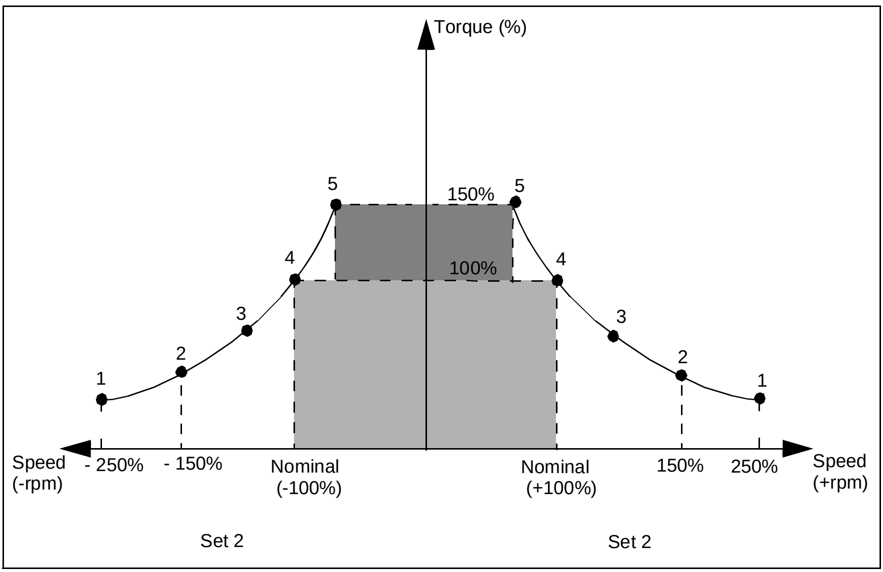
The two power curves can be selected with parameter *80.30 Set1/Set2 switch*.

Selection	**Description**
Set1	Used in forward and reverse direction. The speed crosspoints are mirrored in the torque axis.
Set2	
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* 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 Power control* on page *505*.

Signals: *01.10 Motor torque* (page *192*), *09.01 Winch status word 1* (page *219*) and *09.21 Power control ref* (page *224*).

Parameters: *80.01 Power control enable* (page *505*), *80.22 Acc torque buffer* (page *507*), *80.23 Dec torque buffer* (page *507*) and *80.30 Set1/Set2 switch* (page *508*).

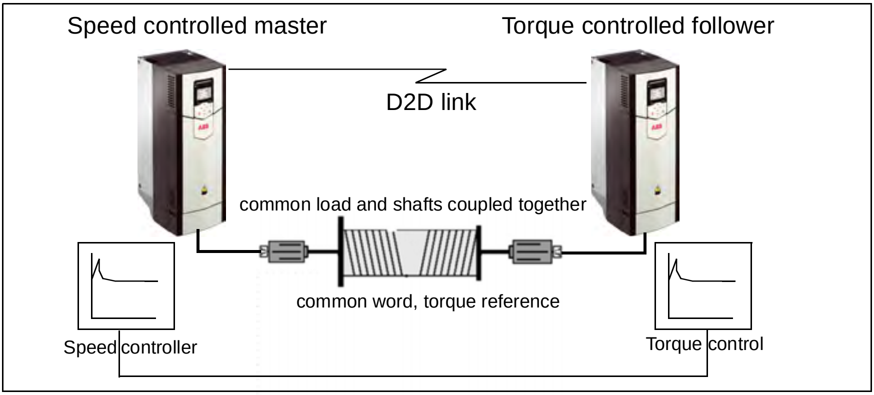
Events: -

Master/follower communication in winch application

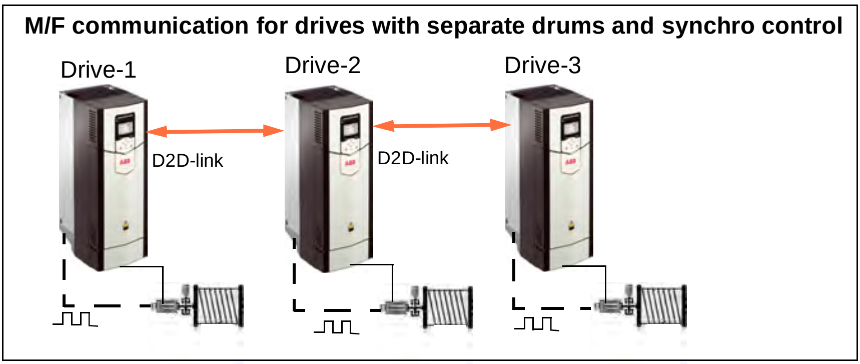
M/F communication types in winch application

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. See figure below.



- 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, see *Shaft synchro control* (page *90*).

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.

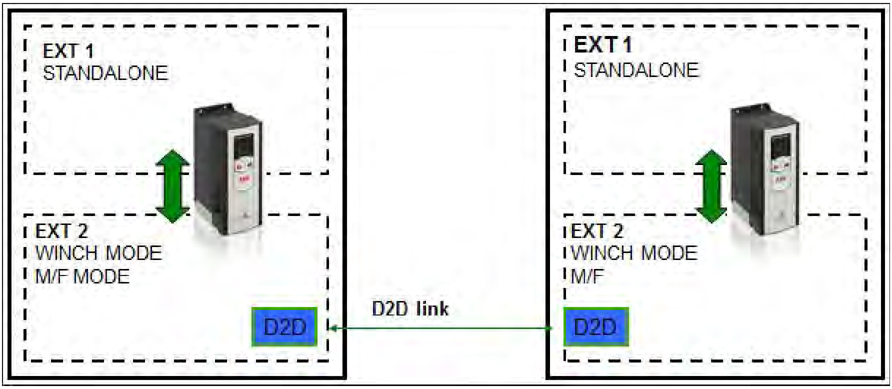
For information on D2D connections and terminations, see *Hardware Manual* of the drive.

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.

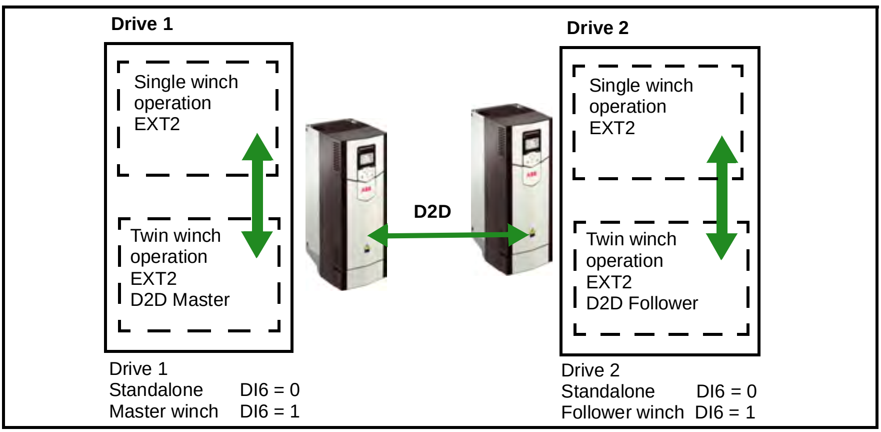


D2D-link: In each drive the M/F communication in the D2D-link is activated with parameter *60.200 Winch drive type* by selecting the appropriate drive type.

Communication supervision is activated with the following parameters:

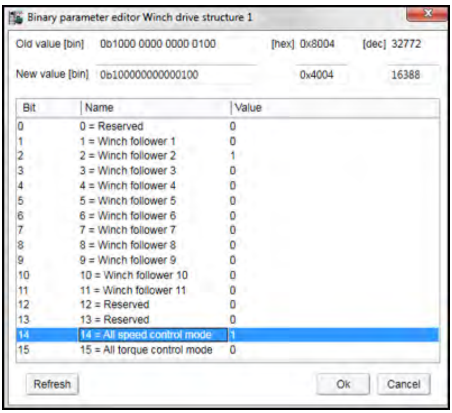
- *60.201 Winch drive structure 1*, when *60.205 Winch drive structure sel* = Structure 1, or
- *60.202 Winch drive structure 2*, when *60.205 Winch drive structure sel* = Structure 2.

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*.



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

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

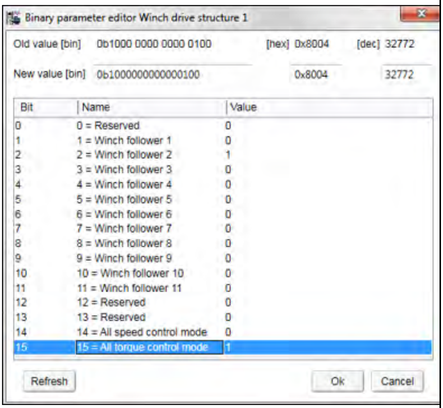
Parameter	Master	Follower	Notes
Selecting the control location			
19.11 Ext1/Ext2 selection	EXT2	EXT2	Any bit pointer source which should be *ON*.
19.14 Ext2 control mode	Speed	Not needed	Master can define the control mode of follower drives. Parameter *60.201 Winch drive structure 1*, bit 14 = 1.
Setting D2D communication parameters			
60.200 Winch drive type	Main winch	Winch follower 2	Not needed
60.201 Winch drive structure 1			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 Winch drive structure sel	Structure 1	Not needed	Not needed
Setting reference signals parameters			
22.12 Speed ref2 source	AI1 scaled	Not needed	If winch is operated from control stands, select appropriate speed reference source in group *75 Winch interface*.

Parameter	Master	Follower	Notes
22.14 Speed ref1/2 selection	Follow Ext1/Ext2	Follow Ext1/Ext2	Not needed
Setting Start/Stop/Direction parameters			
20.06 Ext2 commands	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 Ext2 start trigger type	Level	Not needed	Not needed
20.08 Ext2 in1 source	DI1	Not needed	Start command forward
20.09 Ext2 in2 source	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 Ext1/Ext2 selection	EXT2	EXT2	Any bit pointer source which should be *ON*.
19.14 Ext2 control mode	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 Winch drive type	Main winch	Winch follower 2	Not needed

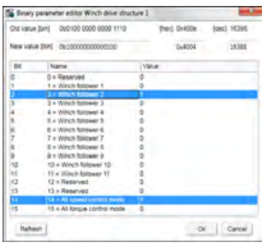
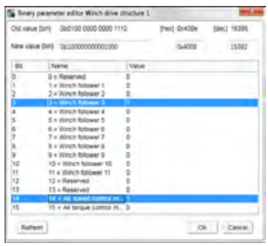
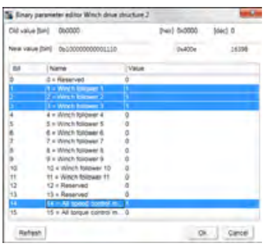
Parameter	Master	Follower	Notes
60.201 Winch drive structure 1			Define which follower drives belong to the master (bit 2 = 1 for Winch follower 2), and select bit 15 = All torque control mode.
60.205 Winch drive structure sel	Structure 1	Not needed	Not needed
Setting reference signals parameters			
22.12 Speed ref2 source	AI1 scaled	Not needed	If winch is operated from control stands, select appropriate speed reference source in group *75 Winch interface*.
22.14 Speed ref1/2 selection	Follow Ext1/Ext2	Follow Ext1/Ext2	Not needed
26.14 Torque ref1/2 selection	Not needed	Torque reference 2	Not needed
Setting Start/Stop/Direction parameters			
20.06 Ext2 commands	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 Ext2 start trigger type	Level	Not needed	Not needed
20.08 Ext2 in1 source	DI1	Not needed	Start command forward

Parameter	Master	Follower	Notes
20.09 Ext2 in2 source	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

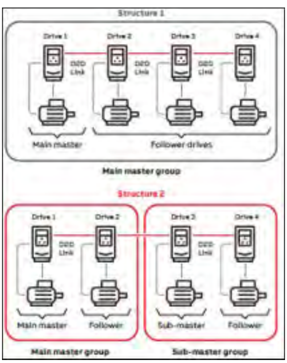
The table below shows master-follower settings for fast changing system: From one Winch master and three follower drives to two separate systems that has two master drives with its own follower drive.

Parameter	Main D2D master	Follower	Follower or master	Follower
Selecting the control location				
19.11 Ext1/Ext2 selection	EXT2	EXT2	EXT2	EXT2
19.14 Ext2 control mode	Speed	Not needed	Speed	Not needed
Setting D2D communication parameters				
60.200 Winch drive type	Main winch	Winch follower 2	Winch follower 1 / Sub master winch	Winch follower 3
60.201 Winch drive structure 1				
60.202 Winch drive structure 2			Not needed	

Parameter	Main D2D master	Follower	Follower or master	Follower
60.205 Winch drive structure sel	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 Speed ref2 source	AI1 scaled	Not needed	AI1 scaled	Not needed
22.14 Speed ref1/2 selection	Follow Ext1/Ext2	Follow Ext1/Ext2	Follow Ext1/Ext2	Follow Ext1/Ext2
Setting Start/Stop/Direction parameters				
20.06 Ext2 commands	In1 Start fwd; In2 Start rev	Not selected	In1 Start fwd; In2 Start rev	Not needed
20.07 Ext2 start trigger type	Level	Not needed	Level	Not needed
20.08 Ext2 in1 source	DI1	Not needed	DI1	Not needed
20.09 Ext2 in2 source	DI2	Not needed	DI2	Not needed

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).



Notes:

- 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.

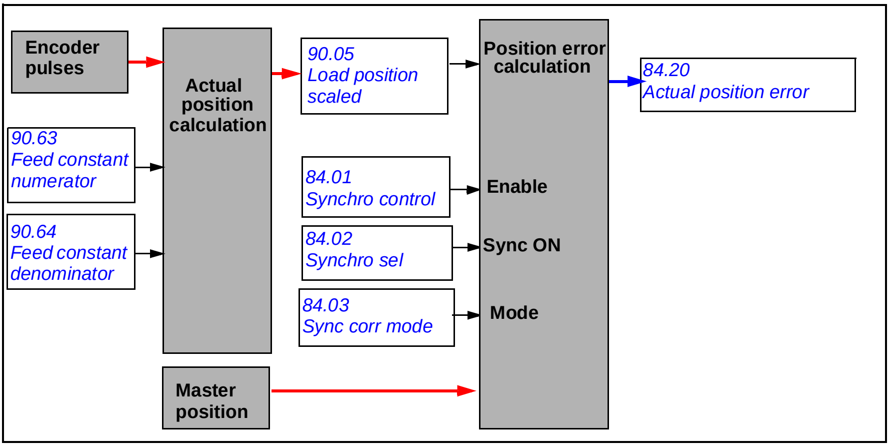
Shaft synchro function works in control location EXT2, with following conditions:

- drives are in D2D master/follower speed/ speed mode. See *Master/follower communication in winch application* (page 81)
- 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 *84.01 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:

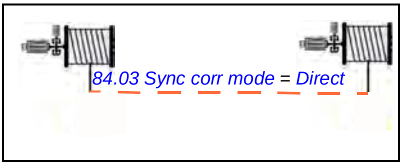
The parameter *84.01 Synchro control* = On activates the execution of the synchro function in the standalone drives. The master system (PLC) provides the target position (par. *84.21 Target position*) based on the value selected in parameter *84.40 Target position source*.

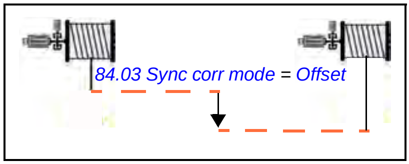
Parameter *84.02 Synchro sel* activates the position error and speed correction reference calculation to eliminate the position difference.

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). See in below figure.

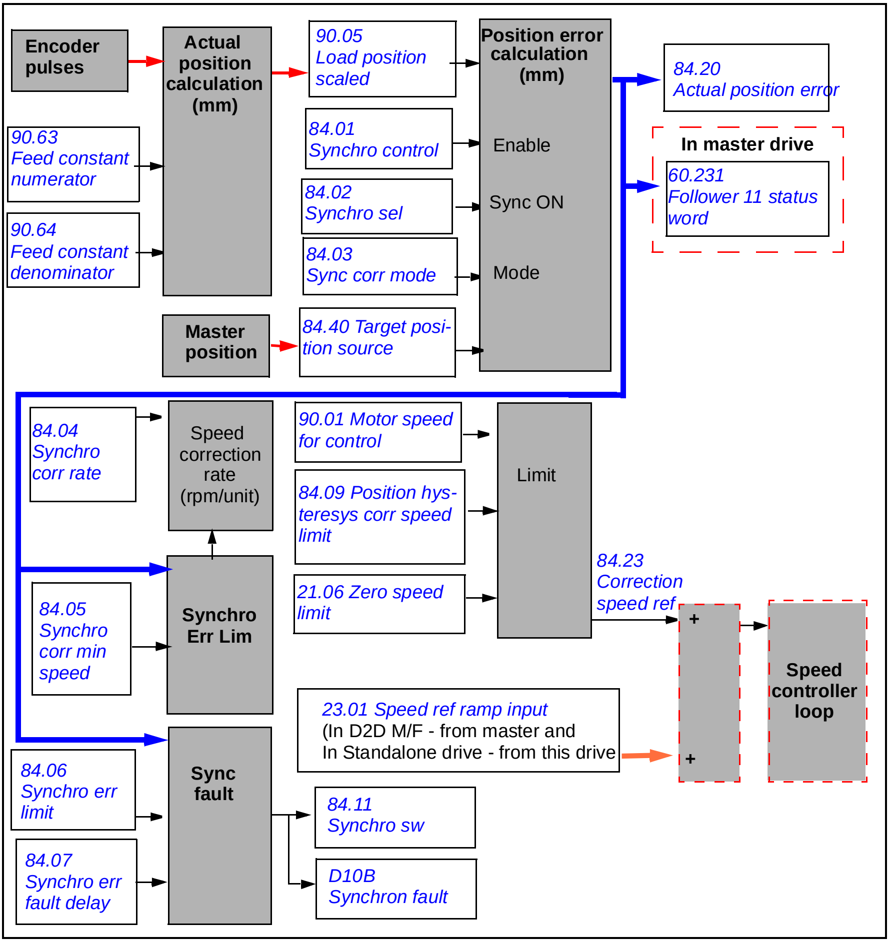
Offset mode: In this mode, the follower runs at the master position with the offset value (master position + offset value = follower position). See in below figure.





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* (page *90*). 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. See description in parameter *84.05 Synchro corr min speed*.

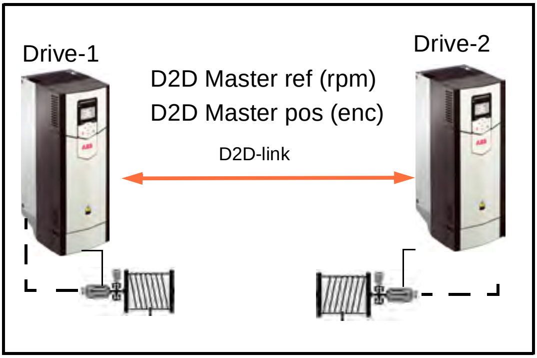
When the detected absolute error is greater than the value defined in parameter *84.06 Synchro err limit* for a period longer than *84.07 Synchro err fault delay*, the drive trips on *D10B Synchron fault* and parameter *84.11 Synchro sw*, bit 2 is set.

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:

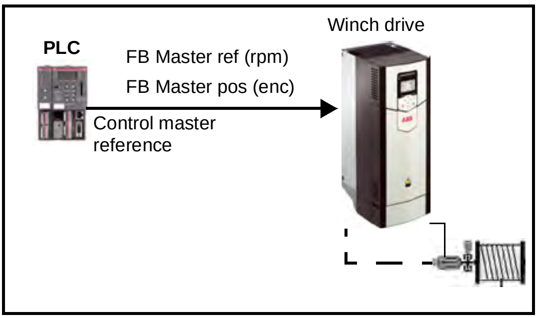
Synchro control between drives in D2D M/F network:

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 Follower 1 status word	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
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 selected	Start command fwd
20.09 Ext2 in2 source	DI2	Not selected	Start command rev
Setting the Synchro control function parameters			
84.01 Synchro control	ON	ON	Or pointer to DI
84.02 Synchro sel	Select	Select	Or pointer to DI

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

Settings and diagnostics

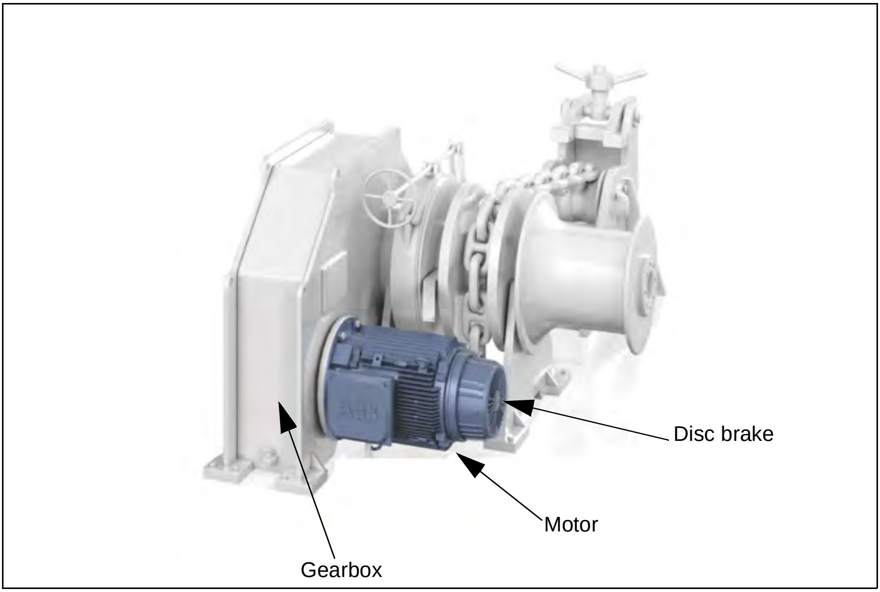
Parameters: *84.01 Synchro control*, *84.02 Synchro sel*, *84.03 Sync corr mode*, *84.04 Synchro corr rate*, *84.05 Synchro corr min speed*, *84.06 Synchro err limit*, *84.07 Synchro err fault delay*, *84.08 Position hysteresys*, *84.09 Position hysteresys corr speed limit*, *90.53 Load gear numerator*, *90.54 Load gear denominator*, *90.63 Feed constant numerator*, *90.64 Feed constant denominator*.

Signals: *84.11 Synchro sw*, *84.19 Actual position*, *84.20 Actual position error*, *84.21 Target position*, *84.22 Offset value*, *84.23 Correction speed ref*, *84.50 Position from D2D master*.

Events: *D10B Synchron fault*

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* (page *98*) 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. See *Wiring example* on page *99*.

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.

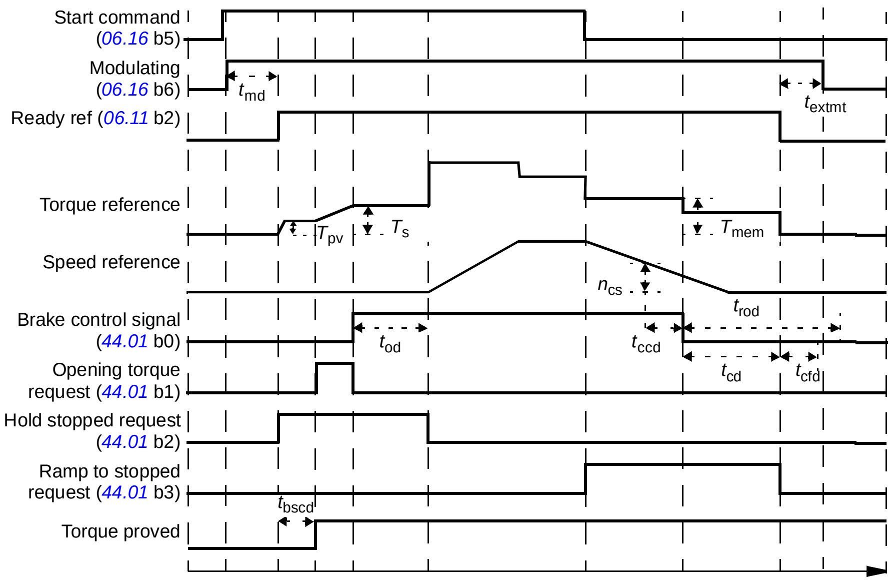
Settings and diagnostics

Parameter group: *44 Mechanical brake control*.

Events: -

Mechanical brake control diagram

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



T_{pv}	Torque proving reference (parameter *81.02 Torque proving reference*)
T_s	Start torque at brake open (parameter *44.03 Brake open torque reference*)
T_{mem}	Stored torque value at brake close (*44.02 Brake torque memory*)
t_{md}	Motor magnetization delay
t_{od}	Brake open delay (parameter *44.08 Brake reopen 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.

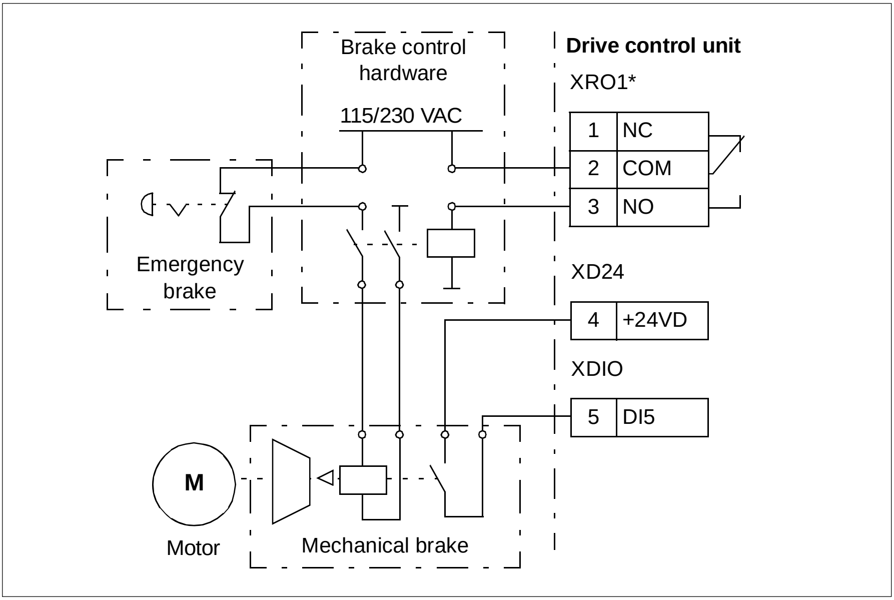
Wiring example

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*.

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.

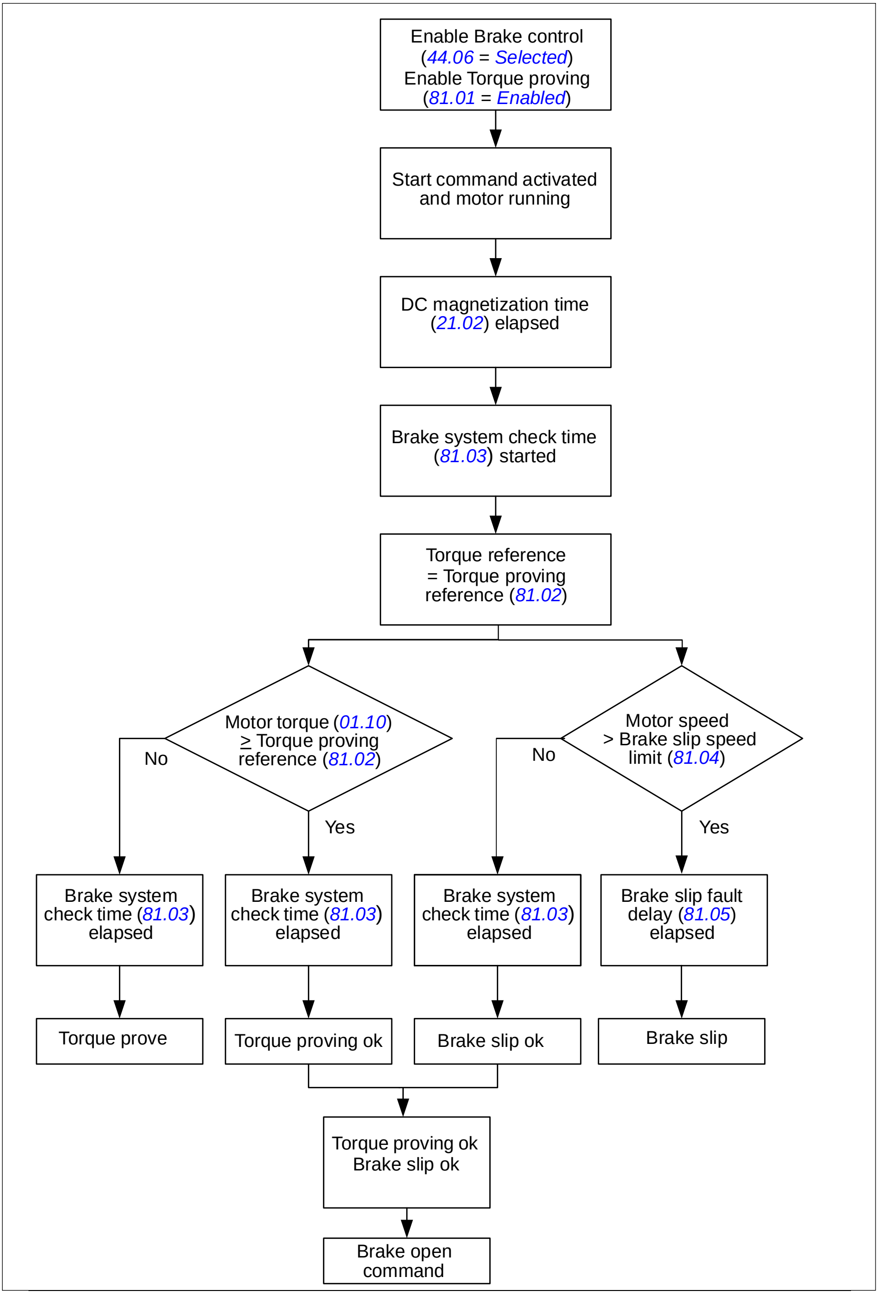
Mechanical test – Brake slip test makes sure that the motor brake is not slipping.

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. See parameter group *44 Mechanical brake control* on page *390*.

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.

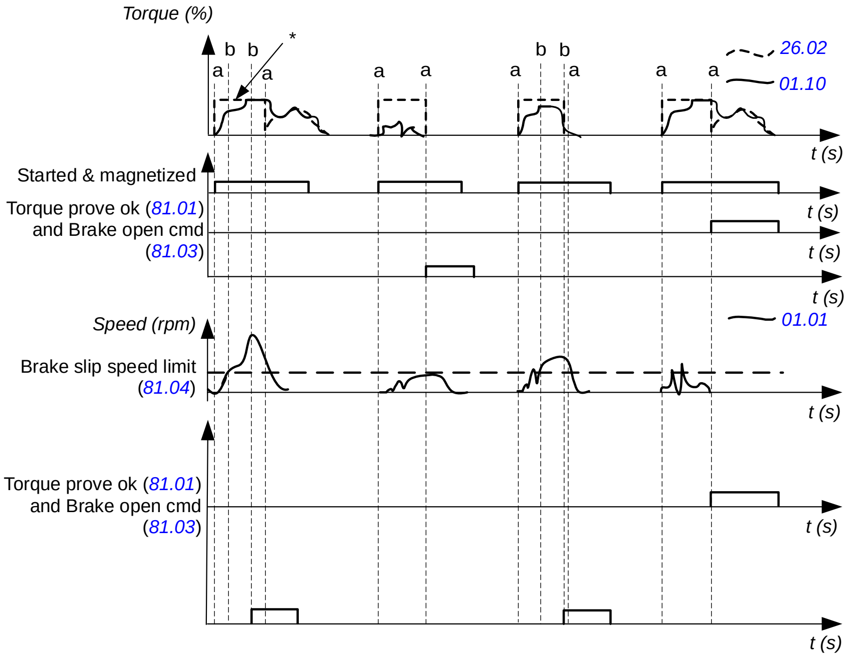
For more detailed information on the tests, see sections *Brake system checks – Torque proving* on page *103* and *Brake system checks – Brake slip* on page *103*.

This flowchart shows the brake system check sequence.



Timing diagram

This timing diagram shows the operation of the Torque proving and Brake system check functions.



Symbol	Description
a	Brake system check time (81.03)
b	Brake slip fault delay (81.05)

* Torque proving reference is held for the brake system check time even though the torque has been proved.

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 Torque proving reference*), the drive lets the brake open and starts the next step in the starting sequence.

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

See *Timing diagram* on page *102*.

Settings and diagnostics

Parameters: *81.01 Torque proving enable*, *81.02 Torque proving reference* and *81.03 Winch system check time*.

Events: -

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 Brake slip speed limit*) during a check time (*81.03 Winch system check time*), and stays there for longer than a time delay (*81.05 Brake slip fault delay*), the drive trips on a fault (*D101*).

See *Timing diagram* on page *102*.

Settings and diagnostics

Parameters: *81.03 Winch system check time*, *81.04 Brake slip speed limit* and *81.05 Brake slip fault delay*.

Events: *D101 Automooring max time reached*

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 open torque*.
- 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 Brake open torque*.

Settings and diagnostics

Parameters *44.200 Brake open torque source* and *44.201 Brake open torque*.

Events: -

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 (page *161*) and torque proving (page *103*).

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* on page *98*, 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*, *44.202 Extended runtime*, and *44.203 Extended runtime sw*.

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

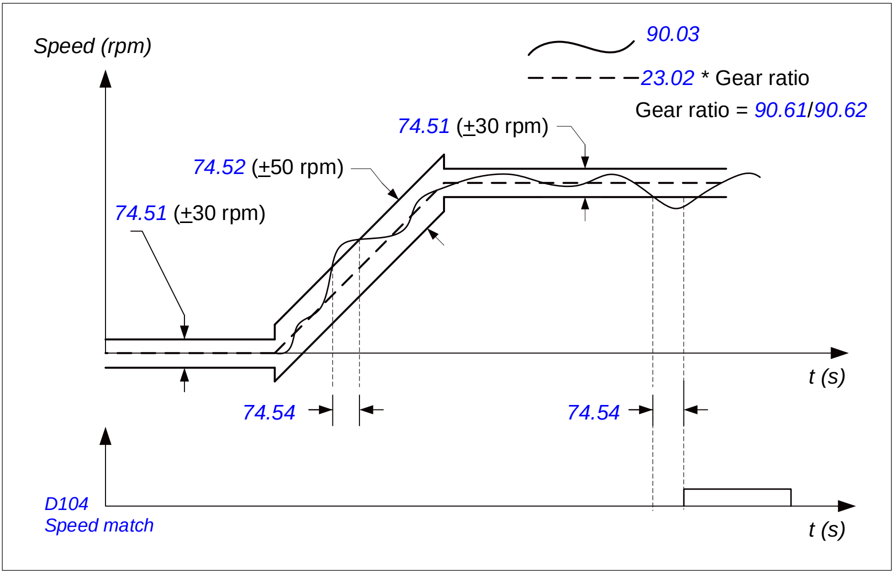
Parameters: *74.11 Chain length source*, *74.50 Speed match enable*, *74.51 Speed steady deviation level*, *74.52 Speed ramp deviation level*, *74.53 Speed match action*, *74.54 Speed match action delay* and *90.51 Load feedback selection*.

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* or warning *D20C* is shown below.



Settings and diagnostics

Parameter group: *74 Winch general* (page *457*).

Events: -

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 Proximity speed raw* 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*) 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*, *31.203 User limit bit selection*, *31.204 Inverter overload delay*

Signal: *30.02 Torque limit status*

Events: *D106 Inverter overload* (page *671*).

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*.

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

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, see chapter *Standard program features*, section *Position counter* on page *148*.

Settings and diagnostics

Parameters: *23.02 Speed ref ramp output*, *90.61 Gear numerator* and *90.62 Gear denominator*.

Events: -

Miscellaneous

Power on acknowledgement

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:

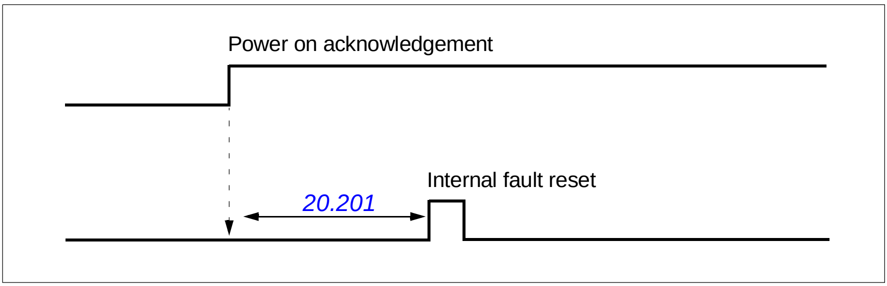
- typically from the auxiliary contact of the main contactor. By default, the signal is connected to the DIIL input of the drive control unit. This is the default connection.

or

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

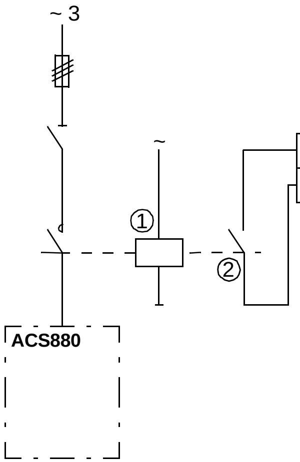
If the drive trips on a fault, and the power on acknowledgment signal is activated (a rising edge), the drive generates one internal fault reset after a time delay (*20.201 Power on ackn reset delay*).

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



Drive control unit

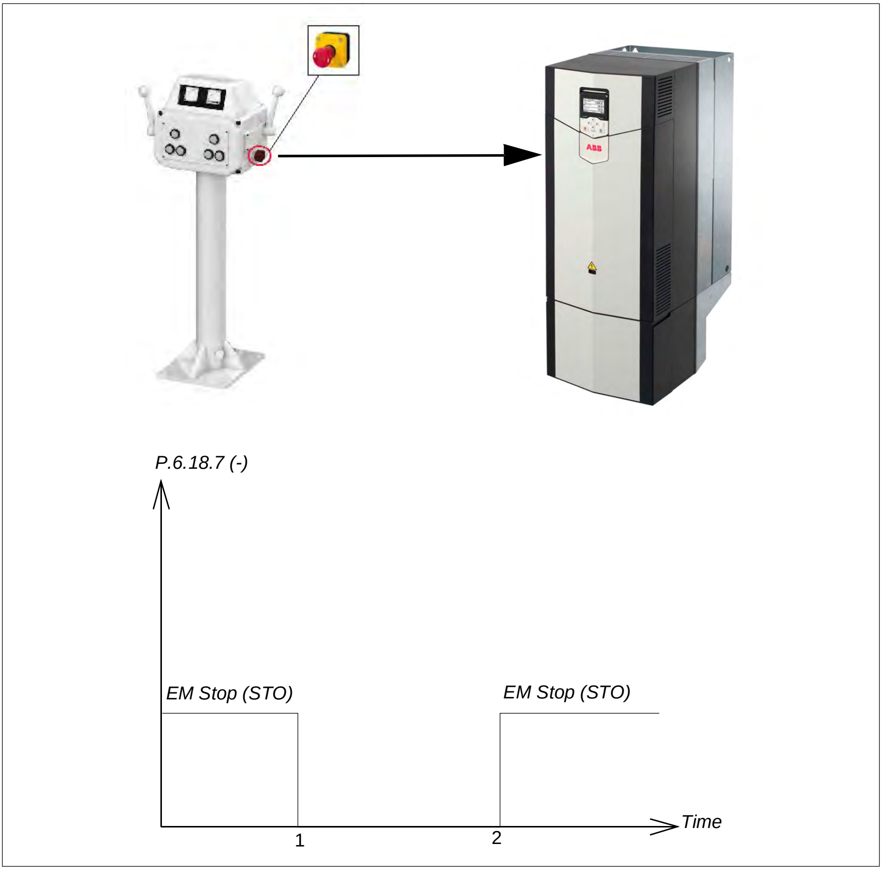
XD24 Digital interlock

1	DIIL	Power acknowledge. See par. *20.200*.
2	+24VD	+24 V DC 200 mA

Item	**Description**
1	Main contactor
2	Auxiliary contact

Note: By default, the input DIIL is also used in parameter *20.12 Run enable 1 source*

Example: Overview of emergency stop and fault reset



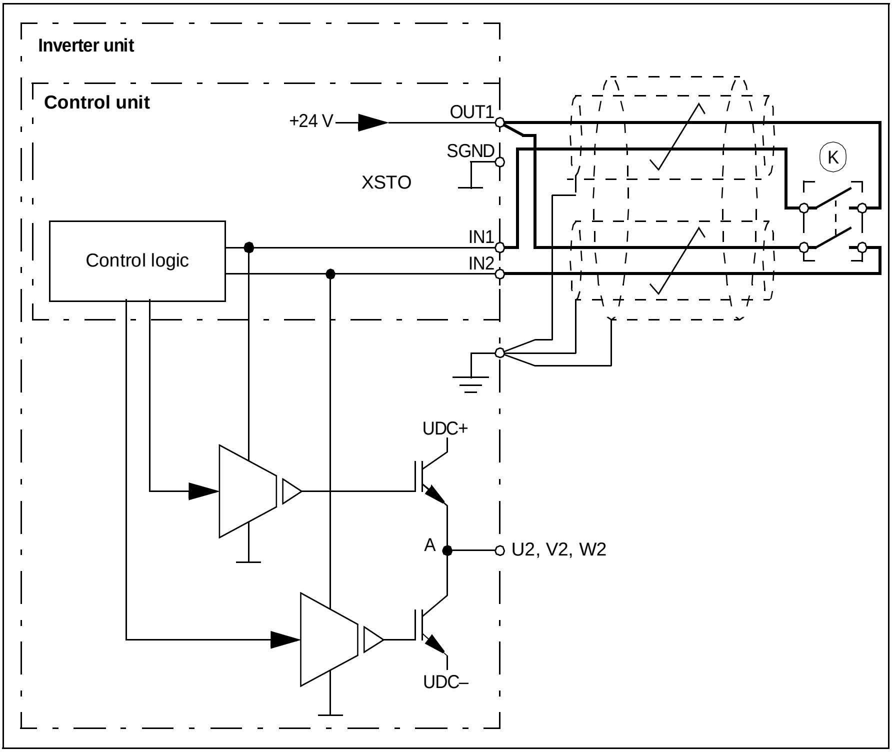
[1] EM Stop (STO) triggered and the mechanical brake is closed.

[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, see parameter *09.09 Winch FB control word* on page*223*.

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*, *20.200 Power on acknowledge*, *20.201 Power on ackn reset delay*, and *09.01 Winch status word 1*.

Events: -

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.

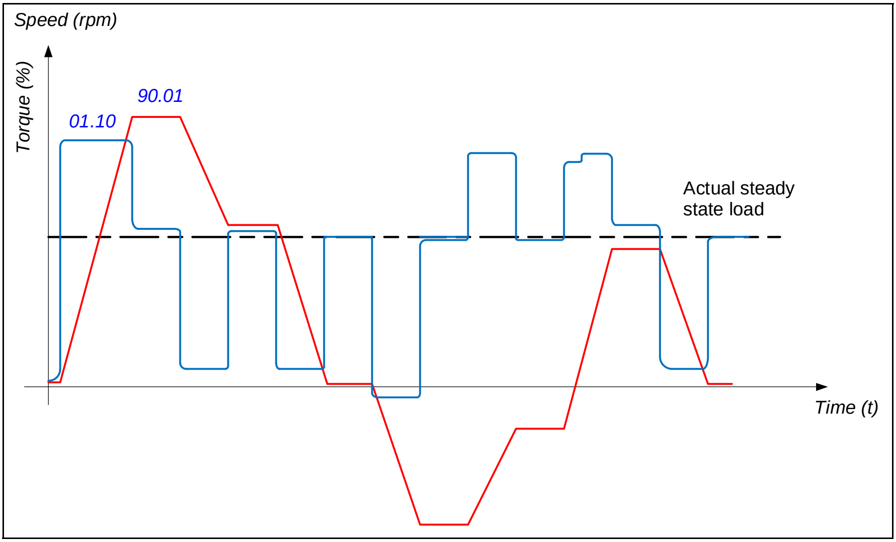
Tension inaccuracies

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

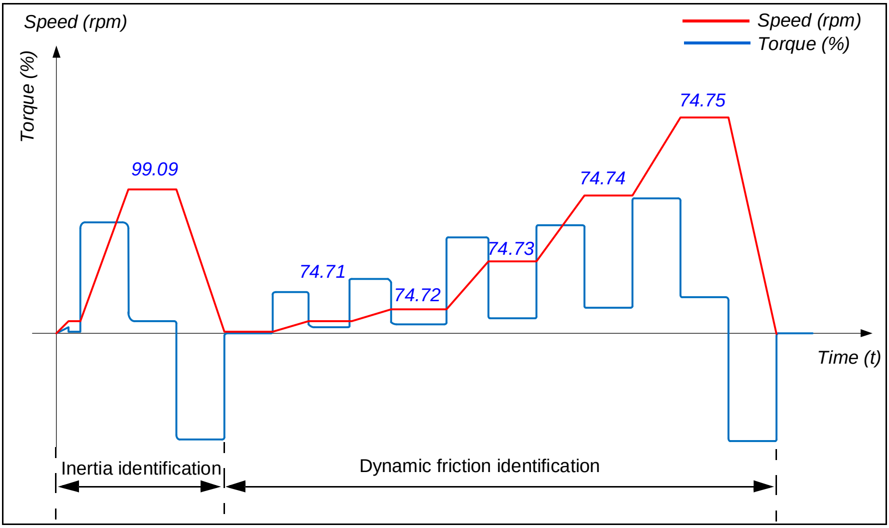
Signals: *01.10 Motor torque* (page *192*) and *90.01 Motor speed for control* (page *515*).

Events: -

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 *74.01 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* 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* is displayed.

After the winch system ID run is completed, the drive stops and displays a warning *D20F*. 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

Signals: *09.23 Rope actual tension* and *09.24 Rope tension memorized* (page *224*).

Parameter groups: *30 Limits* (page *338*), *74 Winch general* (page *457*) and *99 Motor data* (page *562*).

Events: *D20E Winch system ID run active* and *D20F Winch system ID run done* (page *650*).

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

Signals: *09.23 Rope actual tension* and *09.24 Rope tension memorized* (page *224*).

Parameter groups: *09 Winch actual signals* (page *219*) and *74 Winch general* (page *457*).

Events: -

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. See *Winch system ID run sequence* (page *115*).
☐	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* or *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 kgm^2, then first change the value to 1.60 kgm^2 and then to 1.55 kgm^2. 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* and *09.24* 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

Signals: *09.23 Rope actual tension* and *09.24 Rope tension memorized* (page *224*).

Parameter groups: *01 Actual values* (page *192*), *30 Limits* (page *338*), *74 Winch general* (page *457*), *80 Power control* (page *505*), *96 System* (page *544*) and *99 Motor data* (page *562*).

Events: -

5

Standard program features

What this chapter contains

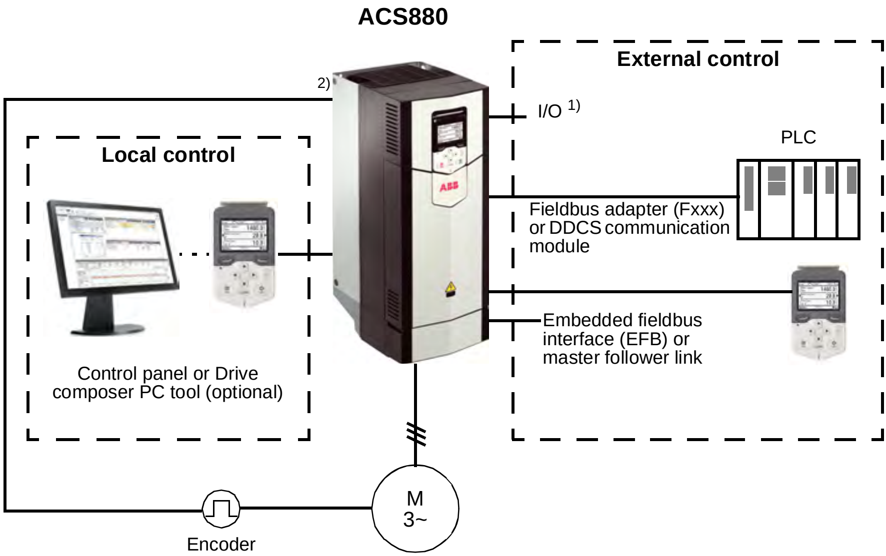
This chapter describes

- the control locations and operating modes supported by the control program
- some of the more important functions in the control program that are not specific to winch applications, such as motor control.

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

Local control vs. external control

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



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

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

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 mode*19.16 Local control mode).

Local control is mainly used during commissioning and maintenance. The control panel always overrides the external control signal sources when used in local control. Changing the control location to local can be prevented by parameter *19.17 Local control disable*.

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

External control

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

- the I/O terminals (digital and analog inputs), or optional I/O extension modules
- the embedded fieldbus interface or an optional fieldbus adapter module
- the external (DDCS) controller interface
- the master/follower link and/or
- the control panel
- the winch interface control stands (EXT2)

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 (parameter group *19 Operation mode*), 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 Ext1/Ext2 selection*). The source of reference is selectable for each operating mode separately.

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.

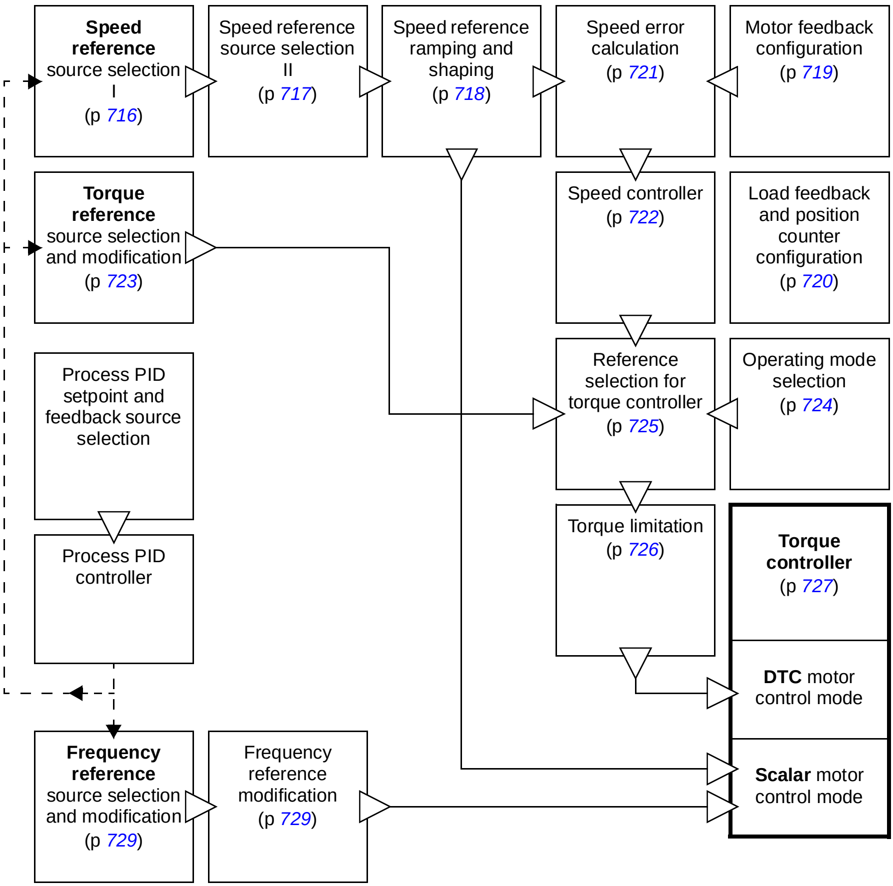
The panel reference is saved whenever another reference source is selected. If the reference source selection parameter is set to *Control panel (ref saved)*, the saved value is used as the initial reference when control switches back to the panel. Note that only one type of reference can be saved at 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 Panel reference conflict*. The panel reference can be separately limited by parameters in group *49 Panel port communication*.

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 Operation mode*.

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



Note: In winch control program, the frequency and process PID controller are not used and the related parameters are normally hidden. You can unlock the related parameters using parameter *96.02 Pass code* on page *545*.

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 winch 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:

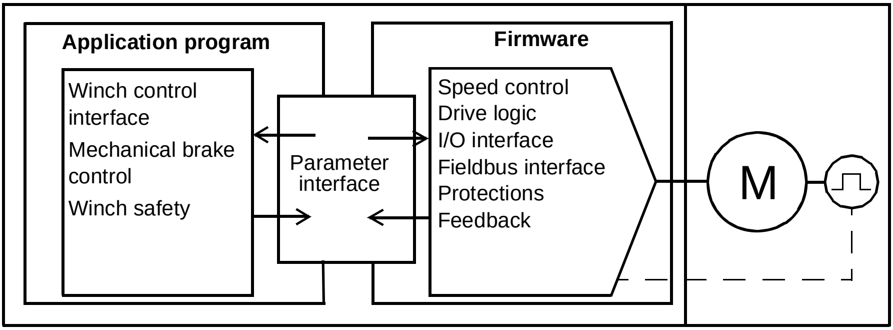
- Emergency stop modes Off1 and Off3: Drive stops along the defined deceleration ramp and drive modulation stops.
- Jogging mode: Drive starts and accelerates to the defined speed when the jogging signal is activated. For more information, see section *Jogging* (page *153*).

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. The applications program extends the functions of the firmware program. Both the application and firmware functions are configured and programmed with parameters.

Programming via parameters

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

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

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

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

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 winch application contain approximately 50 blocks depending on block size and the number of inputs and outputs used.

With 50 blocks,

- CPU load might be high and result in time level overflow
- Tool might be slow to open a program from file, uploading from drive, adding blocks or parameters connections.
- AP programmer is responsible for final configuration and testing.

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 Adaptive program status*. The adaptive program can be disabled by parameter *96.70 Disable adaptive program*.

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 *218*) and *96.70 Disable adaptive program* (page *553*).

Events: -

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 *239*).

Events: -

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 *244*).

Events: -

Programmable digital inputs and outputs

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

One digital input (DI6) doubles as a PTC thermistor input. See section *Motor thermal protection* (page *171*).

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 or 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 *226*) and *11 Standard DIO, FI, FO* (page *233*).

Events: -

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 I/O or FDIO-01 extensions. The relay outputs on extension modules are updated on a 2 ms time level.

Settings and diagnostics

Parameter group: *10 Standard DI, RO* (page *226*).

Events: -

Programmable I/O extensions

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

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

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

Three I/O extension modules can be activated and configured using parameter groups 14…16.

Note: Each configuration parameter group contains parameters that display the values of the inputs on that particular extension module. These parameters are the only way of utilizing the inputs on I/O extension modules as signal sources. To connect to an input, choose the setting *Other* in the source selector parameter, then specify the appropriate value parameter (and bit, for digital signals) in group 14, 15 or 16.

Settings and diagnostics

Parameter groups: *14 I/O extension module 1* (page *249*), *15 I/O extension module 2* (page *270*), *16 I/O extension module 3* (page *274*).

Parameter: *60.41 Extension adapter com port*(page *437*).

Events: -

Fieldbus control

The drive can be connected to several different automation systems through its fieldbus interfaces. See chapters *Fieldbus control through the embedded fieldbus interface (EFB)* (page *679*) and *Fieldbus control through a fieldbus adapter* (page *703*).

Settings and diagnostics

Parameter groups: *50 Fieldbus adapter (FBA)* (page *407*), *51 FBA A settings* (page *415*), *52 FBA A data in* (page *417*), and *53 FBA A data out* (page *417*), *54 FBA B settings* (page *418*), *55 FBA B data in* (page *420*), and *56 FBA B data out* (page *420*) and *58 Embedded fieldbus* (page *421*).

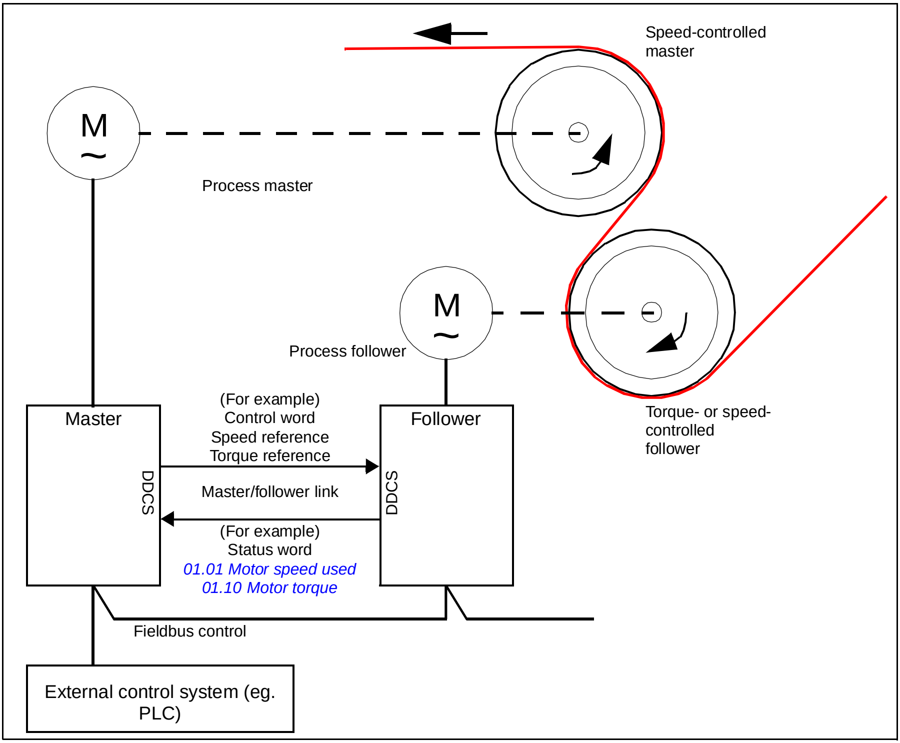
Events: -

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 Drooping rate*). 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 Ext1 control mode* or *19.14 Ext2 control mode*). 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 Load share* 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 *182*) can be saved with the master settings, another with the follower settings. The suitable settings can then be activated using eg. 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 based on the torque reference. The torque reference is selected by parameter *23.42 Follower speed corr torq source* (by default, reference 2 received from the master). Load share is adjusted by parameter *26.15 Load share* and activated by the source selected by *23.40 Follower speed correction enable*. Parameter *23.41 Follower speed correction gain* provides a gain adjustment for the speed correction. The final correction signal added to the speed reference is shown by *23.39 Follower speed correction out*. See the block diagram on page *721*.

Notes:

- The function can be enabled only when the drive is a speed-controlled follower in remote control mode.
- Drooping (*25.08 Drooping rate*) 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 Speed error window low* and *24.43 Speed error window high*. An active limitation is indicated by *06.19 Speed control status word*.

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 M/F communication port*.

Parameter *60.03 M/F mode* 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 M/F data 1 selection* is *Follower CW*. With this setting in the master, a word consisting of bits 0…11 of *06.01 Main control word* 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 M/F follower selection* 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 *60.17 Follower fault action*. External events (see parameter group *31 Fault functions*) can be used to indicate the status of other bits of the status word.

Block diagrams of the master/follower communication are presented on pages *732* and *733*.

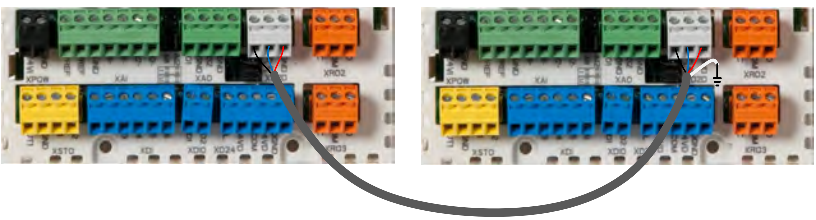
Construction of the master/follower link

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 module.

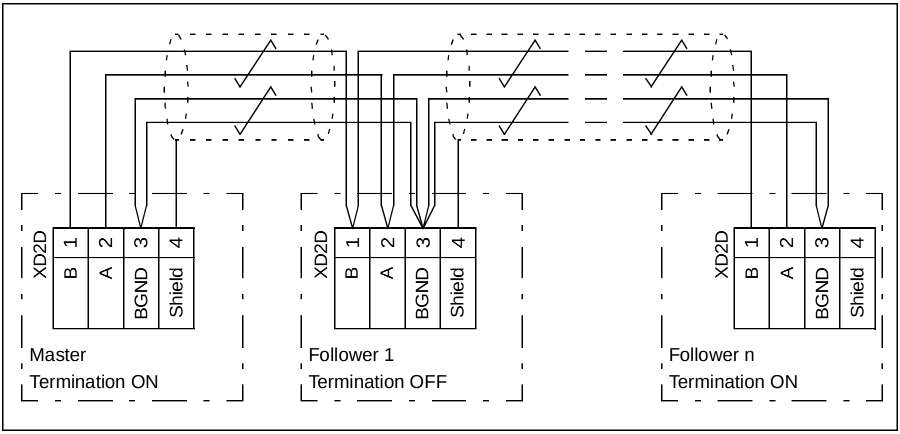
*This connection cannot co-exist with, and is not to be confused with, drive-to-drive (D2D) communication implemented by application programming (detailed in *Drive application programming manual (IEC 61131-3)*, 3AUA0000127808 [English]).

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



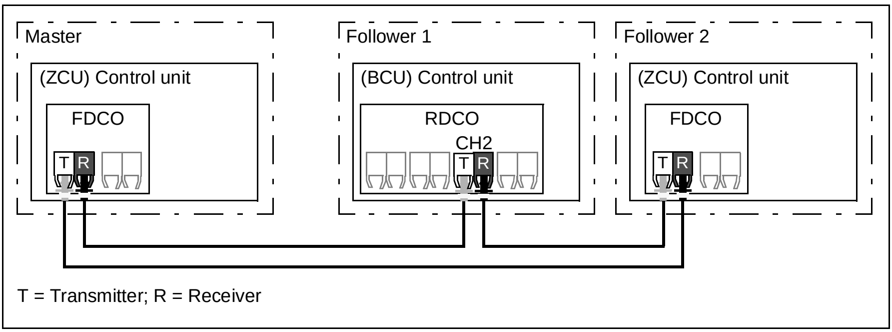
Connection examples are shown below. Note that a star configuration using fiber optic cables requires an NDBU-95C DDCS branching unit.

Master/follower wiring with electrical cable

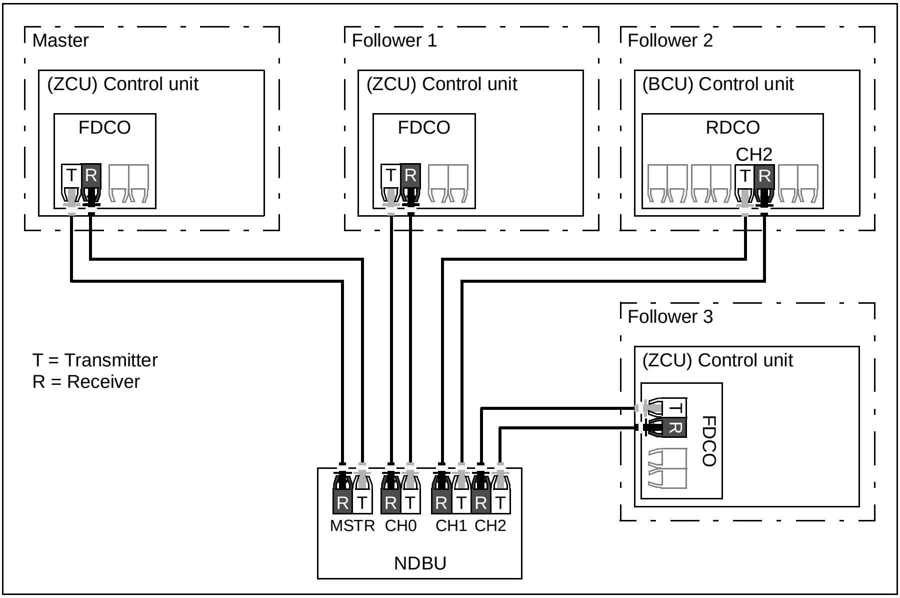


See the hardware manual of the drive for wiring and termination details.

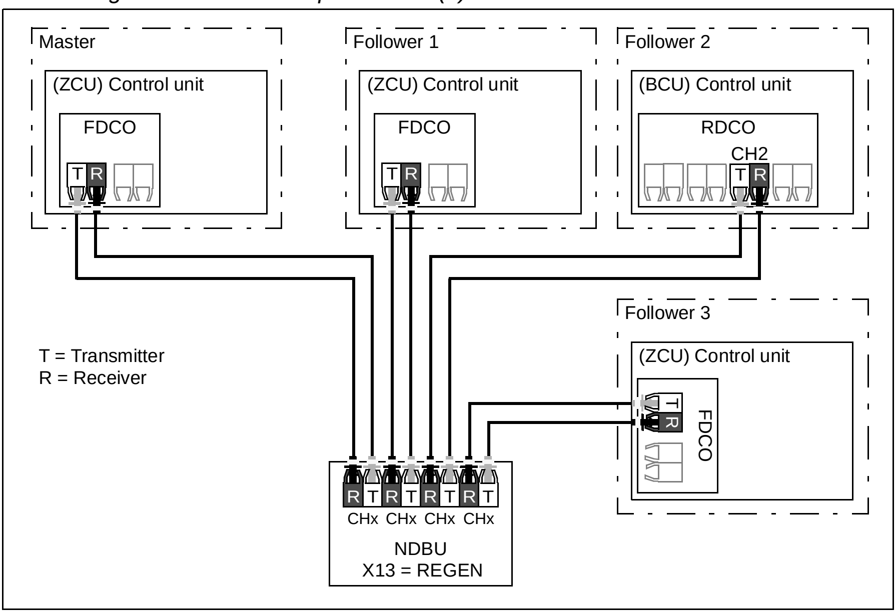
Ring configuration with fiber optic cables



Star configuration with fiber optic cables (1)



Star configuration with fiber optic cables (2)



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 master* (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* = *D2D or 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 with POF (Plastic Optic Fiber): 30 m
  - FDCO-01/02 with HCS (Hard-clad Silica Fiber): 200 m
  - For distances up to 1000 m, use two NOCR-01 optical converter/repeaters with glass optic cable (GOF, 6.25 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 *429*), *61 D2D and DDCS transmit data* (page *446*) and *62 D2D and DDCS receive data* (page *450*).

Events: -

External controller interface

General

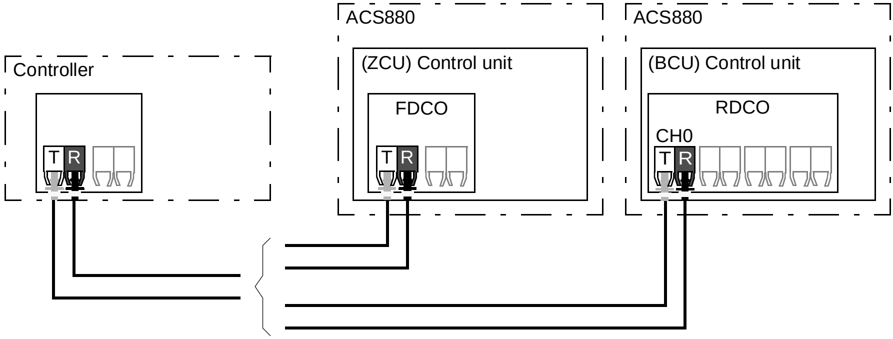
The drive can be connected to an external controller (such as the ABB AC 800M) using either fiber optic or twisted-pair cable. The ACS880 is compatible with both the ModuleBus and DriveBus connections. Note that some features of DriveBus (such as BusManager) are not supported.

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 (see section *Master/follower functionality* on page *129*); 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.



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 DDCS controller comm port*.

The transfer rate can be selected by parameter *60.56 DDCS controller baud rate*.

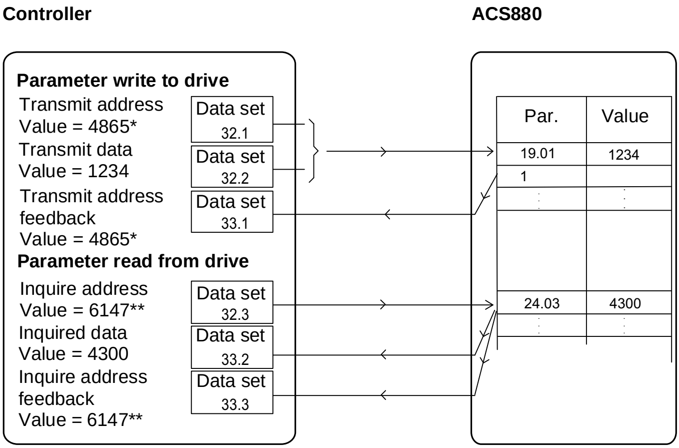
Communication

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 DDCS controller drive type*. 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 *709*). Likewise, the coding of the status word is as shown in section *Contents of the fieldbus Status word (ABB Drives profile)* (page *710*).

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 Mailbox dataset selection*, 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 *429*), *61 D2D and DDCS transmit data* (p;age *446*) and *62 D2D and DDCS receive data* (page *450*).

Events: -

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 switching frequency is changed only if the actual torque and stator flux values differ from their reference values by more than the allowed hysteresis. The reference value for the torque controller comes from the speed controller, 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 at 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 *156*).

Settings and diagnostics

Parameters: *99.04 Motor control mode* (page *563*) and *99.13 ID run requested* (page *565*).

Events: -

Reference ramping

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

With a speed or frequency reference, the ramps are defined as the time it takes for the drive to accelerate or decelerate between zero speed or frequency and the value defined by parameter *46.01 Speed scaling* or *46.02 Frequency scaling*. The user can switch between two preset ramp sets using a binary source such as a digital input. For speed reference, 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 Nominal torque scale*).

Special acceleration/deceleration ramps

The acceleration/deceleration times for the jogging function can be defined separately; see section *Jogging* (page *153)*.

The change rate of the motor potentiometer function (page *163*) 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: Parameters *23.200*…*23.205* (pages *312*).
- Torque reference ramping: Parameters *01.30*, *26.18* and *26.19* (pages *194* and *332*).
- Frequency reference ramping: Parameter *46.02* (pages *398*).
- Motor potentiometer: Parameter *22.75* (page *305*).
- Emergency stop ("Off3" mode): Parameter *23.23 Emergency stop time* (page *309*).

Events: -

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.

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

Note: This feature does not work in EXT2 mode.

WARNING: Constant speeds override the normal reference irrespective of where the reference is coming from.

Settings and diagnostics

Parameter groups *22 Speed reference selection* (page *299*).

Events: -

Critical speeds

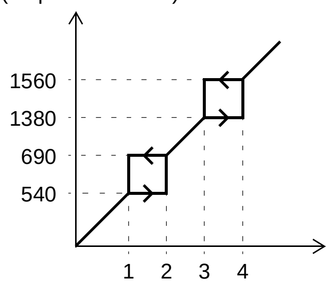
Critical speeds (sometimes called "skip speeds") can be predefined for applications where it is necessary to avoid certain motor speeds or speed ranges because of, for example, mechanical resonance problems.

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

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 Critical speed function*, and
- set the critical speed ranges as in the figure below.



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

Settings

Parameters:

- Critical speeds: parameters *22.51*…*22.57* (page *303*).

Events: -

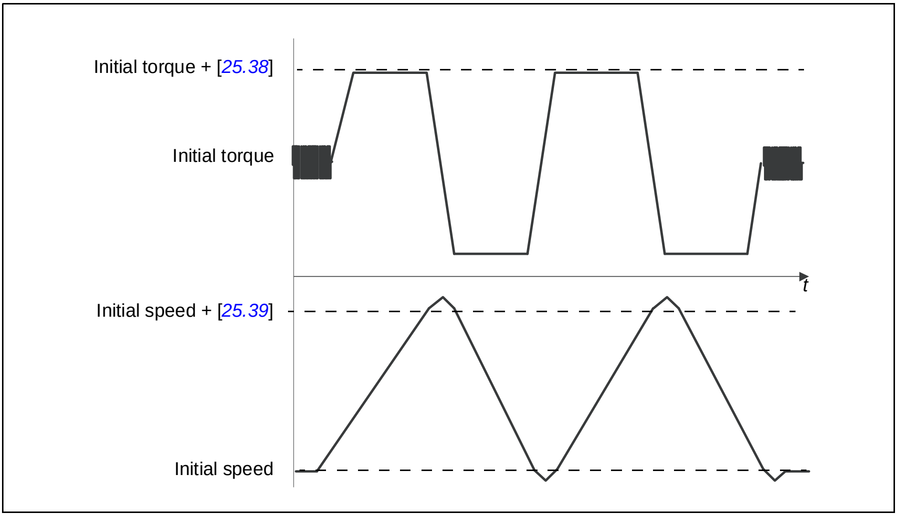
Speed controller autotune

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

The maximum torque reference used during autotuning is the initial torque (ie. torque when the routine is activated) plus *25.38 Autotune torque step*, unless limited by the maximum torque limit (parameter group *30 Limits*) or the nominal motor torque (*99 Motor data*). The calculated maximum speed during the routine is the initial speed (ie. speed when the routine is activated) + *25.39 Autotune speed step*, unless limited by *30.12 Maximum speed* or *99.09 Motor nominal speed*.

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



Notes:

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

Before activating the autotune routine

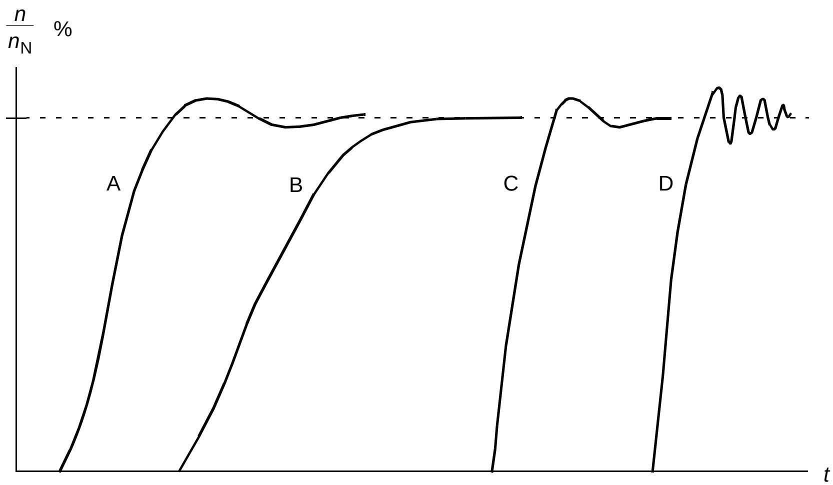
The prerequisites for performing the autotune routine are:

- The motor identification run (ID run) has been successfully completed
- Speed and torque limits (parameter group *30 Limits*) have been set
- The speed feedback has been monitored for noise, vibrations and other disturbances caused by the mechanics of the system, and following parameters are set to eliminate these disturbances:
  - speed feedback filtering (parameter group *90 Feedback selection*)
  - speed error filtering (*24 Speed reference conditioning*) 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 Speed controller autotune* (or the signal source selected by it).

Autotune modes

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



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

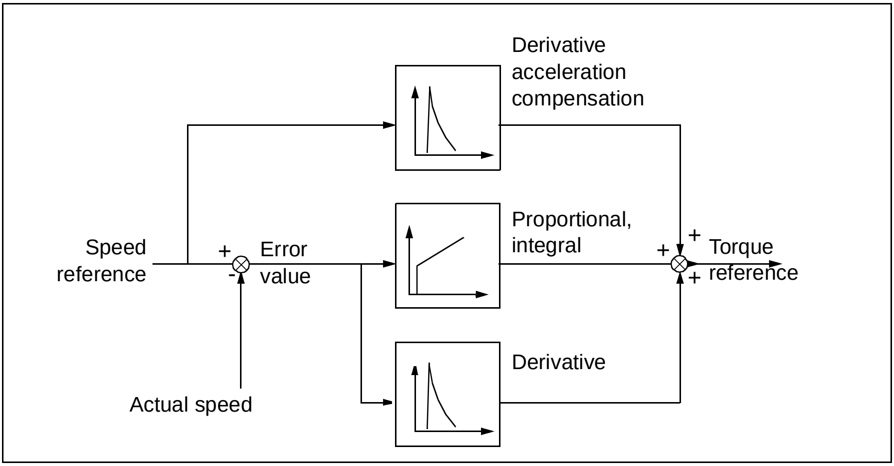
Autotune results

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

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

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

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



Warning indications

A warning message, *AF90 Speed controller autotuning*, will be generated if the autotune routine does not complete successfully. See chapter *Fault tracing* (page *625*) for further information.

Settings and diagnostics

Parameters: *25.33*…*25.40* (page *327*).

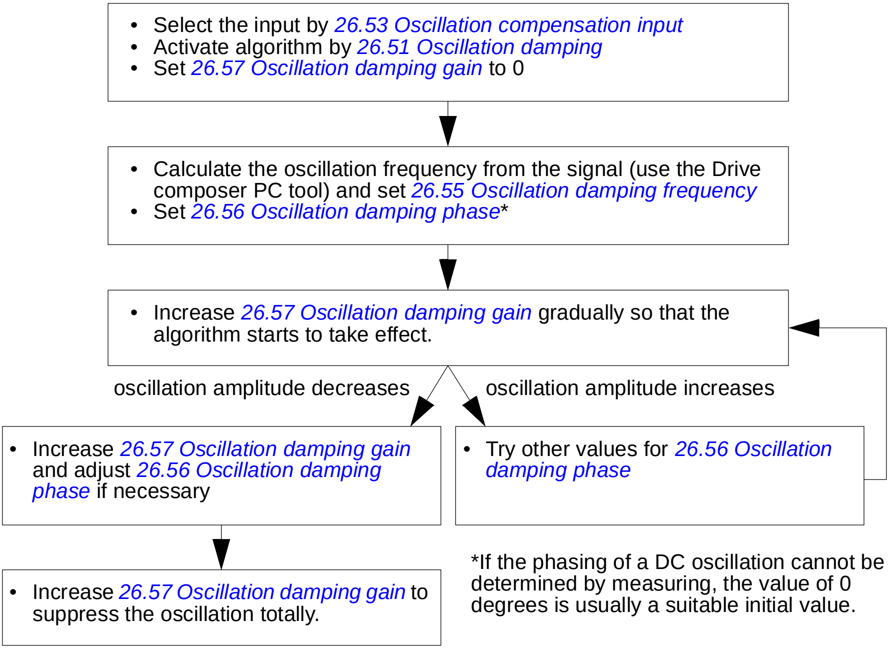
Events: -

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



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*…*26.58* (page *334*).

Events: -

Resonance frequency elimination

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

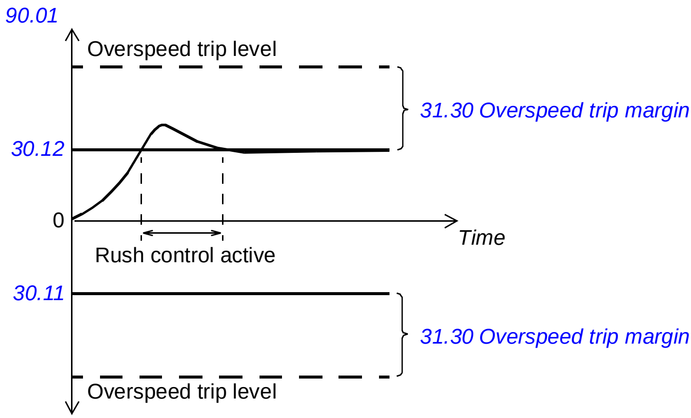
Settings and diagnostics

Parameters *24.13*…*24.17* (page *315*).

Events: -

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 Motor speed for control*) exceeds *30.11 Minimum speed* or *30.12 Maximum speed*.



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

Settings and diagnostics

Parameter groups: *30 Limits* (page *338*), *31 Fault functions* (page *344*) and *90 Feedback selection* (page *515*).

Parameters: *26.81 Rush control gain* and *26.82 Rush control integration time* (page *337*).

Events: -

Encoder support

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

- TTL encoder interface FEN-01: two TTL inputs, TTL output (for encoder emulation and echo) and two digital inputs
- Absolute encoder interface FEN-11: absolute encoder input, TTL input, TTL output (for encoder emulation and echo) and two digital inputs
- Resolver interface FEN-21: resolver input, TTL input, TTL output (for encoder emulation and echo) and two digital inputs
- HTL encoder interface FEN-31: HTL encoder input, TTL output (for encoder emulation and echo) and two digital inputs
- HTL/TTL encoder interface FSE-31 (for use with an FSO-xx safety functions module): Two HTL/TTL encoder inputs (one HTL input supported at the time of publication).

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

Encoder echo and emulation

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

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

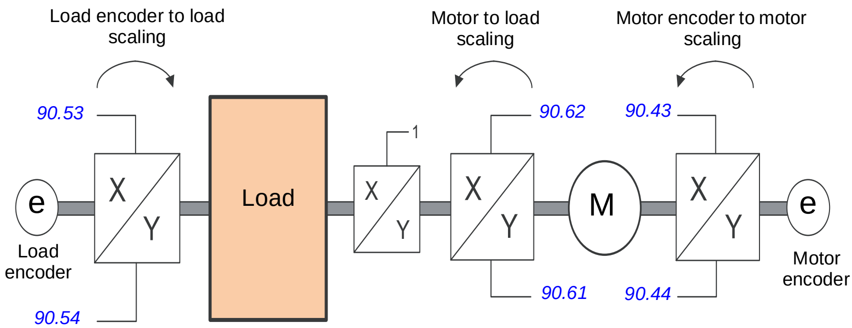
Encoder emulation also relays the encoder signal to the output, but the signal is either scaled, or position data converted to pulses. Emulation can be used when absolute encoder or resolver position needs to be converted to TTL pulses, or when the signal must be converted to a different pulse number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

Load and motor feedback

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

For detailed parameter connections of the motor and load feedback functions, see the block diagrams on pages *719* and *720*. For more information on load position calculation, see section *Position counter* (page *148*).

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



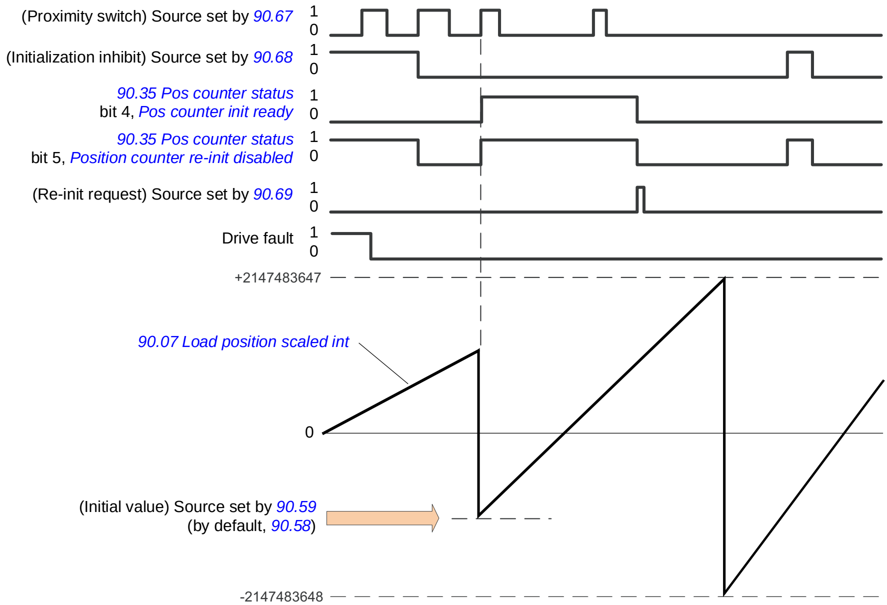
Any gear ratio between the load encoder and the load is defined by *90.53 Load gear numerator* and *90.54 Load gear denominator*. Similarly, any gear ratio between the motor encoder and the motor is defined by *90.43 Motor gear numerator* and *90.44 Motor gear denominator*. In case the internal estimated position is chosen as load feedback, the gear ratio between the motor and load can be defined by *90.61 Gear numerator* and *90.62 Gear denominator*. 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 Encoder parameter refresh*.

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 Load position scaled int*, indicates the scaled number of revolutions read from the selected source (see *Load and motor feedback* on page *147*).

The relation between revolutions of the motor shaft and the translatory movement of the load (in any given unit of distance) is defined by parameters *90.63 Feed constant numerator* and *90.64 Feed constant denominator*. 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 *720*.



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

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

See also the block diagram on page *720*.

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 Load feedback fault*. 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 Pos counter status* 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 Pos counter error and boot action* defines whether position calculation resumes from the previous value over an encoder error or control unit reboot. By default, bit 4 of *90.35 Pos counter status* 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 Pos counter error and boot action* 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 Load position scaled int* and *90.58 Pos counter init value int*, can be accessed from an upper-level control system in the following formats:

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

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

Configuration of HTL encoder motor feedback

1. Specify the type of the encoder interface module (parameter *91.11 Module 1 type* = *FEN-31*) and the slot the module is installed into (*91.12 Module 1 location*).
2. Specify the type of the encoder (*92.01 Encoder 1 type* = *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 Encoder 1 source* = *Module 1*).
4. Set the number of pulses according to encoder nameplate (*92.10 Pulses/revolution*).

5. If the encoder rotates at a different speed to the motor (ie. is not mounted directly on the motor shaft), enter the gear ratio in *90.43 Motor gear numerator* and *90.44 Motor gear denominator*.
6. Set parameter *91.10 Encoder parameter refresh* to *Refresh* to apply the new parameter settings. The parameter will automatically revert to *Done*.
7. Check that *91.02 Module 1 status* is showing the correct interface module type (*FEN-31*). Also check the status of the module; both LEDs should be glowing green.
8. Start the motor with a reference of eg. 400 rpm.
9. Compare the estimated speed (*01.02 Motor speed estimated*) with the measured speed (*01.04 Encoder 1 speed filtered*). If the values are the same, set the encoder as the feedback source (*90.41 Motor feedback selection* = *Encoder 1*).
10. Specify the action taken in case the feedback signal is lost (*90.45 Motor feedback fault*).

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 Motor gear numerator* = 1)
- (*90.44 Motor gear denominator* = 1)

(No gear is needed as the encoder is mounted directly on the motor shaft.)

- *90.51 Load feedback selection* = *Encoder 1*
- (*90.53 Load gear numerator* = 1)
- *90.54 Load gear denominator* = 50

The cable drum turns one revolution per 50 revolutions of the motor shaft.

- (*90.61 Gear numerator* = 1)
- (*90.62 Gear denominator* = 1)

(These parameters need not be changed as position estimate is not being used for feedback.)

- *90.63 Feed constant numerator* = 7
- *90.64 Feed constant denominator* = 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 Load position scaled int*, while *90.03 Load speed* 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 Motor feedback selection* = *Encoder 1*)
- (*90.43 Motor gear numerator* = 1)
- *90.44 Motor gear denominator* = 3

  The encoder turns three revolutions per one revolution of the motor shaft.
- *90.51 Load feedback selection* = *Encoder 2*

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

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 Encoder 1 type* = *HTL*
- *92.02 Encoder 1 source* = *Module 1*
- *92.10 Pulses/revolution* = 2048
- *92.13 Position estimation enable* = *Enable*
- *90.51 Load feedback selection* = *Encoder 1*
- *90.63 Feed constant numerator* = 8192 (ie. 4 × value of *92.10*, as the received number of pulses is 4 times nominal. See also parameter *92.12 Resolver polepairs*).
- The desired “data out” parameter is set to Other – *90.58 Pos counter init value int* (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 Pos counter init cmd source* and *90.69 Reset pos counter init ready*.

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 66536)
- 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 Load position scaled int* 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 *515*), *91 Encoder module settings* (page *528*), *92 Encoder 1 configuration* (page *531*) and *93 Encoder 2 configuration* (page *537*).

Events: -

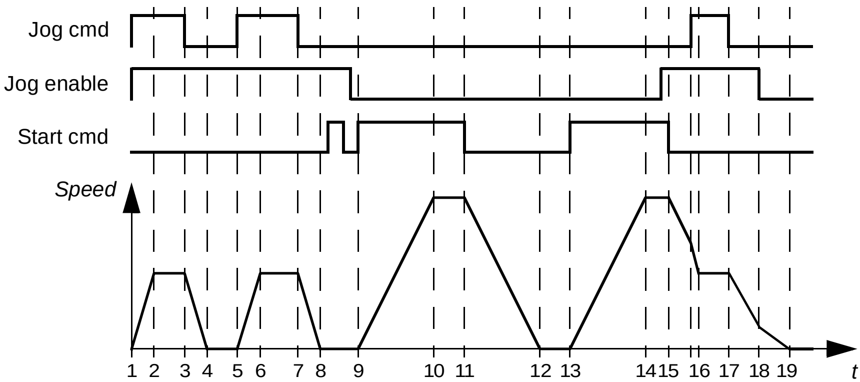
Jogging

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

Two jogging functions (1 and 2) are available, each with their own activation sources and references. The signal sources are selected by parameters *20.26 Jogging 1 start source* and *20.27 Jogging 2 start source*. When jogging is activated, the drive starts and accelerates to the defined jogging speed (*22.42 Jogging 1 ref* or *22.43 Jogging 2 ref* along the defined jogging acceleration ramp (*23.20*). 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 Stop mode*).

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



Phase	Jog cmd	Jog enable	Start cmd	Description
1-2	1	1	0	Drive accelerates to the jogging speed along the acceleration ramp of the jogging function.
2-3	1	1	0	Drive follows the jog reference.
3-4	0	1	0	Drive decelerates to zero speed along the deceleration ramp of the jogging function.
4-5	0	1	0	Drive is stopped.
5-6	1	1	0	Drive accelerates to the jogging speed along the acceleration ramp of the jogging function.
6-7	1	1	0	Drive follows the jog reference.
7-8	0	1	0	Drive decelerates to zero speed along the deceleration ramp of the jogging function.
8-9	0	1->0	0	Drive is stopped. As long as the jog enable signal is on, start commands are ignored. After jog enable switches off, a fresh start command is required.
9-10	x	0	1	Drive accelerates to the speed reference along the selected acceleration ramp (parameters *23.200*…*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.

Phase	Jog cmd	Jog enable	Start cmd	Description
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*).

See also the block diagram on page *718*.

The jogging function operates on a 2 ms time level.

Notes:

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

Settings and diagnostics

Parameters: *20.25 Jogging enable* (page 289), *20.26 Jogging 1 start source* (page 289), *20.27 Jogging 2 start source* (page 290), *22.42 Jogging 1 ref*, *22.43 Jogging 2 ref*, *23.20 Acc time jogging*, *23.21 Dec time jogging*.

Events: -

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.

Note: Scalar mode is meant only for testing purpose. Normally winch/anchor are driven in DTC-mode.

It is recommended to activate scalar motor control mode

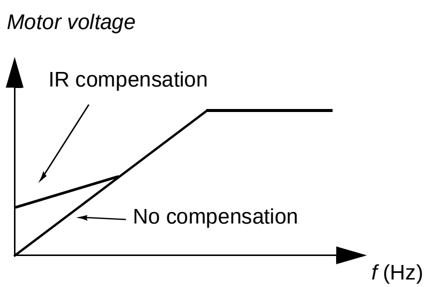
- if the nominal current of the motor is less than 1/6 of the nominal output current of the drive
- if the drive is used without a motor connected (for example, for test purposes)
- if the drive runs a medium-voltage motor through a step-up transformer, or
- in multimotor drives, if
  - the load is not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

In scalar control, some standard features are not available.

See also section *Operating modes of the drive* (page 22).

IR compensation for scalar motor control

IR compensation (also known as voltage boost) is available only when the motor control mode is scalar. When IR compensation is activated, the drive gives an extra voltage boost to the motor at low speeds. IR compensation is useful in applications that require a high break-away torque. In step-up applications, voltage cannot be fed through the transformer at 0 Hz, so an additional breakpoint is available for defining the compensation near zero frequency.



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

Settings

Parameters: *19.20 Scalar control reference unit* (page *280*), *97.12 IR comp step-up frequency* (page *558*), *97.13 IR compensation* (page *559*) and *99.04 Motor control mode* (page *563*).

Events: -

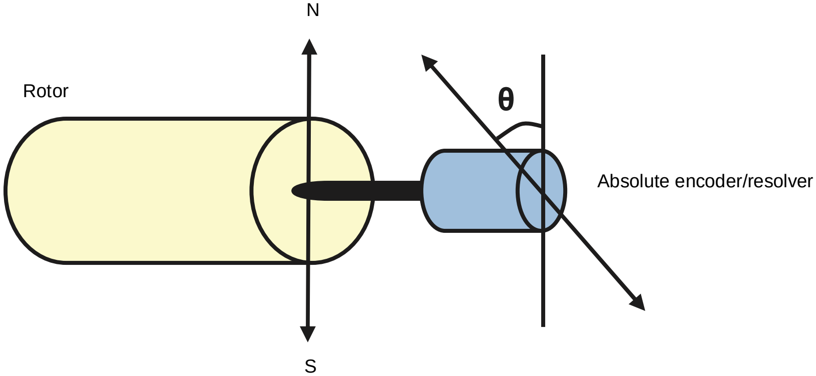
Autophasing

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 the 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.

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

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

Bit 4 of *06.21 Drive status word 3* indicates if the rotor position has already been determined.

Autophasing modes

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

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

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

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

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

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

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

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

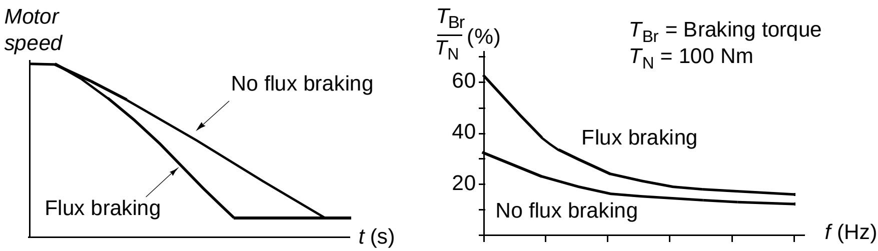
Settings and diagnostics

Parameters: *06.21 Drive status word 3* (page 210), *21.13 Autophasing mode* (page 296), *98.15 Position offset user* (page 562) and *99.13 ID run requested* (page 565).

Events: -

Flux braking

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



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

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

Two braking power levels are available:

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

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

Settings and diagnostics

Parameter: *97.05 Flux braking* (page *556*).

Events: -

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.

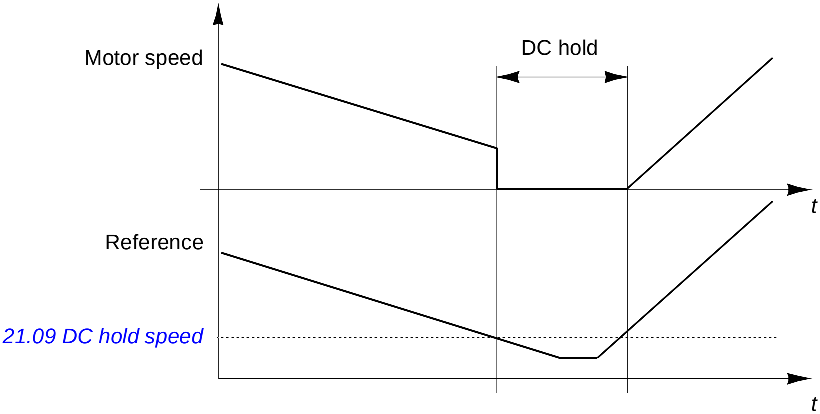
A digital source to control pre-heating is selected by parameter *21.14 Pre-heating input source*. The heating current is set by *21.16 Pre-heating current*

Pre-magnetization

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

DC hold

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



Note:

- DC hold is only available in speed control in DTC motor control mode (see page *22*).
- The function applies the DC current to one phase only, depending on the position of the rotor. The return current will be shared between the other phases.

Post-magnetization

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

Note: Post-magnetization is only available when ramping is the selected stop mode (see parameter *21.03 Stop mode*).

Settings and diagnostics

Parameters: *06.21 Drive status word 3* (page *210*), *21.02 Magnetization time*, *21.08*…*21.10* (page *296*), *21.14 Pre-heating input source* and *21.16 Pre-heating current* (page *297*).

Events: -

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. For better results, set correct temperature value in parameter *35.50* during 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 *299*), *21.38 Motor temperature estimation time* (page *299*), and *35.50 Motor ambient temperature* (page *375*).

Events: -

Hexagonal motor flux pattern

Note: This feature is only available in scalar motor control mode (see page *122*).

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

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

Settings and diagnostics

Parameters: *97.18 Hexagonal field weakening* and *97.19 Hexagonal field weakening point* (page *559*).

Events: -

Motor potentiometer

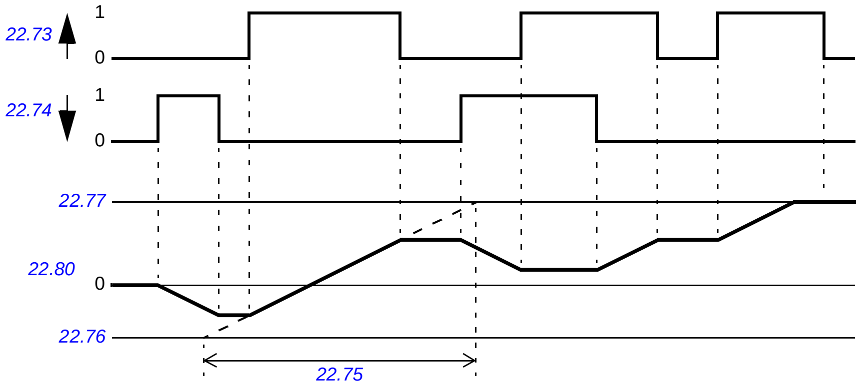
The motor potentiometer is, in effect, a counter whose value can be adjusted up and down using two digital signals selected by parameters *22.73 Motor potentiometer up source* and *22.74 Motor potentiometer down source*. Note that these signals have no effect when the drive is stopped.

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* (page *304*).

Events: -

DC voltage control

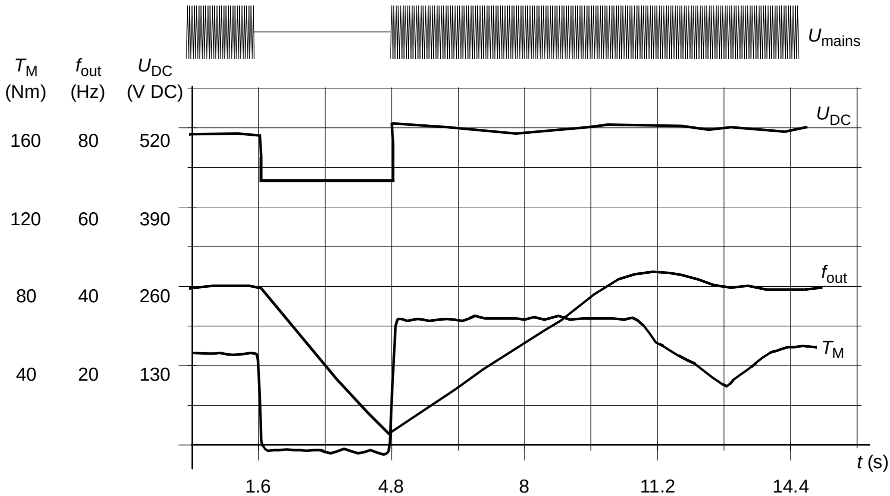
Overvoltage control

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

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

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

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

If the DC voltage is restored before the expiration of the period defined by parameter *21.18 Auto restart time* and the start signal is still on, normal operation will continue. However, if the DC voltage remains too low at that point, the drive trips on a fault, *3280 Standby timeout*.

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

Settings and diagnostics

Parameter: *21.18 Auto restart time* (page *297*),

Event: *3280 Standby timeout* (page *653*).

Voltage control and trip limits

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

All levels are relative to the supply voltage range selected in parameter *95.01 Supply voltage*. The following table shows the values of selected DC voltage levels in volts.

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
$U_{DC,ovc}$	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
$U_{DC,max}$	324		560	648	675	810	932
$U_{DC,brcl}$	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 × 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.
$U_{DC,max}$	DC voltage at upper bound of supply voltage range.
$U_{DC,brcl}$, $U_{DC,brch}$	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 *193*), *30.30 Overvoltage control* (page *344*), *30.31 Undervoltage control* (page *344*), *95.01 Supply voltage* (page *540*), and *95.02 Adaptive voltage limits* (page *540*).

Events: -

Brake chopper

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

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

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

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

Settings and diagnostics

Parameters: *01.11 DC voltage* (page *193*) and *30.30 Overvoltage control* (page *344*).

Parameter group: *43 Brake chopper* (page *388*).

Events: -

Safety and protections

Emergency stop

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

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

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

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

Notes:

- For SIL 3 / PL e-level emergency stop functions, the drive can be fitted with a TÜV-certified FSO-xx safety options module. The module can then be incorporated into certified safety systems.
- The installer of the equipment is responsible for installing the emergency stop devices and all additional devices needed for the emergency stop function to fulfill the required emergency stop categories. For more information, contact your local ABB representative.
- After an emergency stop signal is detected, the emergency stop function cannot be canceled even though the signal is canceled.
- If the minimum (or maximum) torque limit is set to 0%, the emergency stop function may not be able to stop the drive.
- 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.

Settings and diagnostics

Parameters: *06.17 Drive status word 2* (page *207*), *06.18 Start inhibit status word* (page *208*), *21.04 Emergency stop mode* (page *293*), *21.05 Emergency stop source* (page *293*), *23.23 Emergency stop time* (page *309*), *25.13 Min torq sp ctrl em stop* (page *324*), *25.14 Max torq sp ctrl em stop* (page *324*), *25.15 Proportional gain em stop* (page *324*), *31.32 Emergency ramp supervision* (page *352*) and *31.33 Emergency ramp supervision delay* (page *353*).

Events: -

Motor thermal protection

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

The motor temperature can be monitored using

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

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

Motor thermal protection model

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

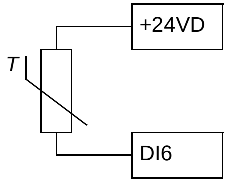
1. When power is applied to the drive for the first time, the motor is assumed to be at ambient temperature (defined by parameter *35.50 Motor ambient temperature*). After this, when power is applied to the drive, the motor is assumed to be at the estimated temperature.
2. Motor temperature is calculated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

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 Motor load curve*, *35.52 Zero speed load* and *35.53 Break point*.

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

Temperature monitoring using PTC sensors

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

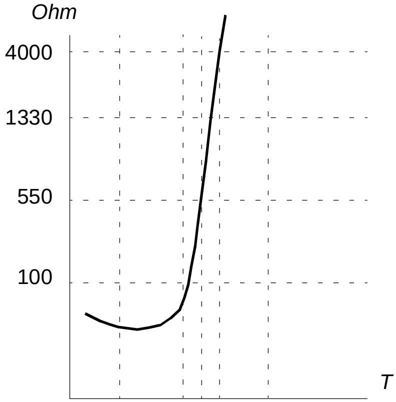


The resistance of the PTC sensor increases when its temperature rises. The increasing resistance of the sensor decreases the voltage at the input, and eventually its state switches from 1 to 0, indicating overtemperature.

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

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

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



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

Temperature monitoring using Pt100 sensors or Pt 1000 sensors

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.

Temperature monitoring using KTY84 sensors

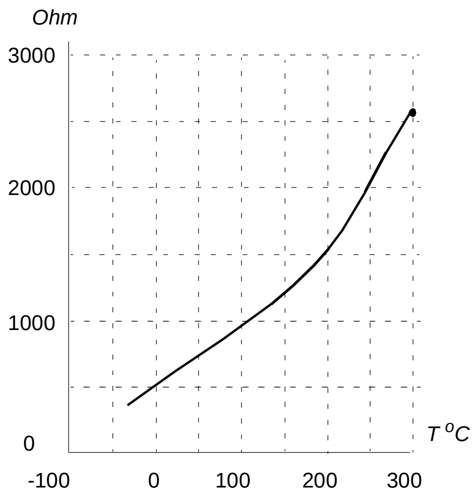
One KTY84 sensor can be connected to an analog input and an analog output on the control unit.

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

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

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

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



The warning and fault limits can be adjusted by parameters.

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

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

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

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

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

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

Settings and diagnostics

Parameter groups: *35 Motor thermal protection* (page *368*) and *91 Encoder module settings* (page *528*); parameter *95.15 Special HW settings* (page *542*).

Events: -

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, see section *Motor thermal protection* (page *171*).

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 Motor overload class*, 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 *376*).

Parameters specific to motor overload protection: *35.05 Motor overload level* (page *369*), *35.56 Motor overload action* … *35.57 Motor overload class* (page *378*).

Events: -

Thermal protection of motor cable

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

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

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

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

Settings and diagnostics

Parameters: *35.60 Cable temperature*…*35.62 Cable thermal rise time* (page *378*).

Events: *A480 Motor cable overload* (page *630*) and *4000 Motor cable overload* (page *654*).

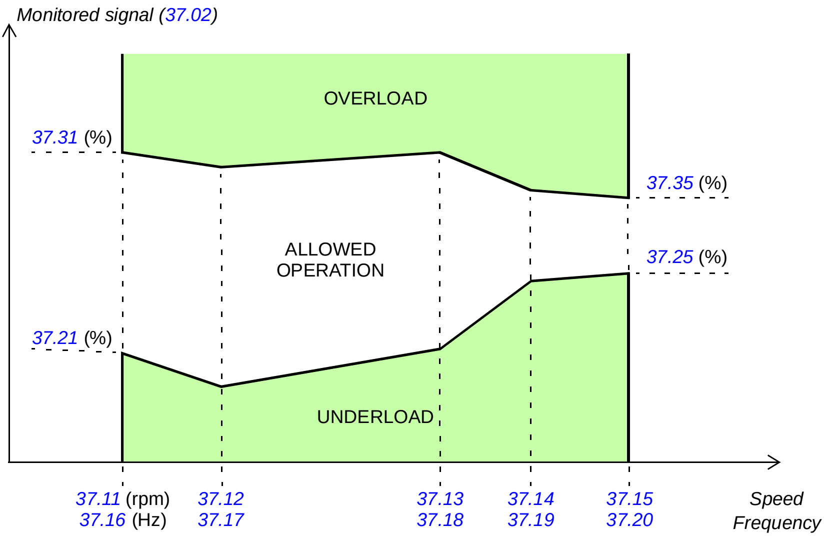
User load curve

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 *385*).

Events: -

Automatic fault resets

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) that is automatically reset.

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

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

Settings and diagnostics

Parameters: *31.12*…*31.16* (page *347*).

Events: -

Other programmable protection functions

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

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

Motor phase loss detection (parameter *31.19*)

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

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

The earth fault detection function is based on sum current measurement. Note that

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

Safe torque off detection (parameter *31.22*)

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

Swapped supply and motor cabling (parameter *31.23*)

The drive can detect if the supply and motor cables have accidentally been swapped (for example, if the supply is connected to the motor connection of the drive). The parameter selects if a fault is generated or not. Note that the protection should be disabled in drive/inverter hardware supplied from a common DC bus.

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

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

Overspeed protection (parameter *31.30*)

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

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

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

Main cooling fan supervision (parameter *31.35*)

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

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

Custom motor current fault limit (parameter *31.42*)

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

Local control loss detection (parameter *49.05*)

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

Diagnostics

Fault and warning messages, data logging

See chapter *Fault tracing* (page *625*).

Signal supervision

Three signals can be selected to be supervised by this function. Whenever a supervised signal exceeds or falls below predefined limits, a bit in *32.01 Supervision status* is activated, and a warning or fault generated. The contents of the message can be edited on the control panel by selecting **Menu - Settings** - **Edit texts**.

The supervised signal is low-pass filtered.

Settings and diagnostics

Parameter group: *32 Supervision* (page *356*).

Events: -

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. An alarm 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 *359*).

Events: -

Energy saving calculators

This feature consists of the following functionalities:

- An energy optimizer that adjusts the motor flux in such a way that the total system efficiency is maximized
- A counter that monitors used and saved energy by the motor and displays them in kWh, currency or volume of CO_2 emissions, and
- A load analyzer showing the load profile of the drive (see separate section on page *180*).

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 *395*).

Events: -

Load analyzer

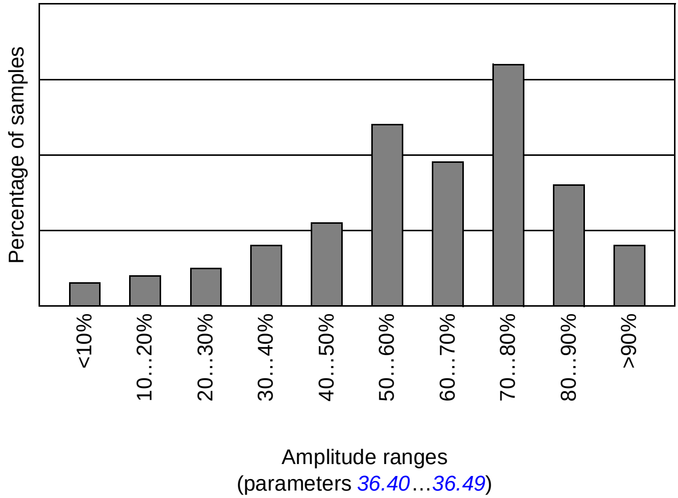
Peak value logger

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 Logger function*, 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 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 samples is shown by parameters *36.20*…*36.29*.

Settings and diagnostics

Parameter group: *36 Load analyzer* (page *381*).

Events: -

Miscellaneous

User parameter sets

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

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

- forced I/O values such as parameters *10.03 DI force selection* and *10.04 DI force data*
- I/O extension module settings (groups 14…16)
- fieldbus communication enable parameters (*50.01 FBA A enable* and *50.31 FBA B enable*)
- other fieldbus communication settings (groups 51…56 and 58)
- encoder configuration settings (groups 92…93)
- some hardware settings in parameter group *95 HW configuration*, 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 *227*), *10.04 DI force data* (page *227*), *50.01 FBA A enable* (page *407*), *50.31 FBA B enable* (page *411*) and *96.10 User set status* (page *547*)…*96.13 User set I/O mode in2* (page *547*).

Parameter group: *95 HW configuration* (page *540*)

Events: -

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 Data storage*
- 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*…*96.59 Approved checksum 4* (page *552*).

Events: -

User lock

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.

⚠ **WARNING!** ABB will not be liable for damages or losses caused by the failure to activate the user lock using a new pass code. See *Cybersecurity disclaimer* (page *21*).

To activate the user lock for the first time,

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

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

- In *96.102 User lock functionality*, define the actions that you want to prevent (we recommend you select all the actions unless otherwise required by the application).
- Enter an invalid (random) pass code into *96.02 Pass code*.
- Activate *96.08 Control board boot*, 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 Pass code*. This will again make parameters *96.100*…*96.102* visible.

Settings and diagnostics

Parameters: *96.02 Pass code* (page *545*) and *96.100*…*96.102* (page *554*).

Events: -

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 linking, testing and commissioning purposes. They can be written to and read from using other parameters' source or target selections.

Note: 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 *402*).

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 Special HW settings* 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 Special HW settings* 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 *542*), *97.01 Switching frequency reference*, and *97.02 Minimum switching frequency* (page *556*).

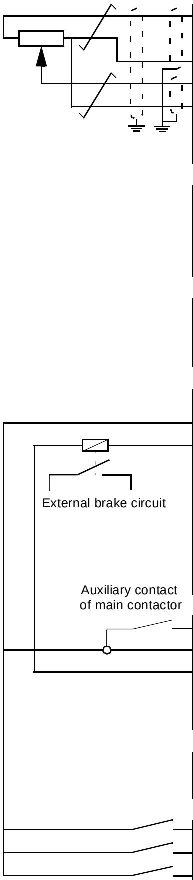
6

Default control connections

What this chapter contains

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

Winch I/O control connections



XPOW	External power input	
1	+24VI	24 V DC, 2 A
2	GND	
XAI	Reference voltage and analog inputs	
1	+VREF	10 V DC, R_L 1…10 kohm
2	-VREF	-10 V DC, R_L 1…10 kohm
3	AGND	Ground
4	AI1+	**Speed reference**
5	AI1-	0(2)…10 V, R_{in} > 200 kohm
6	AI2+	By default not in use.
7	AI2-	0(4)…20 mA, R_{in} > 100 ohm
XAO	Analog outputs	
1	AO1	**Motor speed rpm**
2	AGND	0…20 mA, R_L < 500 ohm
3	AO2	**Motor current**
4	AGND	0…20 mA, R_L < 500 ohm
XD2D	Drive-to-drive link	
1	B	Drive-to-drive link
2	A	
3	BGND	
XRO1, XRO2, XRO3	Relay outputs	
1	NC	P 44.204.0, Winch brake open command
2	COM	250 V AC / 30 V DC
3	NO	2 A
1	NC	**Ready run**
2	COM	250 V AC / 30 V DC
3	NO	2 A
1	NC	**Fault (-1)**
2	COM	250 V AC / 30 V DC
3	NO	2 A
XD24	Digital interlock	
1	DIIL	Power ackn. (par. *20.200*) / Run enable (par. *20.12*)
2	+24VD	+24 V DC 200 mA
3	DICOM	Digital input ground
4	+24VD	+24 V DC 200 mA
5	DIOGND	Digital input/output ground
XDIO	Digital input/outputs	
1	DIO1	Output: Not in use.
2	DIO2	Output: Not in use.
XDI	Digital inputs	
1	DI1	Control stand 1 enable (EXT2)
2	DI2	Control stand 1 heave (EXT2), In1 Start Fwd (EXT1)
3	DI3	Control stand 1 lower (EXT2), In2 Start Rev (EXT1)
4	DI4	Not in use
5	DI5	Not in use
6	DI6	Not in use
XSTO	Safe torque off circuits must be closed for the drive to start. See *Hardware manual* of drive.	
X12	Safety options connection	
X13	Control panel connection	
X205	Memory unit connection	

7

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*. **Note:** Certain drive hardware or optional equipment may require different default values. These are labeled as follows: (*95.20* bx) = Default changed or write-protected by parameter *95.20*, bit x.
FbEq16	(In the following table, shown on the same row as the parameter range, or for each selection) 16-bit fieldbus equivalent: The scaling between the integer used in communication and the value shown on the panel when a 16-bit value is selected for transmission to an external system. A dash (-) indicates that the parameter is not accessible in 16-bit format. The corresponding 32-bit scalings are listed in chapter *Additional parameter data* (page *569*).
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* (page *402*) can be used. The parameter types are listed in chapter *Additional parameter data* (page *569*).

Term	Definition
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

Summary of parameter groups

Group	Contents	Page
01 Actual values	Basic signals for monitoring the drive.	*192*
03 Input references	Values of references received from various sources.	*195*
04 Warnings and faults	Information on warnings and faults that occurred last.	*197*
05 Diagnostics	Various run-time-type counters and measurements related to drive maintenance.	*203*
06 Control and status words	Drive control and status words.	*204*
07 System info	Information on drive hardware, firmware and application program.	*216*
09 Winch actual signals	Monitoring signals related to winch control program.	*219*
10 Standard DI, RO	Configuration of digital inputs and relay outputs.	*226*
11 Standard DIO, FI, FO	Configuration of digital input/outputs and frequency inputs/outputs.	*233*
12 Standard AI	Configuration of standard analog inputs.	*239*
13 Standard AO	Configuration of standard analog outputs.	*244*
14 I/O extension module 1	Configuration of I/O extension module 1.	*249*
15 I/O extension module 2	Configuration of I/O extension module 2.	*270*
16 I/O extension module 3	Configuration of I/O extension module 3.	*274*
19 Operation mode	Selection of local and external control location sources and operating modes.	*278*
20 Start/stop/direction	Start/stop/direction and run/start/jog enable signal source selection; positive/negative reference enable signal source selection.	*280*
21 Start/stop mode	Start and stop modes; emergency stop mode and signal source selection; DC magnetization settings; autophasing mode selection.	*291*
22 Speed reference selection	Speed reference selection; motor potentiometer settings.	*299*
23 Speed reference ramp	Speed reference ramp settings (programming of the acceleration and deceleration rates for the drive).	*307*
24 Speed reference conditioning	Speed error calculation; speed error window control configuration; speed error step.	*314*
25 Speed control	Speed controller settings.	*319*
26 Torque reference chain	Settings for the torque reference chain.	*329*
30 Limits	Drive operation limits.	*338*
31 Fault functions	Configuration of external events; selection of behavior of the drive upon fault situations.	*344*
32 Supervision	Configuration of signal supervision functions 1…3.	*356*
33 Generic timer & counter	Configuration of maintenance timers/counters.	*359*
35 Motor thermal protection	Motor thermal protection settings such as temperature measurement configuration, load curve definition and motor fan control configuration.	*368*
36 Load analyzer	Peak value and amplitude logger settings.	*381*
37 User load curve	Settings for user load curve.	*385*
43 Brake chopper	Settings for the internal brake chopper.	*388*
44 Mechanical brake control	Configuration of mechanical brake control.	*390*

Group	Contents	Page
45 Energy efficiency	Settings for the energy saving calculators.	*395*
46 Monitoring/scaling settings	Speed supervision settings; actual signal filtering; general scaling settings.	*398*
47 Data storage	Data storage parameters that can be written to and read from using other parameters' source and target settings.	*402*
49 Panel port communication	Communication settings for the control panel port on the drive.	*404*
50 Fieldbus adapter (FBA)	Fieldbus communication configuration.	*407*
51 FBA A settings	Fieldbus adapter A configuration.	*415*
52 FBA A data in	Selection of data to be transferred from drive to fieldbus controller through fieldbus adapter A.	*417*
53 FBA A data out	Selection of data to be transferred from fieldbus controller to drive through fieldbus adapter A.	*417*
54 FBA B settings	Fieldbus adapter B configuration.	*418*
55 FBA B data in	Selection of data to be transferred from drive to fieldbus controller through fieldbus adapter B.	*420*
56 FBA B data out	Selection of data to be transferred from fieldbus controller to drive through fieldbus adapter B.	*420*
58 Embedded fieldbus	Configuration of the embedded fieldbus (EFB) interface.	
60 DDCS communication	DDCS communication configuration.	*429*
61 D2D and DDCS transmit data	Defines the data sent to the DDCS link.	*446*
62 D2D and DDCS receive data	Mapping of data received through the DDCS link.	*450*
74 Winch general	General settings for winch.	*457*
75 Winch interface	Winch control stand configuration.	*476*
76 Automooring	Settings for Automooring.	*484*
77 Anchor stowing protection	Settings for anchor stowing protection.	*498*
78 Slip detection	Settings for slip detection.	*501*
79 Peak torque protection	Settings for peak torque protection.	*504*
80 Power control	Settings for power control.	*505*
81 Winch system check	Settings for torque proving and brake slip detection.	*509*
82 Clutch control	Settings for clutch control.	*510*
84 Synchro control	Settings for synchro control.	*512*
90 Feedback selection	Motor and load feedback configuration.	*515*
91 Encoder module settings	Configuration of encoder interface modules.	*528*
92 Encoder 1 configuration	Settings for encoder 1.	*531*
93 Encoder 2 configuration	Settings for encoder 2.	*537*
95 HW configuration	Various hardware-related settings.	*540*
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.	*544*
97 Motor control	Motor model settings.	*555*
98 User motor parameters	Motor values supplied by the user that are used in the motor model.	*560*

Group	Contents	Page
99 Motor data	Motor configuration settings.	*562*
200 Safety	FSO-xx settings.	*568*

Parameter listing

No.	Name/Value	Description	Def/FbEq16
01 Actual values		Basic signals for monitoring the drive. **Note**: 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.	-
	-30000.00 … 30000.00 rpm	Measured or estimated motor speed.	See par. 46.01
01.02	Motor speed estimated	Estimated motor speed in rpm. A filter time constant for this signal can be defined by parameter 46.11 Filter time motor speed.	-
	-30000.00 … 30000.00 rpm	Estimated motor speed.	See par. 46.01
01.03	Motor speed%	Displays the value of 01.01 Motor speed used in percent of the synchronous speed of the motor.	10 = 1%
	-1000.00 ...1000.00%	Measured or estimated motor speed.	See par. 46.01
01.04	Encoder 1 speed filtered	Speed of encoder 1 in rpm. A filter time constant for this signal can be defined by parameter 46.11 Filter time motor speed.	-
	-30000.00 … 30000.00 rpm	Encoder 1 speed.	See par. 46.01
01.05	Encoder 2 speed filtered	Speed of encoder 2 in rpm. A filter time constant for this signal can be defined by parameter 46.11 Filter time motor speed.	-
	-30000.00 … 30000.00 rpm	Encoder 2 speed.	See par. 46.01
01.06	Output frequency	Estimated drive output frequency in Hz. A filter time constant for this signal can be defined by parameter 46.12 Filter time output frequency.	-
	-500.00 … 500.00 Hz	Estimated output frequency.	See par. 46.02
01.07	Motor current	Measured (absolute) motor current in A.	-
	0.00 … 30000.00 A	Motor current.	See par. 46.05
01.08	Motor current% of motor nom	Motor current (drive output current) in percent of the nominal motor current.	-
	0.0 … 1000.0%	Motor current.	1 = 1%
01.10	Motor torque	Motor torque in percent of the nominal motor torque. See also parameter 01.30 Nominal torque scale. A filter time constant for this signal can be defined by parameter 46.13 Filter time motor torque.	-
	-1600.0 … 1600.0%	Motor torque.	See par. 46.03

No.	Name/Value	Description	Def/FbEq16
01.11	*DC voltage*	Measured DC link voltage.	-
	0.00 … 2000.00 V	DC link voltage.	10 = 1 V
01.13	*Output voltage*	Calculated motor voltage in V AC.	-
	0…2000 V	Motor voltage.	1 = 1 V
01.14	*Output power*	Drive output power. The unit is selected by parameter *96.16 Unit selection*. A filter time constant for this signal can be defined by parameter *46.14 Filter time power out*.	-
	-32768.00 … 32767.00 kW or hp	Output power.	1 = 1 unit
01.15	*Output power% of motor nom*	Displays the value of *01.14 Output power* in percent of the nominal power of the motor.	-
	-300.00...300.00%	Output power.	1 = 1%
01.17	*Motor shaft power*	Estimated mechanical power at motor shaft. The unit is selected by parameter *96.16 Unit selection*. A filter time constant for this signal can be defined by parameter *46.14 Filter time power out*.	-
	-32768.00... 32767.00 kW or hp	Motor shaft power.	1 = 1 unit
01.18	*Inverter GWh motoring*	Amount of energy that has passed through the drive (in either direction) in full gigawatt-hours. The minimum value is zero.	-
	0…65535 GWh	Energy in GWh.	1 = 1 GWh
01.19	*Inverter MWh motoring*	Amount of energy that has passed through the drive (in either direction) in full megawatt-hours. Whenever the counter rolls over, *01.18 Inverter GWh motoring* is incremented.The minimum value is zero.	-
	0…999 MWh	Energy in MWh.	1 = 1 MWh
01.20	*Inverter kWh motoring*	Amount of energy that has passed through the drive (in either direction) in full kilowatt-hours. Whenever the counter rolls over, *01.19 Inverter MWh motoring* is incremented.The minimum value is zero.	-
	0…999 kWh	Energy in kWh.	10 = 1 kWh
01.21	*U-phase current*	Measured U-phase current.	-
	-30000.00 … 30000.00 A	U-phase current.	See par. *46.05*
01.22	*V-phase current*	Measured V-phase current.	-
	-30000.00 … 30000.00 A	V-phase current.	See par. *46.05*
01.23	*W-phase current*	Measured W-phase current.	-
	-30000.00 … 30000.00 A	W-phase current.	See par. *46.05*
01.24	*Flux actual%*	Used flux reference in percent of nominal flux of motor.	-
	0…200%	Flux reference.	1 = 1%
01.25	*INU momentary cos ?*	Momentary cosphi of the drive.	-
	-1.00 … 1.00	Cosphi.	100 = 1

No.	Name/Value	Description	Def/FbEq16
01.29	*Speed change rate*	Rate of speed reference change after the speed ramp generator. See also parameters *31.32 Emergency ramp supervision* and *31.33 Emergency ramp supervision delay*.	-
	-15000 … 15000 rpm/s	Rate of speed change.	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… N·m or lb·ft	Nominal torque.	1 = 1 unit
01.31	*Ambient temperature*	Measured temperature of incoming cooling air. The unit is selected by parameter *96.16 Unit selection*.	-
	-40.0 … 200.0 °C or °F	Cooling air temperature.	1 = 1°
01.32	*Inverter GWh regenerating*	Amount of energy that has passed through the drive (towards the supply) in full gigawatt-hours. The minimum value is zero.	-
	0…32767 GWh	Regenerative energy in GWh.	1 = 1 GWh
01.33	*Inverter MWh regenerating*	Amount of energy that has passed through the drive (towards the supply) in full megawatt-hours. Whenever the counter rolls over, *01.32 Inverter GWh regenerating* is incremented.The minimum value is zero.	-
	0…999 MWh	Regenerative energy in MWh.	1 = 1 MWh
01.34	*Inverter kWh regenerating*	Amount of energy that has passed through the drive (towards the supply) in full kilowatt-hours. Whenever the counter rolls over, *01.33 Inverter MWh regenerating* is incremented.The minimum value is zero.	-
	0…999 kWh	Regenerative energy in kWh.	10 = 1 kWh
01.35	*Mot - regen energy GWh*	Amount of net energy (motoring energy - regenerating energy) that has passed through the drive in full gigawatt-hours.	-
	-32768…32767 GWh	Energy balance in GWh.	1 = 1 GWh
01.36	*Mot - regen energy MWh*	Amount of net energy (motoring energy - regenerating energy) that has passed through the drive in full megawatt-hours. Whenever the counter rolls over, *01.35 Mot - regen energy GWh* is incremented or decremented.	-
	-999…999 MWh	Energy balance in MWh.	1 = 1 MWh
01.37	*Mot - regen energy kWh*	Amount of energy (motoring energy - regenerating energy) that has passed through the drive in full kilowatt-hours. Whenever the counter rolls over, *01.36 Mot - regen energy MWh* is incremented or decremented.	-
	-999…999 kWh	Energy balance in kWh.	10 = 1 kWh
01.61	*Abs motor speed used*	Absolute value of *01.01 Motor speed used*.	-
	0.00 … 30000.00 rpm	Measured or estimated motor speed.	See par. *46.01*

No.	Name/Value	Description	Def/FbEq16
01.62	*Abs motor speed%*	Absolute value of *01.03 Motor speed%*.	-
	0.00 … 1000.00%	Measured or estimated motor speed.	10 = 1%
01.63	*Abs output frequency*	Absolute value of *01.06 Output frequency*.	-
	0.00 … 500.00 Hz	Estimated output frequency.	See par. *46.02*
01.64	*Abs motor torque*	Absolute value of *01.10 Motor torque*.	-
	0.0 … 1600.0%	Motor torque.	See par. *46.03*
01.65	*Abs output power*	Absolute value of *01.14 Output power*.	-
	0.00 … 32767.00 kW or hp	Output power.	1 = 1 unit
01.66	*Abs output power% motor nom*	Absolute value of *01.15 Output power% of motor nom*.	-
	0.00 … 300.00%	Output power.	10 = 1%
01.68	*Abs motor shaft power*	Absolute value of *01.17 Motor shaft power*.	-
	0.00 … 32767.00 kW or hp	Motor shaft power.	1 = 1 unit
01.70	*Ambient temperature%*	Measured temperature of incoming cooling air. The amplitude range of 0…100% corresponds to 0…60 °C or 32…140 °F. See also *01.31 Ambient temperature*.	-
	-200.00...200.00%	Cooling air temperature	1 = 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.	-
	0.00 … 30000.00 A	Estimated motor current.	See par. *46.05*
01.72	*U-phase RMS current*	U-phase rms current.	-
	0.00 … 30000.00 A	U-phase rms current.	See par. *46.05*
01.73	*V-phase RMS current*	V-phase rms current.	-
	0.00 … 30000.00 A	V-phase rms current.	See par. *46.05*
01.74	*W-phase RMS current*	W-phase rms current.	-
	0.00 … 30000.00 A	W-phase rms current.	See par. *46.05*
03 Input references		Values of references received from various sources. **Note**: 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.	-
	-100000.00 … 100000.00	Local control panel or PC tool reference.	1 = 10

No.	Name/Value	Description	Def/FbEq16
03.02	*Panel reference 2*	Remote reference given from the control panel or PC tool.	-
	-30000.00 … 30000.00	Remote control panel or PC tool reference.	1 = 10
03.05	*FB A reference 1*	Reference 1 received through fieldbus adapter A. See also chapter *Fieldbus control through a fieldbus adapter* (page *703*).	-
	-100000.00 … 100000.00	Reference 1 from fieldbus adapter A.	1 = 10
03.06	*FB A reference 2*	Reference 2 received through fieldbus adapter A.	-
	-100000.00 … 100000.00	Reference 2 from fieldbus adapter A.	1 = 10
03.07	*FB B reference 1*	Reference 1 received through fieldbus adapter B.	-
	-100000.00 … 100000.00	Reference 1 from fieldbus adapter B.	1 = 10
03.08	*FB B reference 2*	Reference 2 received through fieldbus adapter B.	-
	-100000.00 … 100000.00	Reference 2 from fieldbus adapter B.	1 = 10
03.09	*EFB reference 1*	Scaled reference 1 received through the embedded fieldbus interface. The scaling is defined by *58.26 EFB ref1 type*.	1 = 10
	-30000.00 … 30000.00	Reference 1 received through the embedded fieldbus interface.	1 = 10
03.10	*EFB reference 2*	Scaled reference 2 received through the embedded fieldbus interface. The scaling is defined by *58.27 EFB ref2 type*.	1 = 10
	-30000.00 … 30000.00	Reference 2 received through the embedded fieldbus interface.	1 = 10
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*. See also section *External controller interface* (page *136*).	1 = 10
	-30000.00 … 30000.00	Scaled reference 1 received from external controller.	1 = 10
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*.	1 = 10
	-30000.00 … 30000.00	Scaled reference 2 received from external controller.	1 = 10
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*. See also section *Master/follower functionality* (page *129*).	1 = 10
	-30000.00 … 30000.00	Scaled reference 1 received from master.	1 = 10
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*.	1 = 10
	-30000.00 … 30000.00	Scaled reference 2 received from master.	1 = 10

No.	Name/Value	Description	Def/FbEq16
03.30	*FB A reference 1 int32*	Reference 1 received through fieldbus adapter A as a 32-bit integer.	-
	-2147483648... 2147483647	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.	-
	-2147483648... 2147483647	Reference 2 from fieldbus adapter A.	-

04 Warnings and faults		Information on warnings and faults that occurred last. For explanations of individual warning and fault codes, see chapter *Fault tracing*. **Note**: All parameters in this group are read-only unless otherwise noted.	
04.01	*Tripping fault*	Code of the 1st active fault (the fault that caused the current trip).	-
	0000h…FFFFh	1st active fault.	1 = 1
04.02	*Active fault 2*	Code of the 2nd active fault.	-
	0000h…FFFFh	2nd active fault.	1 = 1
04.03	*Active fault 3*	Code of the 3rd active fault.	-
	0000h…FFFFh	3rd active fault.	1 = 1
04.04	*Active fault 4*	Code of the 4th active fault.	-
	0000h…FFFFh	4th active fault.	1 = 1
04.05	*Active fault 5*	Code of the 5th active fault.	-
	0000h…FFFFh	5th active fault.	1 = 1
04.06	*Active warning 1*	Code of the 1st active warning.	-
	0000h…FFFFh	1st active warning.	1 = 1
04.07	*Active warning 2*	Code of the 2nd active warning.	-
	0000h…FFFFh	2nd active warning.	1 = 1
04.08	*Active warning 3*	Code of the 3rd active warning.	-
	0000h…FFFFh	3rd active warning.	1 = 1
04.09	*Active warning 4*	Code of the 4th active warning.	-
	0000h…FFFFh	4th active warning.	1 = 1
04.10	*Active warning 5*	Code of the 5th active warning.	-
	0000h…FFFFh	5th active warning.	1 = 1
04.11	*Latest fault*	Code of the 1st stored (non-active) fault.	-
	0000h…FFFFh	1st stored fault.	1 = 1
04.12	*2nd latest fault*	Code of the 2nd stored (non-active) fault.	-
	0000h…FFFFh	2nd stored fault.	1 = 1
04.13	*3rd latest fault*	Code of the 3rd stored (non-active) fault.	-
	0000h…FFFFh	3rd stored fault.	1 = 1
04.14	*4th latest fault*	Code of the 4th stored (non-active) fault.	-
	0000h…FFFFh	4th stored fault.	1 = 1

No.	Name/Value	Description	Def/FbEq16
04.15	*5th latest fault*	Code of the 5th stored (non-active) fault.	-
	0000h…FFFFh	5th stored fault.	1 = 1
04.16	*Latest warning*	Code of the 1st stored (non-active) warning.	-
	0000h…FFFFh	1st stored warning.	1 = 1
04.17	*2nd latest warning*	Code of the 2nd stored (non-active) warning.	-
	0000h…FFFFh	2nd stored warning.	1 = 1
04.18	*3rd latest warning*	Code of the 3rd stored (non-active) warning.	-
	0000h…FFFFh	3rd stored warning.	1 = 1
04.19	*4th latest warning*	Code of the 4th stored (non-active) warning.	-
	0000h…FFFFh	4th stored warning.	1 = 1
04.20	*5th latest warning*	Code of the 5th stored (non-active) warning.	-
	0000h…FFFFh	5th stored warning.	1 = 1
04.21	*Fault word 1*	ACS800-compatible fault word 1. The bit assignments of this word correspond to FAULT WORD 1 in the ACS800. Parameter *04.120 Fault/Warning word compatibility* determines whether the bit assignments are according to the ACS800 Standard or ACS800 System control program. Each bit can indicate several ACS880 events as listed below. This parameter is read-only.	-

Bit	ACS800 fault name (*04.120* = *ACS800 Standard ctrl program*)	ACS800 fault name (*04.120* = *ACS800 System ctrl program*)	ACS880 events indicated by this bit (see *Fault tracing*, page *625*)
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		CH2 COMM LOSS	*7582*
12		SC (INU1)	*2340* (XXYY YY01)
13		SC (INU2)	*2340* (XXYY YY02)
14		SC (INU3)	*2340* (XXYY YY03)
15		SC (INU4)	*2340* (XXYY YY04)

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

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

Bit	ACS800 fault name		ACS880 events indicated by this bit (see *Fault tracing*, page *625*)
	(*04.120* = *ACS800 Standard ctrl program*)	(*04.120* = *ACS800 System ctrl program*)	
0	SUPPLY PHASE	SUPPLY PHASE	*3130*
1	NO MOT DATA	NO MOTOR DATA	-
2	DC UNDERVOLT	DC UNDERVOLT	*3220*
3	Reserved	CABLE TEMP	*4000*
4	RUN ENABLE	RUN DISABLE	*AFEB*
5	ENCODER ERR	ENCODER ERR	*7301*, *7380*, *7381*, *73A0*, *73A1*
6	I/O COMM	IO COMM ERR	*7080*, *7082*
7	CTRL B TEMP	CTRL B TEMP	-
8	EXTERNAL FLT	SELECTABLE	*9082*
9	OVER SWFREQ	OVER SWFREQ	-
10	AI < MIN FUNC	AI<MIN FUNC	*80A0*
11	PPCC LINK	PPCC LINK	*5681*, *5682*, *5690*, *5691*, *5692*, *5693*, *5694*, *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*

	0000h…FFFFh	ACS800-compatible fault word 2.	1 = 1

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

Bit	ACS800 alarm name (*04.120* = *ACS800 Standard ctrl program*)	ACS800 alarm name (*04.120* = *ACS800 System ctrl program*)	ACS880 events indicated by this bit (see *Fault tracing*, page *625*)
0	START INHIBIT	START INHIBI	*B5A0*
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*, *A4A1*, *A4A9*, *A4B0*, *A4B1*, *A4F6*
5	ENCODER ERR	ENCODER ERR	*A797*, *A7B0*, *A7B1*, *A7E1*
6	T MEAS ALM	T MEAS CIRC	*A490*, *A5EA*, *A782*, *A8A0*
7	Reserved	DIGITAL IO	-
8	Reserved	ANALOG IO	-
9	Reserved	EXT DIGITAL IO	-
10	Reserved	EXT ANALOG IO	*A6E5*, *A7AA*, *A7AB*
11	Reserved	CH2 COMM LOSS	*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	ACS800-compatible warning (alarm) word 1.	1 = 1

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

Bit	ACS800 alarm name (*04.120* = *ACS800 Standard ctrl program*)	ACS800 alarm name (*04.120* = *ACS800 System ctrl program*)	ACS880 events indicated by this bit (see *Fault tracing*, page *625*)
0	Reserved	MOTOR FAN	*A781*
1	UNDERLOAD	UNDERLOAD	-
2	Reserved	INV OVERLOAD	-
3	Reserved	CABLE TEMP	*A480*
4	ENCODER	ENCODER A<>B	-
5	Reserved	FAN OVERTEMP	*A984*
6	Reserved	Reserved	-
7	POWFAIL FILE	POWFAIL FILE	-
8	ALM (OS_17)	POWDOWN FILE	-
9	MOTOR STALL	MOTOR STALL	*A780*
10	AI < MIN FUNC	AI<MIN FUNC	*A8A0*
11	Reserved	COMM MODULE	*A6D1*, *A6D2*, *A7C1*, *A7C2*, *A7CA*, *A7CE*
12	Reserved	BATT FAILURE	-
13	PANEL LOSS	PANEL LOSS	*A7EE*
14	Reserved	DC UNDERVOLT	*A3A2*
15	Reserved	RESTARTED	-

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

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

No.	Name/Value	Description	Def/FbEq16
	0000h…FFFFh	User-defined event word.	1 = 1
04.41	*Event word 1 bit 0 code*	Selects the hexadecimal code of an event (warning, fault or pure event) whose status is shown as bit 0 of *04.40 Event word 1*. The event codes are listed in chapter *Fault tracing* (page *625*).	0000h
	0000h…FFFFh	Code of event.	1 = 1

No.	Name/Value	Description	Def/FbEq16
04.42	*Event word 1 bit 0 aux code*	Specifies an auxiliary code for the event selected by the previous parameter. The selected event is indicated by the event word only if its auxiliary code matches the value of this parameter. With a value of 0000 0000h, the event word will indicate the event regardless of the auxiliary code.	0000 0000h
	0000 0000h … FFFF FFFFh	Code of warning, fault or pure event.	1 = 1
04.43	*Event word 1 bit 1 code*	Selects the hexadecimal code of an event (warning, fault or pure event) whose status is shown as bit 1 of *04.40 Event word 1*. The event codes are listed in chapter *Fault tracing* (page *625*).	0000h
	0000h…FFFFh	Code of event.	1 = 1
04.44	*Event word 1 bit 1 aux code*	Specifies an auxiliary code for the event selected by the previous parameter. The selected event is indicated by the event word only if its auxiliary code matches the value of this parameter. With a value of 0000 0000h, the event word will indicate the event regardless of the auxiliary code.	0000 0000h
	0000 0000h … FFFF FFFFh	Code of warning, fault or pure event.	1 = 1
…	…	…	…
04.71	*Event word 1 bit 15 code*	Selects the hexadecimal code of an event (warning, fault or pure event) whose status is shown as bit 15 of *04.40 Event word 1*. The event codes are listed in chapter *Fault tracing* (page *625*).	0000h
	0000h…FFFFh	Code of event.	1 = 1
04.72	*Event word 1 bit 15 aux code*	Specifies an auxiliary code for the event selected by the previous parameter. The selected event is indicated by the event word only if its auxiliary code matches the value of this parameter. With a value of 0000 0000h, the event word will indicate the event regardless of the auxiliary code.	0000 0000h
	0000 0000h … FFFF FFFFh	Code of warning, fault or pure event.	1 = 1
04.120	*Fault/Warning word compatibility*	Selects whether the bit assignments of parameters *04.21…04.32* correspond to the ACS800 Standard control program or the ACS800 System control program.	*False*
	ACS800 Standard ctrl program	The bit assignments of parameters *04.21…04.32* correspond to the ACS800 Standard control program as follows: *04.21 Fault word 1*: 03.05 FAULT WORD 1 *04.22 Fault word 2*: 03.06 FAULT WORD 2 *04.31 Warning word 1*: 03.08 ALARM WORD 1 *04.32 Warning word 2*: 03.09 ALARM WORD 2	0
	ACS800 System ctrl program	The bit assignments of parameters *04.21…04.32* correspond to the ACS800 System control program as follows: *04.21 Fault word 1*: 09.01 FAULT WORD 1 *04.22 Fault word 2*: 09.02 FAULT WORD 2 *04.31 Warning word 1*: 09.04 ALARM WORD 1 *04.32 Warning word 2*: 09.05 ALARM WORD 2	1

No.	Name/Value	Description	Def/FbEq16
05 Diagnostics		Various run-time-type counters and measurements related to drive maintenance. **Note**: All parameters in this group are read-only unless otherwise noted.	
05.01	*On-time counter*	On-time counter. The counter runs when the drive is powered.	-
	0…65535 d	On-time counter.	1 = 1 d
05.02	*Run-time counter*	Motor run-time counter. The counter runs when the inverter modulates.	-
	0…65535 d	Motor run-time counter.	1 = 1 d
05.04	*Fan on-time counter*	Running time of the drive cooling fan. Can be reset from the control panel by keeping Reset depressed for over 3 seconds.	-
	0…65535 d	Cooling fan run-time counter.	1 = 1 d
05.09	*Time from power-up*	500-microsecond ticks elapsed since the last boot of the control unit.	-
	0…4294967295	500-microsecond ticks since last boot.	1 = 1
05.11	*Inverter temperature*	Estimated drive temperature in percent of fault limit. The actual trip temperature varies according to the type of the drive. 0.0% = 0 °C (32 °F) 94% approx. = Warning limit 100.0% = Fault limit	-
	-40.0 … 160.0%	Drive temperature in percent.	1 = 1%
05.22	*Diagnostic word 3*	Diagnostic word 3.	-

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

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

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

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 709. The related status word and state diagram are presented on pages 710 and 711 respectively. **Note:** • Bits 12…15 can be used to carry additional control data, and used as a signal source by any binary-source selector parameter. Bit 10 must be active for bits 12...15 to update. • In fieldbus control, this parameter value is not exactly the same as the control word that the drive receives from the PLC. See parameter 50.12 FBA A debug mode. This parameter is read-only.	-
	0000h…FFFFh	Main control word.	1 = 1
06.02	Application control word	The drive control word received from the application program (if any). The bit assignments are described on page 709. This parameter is read-only.	-
	0000h…FFFFh	Application program control word.	1 = 1
06.03	FBA A transparent control word	Displays the unaltered control word received from the PLC through fieldbus adapter A when a transparent communication profile is selected eg. by parameter group 51 FBA A settings. See section Control word and Status word (page 706). This parameter is read-only.	-
	00000000h … FFFFFFFFh	Control word received through fieldbus adapter A.	-
06.04	FBA B transparent control word	Displays the unaltered control word received from the PLC through fieldbus adapter B when a transparent communication profile is selected eg. by parameter group 54 FBA B settings. See section Control word and Status word (page 706). This parameter is read-only.	-
	00000000h … FFFFFFFFh	Control word received through fieldbus adapter B.	1 = 1

No.	Name/Value	Description	Def/FbEq16
06.05	*EFB transparent control word*	Displays the unaltered control word received from the PLC through the embedded fieldbus interface when a transparent communication profile is selected in parameter *58.25 Control profile*. See section The *The Transparent profile* (page *695*). This parameter is read-only.	-
	00000000h … FFFFFFFFh	Control word received through the embedded fieldbus interface.	1 = 1
06.11	*Main status word*	Main status word of the drive. The bit assignments are described on page *710*. The related control word and state diagram are presented on pages *709* and *711* respectively. **Note**: In fieldbus control, this parameter value is not exactly the same as the status word that the drive sends to the PLC. See parameter *50.12 FBA A debug mode*. This parameter is read-only.	-
	0000h…FFFFh	Main status word.	1 = 1

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

Bit	Name	Description
0	Enabled	1 = Both run enable (see par. *20.12*) and start enable (*20.19*) signals are present and safe torque off has not been activated. Notes: • In I/O or local control, clearing this bit makes the drive enter the SWITCH-ON INHIBITED state (see page *710*). • This bit is not affected by the presence of a fault.
1	Inhibited	1 = Start inhibited. See parameters *06.18* and *06.25* for the source of the inhibiting signal.
2	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*.
3	Ready to start	1 = Drive is ready to receive a start command
4	Following reference	1 = Drive is ready to follow given reference
5	Started	1 = Drive has been started
6	Modulating	1 = Drive is modulating (output stage is being controlled)
7	Limiting	1 = Any operating limit (speed, torque, etc.) is active
8	Local control	1 = Drive is in local control
9	Network ctrl	1 = Drive is in *network control* (see page *20*)
10	Ext1 active	1 = Control location EXT1 active
11	Ext2 active	1 = Control location EXT2 active
12	Reserved	
13	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.
14…15	Reserved	

	0b0000...1b1111	Drive status word 1.	1 = 1

No.	Name/Value	Description	Def/FbEq16
06.17	*Drive status word 2*	Drive status word 2. This parameter is read-only.	-

Bit	Name	Description
0	Identification run done	1 = Motor identification (ID) run has been performed
1	Magnetized	1 = The motor has been magnetized
2	Torque control	1 = Torque control mode active
3	Speed control	1 = Speed control mode active
4	Power control	1 = Power control mode active
5	Safe reference active	1 = A “safe” reference is being applied by functions such as parameters *49.05* and *50.02*
6	Last speed active	1 = A “last speed” reference is being applied by functions such as parameters *49.05* and *50.02*
7	Loss of reference	1 = Reference signal lost
8	Emergency stop failed	1 = Emergency stop failed (see parameters *31.32* and *31.33*)
9	Jogging active	1 = Jogging enable signal is on
10	Above limit	1 = Actual speed, frequency or torque equals or exceeds limit (defined by parameters *46.31*…*46.33*). Valid in both directions of rotation.
11	Emergency stop active	1 = An emergency stop command signal is active, or the drive is stopping after receiving an emergency stop command.
12	Reduced run	1 = Reduced run active (see section *Sine filter support* on page *184*)
13	Reserved	
14	Stop failed	1 = Stopping failed (see parameters *31.37* and *31.38*)
15	Reserved	

	0b0000...1b1111	Drive status word 2.	1 = 1

No.	Name/Value	Description	Def/FbEq16
06.18	*Start inhibit status word*	Start inhibit status word. This word specifies the source of the inhibiting condition that is preventing the drive from starting. After the condition is removed, the start command must be cycled. See bit-specific notes. See also parameter *06.25 Drive inhibit status word 2*, and *06.16 Drive status word 1*, bit 1. This parameter is read-only.	-

Bit	Name	Description	Note
0	Not ready run	1 = DC voltage is missing or drive has not been parametrized correctly. Check the parameters in groups 95 and 99.	a
1	Ctrl location changed	1 = Control location has changed	a, c
2	SSW inhibit	1 = Control program is keeping itself in inhibited state	a
3	Fault	1 = A fault is active	a, c
4	Lost start enable	1 = Start enable signal missing	a
5	Lost run enable	1 = Run enable signal missing	a
6	FSO inhibit	1 = Operation prevented by FSO-xx safety functions module	b
7	STO	1 = Safe torque off active	b
8	Current calibration ended	1 = Current calibration routine has finished	b, c
9	ID run ended	1 = Motor identification run has finished	b, c
10	Auto phase ended	1 = Autophasing routine has finished	b, c
11	Em Off1	1 = Emergency stop signal (mode Off1)	b
12	Em Off2	1 = Emergency stop signal (mode Off2)	b
13	Em Off3	1 = Emergency stop signal (mode Off3)	b
14	Auto reset inhibit	1 = The autoreset function is inhibiting operation	
15	Jogging active	1 = The jogging enable signal is inhibiting operation	b

Notes:	
a	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*
b	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.
c	Informative bit. The inhibiting condition need not be removed by the user.

	0b0000...1b1111	Start inhibit status word.	1 = 1

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

Bit	Name	Description
0	Zero speed	1 = Drive is running at zero speed, 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*. Notes: • 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*].
1	Forward	1 = Drive is running in forward direction above zero speed limit, i.e. [*90.01*] > +[*21.06*].
2	Reverse	1 = Drive is running in reverse direction above zero speed limit i.e. [*90.01*] > -[*21.06*].
3	Out of window	1 = Speed error window control active (see par. *24.41*)
4	Internal speed feedback	1 = Estimated speed feedback used in motor control, i.e. estimated speed is selected by par.*90.41* or *90.46*, or selected encoder has faulted (par. *90.45*). 0 = Encoder 1 or 2 is used for speed feedback
5	Encoder 1 feedback	1 = Encoder 1 used for speed feedback in motor control 0 = Encoder 1 faulted or not selected as source of speed feedback (see par. *90.41* and *90.46*).
6	Encoder 2 feedback	1 = Encoder 2 used for speed feedback (see par. *90.41*)
7	Any constant speed request	1 = A constant speed or frequency has been selected; see par. *06.20*.
8	Follower speed corr min lim	1 = Minimum limit of speed correction (in a speed-controlled follower) has been reached (see par. *23.39*…*23.41*).
9	Follower speed corr max lim	1 = Maximum limit of speed correction (in a speed-controlled follower) has been reached (see par. *23.39*…*23.41*).
10…15	Reserved	

	0b0000...1b1111	Speed control status word.	1 = 1

No.	Name/Value	Description	Def/FbEq16
06.20	*Constant speed status word*	Constant speed/frequency status word. Indicates which constant speed or frequency is active (if any). See also parameter *06.19 Speed control status word*, bit 7, and section *Constant speeds* (page *140*). This parameter is read-only.	-

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

No.	Name/Value	Description	Def/FbEq16
	0b0000...1b1111	Constant speed/frequency status word.	1 = 1
06.21	*Drive status word 3*	Drive status word 3. This parameter is read-only.	-

Bit	Name	Description
0	DC hold active	1 = DC hold is active (see par. *21.08*)
1	Post-magnetizing active	1 = Post-magnetizing is active (see par. *21.08*)
2	Motor pre-heating active	1 = Motor pre-heating is active (see par. *21.14*)
3	Smooth start active	Reserved.
4	Rotor position known	1 = Rotor position has been determined (autophasing not needed). See section *Autophasing* (page *157*).
5	Brake chopper active	1 = Brake chopper is active.
6…15	Reserved	

No.	Name/Value	Description	Def/FbEq16
	0b0000...1b1111	Drive status word 3.	1 = 1

No.	Name/Value	Description	Def/FbEq16
06.25	*Drive inhibit status word 2*	Drive inhibit status word 2. This word specifies the source of the inhibiting condition that is preventing the drive from starting. After the condition is removed, the start command must be cycled. See bit-specific notes. See also parameter *06.18 Start inhibit status word*, and *06.16 Drive status word 1*, bit 1. This parameter is read-only.	-

Bit	Name	Description
0	Follower drive	1 = A follower is preventing the master from starting.
1	Application	1 = The application program is preventing the drive from starting.
2	Aux. power failure	1 = A control unit auxiliary power failure is preventing the drive from starting.
3	Encoder feedback	1 = The encoder feedback configuration is preventing the drive from starting.
4	Ref source parametrization	1 = A reference source parametrization conflict is preventing the drive from starting. See warning *A6DA Reference source parametrization* (page *636*).
5…15	Reserved	

Notes:	
a	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*
b	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.

No.	Name/Value	Description	Def/FbEq16
	0b0000...1b1111	Start inhibit status word 2.	1 = 1
06.29	*MSW bit 10 sel*	Selects a binary source whose status is transmitted as bit 10 of *06.11 Main status word*.	*Above limit*
	False	0.	0
	True	1.	1
	Above limit	Bit 10 of *06.17 Drive status word 2* (see page *207*).	2
	Other [bit]	Source selection (see *Terms and abbreviations* on page *187*).	-
06.30	*MSW bit 11 sel*	Selects a binary source whose status is transmitted as bit 11 of *06.11 Main status word*.	*Ext ctrl loc*
	False	0.	0
	True	1.	1
	Ext ctrl loc	Bit 11 of *06.01 Main control word* (see page *204*).	2
	Other [bit]	Source selection (see *Terms and abbreviations* on page *187*).	-
06.31	*MSW bit 12 sel*	Selects a binary source whose status is transmitted as bit 12 of *06.11 Main status word*.	*Ext run enable*
	False	0.	0
	True	1.	1
	Ext run enable	Inverted bit 5 of *06.18 Start inhibit status word* (see page *208*).	2

No.	Name/Value	Description	Def/FbEq16
	Other [bit]	Source selection (see *Terms and abbreviations* on page *187*).	-
06.32	*MSW bit 13 sel*	Selects a binary source whose status is transmitted as bit 13 of *06.11 Main status word*.	*False*
	False	0.	0
	True	1.	1
	Other [bit]	Source selection (see *Terms and abbreviations* on page *187*).	-
06.33	*MSW bit 14 sel*	Selects a binary source whose status is transmitted as bit 14 of *06.11 Main status word*.	*False*
	False	0.	0
	True	1.	1
	Other [bit]	Source selection (see *Terms and abbreviations* on page *187*).	-
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* (page *129*).	*MCW user bit 0*
	False	0.	0
	True	1.	1
	MCW user bit 0	Bit 12 of *06.01 Main control word* (see page *204*).	2
	MCW user bit 1	Bit 13 of *06.01 Main control word* (see page *204*).	3
	MCW user bit 2	Bit 14 of *06.01 Main control word* (see page *204*).	4
	MCW user bit 3	Bit 15 of *06.01 Main control word* (see page *204*).	5
	Other [bit]	Source selection (see *Terms and abbreviations* on page *187*).	-
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*
	False	0.	0
	True	1.	1
	MCW user bit 0	Bit 12 of *06.01 Main control word* (see page *204*).	2
	MCW user bit 1	Bit 13 of *06.01 Main control word* (see page *204*).	3
	MCW user bit 2	Bit 14 of *06.01 Main control word* (see page *204*).	4
	MCW user bit 3	Bit 15 of *06.01 Main control word* (see page *204*).	5
	Other [bit]	Source selection (see *Terms and abbreviations* on page *187*).	-
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*
	False	0.	0
	True	1.	1
	MCW user bit 0	Bit 12 of *06.01 Main control word* (see page *204*).	2

No.	Name/Value	Description	Def/FbEq16
	MCW user bit 1	Bit 13 of *06.01 Main control word* (see page *204*).	3
	MCW user bit 2	Bit 14 of *06.01 Main control word* (see page *204*).	4
	MCW user bit 3	Bit 15 of *06.01 Main control word* (see page *204*).	5
	Other [bit]	Source selection (see *Terms and abbreviations* on page *187*).	-
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*
	False	0.	0
	True	1.	1
	MCW user bit 0	Bit 12 of *06.01 Main control word* (see page *204*).	2
	MCW user bit 1	Bit 13 of *06.01 Main control word* (see page *204*).	3
	MCW user bit 2	Bit 14 of *06.01 Main control word* (see page *204*).	4
	MCW user bit 3	Bit 15 of *06.01 Main control word* (see page *204*).	5
	Other [bit]	Source selection (see *Terms and abbreviations* on page *187*).	-
06.50	*User status word 1*	User-defined status word. This word shows the status of the binary sources selected by parameters *06.60*…*06.75*. This parameter is read-only.	-

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

No.	Name/Value	Description	Def/FbEq16
	0b0000...1b1111	User-defined status word.	1 = 1
06.60	*User status word 1 bit 0 sel*	Selects a binary source whose status is shown as bit 0 of *06.50 User status word 1*.	*False*
	False	0.	0
	True	1.	1
	Other [bit]	Source selection (see *Terms and abbreviations* on page *187*).	-
06.61	*User status word 1 bit 1 sel*	Selects a binary source whose status is shown as bit 1 of *06.50 User status word 1*.	*Out of window*
	False	0.	0
	True	1.	1
	Out of window	Bit 3 of *06.19 Speed control status word* (see page *209*).	2
	Other [bit]	Source selection (see *Terms and abbreviations* on page *187*).	-
06.62	*User status word 1 bit 2 sel*	Selects a binary source whose status is shown as bit 2 of *06.50 User status word 1*.	*Emergency stop failed*
	False	0.	0
	True	1.	1

No.	Name/Value	Description	Def/FbEq16
	Emergency stop failed	Bit 8 of *06.17 Drive status word 2* (see page *207*).	2
	Other [bit]	Source selection (see *Terms and abbreviations* on page *187*).	-
06.63	*User status word 1 bit 3 sel*	Selects a binary source whose status is shown as bit 3 of *06.50 User status word 1*.	*Magnetized*
	False	0.	0
	True	1.	1
	Magnetized	Bit 1 of *06.17 Drive status word 2* (see page *207*).	2
	Other [bit]	Source selection (see *Terms and abbreviations* on page *187*).	-
06.64	*User status word 1 bit 4 sel*	Selects a binary source whose status is shown as bit 4 of *06.50 User status word 1*.	*Run disable*
	False	0.	0
	True	1.	1
	Run disable	Bit 5 of *06.18 Start inhibit status word* (see page *208*).	2
	Other [bit]	Source selection (see *Terms and abbreviations* on page *187*).	-
06.65	*User status word 1 bit 5 sel*	Selects a binary source whose status is shown as bit 5 of *06.50 User status word 1*.	*False*
	False	0.	0
	True	1.	1
	Other [bit]	Source selection (see *Terms and abbreviations* on page *187*).	-
06.66	*User status word 1 bit 6 sel*	Selects a binary source whose status is shown as bit 6 of *06.50 User status word 1*.	*False*
	False	0.	0
	True	1.	1
	Other [bit]	Source selection (see *Terms and abbreviations* on page *187*).	-
06.67	*User status word 1 bit 7 sel*	Selects a binary source whose status is shown as bit 7 of *06.50 User status word 1*.	*Identification run done*
	False	0.	0
	True	1.	1
	Identification run done	Bit 0 of *06.17 Drive status word 2* (see page *207*).	2
	Other [bit]	Source selection (see *Terms and abbreviations* on page *187*).	-
06.68	*User status word 1 bit 8 sel*	Selects a binary source whose status is shown as bit 8 of *06.50 User status word 1*.	*Start inhibition*
	False	0.	0
	True	1.	1
	Start inhibition	Bit 7 of *06.18 Start inhibit status word* (see page *208*).	2
	Other [bit]	Source selection (see *Terms and abbreviations* on page *187*).	-

No.	Name/Value	Description	Def/FbEq16
06.69	*User status word 1 bit 9 sel*	Selects a binary source whose status is shown as bit 9 of *06.50 User status word 1*.	*Limiting*
	False	0.	0
	True	1.	1
	Limiting	Bit 7 of *06.16 Drive status word 1* (see page *206*).	2
	Other [bit]	Source selection (see *Terms and abbreviations* on page *187*).	-
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*
	False	0.	0
	True	1.	1
	Torque control	Bit 2 of *06.17 Drive status word 2* (see page *207*).	2
	Other [bit]	Source selection (see *Terms and abbreviations* on page *187*).	-
06.71	*User status word 1 bit 11 sel*	Selects a binary source whose status is shown as bit 11 of *06.50 User status word 1*.	*Zero speed*
	False	0.	0
	True	1.	1
	Zero speed	Bit 0 of *06.19 Speed control status word* (see page *209*).	2
	Other [bit]	Source selection (see *Terms and abbreviations* on page *187*).	-
06.72	*User status word 1 bit 12 sel*	Selects a binary source whose status is shown as bit 12 of *06.50 User status word 1*.	*Internal speed feedback*
	False	0.	0
	True	1.	1
	Internal speed feedback	Bit 4 of *06.19 Speed control status word* (see page *209*).	2
	Other [bit]	Source selection (see *Terms and abbreviations* on page *187*).	-
06.73	*User status word 1 bit 13 sel*	Selects a binary source whose status is shown as bit 13 of *06.50 User status word 1*.	*False*
	False	0.	0
	True	1.	1
	Other [bit]	Source selection (see *Terms and abbreviations* on page *187*).	-
06.74	*User status word 1 bit 14 sel*	Selects a binary source whose status is shown as bit 14 of *06.50 User status word 1*.	*False*
	False	0.	0
	True	1.	1
	Other [bit]	Source selection (see *Terms and abbreviations* on page *187*).	-
06.75	*User status word 1 bit 15 sel*	Selects a binary source whose status is shown as bit 15 of *06.50 User status word 1*.	*False*
	False	0.	0
	True	1.	1

No.	Name/Value	Description	Def/FbEq16
	Other [bit]	Source selection (see *Terms and abbreviations* on page *187*).	-
06.100	*User control word 1*	User-defined control word 1.	-

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

	0000h…FFFFh	User-defined control word 1.	1 = 1
06.101	*User control word 2*	User-defined control word 2.	-

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

	0000h…FFFFh	User-defined control word 2.	1 = 1

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.	-
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).	-
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.	-
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).	-
07.07	*Loading package version*	Version number of the firmware loading package. See parameter *07.05*.	-
07.08	*Bootloader version*	Version number of the firmware bootloader.	-
07.11	*Cpu usage*	Microprocessor load in percent.	-
	0…100%	Microprocessor load.	1 = 1%
07.13	*PU logic version number*	Version number of the power unit logic. The value of FFFF indicates that the version numbers of parallel-connected power units are different. See the drive information on the control panel.	-
07.15	*FPGA logic version number*	Version number of the FPGA logic of the control unit.	-

No.	Name/Value	Description	Def/FbEq16
07.21	*Application environment status 1*	*(Visible only with option +N8010 [application programmability])* Displays which tasks of the application program are running. See the *Drive (IEC 61131-3) application programming manual* (3AUA0000127808 [English]). This parameter is read-only.	-

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

No.	Name/Value	Description	Def/FbEq16
	0b0000...1b1111	Application program task status.	1 = 1
07.22	*Application environment status 2*	*(Visible only with option +N8010 [application programmability])* Displays the status of the openings in the application program. See the *Drive (IEC 61131-3) application programming manual* (3AUA0000127808 [English]). This parameter is read-only.	-

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

No.	Name/Value	Description	Def/FbEq16
	0b0000...1b1111	Application program opening status.	1 = 1
07.23	*Application name*	*(Visible only with option +N8010 [application programmability])* First five ASCII letters of the name given to the application program in the programming tool. The full name is visible under System info on the control panel or the Drive composer PC tool. _N/A_ = None.	-
07.24	*Application version*	*(Visible only with option +N8010 [application programmability])* Application program version number given to the application program in the programming tool. Also visible under System info on the control panel or the Drive composer PC tool.	-
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.	-

No.	Name/Value	Description	Def/FbEq16
07.26	*Customization package version*	Customization package version number. Also visible under System info on the control panel or the Drive composer PC tool.	-
07.30	*Adaptive program status*	Displays the status of the adaptive program. See section *Adaptive programming* (page *125*).	-

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

No.	Name/Value	Description	Def/FbEq16
	0000h…FFFFh	Adaptive program status.	1 = 1
07.40	*IEC application Cpu usage peak*	*(Visible only with option +N8010 [application programmability])* Displays the peak loading of the microprocessor caused by the application program. This parameter can, for example, be used to check the effect of a given application program functionality on the CPU load. The value is in percent of an internally-defined quota. Can be reset from the control panel by keeping Reset depressed for over 3 seconds.	-
	0.0 … 100.0%	Peak microprocessor loading caused by application program.	10 = 1%
07.41	*IEC application Cpu load average*	*(Visible only with option +N8010 [application programmability])* Displays the average loading of the microprocessor caused by the application program. The value is in percent of an internally-defined quota.	-
	0.0 … 100.0%	Average microprocessor loading caused by application program.	10 = 1%
07.51	*Slot 1 option module*	Displays the type of module detected in slot 1 of the drive control unit.	*No option*
	No option	No module detected.	0
	[module type]	Type of module detected.	-
07.52	*Slot 2 option module*	Displays the type of module detected in slot 2 of the drive control unit.	*No option*
	No option	No module detected.	0
	[module type]	Type of module detected.	-
07.53	*Slot 3 option module*	Displays the type of module detected in slot 3 of the drive control unit.	*No option*
	No option	No module detected.	0
	[module type]	Type of module detected.	-

No.	Name/Value	Description	Def/FbEq16
09 Winch actual signals		Monitoring signals related to winch control program. **Note**: All parameters in this group are read-only unless otherwise noted.	
09.01	*Winch status word 1*	A 16-bit data word. Displays the status of various winch modes or functions that are active. Active=1 Inactive=0	

Bit	Name	Description
0	Anchor mode active	Anchor mode is enabled by activating the configured input in parameter *74.01 Anchor mode enable*.
1	Handmooring mode active	Handmooring mode is enabled by activating the configured input in parameter *74.02 Handmooring mode enable*.
2	Automooring mode active	Automooring mode is enabled by activating the configured input in parameter *74.03 Automooring mode enable* or by Automooring setpoint selector source in parameter group *76 Automooring*.
3	Reserved 3	
4	Reserved 4	
5	Power control active	Power control function is enabled with parameter *80.01 Power control enable*.
6	Speed lim in set1 from power ctrl	Speed limitation in forward operation from the power control logic.
7	Speed lim in set2 from power ctrl	Speed limitation in reverse operation from the power control logic.
8	Anchor stowing prot active	Anchor stowing protection is active.
9	Anchor at chain length limit	Anchor chain position inside protection region.
10	Anchor stowing prot disable time	Anchor stowing protection is temporarily disabled.
11	Slip detected	Slip detection is active.
12	Slip detection disable time	Slip detection disable time running.
13	Peak torque protection active	Peak torque protection is active.
14	Torque proving ok	Torque proving successful.
15	Reserved	

	0b0000...1b1111	Winch status word 1	1 = 1

No.	Name/Value	Description	Def/FbEq16
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	

Bit	Name	Description
0	Control stand 1 active	Control stand 1 is activated to control the winch. See parameter *75.10 Control stand 1 enable*.
1	Control stand 2 active	Control stand 2 is activated to control the winch. See parameter *75.14 Control stand 2 enable*.
2	Control stand 3 active	Control stand 3 is activated to control the winch. See parameter *75.18 Control stand 3 enable*.
3	FB control stand active	Fieldbus control stand is activated to control the winch. See parameter *75.22 Include FB control stand*.
4	Control stand 1 start heaving	Winch operates from control stand 1 in the heaving direction. See parameter *75.12 Control stand 1 heave*.
5	Control stand 1 start lowering	Winch operates from control stand 1 in the lowering direction. See parameter *75.13 Control stand 1 lower*.
6	Control stand 2 start heaving	Winch operates from control stand 2 in the heaving direction. See parameter *75.16 Control stand 2 heave*.
7	Control stand 2 start lowering	Winch operates from control stand 2 in the lowering direction. See parameter *75.17 Control stand 2 lower*.
8	Control stand 3 start heaving	Winch operates from control stand 3 in the heaving direction. See parameter *75.20 Control stand 3 heave*.
9	Control stand 3 start lowering	Winch operates from control stand 3 in the lowering direction. See parameter *75.21 Control stand 3 lower*.
10	FB control stand start heaving	Winch operates from fieldbus control stand in the heaving direction.
11	FB control stand start lowering	Winch operates from fieldbus control stand in the lowering direction.
12	Any stand active	Any one of the control stand is enabled at present.
13	Any stand heaving	Any one of the control stand is heaving at present.
14	Any stand lowering	Any one of the control stand is lowering at present.
15	Reserved	

	0b0000...1b1111	Winch status word 2	1 = 1

No.	Name/Value	Description	Def/FbEq16
09.03	*Winch status word 3*	A 16-bit data word. Displays the status of various Automooring states that are active. Active=1 Inactive=0	

Bit	Name	Description
0	AM load above hysteresis high	Automooring load or actual rope tension is above hysteresis high level.
1	AM load btw hyst high and DB high	Automooring load or actual rope tension is between hysteresis high level and deadband high level.
2	AM load inside upper deadband	Automooring load or actual rope tension is between upper deadband and Automooring setpoint level.
3	AM load inside lower deadband	Automooring load or actual rope tension is between lower deadband and Automooring setpoint level.
4	AM load btw DB low and hyst low	Automooring load or actual rope tension is between deadband low level and hysteresis low level.
5	AM load below hysteresis low	Automooring load or actual rope tension is below the hysteresis low level.
6	AM re-mooring time active	Automooring re-mooring time is active.
7	AM torque measuring active	Automooring torque measuring time is active.
8	AM max time reached	Automooring maximum time is reached. See parameter *76.60 Max AM time*.
9	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.
10	AM tension below min level	Automooring load or actual rope tension is below the minimum level set in parameter *76.05 Automooring min tension*.
11	AM enable by setpoint 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.
12	AM joystick motpot active	Automooring setpoint is varied using control stand joystick.
13	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*.
14	Automooring indication	Automooring is active without any faults. This bit becomes FALSE when the drive is tripped.
15	Reserved	

	0b0000...1b1111	Winch status word 3	

No.	Name/Value	Description	Def/FbEq16
09.04	*Winch status word 4*	A 16-bit data word. Displays the status of clutch control speed.	

Bit	Name	Description
0	Clutch control speed 1 active	Winch is running with Clutch control speed 1.
1	Clutch control speed 2 active	Winch is running with Clutch control speed 2.
2	Anchor mode heaving	Anchor mode in the heave direction.
3	Anchor mode lowering	Anchor mode in the lower direction.
4	Reserved	
5	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*.
6	Winch system ID run active	Winch system ID run is active. See parameter *74.60*.
7...15	Reserved	

No.	Name/Value	Description	Def/FbEq16
	0b0000...1b1111	Winch status word 4	1 = 1
09.05	*Winch abnormal condition status*	A 16-bit data word. Displays the status of winch abnormal condition.	

Bit	Name	Description
0	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.
1	Faulted	1 = Drive is faulted 0 = Drive has no active faults
2	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.
3	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.
4	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.
5	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.
6...15	Reserved	

No.	Name/Value	Description	Def/FbEq16
	0b0000...1b1111	Winch abnormal condition status.	1 = 1
09.06	*Winch M/F status*	Displays the current role of drive in the D2D network.	None
	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

No.	Name/Value	Description	Def/FbEq16
	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
	Local control	Drive in local control mode	0
	Ext 1	Drive in Ext 1 control mode	1
	Ext 2 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
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 *53.03 FBA A data out3*, must be mapped to this parameter.	

Bit	**Name**	**Description**
0	FB control stand enable	0 = Enable command from fieldbus is FALSE 1 = Enable command from fieldbus is TRUE
1	FB control stand heave	0 = Heave command from fieldbus is FALSE 1 = Heave command from fieldbus is TRUE
2	FB control stand lower	0 = Lower command from fieldbus is FALSE 1 = Lower command from fieldbus is TRUE
3	FB clutch speed 1 start	0 = Clutch speed1 start command from fieldbus is FALSE 1 = Clutch speed1 start command from fieldbus is TRUE
4	FB clutch speed 2 start	0= Clutch speed2 start command from fieldbus is FALSE 1= Clutch speed2 start command from fieldbus is TRUE
5	FB control stand fault reset	0= Fault reset command from fieldbus is FALSE 1= Fault reset command from fieldbus is TRUE
6...15	Reserved	

No.	Name/Value	Description	Def/FbEq16
	0b0000...1b1111	Winch fieldbus control word	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
	-2000.000.... 2000.000 m/s	Chain actual speed.	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
	--2000.000.... 2000.000 m	Chain length OUT.	1 = 1 m

No.	Name/Value	Description	Def/FbEq16
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
	-2000.000.... 2000.000 m	Chain length IN.	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*.	0.0
	-120000.000... 120000.000 m/min	Chain actual speed in m/min.	1 = 1 m/min
09.17	*Winch motor torque*	Winch motor torque in percent of the nominal motor torque.	0.0%
	-600.0...600.0%	Motoring power limit for handmooring.	10 = 1%
09.20	*Winch speed ref*	Final winch speed reference in rpm.	0
	-15000... 15000 rpm	Winch speed reference.	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
	-600.00...600.00%	Power control ref	10 = 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
	0.0...1000000.0%	Automooring actual setpoint.	10 = 1%
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 Automooring is active (parameter *09.01 Winch status word 1*, bit 2). See parameter *09.24 Rope tension memorized*.	0.0
	0.0...32767.0%	Rope actual tension.	10 = 1%
09.24	*Rope tension memorized*	Actual motor torque value memorized when Automooring 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
	0.0...32767.0%	Rope tension memorized.	10 = 1%

No.	Name/Value	Description	Def/FbEq16
09.25	*Automooring control deviation*	Automooring control deviation between the reference value and the actual value (difference between *09.22 Automooring actual setpoint* and *09.23 Rope actual tension*).	0.0
	-32768.0... 32767.0%	Automooring control deviation.	10 = 1%
09.26	*AM hysteresis high used*	Calculated actual value of Automooring hysteresis high level.	0.0
	0.0...32767.0%	Automooring hysteresis high used.	10 = 1%
09.27	*AM hysteresis low used*	Calculated actual value of Automooring hysteresis low level.	0.0
	0.0...32767.0%	Automooring hysteresis low used.	10 = 1%
09.28	*AM deadband high used*	Calculated actual value of Automooring deadband high level.	0.0
	0.0...32767.0%	AM deadband high used.	10 = 1%
09.29	*AM deadband low used*	Calculated actual value of Automooring deadband low level.	0.0
	0.0...32767.0%	AM deadband low used.	10 = 1%
09.30	*AM setpoint switch output*	The final Automooring 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 Automooring setpoint selection*, select *Switch list output* to use this value as AM setpoint.	0.0
	0.0...1000000.0%	AM setpoint switch output.	10 = 1%
09.31	*Rotating mode rope tension*	Actual rope tension calculated when the torque measuring mode is set to rotating mode.	0.0
	0.0...32767.0%	Rotating mode rope tension.	10 = 1%
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. $\text{Actual tension} \times \dfrac{100\%}{\text{Max mode torque}}$	0.0
	0.0...32767.0%	Winch actual tension.	10 = 1%
09.33	*AM joystick motpot output*	Displays the value of Automooring setpoint when Automooring mode is active and the parameter *76.13 Automooring setpoint selection* is set to joystick motor potentiometer.	0.0
	0.0...1000000.0%	Automooring joystick motpot output.	10 = 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
	0.00...100.00%	Step reference output	100 = 1%
09.36	*AM scaled setpoint*	Displays Automooring setpoint scaled to the value of parameter *74.44 Automooring max torque*.	0.0
	0.0...1000000.0%	Automooring scaled setpoint.	10 = 1%

No.	Name/Value	Description	Def/FbEq16
09.37	*AM combined setpoint/actual*	Displays the Automooring scaled setpoint whenever there is a change in Automooring 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-mooring 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
	0.0...1000000.0%	Automooring combined setpoint/actual.	10 = 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
	0...1100000 hours	Winch operating time in hours.	1 = 1 h
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
	0...65535	Number of power on.	1 = 1
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
	0...4294967295	Number of brake open.	1 = 1
09.200	*CC Winch SW 1*	Control columns winch status word 1	

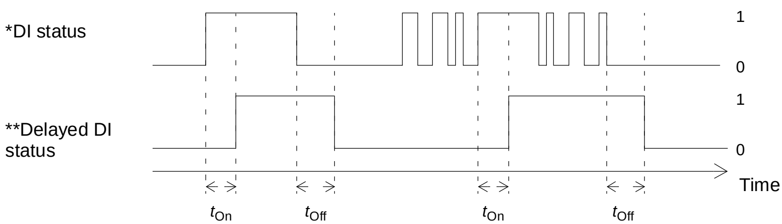
Bit	**Name**	**Description**
0	Control stand 2 ref active	0 = Control stand 2 reference is inactive 1 = Control stand 2 reference is active
1	Control stand 3 ref active	0 = Control stand 3 reference is inactive 1 = Control stand 3 reference is active
2	Brake force time delay	0 = Brake force time delay is inactive 1 = Brake force time delay is active
3	General failure	0 = General failure is inactive 1 = General failure is active
4...15	Reserved	

No.	Name/Value	Description	Def/FbEq16
	0000h…FFFFh	Winch status word 1	1 = 1
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.	-
	0b0000...1b1111	Status of digital inputs.	1 = 1

No.	Name/Value	Description	Def/FbEq16
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.	-
	0b0000...1b1111	Delayed status of digital inputs.	1 = 1
10.03	*DI force selection*	The electrical statuses of the digital inputs can be overridden for eg. testing purposes. A bit in parameter *10.04 DI force data* is provided for each digital input, and its value is applied whenever the corresponding bit in this parameter is 1.	0000h

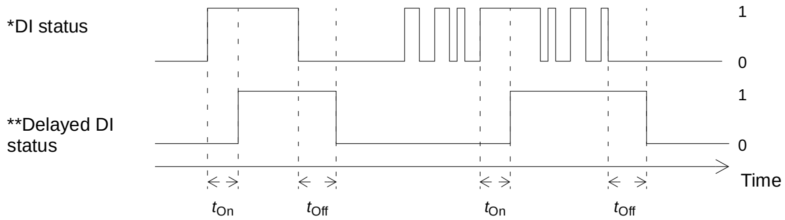
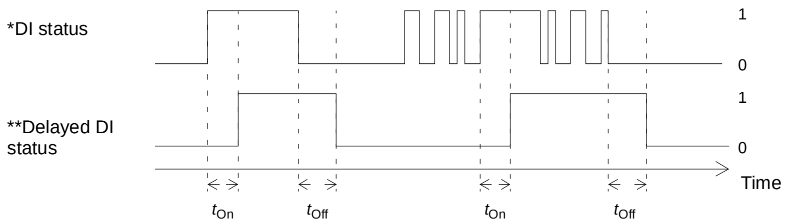
Bit	Value
0	1 = Force DI1 to value of bit 0 of parameter *10.04 DI force data*.
1	1 = Force DI2 to value of bit 1 of parameter *10.04 DI force data*.
2	1 = Force DI3 to value of bit 2 of parameter *10.04 DI force data*.
3	1 = Force DI4 to value of bit 3 of parameter *10.04 DI force data*.
4	1 = Force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

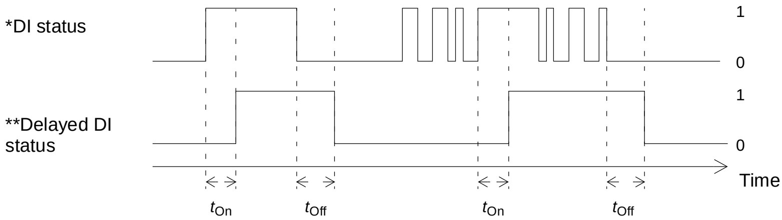
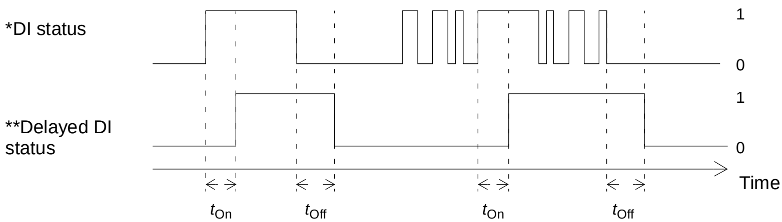
No.	Name/Value	Description	Def/FbEq16
	0b0000...1b1111	Override selection for digital inputs.	1 = 1
10.04	*DI force data*	Allows the data value of a forced digital input to be changed from 0 to 1. It is only possible to force an input that has been selected in parameter *10.03 DI force selection*. Bit 0 is the forced value for DI1; bit 15 is the forced value for the DIIL input.	0000h
	0b0000...1b1111	Forced values of digital inputs.	1 = 1
10.05	*DI1 ON delay*	Defines the activation delay for digital input DI1.	0.0 s



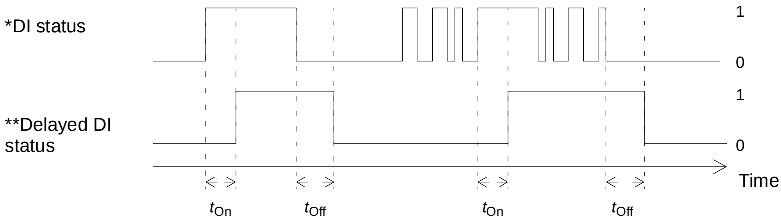
t_{On} = *10.05 DI1 ON delay*
t_{Off} = *10.06 DI1 OFF delay*
*Electrical status of digital input. Indicated by *10.01 DI status*.
**Indicated by *10.02 DI delayed status*.

No.	Name/Value	Description	Def/FbEq16
	0.0 … 3000.0 s	Activation delay for DI1.	10 = 1 s
10.06	*DI1 OFF delay*	Defines the deactivation delay for digital input DI1. See parameter *10.05 DI1 ON delay*.	0.0 s
	0.0 … 3000.0 s	Deactivation delay for DI1.	10 = 1 s

No.	Name/Value	Description	Def/FbEq16
10.07	*DI2 ON delay*	Defines the activation delay for digital input DI2.	0.0 s
	 t_{On} = *10.07 DI2 ON delay* t_{Off} = *10.08 DI2 OFF delay* *Electrical status of digital input. Indicated by *10.01 DI status*. **Indicated by *10.02 DI delayed status*.		
	0.0 … 3000.0 s	Activation delay for DI2.	10 = 1 s
10.08	*DI2 OFF delay*	Defines the deactivation delay for digital input DI2. See parameter *10.07 DI2 ON delay*.	0.0 s
	0.0 … 3000.0 s	Deactivation delay for DI2.	10 = 1 s
10.09	*DI3 ON delay*	Defines the activation delay for digital input DI3.	0.0 s
	 t_{On} = *10.09 DI3 ON delay* t_{Off} = *10.10 DI3 OFF delay* *Electrical status of digital input. Indicated by *10.01 DI status*. **Indicated by *10.02 DI delayed status*.		
	0.0 … 3000.0 s	Activation delay for DI3.	10 = 1 s
10.10	*DI3 OFF delay*	Defines the deactivation delay for digital input DI3. See parameter *10.09 DI3 ON delay*.	0.0 s
	0.0 … 3000.0 s	Deactivation delay for DI3.	10 = 1 s

No.	Name/Value	Description	Def/FbEq16
10.11	*DI4 ON delay*	Defines the activation delay for digital input DI4.	0.0 s
	 t_{On} = *10.11 DI4 ON delay* t_{Off} = *10.12 DI4 OFF delay* *Electrical status of digital input. Indicated by *10.01 DI status*. **Indicated by *10.02 DI delayed status*.		
	0.0 … 3000.0 s	Activation delay for DI4.	10 = 1 s
10.12	*DI4 OFF delay*	Defines the deactivation delay for digital input DI4. See parameter *10.11 DI4 ON delay*.	0.0 s
	0.0 … 3000.0 s	Deactivation delay for DI4.	10 = 1 s
10.13	*DI5 ON delay*	Defines the activation delay for digital input DI5.	0.0 s
	 t_{On} = *10.13 DI5 ON delay* t_{Off} = *10.14 DI5 OFF delay* *Electrical status of digital input. Indicated by *10.01 DI status*. **Indicated by *10.02 DI delayed status*.		
	0.0 … 3000.0 s	Activation delay for DI5.	10 = 1 s
10.14	*DI5 OFF delay*	Defines the deactivation delay for digital input DI5. See parameter *10.13 DI5 ON delay*.	0.0 s
	0.0 … 3000.0 s	Deactivation delay for DI5.	10 = 1 s

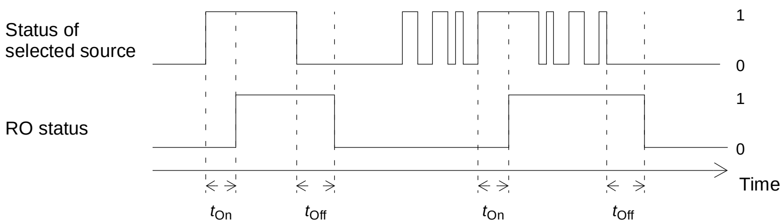
No.	Name/Value	Description	Def/FbEq16
10.15	*DI6 ON delay*	Defines the activation delay for digital input DI6.	0.0 s



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

No.	Name/Value	Description	Def/FbEq16
	0.0 … 3000.0 s	Activation delay for DI6.	10 = 1 s
10.16	*DI6 OFF delay*	Defines the deactivation delay for digital input DI6. See parameter *10.15 DI6 ON delay*.	0.0 s
	0.0 … 3000.0 s	Deactivation delay for DI6.	10 = 1 s
10.21	*RO status*	Status of relay outputs RO8…RO1. **Example:** 00000001b = RO1 is energized, RO2…RO8 are de-energized.	-
	0000h…FFFFh	Status of relay outputs.	1 = 1
10.24	*RO1 source*	Selects a drive signal to be connected to relay output RO1. **Note:** The default value of this parameter is winch brake open command from the application. The default value must not be changed. RO1 is to be used only for the control of the mechanical brake.	P.*44.204*.0
	Not energized	Output is not energized.	0
	Energized	Output is energized.	1
	Ready run	Bit 1 of *06.11 Main status word* (see page *205*).	2
	Enabled	Bit 0 of *06.16 Drive status word 1* (see page *206*).	4
	Started	Bit 5 of *06.16 Drive status word 1* (see page *206*).	5
	Magnetized	Bit 1 of *06.17 Drive status word 2* (see page *207*).	6
	Running	Bit 6 of *06.16 Drive status word 1* (see page *206*).	7
	Ready ref	Bit 2 of *06.11 Main status word* (see page *205*).	8
	At setpoint	Bit 8 of *06.11 Main status word* (see page *205*).	9
	Reverse	Bit 2 of *06.19 Speed control status word* (see page *209*).	10
	Zero speed	Bit 0 of *06.19 Speed control status word* (see page *209*).	11
	Above limit	Bit 10 of *06.17 Drive status word 2* (see page *207*).	12
	Warning	Bit 7 of *06.11 Main status word* (see page *205*).	13
	Fault	Bit 3 of *06.11 Main status word* (see page *205*).	14
	Fault (-1)	Inverted bit 3 of *06.11 Main status word* (see page *205*).	15
	Start request	Bit 13 of *06.16 Drive status word 1* (see page *206*).	16

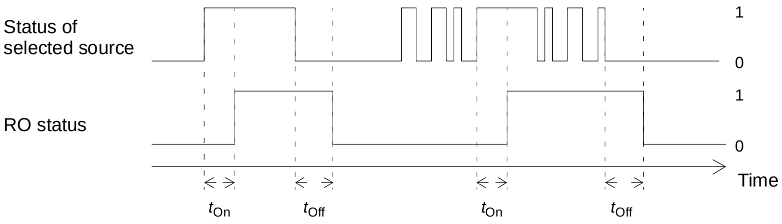
No.	Name/Value	Description	Def/FbEq16
	Open brake command	Bit 0 of *44.01 Brake control status* (see page *390*). **Note:** Do not use this bit for controlling the mechanical brake. Use *44.204 Winch brake status*, bit 0.	22
	Ext2 active	Bit 11 of *06.16 Drive status word 1* (see page *206*).	23
	Remote control	Bit 9 of *06.11 Main status word* (see page *205*).	24
	Supervision 1	Bit 0 of *32.01 Supervision status* (see page *356*).	33
	Supervision 2	Bit 1 of *32.01 Supervision status* (see page *356*).	34
	Supervision 3	Bit 2 of *32.01 Supervision status* (see page *356*).	35
	RO/DIO control word bit0	Bit 0 of *10.99 RO/DIO control word* (see page *233*).	40
	RO/DIO control word bit1	Bit 1 of *10.99 RO/DIO control word* (see page *233*).	41
	RO/DIO control word bit2	Bit 2 of *10.99 RO/DIO control word* (see page *233*).	42
	RO/DIO control word bit8	Bit 8 of *10.99 RO/DIO control word* (see page *233*).	43
	RO/DIO control word bit9	Bit 9 of *10.99 RO/DIO control word* (see page *233*).	44
	Other [bit]	Source selection (see *Terms and abbreviations* on page *187*).	-
10.25	*RO1 ON delay*	Defines the activation delay for relay output RO1.	0.0 s



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

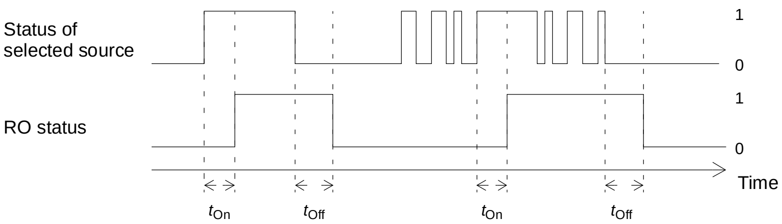
No.	Name/Value	Description	Def/FbEq16
	0.0 … 3000.0 s	Activation delay for RO1.	10 = 1 s
10.26	*RO1 OFF delay*	Defines the deactivation delay for relay output RO1. See parameter *10.25 RO1 ON delay*.	0.0 s
	0.0 … 3000.0 s	Deactivation delay for RO1.	10 = 1 s
10.27	*RO2 source*	Selects a drive signal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

No.	Name/Value	Description	Def/FbEq16
10.28	*RO2 ON delay*	Defines the activation delay for relay output RO2.	0.0 s (*95.20* b3)



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

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



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

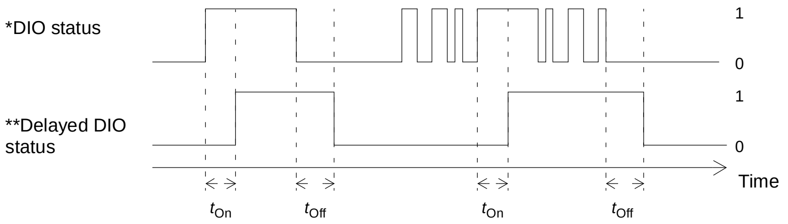
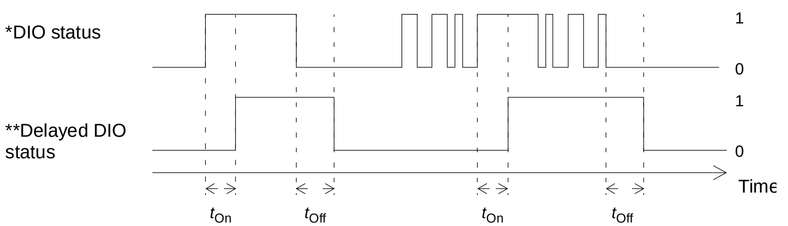
No.	Name/Value	Description	Def/FbEq16
	0.0 … 3000.0 s	Activation delay for RO3.	10 = 1 s
10.32	*RO3 OFF delay*	Defines the deactivation delay for relay output RO3. See parameter *10.31 RO3 ON delay*.	0.0 s
	0.0 … 3000.0 s	Deactivation delay for RO3.	10 = 1 s
10.51	*DI filter time*	Defines a filtering time for parameter *10.01 DI status*.	10.0 ms
	0.3 … 100.0 ms	Filtering time for *10.01*.	10 = 1 ms
10.90	*IO time level selection*	Selects the standard I/O communication time level.	Normal
	Fast	Standard I/O time level 500 µs.	0
	Normal	Standard I/O time level 2 ms.	1

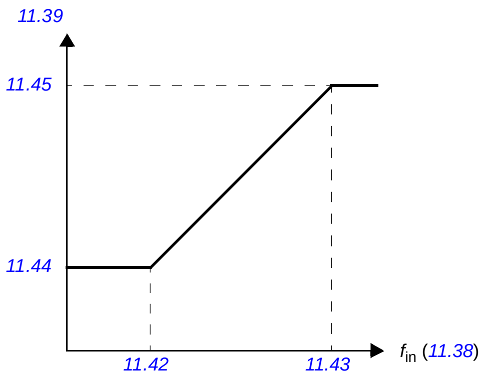
No.	Name/Value	Description	Def/FbEq16
10.99	*RO/DIO control word*	Storage parameter for controlling the relay outputs and digital input/outputs eg. through the embedded fieldbus interface. To control the relay outputs (RO) and the digital input/outputs (DIO) of the drive, send a control word with the 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.	0000h

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

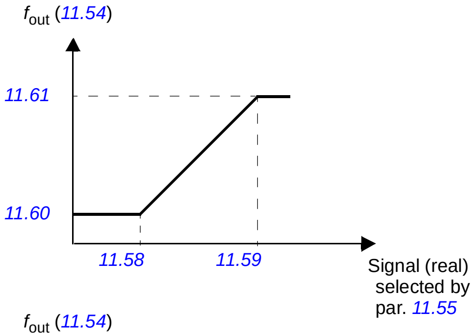
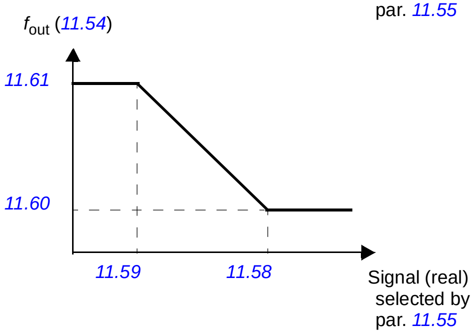
No.	Name/Value	Description	Def/FbEq16
	0b0000...1b1111	RO/DIO control word.	1 = 1
11 Standard DIO, FI, FO		Configuration of digital input/outputs and frequency inputs/outputs.	
11.01	*DIO status*	Displays the status of digital input/outputs DIO2 and DIO1. The activation/deactivation delays (if any are specified) are ignored. A filtering time (for input mode) can be defined by parameter *11.81 DIO filter time*. **Example:** 0010 = DIO2 is o*n* and DIO1 is *Off*. This parameter is read-only.	-
	0b0000...1b1111	Status of digital input/outputs.	1 = 1
11.02	*DIO delayed status*	Displays the delayed status of digital input/outputs DIO8…DIO1. This word is updated only after activation/deactivation delays (if any are specified). A filtering time (for input mode) can be defined by parameter *11.81 DIO filter time*. **Example:** 0010 = DIO2 is on, DIO1 is off. This parameter is read-only.	-
	0b0000...1b1111	Delayed status of digital input/outputs.	1 = 1
11.05	*DIO1 function*	Selects whether DIO1 is used as a digital output or input, or a frequency input.	*Input*
	Output	DIO1 is used as a digital output.	0
	Input	DIO1 is used as a digital input.	1
	Frequency	DIO1 is used as a frequency input.	2
11.06	*DIO1 output source*	Selects a drive signal to be connected to digital input/output DIO1 when parameter *11.05 DIO1 function* is set to *Output*.	*Ready run*
	Not energized	Output is off.	0
	Energized	Output is on.	1
	Ready run	Bit 1 of *06.11 Main status word* (see page *205*).	2
	Enabled	Bit 0 of *06.16 Drive status word 1* (see page *206*).	4

No.	Name/Value	Description	Def/FbEq16
	Started	Bit 5 of *06.16 Drive status word 1* (see page *206*).	5
	Magnetized	Bit 1 of *06.17 Drive status word 2* (see page *207*).	6
	Running	Bit 6 of *06.16 Drive status word 1* (see page *206*).	7
	Ready ref	Bit 2 of *06.11 Main status word* (see page *205*).	8
	At setpoint	Bit 8 of *06.11 Main status word* (see page *205*).	9
	Reverse	Bit 2 of *06.19 Speed control status word* (see page *209*).	10
	Zero speed	Bit 0 of *06.19 Speed control status word* (see page *209*).	11
	Above limit	Bit 10 of *06.17 Drive status word 2* (see page *207*).	12
	Warning	Bit 7 of *06.11 Main status word* (see page *205*).	13
	Fault	Bit 3 of *06.11 Main status word* (see page *205*).	14
	Fault (-1)	Inverted bit 3 of *06.11 Main status word* (see page *205*).	15
	Start request	Bit 13 of *06.16 Drive status word 1* (see page *206*).	16
	Open brake command	Bit 0 of *44.01 Brake control status* (see page *390*).	22
	Ext2 active	Bit 11 of *06.16 Drive status word 1* (see page *206*).	23
	Remote control	Bit 9 of *06.11 Main status word* (see page *205*).	24
	Supervision 1	Bit 0 of *32.01 Supervision status* (see page *356*).	33
	Supervision 2	Bit 1 of *32.01 Supervision status* (see page *356*).	34
	Supervision 3	Bit 2 of *32.01 Supervision status* (see page *356*).	35
	RO/DIO control word bit0	Bit 0 of *10.99 RO/DIO control word* (see page *233*).	40
	RO/DIO control word bit1	Bit 1 of *10.99 RO/DIO control word* (see page *233*).	41
	RO/DIO control word bit2	Bit 2 of *10.99 RO/DIO control word* (see page *233*).	42
	RO/DIO control word bit8	Bit 8 of *10.99 RO/DIO control word* (see page *233*).	43
	RO/DIO control word bit9	Bit 9 of *10.99 RO/DIO control word* (see page *233*).	44
	Other [bit]	Source selection (see *Terms and abbreviations* on page *187*).	-

No.	Name/Value	Description	Def/FbEq16
11.07	*DIO1 ON delay*	Defines the activation delay for digital input/output DIO1 (when used as a digital output or digital input).	0.0 s
	 t_{On} = *11.07 DIO1 ON delay* t_{Off} = *11.08 DIO1 OFF delay* *Electrical status of DIO (in input mode) or status of selected source (in output mode). Indicated by *11.01 DIO status*. **Indicated by *11.02 DIO delayed status*.		
	0.0 … 3000.0 s	Activation delay for DIO1.	10 = 1 s
11.08	*DIO1 OFF delay*	Defines the deactivation delay for digital input/output DIO1 (when used as a digital output or digital input). See parameter *11.07 DIO1 ON delay*.	0.0 s
	0.0 … 3000.0 s	Deactivation delay for DIO1.	10 = 1 s
11.09	*DIO2 function*	Selects whether DIO2 is used as a digital output or input, or a frequency output.	*Input*
	Output	DIO2 is used as a digital output.	0
	Input	DIO2 is used as a digital input.	1
	Frequency	DIO2 is used as a frequency output.	2
11.10	*DIO2 output source*	Selects a drive signal to be connected to digital input/output DIO2 when parameter *11.09 DIO2 function* is set to *Output*. For the available selections, see parameter *11.06 DIO1 output source*.	*Running*
11.11	*DIO2 ON delay*	Defines the activation delay for digital input/output DIO2 (when used as a digital output or digital input).	0.0 s
	 t_{On} = *11.11 DIO2 ON delay* t_{Off} = *11.12 DIO2 OFF delay* *Electrical status of DIO (in input mode) or status of selected source (in output mode). Indicated by *11.01 DIO status*. **Indicated by *11.02 DIO delayed status*.		
	0.0 … 3000.0 s	Activation delay for DIO2.	10 = 1 s

No.	Name/Value	Description	Def/FbEq16
11.12	*DIO2 OFF delay*	Defines the deactivation delay for digital input/output DIO2 (when used as a digital output or digital input). See parameter *11.11 DIO2 ON delay*.	0.0 s
	0.0 … 3000.0 s	Deactivation delay for DIO2.	10 = 1 s
11.38	*Freq in 1 actual value*	Displays the value of frequency input 1 (via DIO1 when it is used as a frequency input) before scaling. See parameter *11.42 Freq in 1 min*. This parameter is read-only.	-
	0 … 16000 Hz	Unscaled value of frequency input 1.	1 = 1 Hz
11.39	*Freq in 1 scaled*	Displays the value of frequency input 1 (via DIO1 when it is used as a frequency input) after scaling. See parameter *11.42 Freq in 1 min*. This parameter is read-only.	-
	-32768.000 … 32767.000	Scaled value of frequency input 1.	1 = 1
11.42	*Freq in 1 min*	Defines the minimum for the frequency actually arriving at frequency input 1 (DIO1 when it is used as a frequency input). The incoming frequency signal (*11.38 Freq in 1 actual value*) is scaled into an internal signal (*11.39 Freq in 1 scaled*) by parameters *11.42*…*11.45* as follows:  	0 Hz
	0 … 16000 Hz	Minimum frequency of frequency input 1 (DIO1).	1 = 1 Hz
11.43	*Freq in 1 max*	Defines the maximum for the frequency actually arriving at frequency input 1 (DIO1 when it is used as a frequency input). See parameter *11.42 Freq in 1 min*.	16000 Hz
	0 … 16000 Hz	Maximum frequency for frequency input 1 (DIO1).	1 = 1 Hz
11.44	*Freq in 1 at scaled min*	Defines the value that is required to correspond internally to the minimum input frequency defined by parameter *11.42 Freq in 1 min*. See diagram at parameter *11.42 Freq in 1 min*.	0.000
	-32768.000 … 32767.000	Value corresponding to minimum of frequency input 1.	1 = 1

No.	Name/Value	Description	Def/FbEq16
11.45	*Freq in 1 at scaled max*	Defines the value that is required to correspond internally to the maximum input frequency defined by parameter *11.43 Freq in 1 max*. See diagram at parameter *11.42 Freq in 1 min*.	1500.000; 1800.000 (*95.20* b0)
	-32768.000 … 32767.000	Value corresponding to maximum of frequency input 1.	1 = 1
11.54	*Freq out 1 actual value*	Displays the value of frequency output 1 after scaling. See parameter *11.58 Freq out 1 src min*. This parameter is read-only.	-
	0 … 16000 Hz	Value of frequency output 1.	1 = 1
11.55	*Freq out 1 source*	Selects a signal to be connected to frequency output 1.	*Motor speed used*
	Zero	None.	0
	Motor speed used	*01.01 Motor speed used* (page *192*).	1
	Output frequency	*01.06 Output frequency* (page *192*).	3
	Motor current	*01.07 Motor current* (page *192*).	4
	Motor torque	*01.10 Motor torque* (page *192*).	6
	Dc-voltage	*01.11 DC voltage* (page *193*).	7
	Power inu out	*01.14 Output power* (page *193*).	8
	Speed ref ramp in	*23.01 Speed ref ramp input* (page *307*).	10
	Speed ref ramped	*23.02 Speed ref ramp output* (page *307*).	11
	Speed ref used	*24.01 Used speed reference* (page *314*).	12
	Torq ref used	*26.02 Torque reference used* (page *329*).	13
	Other [bit]	Source selection (see *Terms and abbreviations* on page *187*).	-

No.	Name/Value	Description	Def/FbEq16
11.58	*Freq out 1 src min*	Defines the real value of the signal (selected by parameter *11.55 Freq out 1 source* and shown by parameter *11.54 Freq out 1 actual value*) that corresponds to the minimum value of frequency output 1 (defined by parameter *11.60 Freq out 1 at src min*).  	0.000
	-32768.000 … 32767.000	Real signal value corresponding to minimum value of frequency output 1.	1 = 1
11.59	*Freq out 1 src max*	Defines the real value of the signal (selected by parameter *11.55 Freq out 1 source* and shown by parameter *11.54 Freq out 1 actual value*) that corresponds to the maximum value of frequency output 1 (defined by parameter *11.61 Freq out 1 at src max*). See parameter *11.58 Freq out 1 src min*.	1500.000; 1800.000 (*95.20* b0)
	-32768.000 … 32767.000	Real signal value corresponding to maximum value of frequency output 1.	1 = 1
11.60	*Freq out 1 at src min*	Defines the minimum value of frequency output 1. See diagrams at parameter *11.58 Freq out 1 src min*.	0 Hz
	0…16000 Hz	Minimum value of frequency output 1.	1 = 1 Hz
11.61	*Freq out 1 at src max*	Defines the maximum value of frequency output 1. See diagrams at parameter *11.58 Freq out 1 src min*.	16000 Hz
	0…16000 Hz	Maximum value of frequency output 1.	1 = 1 Hz
11.81	*DIO filter time*	Defines a filtering time for parameter *11.01 DIO status* and *11.02 DIO delayed status*. The filtering time will only affect the DIOs that are in input mode.	10.0 ms
	0.3 … 100.0 ms	Filtering time for *11.01*.	10 = 1 ms

No.	Name/Value	Description	Def/FbEq16
12 Standard AI		Configuration of standard analog inputs.	
12.01	*AI tune*	Triggers the analog input tuning function. Connect the signal to the input and select the appropriate tuning function.	
	No action	AI tune is not activated.	0
	AI1 min tune	Current analog input AI1 signal value is set as minimum value of AI1 into parameter *12.17 AI1 min*. The value reverts back to *No action* automatically.	1
	AI1 max tune	Current analog input AI1 signal value is set as maximum value of AI1 into parameter *12.18 AI1 max*. The value reverts back to *No action* automatically.	2
	AI2 min tune	Current analog input AI2 signal value is set as minimum value of AI2 into parameter *12.27 AI2 min*. The value reverts back to *No action* automatically.	3
	AI2 max tune	Current analog input AI2 signal value is set as maximum value of AI2 into parameter *12.28 AI2 max*. The value reverts back to *No action* automatically.	4
12.03	*AI supervision function*	Selects how the drive reacts when an analog input signal moves out of the minimum and/or maximum limits specified for the input. The 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*, *26.16*, *26.25*, *26.11*, *30.21*, *30.22*, and is being used as the active source or • supervision is forced using parameter *12.05 AI supervision force*.	*No action*
	No action	No action taken.	0
	Fault	Drive trips on *80A0 AI supervision*.	1
	Warning	Drive generates an *A8A0 AI supervision* warning.	2
	Last speed	Drive generates a warning (*A8A0 AI supervision*) and freezes the speed (or frequency) to the level the drive was operating at. The speed/frequency is determined on the basis of actual speed using 850 ms low-pass filtering. **WARNING!** Make sure that it is safe to continue operation in case of a communication break.	3
	Speed ref safe	Drive generates a warning (*A8A0 AI supervision*) and sets the speed to the speed defined by parameter *49.05 Communication loss action Speed ref safe*. **WARNING!** Make sure that it is safe to continue operation in case of a communication break.	4

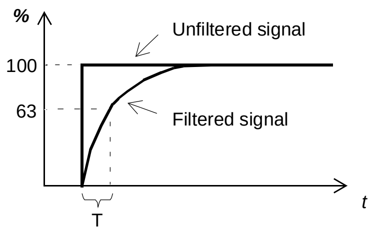
No.	Name/Value	Description	Def/FbEq16
12.04	*AI supervision selection*	Specifies the analog input limits to be supervised. See parameter *12.03 AI supervision function*.	0000h

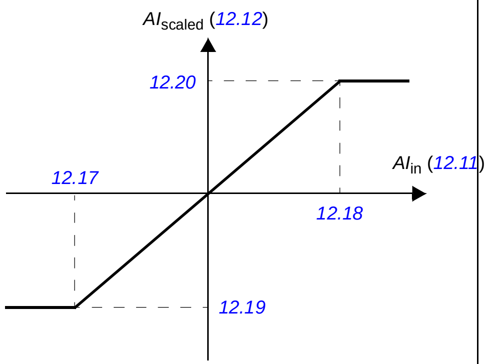
Bit	Name	Description
0	AI1 < MIN	1 = Minimum limit supervision of AI1 active.
1	AI1 > MAX	1 = Maximum limit supervision of AI1 active.
2	AI2 < MIN	1 = Minimum limit supervision of AI2 active.
3	AI2 > MAX	1 = Maximum limit supervision of AI2 active.
4…15	Reserved	

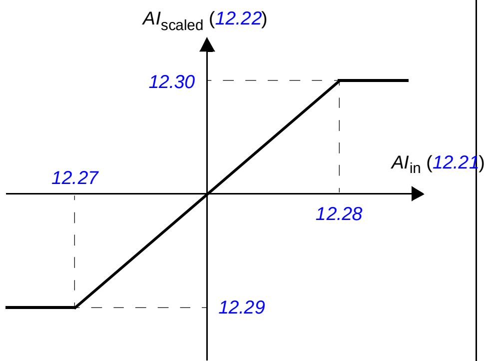
No.	Name/Value	Description	Def/FbEq16
	0000h…FFFFh	Activation of analog input supervision.	1 = 1
12.05	*AI supervision force*	Activates analog input supervision separately for each control location (see section *Local control vs. external control* on page *120*). The parameter is primarily intended for analog input supervision when the input is connected to the application program and not selected as a control source by drive parameters.	

Bit	Name	Description
0	AI1 EXT1	1 = AI1 supervision active when EXT1 is being used.
1	AI1 EXT2	1 = AI1 supervision active when EXT2 is being used.
2	AI1 Local	1 = AI1 supervision active when local control is being used.
3	Reserved	
4	AI2 EXT1	1 = AI2 supervision active when EXT1 is being used.
5	AI2 EXT2	1 = AI2 supervision active when EXT2 is being used.
6	AI2 Local	1 = AI2 supervision active when local control is being used.
7...15	Reserved	

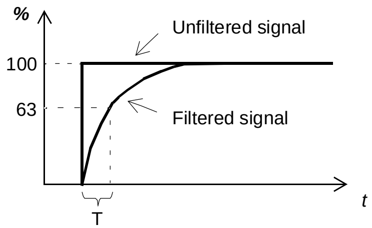
No.	Name/Value	Description	Def/FbEq16
	0000 0000b … 0111 0111b	Analog input supervision selection.	1 = 1
12.11	*AI1 actual value*	Displays the value of analog input AI1 in mA or V (depending on whether the input is set to current or voltage by a hardware setting). This parameter is read-only.	-
	-22.000 … 22.000 mA or V	Value of analog input AI1.	1000 = 1 mA or V
12.12	*AI1 scaled value*	Displays the value of analog input AI1 after scaling. See parameters *12.19 AI1 scaled at AI1 min* and *12.20 AI1 scaled at AI1 max*. This parameter is read-only.	-
	-32768.000 … 32767.000	Scaled value of analog input AI1.	1 = 1

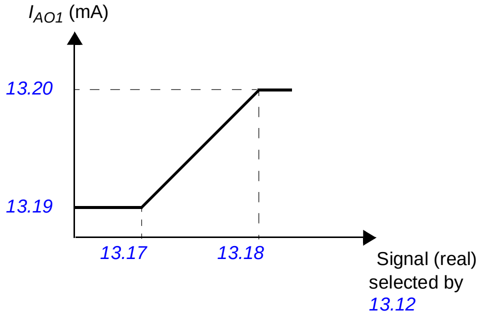
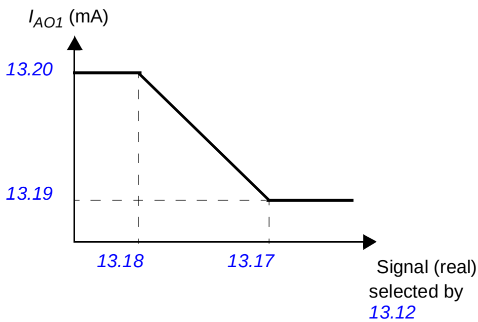
No.	Name/Value	Description	Def/FbEq16
12.15	*AI1 unit selection*	Selects the unit for readings and settings related to analog input AI1. Note: This setting must match the corresponding hardware setting on the drive control unit (see the hardware manual of the drive). Control board reboot (either by cycling the power or through parameter *96.08 Control board boot*) is required to validate any changes in the hardware settings.	*V*
	V	Volts.	2
	mA	Milliamperes.	10
12.16	*AI1 filter time*	Defines the filter time constant for analog input AI1.  $O = I \times (1 - e^{-t/T})$ I = filter input (step) O = filter output *t* = time T = filter time constant **Note:** The signal is also filtered due to the signal interface hardware (approximately 0.25 ms time constant). This cannot be changed by any parameter.	0.100 s
	0.000 … 30.000 s	Filter time constant.	1000 = 1 s
12.17	*AI1 min*	Defines the minimum site value for analog input AI1. Set the value actually sent to the drive when the analog signal from plant is wound to its minimum setting. See parameter *12.01 AI tune*.	0.000 mA or V
	-22.000 … 22.000 mA or V	Minimum value of AI1.	1000 = 1 mA or V
12.18	*AI1 max*	Defines the maximum site value for analog input AI1. Set the value actually sent to the drive when the analog signal from plant is wound to its maximum setting. See parameter *12.01 AI tune*.	20.000 mA or 10.000 V
	-22.000 … 22.000 mA or V	Maximum value of AI1.	1000 = 1 mA or V

No.	Name/Value	Description	Def/FbEq16
12.19	*AI1 scaled at AI1 min*	Defines the real internal value that corresponds to the minimum analog input AI1 value defined by parameter *12.17 AI1 min*. (Changing the polarity settings of *12.19* and *12.20* can effectively invert the analog input.) 	0.000
	-32768.000 … 32767.000	Real value corresponding to minimum AI1 value.	1 = 1
12.20	*AI1 scaled at AI1 max*	Defines the real internal value that corresponds to the maximum analog input AI1 value defined by parameter *12.18 AI1 max*. See the drawing at parameter *12.19 AI1 scaled at AI1 min*.	100.000
	-32768.000 … 32767.000	Real value corresponding to maximum AI1 value.	1 = 1
12.21	*AI2 actual value*	Displays the value of analog input AI2 in mA or V (depending on whether the input is set to current or voltage by a hardware setting). This parameter is read-only.	-
	-22.000 … 22.000 mA or V	Value of analog input AI2.	1000 = 1 mA or V
12.22	*AI2 scaled value*	Displays the value of analog input AI2 after scaling. See parameters *12.29 AI2 scaled at AI2 min* and *12.30 AI2 scaled at AI2 max*. This parameter is read-only.	-
	-32768.000 … 32767.000	Scaled value of analog input AI2.	1 = 1
12.25	*AI2 unit selection*	Selects the unit for readings and settings related to analog input AI2. Note: This setting must match the corresponding hardware setting on the drive control unit (see the hardware manual of the drive). Control board reboot (either by cycling the power or through parameter *96.08 Control board boot*) is required to validate any changes in the hardware settings.	*mA*
	V	Volts.	2
	mA	Milliamperes.	10
12.26	*AI2 filter time*	Defines the filter time constant for analog input AI2. See parameter *12.16 AI1 filter time*.	0.100 s
	0.000 … 30.000 s	Filter time constant.	1000 = 1 s

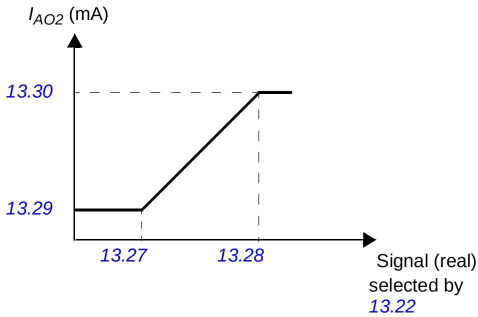
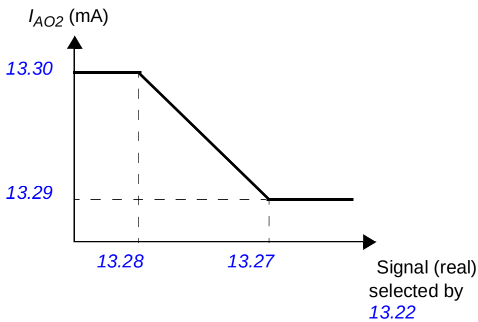
No.	Name/Value	Description	Def/FbEq16
12.27	*AI2 min*	Defines the minimum site value for analog input AI2. Set the value actually sent to the drive when the analog signal from plant is wound to its minimum setting. See parameter *12.01 AI tune*.	0.000 mA or V
	-22.000 … 22.000 mA or V	Minimum value of AI2.	1000 = 1 mA or V
12.28	*AI2 max*	Defines the maximum site value for analog input AI2. Set the value actually sent to the drive when the analog signal from plant is wound to its maximum setting. See parameter *12.01 AI tune*.	20.000 mA or 10.000 V
	-22.000 … 22.000 mA or V	Maximum value of AI2.	1000 = 1 mA or V
12.29	*AI2 scaled at AI2 min*	Defines the real value that corresponds to the minimum analog input AI2 value defined by parameter *12.27 AI2 min*. (Changing the polarity settings of *12.29* and *12.30* can effectively invert the analog input.) 	0.000
	-32768.000 … 32767.000	Real value corresponding to minimum AI2 value.	1 = 1
12.30	*AI2 scaled at AI2 max*	Defines the real value that corresponds to the maximum analog input AI2 value defined by parameter *12.28 AI2 max*. See the drawing at parameter *12.29 AI2 scaled at AI2 min*.	100.000
	-32768.000 … 32767.000	Real value corresponding to maximum AI2 value.	1 = 1
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
	-30000.00... 30000.00 rpm	EXT1 scaled AI reference.	1 = 1 rpm

No.	Name/Value	Description	Def/FbEq16
12.201	*EXT1 scaled AI referencesource*	Selects the source of analog signal that would be scaled to use as speed reference in EXT1 mode. For example, if AI1 scaled is selected, the value read from parameter *12.12 AI1 scaled value* is used for final scaling. The analog scaled value of 0-100% is multiplied with parameter *46.200 Speed scaling stand alone* and the resulting value is displayed in parameter *12.200 EXT1 scaled AI reference*.	*Not selected*
	Not selected	0	0
	AI1 scaled	Analog input AI1.	1
	AI2 scaled	Analog input AI2.	2
	Other	Source selection (see *Terms and abbreviations* on page *187*).	-
13 Standard AO		Configuration of standard analog outputs.	
13.11	*AO1 actual value*	Displays the value of AO1 in mA. This parameter is read-only.	-
	0.000 … 22.000 mA	Value of AO1.	1000 = 1 mA
13.12	*AO1 source*	Selects a signal to be connected to analog output AO1. Alternatively, sets the output to excitation mode to feed a constant current to a temperature sensor.	*Motor speed used*
	Zero	None.	0
	Motor speed used	*01.01 Motor speed used* (page *192*).	1
	Output frequency	*01.06 Output frequency* (page *192*).	3
	Motor current	*01.07 Motor current* (page *192*).	4
	Motor torque	*01.10 Motor torque* (page *192*).	6
	DC voltage	*01.11 DC voltage* (page *193*).	7
	Power inu out	*01.14 Output power* (page *193*).	8
	Speed ref ramp in	*23.01 Speed ref ramp input* (page *307*).	10
	Speed ref ramp out	*23.02 Speed ref ramp output* (page *307*).	11
	Speed ref used	*24.01 Used speed reference* (page *314*).	12
	Torq ref used	*26.02 Torque reference used* (page *329*).	13
	Force PT100 excitation	The output is used to feed an excitation current to 1…3 Pt100 sensors. See section *Motor thermal protection* (page *171*).	20
	Force KTY84 excitation	The output is used to feed an excitation current to a KTY84 sensor. See section *Motor thermal protection* (page *171*).	21
	Force PTC excitation	The output is used to feed an excitation current to 1…3 PTC sensors. See section *Motor thermal protection* (page *171*).	22
	Force Pt1000 excitation	The output is used to feed an excitation current to 1…3 Pt1000 sensors. See section *Motor thermal protection* (page *171*).	23
	AO1 data storage	*13.91 AO1 data storage* (page *249*).	37

No.	Name/Value	Description	Def/FbEq16
	AO2 data storage	*13.92 AO2 data storage* (page *249*).	38
	Other	Source selection (see *Terms and abbreviations* on page *187*).	-
13.16	*AO1 filter time*	Defines the filtering time constant for analog output AO1.  $O = I \times (1 - e^{-t/T})$ I = filter input (step) O = filter output *t* = time T = filter time constant	0.100 s
	0.000 … 30.000 s	Filter time constant.	1000 = 1 s

No.	Name/Value	Description	Def/FbEq16
13.17	*AO1 source min*	Defines the real minimum value of the signal (selected by parameter *13.12 AO1 source*) that corresponds to the minimum required AO1 output value (defined by parameter *13.19 AO1 out at AO1 src min*).  Programming *13.17* as the maximum value and *13.18* as the minimum value inverts the output. 	0.0
	-32768.0 … 32767.0	Real signal value corresponding to minimum AO1 output value.	1 = 1
13.18	*AO1 source max*	Defines the real maximum value of the signal (selected by parameter *13.12 AO1 source*) that corresponds to the maximum required AO1 output value (defined by parameter *13.20 AO1 out at AO1 src max*). See parameter *13.17 AO1 source min*.	1500.0; 1800.0 (*95.20* b0)
	-32768.0 … 32767.0	Real signal value corresponding to maximum AO1 output value.	1 = 1
13.19	*AO1 out at AO1 src min*	Defines the minimum output value for analog output AO1. See also drawing at parameter *13.17 AO1 source min*.	0.000 mA
	0.000 … 22.000 mA	Minimum AO1 output value.	1000 = 1 mA

No.	Name/Value	Description	Def/FbEq16
13.20	*AO1 out at AO1 src max*	Defines the maximum output value for analog output AO1. See also drawing at parameter *13.17 AO1 source min*.	20.000 mA
	0.000 … 22.000 mA	Maximum AO1 output value.	1000 = 1 mA
13.21	*AO2 actual value*	Displays the value of AO2 in mA. This parameter is read-only.	-
	0.000 … 22.000 mA	Value of AO2.	1000 = 1 mA
13.22	*AO2 source*	Selects a signal to be connected to analog output AO2. Alternatively, sets the output to excitation mode to feed a constant current to a temperature sensor. For the selections, see parameter *13.12 AO1 source*.	*Motor current*
13.26	*AO2 filter time*	Defines the filtering time constant for analog output AO2. See parameter *13.16 AO1 filter time*.	0.100 s
	0.000 … 30.000 s	Filter time constant.	1000 = 1 s

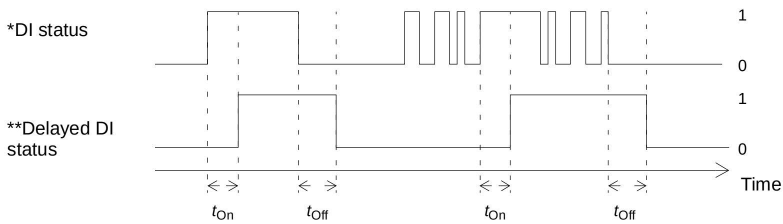
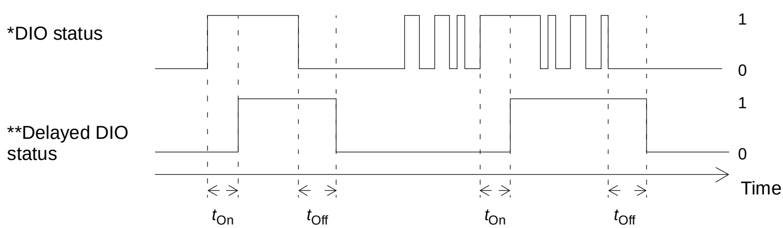
No.	Name/Value	Description	Def/FbEq16
13.27	*AO2 source min*	Defines the real minimum value of the signal (selected by parameter *13.22 AO2 source*) that corresponds to the minimum required AO2 output value (defined by parameter *13.29 AO2 out at AO2 src min*).  Programming *13.27* as the maximum value and *13.28* as the minimum value inverts the output.  	0.0
	-32768.0 … 32767.0	Real signal value corresponding to minimum AO2 output value.	1 = 1
13.28	*AO2 source max*	Defines the real maximum value of the signal (selected by parameter *13.22 AO2 source*) that corresponds to the maximum required AO2 output value (defined by parameter *13.30 AO2 out at AO2 src max*). See parameter *13.27 AO2 source min*.	100.0
	-32768.0 … 32767.0	Real signal value corresponding to maximum AO2 output value.	1 = 1
13.29	*AO2 out at AO2 src min*	Defines the minimum output value for analog output AO2. See also drawing at parameter *13.27 AO2 source min*.	0.000 mA
	0.000 … 22.000 mA	Minimum AO2 output value.	1000 = 1 mA

No.	Name/Value	Description	Def/FbEq16
13.30	*AO2 out at AO2 src max*	Defines the maximum output value for analog output AO2. See also drawing at parameter *13.27 AO2 source min*.	20.000 mA
	0.000 … 22.000 mA	Maximum AO2 output value.	1000 = 1 mA
13.91	*AO1 data storage*	Storage parameter for controlling analog output AO1 eg. through fieldbus. In *13.12 AO1 source*, select *AO1 data storage*. Then set this parameter as the target of the incoming value data. With the embedded fieldbus interface, simply set the target selection parameter of that particular data (*58.101*…*58.124*) to *AO1 data storage*.	0.00
	-327.68 … 327.67	Storage parameter for AO1.	100 = 1
13.92	*AO2 data storage*	Storage parameter for controlling analog output AO2 eg. through fieldbus. In *13.22 AO2 source*, select *AO2 data storage*. Then set this parameter as the target of the incoming value data. With the embedded fieldbus interface, simply set the target selection parameter of that particular data (*58.101*…*58.124*) to *AO2 data storage*.	0.00
	-327.68 … 327.67	Storage parameter for AO2.	100 = 1

14 I/O extension module 1		Configuration of I/O extension module 1. See also section *Programmable I/O extensions* (page *127*). **Note:** The contents of the parameter group vary according to the selected I/O extension module type.	
14.01	*Module 1 type*	Activates (and specifies the type of) I/O extension module 1.	*None*
	None	Inactive.	0
	FIO-01	FIO-01.	1
	FIO-11	FIO-11.	2
	FDIO-01	FDIO-01.	3
	FAIO-01	FAIO-01.	4
14.02	*Module 1 location*	Specifies the slot (1…3) on the control unit of the drive into which the I/O extension module is installed. Alternatively, specifies the node ID of the slot on an FEA-03 extension adapter.	*Slot 1*
	Slot 1	Slot 1.	1
	Slot 2	Slot 2.	2
	Slot 3	Slot 3.	3
	4…254	Node ID of the slot on the FEA-03 extension adapter.	1 = 1
14.03	*Module 1 status*	Displays the status of I/O extension module 1.	*No option*
	No option	No module detected in the specified slot.	0
	No communication	A module has been detected but cannot be communicated with.	1
	Unknown	The module type is unknown.	2
	FIO-01	An FIO-01 module has been detected and is active.	15

No.	Name/Value	Description	Def/FbEq16
	FIO-11	An FIO-11 module has been detected and is active.	20
	FAIO-01	An FAIO-01 module has been detected and is active.	24
14.05	*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 DIO 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.	-
	0000b…1111b	Status of digital inputs.	1 = 1
14.05	*DIO status*	*(Visible when 14.01 Module 1 type = FIO-01 or FIO-11)* Displays the status of the digital input/outputs on the extension module. The activation/deactivation delays (if any are specified) are ignored. A filtering time (for input mode) can be defined by parameter *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:** 00001001b = DIO1 and DIO4 are on, remainder are off. This parameter is read-only.	-
	0000h…FFFFh	Status of digital input/outputs.	1 = 1
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.	-
	0000b…1111b	Delayed status of digital inputs.	1 = 1
14.06	*DIO delayed status*	*(Visible when 14.01 Module 1 type = FIO-01 or FIO-11)* Displays the delayed status of the digital input/outputs on the extension module. This word is updated only after activation/deactivation delays (if any are specified). Bit 0 indicates the status of DIO1. **Note:** The number of active bits in this parameter depends on the number of digital input/outputs on the extension module. **Example:** 0000001001b = DIO1 and DIO4 are on, remainder are off. This parameter is read-only.	-
	0000h…FFFFh	Delayed status of digital input/outputs.	1 = 1

No.	Name/Value	Description	Def/FbEq16
14.08	*DI filter time*	*(Visible when 14.01 Module 1 type = FDIO-01)* Defines a filtering time for parameter *14.05 DI status*.	10.0 ms
	0.8 … 100.0 ms	Filtering time for *14.05*.	10 = 1 ms
14.08	*DIO filter time*	*(Visible when 14.01 Module 1 type = FIO-01 or FIO-11)* Defines a filtering time for parameter *14.05 DIO status*. The filtering time will only affect the DIOs that are in input mode.	10.0 ms
	0.8 … 100.0 ms	Filtering time for *14.05*.	10 = 1 ms
14.09	*DIO1 function*	*(Visible when 14.01 Module 1 type = FIO-01 or FIO-11)* Selects whether DIO1 of the extension module is used as a digital input or output.	*Input*
	Output	DIO1 is used as a digital output.	0
	Input	DIO1 is used as a digital input.	1
14.11	*DIO1 output source*	*(Visible when 14.01 Module 1 type = FIO-01 or FIO-11)* Selects a drive signal to be connected to digital input/output DIO1 of the extension module when parameter *14.09 DIO1 function* is set to *Output*.	*Not energized*
	Not energized	Output is not energized.	0
	Energized	Output is energized.	1
	Ready run	Bit 1 of *06.11 Main status word* (see page *205*).	2
	Enabled	Bit 0 of *06.16 Drive status word 1* (see page *206*).	4
	Started	Bit 5 of *06.16 Drive status word 1* (see page *206*).	5
	Magnetized	Bit 1 of *06.17 Drive status word 2* (see page *207*).	6
	Running	Bit 6 of *06.16 Drive status word 1* (see page *206*).	7
	Ready ref	Bit 2 of *06.11 Main status word* (see page *205*).	8
	At setpoint	Bit 8 of *06.11 Main status word* (see page *205*).	9
	Reverse	Bit 2 of *06.19 Speed control status word* (see page *209*).	10
	Zero speed	Bit 0 of *06.19 Speed control status word* (see page *209*).	11
	Above limit	Bit 10 of *06.17 Drive status word 2* (see page *207*).	12
	Warning	Bit 7 of *06.11 Main status word* (see page *205*).	13
	Fault	Bit 3 of *06.11 Main status word* (see page *205*).	14
	Fault (-1)	Inverted bit 3 of *06.11 Main status word* (see page *205*).	15
	Start request	Bit 13 of *06.16 Drive status word 1* (see page *206*).	16
	Open brake command	Bit 0 of *44.01 Brake control status* (see page *390*).	22
	Ext2 active	Bit 11 of *06.16 Drive status word 1* (see page *206*).	23
	Remote control	Bit 9 of *06.11 Main status word* (see page *205*).	24
	Supervision 1	Bit 0 of *32.01 Supervision status* (see page *356*).	33
	Supervision 2	Bit 1 of *32.01 Supervision status* (see page *356*).	34
	Supervision 3	Bit 2 of *32.01 Supervision status* (see page *356*).	35
	RO/DIO control word bit0	Bit 0 of *10.99 RO/DIO control word* (see page *233*).	40
	RO/DIO control word bit1	Bit 1 of *10.99 RO/DIO control word* (see page *233*).	41

No.	Name/Value	Description	Def/FbEq16
	RO/DIO control word bit2	Bit 2 of *10.99 RO/DIO control word* (see page *233*).	42
	RO/DIO control word bit8	Bit 8 of *10.99 RO/DIO control word* (see page *233*).	43
	RO/DIO control word bit9	Bit 9 of *10.99 RO/DIO control word* (see page *233*).	44
	Other [bit]	Source selection (see *Terms and abbreviations* on page *187*).	-
14.12	*DI1 ON delay*	*(Visible when 14.01 Module 1 type = FDIO-01)* Defines the activation delay for digital input DI1.	0.00 s
		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 … 3000.00 s	Activation delay for DI1.	10 = 1 s
14.12	*DIO1 ON delay*	*(Visible when 14.01 Module 1 type = FIO-01 or FIO-11)* Defines the activation delay for digital input/output DIO1.	0.00 s
		t_{On} = *14.12 DIO1 ON delay* t_{Off} = *14.13 DIO1 OFF delay* *Electrical status of DIO (in input mode) or status of selected source (in output mode). Indicated by *14.05 DIO status*. **Indicated by *14.06 DIO delayed status*.	
	0.00 … 3000.00 s	Activation delay for DIO1.	10 = 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
	0.00 … 3000.00 s	Deactivation delay for DI1.	10 = 1 s

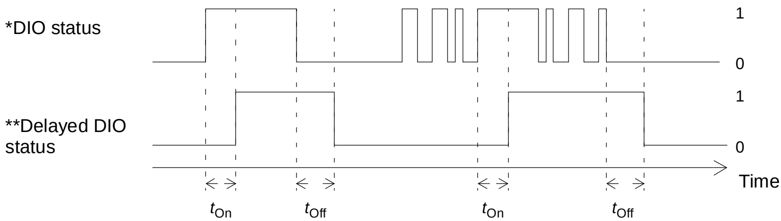
No.	Name/Value	Description	Def/FbEq16
14.13	*DIO1 OFF delay*	*(Visible when 14.01 Module 1 type = FIO-01 or FIO-11)* Defines the deactivation delay for digital input/output DIO1. See parameter *14.12 DIO1 ON delay*.	0.00 s
	0.00 … 3000.00 s	Deactivation delay for DIO1.	10 = 1 s
14.14	*DIO2 function*	*(Visible when 14.01 Module 1 type = FIO-01 or FIO-11)* Selects whether DIO2 of the extension module is used as a digital input or output.	*Input*
	Output	DIO2 is used as a digital output.	0
	Input	DIO2 is used as a digital input.	1
14.16	*DIO2 output source*	*(Visible when 14.01 Module 1 type = FIO-01 or FIO-11)* Selects a drive signal to be connected to digital input/output DIO2 when parameter *14.14 DIO2 function* is set to *Output*. For the available selections, see parameter *14.11 DIO1 output source*.	*Not energized*
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
	0.00 … 3000.00 s	Activation delay for DI2.	10 = 1 s
14.17	*DIO2 ON delay*	*(Visible when 14.01 Module 1 type = FIO-01 or FIO-11)* Defines the activation delay for digital input/output DIO2. See parameter *14.12 DI1 ON delay*.	0.00 s
	0.00 … 3000.00 s	Activation delay for DIO2.	10 = 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
	0.00 … 3000.00 s	Deactivation delay for DI2.	10 = 1 s
14.18	*DIO2 OFF delay*	*(Visible when 14.01 Module 1 type = FIO-01 or FIO-11)* Defines the deactivation delay for digital input/output DIO2. See parameter *14.12 DIO1 ON delay*.	0.00 s
	0.00 … 3000.00 s	Deactivation delay for DIO2.	10 = 1 s
14.19	*DIO3 function*	(Visible when *14.01 Module 1 type* = *FIO-01*) Selects whether DIO3 of the extension module is used as a digital input or output.	*Input*
	Output	DIO3 is used as a digital output.	0
	Input	DIO3 is used as a digital input.	1
14.19	*AI supervision function*	*(Visible when 14.01 Module 1 type = FIO-11 or FAIO-01)* Selects how the drive reacts when an analog input signal moves out of the minimum and/or maximum limits specified for the input. The inputs and the limits to be observed are selected by parameter *14.20 AI supervision selection*.	*No action*
	No action	No action taken.	0
	Fault	Drive trips on *80A0 AI supervision*.	1
	Warning	Drive generates an *A8A0 AI supervision* warning.	2

No.	Name/Value	Description	Def/FbEq16
	Last speed	Drive generates a warning (*A8A0 AI supervision*) and freezes the speed (or frequency) to the level the drive was operating at. The speed/frequency is determined on the basis of actual speed using 850 ms low-pass filtering. **WARNING!** Make sure that it is safe to continue operation in case of a communication break.	3
	Speed ref safe	Drive generates a warning (*A8A0 AI supervision*) and sets the speed to the speed defined by parameter *49.05 Communication loss action Speed ref safe*. **WARNING!** Make sure that it is safe to continue operation in case of a communication break.	4
14.20	*AI supervision selection*	*(Visible when 14.01 Module 1 type = FIO-11 or FAIO-01)* Specifies the analog input limits to be supervised. See parameter *14.19 AI supervision function*. **Note:** The number of active bits in this parameter depends on the number of inputs on the extension module.	0000h

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

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

No.	Name/Value	Description	Def/FbEq16
	AI2 max tune	The measured value of AI2 is set as the maximum value of AI2 into parameter *14.49 AI2 max*.	4
	AI3 min tune	*(Visible when 14.01 Module 1 type = FIO-11)* The measured value of AI3 is set as the minimum value of AI3 into parameter *14.63 AI3 min*.	5
	AI3 max tune	*(Visible when 14.01 Module 1 type = FIO-11)* The measured value of AI3 is set as the maximum value of AI3 into parameter *14.64 AI3 max*.	6
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
	0.00 … 3000.00 s	Activation delay for DI3.	10 = 1 s
14.22	*DIO3 ON delay*	*(Visible when 14.01 Module 1 type = FIO-01)* Defines the activation delay for digital input/output DIO3.	0.00 s



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

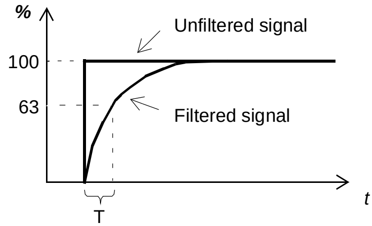
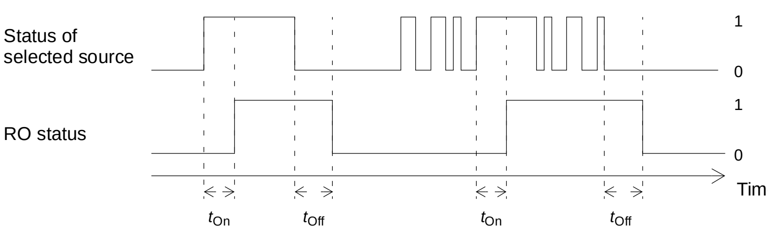
No.	Name/Value	Description	Def/FbEq16
	0.00 … 3000.00 s	Activation delay for DIO3.	10 = 1 s
14.22	*AI force selection*	*(Visible when 14.01 Module 1 type = FIO-11 or FAIO-01)* The true readings of the analog inputs can be overridden for eg. testing purposes. A forced value parameter is provided for each analog input, and its value is applied whenever the corresponding bit in this parameter is 1.	0000h

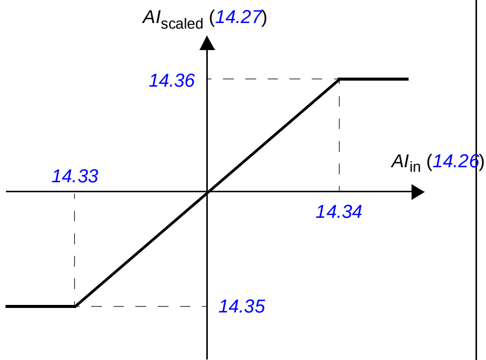
Bit	Value
0	1 = Force AI1 to value of parameter *14.28 AI1 force data*.
1	1 = Force AI2 to value of parameter *14.43 AI2 force data*.
2	1 = Force AI3 to value of parameter *14.58 AI3 force data* (FIO-11 only).
3…15	Reserved.

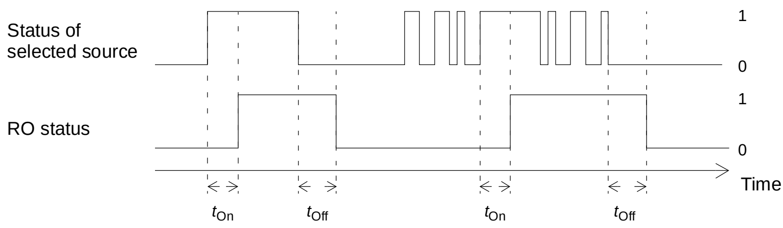
No.	Name/Value	Description	Def/FbEq16
	0000h … FFFFh	Forced values selector for analog inputs.	1 = 1
14.23	*DI3 OFF delay*	*(Visible when 14.01 Module 1 type = FDIO-01)* Defines the deactivation delay for digital input DI3. See parameter *14.12 DI1 ON delay*.	0.00 s
	0.00 … 3000.00 s	Deactivation delay for DI3.	10 = 1 s

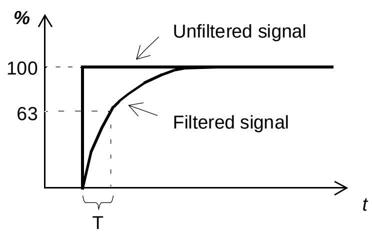
No.	Name/Value	Description	Def/FbEq16
14.23	*DIO3 OFF delay*	*(Visible when 14.01 Module 1 type = FIO-01)* Defines the deactivation delay for digital input/output DIO3. See parameter *14.12 DIO1 ON delay*.	0.00 s
	0.00 … 3000.00 s	Deactivation delay for DIO3.	10 = 1 s
14.24	*DIO4 function*	(Visible when *14.01 Module 1 type* = *FIO-01*) Selects whether DIO4 of the extension module is used as a digital input or output.	*Input*
	Output	DIO4 is used as a digital output.	0
	Input	DIO4 is used as a digital input.	1
14.26	*DIO4 output source*	*(Visible when 14.01 Module 1 type = FIO-01)* Selects a drive signal to be connected to digital input/output DIO4 when parameter *14.24 DIO4 function* is set to *Output*. For the available selections, see parameter *14.11 DIO1 output source*.	*Not energized*
14.26	*AI1 actual value*	*(Visible when 14.01 Module 1 type = FIO-11 or FAIO-01)* Displays the value of analog input AI1 in mA or V (depending on whether the input is set to current or voltage). This parameter is read-only.	-
	-22.000 … 22.000 mA or V	Value of analog input AI1.	1000 = 1 mA or V
14.27	*DIO4 ON delay*	*(Visible when 14.01 Module 1 type = FIO-01 or FIO-11)* Defines the activation delay for digital input/output DIO4. See parameter *14.12 DIO1 ON delay*.	0.00 s
	0.00 … 3000.00 s	Activation delay for DIO4.	10 = 1 s
14.27	*AI1 scaled value*	*(Visible when 14.01 Module 1 type = FIO-11 or FAIO-01)* Displays the value of analog input AI1 after scaling. See parameter *14.35 AI1 scaled at AI1 min*. This parameter is read-only.	-
	-32768.000 … 32767.000	Scaled value of analog input AI1.	1 = 1
14.28	*DIO4 OFF delay*	*(Visible when 14.01 Module 1 type = FIO-01)* Defines the deactivation delay for digital input/output DIO4. See parameter *14.12 DIO1 ON delay*.	0.00 s
	0.00 … 3000.00 s	Deactivation delay for DIO4.	10 = 1 s
14.28	*AI1 force data*	*(Visible when 14.01 Module 1 type = FIO-11 or FAIO-01)* Forced value that can be used instead of the true reading of the input. See parameter *14.22 AI force selection*.	0.000 mA
	-22.000 … 22.000 mA or V	Forced value of analog input AI1.	1000 = 1 mA or V

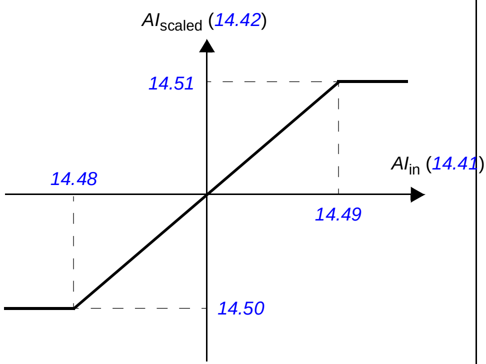
No.	Name/Value	Description	Def/FbEq16
14.29	*AI1 HW switch position*	*(Visible when 14.01 Module 1 type* = *FIO-11 or FAIO-01)* Displays the position of the hardware current/voltage selector on the I/O extension module. **Note**: The setting of the current/voltage selector must match the unit selection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

No.	Name/Value	Description	Def/FbEq16
14.32	*AI1 filter time*	*(Visible when 14.01 Module 1 type = FIO-11 or FAIO-01)* Defines the filter time constant for analog input AI1.  $O = I \times (1 - e^{-t/T})$ I = filter input (step) O = filter output *t* = time T = filter time constant **Note:** The signal is also filtered due to the signal interface hardware. See parameter *14.31 AI1 filter gain*.	0.040 s
	0.000 … 30.000 s	Filter time constant.	1000 = 1 s
14.33	*AI1 min*	*(Visible when 14.01 Module 1 type = FIO-11 or FAIO-01)* Defines the minimum value for analog input AI1.	0.000 mA or V
	-22.000 … 22.000 mA or V	Minimum value of AI1.	1000 = 1 mA or V
14.34	*RO1 source*	*(Visible when 14.01 Module 1 type = FIO-01 or 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*
14.34	*AI1 max*	*(Visible when 14.01 Module 1 type = FIO-11 or FAIO-01)* Defines the maximum value for analog input AI1.	10.000 mA or V
	-22.000 … 22.000 mA or V	Maximum value of AI1.	1000 = 1 mA or V
14.35	*RO1 ON delay*	*(Visible when 14.01 Module 1 type = FIO-01 or FDIO-01)* Defines the activation delay for relay output RO1.	0.00 s
	 t_{On} = *14.35 RO1 ON delay* t_{Off} = *14.36 RO1 OFF delay*		
	0.00 … 3000.00 s	Activation delay for RO1.	10 = 1 s

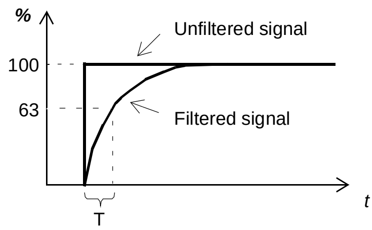
No.	Name/Value	Description	Def/FbEq16
14.35	*AI1 scaled at AI1 min*	*(Visible when 14.01 Module 1 type = FIO-11 or FAIO-01)* Defines the real value that corresponds to the minimum analog input AI1 value defined by parameter *14.33 AI1 min*. 	0.000
	-32768.000 … 32767.000	Real value corresponding to minimum AI1 value.	1 = 1
14.36	*RO1 OFF delay*	*(Visible when 14.01 Module 1 type = FIO-01 or FDIO-01)* Defines the deactivation delay for relay output RO1. See parameter *14.35 RO1 ON delay*.	0.00 s
	0.00 … 3000.00 s	Deactivation delay for RO1.	10 = 1 s
14.36	*AI1 scaled at AI1 max*	*(Visible when 14.01 Module 1 type = FIO-11 or FAIO-01)* Defines the real value that corresponds to the maximum analog input AI1 value defined by parameter *14.34 AI1 max*. See the drawing at parameter *14.35 AI1 scaled at AI1 min*.	100.000
	-32768.000 … 32767.000	Real value corresponding to maximum AI1 value.	1 = 1
14.37	*RO2 source*	*(Visible when 14.01 Module 1 type = FIO-01 or 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*

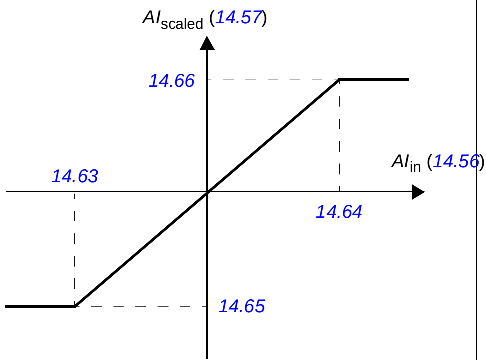
No.	Name/Value	Description	Def/FbEq16
14.38	*RO2 ON delay*	*(Visible when 14.01 Module 1 type = FIO-01)* Defines the activation delay for relay output RO2.	0.0 s
	 t_{On} = *14.38 RO2 ON delay* t_{Off} = *14.39 RO2 OFF delay*		
	0.0 … 3000.0 s	Activation delay for RO2.	10 = 1 s
14.39	*RO2 OFF delay*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

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

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

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

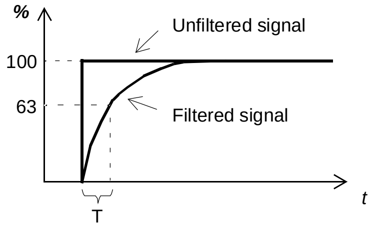
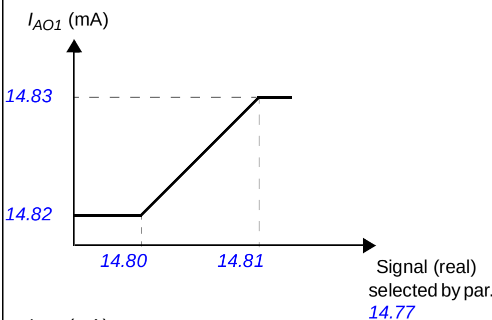
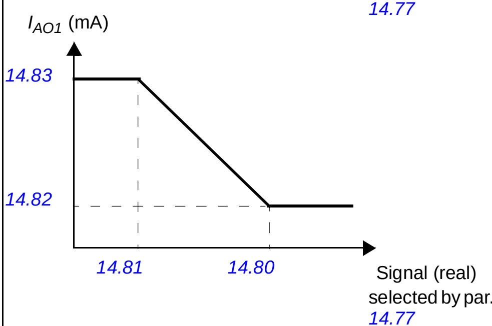
No.	Name/Value	Description	Def/FbEq16
14.62	*AI3 filter time*	*(Visible when 14.01 Module 1 type = FIO-11)* Defines the filter time constant for analog input AI3.  $O = I \times (1 - e^{-t/T})$ I = filter input (step) O = filter output *t* = time T = filter time constant **Note:** The signal is also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

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

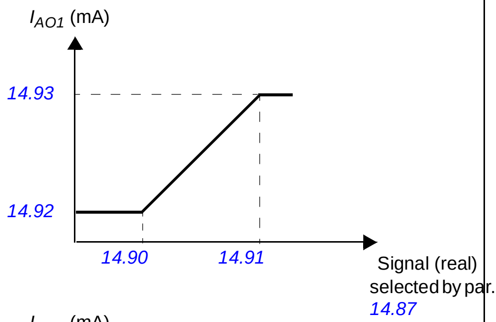
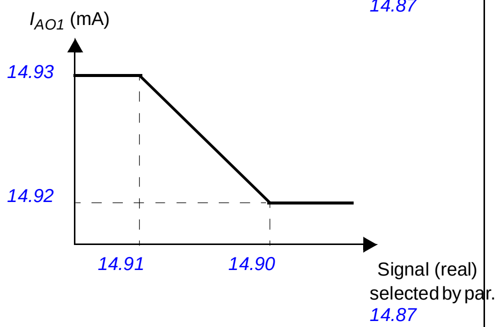
Bit	Name	Value
0	AO1	1 = Force AO1 to value of parameter *14.78 AO1 force data*.
1	AO2	1 = Force AO2 to value of parameter *14.88 AO2 force data*. (FAIO-01 only).
3…15	Reserved.	

	00b…11b	Forced values selector for analog outputs.	1 = 1
14.76	*AO1 actual value*	*(Visible when 14.01 Module 1 type = FIO-11 or FAIO-01)* Displays the value of AO1 in mA. This parameter is read-only.	-
	0.000 … 22.000 mA	Value of AO1.	1000 = 1 mA

No.	Name/Value	Description	Def/FbEq16
14.77	*AO1 source*	*(Visible when 14.01 Module 1 type = FIO-11 or FAIO-01)* Selects a signal to be connected to analog output AO1. Alternatively, sets the output to excitation mode to feed a constant current to a temperature sensor.	*Zero*
	Zero	None.	0
	Motor speed used	*01.01 Motor speed used* (page *192*).	1
	Output frequency	*01.06 Output frequency* (page *192*).	3
	Motor current	*01.07 Motor current* (page *192*).	4
	Motor torque	*01.10 Motor torque* (page *192*).	6
	DC voltage	*01.11 DC voltage* (page *193*).	7
	Power inu out	*01.14 Output power* (page *193*).	8
	Speed ref ramp in	*23.01 Speed ref ramp input* (page *307*).	10
	Speed ref ramp out	*23.02 Speed ref ramp output* (page *307*).	11
	Speed ref used	*24.01 Used speed reference* (page *314*).	12
	Torq ref used	*26.02 Torque reference used* (page *329*).	13
	Force PT100 excitation	The output is used to feed an excitation current to 1…3 Pt100 sensors. See section *Motor thermal protection* (page *171*).	20
	Force KTY84 excitation	The output is used to feed an excitation current to a KTY84 sensor. See section *Motor thermal protection* (page *171*).	21
	Force PTC excitation	The output is used to feed an excitation current to 1…3 PTC sensors. See section *Motor thermal protection* (page *171*).	22
	Force Pt1000 excitation	The output is used to feed an excitation current to 1…3 Pt1000 sensors. See section *Motor thermal protection* (page *171*).	23
	AO1 data storage	*13.91 AO1 data storage* (page *249*).	37
	AO2 data storage	*13.92 AO2 data storage* (page *249*).	38
	Other	Source selection (see *Terms and abbreviations* on page *187*).	-
14.78	*AO1 force data*	*(Visible when 14.01 Module 1 type = FIO-11 or FAIO-01)* Forced value that can be used instead of the selected output signal. See parameter *14.71 AO force selection*.	0.000 mA
	0.000 … 22.000 mA	Forced value of analog output AO1.	1000 = 1 mA

No.	Name/Value	Description	Def/FbEq16
14.79	*AO1 filter time*	*(Visible when 14.01 Module 1 type = FIO-11 or FAIO-01)* Defines the filtering time constant for analog output AO1.  $O = I \times (1 - e^{-t/T})$ I = filter input (step) O = filter output *t* = time T = filter time constant	0.100 s
	0.000 … 30.000 s	Filter time constant.	1000 = 1 s
14.80	*AO1 source min*	*(Visible when 14.01 Module 1 type = FIO-11 or FAIO-01)* Defines the real value of the signal (selected by parameter *14.77 AO1 source*) that corresponds to the minimum AO1 output value (defined by parameter *14.82 AO1 out at AO1 src min*).  	0.0
	-32768.0 … 32767.0	Real signal value corresponding to minimum AO1 output value.	1 = 1

No.	Name/Value	Description	Def/FbEq16
14.81	*AO1 source max*	*(Visible when 14.01 Module 1 type = FIO-11 or FAIO-01)* Defines the real value of the signal (selected by parameter *14.77 AO1 source*) that corresponds to the maximum AO1 output value (defined by parameter *14.83 AO1 out at AO1 src max*). See parameter *14.80 AO1 source min*.	100.0
	-32768.0 … 32767.0	Real signal value corresponding to maximum AO1 output value.	1 = 1
14.82	*AO1 out at AO1 src min*	*(Visible when 14.01 Module 1 type = FIO-11 or FAIO-01)* Defines the minimum output value for analog output AO1. See also drawing at parameter *14.80 AO1 source min*.	0.000 mA
	0.000 … 22.000 mA	Minimum AO1 output value.	1000 = 1 mA
14.83	*AO1 out at AO1 src max*	*(Visible when 14.01 Module 1 type = FIO-11 or FAIO-01)* Defines the maximum output value for analog output AO1. See also drawing at parameter *14.80 AO1 source min*.	10.000 mA
	0.000 … 22.000 mA	Maximum AO1 output value.	1000 = 1 mA
14.86	*AO2 actual value*	*(Visible when 14.01 Module 1 type = FAIO-01)* Displays the value of AO2 in mA. This parameter is read-only.	-
	0.000 … 22.000 mA	Value of AO2.	1000 = 1 mA
14.87	*AO2 source*	*(Visible when 14.01 Module 1 type = FAIO-01)* Selects a signal to be connected to analog output AO2. Alternatively, sets the output to excitation mode to feed a constant current to a temperature sensor. For selections, see parameter *14.77 AO1 source*.	*Zero*
14.88	*AO2 force data*	*(Visible when 14.01 Module 1 type = FAIO-01)* Forced value that can be used instead of the selected output signal. See parameter *14.71 AO force selection*.	0.000 mA
	0.000 … 22.000 mA	Forced value of analog output AO2.	1000 = 1 mA
14.89	*AO2 filter time*	*(Visible when 14.01 Module 1 type = FAIO-01)* Defines the filtering time constant for analog output AO2. See parameter *14.79 AO1 filter time*.	0.100 s
	0.000 … 30.000 s	Filter time constant.	1000 = 1 s

No.	Name/Value	Description	Def/FbEq16
14.90	*AO2 source min*	*(Visible when 14.01 Module 1 type = FAIO-01)* Defines the real value of the signal (selected by parameter *14.87 AO2 source*) that corresponds to the minimum AO2 output value (defined by parameter *14.92 AO2 out at AO2 src min*).  	0.0
	-32768.0 … 32767.0	Real signal value corresponding to minimum AO2 output value.	1 = 1
14.91	*AO2 source max*	*(Visible when 14.01 Module 1 type = 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
	-32768.0 … 32767.0	Real signal value corresponding to maximum AO2 output value.	1 = 1
14.92	*AO2 out at AO2 src min*	*(Visible when 14.01 Module 1 type = FAIO-01)* Defines the minimum output value for analog output AO2. See also drawing at parameter *14.90 AO2 source min*.	0.000 mA
	0.000 … 22.000 mA	Minimum AO2 output value.	1000 = 1 mA

No.	Name/Value	Description	Def/FbEq16
14.93	AO2 out at AO2 src max	(Visible when 14.01 Module 1 type = FAIO-01) Defines the maximum output value for analog output AO2. See also drawing at parameter 14.90 AO2 source min.	10.000 mA
	0.000 … 22.000 mA	Maximum AO2 output value.	1000 = 1 mA
15 I/O extension module 2		Configuration of I/O extension module 2. See also section Programmable I/O extensions (page 127). **Note:** The contents of the parameter group vary according to the selected I/O extension module type.	
15.01	Module 2 type	See parameter 14.01 Module 1 type.	None
15.02	Module 2 location	See parameter 14.02 Module 1 location.	Slot 1
15.03	Module 2 status	See parameter 14.03 Module 1 status.	No option
15.05	DI status	(Visible when 15.01 Module 2 type = FDIO-01) See parameter 14.05 DI status.	-
15.05	DIO status	(Visible when 15.01 Module 2 type = FIO-01 or FIO-11) See parameter 14.05 DIO status.	-
15.06	DI delayed status	(Visible when 15.01 Module 2 type = FDIO-01) See parameter 14.06 DI delayed status.	-
15.06	DIO delayed status	(Visible when 15.01 Module 2 type = FIO-01 or FIO-11) See parameter 14.06 DIO delayed status.	-
15.08	DI filter time	(Visible when 15.01 Module 2 type = FDIO-01) See parameter 14.08 DI filter time.	-
15.08	DIO filter time	(Visible when 15.01 Module 2 type = FIO-01 or FIO-11) See parameter 14.08 DIO filter time.	10.0 ms
15.09	DIO1 function	(Visible when 15.01 Module 2 type = FIO-01 or FIO-11) See parameter 14.09 DIO1 function.	Input
15.11	DIO1 output source	(Visible when 15.01 Module 2 type = FIO-01 or FIO-11) See parameter 14.11 DIO1 output source.	Not energized
15.12	DI1 ON delay	(Visible when 15.01 Module 2 type = FDIO-01) See parameter 14.12 DI1 ON delay.	
15.12	DIO1 ON delay	(Visible when 15.01 Module 2 type = FIO-01 or FIO-11) See parameter 14.12 DIO1 ON delay.	0.00 s
15.13	DI1 OFF delay	(Visible when 15.01 Module 2 type = FDIO-01) See parameter 14.13 DI1 OFF delay.	
15.13	DIO1 OFF delay	(Visible when 15.01 Module 2 type = FIO-01 or FIO-11) See parameter 14.13 DIO1 OFF delay.	0.00 s
15.14	DIO2 function	(Visible when 15.01 Module 2 type = FIO-01 or FIO-11) See parameter 14.14 DIO2 function.	Input
15.16	DIO2 output source	(Visible when 15.01 Module 2 type = FIO-01 or FIO-11) See parameter 14.16 DIO2 output source.	Not energized
15.17	DI2 ON delay	(Visible when 15.01 Module 2 type = FDIO-01) See parameter 14.17 DI2 ON delay.	0.00 s
15.17	DIO2 ON delay	(Visible when 15.01 Module 2 type = FIO-01 or FIO-11) See parameter 14.17 DIO2 ON delay.	0.00 s

No.	Name/Value	Description	Def/FbEq16
15.18	*DI2 OFF delay*	*(Visible when 15.01 Module 2 type = FDIO-01)* See parameter *14.18 DI2 OFF delay*.	0.00 s
15.18	*DIO2 OFF delay*	*(Visible when 15.01 Module 2 type = FIO-01* or *FIO-11)* See parameter *14.18 DIO2 OFF delay*.	0.0 s
15.19	*DIO3 function*	(Visible when *15.01 Module 2 type* = *FIO-01*) See parameter *14.19 DIO3 function*.	*Input*
15.19	*AI supervision function*	(Visible when *15.01 Module 2 type* = *FIO-11* or *FAIO-01*) See parameter *14.19 AI supervision function*.	*No action*
15.20	*AI supervision selection*	(Visible when *15.01 Module 2 type* = *FIO-11* or *FAIO-01*) See parameter *14.20 AI supervision selection*.	0000h
15.21	*DIO3 output source*	*(Visible when 15.01 Module 2 type = FIO-01)* See parameter *14.21 DIO3 output source*.	*Not energized*
15.21	*AI tune*	(Visible when *15.01 Module 2 type* = *FIO-11* or *FAIO-01*) See parameter *14.21 AI tune*.	*No action*
15.22	*DI3 ON delay*	*(Visible when 15.01 Module 2 type = FDIO-01)* See parameter *14.22 DI3 ON delay*.	0.00 s
15.22	*DIO3 ON delay*	*(Visible when 15.01 Module 2 type = FIO-01)* See parameter *14.22 DIO3 ON delay*.	0.00 s
15.22	*AI force selection*	(Visible when *15.01 Module 2 type* = *FIO-11* or *FAIO-01*) See parameter *14.22 AI force selection*.	00000000h
15.23	*DI3 OFF delay*	*(Visible when 15.01 Module 2 type = FDIO-01)* See parameter *14.23 DI3 OFF delay*.	0.00 s
15.23	*DIO3 OFF delay*	*(Visible when 15.01 Module 2 type = FIO-01)* See parameter *14.23 DIO3 OFF delay*.	0.00 s
15.24	*DIO4 function*	(Visible when *15.01 Module 2 type* = *FIO-01*) See parameter *14.24 DIO4 function*.	*Input*
15.26	*DIO4 output source*	(Visible when *15.01 Module 2 type* = *FIO-01*) See parameter *14.26 DIO4 output source*.	*Not energized*
15.26	*AI1 actual value*	(Visible when *15.01 Module 2 type* = *FIO-11* or *FAIO-01*) See parameter *14.26 AI1 actual value*.	-
15.27	*DIO4 ON delay*	(Visible when *15.01 Module 2 type* = *FIO-01*) See parameter *14.27 DIO4 ON delay*.	0.00 s
15.27	*AI1 scaled value*	(Visible when *15.01 Module 2 type* = *FIO-11* or *FAIO-01*) See parameter *14.27 AI1 scaled value*.	-
15.28	*DIO4 OFF delay*	(Visible when *15.01 Module 2 type* = *FIO-01*) See parameter *14.28 DIO4 OFF delay*.	0.00 s
15.28	*AI1 force data*	(Visible when *15.01 Module 2 type* = *FIO-11* or *FAIO-01*) See parameter *14.28 AI1 force data*.	0.000 mA
15.29	*AI1 HW switch position*	(Visible when *15.01 Module 2 type* = *FIO-11* or *FAIO-01*) See parameter *14.29 AI1 HW switch position*.	-
15.30	*AI1 unit selection*	(Visible when *15.01 Module 2 type* = *FIO-11* or *FAIO-01*) See parameter *14.30 AI1 unit selection*.	*mA*
15.31	*RO status*	*(Visible when 15.01 Module 2 type = FIO-01* or *FDIO-01)* See parameter *14.31 RO status*.	-
15.31	*AI1 filter gain*	(Visible when *15.01 Module 2 type* = *FIO-11* or *FAIO-01*) See parameter *14.31 AI1 filter gain*.	*1 ms*

No.	Name/Value	Description	Def/FbEq16
15.32	*AI1 filter time*	*(Visible when 15.01 Module 2 type = FIO-11 or FAIO-01)* See parameter *14.32 AI1 filter time*.	0.040 s
15.33	*AI1 min*	*(Visible when 15.01 Module 2 type = FIO-11 or FAIO-01)* See parameter *14.33 AI1 min*.	0.000 mA or V
15.34	*RO1 source*	*(Visible when 15.01 Module 2 type = FIO-01 or FDIO-01)* See parameter *14.34 RO1 source*.	*Not energized*
15.34	*AI1 max*	*(Visible when 15.01 Module 2 type = FIO-11 or FAIO-01)* See parameter *14.34 AI1 max*.	10.000 mA or V
15.35	*RO1 ON delay*	*(Visible when 15.01 Module 2 type = FIO-01 or FDIO-01)* See parameter *14.35 RO1 ON delay*.	0.00 s
15.35	*AI1 scaled at AI1 min*	*(Visible when 15.01 Module 2 type = FIO-11 or FAIO-01)* See parameter *14.35 AI1 scaled at AI1 min*.	0.000
15.36	*RO1 OFF delay*	*(Visible when 15.01 Module 2 type = FIO-01 or FDIO-01)* See parameter *14.36 RO1 OFF delay*.	0.00 s
15.36	*AI1 scaled at AI1 max*	*(Visible when 15.01 Module 2 type = FIO-11 or FAIO-01)* See parameter *14.36 AI1 scaled at AI1 max*.	100.000
15.37	*RO2 source*	*(Visible when 15.01 Module 2 type = FIO-01 or FDIO-01)* See parameter *14.37 RO2 source*.	*Not energized*
15.38	*RO2 ON delay*	*(Visible when 15.01 Module 2 type = FIO-01 or FDIO-01)* See parameter *14.38 RO2 ON delay*.	0.00 s
15.39	*RO2 OFF delay*	*(Visible when 15.01 Module 2 type = FIO-01 or FDIO-01)* See parameter *14.39 RO2 OFF delay*.	0.00 s
15.41	*AI2 actual value*	*(Visible when 15.01 Module 2 type = FIO-11 or FAIO-01)* See parameter *14.41 AI2 actual value*.	-
15.42	*AI2 scaled value*	*(Visible when 15.01 Module 2 type = FIO-11 or FAIO-01)* See parameter *14.42 AI2 scaled value*.	-
15.43	*AI2 force data*	*(Visible when 15.01 Module 2 type = FIO-11 or FAIO-01)* See parameter *14.43 AI2 force data*.	0.000 mA
15.44	*AI2 HW switch position*	*(Visible when 15.01 Module 2 type = FIO-11 or FAIO-01)* See parameter *14.44 AI2 HW switch position*.	-
15.45	*AI2 unit selection*	*(Visible when 15.01 Module 2 type = FIO-11 or FAIO-01)* See parameter *14.45 AI2 unit selection*.	*mA*
15.46	*AI2 filter gain*	*(Visible when 15.01 Module 2 type = FIO-11 or FAIO-01)* See parameter *14.46 AI2 filter gain*.	*No filtering*
15.47	*AI2 filter time*	*(Visible when 15.01 Module 2 type = FIO-11 or FAIO-01)* See parameter *14.47 AI2 filter time*.	0.100 s
15.48	*AI2 min*	*(Visible when 15.01 Module 2 type = FIO-11 or FAIO-01)* See parameter *14.48 AI2 min*.	0.000 mA or V
15.49	*AI2 max*	*(Visible when 15.01 Module 2 type = FIO-11 or FAIO-01)* See parameter *14.49 AI2 max*.	10.000 mA or V
15.50	*AI2 scaled at AI2 min*	*(Visible when 15.01 Module 2 type = FIO-11 or FAIO-01)* See parameter *14.50 AI2 scaled at AI2 min*.	0.000
15.51	*AI2 scaled at AI2 max*	*(Visible when 15.01 Module 2 type = FIO-11 or FAIO-01)* See parameter *14.51 AI2 scaled at AI2 max*.	100.000
15.56	*AI3 actual value*	*(Visible when 15.01 Module 2 type = FIO-11)* See parameter *14.56 AI3 actual value*.	-

No.	Name/Value	Description	Def/FbEq16
15.57	*AI3 scaled value*	*(Visible when 15.01 Module 2 type* = *FIO-11)* See parameter *14.57 AI3 scaled value*.	-
15.58	*AI3 force data*	*(Visible when 15.01 Module 2 type* = *FIO-11)* See parameter *14.58 AI3 force data*.	0.000 mA
15.59	*AI3 HW switch position*	*(Visible when 15.01 Module 2 type* = *FIO-11)* See parameter *14.59 AI3 HW switch position*.	-
15.60	*AI3 unit selection*	*(Visible when 15.01 Module 2 type* = *FIO-11)* See parameter *14.60 AI3 unit selection*.	*mA*
15.61	*AI3 filter gain*	*(Visible when 15.01 Module 2 type* = *FIO-11)* See parameter *14.61 AI3 filter gain*.	*No filtering*
15.62	*AI3 filter time*	*(Visible when 15.01 Module 2 type* = *FIO-11)* See parameter *14.62 AI3 filter time*.	0.100 s
15.63	*AI3 min*	*(Visible when 15.01 Module 2 type* = *FIO-11)* See parameter *14.63 AI3 min*.	0.000 mA or V
15.64	*AI3 max*	*(Visible when 15.01 Module 2 type* = *FIO-11)* See parameter *14.64 AI3 max*.	10.000 mA or V
15.65	*AI3 scaled at AI3 min*	*(Visible when 15.01 Module 2 type* = *FIO-11)* See parameter *14.65 AI3 scaled at AI3 min*.	0.000
15.66	*AI3 scaled at AI3 max*	*(Visible when 15.01 Module 2 type* = *FIO-11)* See parameter *14.66 AI3 scaled at AI3 max*.	100.000
15.71	*AO force selection*	*(Visible when 15.01 Module 2 type* = *FIO-11* or *FAIO-01)* See parameter *14.71 AO force selection*.	00b
15.76	*AO1 actual value*	*(Visible when 15.01 Module 2 type* = *FIO-11* or *FAIO-01)* See parameter *14.76 AO1 actual value*.	-
15.77	*AO1 source*	*(Visible when 15.01 Module 2 type* = *FIO-11* or *FAIO-01)* See parameter *14.77 AO1 source*.	*Zero*
15.78	*AO1 force data*	*(Visible when 15.01 Module 2 type* = *FIO-11* or *FAIO-01)* See parameter *14.78 AO1 force data*.	0.000 mA
15.79	*AO1 filter time*	*(Visible when 15.01 Module 2 type* = *FIO-11* or *FAIO-01)* See parameter *14.79 AO1 filter time*.	0.100 s
15.80	*AO1 source min*	*(Visible when 15.01 Module 2 type* = *FIO-11* or *FAIO-01)* See parameter *14.80 AO1 source min*.	0.0
15.81	*AO1 source max*	*(Visible when 15.01 Module 2 type* = *FIO-11* or *FAIO-01)* See parameter *14.81 AO1 source max*.	100.0
15.82	*AO1 out at AO1 src min*	*(Visible when 15.01 Module 2 type* = *FIO-11* or *FAIO-01)* See parameter *14.82 AO1 out at AO1 src min*.	0.000 mA
15.83	*AO1 out at AO1 src max*	*(Visible when 15.01 Module 2 type* = *FIO-11* or *FAIO-01)* See parameter *14.83 AO1 out at AO1 src max*.	10.000 mA
15.86	*AO2 actual value*	*(Visible when 15.01 Module 2 type* = *FAIO-01)* See parameter *14.86 AO2 actual value*.	-
15.87	*AO2 source*	*(Visible when 15.01 Module 2 type* = *FAIO-01)* See parameter *14.87 AO2 source*.	*Zero*
15.88	*AO2 force data*	*(Visible when 15.01 Module 2 type* = *FAIO-01)* See parameter *14.88 AO2 force data*.	0.000 mA
15.89	*AO2 filter time*	*(Visible when 15.01 Module 2 type* = *FAIO-01)* See parameter *14.89 AO2 filter time*.	0.100 s

No.	Name/Value	Description	Def/FbEq16
15.90	*AO2 source min*	*(Visible when 15.01 Module 2 type = FAIO-01)* See parameter *14.90 AO2 source min*.	0.0
15.91	*AO2 source max*	*(Visible when 15.01 Module 2 type = FAIO-01)* See parameter *14.91 AO2 source max*.	100.0
15.92	*AO2 out at AO2 src min*	*(Visible when 15.01 Module 2 type = FAIO-01)* See parameter *14.92 AO2 out at AO2 src min*.	0.000 mA
15.93	*AO2 out at AO2 src max*	*(Visible when 15.01 Module 2 type = FAIO-01)* See parameter *14.93 AO2 out at AO2 src max*.	10.000 mA
16 I/O extension module 3		Configuration of I/O extension module 3. See also section *Programmable I/O extensions* (page *127*). **Note:** The contents of the parameter group vary according to the selected I/O extension module type.	
16.01	*Module 3 type*	See parameter *14.01 Module 1 type*.	*None*
16.02	*Module 3 location*	See parameter *14.02 Module 1 location*.	*Slot 1*
16.03	*Module 3 status*	See parameter *14.03 Module 1 status*.	*No option*
16.05	*DI status*	*(Visible when 16.01 Module 3 type = FDIO-01)* See parameter *14.05 DIO status*.	-
16.05	*DIO status*	*(Visible when 16.01 Module 3 type = FIO-01* or *FIO-11)* See parameter *14.05 DIO status*.	-
16.06	*DI delayed status*	*(Visible when 16.01 Module 3 type = FDIO-01)* See parameter *14.06 DI delayed status*.	-
16.06	*DIO delayed status*	*(Visible when 16.01 Module 3 type = FIO-01* or *FIO-11)* See parameter *14.06 DIO delayed status*.	-
16.08	*DI filter time*	*(Visible when 16.01 Module 3 type = FDIO-01)* See parameter *14.08 DI filter time*	10.0 ms
16.08	*DIO filter time*	*(Visible when 16.01 Module 3 type = FIO-01* or *FIO-11)* See parameter *14.08 DIO filter time*.	10.0 ms
16.09	*DIO1 function*	*(Visible when 16.01 Module 3 type = FIO-01* or *FIO-11)* See parameter *14.09 DIO1 function*.	*Input*
16.11	*DIO1 output source*	*(Visible when 16.01 Module 3 type = FIO-01* or *FIO-11)* See parameter *14.11 DIO1 output source*.	*Not energized*
16.12	*DI1 ON delay*	*(Visible when 16.01 Module 3 type = FDIO-01)* See parameter *14.12 DI1 ON delay*	0.00 s
16.12	*DIO1 ON delay*	*(Visible when 16.01 Module 3 type = FIO-01* or *FIO-11)* See parameter *14.12 DIO1 ON delay*.	0.00 s
16.13	*DI1 OFF delay*	*(Visible when 16.01 Module 3 type = FDIO-01)* See parameter *14.13 DI1 OFF delay*	0.00 s
16.13	*DIO1 OFF delay*	*(Visible when 16.01 Module 3 type = FIO-01* or *FIO-11)* See parameter *14.13 DIO1 OFF delay*.	0.0 s
16.14	*DIO2 function*	*(Visible when 16.01 Module 3 type = FIO-01* or *FIO-11)* See parameter *14.14 DIO2 function*.	*Input*
16.16	*DIO2 output source*	*(Visible when 16.01 Module 3 type = FIO-01* or *FIO-11)* See parameter *14.16 DIO2 output source*.	*Not energized*
16.17	*DI2 ON delay*	*(Visible when 16.01 Module 3 type = FDIO-01)* See parameter *14.17 DI2 ON delay*	0.00 s

No.	Name/Value	Description	Def/FbEq16
16.17	*DIO2 ON delay*	*(Visible when 16.01 Module 3 type = FIO-01* or *FIO-11)* See parameter *14.17 DIO2 ON delay*.	0.00 s
16.18	*DI2 OFF delay*	*(Visible when 16.01 Module 3 type = FDIO-01)* See parameter *14.18 DI2 OFF delay*	0.00 s
16.18	*DIO2 OFF delay*	*(Visible when 16.01 Module 3 type = FIO-01* or *FIO-11)* See parameter *14.18 DIO2 OFF delay*.	0.00 s
16.19	*DIO3 function*	*(Visible when 16.01 Module 3 type = FIO-01)* See parameter *14.19 DIO3 function*.	*Input*
16.19	*AI supervision function*	*(Visible when 16.01 Module 3 type = FIO-11* or *FAIO-01)* See parameter *14.19 AI supervision function*.	*No action*
16.20	*AI supervision selection*	*(Visible when 16.01 Module 3 type = FIO-11* or *FAIO-01)* See parameter *14.20 AI supervision selection*.	0000h
16.21	*DIO3 output source*	*(Visible when 16.01 Module 3 type = FIO-01)* See parameter *14.21 DIO3 output source*.	*Not energized*
16.21	*AI tune*	*(Visible when 16.01 Module 3 type = FIO-11* or *FAIO-01)* See parameter *14.21 AI tune*.	*No action*
16.22	*DI3 ON delay*	*(Visible when 16.01 Module 3 type = FDIO-01)* See parameter *14.22 DI3 ON delay*	0.00 s
16.22	*DIO3 ON delay*	*(Visible when 16.01 Module 3 type = FIO-01)* See parameter *14.22 DIO3 ON delay*.	0.00 s
16.22	*AI force selection*	(Visible when *16.01 Module 3 type = FIO-11* or *FAIO-01*) See parameter *14.22 AI force selection*.	00000000h
16.23	*DI3 OFF delay*	*(Visible when 16.01 Module 3 type = FDIO-01)* See parameter *14.23 DI3 OFF delay*	0.00 s
16.23	*DIO3 OFF delay*	*(Visible when 16.01 Module 3 type = FIO-01)* See parameter *14.23 DIO3 OFF delay*.	0.00 s
16.24	*DIO4 function*	*(Visible when 16.01 Module 3 type = FIO-01)* See parameter *14.24 DIO4 function*.	*Input*
16.26	*DIO4 output source*	*(Visible when 16.01 Module 3 type = FIO-01)* See parameter *14.26 DIO4 output source*.	*Not energized*
16.26	*AI1 actual value*	*(Visible when 16.01 Module 3 type = FIO-11* or *FAIO-01)* See parameter *14.26 AI1 actual value*.	-
16.27	*DIO4 ON delay*	*(Visible when 16.01 Module 3 type = FIO-01)* See parameter *14.27 DIO4 ON delay*.	0.00 s
16.27	*AI1 scaled value*	*(Visible when 16.01 Module 3 type = FIO-11* or *FAIO-01)* See parameter *14.27 AI1 scaled value*.	-
16.28	*DIO4 OFF delay*	*(Visible when 16.01 Module 3 type = FIO-01)* See parameter *14.28 DIO4 OFF delay*.	0.00 s
16.28	*AI1 force data*	*(Visible when 16.01 Module 3 type = FIO-11* or *FAIO-01)* See parameter *14.28 AI1 force data*.	0.000 mA
16.29	*AI1 HW switch position*	*(Visible when 16.01 Module 3 type = FIO-11* or *FAIO-01)* See parameter *14.29 AI1 HW switch position*.	-
16.30	*AI1 unit selection*	*(Visible when 16.01 Module 3 type = FIO-11* or *FAIO-01)* See parameter *14.30 AI1 unit selection*.	*mA*

No.	Name/Value	Description	Def/FbEq16
16.31	*RO status*	(*Visible when 16.01 Module 3 type* = *FIO-11* or *FDIO-01*) See parameter *14.31 RO status*.	-
16.31	*AI1 filter gain*	(*Visible when 16.01 Module 3 type* = *FIO-11* or *FAIO-01*) See parameter *14.31 AI1 filter gain*.	*No filtering*
16.32	*AI1 filter time*	(*Visible when 16.01 Module 3 type* = *FIO-11* or *FAIO-01*) See parameter *14.32 AI1 filter time*.	0.040 s
16.33	*AI1 min*	(*Visible when 16.01 Module 3 type* = *FIO-11* or *FAIO-01*) See parameter *14.33 AI1 min*.	0.000 mA or V
16.34	*RO1 source*	(*Visible when 16.01 Module 3 type* = *FIO-01* or *FDIO-01*) See parameter *14.34 RO1 source*.	*Not energized*
16.34	*AI1 max*	(*Visible when 16.01 Module 3 type* = *FIO-11* or *FAIO-01*) See parameter *14.34 AI1 max*.	10.000 mA or V
16.35	*RO1 ON delay*	(*Visible when 16.01 Module 3 type* = *FIO-01* or *FDIO-01*) See parameter *14.35 RO1 ON delay*.	0.00 s
16.35	*AI1 scaled at AI1 min*	(*Visible when 16.01 Module 3 type* = *FIO-11* or *FAIO-01*) See parameter *14.35 AI1 scaled at AI1 min*.	0.000
16.36	*RO1 OFF delay*	(*Visible when 16.01 Module 3 type* = *FIO-01* or *FDIO-01*) See parameter *14.36 RO1 OFF delay*.	0.00 s
16.36	*AI1 scaled at AI1 max*	(*Visible when 16.01 Module 3 type* = *FIO-11* or *FAIO-01*) See parameter *14.36 AI1 scaled at AI1 max*.	100.000
16.37	*RO2 source*	(*Visible when 16.01 Module 3 type* = *FIO-01* or *FDIO-01*) See parameter *14.37 RO2 source*.	*Not energized*
16.38	*RO2 ON delay*	(*Visible when 16.01 Module 3 type* = *FIO-01* or *FDIO-01*) See parameter *14.38 RO2 ON delay*.	0.00 s
16.39	*RO2 OFF delay*	(*Visible when 16.01 Module 3 type* = *FIO-01* or *FDIO-01*) See parameter *14.39 RO2 OFF delay*.	0.00 s
16.41	*AI2 actual value*	(*Visible when 16.01 Module 3 type* = *FIO-11* or *FAIO-01*) See parameter *14.41 AI2 actual value*.	-
16.42	*AI2 scaled value*	(*Visible when 16.01 Module 3 type* = *FIO-11* or *FAIO-01*) See parameter *14.42 AI2 scaled value*.	-
16.43	*AI2 force data*	(*Visible when 16.01 Module 3 type* = *FIO-11* or *FAIO-01*) See parameter *14.43 AI2 force data*.	0.000 mA
16.44	*AI2 HW switch position*	(*Visible when 16.01 Module 3 type* = *FIO-11* or *FAIO-01*) See parameter *14.44 AI2 HW switch position*.	-
16.45	*AI2 unit selection*	(*Visible when 16.01 Module 3 type* = *FIO-11* or *FAIO-01*) See parameter *14.45 AI2 unit selection*.	*mA*
16.46	*AI2 filter gain*	(*Visible when 16.01 Module 3 type* = *FIO-11* or *FAIO-01*) See parameter *14.46 AI2 filter gain*.	*No filtering*
16.47	*AI2 filter time*	(*Visible when 16.01 Module 3 type* = *FIO-11* or *FAIO-01*) See parameter *14.47 AI2 filter time*.	0.100 s
16.48	*AI2 min*	(*Visible when 16.01 Module 3 type* = *FIO-11* or *FAIO-01*) See parameter *14.48 AI2 min*.	0.000 mA or V
16.49	*AI2 max*	(*Visible when 16.01 Module 3 type* = *FIO-11* or *FAIO-01*) See parameter *14.49 AI2 max*.	10.000 mA or V
16.50	*AI2 scaled at AI2 min*	(*Visible when 16.01 Module 3 type* = *FIO-11* or *FAIO-01*) See parameter *14.50 AI2 scaled at AI2 min*.	0.000

No.	Name/Value	Description	Def/FbEq16
16.51	*AI2 scaled at AI2 max*	*(Visible when 16.01 Module 3 type = FIO-11* or *FAIO-01)* See parameter *14.51 AI2 scaled at AI2 max*.	100.000
16.56	*AI3 actual value*	*(Visible when 16.01 Module 3 type = FIO-11)* See parameter *14.56 AI3 actual value*.	-
16.57	*AI3 scaled value*	*(Visible when 16.01 Module 3 type = FIO-11)* See parameter *14.57 AI3 scaled value*.	-
16.58	*AI3 force data*	*(Visible when 16.01 Module 3 type = FIO-11)* See parameter *14.58 AI3 force data*.	0.000 mA
16.59	*AI3 HW switch position*	*(Visible when 16.01 Module 3 type = FIO-11)* See parameter *14.59 AI3 HW switch position*.	-
16.60	*AI3 unit selection*	*(Visible when 16.01 Module 3 type = FIO-11)* See parameter *14.60 AI3 unit selection*.	*mA*
16.61	*AI3 filter gain*	*(Visible when 16.01 Module 3 type = FIO-11)* See parameter *14.61 AI3 filter gain*.	*1 ms*
16.62	*AI3 filter time*	*(Visible when 16.01 Module 3 type = FIO-11)* See parameter *14.62 AI3 filter time*.	0.100 s
16.63	*AI3 min*	*(Visible when 16.01 Module 3 type = FIO-11)* See parameter *14.63 AI3 min*.	0.000 mA or V
16.64	*AI3 max*	*(Visible when 16.01 Module 3 type = FIO-11)* See parameter *14.64 AI3 max*.	10.000 mA or V
16.65	*AI3 scaled at AI3 min*	*(Visible when 16.01 Module 3 type = FIO-11)* See parameter *14.65 AI3 scaled at AI3 min*.	0.000
16.66	*AI3 scaled at AI3 max*	*(Visible when 16.01 Module 3 type = FIO-11)* See parameter *14.66 AI3 scaled at AI3 max*.	100.000
16.71	*AO force selection*	*(Visible when 16.01 Module 3 type = FIO-11* or *FAIO-01)* See parameter *14.71 AO force selection*.	00b
16.76	*AO1 actual value*	*(Visible when 16.01 Module 3 type = FIO-11* or *FAIO-01)* See parameter *14.76 AO1 actual value*.	-
16.77	*AO1 source*	*(Visible when 16.01 Module 3 type = FIO-11* or *FAIO-01)* See parameter *14.77 AO1 source*.	*Zero*
16.78	*AO1 force data*	*(Visible when 16.01 Module 3 type = FIO-11* or *FAIO-01)* See parameter *14.78 AO1 force data*.	0.000 mA
16.79	*AO1 filter time*	*(Visible when 16.01 Module 3 type = FIO-11* or *FAIO-01)* See parameter *14.79 AO1 filter time*.	0.100 s
16.80	*AO1 source min*	*(Visible when 16.01 Module 3 type = FIO-11* or *FAIO-01)* See parameter *14.80 AO1 source min*.	0.0
16.81	*AO1 source max*	*(Visible when 16.01 Module 3 type = FIO-11* or *FAIO-01)* See parameter *14.81 AO1 source max*.	100.0
16.82	*AO1 out at AO1 src min*	*(Visible when 16.01 Module 3 type = FIO-11* or *FAIO-01)* See parameter *14.82 AO1 out at AO1 src min*.	0.000 mA
16.83	*AO1 out at AO1 src max*	*(Visible when 16.01 Module 3 type = FIO-11* or *FAIO-01)* See parameter *14.83 AO1 out at AO1 src max*.	10.000 mA
16.86	*AO2 actual value*	*(Visible when 16.01 Module 3 type = FAIO-01)* See parameter *14.86 AO2 actual value*.	-
16.87	*AO2 source*	*(Visible when 16.01 Module 3 type = FAIO-01)* See parameter *14.87 AO2 source*.	*Zero*

No.	Name/Value	Description	Def/FbEq16
16.88	*AO2 force data*	*(Visible when 16.01 Module 3 type = FAIO-01)* See parameter *14.88 AO2 force data*.	0.000 mA
16.89	*AO2 filter time*	*(Visible when 16.01 Module 3 type = FAIO-01)* See parameter *14.89 AO2 filter time*.	0.100 s
16.90	*AO2 source min*	*(Visible when 16.01 Module 3 type = FAIO-01)* See parameter *14.90 AO2 source min*.	0.0
16.91	*AO2 source max*	*(Visible when 16.01 Module 3 type = FAIO-01)* See parameter *14.91 AO2 source max*.	100.0
16.92	*AO2 out at AO2 src min*	*(Visible when 16.01 Module 3 type = FAIO-01)* See parameter *14.92 AO2 out at AO2 src min*.	0.000 mA
16.93	*AO2 out at AO2 src max*	*(Visible when 16.01 Module 3 type = FAIO-01)* See parameter *14.93 AO2 out at AO2 src max*.	10.000 mA

19 Operation mode		Selection of local and external control location sources and operating modes. See also section *Operating modes of the drive* (page *22*).	
19.01	*Actual operation mode*	Displays the operating mode currently used. See parameters *19.11*…*19.14*. This parameter is read-only.	-
	Zero	None.	1
	Speed	Speed control (in DTC motor control mode).	2
	Torque	Torque control (in DTC motor control mode).	3
	Min	The torque selector is comparing the output of the speed controller (*25.01 Torque reference speed control*) and torque reference (*26.74 Torque ref ramp out*) and the smaller of the two is used.	4
	Max	The torque selector is comparing the output of the speed controller (*25.01 Torque reference speed control*) and torque reference (*26.74 Torque ref ramp out*) and the greater of the two is used.	5
	Add	The speed controller output is added to the torque reference.	6
	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	*EXT2*
	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

No.	Name/Value	Description	Def/FbEq16
	DI5	Digital input DI5 (*10.02 DI delayed status*, bit 4).	7
	DI6	Digital input DI6 (*10.02 DI delayed status*, bit 5).	8
	DIO1	Digital input/output DIO1 (*11.02 DIO delayed status*, bit 0).	11
	DIO2	Digital input/output DIO2 (*11.02 DIO delayed status*, bit 1).	12
	EFB MCW bit 11	Control word bit 11 received through the embedded fieldbus 32 interface.	32
	Other [bit]	Source selection (see *Terms and abbreviations* on page *187*).	-
19.12	*Ext1 control mode*	Selects the operating mode for external control location EXT1.	*Speed*
	Zero	None.	1
	Speed	Speed control. The torque reference used is *25.01 Torque reference speed control* (output of the speed reference chain).	2
	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	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*
19.16	*Local control mode*	Selects the operating mode for local control.	*Speed*
	Speed	Speed control. The torque reference used is *25.01 Torque reference speed control* (output of the speed reference chain).	0
	Torque	Torque control. The torque reference used is *26.74 Torque ref ramp out* (output of the torque reference chain).	1

<table>
<tr><th>No.</th><th>Name/Value</th><th>Description</th><th>Def/FbEq16</th></tr>
<tr><td>19.17</td><td>Local control disable</td><td>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.</td><td>No</td></tr>
<tr><td></td><td>No</td><td>Local control enabled.</td><td>0</td></tr>
<tr><td></td><td>Yes</td><td>Local control disabled.</td><td>1</td></tr>
<tr><td>19.20</td><td>Scalar control reference unit</td><td>Selects the reference type for scalar motor control mode. See also section Operating modes of the drive (page 22), and parameter 99.04 Motor control mode.</td><td>Rpm</td></tr>
<tr><td></td><td>Hz</td><td>Hz.</td><td>0</td></tr>
<tr><td></td><td>Rpm</td><td>Rpm. The reference is taken from parameter 23.02 Speed ref ramp output (speed reference after ramping and shaping).</td><td>1</td></tr>
</table>

<table>
<tr><td colspan="2">20 Start/stop/direction</td><td>Start/stop/direction and run/start/jog enable signal source selection; positive/negative reference enable signal source selection.
For information on control locations, see section Local control vs. external control (page 20).</td><td></td></tr>
<tr><td>20.01</td><td>Ext1 commands</td><td>Selects the source of start, stop and direction commands for external control location 1 (EXT1).
See also parameters 20.02…20.05.</td><td>Not selected</td></tr>
<tr><td></td><td>Not selected</td><td>No start or stop command sources selected.</td><td>0</td></tr>
<tr><td></td><td>In1 Start</td><td>The source of the start and stop commands is selected by parameter 20.03 Ext1 in1 source. The state transitions of the source bits are interpreted as follows:
<table><tr><th>State of source 1 (20.03)</th><th>Command</th></tr><tr><td>0 -> 1 (20.02 = Edge)
1 (20.02 = Level)</td><td>Start</td></tr><tr><td>0</td><td>Stop</td></tr></table></td><td>1</td></tr>
<tr><td></td><td>In1 Start; In2 Dir</td><td>The source selected by 20.03 Ext1 in1 source is the start signal; the source selected by 20.04 Ext1 in2 source determines the direction. The state transitions of the source bits are interpreted as follows:
<table><tr><th>State of source 1 (20.03)</th><th>State of source 2 (20.04)</th><th>Command</th></tr><tr><td>0</td><td>Any</td><td>Stop</td></tr><tr><td rowspan="2">0 -> 1 (20.02 = Edge)
1 (20.02 = Level)</td><td>0</td><td>Start forward</td></tr><tr><td>1</td><td>Start reverse</td></tr></table></td><td>2</td></tr>
</table>

<table>
<tr><th>No.</th><th>Name/Value</th><th>Description</th><th>Def/FbEq16</th></tr>
<tr><td></td><td>In1 Start fwd; In2 Start rev</td><td>The source selected by 20.03 Ext1 in1 source is the forward start signal; the source selected by 20.04 Ext1 in2 source is the reverse start signal. The state transitions of the source bits are interpreted as follows:
<table>
<tr><th>State of source 1 (20.03)</th><th>State of source 2 (20.04)</th><th>Command</th></tr>
<tr><td>0</td><td>0</td><td>Stop</td></tr>
<tr><td>0 -> 1 (20.02 = Edge)
1 (20.02 = Level)</td><td>0</td><td>Start forward</td></tr>
<tr><td>0</td><td>0 -> 1 (20.02 = Edge)
1 (20.02 = Level)</td><td>Start reverse</td></tr>
<tr><td>1</td><td>1</td><td>Stop</td></tr>
</table></td><td>3</td></tr>
<tr><td></td><td>In1P Start; In2 Stop</td><td>The sources of the start and stop commands are selected by parameters 20.03 Ext1 in1 source and 20.04 Ext1 in2 source. The state transitions of the source bits are interpreted as follows:
<table>
<tr><th>State of source 1 (20.03)</th><th>State of source 2 (20.04)</th><th>Command</th></tr>
<tr><td>0 -> 1</td><td>1</td><td>Start</td></tr>
<tr><td>Any</td><td>0</td><td>Stop</td></tr>
</table>
Notes:
• The start signal is always edge-triggered with this setting regardless of parameter 20.02 Ext1 start trigger type.
• When source 2 is 0, the Start and Stop keys on the control panel are disabled.</td><td>4</td></tr>
<tr><td></td><td>In1P Start; In2 Stop; In3 Dir</td><td>The sources of the start and stop commands are selected by parameters 20.03 Ext1 in1 source and 20.04 Ext1 in2 source. The source selected by 20.05 Ext1 in3 source determines the direction. The state transitions of the source bits are interpreted as follows:
<table>
<tr><th>State of source 1 (20.03)</th><th>State of source 2 (20.04)</th><th>State of source 3 (20.05)</th><th>Command</th></tr>
<tr><td>0 -> 1</td><td>1</td><td>0</td><td>Start forward</td></tr>
<tr><td>0 -> 1</td><td>1</td><td>1</td><td>Start reverse</td></tr>
<tr><td>Any</td><td>0</td><td>Any</td><td>Stop</td></tr>
</table>
Notes:
• The start signal is always edge-triggered with this setting regardless of parameter 20.02 Ext1 start trigger type.
• When source 2 is 0, the Start and Stop keys on the control panel are disabled.</td><td>5</td></tr>
</table>

<table>
<tr><th>No.</th><th>Name/Value</th><th>Description</th><th>Def/FbEq16</th></tr>
<tr><td></td><td>In1P Start fwd; In2P Start rev; In3 Stop</td><td>The sources of the start and stop commands are selected by parameters *20.03 Ext1 in1 source*, *20.04 Ext1 in2 source* and *20.05 Ext1 in3 source*. The state transitions of the source bits are interpreted as follows:
<table>
<tr><th>State of source 1 (*20.03*)</th><th>State of source 2 (*20.04*)</th><th>State of source 3 (*20.05*)</th><th>Command</th></tr>
<tr><td>0 -> 1</td><td>Any</td><td>1</td><td>Start forward</td></tr>
<tr><td>Any</td><td>0 -> 1</td><td>1</td><td>Start reverse</td></tr>
<tr><td>Any</td><td>Any</td><td>0</td><td>Stop</td></tr>
</table>
Note: The start signal is always edge-triggered with this setting regardless of parameter *20.02 Ext1 start trigger type*.</td><td>6</td></tr>
<tr><td></td><td>Control panel</td><td>The start and stop commands are taken from the control panel.</td><td>11</td></tr>
<tr><td></td><td>Fieldbus A</td><td>The start and stop commands are taken from fieldbus adapter A.
Note: The start signal is always level-triggered with this setting regardless of parameter *20.02 Ext1 start trigger type*.</td><td>12</td></tr>
<tr><td></td><td>Embedded fieldbus</td><td>The start and stop commands are taken from the embedded fieldbus interface.
Note: The start signal is always level-triggered with this setting regardless of parameter *20.02 Ext1 start trigger type*.</td><td>14</td></tr>
<tr><td></td><td>M/F link</td><td>The start and stop commands are taken from another drive through the master/follower link.
Note: The start signal is always level-triggered with this setting regardless of parameter *20.02 Ext1 start trigger type*.</td><td>15</td></tr>
<tr><td></td><td>Application Program</td><td>The start and stop commands are taken from the application program control word (parameter *06.02 Application control word*).
Note: The start signal is always level-triggered with this setting regardless of parameter *20.02 Ext1 start trigger type*.</td><td>21</td></tr>
<tr><td></td><td>ATF</td><td>Reserved.</td><td>22</td></tr>
<tr><td></td><td>DDCS controller</td><td>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*.</td><td>16</td></tr>
<tr><td>*20.02*</td><td>*Ext1 start trigger type*</td><td>Defines whether the start signal for external control location EXT1 is edge-triggered or level-triggered.
Note: This parameter is only effective when parameter *20.01 Ext1 commands* is set to *In1 Start*, *In1 Start; In2 Dir* or *In1 Start fwd; In2 Start rev* or *Control panel*.</td><td>*Level*</td></tr>
<tr><td></td><td>Edge</td><td>The start signal is edge-triggered.</td><td>0</td></tr>
<tr><td></td><td>Level</td><td>The start signal is level-triggered.</td><td>1</td></tr>
</table>

<table>
<tr><th>No.</th><th>Name/Value</th><th>Description</th><th>Def/FbEq16</th></tr>
<tr><td>20.03</td><td>Ext1 in1 source</td><td>Selects source 1 for parameter 20.01 Ext1 commands.</td><td>Not selected</td></tr>
<tr><td></td><td>Not selected</td><td>0 (always off).</td><td>0</td></tr>
<tr><td></td><td>Selected</td><td>1 (always on).</td><td>1</td></tr>
<tr><td></td><td>DI1</td><td>Digital input DI1 (10.02 DI delayed status, bit 0).</td><td>2</td></tr>
<tr><td></td><td>DI2</td><td>Digital input DI2 (10.02 DI delayed status, bit 1).</td><td>3</td></tr>
<tr><td></td><td>DI3</td><td>Digital input DI3 (10.02 DI delayed status, bit 2).</td><td>4</td></tr>
<tr><td></td><td>DI4</td><td>Digital input DI4 (10.02 DI delayed status, bit 3).</td><td>5</td></tr>
<tr><td></td><td>DI5</td><td>Digital input DI5 (10.02 DI delayed status, bit 4).</td><td>6</td></tr>
<tr><td></td><td>DI6</td><td>Digital input DI6 (10.02 DI delayed status, bit 5).</td><td>7</td></tr>
<tr><td></td><td>DIO1</td><td>Digital input/output DIO1 (11.02 DIO delayed status, bit 0).</td><td>10</td></tr>
<tr><td></td><td>DIO2</td><td>Digital input/output DIO2 (11.02 DIO delayed status, bit 1).</td><td>11</td></tr>
<tr><td></td><td>Other [bit]</td><td>Source selection (see Terms and abbreviations on page 187).</td><td>-</td></tr>
<tr><td>20.04</td><td>Ext1 in2 source</td><td>Selects source 2 for parameter 20.01 Ext1 commands.
For the available selections, see parameter 20.03 Ext1 in1 source.</td><td>Not selected</td></tr>
<tr><td>20.05</td><td>Ext1 in3 source</td><td>Selects source 3 for parameter 20.01 Ext1 commands.
For the available selections, see parameter 20.03 Ext1 in1 source.</td><td>Not selected</td></tr>
<tr><td>20.06</td><td>Ext2 commands</td><td>Selects the source of start, stop and direction commands for external control location 2 (EXT2).
See also parameters 20.07…20.10.</td><td>Not selected</td></tr>
<tr><td></td><td>Not selected</td><td>No start or stop command sources selected.
Note: This selection is required for group 75 Winch interface control stands to work.</td><td>0</td></tr>
<tr><td></td><td>In1 Start</td><td>The source of the start and stop commands is selected by parameter 20.08 Ext2 in1 source. The state transitions of the source bits are interpreted as follows:
<table>
<tr><th>State of source 1 (20.08)</th><th>Command</th></tr>
<tr><td>0 -> 1 (20.07 = Edge)
1 (20.07 = Level)</td><td>Start</td></tr>
<tr><td>0</td><td>Stop</td></tr>
</table></td><td>1</td></tr>
<tr><td></td><td>In1 Start; In2 Dir</td><td>The source selected by 20.08 Ext2 in1 source is the start signal; the source selected by 20.09 Ext2 in2 source determines the direction. The state transitions of the source bits are interpreted as follows:
<table>
<tr><th>State of source 1 (20.08)</th><th>State of source 2 (20.09)</th><th>Command</th></tr>
<tr><td>0</td><td>Any</td><td>Stop</td></tr>
<tr><td rowspan="2">0 -> 1 (20.07 = Edge)
1 (20.07 = Level)</td><td>0</td><td>Start forward</td></tr>
<tr><td>1</td><td>Start reverse</td></tr>
</table></td><td>2</td></tr>
</table>

<table>
<tr><th>No.</th><th>Name/Value</th><th>Description</th><th>Def/FbEq16</th></tr>
<tr><td></td><td>In1 Start fwd; In2 Start rev</td><td>The source selected by 20.08 Ext2 in1 source is the forward start signal; the source selected by 20.09 Ext2 in2 source is the reverse start signal. The state transitions of the source bits are interpreted as follows:
<table>
<tr><th>State of source 1 (20.08)</th><th>State of source 2 (20.09)</th><th>Command</th></tr>
<tr><td>0</td><td>0</td><td>Stop</td></tr>
<tr><td>0 -> 1 (20.07 = Edge)
1 (20.07 = Level)</td><td>0</td><td>Start forward</td></tr>
<tr><td>0</td><td>0 -> 1 (20.07 = Edge)
1 (20.07 = Level)</td><td>Start reverse</td></tr>
<tr><td>1</td><td>1</td><td>Stop</td></tr>
</table></td><td>3</td></tr>
<tr><td></td><td>In1P Start; In2 Stop</td><td>The sources of the start and stop commands are selected by parameters 20.08 Ext2 in1 source and 20.09 Ext2 in2 source. The state transitions of the source bits are interpreted as follows:
<table>
<tr><th>State of source 1 (20.08)</th><th>State of source 2 (20.09)</th><th>Command</th></tr>
<tr><td>0 -> 1</td><td>1</td><td>Start</td></tr>
<tr><td>Any</td><td>0</td><td>Stop</td></tr>
</table>
Notes:
• The start signal is always edge-triggered with this setting regardless of parameter 20.07 Ext2 start trigger type.</td><td>4</td></tr>
<tr><td></td><td>In1P Start; In2 Stop; In3 Dir</td><td>The sources of the start and stop commands are selected by parameters 20.08 Ext2 in1 source and 20.09 Ext2 in2 source. The source selected by 20.10 Ext2 in3 source determines the direction. The state transitions of the source bits are interpreted as follows:
<table>
<tr><th>State of source 1 (20.08)</th><th>State of source 2 (20.09)</th><th>State of source 3 (20.10)</th><th>Command</th></tr>
<tr><td>0 -> 1</td><td>1</td><td>0</td><td>Start forward</td></tr>
<tr><td>0 -> 1</td><td>1</td><td>1</td><td>Start reverse</td></tr>
<tr><td>Any</td><td>0</td><td>Any</td><td>Stop</td></tr>
</table>
Notes:
• The start signal is always edge-triggered with this setting regardless of parameter 20.07 Ext2 start trigger type.</td><td>5</td></tr>
</table>

No.	Name/Value	Description	Def/FbEq16
	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:	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

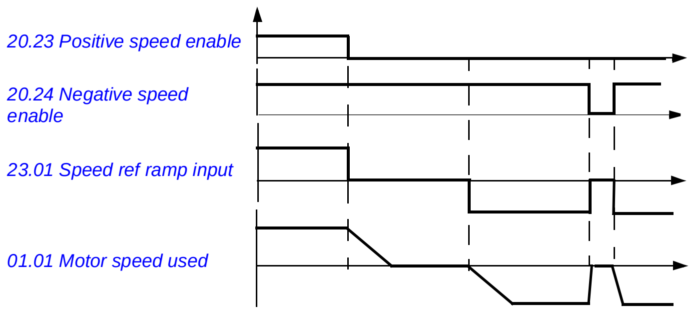
Note: The start signal is always edge-triggered with this setting regardless of parameter *20.07 Ext2 start trigger type*.

No.	Name/Value	Description	Def/FbEq16
	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 level-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 level-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 level-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 level-triggered with this setting regardless of parameter *20.07 Ext2 start trigger type*.	21
	ATF	Reserved.	22
	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 *20.07 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* or *In1 Start fwd; In2 Start rev* or *Control panel*.	*Level*
	Edge	The start signal is edge-triggered.	0
	Level	The start signal is level-triggered.	1

No.	Name/Value	Description	Def/FbEq16
20.08	*Ext2 in1 source*	Selects source 1 for parameter *20.06 Ext2 commands*. For the available selections, see parameter *20.03 Ext1 in1 source*.	*Not selected*
20.09	*Ext2 in2 source*	Selects source 2 for parameter *20.06 Ext2 commands*. For the available selections, see parameter *20.03 Ext1 in1 source*.	*Not selected*
20.10	*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*
20.11	*Run enable stop mode*	Selects the way the motor is stopped when the run enable signal switches off. The source of the run enable signal is selected by parameter *20.12 Run enable 1 source*.	*Coast* (*95.20* b10)
	Coast	Stop by switching off the output semiconductors of the drive. The motor coasts to a stop. **WARNING!** If a mechanical brake is used, ensure it is safe to stop the drive by coasting.	0
	Ramp	Stop along the active deceleration ramp. See parameter group *23 Speed reference ramp* on page *307*.	1
	Torque limit	Stop according to torque limits (parameters *30.19* and *30.20*).	2
20.12	*Run enable 1 source*	Selects the source of the external run enable signal. If the run enable signal is switched off, the drive will not start. If already running, the drive will stop according to the setting of parameter *20.11 Run enable stop mode*. 1 = Run enable signal on. **Note:** The warning that indicates a missing signal can be suppressed using parameter *20.30 Enable signals warning function*. See also parameter *20.19 Enable start command*.	*DIIL* (*95.20* b10) *Selected* (*95.20* b5) *DI5* (*95.20* b9)
	Not selected	0.	0
	Selected	1.	1
	DI1	Digital input DI1 (*10.02 DI delayed status*, bit 0).	2
	DI2	Digital input DI2 (*10.02 DI delayed status*, bit 1).	3
	DI3	Digital input DI3 (*10.02 DI delayed status*, bit 2).	4
	DI4	Digital input DI4 (*10.02 DI delayed status*, bit 3).	5
	DI5	Digital input DI5 (*10.02 DI delayed status*, bit 4).	6
	DI6	Digital input DI6 (*10.02 DI delayed status*, bit 5).	7
	DIO1	Digital input/output DIO1 (*11.02 DIO delayed status*, bit 0).	10
	DIO2	Digital input/output DIO2 (*11.02 DIO delayed status*, bit 1).	11
	FBA A MCW bit 3	Control word bit 3 received through fieldbus interface A.	30
	EFB MCW bit 3	Control word bit 3 received through the embedded fieldbus interface.	32
	DIIL	DIIL input (*10.02 DI delayed status*, bit 15).	33

No.	Name/Value	Description	Def/FbEq16
	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]	Source selection (see *Terms and abbreviations* on page *187*).	-
20.19	*Enable start command*	Selects the source for the start enable signal. 1 = Start enable. With the signal switched off, any drive start command is inhibited. (Switching the signal off while the drive is running will not stop the drive.) Notes: • If a level-triggered start command is on when the start enable signal switches on, the drive will start. (An edge-triggered start signal must be cycled for the drive to start.) See parameters *20.02 Ext1 start trigger type* and *20.07 Ext2 start trigger type*. • The warning that indicates a missing signal can be suppressed using parameter *20.30 Enable signals warning function*. See also parameter *20.12 Run enable 1 source*.	*Selected*
	Not selected	0.	0
	Selected	1.	1
	DI1	Digital input DI1 (*10.02 DI delayed status*, bit 0).	2
	DI2	Digital input DI2 (*10.02 DI delayed status*, bit 1).	3
	DI3	Digital input DI3 (*10.02 DI delayed status*, bit 2).	4
	DI4	Digital input DI4 (*10.02 DI delayed status*, bit 3).	5
	DI5	Digital input DI5 (*10.02 DI delayed status*, bit 4).	6
	DI6	Digital input DI6 (*10.02 DI delayed status*, bit 5).	7
	DIO1	Digital input/output DIO1 (*11.02 DIO delayed status*, bit 0).	10
	DIO2	Digital input/output DIO2 (*11.02 DIO delayed status*, bit 1).	11
	DIIL	DIIL input (*10.02 DI delayed status*, bit 15).	30
	Other [bit]	Source selection (see *Terms and abbreviations* on page *187*).	-

No.	Name/Value	Description	Def/FbEq16
20.23	*Positive speed enable*	Selects the source of the positive speed enable command. 1 = Positive speed enabled. 0 = Positive speed interpreted as zero speed reference. In the figure below, *23.01 Speed ref ramp input* is set to zero after the positive speed enable signal has cleared. Actions in different control modes: Speed control: Speed reference is set to zero and the motor is stopped along the currently active deceleration ramp. The rush controller prevents additional torque terms from running the motor in the positive direction. Torque control: The rush controller monitors the rotation direction of the motor.	*Selected*



No.	Name/Value	Description	Def/FbEq16
		Example: The motor is rotating in the forward direction. To stop the motor, the positive speed enable signal is deactivated by a hardware limit switch (e.g. via digital input). If the positive speed enable signal remains deactivated and the negative speed enable signal is active, only reverse rotation of the motor is allowed.	
	Not selected	0.	0
	Selected	1.	1
	DI1	Digital input DI1 (*10.02 DI delayed status*, bit 0).	2
	DI2	Digital input DI2 (*10.02 DI delayed status*, bit 1).	3
	DI3	Digital input DI3 (*10.02 DI delayed status*, bit 2).	4
	DI4	Digital input DI4 (*10.02 DI delayed status*, bit 3).	5
	DI5	Digital input DI5 (*10.02 DI delayed status*, bit 4).	6
	DI6	Digital input DI6 (*10.02 DI delayed status*, bit 5).	7
	DIO1	Digital input/output DIO1 (*11.02 DIO delayed status*, bit 0).	10
	DIO2	Digital input/output DIO2 (*11.02 DIO delayed status*, bit 1).	11
	Other [bit]	Source selection (see *Terms and abbreviations* on page *187*).	-

No.	Name/Value	Description	Def/FbEq16
20.24	*Negative speed enable*	Selects the source of the negative speed reference enable command. See parameter *20.23 Positive speed enable*.	*Selected*
20.25	*Jogging enable*	Selects the source for a jog enable signal. (The sources for jogging activation signals are selected by parameters *20.26 Jogging 1 start source* and *20.27 Jogging 2 start source*.) 1 = Jogging is enabled. 0 = Jogging is disabled. **Note**: Jogging can be enabled only when no start command from an external control location is active. On the other hand, if jogging is already enabled, the drive cannot be started from an external control location (apart from inching commands through fieldbus). See section *Jogging* (page *153*). **Note**: For winch application, jogging is not available in EXT2 mode, but available in EXT1.	*Not selected*
	Not selected	0.	0
	Selected	1.	1
	DI1	Digital input DI1 (*10.02 DI delayed status*, bit 0).	2
	DI2	Digital input DI2 (*10.02 DI delayed status*, bit 1).	3
	DI3	Digital input DI3 (*10.02 DI delayed status*, bit 2).	4
	DI4	Digital input DI4 (*10.02 DI delayed status*, bit 3).	5
	DI5	Digital input DI5 (*10.02 DI delayed status*, bit 4).	6
	DI6	Digital input DI6 (*10.02 DI delayed status*, bit 5).	7
	DIO1	Digital input/output DIO1 (*11.02 DIO delayed status*, bit 0).	10
	DIO2	Digital input/output DIO2 (*11.02 DIO delayed status*, bit 1).	11
	Other [bit]	Source selection (see *Terms and abbreviations* on page *187*).	-
20.26	*Jogging 1 start source*	If enabled by parameter *20.25 Jogging enable*, selects the source for the activation of jogging function 1. (Jogging function 1 can also be activated through fieldbus regardless of parameter *20.25*.) 1 = Jogging 1 active. **Note**: If both jogging 1 and 2 are activated, the one that was activated first has priority.	*Not selected*
	Not selected	0.	0
	Selected	1.	1
	DI1	Digital input DI1 (*10.02 DI delayed status*, bit 0).	2
	DI2	Digital input DI2 (*10.02 DI delayed status*, bit 1).	3
	DI3	Digital input DI3 (*10.02 DI delayed status*, bit 2).	4
	DI4	Digital input DI4 (*10.02 DI delayed status*, bit 3).	5
	DI5	Digital input DI5 (*10.02 DI delayed status*, bit 4).	6
	DI6	Digital input DI6 (*10.02 DI delayed status*, bit 5).	7
	DIO1	Digital input/output DIO1 (*11.02 DIO delayed status*, bit 0).	10

No.	Name/Value	Description	Def/FbEq16
	DIO2	Digital input/output DIO2 (*11.02 DIO delayed status*, bit 1).	11
	Other [bit]	Source selection (see *Terms and abbreviations* on page *187*).	-
20.27	*Jogging 2 start source*	If enabled by parameter *20.25 Jogging enable*, selects the source for the activation of jogging function 2. (Jogging function 2 can also be activated through fieldbus regardless of parameter *20.25*.) 1 = Jogging 2 active. For the selections, see parameter *20.26 Jogging 1 start source*. **Note**: If both jogging 1 and 2 are activated, the one that was activated first has priority.	*Not selected*
20.29	*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*
	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, i.e. no warning is generated even if the signal is switched off. The bits of this binary number correspond to the following warnings:	00b

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

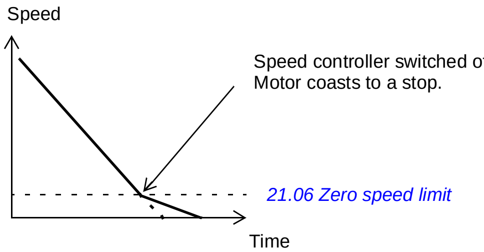
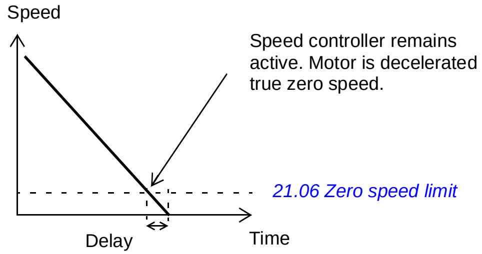
No.	Name/Value	Description	Def/FbEq16
	00b…11b	Suppression of “enable signal missing” warnings.	1 = 1
20.200	*Power on acknowledge*	Selects the source for activating the power on acknowledgement signal. 0 = Power on acknowledgement signal is inactive. 1 = Power on acknowledgement signal is active.	*DIIL*
	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
	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]	Source selection (see *Terms and abbreviations* on page *187*).	-

No.	Name/Value	Description	Def/FbEq16
20.201	*Power on ackn reset delay*	Defines the time delay for a fault reset after the power on acknowledgement signal is activated.	1000
	0...30000 ms	Time delay.	1 = 1
21 Start/stop mode		Start and stop modes; emergency stop mode and signal source selection; DC magnetization settings; autophasing mode selection.	
21.01	*Start mode*	Selects the motor start function for the DTC motor control mode, ie. when *99.04 Motor control mode* is set to *DTC*. **Notes**: • The start function for the scalar motor control mode is selected by parameter *21.19 Scalar start mode*. • Starting into a rotating motor is not possible when DC magnetizing is selected (*Fast* or *Constant time*). • With permanent magnet motors and synchronous reluctance motors, *Automatic* start mode must be used. • This parameter cannot be changed while the drive is running. See also section *DC magnetization* (page *161*).	*Constant time*
	Fast	The drive pre-magnetizes the motor before start. The pre-magnetizing time is determined automatically, being typically 200 ms to 2 s depending on motor size. This mode should be selected if a high break-away torque is required.	0
	Constant time	The drive pre-magnetizes the motor before start. The pre-magnetizing time is defined by parameter *21.02 Magnetization time*. This mode should be selected if constant pre-magnetizing time is required (e.g. if the motor start must be synchronized with the release of a mechanical brake). This setting also guarantees the highest possible break-away torque when the pre-magnetizing time is set long enough. **WARNING!** The drive will start after the set magnetizing time has passed even if motor magnetization is not completed. In applications where a full break-away torque is essential, ensure that the constant magnetizing time is long enough to allow generation of full magnetization and torque.	1
	Automatic	Automatic start guarantees optimal motor start in most cases. It includes the flying start function (starting into a rotating motor) and the automatic restart function (a stopped motor can be restarted immediately without waiting the motor flux to die away). The drive motor control program identifies the flux as well as the mechanical state of the motor and starts the motor instantly under all conditions.	2
	Flying start	This method is intended for asynchronous motors only, and is optimized for applications where the drive must be started into a rotating motor at high frequencies (above 150 Hz).	3

<table>
<tr><th>No.</th><th>Name/Value</th><th>Description</th><th>Def/FbEq16</th></tr>
<tr><td>21.02</td><td>Magnetization time</td><td>Defines the pre-magnetization time when
• parameter 21.01 Start mode is set to Constant time (in DTC motor control mode), or
• parameter 21.19 Scalar start mode is set to Const time (in scalar motor control mode).
After the start command, the drive automatically premagnetizes the motor for the set time. To ensure full magnetizing, set this parameter to the same value as, or higher than, the rotor time constant. If not known, use the rule-of-thumb value given in the table below:
<table>
<tr><th>Motor rated power</th><th>Constant magnetizing time</th></tr>
<tr><td>< 1 kW</td><td>≥ 50 to 100 ms</td></tr>
<tr><td>1 to 10 kW</td><td>≥ 100 to 200 ms</td></tr>
<tr><td>10 to 200 kW</td><td>≥ 200 to 1000 ms</td></tr>
<tr><td>200 to 1000 kW</td><td>≥ 1000 to 2000 ms</td></tr>
</table>
Note: This parameter cannot be changed while the drive is running.</td><td>500 ms</td></tr>
<tr><td></td><td>0 … 10000 ms</td><td>Constant DC magnetizing time.</td><td>1 = 1 ms</td></tr>
<tr><td>21.03</td><td>Stop mode</td><td>Selects the way the motor is stopped when a stop command is received.
Additional braking is possible by selecting flux braking (see parameter 97.05 Flux braking).
Note: This parameter has no effect in a follower drive in a master/follower configuration.
Note: This parameter is controlled by the Winch program. Normally, the stop mode is always in Ramp.
This parameter is read only.</td><td>Ramp</td></tr>
<tr><td></td><td>Coast</td><td>Stop by switching off the output semiconductors of the drive. The motor coasts to a stop.
WARNING! If a mechanical brake is used, ensure it is safe to stop the drive by coasting.</td><td>0</td></tr>
<tr><td></td><td>Ramp</td><td>Stop along the active deceleration ramp. See parameter group 23 Speed reference ramp on page 307.</td><td>1</td></tr>
<tr><td></td><td>Torque limit</td><td>Stop according to torque limits (parameters 30.19 and 30.20).</td><td>2</td></tr>
</table>

No.	Name/Value	Description	Def/FbEq16
21.04	*Emergency stop mode*	Selects the way the motor is stopped when an emergency stop command is received. The source of the emergency stop signal is selected by parameter *21.05 Emergency stop source*.	*Ramp stop (Off1)*; *Coast stop (Off2)* (*95.20* b1); *Eme ramp stop (Off3)* (*95.20* b2);
	Ramp stop (Off1)	With the drive running: • 1 = Normal operation. • 0 = Normal stop along the standard deceleration ramp defined for the particular reference type (see section *Reference ramping* [page *139*]). After the drive has stopped, it can be restarted by removing the emergency stop signal and switching the start signal from 0 to 1. With the drive stopped: • 1 = Starting allowed. 0 = Starting not allowed.	0
	Coast stop (Off2)	With the drive running: • 1 = Normal operation. • 0 = Stop by coasting. The drive can be restarted by restoring the start interlock signal and switching the start signal from 0 to 1. With the drive stopped: • 1 = Starting allowed. • 0 = Starting not allowed.	1
	Eme ramp stop (Off3)	With the drive running: • 1 = Normal operation. • 0 = Stop by ramping along emergency stop ramp defined by parameter *23.23 Emergency stop time*. After the drive has stopped, it can be restarted by removing the emergency stop signal and switching the start signal from 0 to 1. With the drive stopped: • 1 = Starting allowed. 0 = Starting not allowed.	2
21.05	*Emergency stop source*	Selects the source of the emergency stop signal. The stop mode is selected by parameter *21.04 Emergency stop mode*. 0 = Emergency stop active 1 = Normal operation **Note:** This parameter cannot be changed while the drive is running.	*Inactive (true)*; *DI4* (*95.20* b1, *95.20* b2)
	Active (false)	0.	0
	Inactive (true)	1.	1
	DIIL	DIIL input (*10.02 DI delayed status*, bit 15).	2
	DI1	Digital input DI1 (*10.02 DI delayed status*, bit 0).	3
	DI2	Digital input DI2 (*10.02 DI delayed status*, bit 1).	4
	DI3	Digital input DI3 (*10.02 DI delayed status*, bit 2).	5
	DI4	Digital input DI4 (*10.02 DI delayed status*, bit 3).	6
	DI5	Digital input DI5 (*10.02 DI delayed status*, bit 4).	7
	DI6	Digital input DI6 (*10.02 DI delayed status*, bit 5).	8

No.	Name/Value	Description	Def/FbEq16
	DIO1	Digital input/output DIO1 (*11.02 DIO delayed status*, bit 0).	11
	DIO2	Digital input/output DIO2 (*11.02 DIO delayed status*, bit 1).	12
	Other [bit]	Source selection (see *Terms and abbreviations* on page *187*).	-
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
	0.00 … 30000.00 rpm	Zero speed limit.	See par. *46.01*

No.	Name/Value	Description	Def/FbEq16
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
	0 … 30000 ms	Zero speed delay.	1 = 1 ms

No.	Name/Value	Description	Def/FbEq16
21.08	*DC current control*	Activates/deactivates the DC hold and post-magnetization functions. See section *DC magnetization* (page *161*). **Notes**: • These functions are only available in speed control in DTC motor control mode (see page *22*). • 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.	00b

Bit	Name	Description
0	DC hold	1 = Enable DC hold. See section *DC hold* (page *161*). **Note:** The DC hold function has no effect if the start signal is switched off.
1	Post magnetization	1 = Enable post-magnetization. See section *Post-magnetization* (page *162*). **Note:** Post-magnetization is only available when ramping is the selected stop mode (see parameter *21.03 Stop mode*).
2…15	Reserved	

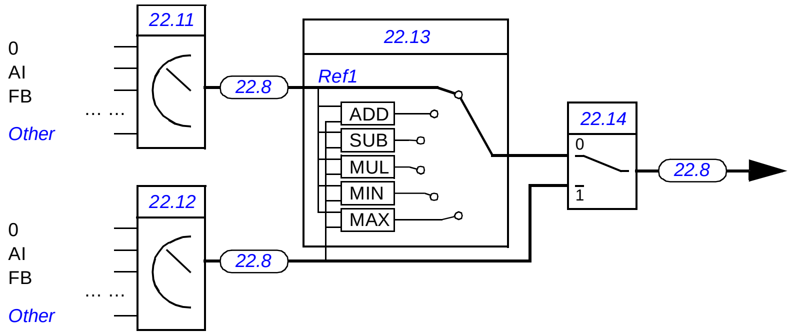
No.	Name/Value	Description	Def/FbEq16
	0000h…FFFFh	DC current control.	1 = 1
21.09	*DC hold speed*	Defines the DC hold speed. See parameter *21.08 DC current control*, and section *DC hold* (page *161*).	5.00 rpm
	0.00 … 1000.00 rpm	DC hold speed.	See par. *46.01*
21.10	*DC current reference*	Defines the DC hold current in percent of the motor nominal current. See parameter *21.08 DC current control*, and section *DC magnetization* (page *161*).	30.0%
	0.0 … 100.0%	DC hold current.	1 = 1%
21.11	*Post magnetization time*	Defines the length of time for which post-magnetization is active after stopping the motor. The magnetization current is defined by parameter *21.10 DC current reference*. See parameter *21.08 DC current control*.	0 s
	0…3000 s	Post-magnetization time.	1 = 1 s
21.13	*Autophasing mode*	Selects the way autophasing is performed. See section *Autophasing* on page *157*.	*Turning*
	Turning	This mode gives the most accurate autophasing result. This mode can be used, and is recommended, if the motor is allowed to rotate and the start-up is not time-critical. Note: This mode will cause the motor to rotate. The load torque must be less than 5%.	0
	Standstill 1	Faster than the *Turning* mode, but not as accurate. The motor will not rotate.	1
	Standstill 2	An alternative standstill autophasing mode that can be used if the *Turning* mode cannot be used, and the *Standstill 1* mode gives erratic results. However, this mode is considerably slower than *Standstill 1*.	2

No.	Name/Value	Description	Def/FbEq16
	Turning with Z-pulse	This mode should be used if the zero pulse signal of the pulse encoder is to be observed, and other modes do not give a result. The motor will turn until a zero pulse is detected.	3
21.14	*Pre-heating input source*	Selects the source of the motor pre-heat on/off command. See section *Pre-heating* (page *161*). 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)*
	Inactive (false)	0. Pre-heating is always deactivated.	0
	Active (true)	1. Pre-heating is always activated when the drive is stopped (apart from conditions stated above).	1
	DI1	Digital input DI1 (*10.02 DI delayed status*, bit 0).	2
	DI2	Digital input DI2 (*10.02 DI delayed status*, bit 1).	3
	DI3	Digital input DI3 (*10.02 DI delayed status*, bit 2).	4
	DI4	Digital input DI4 (*10.02 DI delayed status*, bit 3).	5
	DI5	Digital input DI5 (*10.02 DI delayed status*, bit 4).	6
	DI6	Digital input DI6 (*10.02 DI delayed status*, bit 5).	7
	Supervision 1	Supervision 1 active (*32.01 Supervision status*, bit 0).	8
	Supervision 2	Supervision 2 active (*32.01 Supervision status*, bit 1).	9
	Supervision 3	Supervision 3 active (*32.01 Supervision status*, bit 2).	10
	Other [bit]	Source selection (see *Terms and abbreviations* on page *187*).	-
21.15	*Pre-heating time delay*	Defines the delay time for the pre-heating function.	60 s
	10 … 3000	Pre-heating time delay.	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
	0.0 … 30.0%	Pre-heating current.	1 = 1%
21.18	*Auto restart time*	The motor can be automatically started after a short supply power failure using the automatic restart function. See section *Automatic restart* (page *165*). When this parameter is set to 0.0 seconds, automatic restarting is disabled. Otherwise, the parameter defines the maximum duration of the power failure after which restarting is attempted. Note that this time also includes the DC pre-charging delay.	5.0 s
	0.0...10.0 s	0.0 s = Automatic restarting disabled. 0.1 … 5.0 s = Maximum power failure duration.	10 = 1 s

No.	Name/Value	Description	Def/FbEq16
21.19	*Scalar start mode*	Selects the motor start function for the scalar motor control mode, ie. when *99.04 Motor control mode* is set to *Scalar*. **Notes**: • The start function for the DTC motor control mode is selected by parameter *21.01 Start mode*. • With permanent magnet motors, *Automatic* start mode must be used. • This parameter cannot be changed while the drive is running. See also section *DC magnetization* (page *161*).	*Normal*
	Normal	Immediate start from zero speed.	0
	Const time	The drive pre-magnetizes the motor before start. The pre-magnetizing time is defined by parameter *21.02 Magnetization time*. This mode should be selected if constant pre-magnetizing time is required (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	*Follower force ramp stop*	In a torque-controlled follower drive, forces (or selects a source that forces) the drive to switch to speed control upon a ramp stop (Off1 or Off3) command. This is required for an independent ramp stop of the follower. See also section *Master/follower functionality* (page *129*). 1 = Ramp stop forces speed control	*Not selected*
	Not selected	0.	0
	Selected	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

No.	Name/Value	Description	Def/FbEq16
	Other [bit]	Source selection (see *Terms and abbreviations* on page *187*).	-
21.37	*Motor temperature estimation*	Selects the source of the motor temperature estimation on/off command. See also section *Motor temperature estimation* (page *162*). **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)*
	Inactive (false)	0.	0
	Active (true)	1.	1
	DI1	Digital input DI1 (*10.02 DI delayed status*, bit 0).	2
	DI2	Digital input DI2 (*10.02 DI delayed status*, bit 1).	3
	DI3	Digital input DI3 (*10.02 DI delayed status*, bit 2).	4
	DI4	Digital input DI4 (*10.02 DI delayed status*, bit 3).	5
	DI5	Digital input DI5 (*10.02 DI delayed status*, bit 4).	6
	DI6	Digital input DI6 (*10.02 DI delayed status*, bit 5).	7
	Supervision 1	Supervision 1 active (*32.01 Supervision status*, bit 0).	8
	Supervision 2	Supervision 2 active (*32.01 Supervision status*, bit 1).	9
	Supervision 3	Supervision 3 active (*32.01 Supervision status*, bit 2).	10
	Drive start command	Motor temperature estimation is performed always with drive start command.	11
	Drive power-up	Motor temperature estimation is performed once after drive power-up (control board boot).	12
	Other [bit]	Source selection (see *Terms and abbreviations* on page *187*).	-
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
	0.5...20.0 s	Motor temperature estimation time in seconds.	10 = 1 s
22 Speed reference selection		Speed reference selection; motor potentiometer settings. See the control chain diagrams on pages *716*…*718*.	
22.01	*Speed ref unlimited*	Displays the output of the speed reference selection block. See the control chain diagram on page *717*. This parameter is read-only.	-
	-30000.00 … 30000.00 rpm	Value of the selected speed reference.	See par. *46.01*

No.	Name/Value	Description	Def/FbEq16
22.11	Speed ref1 source	(*Visible only when user lock is open with pass code 584. See parameter 96.02 Pass code.*) 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. **Note:** When winch interface (see *Winch control interface*) control stands are used, the reference comes from the winch interface and overrides selections made in this parameter.	*Zero*



	Zero	None.	0
	AI1 scaled	*12.12 AI1 scaled value* (see page *240*).	1
	AI2 scaled	*12.22 AI2 scaled value* (see page *242*).	2
	FB A ref1	*03.05 FB A reference 1* (see page *196*).	4
	FB A ref2	*03.06 FB A reference 2* (see page *196*).	5
	EFB ref1	*03.09 EFB reference 1* (see page *196*)	8
	EFB ref2	*03.10 EFB reference 2* (see page *196*)	9
	DDCS ctrl ref1	*03.11 DDCS controller ref 1* (see page *196*).	10
	DDCS ctrl ref2	*03.12 DDCS controller ref 2* (see page *196*).	11
	M/F reference 1	*03.13 M/F or D2D ref1* (see page *196*).	12
	M/F reference 2	*03.14 M/F or D2D ref2* (see page *196*).	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. See section *Using the control panel as an external control source* (page *121*).	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 *121*).	19
	Other	Source selection (see *Terms and abbreviations* on page *187*).	-

No.	Name/Value	Description	Def/FbEq16
22.12	*Speed ref2 source*	(*Visible only when user lock is open with pass code 584. See parameter 96.02 Pass code.*) Selects speed reference source 2. For the selections, and a diagram of reference source selection, see parameter *22.11 Speed ref1 source*. **Note:** When winch interface (see *Winch control interface*) control stands are used, the reference comes from the winch interface and overrides selections made in this parameter.	*Zero*
22.13	*Speed ref1 function*	(*Visible only when user lock is open with pass code 584. See parameter 96.02 Pass code.*) Selects a mathematical function between the reference sources selected by parameters *22.11 Speed ref1 source* and *22.12 Speed ref2 source*. See diagram at *22.11 Speed ref1 source*.	*Ref1*
	Ref1	Signal selected by *22.11 Speed ref1 source* is used as speed reference 1 as such (no function applied).	0
	Add (ref1 + ref2)	The sum of the reference sources is used as speed reference 1.	1
	Sub (ref1 - ref2)	The subtraction ([*22.11 Speed ref1 source*] - [*22.12 Speed ref2 source*]) of the reference sources is used as speed reference 1.	2
	Mul (ref1 × ref2)	The multiplication of the reference sources is used as speed reference 1.	3
	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*	(*Visible only when user lock is open with pass code 584. See parameter 96.02 Pass code.*) Configures the selection between speed references 1 and 2. See diagram at *22.11 Speed ref1 source*. If control stands are used, speed ref1/2 are overridden with the winch reference. 0 = Speed reference 1 1 = Speed reference 2 **Note:** When winch interface (see *Winch control interface*) control stands are used, the reference comes from the winch interface and overrides selections made in this parameter.	*Follow Ext1/Ext2 selection*
	Speed reference 1	0.	0
	Speed reference 2	1.	1
	Follow Ext1/Ext2 selection	Speed reference 1 is used when external control location EXT1 is active. Speed reference 2 is used when external control location EXT2 is active. See also parameter *19.11 Ext1/Ext2 selection*.	2
	DI1	Digital input DI1 (*10.02 DI delayed status*, bit 0).	3
	DI2	Digital input DI2 (*10.02 DI delayed status*, bit 1).	4
	DI3	Digital input DI3 (*10.02 DI delayed status*, bit 2).	5
	DI4	Digital input DI4 (*10.02 DI delayed status*, bit 3).	6
	DI5	Digital input DI5 (*10.02 DI delayed status*, bit 4).	7

No.	Name/Value	Description	Def/FbEq16
	DI6	Digital input DI6 (*10.02 DI delayed status*, bit 5).	8
	DIO1	Digital input/output DIO1 (*11.02 DIO delayed status*, bit 0).	11
	DIO2	Digital input/output DIO2 (*11.02 DIO delayed status*, bit 1).	12
	Other [bit]	Source selection (see *Terms and abbreviations* on page *187*).	-
22.15	*Speed additive 1 source*	(*Visible only when user lock is open with pass code 584. See parameter 96.02 Pass code.*) Defines a reference to be added to the speed reference after reference selection (see page *716*). For the selections, see parameter *22.11 Speed ref1 source*. **Note:** For safety reasons, the additive is not applied when any of the stop functions are active.	*Zero*
22.16	*Speed share*	Defines a scaling factor for the selected speed reference (speed reference 1 or 2, multiplied by the defined value). Speed reference 1 or 2 is selected by parameter *22.14 Speed ref1/2 selection*.	1.000
	-8.000 …8.000	Speed reference scaling factor.	1000 = 1
22.17	*Speed additive 2 source*	(*Visible only when user lock is open with pass code 584. See parameter 96.02 Pass code.*) Defines a reference to be added to the speed reference after the speed share function (see page *716*). For the selections, see parameter *22.11 Speed ref1 source*. **Note:** For safety reasons, the additive is not applied when any of the stop functions are active.	*Zero*
22.41	*Speed ref safe*	Defines a safe speed reference value that is used with supervision functions such as • *12.03 AI supervision function* • *49.05 Communication loss action* • *50.02 FBA A comm loss func* • *50.32 FBA B comm loss func* • *58.14 Communication loss action.*	0.00 rpm
	-30000.00 … 30000.00 rpm	Safe speed reference.	See par. *46.01*

No.	Name/Value	Description	Def/FbEq16
22.51	*Critical speed function*	(*Visible only when user lock is open with pass code 584. See parameter 96.02 Pass code*.) 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 *140*).	0000b

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

No.	Name/Value	Description	Def/FbEq16
	0000b…0011b	Critical speeds configuration word.	1 = 1
22.52	*Critical speed 1 low*	(*Visible only when user lock is open with pass code 584. See parameter 96.02 Pass code*.) Defines the low limit for critical speed range 1. **Note:** This value must be less than or equal to the value of *22.53 Critical speed 1 high*.	0.00 rpm
	-30000.00 … 30000.00 rpm	Low limit for critical speed 1.	See par. *46.01*
22.53	*Critical speed 1 high*	(*Visible only when user lock is open with pass code 584. See parameter 96.02 Pass code*.) Defines the high limit for critical speed range 1. **Note:** This value must be greater than or equal to the value of *22.52 Critical speed 1 low*.	0.00 rpm
	-30000.00 … 30000.00 rpm	High limit for critical speed 1.	See par. *46.01*
22.54	*Critical speed 2 low*	(*Visible only when user lock is open with pass code 584. See parameter 96.02 Pass code*.) Defines the low limit for critical speed range 2. **Note:** This value must be less than or equal to the value of *22.55 Critical speed 2 high*.	0.00 rpm
	-30000.00 … 30000.00 rpm	Low limit for critical speed 2.	See par. *46.01*
22.55	*Critical speed 2 high*	(*Visible only when user lock is open with pass code 584. See parameter 96.02 Pass code*.) Defines the high limit for critical speed range 2. **Note:** This value must be greater than or equal to the value of *22.54 Critical speed 2 low*.	0.00 rpm
	-30000.00 … 30000.00 rpm	High limit for critical speed 2.	See par. *46.01*

No.	Name/Value	Description	Def/FbEq16
22.56	*Critical speed 3 low*	(*Visible only when user lock is open with pass code 584. See parameter 96.02 Pass code*.) Defines the low limit for critical speed range 3. **Note:** This value must be less than or equal to the value of *22.57 Critical speed 3 high*.	0.00 rpm
	-30000.00 … 30000.00 rpm	Low limit for critical speed 3.	See par. *46.01*
22.57	*Critical speed 3 high*	(*Visible only when user lock is open with pass code 584. See parameter 96.02 Pass code*.) Defines the high limit for critical speed range 3. **Note:** This value must be greater than or equal to the value of *22.56 Critical speed 3 low*.	0.00 rpm
	-30000.00 … 30000.00 rpm	High limit for critical speed 3.	See par. *46.01*
22.71	*Motor potentiometer function*	(*Visible only when user lock is open with pass code 584. See parameter 96.02 Pass code*.) Activates and selects the mode of the motor potentiometer. See section *Motor potentiometer* (page *163*).	*Disabled*
	Disabled	Motor potentiometer is disabled and its value set to 0.	0
	Enabled (init at stop/power-up)	When enabled, the motor potentiometer first adopts the value defined by parameter *22.72 Motor potentiometer initial value*. When the drive is running, the value can be adjusted from the up and down sources defined by parameters *22.73 Motor potentiometer up source* and *22.74 Motor potentiometer down source*. A stop or a power cycle will reset the motor potentiometer to the initial value (*22.72*).	1
	Enabled (resume always)	As *Enabled (init at stop/power-up)*, but the motor potentiometer value is retained over a stop or a power cycle.	2
22.72	*Motor potentiometer initial value*	(*Visible only when user lock is open with pass code 584. See parameter 96.02 Pass code*.) Defines an initial value (starting point) for the motor potentiometer. See the selections of parameter *22.71 Motor potentiometer function*.	0.00
	-32768.00 … 32767.00	Initial value for motor potentiometer.	1 = 1
22.73	*Motor potentiometer up source*	(*Visible only when user lock is open with pass code 584. See parameter 96.02 Pass code*.) Selects the source of motor potentiometer up signal. 0 = No change 1 = Increase motor potentiometer value. (If both the up and down sources are on, the potentiometer value will not change.)	*Not selected*
	Not selected	0.	0
	Selected	1.	1
	DI1	Digital input DI1 (*10.02 DI delayed status*, bit 0).	2
	DI2	Digital input DI2 (*10.02 DI delayed status*, bit 1).	3
	DI3	Digital input DI3 (*10.02 DI delayed status*, bit 2).	4
	DI4	Digital input DI4 (*10.02 DI delayed status*, bit 3).	5

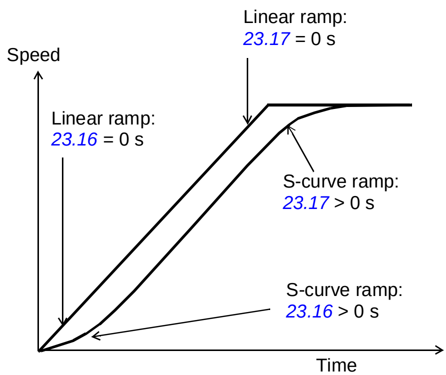
No.	Name/Value	Description	Def/FbEq16
	DI5	Digital input DI5 (*10.02 DI delayed status*, bit 4).	6
	DI6	Digital input DI6 (*10.02 DI delayed status*, bit 5).	7
	DIO1	Digital input/output DIO1 (*11.02 DIO delayed status*, bit 0).	10
	DIO2	Digital input/output DIO2 (*11.02 DIO delayed status*, bit 1).	11
	Other [bit]	Source selection (see *Terms and abbreviations* on page *187*).	-
22.74	*Motor potentiometer down source*	(*Visible only when user lock is open with pass code 584. See parameter 96.02 Pass code*.) Selects the source of motor potentiometer down signal. 0 = No change 1 = Decrease motor potentiometer value. (If both the up and down sources are on, the potentiometer value will not change.) For the selections, see parameter *22.73 Motor potentiometer up source*.	*Not selected*
22.75	*Motor potentiometer ramp time*	(*Visible only when user lock is open with pass code 584. See parameter 96.02 Pass code*.) Defines the change rate of the motor potentiometer. This parameter specifies the time required for the motor potentiometer to change from minimum (*22.76*) to maximum (*22.77*). The same change rate applies in both directions.	60.0 s
	0.0 … 3600.0 s	Motor potentiometer change time.	10 = 1 s
22.76	*Motor potentiometer min value*	(*Visible only when user lock is open with pass code 584. See parameter 96.02 Pass code*.) Defines the minimum value of the motor potentiometer.	-1500.00
	-32768.00 … 32767.00	Motor potentiometer minimum.	1 = 1
22.77	*Motor potentiometer max value*	(*Visible only when user lock is open with pass code 584. See parameter 96.02 Pass code*.) Defines the maximum value of the motor potentiometer.	1500.00
	-32768.00 … 32767.00	Motor potentiometer maximum.	1 = 1
22.80	*Motor potentiometer ref act*	(*Visible only when user lock is open with pass code 584. See parameter 96.02 Pass code*.) Displays the output of the motor potentiometer function. (The motor potentiometer is configured using parameters *22.71*…*22.74*.) This parameter is read-only.	-
	-32768.00 … 32767.00	Value of motor potentiometer.	1 = 1
22.81	*Speed reference act 1*	Displays the value of speed reference source 1 (selected by parameter *22.11 Speed ref1 source*). See the control chain diagram on page *716*. This parameter is read-only.	-
	-30000.00 … 30000.00 rpm	Value of reference source 1.	See par. *46.01*

No.	Name/Value	Description	Def/FbEq16
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 *716*. This parameter is read-only.	-
	-30000.00 … 30000.00 rpm	Value of reference source 2.	See par. *46.01*
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 *716*. This parameter is read-only.	-
	-30000.00 … 30000.00 rpm	Speed reference after source selection.	See par. *46.01*
22.84	*Speed reference act 4*	Displays the value of speed reference after application of 1st speed additive (*22.15 Speed additive 1 source*). See the control chain diagram on page *716*. This parameter is read-only.	-
	-30000.00 … 30000.00 rpm	Speed reference after additive 1.	See par. *46.01*
22.85	*Speed reference act 5*	Displays the value of speed reference after the application of the speed share scaling factor (*22.16 Speed share*). See the control chain diagram on page *716*. This parameter is read-only.	-
	-30000.00 … 30000.00 rpm	Speed reference after speed share scaling.	See par. *46.01*
22.86	*Speed reference act 6*	Displays the value of speed reference after application of 2nd speed additive (*22.17 Speed additive 2 source*). See the control chain diagram on page *716*. This parameter is read-only.	-
	-30000.00 … 30000.00 rpm	Speed reference after additive 2.	See par. *46.01*
22.87	*Speed reference act 7*	Displays the value of speed reference before application of critical speeds. See the control chain diagram on page *717*. The value is received from *22.86 Speed reference act 6* unless overridden by • any constant speed • a jogging reference • *network control* reference • control panel reference • safe speed reference. This parameter is read-only.	-
	-30000.00 … 30000.00 rpm	Speed reference before application of critical speeds.	See par. *46.01*

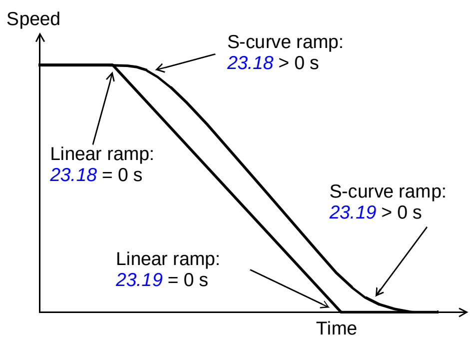
No.	Name/Value	Description	Def/FbEq16
23 Speed reference ramp		Speed reference ramp settings (programming of the acceleration and deceleration rates for the drive). See the control chain diagram on page *718*.	
23.01	*Speed ref ramp input*	Displays the used speed reference (in rpm) before it enters the ramping and shaping functions. See the control chain diagram on page *718*. This parameter is read-only.	-
	-30000.00 … 30000.00 rpm	Speed reference before ramping and shaping.	See par. *46.01*
23.02	*Speed ref ramp output*	Displays the ramped and shaped speed reference in rpm. See the control chain diagram on page *718*. This parameter is read-only.	-
	-30000.00 … 30000.00 rpm	Speed reference after ramping and shaping.	See par. *46.01*

<table>
<tr><th>No.</th><th>Name/Value</th><th>Description</th><th>Def/FbEq16</th></tr>
<tr><td>23.16</td><td>Shape time acc 1</td><td>

(*Visible only when user lock is open with pass code 584. See parameter 96.02 Pass code*.)
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.
Acceleration:

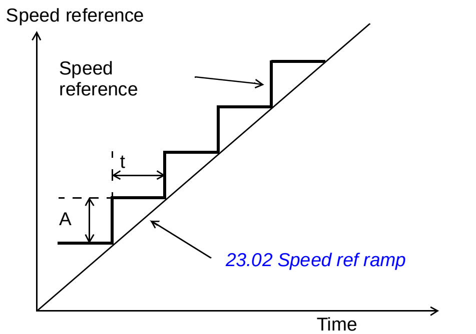


Deceleration:



</td><td>0.000 s</td></tr>
<tr><td></td><td>0.000 …
1800.000 s</td><td>Ramp shape at start of acceleration.</td><td>10 = 1 s</td></tr>
<tr><td>23.17</td><td>Shape time acc 2</td><td>(Visible only when user lock is open with pass code 584. See parameter 96.02 Pass code.)
Defines the shape of the acceleration ramp at the end of the acceleration. See parameter 23.16 Shape time acc 1.</td><td>0.000 s</td></tr>
<tr><td></td><td>0.000 …
1800.000 s</td><td>Ramp shape at end of acceleration.</td><td>10 = 1 s</td></tr>
</table>

No.	Name/Value	Description	Def/FbEq16
23.18	*Shape time dec 1*	(*Visible only when user lock is open with pass code 584. See parameter 96.02 Pass code*.) Defines the shape of the deceleration ramp at the beginning of the deceleration. See parameter *23.16 Shape time acc 1*.	0.000 s
	0.000 … 1800.000 s	Ramp shape at start of deceleration.	10 = 1 s
23.19	*Shape time dec 2*	(*Visible only when user lock is open with pass code 584. See parameter 96.02 Pass code*.) Defines the shape of the deceleration ramp at the end of the deceleration. See parameter *23.16 Shape time acc 1*.	0.000 s
	0.000 … 1800.000 s	Ramp shape at end of deceleration.	10 = 1 s
23.23	*Emergency stop time*	In speed control mode, this parameter defines the deceleration rate for emergency stop Off3 as the time it would take for the speed to decrease from the value of parameter *46.01 Speed scaling* to zero. This also applies to torque control 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).	3.000 s
	0.000 … 1800.000 s	Emergency stop Off3 deceleration time.	10 = 1 s
23.26	*Ramp out balancing enable*	(*Visible only when user lock is open with pass code 584. See parameter 96.02 Pass code*.) 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 speedcontrolled. 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*
	Not selected	0.	0
	Selected	1.	1
	DI1	Digital input DI1 (*10.02 DI delayed status*, bit 0).	2
	DI2	Digital input DI2 (*10.02 DI delayed status*, bit 1).	3
	DI3	Digital input DI3 (*10.02 DI delayed status*, bit 2).	4
	DI4	Digital input DI4 (*10.02 DI delayed status*, bit 3).	5
	DI5	Digital input DI5 (*10.02 DI delayed status*, bit 4).	6
	DI6	Digital input DI6 (*10.02 DI delayed status*, bit 5).	7

No.	Name/Value	Description	Def/FbEq16
	DIO1	Digital input/output DIO1 (*11.02 DIO delayed status*, bit 0).	10
	DIO2	Digital input/output DIO2 (*11.02 DIO delayed status*, bit 1).	11
	Other [bit]	Source selection (see *Terms and abbreviations* on page *187*).	-
23.27	*Ramp out balancing ref*	(*Visible only when user lock is open with pass code 584. See parameter 96.02 Pass code*.) Defines the reference for speed ramp balancing. The output of the ramp generator is forced to this value when balancing is enabled by parameter *23.26 Ramp out balancing enable*.	0.00 rpm
	-30000.00 … 30000.00 rpm	Speed ramp balancing reference.	See par. *46.01*
23.28	*Variable slope enable*	(*Visible only when user lock is open with pass code 584. See parameter 96.02 Pass code*.) Activates the variable slope function, which controls the slope of the speed ramp during a speed reference change. This allows for a constantly variable ramp rate to be generated, instead of just the standard two ramps normally available. If the update interval of the signal from an external control system and the variable slope rate (*23.29 Variable slope rate*) are equal, the resulting speed reference (*23.02 Speed ref ramp output*) is a straight line.  t = update interval of signal from external control system A = speed reference change during t This function is only active in remote control.	*Off*
	Off	Variable slope disabled.	0
	On	Variable slope enabled (not available in local control).	1
	Other [bit]	Source selection (see *Terms and abbreviations* on page *187*).	-

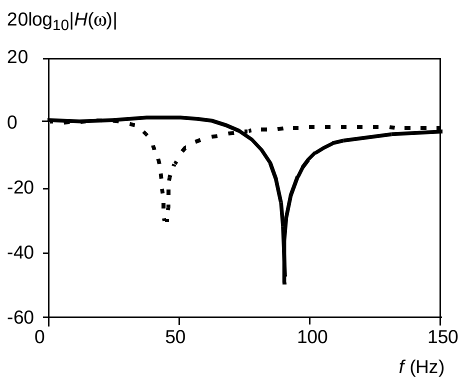
No.	Name/Value	Description	Def/FbEq16
23.29	*Variable slope rate*	(*Visible only when user lock is open with pass code 584. See parameter 96.02 Pass code*.) Defines the rate of the speed reference change when variable slope is enabled by parameter *23.28 Variable slope enable*. For the best result, enter the reference update interval into this parameter.	50 ms
	2…30000 ms	Variable slope rate.	1 = 1 ms
23.39	*Follower speed correction out*	(*Visible only when user lock is open with pass code 584. See parameter 96.02 Pass code*.) Displays the speed correction term for the load share function with a speed-controlled follower drive. See section *Load share function with a speed-controlled follower* (page *130*). This parameter is read-only.	-
	-30000.00 … 30000.00 rpm	Speed correction term.	See par. *46.01*
23.40	*Follower speed correction enable*	(*Visible only when user lock is open with pass code 584. See parameter 96.02 Pass code*.) With a speed-controlled follower, selects the source for enabling/disabling the load share function. See section *Load share function with a speed-controlled follower* (page *130*). 0 = Disabled 1 = Enabled	*Not selected*
	Not selected	0.	0
	Selected	1.	1
	DI1	Digital input DI1 (*10.02 DI delayed status*, bit 0).	2
	DI2	Digital input DI2 (*10.02 DI delayed status*, bit 1).	3
	DI3	Digital input DI3 (*10.02 DI delayed status*, bit 2).	4
	DI4	Digital input DI4 (*10.02 DI delayed status*, bit 3).	5
	DI5	Digital input DI5 (*10.02 DI delayed status*, bit 4).	6
	DI6	Digital input DI6 (*10.02 DI delayed status*, bit 5).	7
	DIO1	Digital input/output DIO1 (*11.02 DIO delayed status*, bit 0).	10
	DIO2	Digital input/output DIO2 (*11.02 DIO delayed status*, bit 1).	11
	Other [bit]	Source selection (see *Terms and abbreviations* on page *187*).	-
23.41	*Follower speed correction gain*	(*Visible only when user lock is open with pass code 584. See parameter 96.02 Pass code*.) Adjusts the gain of the speed correction term in a speed-controlled follower. In effect, defines how accurately the follower follows the master torque. A greater value results in a more accurate performance. See section *Load share function with a speed-controlled follower* (page *130*).	1.00%
	0.00 … 100.00%	Speed correction term adjustment.	1 = 1%

No.	Name/Value	Description	Def/FbEq16
23.42	*Follower speed corr torq source*	(*Visible only when user lock is open with pass code 584. See parameter 96.02 Pass code*.) Selects the source of the torque reference for the load share function. See section *Load share function with a speed-controlled follower* (page *130*).	*MF ref 2*
	NULL	None.	0
	MF ref 2	*03.14 M/F or D2D ref2* (page *196*).	1
	Other	Source selection (see *Terms and abbreviations* on page *187*).	-
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*
	Set 1	0. Acceleration time1 and deceleration time1.	0
	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	3
	DI2	Digital input DI2	4
	DI3	Digital input DI3	5
	DI4	Digital input DI4	6
	DI5	Digital input DI5	7
	DI6	Digital input DI6	8
	DIO1	Digital input/output DIO1	9
	DIO2	Digital input/output DIO2	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	Source selection (see *Terms and abbreviations* on page *187*).	-

No.	Name/Value	Description	Def/FbEq16
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*
	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	2
	DI2	Digital input DI2	3
	DI3	Digital input DI3	4
	DI4	Digital input DI4	5
	DI5	Digital input DI5	6
	DI6	Digital input DI6	7
	DIO1	Digital input/output DIO1	8
	DIO2	Digital input/output DIO2	9
	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	Source selection (see *Terms and abbreviations* on page *187*).	-
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
	0.00...1800.00 s	Acceleration time 1.	10 = 1

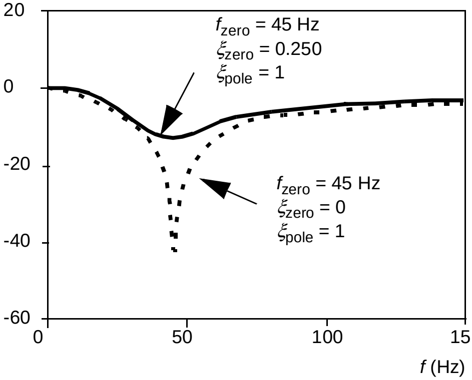
No.	Name/Value	Description	Def/FbEq16
23.203	*Deceleration time 1*	Defines deceleration time 1 required for the speed to change from the speed defined in parameter *46.01 Speed scaling* (**not** from parameter *30.12 Maximum speed*) to zero. If the speed reference decreases than the set deceleration 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
	0.00...1800.00 s	Deceleration time 1.	10 = 1
23.204	*Acceleration time 2*	Defines acceleration time 2. See parameter *23.202 Acceleration time 1*.	3.00 s
	0.00...1800.00 s	Acceleration time 2.	10 = 1
23.205	*Deceleration time 2*	Defines deceleration time 2. See parameter *23.203 Deceleration time 1*.	3.00 s
	0.00...1800.00 s	Deceleration time 2.	10 = 1

24 Speed reference conditioning		Speed error calculation; speed error window control configuration; speed error step. See the control chain diagrams on pages *721* and *722*.	
24.01	*Used speed reference*	Displays the ramped and corrected speed reference (before speed error calculation). See the control chain diagram on page *721*. This parameter is read-only.	-
	-30000.00 … 30000.00 rpm	Speed reference used for speed error calculation.	See par. *46.01*
24.02	*Used speed feedback*	Displays the speed feedback used for speed error calculation. See the control chain diagram on page *721*. This parameter is read-only.	-
	-30000.00 … 30000.00 rpm	Speed feedback used for speed error calculation.	See par. *46.01*
24.03	*Speed error filtered*	Displays the filtered speed error. See the control chain diagram on page *721*. This parameter is read-only.	-
	-30000.0 … 30000.0 rpm	Filtered speed error.	See par. *46.01*
24.04	*Speed error inverted*	Displays the inverted (unfiltered) speed error. See the control chain diagram on page *721*. This parameter is read-only.	-
	-30000.0 … 30000.0 rpm	Inverted speed error.	See par. *46.01*

No.	Name/Value	Description	Def/FbEq16
24.12	*Speed error filter time*	Defines the time constant of the speed error low-pass filter. If the used speed reference changes rapidly, the possible interferences in the speed measurement can be filtered with the speed error filter. Reducing the ripple with this filter may cause speed controller tuning problems. A long filter time constant and fast acceleration time contradict one another. A very long filter time results in unstable control.	0 ms
	0…10000 ms	Speed error filtering time constant. 0 = filtering disabled.	1 = 1 ms
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*
	Off	0.	0
	On	1.	1
24.14	*Frequency of zero*	Defines the zero frequency of the resonance frequency filter. The value must be set near the resonance frequency, which is filtered out before the speed controller. The drawing shows the frequency response. 	45.00 Hz
	0.50 … 500.00 Hz	Zero frequency.	1 = 1 Hz

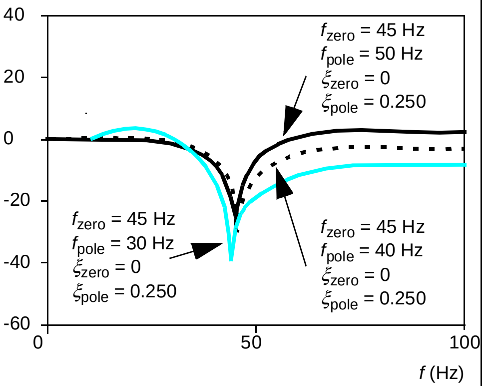
<table>
<tr><th>No.</th><th>Name/Value</th><th>Description</th><th>Def/FbEq16</th></tr>
<tr><td>24.15</td><td>Damping of zero</td><td>Defines the damping coefficient for parameter 24.14. The value of 0 corresponds to the maximum elimination of the resonance frequency.

$20\log_{10}|H(\omega)|$

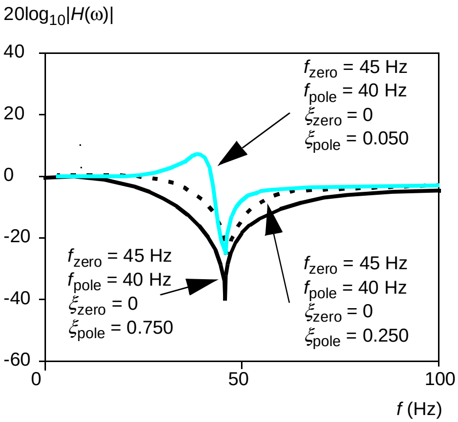


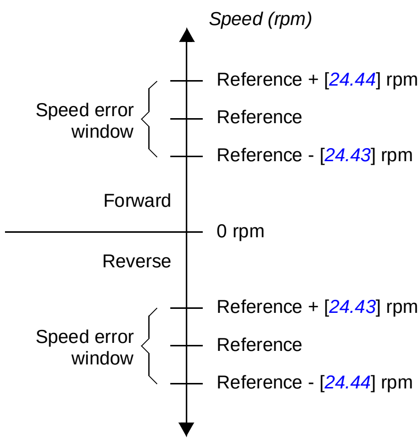
Note: To ensure that the resonance frequency band is filtered (rather than amplified), the value of 24.15 must be smaller than 24.17.</td><td>0.000</td></tr>
<tr><td></td><td>-1.000 … 1.000</td><td>Damping coefficient.</td><td>100 = 1</td></tr>
<tr><td>24.16</td><td>Frequency of pole</td><td>Defines the frequency of pole of the resonance frequency filter.

$20\log_{10}|H(\omega)|$



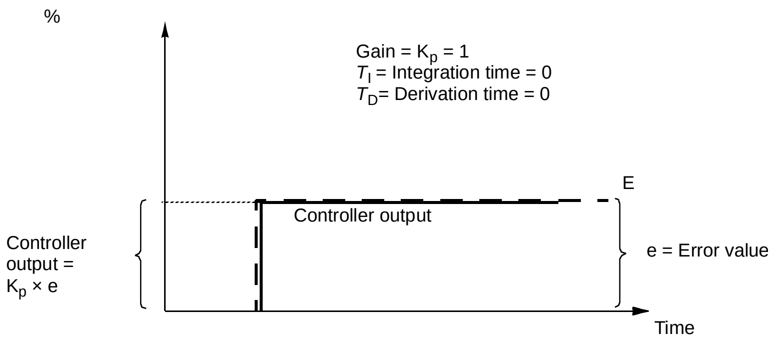
Note: If this value is very different from the value of 24.14, the frequencies near the frequency of pole are amplified, which can damage the driven machine.</td><td>40.00 Hz</td></tr>
<tr><td></td><td>0.50 … 500.00 Hz</td><td>Frequency of pole.</td><td>1 = 1 Hz</td></tr>
</table>

No.	Name/Value	Description	Def/FbEq16
24.17	*Damping of pole*	Defines the damping coefficient for parameter *24.16*. The coefficient shapes the frequency response of the resonance frequency filter. A narrower bandwidth results in better dynamic properties. By setting this parameter to 1, the effect of the pole is eliminated.  Note: To ensure that the resonance frequency band is filtered (rather than amplified), the value of *24.15* must be smaller than *24.17*.	0.250
	-1.000 … 1.000	Damping coefficient.	100 = 1

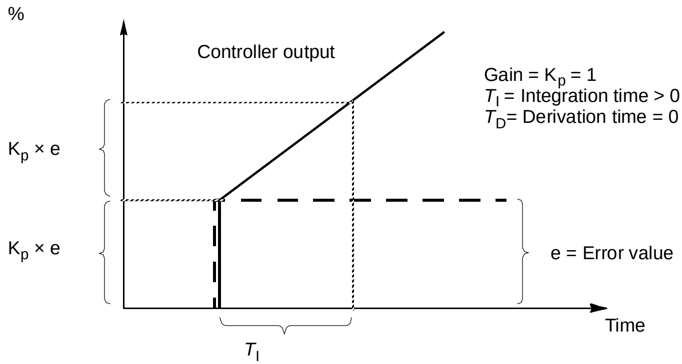
<table>
<tr><th>No.</th><th>Name/Value</th><th>Description</th><th>Def/FbEq16</th></tr>
<tr><td>24.41</td><td>Speed error window control enable</td><td>Enables/disables (or selects a source that enables/disables) speed error window control, sometimes also referred to as deadband control or strip break 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).
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.
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).
0 = Speed error window control disabled
1 = Speed error window control enabled</td><td>Disable</td></tr>
<tr><td></td><td>Disable</td><td>0.</td><td>0</td></tr>
<tr><td></td><td>Enable</td><td>1.</td><td>1</td></tr>
</table>

No.	Name/Value	Description	Def/FbEq16
	Other [bit]	Source selection (see *Terms and abbreviations* on page *187*).	-
24.42	*Speed window control mode*	When speed error window control (see parameter *24.41 Speed error window control enable*) is enabled, this parameter determines whether the speed controller only observes the proportional term instead of all three (P, I and D) terms.	*Normal speed control*
	Normal speed control	All three terms (parameters *25.02*, *25.03* and *25.04*) are observed by the speed controller.	0
	P-control	Only the proportional term (*25.02*) is observed by the speed controller. The integral and derivative terms are internally forced to zero.	1
24.43	*Speed error window high*	Defines the upper boundary of the speed error window. See parameter *24.41 Speed error window control enable*.	0.00 rpm
	0.00 … 3000.00 rpm	Upper boundary of speed error window.	See par. *46.01*
24.44	*Speed error window low*	Defines the lower boundary of the speed error window. See parameter *24.41 Speed error window control enable*.	0.00 rpm
	0.00 … 3000.00 rpm	Lower boundary of speed error window.	See par. *46.01*
24.46	*Speed error step*	Defines an additional speed error step given to the input of the speed controller (and added to the speed error value). This can be used in large drive systems for dynamic speed normalizing. **WARNING!** Make sure the error step value is removed when a stop command is given.	0.00 rpm
	-3000.00 … 3000.00 rpm	Speed error step.	See par. *46.01*
24.200	*Speed correction*	Defines the external speed correction input.	0.00 rpm
	-10000.00 … 10000.00 rpm	Speed correction.	100 = 1 rpm
25 Speed control		Speed controller settings. See the control chain diagrams on pages *721* and *722*.	
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 *722*. This parameter is read-only.	-
	-1600.0 … 1600.0%	Limited speed controller output torque.	See par. *46.03*

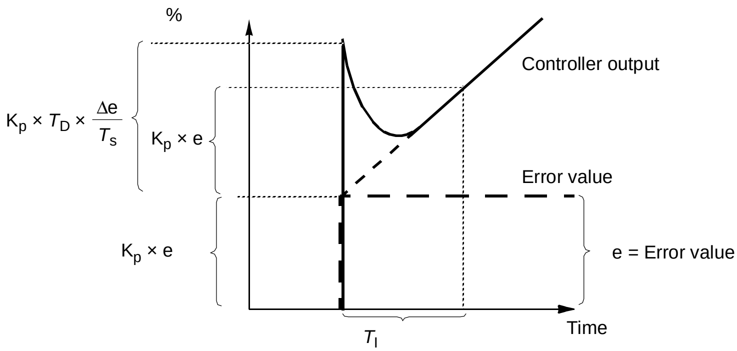
<table>
<tr><th>No.</th><th>Name/Value</th><th>Description</th><th>Def/FbEq16</th></tr>
<tr><td>25.02</td><td>Speed proportional gain</td><td>Defines the proportional gain (K_p) of the speed controller. Too high a gain may cause speed oscillation. The figure below shows the speed controller output after an error step when the error remains constant.</td><td>10.00;
5.00
(95.21 b1/b2)</td></tr>
<tr><td colspan="4">
</td></tr>
<tr><td></td><td></td><td>If gain is set to 1.00, a 10% error (reference - actual value) in the motor synchronous speed produces a proportional term of 10%.
Note: This parameter is automatically set by the speed controller autotune function. See section Speed controller autotune (page 141).</td><td></td></tr>
<tr><td></td><td>0.00 …250.00</td><td>Proportional gain for speed controller.</td><td>100 = 1</td></tr>
</table>

No.	Name/Value	Description	Def/FbEq16
25.03	*Speed integration time*	Defines the integration time of the speed controller. The integration time defines the rate at which the controller output changes when the error value is constant and the proportional gain of the speed controller is 1. The shorter the integration time, the faster the continuous error value is corrected. 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.	2.50 s; 5.00 (*95.21* b1/b2)



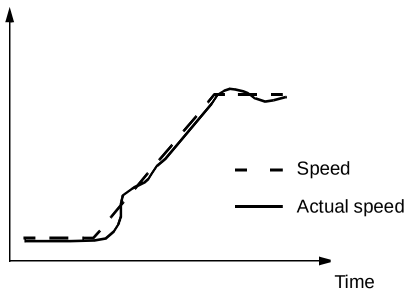
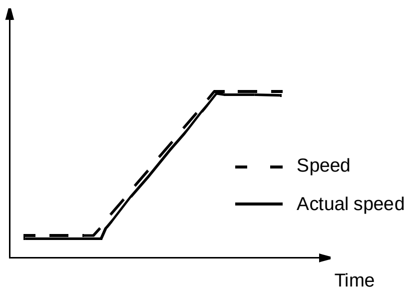
		Note: This parameter is automatically set by the speed controller autotune function. See section *Speed controller autotune* (page *141*).	
	0.00 … 1000.00 s	Integration time for speed controller.	10 = 1 s

No.	Name/Value	Description	Def/FbEq16
25.04	*Speed derivation time*	Defines the derivation time of the speed controller. Derivative action boosts the controller output if the error value changes. The longer the derivation time, the more the speed controller output is boosted during the change. If the derivation time is set to zero, the controller works as a PI controller, otherwise as a PID controller. The derivation makes the control more responsive for disturbances. For simple applications (especially those without 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 disturbances.	0.000 s



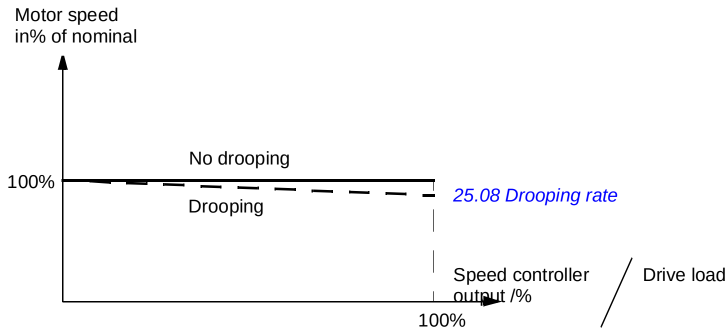
Gain = K_p = 1
T_I = Integration time > 0
T_D= Derivation time > 0
T_s= Sample time period = 500 µs
Δe = Error value change between two samples

No.	Name/Value	Description	Def/FbEq16
	0.000 … 10.000 s	Derivation time for speed controller.	1000 = 1 s
25.05	*Derivation filter time*	Defines the derivation filter time constant. See parameter *25.04 Speed derivation time*.	8 ms
	0…10000 ms	Derivation filter time constant.	1 = 1 ms

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

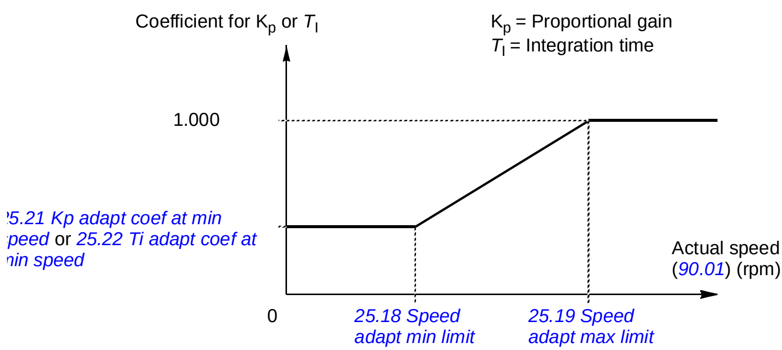
No.	Name/Value	Description	Def/FbEq16
25.08	*Drooping rate*	Defines the droop rate in percent of the nominal motor speed. Drooping decreases the drive speed slightly as the drive load increases. The actual speed decrease at a certain operating point depends on the droop rate setting and the drive load (= torque reference / speed controller output). At 100% speed controller output, drooping is at its nominal level, 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.	0.00%

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



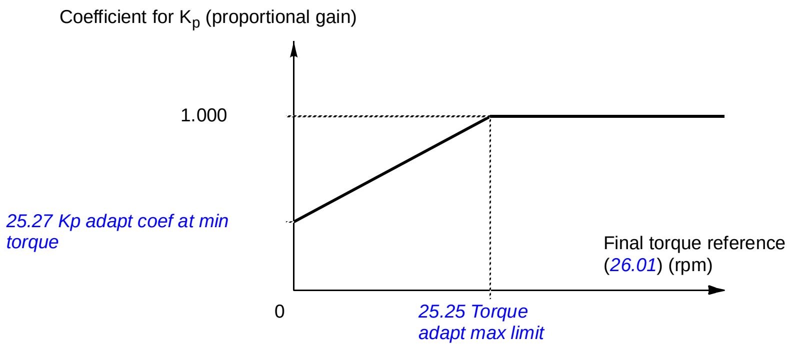
No.	Name/Value	Description	Def/FbEq16
	0.00 … 100.00%	Droop rate.	100 = 1%
25.13	*Min torq sp ctrl em stop*	Defines the minimum speed controller output torque during a ramped emergency stop (Off1 or Off3).	-400.0%
	-1600.0 … 0.0%	Minimum speed controller output torque for ramped emergency stop.	See par. *46.03*
25.14	*Max torq sp ctrl em stop*	Defines the maximum speed controller output torque during a ramped emergency stop (Off1 or Off3).	400.0%
	0.0 … 1600.0%	Maximum speed controller output torque for ramped emergency stop.	See par. *46.03*
25.15	*Proportional gain em stop*	Defines the proportional gain for the speed controller when an emergency stop is active. See parameter *25.02 Speed proportional gain*.	10.00; 5.00 (*95.21* b1/b2)
	1.00 … 250.00	Proportional gain upon an emergency stop.	100 = 1

No.	Name/Value	Description	Def/FbEq16
25.18	*Speed adapt min limit*	Minimum actual speed for speed controller adaptation. Speed controller gain and integration time can be adapted according to actual speed (*90.01 Motor speed for control*). This is done by multiplying the gain (*25.02 Speed proportional gain*) and integration time (*25.03 Speed integration time*) by coefficients at certain speeds. The coefficients are defined individually for both gain and integration time. When actual speed is below or equal to *25.18 Speed adapt min limit*, the gain 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 *722*.	0 rpm



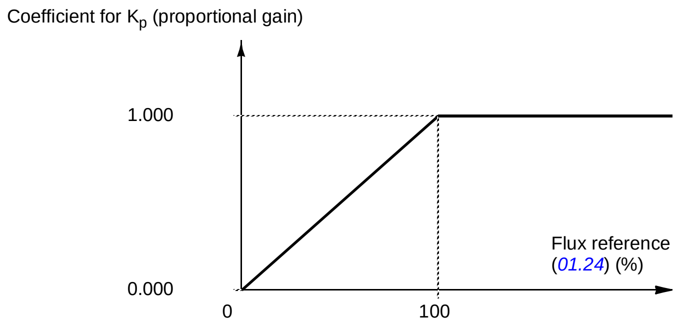
	0…30000 rpm	Minimum actual speed for speed controller adaptation.	1 = 1 rpm
25.19	*Speed adapt max limit*	Maximum actual speed for speed controller adaptation. See parameter *25.18 Speed adapt min limit*.	0 rpm
	0…30000 rpm	Maximum actual speed for speed controller adaptation.	1 = 1 rpm
25.21	*Kp adapt coef at min speed*	Proportional gain coefficient at minimum actual speed. See parameter *25.18 Speed adapt min limit*.	1.000
	0.000 … 10.000	Proportional gain coefficient at minimum actual speed.	1000 = 1
25.22	*Ti adapt coef at min speed*	Integration time coefficient at minimum actual speed. See parameter *25.18 Speed adapt min limit*.	1.000
	0.000 … 10.000	Integration time coefficient at minimum actual speed.	1000 = 1

No.	Name/Value	Description	Def/FbEq16
25.25	*Torque adapt max limit*	Maximum torque reference for speed controller adaptation. Speed controller gain can be adapted according to the final unlimited torque reference (*26.01 Torque reference to TC*). This can be used to smooth out disturbances caused by a small load and backlashes. The functionality involves multiplying the gain (*25.02 Speed proportional gain*) by a coefficient within a certain torque range. When the torque reference is 0%, the gain is multiplied by the value of parameter *25.27 Kp adapt coef at min torque*. When the torque reference is equal to or above *25.25 Torque adapt max limit*, no adaptation takes place (the coefficient is 1). Between 0% and *25.25 Torque adapt max limit*, the coefficient for the gain is calculated linearly on the basis of the breakpoints. Filtering can be applied on the torque reference using parameter *25.26 Torque adapt filt time*. See also the block diagram on page *722*.	0.0%



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

No.	Name/Value	Description	Def/FbEq16
25.30	*Flux adaption 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 *722*.	*Enable*



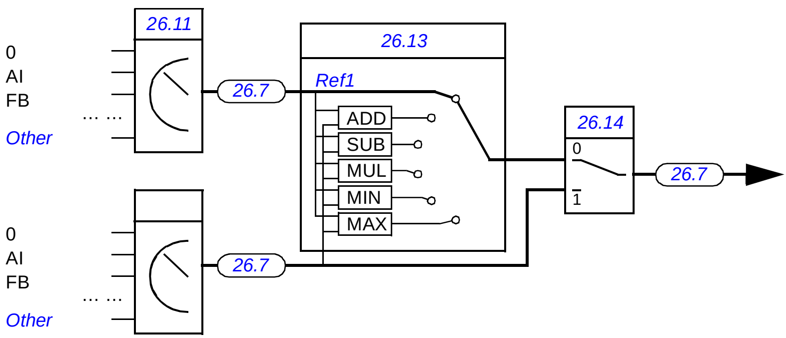
No.	Name/Value	Description	Def/FbEq16
	Disable	Speed controller adaptation based on flux reference disabled.	0
	Enable	Speed controller adaptation based on flux reference enabled.	1
25.33	*Speed controller autotune*	Activates (or selects a source that activates) the speed controller autotune function. See section *Speed controller autotune* (page *141*). The autotune will automatically set parameters *25.02 Speed proportional gain*, *25.03 Speed integration time* and *25.37 Mechanical time constant*. The prerequisites for performing the autotune routine are: • the motor identification run (ID run) has been successfully completed • the speed and torque limits (parameter group *30 Limits*) have been set • speed feedback filtering (parameter group *90 Feedback selection*), speed error filtering (*24 Speed reference conditioning*) and zero speed (*21 Start/stop mode*) have been set, and • the drive has been started and is running in speed control mode. ⚠ **WARNING!** The motor and machinery will run against the torque and speed limits during the autotune routine. MAKE SURE IT IS SAFE TO ACTIVATE THE AUTOTUNE FUNCTION! The autotune routine can be aborted by stopping the drive. 0->1 = Activate speed controller autotune **Note:** The value does not revert to 0 automatically.	*Off*
	Off	0	0
	On	1	1

No.	Name/Value	Description	Def/FbEq16
	Other [bit]	Source selection (see *Terms and abbreviations* on page *187*).	-
25.34	*Speed controller autotune mode*	Defines a control preset for the speed controller autotune function. The setting affects the way the torque reference will respond to a speed reference step.	*Normal*
	Smooth	Slow but robust response.	0
	Normal	Medium setting.	1
	Tight	Fast response. May produce too high a gain value for some applications.	2
25.37	*Mechanical time constant*	Mechanical time constant of the drive and the machinery as determined by the speed controller autotune function. The value can be adjusted manually.	-
	0.00 … 1000.00 s	Mechanical time constant.	10 = 1 s
25.38	*Autotune torque step*	Defines an added torque value used by the autotune function. This value is scaled to motor nominal torque. Note that the torque used by the autotune function can also be limited by the torque limits (in parameter group *30 Limits*) and nominal motor torque.	10.00%
	0.00 … 100.00%	Autotune torque step.	100 = 1%
25.39	*Autotune speed step*	Defines a speed value added to the initial speed for the autotune routine. The initial speed (speed used when autotune is activated) plus the value of this parameter is the calculated maximum speed used by the autotune routine. The maximum speed can also be limited by the speed limits (in parameter group *30 Limits*) and nominal motor speed. The value is scaled to motor nominal speed. **Note:** The motor will exceed the calculated maximum speed slightly at the end of each acceleration stage.	10.00%
	0.00 … 100.00%	Autotune speed step.	100 = 1%
25.40	*Autotune repeat times*	Determines how many acceleration/deceleration cycles are performed during the autotune routine. Increasing the value will improve the accuracy of the autotune function, and allow the use of smaller torque or speed step values.	10
	1…10	Number of cycles during autotune routine.	1 = 1
25.41	*Torque reference Autotune2*	Reserved.	-
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*
	Not selected	0.	0
	Selected	1.	1
	DI1	Digital input DI1 (*10.02 DI delayed status*, bit 0).	2
	DI2	Digital input DI2 (*10.02 DI delayed status*, bit 1).	3
	DI3	Digital input DI3 (*10.02 DI delayed status*, bit 2).	4
	DI4	Digital input DI4 (*10.02 DI delayed status*, bit 3).	5
	DI5	Digital input DI5 (*10.02 DI delayed status*, bit 4).	6
	DI6	Digital input DI6 (*10.02 DI delayed status*, bit 5).	7

No.	Name/Value	Description	Def/FbEq16
	DIO1	Digital input/output DIO1 (*11.02 DIO delayed status*, bit 0).	10
	DIO2	Digital input/output DIO2 (*11.02 DIO delayed status*, bit 1).	11
	Other [bit]	Source selection (see *Terms and abbreviations* on page *187*).	-
25.53	*Torque prop reference*	Displays the output of the proportional (P) part of the speed controller. See the control chain diagram on page *722*. This parameter is read-only.	-
	-30000.0 … 30000.0%	P-part output of speed controller.	See par. *46.03*
25.54	*Torque integral reference*	Displays the output of the integral (I) part of the speed controller. See the control chain diagram on page *722*. This parameter is read-only.	-
	-30000.0 … 30000.0%	I-part output of speed controller.	See par. *46.03*
25.55	*Torque deriv reference*	Displays the output of the derivative (D) part of the speed controller. See the control chain diagram on page *722*. This parameter is read-only.	-
	-30000.0 … 30000.0%	D-part output of speed controller.	See par. *46.03*
25.56	*Torque acc compensation*	Displays the output of the acceleration compensation function. See the control chain diagram on page *722*. This parameter is read-only.	-
	-30000.0 … 30000.0%	Output of acceleration compensation function.	See par. *46.03*
25.57	*Torque reference unbalanced*	Displays the acceleration-compensated output of the speed controller. See the control chain diagram on page *722*. This parameter is read-only.	-
	-30000.0 … 30000.0%	Acceleration-compensated output of speed controller.	See par. *46.03*

No.	Name/Value	Description	Def/FbEq16
26 Torque reference chain		Settings for the torque reference chain. See the control chain diagrams on pages *723* and *725*.	
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 *725* and *726*. This parameter is read-only.	-
	-1600.0 … 1600.0%	Torque reference for torque control.	See par. *46.03*
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 *726*. This parameter is read-only.	-
	-1600.0 … 1600.0%	Torque reference for torque control.	See par. *46.03*

No.	Name/Value	Description	Def/FbEq16
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%
	-1000.0 … 0.0%	Minimum torque reference.	See par. *46.03*
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%
	0.0 … 1000.0%	Maximum torque reference.	See par. *46.03*
26.11	*Torque ref1 source*	Selects torque reference source 1. Two signal sources can be defined by this parameter. 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*



	Zero	None.	0
	AI1 scaled	*12.12 AI1 scaled value* (see page *240*).	1
	AI2 scaled	*12.22 AI2 scaled value* (see page *242*).	2
	FB A ref1	*03.05 FB A reference 1* (see page *196*).	4
	FB A ref2	*03.06 FB A reference 2* (see page *196*).	5
	EFB ref1	*03.09 EFB reference 1* (see page *196*).	
	EFB ref2	*03.10 EFB reference 2* (see page *196*).	
	DDCS ctrl ref1	*03.11 DDCS controller ref 1* (see page *196*).	10
	DDCS ctrl ref2	*03.12 DDCS controller ref 2* (see page *196*).	11
	D2D or M/F reference 1	*03.13 M/F or D2D ref1* (see page *196*).	12
	D2D or M/F reference 2	*03.14 M/F or D2D ref2* (see page *196*).	13
	Motor potentiometer	*22.80 Motor potentiometer ref act* (output of the motor potentiometer).	15

No.	Name/Value	Description	Def/FbEq16
	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 *121*).	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 *121*).	19
	Other	Source selection (see *Terms and abbreviations* on page *187*).	-
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*
26.13	*Torque ref1 function*	Selects a mathematical function between the reference sources selected by parameter *26.11 Torque ref1 source*. See diagram at *26.11 Torque ref1 source*.	*Ref1*
	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 of the reference sources is used as torque reference 1.	2
	Mul (ref1 × 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
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*
	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]	Source selection (see *Terms and abbreviations* on page *187*).	-

No.	Name/Value	Description	Def/FbEq16
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
	-8.000 … 8.000	Torque reference scaling factor.	1000 = 1
26.16	*Torque additive 1 source*	Selects the source for 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 *723*. For the selections, see parameter *26.11 Torque ref1 source*.	*Zero*
26.17	*Torque ref filter time*	Defines a low-pass filter time constant for the torque reference.	0.000 s
	0.000 … 30.000 s	Filter time constant for torque reference.	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
	0.000 … 60.000 s	Torque reference ramp-up time.	100 = 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
	0.000 … 60.000 s	Torque reference ramp-down time.	100 = 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 *725*. For the selections, see parameter *26.11 Torque ref1 source*	*Zero*
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*
	Not selected	0.	0
	Selected	1.	1
	DI1	Digital input DI1 (*10.02 DI delayed status*, bit 0).	2
	DI2	Digital input DI2 (*10.02 DI delayed status*, bit 1).	3
	DI3	Digital input DI3 (*10.02 DI delayed status*, bit 2).	4
	DI4	Digital input DI4 (*10.02 DI delayed status*, bit 3).	5
	DI5	Digital input DI5 (*10.02 DI delayed status*, bit 4).	6
	DI6	Digital input DI6 (*10.02 DI delayed status*, bit 5).	7

No.	Name/Value	Description	Def/FbEq16
	DIO1	Digital input/output DIO1 (*11.02 DIO delayed status*, bit 0).	10
	DIO2	Digital input/output DIO2 (*11.02 DIO delayed status*, bit 1).	11
	Other [bit]	Source selection (see *Terms and abbreviations* on page *187*).	-
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
	0 … 100	Torque limit filter time.	1 = 1
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 step is 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%
	-300.0 … 300.0%	Torque step.	See par. *46.03*
26.42	*Torque step enable*	Enables/disables a torque step (defined by parameter *26.41 Torque step*).	*Disable*
	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*
	Not selected	0.	0
	Selected	1.	1
	DI1	Digital input DI1 (*10.02 DI delayed status*, bit 0).	2
	DI2	Digital input DI2 (*10.02 DI delayed status*, bit 1).	3
	DI3	Digital input DI3 (*10.02 DI delayed status*, bit 2).	4
	DI4	Digital input DI4 (*10.02 DI delayed status*, bit 3).	5
	DI5	Digital input DI5 (*10.02 DI delayed status*, bit 4).	6
	DI6	Digital input DI6 (*10.02 DI delayed status*, bit 5).	7
	DIO1	Digital input/output DIO1 (*11.02 DIO delayed status*, bit 0).	10
	DIO2	Digital input/output DIO2 (*11.02 DIO delayed status*, bit 1).	11
	Other [bit]	Source selection (see *Terms and abbreviations* on page *187*).	-

No.	Name/Value	Description	Def/FbEq16
26.44	*Torque step source*	Selects the source of the torque step enabled by *26.43 Torque step pointer enable*.	*Zero*
	Zero	None.	0
	AI1 scaled	*12.12 AI1 scaled value* (see page *240*).	1
	AI2 scaled	*12.22 AI2 scaled value* (see page *242*).	2
	FB A ref1	*03.05 FB A reference 1* (see page *196*).	4
	FB A ref2	*03.06 FB A reference 2* (see page *196*).	5
	EFB ref1	*03.09 EFB reference 1* (see page *196*).	8
	EFB ref2	*03.10 EFB reference 2* (see page *196*).	9
	DDCS ctrl ref1	*03.11 DDCS controller ref 1* (see page *196*).	10
	DDCS ctrl ref2	*03.12 DDCS controller ref 2* (see page *196*).	11
	M/F reference 1	*03.13 M/F or D2D ref1* (see page *196*).	12
	M/F reference 2	*03.14 M/F or D2D ref2* (see page *196*).	13
	Motor potentiometer	*22.80 Motor potentiometer ref act* (output of the motor potentiometer).	15
	PID	*40.01 Process PID output actual* (output of the process PID controller).	16
	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 *121*).	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 *121*).	19
	Other	Source selection (see *Terms and abbreviations* on page *187*).	-
26.51	*Oscillation damping*	Parameters *26.51*…*26.58* configure the oscillation damping function. See section *Oscillation damping* (page *144*), and the block diagram on page *725*. This parameter enables (or selects a source that enables) the oscillation damping algorithm. 1 = Oscillation damping algorithm enabled	*Not selected*
	Not selected	0.	0
	Selected	1.	1
	DI1	Digital input DI1 (*10.02 DI delayed status*, bit 0).	2
	DI2	Digital input DI2 (*10.02 DI delayed status*, bit 1).	3
	DI3	Digital input DI3 (*10.02 DI delayed status*, bit 2).	4
	DI4	Digital input DI4 (*10.02 DI delayed status*, bit 3).	5
	DI5	Digital input DI5 (*10.02 DI delayed status*, bit 4).	6
	DI6	Digital input DI6 (*10.02 DI delayed status*, bit 5).	7
	DIO1	Digital input/output DIO1 (*11.02 DIO delayed status*, bit 0).	10
	DIO2	Digital input/output DIO2 (*11.02 DIO delayed status*, bit 1).	11
	Other [bit]	Source selection (see *Terms and abbreviations* on page *187*).	-

No.	Name/Value	Description	Def/FbEq16
26.52	*Oscillation damping out enable*	Determines (or selects a source that determines) whether the output of the oscillation damping function is added to the torque reference or not. **Note:** Before enabling the oscillation damping output, adjust parameters *26.53*…*26.57*. Then monitor the input signal (selected by *26.53*) and the output (*26.58*) to make sure that the correction is safe to apply. 1 = Add oscillation damping output to torque reference	*Not selected*
	Not selected	0.	0
	Selected	1.	1
	DI1	Digital input DI1 (*10.02 DI delayed status*, bit 0).	2
	DI2	Digital input DI2 (*10.02 DI delayed status*, bit 1).	3
	DI3	Digital input DI3 (*10.02 DI delayed status*, bit 2).	4
	DI4	Digital input DI4 (*10.02 DI delayed status*, bit 3).	5
	DI5	Digital input DI5 (*10.02 DI delayed status*, bit 4).	6
	DI6	Digital input DI6 (*10.02 DI delayed status*, bit 5).	7
	DIO1	Digital input/output DIO1 (*11.02 DIO delayed status*, bit 0).	10
	DIO2	Digital input/output DIO2 (*11.02 DIO delayed status*, bit 1).	11
	Other [bit]	Source selection (see *Terms and abbreviations* on page *187*).	-
26.53	*Oscillation compensation input*	Selects the input signal for the oscillation damping function. **Note:** Before changing this parameter run-time, disable the oscillation damping output using parameter *26.52*. Monitor the behavior of *26.58* before re-enabling the output.	*Speed error*
	Speed error	*24.01 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
	0.1 … 60.0 Hz	Center frequency for oscillation damping.	10 = 1 Hz
26.56	*Oscillation damping phase*	Defines a phase shift for the output of the filter. **Note:** Before changing this parameter run-time, disable the oscillation damping output using parameter *26.52*. Monitor the behavior of *26.58* before re-enabling the output.	180 deg
	0…360 deg	Phase shift for oscillation damping function output.	10 = 1 deg

No.	Name/Value	Description	Def/FbEq16
26.57	*Oscillation damping gain*	Defines a gain for the output of the oscillation damping function, ie. how much the output of the filter is amplified before it is added to the torque reference. Oscillation gain is scaled according to the speed controller gain so that changing the gain will not disturb oscillation damping. **Note:** Before changing this parameter run-time, disable the oscillation damping output using parameter *26.52*. Monitor the behavior of *26.58* before re-enabling the output.	1.0%
	0.0 … 100.0%	Gain setting for oscillation damping output.	10 = 1%
26.58	*Oscillation damping output*	Displays the output of the oscillation damping function. This value is added to the torque reference (as allowed by parameter *26.52 Oscillation damping out enable*). This parameter is read-only.	-
	-1600.000 … 1600.000%	Output of the oscillation damping function.	10 = 1%
26.70	*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 *723*. This parameter is read-only.	-
	-1600.0 …1600.0%	Value of torque reference source 1.	See par. *46.03*
26.71	*Torque reference act 2*	Displays the value of torque reference source 2. See the control chain diagram on page *723*. This parameter is read-only.	-
	-1600.0 …1600.0%	Value of torque reference source 2.	See par. *46.03*
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 *723*. This parameter is read-only.	-
	-1600.0 …1600.0%	Torque reference after selection.	See par. *46.03*
26.73	*Torque reference act 4*	Displays the torque reference after application of reference additive 1. See the control chain diagram on page *723*. This parameter is read-only.	-
	-1600.0 …1600.0%	Torque reference after application of reference additive 1.	See par. *46.03*
26.74	*Torque ref ramp out*	Displays the torque reference after limiting and ramping. See the control chain diagram on page *723*. This parameter is read-only.	-
	-1600.0 …1600.0%	Torque reference after limiting and ramping.	See par. *46.03*
26.75	*Torque reference act 5*	Displays the torque reference after control mode selection. See the control chain diagram on page *725*. This parameter is read-only.	-
	-1600.0 …1600.0%	Torque reference after control mode selection.	See par. *46.03*

No.	Name/Value	Description	Def/FbEq16
26.76	*Torque reference act 6*	Displays the torque reference after application of reference additive 2. See the control chain diagram on page *725*. This parameter is read-only.	-
	-1600.0 …1600.0%	Torque reference after application of reference additive 2.	See par. *46.03*
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 *725*. This parameter is read-only.	-
	-1600.0 …1600.0%	Torque reference additive 2.	See par. *46.03*
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 *725*. This parameter is read-only.	-
	-1600.0 …1600.0%	Torque reference additive 2.	See par. *46.03*
26.81	*Rush control gain*	Rush controller gain term. See section *Rush control* (page *146*).	10.0
	1.0 …10000.0	Rush controller gain.	1 = 1
26.82	*Rush control integration time*	Rush controller integration time term.	2.0 s
	0.1 …10.0 s	Rush controller integration time.	1 = 1 s

No.	Name/Value	Description	Def/FbEq16
30 Limits		Drive operation limits.	
30.01	*Limit word 1*	Displays limit word 1. This parameter is read-only.	-

Bit	Name	Description
0	Torq lim	1 = Drive torque is being limited by the motor control (undervoltage control, current control, load angle control or pull-out control), or by the torque limits defined by parameters.
1	Spd ctl tlim min	1 = Speed controller output is being limited by *25.11 Speed control min torque*.
2	Spd ctl tlim max	1 = Speed controller output is being limited by *25.12 Speed control max torque*.
3	Torq ref max	1 = Torque reference is being limited by *26.09 Maximum torque ref*
4	Torq ref min	1 = Torque reference is being limited by *26.08 Minimum torque ref*
5	Tlim max speed	1 = Torque reference is being limited by the rush control because of maximum speed limit (*30.12 Maximum speed*)
6	Tlim min speed	1 = Torque reference is being limited by the rush control because of minimum speed limit (*30.11 Minimum speed*)
7	Max speed ref lim	1 = Speed reference is being limited by *30.12 Maximum speed*
8	Min speed ref lim	1 = Speed reference is being limited by *30.11 Minimum speed*
9	Max freq ref lim	1 = Frequency reference is being limited by *30.14 Maximum frequency*
10	Min freq ref lim	1 = Frequency reference is being limited by *30.13 Minimum frequency*
11	Reserved	
12	Sw freq ref lim	1 = Requested output frequency cannot be reached because of switching frequency limitation (because of output filtering or ATEX-related protections)
13	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
14…15	Reserved	

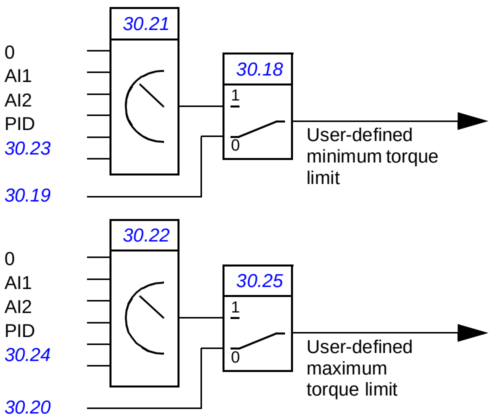
No.	Name/Value	Description	Def/FbEq16
	0000h…FFFFh	Limit word 1.	1 = 1

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

Bit	Name	Description
0	Undervoltage	*1 = Intermediate DC circuit undervoltage
1	Overvoltage	*1 = Intermediate DC circuit overvoltage
2	Minimum torque	*1 = Torque is being limited by *30.26 Power motoring limit*, *30.27 Power generating limit* or source of *30.18 Minimum torque sel*. See diagram on page *726*.
3	Maximum torque	*1 = Torque is being limited by *30.26 Power motoring limit*, *30.27 Power generating limit* or source of *30.18 Minimum torque sel*. See diagram on page *726*.
4	Internal current	1 = An inverter current limit (identified by bits 8…11) is active
5	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
6	Motor pullout	(With asynchronous motors only) 1 = Motor pull-out limit is active, ie. the motor cannot produce any more torque
7	Reserved	
8	Thermal	1 = Input current is being limited by the main circuit thermal limit
9	Max current	*1 = Maximum output current (I_{MAX}) is being limited
10	User current	*1 = Output current is being limited by *30.17 Maximum current*
11	Thermal IGBT	*1 = Output current is being limited by a calculated thermal current value
12	IGBT overtemperature	*1 = Output current is being limited because of estimated IGBT temperature
13	IGBT overload	*1 = Output current is being limited because of IGBT junction to case temperature
14…15	Reserved	
*Only one out of bits 0…3, and one out of bits 9…13 can be on simultaneously. The bit typically indicates the limit that is exceeded first.		

No.	Name/Value	Description	Def/FbEq16
	0000h…FFFFh	Torque limitation status word.	1 = 1
30.11	*Minimum speed*	Maximum speed in reverse direction. **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. See section *Master/follower functionality* (page *129*).	-1500.00 rpm; -1800.00 rpm (*95.20* b0)
	-30000.00 … 30000.00 rpm	Minimum speed. **Note:** Set this limit high enough for all intended winch modes to use. Winch modes have corresponding limits in group *75 Winch interface*. The lower of the group *30 Limits* and *75 Winch interface* limits are always used.	See par. *46.01*

No.	Name/Value	Description	Def/FbEq16
30.12	*Maximum speed*	Maximum speed in forward direction. **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. See section *Master/follower functionality* (page *129*). **Note:** Set this limit high enough for all intended winch modes to use. Winch modes have corresponding limits in group *75 Winch interface*. The lower of the group *30 Limits* and *75 Winch interface* limits are always used.	1500.00 rpm; 1800.00 rpm (*95.20* b0)
	-30000.00 … 30000.00 rpm	Maximum speed.	See par. *46.01*
30.13	*Minimum frequency*	Defines the minimum allowed frequency. **WARNING!** This value must not be higher than *30.14 Maximum frequency*. **WARNING!** This limit is effective in frequency control mode only.	-50.00 Hz -60.00 Hz (*95.20* b0)
	-598.00 … 598.00 Hz	Minimum frequency.	See par. *46.02*
30.14	*Maximum frequency*	Defines the maximum allowed frequency. **WARNING!** This value must not be lower than *30.13 Minimum frequency*. **WARNING!** This limit is effective in frequency control mode only.	50.00 Hz 60.00 Hz (*95.20* b0)
	-598.00 … 598.00 Hz	Maximum frequency.	See par. *46.02*
30.15	*Maximum start current enable*	A temporary motor current limit specifically for starting can be defined by this parameter and *30.16 Maximum start current*. When this parameter is set to *Enable*, the drive observes the start current limit defined by *30.16 Maximum start current*. The limit is in force for 2 seconds after initial magnetization (of an asynchronous induction motor) or autophasing (of a permanent magnet motor), but not more often than once in every 7 seconds. Otherwise, the limit defined by *30.17 Maximum current* is in force. **Note:** The availability of a start current higher than the general limit depends on drive hardware. See the rating data in the hardware manual of the drive.	*Disable*
	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 … 30000.00 A	Maximum start current.	1 = 1 A
30.17	*Maximum current*	Defines the maximum allowed motor current.	0.00 A
	0.00 … 30000.00 A	Maximum motor current.	1 = 1 A

No.	Name/Value	Description	Def/FbEq16
30.18	*Minimum torque sel*	Selects a source that switches between two different predefined minimum torque limits. 0 = Minimum torque limit defined by *30.19* is active 1 = Minimum torque limit selected by *30.21* is active The user can define two sets of torque limits, and switch between the sets using a binary source such as a digital input. The minimum limit selection (*30.18*) is independent of the maximum limit selection (*30.25*). The first set of limits is defined by parameters *30.19* and *30.20*. The second set has selector parameters for both the minimum (*30.21*) and maximum (*30.22*) limits that allows the use of a selectable analog source (such as an analog input).  Note: In addition to the user-defined limits, torque may be limited for other reasons (such as power limitation). Refer to the block diagram on page *726*.	*Minimum torque 1*
	Minimum torque 1	0 (minimum torque limit defined by *30.19* is active).	0
	Minimum torque 2 source	1 (minimum torque limit selected by *30.21* is active).	1
	DI1	Digital input DI1 (*10.02 DI delayed status*, bit 0).	2
	DI2	Digital input DI2 (*10.02 DI delayed status*, bit 1).	3
	DI3	Digital input DI3 (*10.02 DI delayed status*, bit 2).	4
	DI4	Digital input DI4 (*10.02 DI delayed status*, bit 3).	5
	DI5	Digital input DI5 (*10.02 DI delayed status*, bit 4).	6
	DI6	Digital input DI6 (*10.02 DI delayed status*, bit 5).	7
	DIO1	Digital input/output DIO1 (*11.02 DIO delayed status*, bit 0).	10
	DIO2	Digital input/output DIO2 (*11.02 DIO delayed status*, bit 1).	11
	Other [bit]	Source selection (see *Terms and abbreviations* on page *187*).	-

No.	Name/Value	Description	Def/FbEq16
30.19	Minimum torque 1	Defines a minimum torque limit for the drive (in percent of nominal motor torque). See diagram at parameter 30.18 Minimum torque sel. The limit is effective when • the source selected by 30.18 Minimum torque sel is 0, or • 30.18 is set to Minimum torque 1. **Note:** Set this limit high for all intended winch modes to use. Winch modes have corresponding limits in group 75 Winch interface. The lower of the group 30 Limits and 75 Winch interface limits are always used.	-300.0%
	-1600.0 … 0.0%	Minimum torque limit 1.	See par. 46.03
30.20	Maximum torque 1	Defines a maximum torque limit for the drive (in percent of nominal motor torque). See diagram at parameter 30.18 Minimum torque sel. The limit is effective when • the source selected by 30.25 Maximum torque sel is 0, or • 30.25 is set to Maximum torque 1. **Note:** Set this limit high for all intended winch modes to use. Winch modes have corresponding limits in group 75 Winch interface. The lower of the group 30 Limits and 75 Winch interface limits are always used.	300.0%
	0.0 … 1600.0%	Maximum torque 1.	See par. 46.03
30.21	Minimum torque 2 source	Defines the source of the minimum torque limit for the drive (in percent of nominal motor torque) when • the source selected by parameter 30.18 Minimum torque sel is 1, or • 30.18 is set to Minimum torque 2 source. See diagram at 30.18 Minimum torque sel. **Note:** Any positive values received from the selected source are inverted.	Minimum torque 2
	Zero	None.	0
	AI1 scaled	12.12 AI1 scaled value (see page 240).	1
	AI2 scaled	12.22 AI2 scaled value (see page 242).	2
	Minimum torque 2	30.23 Minimum torque 2.	6
	Other	Source selection (see Terms and abbreviations on page 187).	-
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
	Zero	None.	0
	AI1 scaled	12.12 AI1 scaled value (see page 240).	1
	AI2 scaled	12.22 AI2 scaled value (see page 242).	2
	Maximum torque 2	30.24 Maximum torque 2.	6

No.	Name/Value	Description	Def/FbEq16
	Other	Source selection (see *Terms and abbreviations* on page *187*).	-
30.23	*Minimum torque 2*	Defines the minimum torque limit for the drive (in percent of nominal motor torque) when • the source selected by parameter *30.18 Minimum torque sel* is 1, and • *30.21* is set to *Minimum torque 2*. See diagram at *30.18 Minimum torque sel*.	-300.0%
	-1600.0 … 0.0%	Minimum torque limit 2.	See par. *46.03*
30.24	*Maximum torque 2*	Defines the maximum torque limit for the drive (in percent of nominal motor torque) when • the source selected by parameter *30.25 Maximum torque sel* is 1, and • *30.22* is set to *Maximum torque 2*. See diagram at *30.18 Minimum torque sel*.	300.0%
	0.0 … 1600.0%	Maximum torque limit 2.	See par. *46.03*
30.25	*Maximum torque sel*	Selects a source that switches between two different maximum torque limits. 0 = Maximum torque limit 1 defined by *30.20* is active 1 = Maximum torque limit selected by *30.22* is active See also parameter *30.18 Minimum torque sel*.	*Maximum torque 1*
	Maximum torque 1	0.	0
	Maximum torque 2 source	1.	1
	DI1	Digital input DI1 (*10.02 DI delayed status*, bit 0).	2
	DI2	Digital input DI2 (*10.02 DI delayed status*, bit 1).	3
	DI3	Digital input DI3 (*10.02 DI delayed status*, bit 2).	4
	DI4	Digital input DI4 (*10.02 DI delayed status*, bit 3).	5
	DI5	Digital input DI5 (*10.02 DI delayed status*, bit 4).	6
	DI6	Digital input DI6 (*10.02 DI delayed status*, bit 5).	7
	DIO1	Digital input/output DIO1 (*11.02 DIO delayed status*, bit 0).	10
	DIO2	Digital input/output DIO2 (*11.02 DIO delayed status*, bit 1).	11
	Other [bit]	Source selection (see *Terms and abbreviations* on page *187*).	-
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.	300.00%
	0.00 … 600.00%	Maximum shaft power in motoring mode.	1 = 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.	-300.00%
	-600.00 … 0.00%	Maximum shaft power in generating mode.	1 = 1%

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

31 Fault functions		Configuration of external events; selection of behavior of the drive upon fault situations.	
31.01	*External event 1 source*	Defines the source of external event 1. See also parameter *31.02 External event 1 type*. 0 = Trigger event 1 = Normal operation	*Inactive (true)*; *DI6* (*95.20* b8)
	Active (false)	0.	0
	Inactive (true)	1.	1
	DIIL	DIIL input (*10.02 DI delayed status*, bit 15).	2
	DI1	Digital input DI1 (*10.02 DI delayed status*, bit 0).	3
	DI2	Digital input DI2 (*10.02 DI delayed status*, bit 1).	4
	DI3	Digital input DI3 (*10.02 DI delayed status*, bit 2).	5
	DI4	Digital input DI4 (*10.02 DI delayed status*, bit 3).	6
	DI5	Digital input DI5 (*10.02 DI delayed status*, bit 4).	7
	DI6	Digital input DI6 (*10.02 DI delayed status*, bit 5).	8
	DIO1	Digital input/output DIO1 (*11.02 DIO delayed status*, bit 0).	11
	DIO2	Digital input/output DIO2 (*11.02 DIO delayed status*, bit 1).	12
	Other [bit]	Source selection (see *Terms and abbreviations* on page *187*).	-

No.	Name/Value	Description	Def/FbEq16
31.02	*External event 1 type*	Selects the type of external event 1.	*Fault* (*95.20* b8)
	Fault	The external event generates a fault.	0
	Warning	The external event generates a warning.	1
	Warning/Fault	If the drive is modulating, the external event generates a fault. Otherwise, the event generates a warning.	3
31.03	*External event 2 source*	Defines the source of external event 2. See also parameter *31.04 External event 2 type*. For the selections, see parameter *31.01 External event 1 source*.	*Inactive (true)*; *DIIL* (*95.20* b5)
31.04	*External event 2 type*	Selects the type of external event 2.	
	Fault	The external event generates a fault.	0
	Warning	The external event generates a warning.	1
	Warning/Fault	If the drive is modulating, the external event generates a fault. Otherwise, the event generates a warning.	3
31.05	*External event 3 source*	Defines the source of external event 3. See also parameter *31.06 External event 3 type*. For the selections, see parameter *31.01 External event 1 source*.	*Inactive (true)*
31.06	*External event 3 type*	Selects the type of external event 3.	
	Fault	The external event generates a fault.	0
	Warning	The external event generates a warning.	1
	Warning/Fault	If the drive is modulating, the external event generates a fault. Otherwise, the event generates a warning.	3
31.07	*External event 4 source*	Defines the source of external event 4. See also parameter *31.08 External event 4 type*. For the selections, see parameter *31.01 External event 1 source*.	*Inactive (true)*
31.08	*External event 4 type*	Selects the type of external event 4.	
	Fault	The external event generates a fault.	0
	Warning	The external event generates a warning.	1
	Warning/Fault	If the drive is modulating, the external event generates a fault. Otherwise, the event generates a warning.	3
31.09	*External event 5 source*	Defines the source of external event 5. See also parameter *31.10 External event 5 type*. For the selections, see parameter *31.01 External event 1 source*.	*Inactive (true)*
31.10	*External event 5 type*	Selects the type of external event 5.	
	Fault	The external event generates a fault.	0
	Warning	The external event generates a warning.	1
	Warning/Fault	If the drive is modulating, the external event generates a fault. Otherwise, the event generates a warning.	3

No.	Name/Value	Description	Def/FbEq16
31.11	*Fault reset selection*	Selects the source of an external fault reset signal. This signal will be observed even if it is not the active source in the current control location (EXT1/EXT2/Local). (A reset from the active source will be observed regardless of this parameter.) 0 –> 1 = Reset	*Not selected*
	Not selected	0.	0
	Selected	1.	1
	DI1	Digital input DI1 (*10.02 DI delayed status*, bit 0).	2
	DI2	Digital input DI2 (*10.02 DI delayed status*, bit 1).	3
	DI3	Digital input DI3 (*10.02 DI delayed status*, bit 2).	4
	DI4	Digital input DI4 (*10.02 DI delayed status*, bit 3).	5
	DI5	Digital input DI5 (*10.02 DI delayed status*, bit 4).	6
	DI6	Digital input DI6 (*10.02 DI delayed status*, bit 5).	7
	DIO1	Digital input/output DIO1 (*11.02 DIO delayed status*, bit 0).	10
	DIO2	Digital input/output DIO2 (*11.02 DIO delayed status*, bit 1).	11
	FBA A MCW bit 7	Control word bit 7 received through fieldbus interface A.	30
	EFB MCW bit 7	Control word bit 7 received through the embedded fieldbus interface.	32
	Other [bit]	Source selection (see *Terms and abbreviations* on page *187*).	-

No.	Name/Value	Description	Def/FbEq16
31.12	*Autoreset selection*	Selects faults that are automatically reset. The parameter is a 16-bit word with each bit corresponding to a fault type. Whenever a bit is set to 1, the corresponding fault is automatically reset. The number and interval of reset attempts are defined by parameters *31.14*…*31.16*. **WARNING!** Before you activate the function, make sure that no dangerous situations can occur. The function resets the drive automatically and continues operation after a fault. **Note:** • The autoreset function is only available in external control; see section *Local control vs. external control* (page *20*). • Faults related to the Safe torque off (STO) function cannot be automatically reset. The bits of this binary number correspond to the following faults:	0000h

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

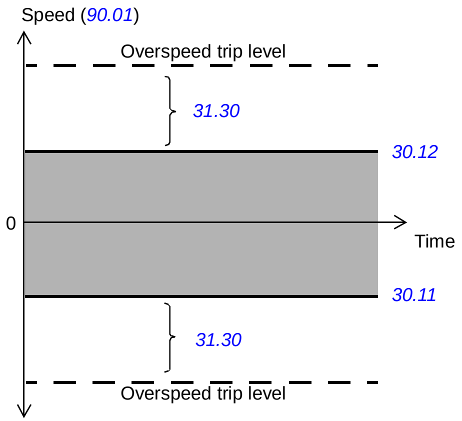
No.	Name/Value	Description	Def/FbEq16
	0000h…FFFFh	Automatic reset configuration word.	1 = 1
31.13	*User selectable fault*	Defines the fault that can be automatically reset using parameter *31.12 Autoreset selection*, bit 10. The faults are listed in chapter *Fault tracing* (page *651*).	0000h
	0000h…FFFFh	Fault code.	10 = 1
31.14	*Number of trials*	Defines the maximum number of automatic resets that the drive is allowed to attempt within the time specified by *31.15 Total trials time.* If the fault persists, subsequent reset attempts will be made at intervals defined by *31.16 Delay time*. The faults to be automatically reset are defined by *31.12 Autoreset selection*.	0
	0…5	Number of automatic resets.	1 = 1

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

<table>
<tr><th>No.</th><th>Name/Value</th><th>Description</th><th>Def/FbEq16</th></tr>
<tr><td>31.22</td><td>STO indication run/stop</td><td>Selects which indications are given when one or both Safe torque off (STO) signals are switched off or lost. The indications also depend on whether the drive is running or stopped when this occurs.
The tables at each selection below show the indications generated with that particular setting.
Notes:
• This parameter does not affect the operation of the STO function itself. The STO function will operate regardless of the setting of this parameter: a running drive will stop upon removal of one or both STO signals, and will not start until both STO signals are restored and all faults reset.
• The loss of only one STO signal always generates a fault as it is interpreted as a malfunction.
• This parameter cannot be changed while the drive is running.
For more information on the STO, see the Hardware manual of the drive.</td><td>Fault/Fault</td></tr>
<tr><td></td><td>Fault/Fault</td><td>
<table>
<tr><th colspan="2">Inputs</th><th rowspan="2">Indication (running or stopped)</th></tr>
<tr><th>IN1</th><th>IN2</th></tr>
<tr><td>0</td><td>0</td><td>Fault 5091 Safe torque off</td></tr>
<tr><td>0</td><td>1</td><td>Faults 5091 Safe torque off and FA81 Safe torque off 1 loss</td></tr>
<tr><td>1</td><td>0</td><td>Faults 5091 Safe torque off and FA82 Safe torque off 2 loss</td></tr>
<tr><td>1</td><td>1</td><td>(Normal operation)</td></tr>
</table>
</td><td>0</td></tr>
<tr><td></td><td>Fault/Warning</td><td>
<table>
<tr><th colspan="2">Inputs</th><th colspan="2">Indication</th></tr>
<tr><th>IN1</th><th>IN2</th><th>Running</th><th>Stopped</th></tr>
<tr><td>0</td><td>0</td><td>Fault 5091 Safe torque off</td><td>Warning A5A0 Safe torque off</td></tr>
<tr><td>0</td><td>1</td><td>Faults 5091 Safe torque off and FA81 Safe torque off 1 loss</td><td>Warning A5A0 Safe torque off and fault FA81 Safe torque off 1 loss</td></tr>
<tr><td>1</td><td>0</td><td>Faults 5091 Safe torque off and FA82 Safe torque off 2 loss</td><td>Warning A5A0 Safe torque off and fault FA82 Safe torque off 2 loss</td></tr>
<tr><td>1</td><td>1</td><td colspan="2">(Normal operation)</td></tr>
</table>
</td><td>1</td></tr>
</table>

<table>
<tr><th>No.</th><th>Name/Value</th><th>Description</th><th>Def/FbEq16</th></tr>
<tr><td></td><td>Fault/Event</td><td>
<table>
<tr><td colspan="2">Inputs</td><td colspan="2">Indication</td></tr>
<tr><td>IN1</td><td>IN2</td><td>Running</td><td>Stopped</td></tr>
<tr><td>0</td><td>0</td><td>Fault 5091 Safe torque off</td><td>Event B5A0 STO event</td></tr>
<tr><td>0</td><td>1</td><td>Faults 5091 Safe torque off and FA81 Safe torque off 1 loss</td><td>Event B5A0 STO event and fault FA81 Safe torque off 1 loss</td></tr>
<tr><td>1</td><td>0</td><td>Faults 5091 Safe torque off and FA82 Safe torque off 2 loss</td><td>Event B5A0 STO event and fault FA82 Safe torque off 2 loss</td></tr>
<tr><td>1</td><td>1</td><td colspan="2">(Normal operation)</td></tr>
</table>
</td><td>2</td></tr>
<tr><td></td><td>Warning/Warning</td><td>
<table>
<tr><td colspan="2">Inputs</td><td rowspan="2">Indication (running or stopped)</td></tr>
<tr><td>IN1</td><td>IN2</td></tr>
<tr><td>0</td><td>0</td><td>Warning A5A0 Safe torque off</td></tr>
<tr><td>0</td><td>1</td><td>Warning A5A0 Safe torque off and fault FA81 Safe torque off 1 loss</td></tr>
<tr><td>1</td><td>0</td><td>Warning A5A0 Safe torque off and fault FA82 Safe torque off 2 loss</td></tr>
<tr><td>1</td><td>1</td><td>(Normal operation)</td></tr>
</table>
</td><td>3</td></tr>
<tr><td></td><td>Event/Event</td><td>
<table>
<tr><td colspan="2">Inputs</td><td rowspan="2">Indication (running or stopped)</td></tr>
<tr><td>IN1</td><td>IN2</td></tr>
<tr><td>0</td><td>0</td><td>Event B5A0 STO event</td></tr>
<tr><td>0</td><td>1</td><td>Event B5A0 STO event and fault FA81 Safe torque off 1 loss</td></tr>
<tr><td>1</td><td>0</td><td>Event B5A0 STO event and fault FA82 Safe torque off 2 loss</td></tr>
<tr><td>1</td><td>1</td><td>(Normal operation)</td></tr>
</table>
</td><td>4</td></tr>
<tr><td></td><td>No indication/No indication</td><td>
<table>
<tr><td colspan="2">Inputs</td><td rowspan="2">Indication (running or stopped)</td></tr>
<tr><td>IN1</td><td>IN2</td></tr>
<tr><td>0</td><td>0</td><td>None</td></tr>
<tr><td>0</td><td>1</td><td>Fault FA81 Safe torque off 1 loss</td></tr>
<tr><td>1</td><td>0</td><td>Fault FA82 Safe torque off 2 loss</td></tr>
<tr><td>1</td><td>1</td><td>(Normal operation)</td></tr>
</table>
</td><td>5</td></tr>
<tr><td>31.23</td><td>Wiring or earth fault</td><td>Selects how the drive reacts to incorrect input power and motor cable connection (i.e. input power cable is connected to drive motor connection).
Note: The protection must be disabled with drive/inverter hardware supplied from a common DC bus.</td><td>Fault, No action
(95.20 b15)</td></tr>
<tr><td></td><td>No action</td><td>No action taken (protection disabled).</td><td>0</td></tr>
<tr><td></td><td>Fault</td><td>The drive trips on fault 3181 Wiring or earth fault.</td><td>1</td></tr>
</table>

No.	Name/Value	Description	Def/FbEq16
31.24	*Stall function*	Selects how the drive reacts to a motor stall condition. A stall condition is defined as follows: • The drive exceeds the stall current limit (*31.25 Stall current limit*), and • the output frequency is below the level set by parameter *31.27 Stall frequency limit* or the motor speed is below the level set by parameter *31.26 Stall speed limit*, and • the conditions above have been true longer than the time set by parameter *31.28 Stall time*.	*Fault*
	No action	None (stall supervision disabled).	0
	Warning	The drive generates an *A780 Motor stall* warning.	1
	Fault	The drive trips on fault *7121 Motor stall*.	2
31.25	*Stall current limit*	Stall current limit in percent of the nominal current of the motor. See parameter *31.24 Stall function*.	200.0%
	0.0 … 1600.0%	Stall current limit.	10 = 1%
31.26	*Stall speed limit*	Stall speed limit in rpm. See parameter *31.24 Stall function*.	150.00 rpm 180.00 rpm (*95.20* b0)
	0.00 … 10000.00 rpm	Stall speed limit.	See par. *46.01*
31.27	*Stall frequency limit*	Stall frequency limit. See parameter *31.24 Stall function*. **Note:** Setting the limit below 10 Hz is not recommended.	15.00 rpm 18.00 rpm (*95.20* b0)
	0.00 … 500.00 Hz	Stall frequency limit.	See par. *46.02*
31.28	*Stall time*	Stall time. See parameter *31.24 Stall function*.	20 s
	0 … 3600 s	Stall time.	1 = 1 s

No.	Name/Value	Description	Def/FbEq16
31.30	*Overspeed trip margin*	Defines, together with *30.11 Minimum speed* and *30.12 Maximum speed*, the maximum allowed speed of the motor (overspeed protection). If *90.01 Motor speed for control* exceeds the speed limit defined by parameter *30.11* or *30.12* by more than the value of this parameter, the drive trips on the *7310 Overspeed* fault. **Example:** If the maximum speed is 1420 rpm and speed trip margin is 300 rpm, the drive trips at 1720 rpm.  	500.00 rpm
	0.00 … 10000.00 rpm	Overspeed trip margin.	See par. *46.01*
31.32	*Emergency ramp supervision*	Parameters *31.32 Emergency ramp supervision* and *31.33 Emergency ramp supervision delay*, together with *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. See also parameter *21.04 Emergency stop mode*.	0%
	0…300%	Maximum deviation from expected deceleration rate.	1 = 1%

No.	Name/Value	Description	Def/FbEq16
31.33	*Emergency ramp supervision delay*	If parameter *31.32 Emergency ramp supervision* is set to 0%, this parameter defines the maximum time an emergency stop (mode Off1 or Off3) is allowed to take. If the motor has not stopped when the time elapses, the drive trips on *73B0 Emergency ramp failed*, sets bit 8 of *06.17 Drive status word 2*, and coasts to a stop. If *31.32* is set to a value other than 0%, this parameter defines a delay between the receipt of the emergency stop command and the activation of the supervision. It is recommended to specify a short delay to allow the speed change rate to stabilize.	0 s
	0…32767 s	Maximum ramp-down time, or supervision activation delay.	1 = 1 s
31.35	*Main fan fault function*	Selects how the drive reacts when a main cooling fan fault is detected. **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.	*Warning*
	Fault	The drive trips on fault *5080 Fan*.	0
	Warning	The drive generates an *A581 Fan* warning.	1
	No action	No action taken.	2
31.36	*Aux fan fault function*	(Only visible with a ZCU control unit) Selects how the drive reacts when an auxiliary fan fault is detected. Temporarily suppresses auxiliary fan faults. Certain drive types (especially those protected to IP55) have an auxiliary fan built into the front cover as standard. If the fan is sticking or disconnected, the control program generates a fault (*5081 Auxiliary fan not running*). If it is necessary to operate the drive without the front cover (for example, during commissioning), this parameter can be activated to temporarily generate a warning (*A582 Auxiliary fan not running*). Notes: • The parameter must be activated within 2 minutes of control unit reboot (either by cycling the power or by parameter *96.08*). • The parameter will be in effect until the auxiliary fan is reconnected and detected, or until the next control unit reboot.	*Fault*
	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

No.	Name/Value	Description	Def/FbEq16
	Warning	The drive generates a warning, *A582 Auxiliary fan not running*.	1
31.37	*Ramp stop supervision*	Parameters *31.37 Ramp stop supervision* and *31.38 Ramp stop supervision delay*, together with *01.29 Speed change rate*, provide a supervision function for normal (ie. non-emergency) ramp stopping. The supervision is based on either • observing the time within which the motor stops, or • comparing the actual and expected deceleration rates. If this parameter is set to 0%, the maximum stop time is directly set in parameter *31.38*. Otherwise, *31.37* defines the maximum allowed deviation from the expected deceleration rate, which is calculated from parameters *23.19*, *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 *31.32* is set to 0% and *31.33* is set to 0 s, the ramp stop supervision is disabled.	0%
	0…300%	Maximum deviation from expected deceleration rate.	1 = 1%
31.38	*Ramp stop supervision delay*	If parameter *31.37 Ramp stop supervision* is set to 0%, this parameter defines the maximum time a ramp stop is allowed to take. If the motor has not stopped when the time elapses, the drive trips on *73B1 Stop failed*, sets bit 14 of *06.17 Drive status word 2*, and coasts to a stop. If *31.37* is set to a value other than 0%, this parameter defines a delay between the receipt of the stop command and the activation of the supervision. It is recommended to specify a short delay to allow the speed change rate to stabilize.	0 s
	0…32767 s	Maximum ramp-down time, or supervision activation delay.	1 = 1 s
31.40	*Disable 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:	0000b

Bit	Name	Warning
0	Overvoltage	*A3A1 DC link overvoltage*
1	Reserved	
2	Encoder 1	*A7E1 Encoder* (for encoder 1)
3	Encoder 2	*A7E1 Encoder* (for encoder 2)
4	CU (Control unit) battery	*A5F0 Control unit battery*
5	Emergency Stop Off2	*AFE1 Emergency stop (off2)*
6	Emergency Stop Off1 Off3	*AFE2 Emergency stop (off1 or off3)*
7…15	Reserved	

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

No.	Name/Value	Description	Def/FbEq16
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 th maximum peak current to one phase.	0.00 A
	0.00 … 30000.00 A	Custom motor current fault limit.	See par. *46.05*
31.54	*Fault action*	Selects the stop mode when a non-critical fault occurs.	*Coast*
	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*
	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
31.202	*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.	

Bit	Name	Description
0	In motor mode	1 = When the drive is motoring, i.e. output power percentage > 10%.
1	In generator mode	1 = When the drive is generating i.e. output power percentage < -10%.
2	Minimum torque	See parameter *30.02 Torque limit status*.
3	Maximum torque	See parameter *30.02 Torque limit status*.
4	Maximum current	See parameter *30.02 Torque limit status*.
5	Load angle	See parameter *30.02 Torque limit status*.
6	Motor pullout	See parameter *30.02 Torque limit status*.
7	User bit	A bit of your own selection.
8...15	Reserved	

No.	Name/Value	Description	Def/FbEq16
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*
	FALSE	0	
	TRUE	1	
	DI1	Digital input DI1 (*10.02 DI delayed status*, bit 0).	
	DI2	Digital input DI2 (*10.02 DI delayed status*, bit 1).	
	DI3	Digital input DI3 (*10.02 DI delayed status*, bit 2).	
	DI4	Digital input DI4 (*10.02 DI delayed status*, bit 3).	

No.	Name/Value	Description	Def/FbEq16
	DI5	Digital input DI5 (*10.02 DI delayed status*, bit 4).	
	DI6	Digital input DI6 (*10.02 DI delayed status*, bit 5).	
	DIO1	Digital input/output DIO1 (*11.02 DIO delayed status*, bit 0).	
	DIO2	Digital input/output DIO2 (*11.02 DIO delayed status*, bit 1).	
	DI1 inverted	Digital input DI1 inverted	
	DI2 inverted	Digital input DI2 inverted	
	DI3 inverted	Digital input DI3 inverted	
	DI4 inverted	Digital input DI4 inverted	
	DI5 inverted	Digital input DI5 inverted	
	DI6 inverted	Digital input DI6 inverted	
	DIO1 inverted	Digital input/output DIO1 inverted	
	DIO2 inverted	Digital input/output DIO2 inverted	
	Other	Source selection (see *Terms and abbreviations* on page*187*).	
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
	0...30000 ms	Inverter overload delay in ms.	
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 *179*).	
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*.	000b

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

No.	Name/Value	Description	Def/FbEq16
	0000…1111b	Signal supervision status word.	1 = 1
32.05	*Supervision 1 function*	Selects the mode of signal supervision function 1. Determines how the monitored signal (see parameter *32.07*) is compared to its lower and upper limits (*32.09* and *32.10* respectively). The action to be taken when the condition is fulfilled is selected by *32.06*.	*Disabled*
	Disabled	Signal supervision 1 not in use.	0
	Low	Action is taken whenever the signal falls below its lower limit.	1

No.	Name/Value	Description	Def/FbEq16
	High	Action is taken whenever the signal rises above its upper limit.	2
	Abs low	Action is taken whenever the absolute value of the signal falls below its (absolute) lower limit.	3
	Abs high	Action is taken whenever the absolute value of the signal rises above its (absolute) upper limit.	4
	Both	Action is taken whenever the signal falls below its low limit or rises above its high limit.	5
	Abs both	Action is taken whenever the absolute value of the signal falls below its (absolute) low limit or rises above its (absolute) high limit.	6
32.06	*Supervision 1 action*	Selects the action the drive takes when the value monitored by signal supervision 1 exceeds its limits. **Note:** This parameter does not affect the status indicated by *32.01 Supervision status*.	*No action*
	No action	No action taken.	0
	Warning	A warning (*A8B0 Signal supervision*) is generated.	1
	Fault	The drive trips on *80B0 Signal supervision*.	2
	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*
	Zero	None.	0
	Speed	*01.01 Motor speed used* (page *192*).	1
	Frequency	*01.06 Output frequency* (page *192*).	3
	Current	*01.07 Motor current* (page *192*).	4
	Torque	*01.10 Motor torque* (page *192*).	6
	DC voltage	*01.11 DC voltage* (page *193*).	7
	Output power	*01.14 Output power* (page *193*).	8
	AI1	*12.11 AI1 actual value* (page *240*).	9
	AI2	*12.21 AI2 actual value* (page *242*).	10
	Speed ref ramp in	*23.01 Speed ref ramp input* (page *307*).	18
	Speed ref ramp out	*23.02 Speed ref ramp output* (page *307*).	19
	Speed ref used	*24.01 Used speed reference* (page *314*).	20
	Torque ref used	*26.02 Torque reference used* (page *329*).	21
	Other [bit]	Source selection (see *Terms and abbreviations* on page *187*).	-
32.08	*Supervision 1 filter time*	Defines a filter time constant for the signal monitored by signal supervision 1.	0.000 s
	0.000 … 30.000 s	Signal filter time.	1000 = 1 s
32.09	*Supervision 1 low*	Defines the lower limit for signal supervision 1.	0.00
	-21474830.00 … 21474830.00	Low limit.	-
32.10	*Supervision 1 high*	Defines the upper limit for signal supervision 1.	0.00
	-21474830.00 … 21474830.00	Upper limit.	-

No.	Name/Value	Description	Def/FbEq16
32.15	*Supervision 2 function*	Selects the mode of signal supervision function 2. Determines how the monitored signal (see parameter *32.17*) is compared to its lower and upper limits (*32.19* and *32.20* respectively). The action to be taken when the condition is fulfilled is selected by *32.16*.	*Disabled*
	Disabled	Signal supervision 2 not in use.	0
	Low	Action is taken whenever the signal falls below its lower limit.	1
	High	Action is taken whenever the signal rises above its upper limit.	2
	Abs low	Action is taken whenever the absolute value of the signal falls below its (absolute) lower limit.	3
	Abs high	Action is taken whenever the absolute value of the signal rises above its (absolute) upper limit.	4
	Both	Action is taken whenever the signal falls below its low limit or rises above its high limit.	5
	Abs both	Action is taken whenever the absolute value of the signal falls below its (absolute) low limit or rises above its (absolute) high limit.	6
32.16	*Supervision 2 action*	Selects the action the drive takes when the value monitored by signal supervision 2 exceeds its limits. **Note:** This parameter does not affect the status indicated by *32.01 Supervision status*.	*No action*
	No action	No action taken.	0
	Warning	A warning (*A8B1 Signal supervision 2*) is generated.	1
	Fault	The drive trips on *80B1 Signal supervision 2*.	2
	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*
32.18	*Supervision 2 filter time*	Defines a filter time constant for the signal monitored by signal supervision 2.	0.000 s
	0.000 … 30.000 s	Signal filter time.	1000 = 1 s
32.19	*Supervision 2 low*	Defines the lower limit for signal supervision 2.	0.00
	-21474830.00 … 21474830.00	Low limit.	-
32.20	*Supervision 2 high*	Defines the upper limit for signal supervision 2.	0.00
	-21474830.00 … 21474830.00	Upper limit.	-
32.25	*Supervision 3 function*	Selects the mode of signal supervision function 3. Determines how the monitored signal (see parameter *32.27*) is compared to its lower and upper limits (*32.29* and *32.30* respectively). The action to be taken when the condition is fulfilled is selected by *32.26*.	*Disabled*
	Disabled	Signal supervision 3 not in use.	0
	Low	Action is taken whenever the signal falls below its lower limit.	1
	High	Action is taken whenever the signal rises above its upper limit.	2

No.	Name/Value	Description	Def/FbEq16
	Abs low	Action is taken whenever the absolute value of the signal falls below its (absolute) lower limit.	3
	Abs high	Action is taken whenever the absolute value of the signal rises above its (absolute) upper limit.	4
	Both	Action is taken whenever the signal falls below its low limit or rises above its high limit.	5
	Abs both	Action is taken whenever the absolute value of the signal falls below its (absolute) low limit or rises above its (absolute) high limit.	6
32.26	*Supervision 3 action*	Selects the action the drive takes when the value monitored by signal supervision 3 exceeds its limits. **Note:** This parameter does not affect the status indicated by *32.01 Supervision status*.	*No action*
	No action	No action taken.	0
	Warning	A warning (*A8B2 Signal supervision 3*) is generated.	1
	Fault	The drive trips on *80B2 Signal supervision 3*.	2
	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*
32.28	*Supervision 3 filter time*	Defines a filter time constant for the signal monitored by signal supervision 3.	0.000 s
	0.000 … 30.000 s	Signal filter time.	1000 = 1 s
32.29	*Supervision 3 low*	Defines the lower limit for signal supervision 3.	0.00
	-21474830.00 … 21474830.00	Low limit.	-
32.30	*Supervision 3 high*	Defines the upper limit for signal supervision 3.	0.00
	-21474830.00 … 21474830.00	Upper limit.	-

33 Generic timer & counter		Configuration of maintenance timers/counters. See also section *Maintenance timers and counters* (page *179*).	
33.01	*Counter status*	Displays the maintenance timer/counter status word, indicating which maintenance timers/counters have exceeded their limits. This parameter is read-only.	-

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

	000000b…111111b	Maintenance time/counter status word.	1 = 1

No.	Name/Value	Description	Def/FbEq16
33.10	*On-time 1 actual*	Displays the actual present value of on-time timer 1. The timer runs whenever the signal selected by parameter *33.13 On-time 1 source* is on. When the timer exceeds the limit set by *33.11 On-time 1 warn limit*, bit 0 of *33.01 Counter status* is set to 1. The warning specified by *33.14 On-time 1 warn message* is also given if enabled by *33.12 On-time 1 function*. The timer can be reset from the Drive composer PC tool, or from the control panel by keeping Reset depressed for over 3 seconds.	-
	0…4294967295 s	Actual present value of on-time timer 1.	-
33.11	*On-time 1 warn limit*	Sets the warning limit for on-time timer 1.	0 s
	0…4294967295 s	Warning limit for on-time timer 1.	-
33.12	*On-time 1 function*	Configures on-time timer 1.	00b

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

No.	Name/Value	Description	Def/FbEq16
	00b…11b	On-time timer 1 configuration word.	1 = 1
33.13	*On-time 1 source*	Selects the signal to be monitored by on-time timer 1.	*False*
	False	Constant 0 (timer disabled).	0
	True	Constant 1.	1
	RO1	Bit 0 of *10.21 RO status* (page *230*).	2
	Other [bit]	Source selection (see *Terms and abbreviations* on page *187*).	-
33.14	*On-time 1 warn message*	Selects the optional warning message for on-time timer 1.	*On-time 1 exceeded*
	On-time 1 exceeded	*A886 On-time 1*. The message text can be edited on the control panel by choosing Menu – Settings – Edit texts.	0
	Clean device	*A88C Device clean*.	6
	Maintain additional cooling fan	*A890 Additional cooling*.	7
	Maintain cabinet fan	*A88E Cabinet fan*.	8
	Maintain DC capacitors	*A88D DC capacitor*.	9
	Maintain motor bearing	*A880 Motor bearing*.	10

No.	Name/Value	Description	Def/FbEq16
33.20	*On-time 2 actual*	Displays the actual present value of on-time timer 2. The timer runs whenever the signal selected by parameter *33.23 On-time 2 source* is on. When the timer exceeds the limit set by *33.21 On-time 2 warn limit*, bit 1 of *33.01 Counter status* is set to 1. The warning specified by *33.24 On-time 2 warn message* is also given if enabled by *33.22 On-time 2 function*. The timer can be reset from the Drive composer PC tool, or from the control panel by keeping Reset depressed for over 3 seconds.	-
	0…4294967295 s	Actual present value of on-time timer 2.	-
33.21	*On-time 2 warn limit*	Sets the warning limit for on-time timer 2.	0 s
	0…4294967295 s	Warning limit for on-time timer 2.	-
33.22	*On-time 2 function*	Configures on-time timer 2.	00b

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

No.	Name/Value	Description	Def/FbEq16
	0000b…0011b	On-time timer 2 configuration word.	1 = 1
33.23	*On-time 2 source*	Selects the signal to be monitored by on-time timer 2.	*False*
	False	Constant 0 (timer disabled).	0
	True	Constant 1.	1
	RO1	Bit 0 of *10.21 RO status* (page *230*).	2
	Other [bit]	Source selection (see *Terms and abbreviations* on page *187*).	-
33.24	*On-time 2 warn message*	Selects the optional warning message for on-time timer 2.	*On-time 2 exceeded*
	On-time 2 exceeded	*A887 On-time 2*. The message text can be edited on the control panel by choosing Menu – Settings – Edit texts.	1
	Clean device	*A88C Device clean*.	6
	Maintain additional cooling fan	*A890 Additional cooling*.	7
	Maintain cabinet fan	*A88E Cabinet fan*.	8
	Maintain DC capacitors	*A88D DC capacitor*.	9
	Maintain motor bearing	*A880 Motor bearing*.	10

No.	Name/Value	Description	Def/FbEq16
33.30	*Edge counter 1 actual*	Actual present value of signal edge counter 1. The counter is incremented every time the signal selected by parameter *33.33 Edge counter 1 source* switches on or off (or either, depending on the setting of *33.32 Edge counter 1 function*). A divisor may be applied to the count (see *33.34 Edge counter 1 divider*). When the counter exceeds the limit set by *33.31 Edge counter 1 warn limit*, bit 2 of *33.01 Counter status* is set to 1. The warning specified by *33.35 Edge counter 1 warn message* is also given if enabled by *33.32 Edge counter 1 function*. The counter can be reset from the Drive composer PC tool, or from the control panel by keeping Reset depressed for over 3 seconds.	-
	0…4294967295	Actual present value of signal edge counter 1.	-
33.31	*Edge counter 1 warn limit*	Sets the warning limit for signal edge counter 1.	0
	0…4294967295	Warning limit for signal edge counter 1.	-
33.32	*Edge counter 1 function*	Configures signal edge counter 1.	0000b

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

	0000b…1111b	Edge counter 1 configuration word.	1 = 1
33.33	*Edge counter 1 source*	Selects the signal to be monitored by signal edge counter 1.	*False*
	False	Constant 0.	0
	True	Constant 1.	1
	RO1	Bit 0 of *10.21 RO status* (page *230*).	2
	Other [bit]	Source selection (see *Terms and abbreviations* on page *187*).	-
33.34	*Edge counter 1 divider*	Defines a divisor for signal edge counter 1. Determines how many signal edges increment the counter by 1.	1
	1…4294967295	Divisor for signal edge counter 1.	-

No.	Name/Value	Description	Def/FbEq16
33.35	*Edge counter 1 warn message*	Selects the optional warning message for signal edge counter 1.	*Edge counter 1 exceeded*
	Edge counter 1 exceeded	*A888 Edge counter 1*. The message text can be edited on the control panel by choosing Menu – Settings – Edit texts.	2
	Counted main contactor	*A884 Main contactor*.	11
	Counted output relay	*A881 Output relay*.	12
	Counted motor starts	*A882 Motor starts*.	13
	Counted power ups	*A883 Power ups*.	14
	Counted DC charges	*A885 DC charge*.	15
33.40	*Edge counter 2 actual*	Displays the actual present value of signal edge counter 2. The counter is incremented every time the signal selected by parameter *33.43 Edge counter 2 source* switches on or off (or either, depending on the setting of *33.42 Edge counter 2 function*). A divisor may be applied to the count (see *33.44 Edge counter 2 divider*). When the counter exceeds the limit set by *33.41 Edge counter 2 warn limit*, bit 3 of *33.01 Counter status* is set to 1. The warning specified by *33.45 Edge counter 2 warn message* is also given if enabled by *33.42 Edge counter 2 function*. The counter can be reset from the Drive composer PC tool, or from the control panel by keeping Reset depressed for over 3 seconds.	-
	0…4294967295	Actual present value of signal edge counter 2.	-
33.41	*Edge counter 2 warn limit*	Sets the warning limit for signal edge counter 2.	0
	0…4294967295	Warning limit for signal edge counter 2.	-

No.	Name/Value	Description	Def/FbEq16
33.42	*Edge counter 2 function*	Configures signal edge counter 2.	0000b

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

No.	Name/Value	Description	Def/FbEq16
	0000b…1111b	Edge counter 2 configuration word.	1 = 1
33.43	*Edge counter 2 source*	Selects the signal to be monitored by signal edge counter 2.	*False*
	False	0.	0
	True	1.	1
	RO1	Bit 0 of *10.21 RO status* (page *230*).	2
	Other [bit]	Source selection (see *Terms and abbreviations* on page *187*).	-
33.44	*Edge counter 2 divider*	Defines a divisor for signal edge counter 2. Determines how many signal edges increment the counter by 1.	1
	1…4294967295	Divisor for signal edge counter 2.	-
33.45	*Edge counter 2 warn message*	Selects the optional warning message for signal edge counter 2.	*Edge counter 2 exceeded*
	Edge counter 2 exceeded	*A889 Edge counter 2*. The message text can be edited on the control panel by choosing Menu – Settings – Edit texts.	3
	Counted main contactor	*A884 Main contactor*.	11
	Counted output relay	*A881 Output relay*.	12
	Counted motor starts	*A882 Motor starts*.	13
	Counted power ups	*A883 Power ups*.	14
	Counted DC charges	*A885 DC charge*.	15

No.	Name/Value	Description	Def/FbEq16
33.50	*Value counter 1 actual*	Displays the actual present value of value counter 1. The value of the source selected by parameter *33.53 Value counter 1 source* is read at one-second intervals and added to the counter. A divisor can be applied to the count (see *33.54 Value counter 1 divider*). When the counter exceeds the limit set by *33.51 Value counter 1 warn limit*, bit 4 of *33.01 Counter status* is set to 1. The warning specified by *33.55 Value counter 1 warn message* is also given if enabled by *33.52 Value counter 1 function*. The counter can be reset from the Drive composer PC tool, or from the control panel by keeping Reset depressed for over 3 seconds.	-
	-2147483008 … 2147483008	Actual present value of value counter 1.	-
33.51	*Value counter 1 warn limit*	Sets the limit for value counter 1. With a positive limit, bit 4 of *33.01 Counter status* is set to 1 (and a warning optionally generated) when the counter is equal or greater than the limit. With a negative limit, bit 4 of *33.01 Counter status* is set to 1 (and a warning optionally generated) when the counter is equal or smaller than the limit. 0 = Counter disabled.	0
	-2147483008 … 2147483008	Limit for value counter 1.	-
33.52	*Value counter 1 function*	Configures value counter 1.	00b

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

No.	Name/Value	Description	Def/FbEq16
	00b…11b	Value counter 1 configuration word.	1 = 1
33.53	*Value counter 1 source*	Selects the signal to be monitored by value counter 1.	*Not selected*
	Not selected	None (counter disabled).	0
	Motor speed	*01.01 Motor speed used* (see page *192*).	1
	Other	Source selection (see *Terms and abbreviations* on page *187*).	-
33.54	*Value counter 1 divider*	Defines a divisor for value counter 1. The value of the monitored signal is divided by this value before integration.	1.000
	0.001 … 2147483.000	Divisor for value counter 1.	-

No.	Name/Value	Description	Def/FbEq16
33.55	*Value counter 1 warn message*	Selects the optional warning message for value counter 1.	*Value counter 1 exceeded*
	Value counter 1 exceeded	*A88A Value counter 1*. The message text can be edited on the control panel by choosing Menu – Settings – Edit texts.	4
	Maintain motor bearing	*A880 Motor bearing*.	10
33.60	*Value counter 2 actual*	Displays the actual present value of value counter 2. The value of the source selected by parameter *33.63 Value counter 2 source* is read at one-second intervals and added to the counter. A divisor can be applied to the count (see *33.64 Value counter 2 divider*). When the counter exceeds the limit set by *33.61 Value counter 2 warn limit*, bit 5 of *33.01 Counter status* is set to 1. The warning specified by *33.65 Value counter 2 warn message* is also given if enabled by *33.62 Value counter 2 function*. The counter can be reset from the Drive composer PC tool, or from the control panel by keeping Reset depressed for over 3 seconds.	-
	-2147483008 … 2147483008	Actual present value of value counter 2.	-
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.	0
	-2147483008 … 2147483008	Limit for value counter 2.	-
33.62	*Value counter 2 function*	Configures value counter 2.	0000b

Bit	Function
0	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.
1	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
2…15	Reserved

No.	Name/Value	Description	Def/FbEq16
	0000b…0011b	Value counter 2 configuration word.	1 = 1
33.63	*Value counter 2 source*	Selects the signal to be monitored by value counter 2.	*Not selected*
	Not selected	None (counter disabled).	0

No.	Name/Value	Description	Def/FbEq16
	Motor speed	*01.01 Motor speed used* (see page *192*).	1
	Other	Source selection (see *Terms and abbreviations* on page *187*).	-
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
	0.001 … 2147483.000	Divisor for value counter 2.	-
33.65	*Value counter 2 warn message*	Selects the optional warning message for value counter 2.	*Value counter 2 exceeded*
	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*...*09.42* (page *226*).	*Done*
	Done	Reset done	
	Reset winch operating time	Winch operating time is reset to zero. See parameter *09.40 Winch operating time* (page *226*).	
	Reset number of power on	Number of power on is reset to zero. See parameter *09.41 Number of power on* (page *226*).	
	Reset number of brake open	Number of brake open is reset to zero. See parameter *09.42 Number of brake open* (page *226*).	
	Set winch operating time	Winch operating time is initialized to the value set in parameter *33.201 Winch operating time preset value* (page *367*).	
	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 *367*).	
	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 *368*).	
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 Reset winch counters* 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...1100000 h	Winch operating time preset value.	
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 Reset winch counters* to *Set number of power on*. 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...65535	Number of power on preset value.	

No.	Name/Value	Description	Def/FbEq16
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 Reset winch counters* 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...4294967295	Number of brake open preset value.	
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 *171*).	
35.01	*Motor estimated temperature*	Displays the motor temperature as estimated by the internal motor thermal protection model (see parameters *35.50*…*35.55*). The unit is selected by parameter *96.16 Unit selection* This parameter is read-only.	-
	-60 … 1000 °C or °F	Estimated motor temperature.	1 = 1°
35.02	*Measured temperature 1*	Displays the temperature received through the source defined by parameter *35.11 Temperature 1 source*. The unit is selected by parameter *96.16 Unit selection*. **Note:** With a PTC sensor, the unit is ohms. This parameter is read-only.	-
	-60 … 1000 °C, -76 … 1832 °F, 0...5000 ohm	Measured temperature 1.	1 = 1 unit
35.03	*Measured temperature 2*	Displays the temperature received through the source defined by parameter *35.21 Temperature 2 source*. The unit is selected by parameter *96.16 Unit selection*. **Note:** With a PTC sensor, the unit is ohms. This parameter is read-only.	-
	-60 … 1000 °C, -76 … 1832 °F, 0...5000 ohm	Measured temperature 2.	1 = 1 unit

No.	Name/Value	Description	Def/FbEq16
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. The modules are activated by parameter *35.30 FPTC configuration word*. This parameter is read-only.	-

Bit	Name	Description
0	Module found in slot 1	1 = Yes: An FPTC-xx module has been detected in slot 1.
1	Fault active in slot 1	1 = Yes: The module in slot 1 has an active fault (*4991*).
2	Warning active in slot 1	1 = Yes: The module in slot 1 has an active warning (*A497*).
3	Module found in slot 2	1 = Yes: An FPTC-xx module has been detected in slot 2.
4	Fault active in slot 2	1 = Yes: The module in slot 2 has an active fault (*4992*).
5	Warning active in slot 2	1 = Yes: The module in slot 2 has an active warning (*A498*).
6	Module found in slot 3	1 = Yes: An FPTC-xx module has been detected in slot 3.
7	Fault active in slot 3	1 = Yes: The module in slot 3 has an active fault (*4993*).
8	Warning active in slot 3	1 = Yes: The module in slot 3 has an active warning (*A499*).
9…15	Reserved	

No.	Name/Value	Description	Def/FbEq16
	0000h…FFFFh	FPTC-xx status word.	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 *174*).	-
	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%
35.09	*Temperature Calibration status word*	Shows temperature calibration status word.	-

Bit	Name	Description
0	Temperature 1 calibration done	Calibration status of temperature 1.
1	Temperature 2 calibration done	Calibration status of temperature 2.
2…15	Reserved	

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

No.	Name/Value	Description	Def/FbEq16
35.11	*Temperature 1 source*	Selects the source from which measured temperature 1 is read. Usually this source is from a sensor connected to the motor controlled by the drive, but it could be used to measure and monitor a temperature from other parts of the process as long as a suitable sensor is used as per the selection list.	*Disabled*
	Disabled	None. Temperature monitoring function 1 is disabled.	0
	Estimated temperature	Estimated motor temperature (see parameter *35.01 Motor estimated temperature*). The temperature is estimated from an internal drive calculation. It is important to set up the ambient temperature of the motor in *35.50 Motor ambient temperature*.	1
	KTY84 analog I/O	KTY84 sensor connected to the analog input selected by parameter *35.14 Temperature 1 AI source* and an analog output. The analog input can be from the standard I/O or from an extension module. The following settings are required: • Set the hardware jumper or switch related to the analog input to ***U*** (voltage). Any change must be validated by a control unit reboot. • Set the appropriate analog input unit selection parameter in group *12 Standard AI* to *V* (volt). • In parameter group *13 Standard AO*, set the source selection parameter of the analog output to "*Force KTY84 excitation*". The analog output feeds a constant current through the sensor. As the resistance of the sensor increases along with its temperature, the voltage over the sensor increases. The voltage is read by the analog input and converted into degrees.	2
	KTY84 encoder module 1	KTY84 sensor connected to encoder interface 1. See also parameters *91.21 Module 1 temp sensor type* and *91.22 Module 1 temp filter time*.	3
	KTY84 encoder module 2	KTY84 sensor connected to encoder interface 2. See also parameters *91.24 Module 2 temp sensor type* and *91.25 Module 2 temp filter time*.	4
	1 × Pt100 analog I/O	Pt100 sensor connected to a standard analog input selected by parameter *35.14 Temperature 1 AI source* and an analog output. The following settings are required: • Set the hardware jumper or switch related to the analog input to ***U*** (voltage). Any change must be validated by a control unit reboot. • Set the appropriate analog input unit selection parameter in group *12 Standard AI* to *V* (volt). • In parameter group *13 Standard AO*, set the source selection parameter of the analog output to "*Force PT100 excitation*". The analog output feeds a constant current through the sensor. As the resistance of the sensor increases along with its temperature, the voltage over the sensor increases. The voltage is read by the analog input and converted into degrees.	5

No.	Name/Value	Description	Def/FbEq16
	2 × Pt100 analog I/O	As selection *1 × Pt100 analog I/O*, but with two sensors connected in series. Using multiple sensors improves measurement accuracy significantly.	6
	3 × Pt100 analog I/O	As selection *1 × Pt100 analog I/O*, but with three sensors connected in series. Using multiple sensors improves measurement accuracy significantly.	7
	PTC DI6	PTC sensor connected to digital input DI6 (see the connection diagram on page *171*). **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
	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 × Pt1000 analog I/O	Pt1000 sensor connected to a standard analog input selected by parameter *35.14 Temperature 1 AI source* and an analog output. The input and output can be on the drive control unit or on an extension module. The required settings are the same as with selection *KTY84 analog I/O*, except that the source selection parameter of the analog output must be set to *Force Pt1000 excitation*.	13
	2 × Pt1000 analog I/O	As selection *1 × Pt1000 analog I/O*, but with two sensors connected in series. Using multiple sensors improves measurement accuracy significantly.	14
	3 × Pt1000 analog I/O	As selection *1 × Pt1000 analog I/O*, but with three sensors connected in series. Using multiple sensors improves measurement accuracy significantly.	15
35.12	*Temperature 1 fault limit*	Defines the fault limit for temperature monitoring function 1. When measured temperature 1 exceeds the limit, the drive trips on fault *4981 External temperature 1*. The unit is selected by parameter *96.16 Unit selection*. **Note:** With a PTC sensor, the unit is ohms.	130 °C or 266 °F or 4500 ohm
	-60 … 1000 °C -76 … 1832 °F or 0...5000 ohm	Fault limit for temperature monitoring function 1.	1 = 1 unit

No.	Name/Value	Description	Def/FbEq16
35.13	*Temperature 1 warning limit*	Defines the warning limit for temperature monitoring function 1. When measured temperature 1 exceeds this limit, a warning (*A491 External temperature 1*) is generated. The unit is selected by parameter *96.16 Unit selection*. **Note:** With a PTC sensor, the unit is ohms.	110 °C 230 °F or 4000 ohm
	-60 … 1000 °C -76 … 9032 °F or 0...5000 ohm	Warning limit for temperature monitoring function 1.	1 = 1 unit
35.14	*Temperature 1 AI source*	Specifies the analog input when the setting of *35.11 Temperature 1 source* requires measurement through an analog input. **Note:** If the input is located on an I/O extension module, use the selection *Other* to point to the AI actual value in group 14, 15 or 16, eg. *14.26 AI1 actual value*.	*Not selected*
	Not selected	None.	0
	AI1 actual value	Analog input AI1 on the control unit.	1
	AI2 actual value	Analog input AI2 on the control unit.	2
	Other	Source selection (see *Terms and abbreviations* on page *187*).	-
35.17	*Temperature 1 calibration*	Shows the calibration of temperature 1. This parameter can be used to calibrate the excitation current of temperature measurement (PT100 and PT1000).	0
	-30 … 1000 °C	Calibration of temperature 1 in Celsius.	1 = 1 unit
35.21	*Temperature 2 source*	Selects the source from which measured temperature 2 is read. Usually this source is from a sensor connected to the motor controlled by the drive, but it could be used to measure and monitor a temperature from other parts of the process as long as a suitable sensor is used as per the selection list.	*Disabled*
	Disabled	None. Temperature monitoring function 2 is disabled.	0
	Estimated temperature	Estimated motor temperature (see parameter *35.01 Motor estimated temperature*). The temperature is estimated from an internal drive calculation. It is important to set up the ambient temperature of the motor in *35.50 Motor ambient temperature*.	1

No.	Name/Value	Description	Def/FbEq16
	KTY84 analog I/O	KTY84 sensor connected to the analog input selected by parameter *35.24 Temperature 2 AI source* and an analog output. The input and output can be on the drive control unit or on an extension module. The following settings are required: • Set the hardware jumper or switch related to the analog input to U (voltage). Any change must be validated by a control unit reboot. • Set the unit selection parameter of the input to volt. • Set the source selection parameter of the analog output to "*Force KTY84 excitation*". • Select the analog input in parameter 35.24. In case the input is located on an I/O extension module, use the selection *Other* to point at the actual input value parameter (for example, *14.26 AI1 actual value*). The analog output feeds a constant current through the sensor. As the resistance of the sensor changes along with its temperature, the voltage over the sensor changes. The voltage is read by the analog input and converted into degrees.	2
	KTY84 encoder module 1	KTY84 sensor connected to encoder interface 1. See also parameters *91.21 Module 1 temp sensor type* and *91.22 Module 1 temp filter time*.	3
	KTY84 encoder module 2	KTY84 sensor connected to encoder interface 2. See also parameters *91.24 Module 2 temp sensor type* and *91.25 Module 2 temp filter time*.	4
	1 × Pt100 analog I/O	Pt100 sensor connected to a standard analog input selected by parameter *35.24 Temperature 2 AI source* and an analog output. The input and output can be on the drive control unit or on an extension module. The required settings are the same as with selection *KTY84 analog I/O*, except that the source selection parameter of the analog output must be set to *Force PT100 excitation*.	5
	2 × Pt100 analog I/O	As selection *1 × Pt100 analog I/O*, but with two sensors connected in series. Using multiple sensors improves measurement accuracy significantly.	6
	3 × Pt100 analog I/O	As selection *1 × Pt100 analog I/O*, but with three sensors connected in series. Using multiple sensors improves measurement accuracy significantly.	7
	PTC DI6	PTC sensor connected to digital input DI6 (see the connection diagram on page *171*). **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

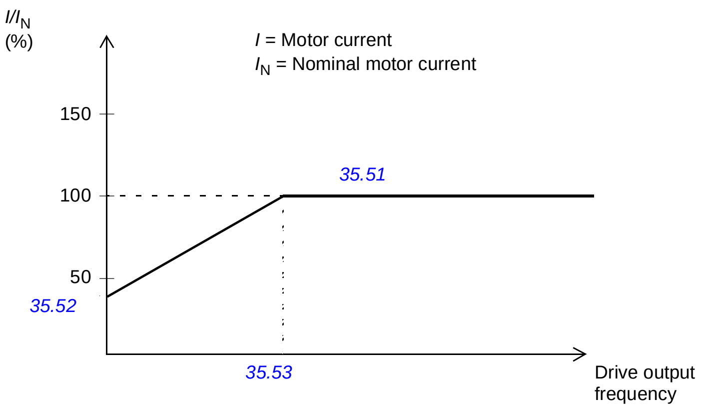
No.	Name/Value	Description	Def/FbEq16
	PTC analog I/O	PTC sensor connected to a standard analog input selected by parameter *35.24 Temperature 2 AI source* and an analog output. The input and output can be on the drive control unit or on an extension module. The required settings are the same as with selection *KTY84 analog I/O*, except that the source selection parameter of the analog output must be set to *Force PTC excitation*.	20
	PTC encoder module 1	PTC sensor connected to encoder interface 1. See also parameters *91.21 Module 1 temp sensor type* and *91.22 Module 1 temp filter time*.	9
	PTC encoder module 2	PTC sensor connected to encoder interface 2. See also parameters *91.24 Module 2 temp sensor type* and *91.25 Module 2 temp filter time*.	10
	Direct temperature	The temperature is taken from the source selected by parameter *35.24 Temperature 2 AI source*. The value of the source is assumed to be in the unit of temperature specified by *96.16 Unit selection*.	11
	1 × Pt1000 analog I/O	Pt1000 sensor connected to a standard analog input selected by parameter *35.24 Temperature 2 AI source* and an analog output. The input and output can be on the drive control unit or on an extension module. The required settings are the same as with selection *KTY84 analog I/O*, except that the source selection parameter of the analog output must be set to *Force Pt1000 excitation*.	13
	2 × Pt1000 analog I/O	As selection *1 × Pt1000 analog I/O*, but with two sensors connected in series. Using multiple sensors improves measurement accuracy significantly.	14
	3 × Pt1000 analog I/O	As selection *1 × Pt1000 analog I/O*, but with three sensors connected in series. Using multiple sensors improves measurement accuracy significantly.	15
35.22	*Temperature 2 fault limit*	Defines the fault limit for temperature monitoring function 2 when measured temperature 2 exceeds the limit, the drive trips on fault *4982 External temperature 2*. The unit is selected by parameter *96.16 Unit selection*. **Note:** With a PTC sensor, the unit is ohms.	130 °C 266 °F or 4500 ohm
	-60 … 1000 °C -76 … 1832 °F or 0...5000 ohm	Fault limit for temperature monitoring function 2.	1 = 1 unit
35.23	*Temperature 2 warning limit*	Defines the warning limit for temperature monitoring function 2. When measured temperature 2 exceeds the limit, a warning (*A492 External temperature 2*) is generated. The unit is selected by parameter *96.16 Unit selection*. **Note:** With a PTC sensor, the unit is ohms.	110 °C 230°F or 4000 ohm
	-60 … 1000 °C -76 … 9032 °F or 0...5000 ohm	Warning limit for temperature monitoring function 2.	1 = 1 unit
35.24	*Temperature 2 AI source*	Selects the input for parameter *35.21 Temperature 2 source*, selections *KTY84 analog I/O*, *1 × Pt100 analog I/O*, *2 × Pt100 analog I/O*, *3 × Pt100 analog I/O* and *Direct temperature*.	*Not selected*
	Not selected	None.	0

No.	Name/Value	Description	Def/FbEq16
	AI1 actual value	Analog input AI1 on the control unit.	1
	AI2 actual value	Analog input AI2 on the control unit.	2
	Other	Source selection (see *Terms and abbreviations* on page *187*).	-
35.27	*Temperature 2 calibration*	Shows the calibration of temperature 2. This parameter can be used to calibrate the excitation current of temperature measurement (PT100 and PT1000).	0
	-30 … 1000 °C	Calibration of temperature 2 in Celsius.	1 = 1 unit
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.	0010 1010b

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

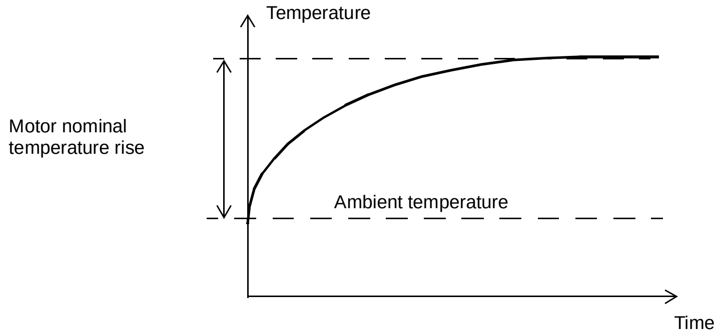
No.	Name/Value	Description	Def/FbEq16
	0000 0000b … 0011 1111b	FPTC-xx module configuration word.	1 = 1
35.50	*Motor ambient temperature*	Defines the ambient temperature of the motor for the motor thermal protection model. The unit is selected by parameter *96.16 Unit selection*. The motor thermal protection model estimates the motor temperature on the basis of parameters *35.50*…*35.55*. The motor temperature increases if it operates in the region above the load curve, and decreases if it operates in the region below the load curve. **WARNING!** The model cannot protect the motor if the motor does not cool properly because of dust, dirt, etc.	20 °C or 68 °F
	-60 … 100 °C or -75 … 212 °F	Ambient temperature.	1 = 1°

No.	Name/Value	Description	Def/FbEq16
35.51	*Motor load curve*	Defines the motor load curve together with parameters *35.52 Zero speed load* and *35.53 Break point*. The load curve is used by the motor thermal protection model to estimate the motor temperature. When the parameter is set to 100%, the maximum load is taken as the value of parameter *99.06 Motor nominal current* (higher loads heat up the motor). The load curve level should be adjusted if the ambient temperature differs from the nominal value set in *35.50 Motor ambient temperature*.	100%

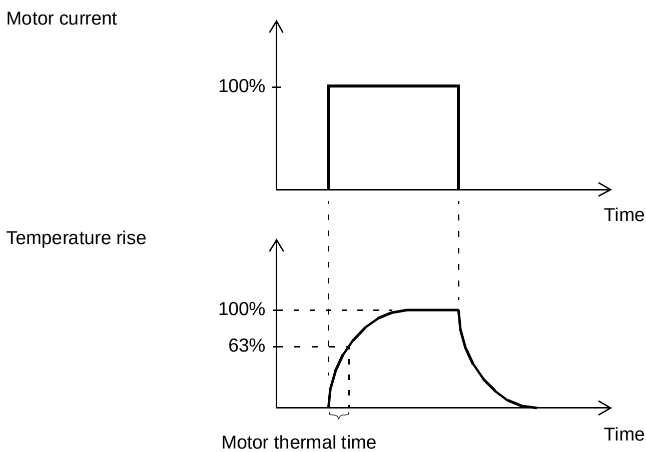


No.	Name/Value	Description	Def/FbEq16
	50 … 150%	Maximum load for the motor load curve.	1 = 1%
35.52	*Zero speed load*	Defines the motor load curve together with parameters *35.51 Motor load curve* and *35.53 Break point*. Defines the maximum motor load at zero speed of the load curve. A higher value can be used if the motor has an external motor fan to boost the cooling. See the motor manufacturer's recommendations. See parameter *35.51 Motor load curve*.	70%
	25 … 150%	Zero speed load for the motor load curve.	1 = 1%
35.53	*Break point*	Defines the motor load curve together with parameters *35.51 Motor load curve* and *35.52 Zero speed load*. Defines the break point frequency of the load curve i.e. the point at which the motor load curve begins to decrease from the value of parameter *35.51 Motor load curve* towards the value of parameter *35.52 Zero speed load*. See parameter *35.51 Motor load curve*.	45.00 Hz
	1.00 … 500.00 Hz	Break point for the motor load curve.	See par. *46.02*

No.	Name/Value	Description	Def/FbEq16
35.54	*Motor nominal temperature rise*	Defines the temperature rise of the motor above ambient when the motor is loaded with nominal current. See the motor manufacturer's recommendations. The unit is selected by parameter *96.16 Unit selection*.	80 °C or 176 °F

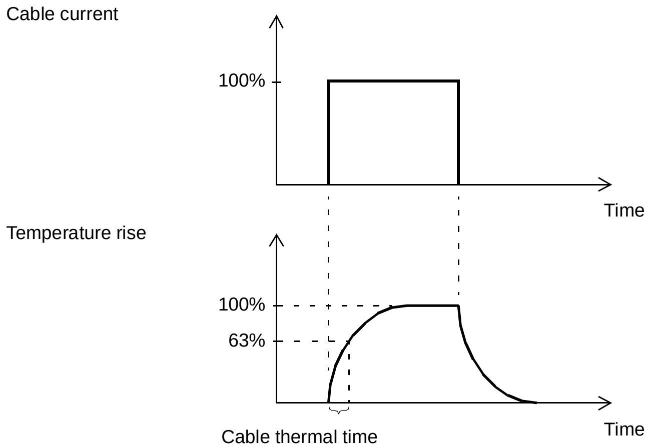


	0…300 °C or 32…572 °F	Temperature rise.	1 = 1°
35.55	*Motor thermal time constant*	Defines the thermal time constant for use with the motor thermal protection model, defined as the time to reach 63% of the nominal motor temperature. See the motor manufacturer's recommendations.	256 s



	100 … 10000 s	Motor thermal time constant.	1 = 1 s
35.56	*Motor overload action*	Selects the action taken when motor overload is detected. See section *Motor overload protection* (page *174*).	*No action*
	No action	No action taken.	0

No.	Name/Value	Description	Def/FbEq16
	Warning only	Drive generates warning *A783 Motor overload* when the motor is overloaded to the warning level, that is, parameter *35.05 Motor overload level* reaches value 88.0%.	1
	Warning and fault	Drive generates warning *A783 Motor overload* when the motor is overloaded to the warning level, that is, parameter *35.05 Motor overload level* reaches value 88.0%. Drive trips on fault *7122 Motor overload* when the motor is overloaded to the fault level, that is, parameter *35.05 Motor overload level* reaches value 100.0%.	2
35.57	*Motor overload class*	Defines the motor overload class to be used. The class of protection is specified by the user as the time for tripping at 7.2 times (IEC 60947-4-1) or 6 times (NEMA ICS) the tripping level current. See section *Motor overload protection* (page *174*).	*Class 20*
	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*	Displays the calculated temperature of the motor cable. See section *Thermal protection of motor cable* (page *175*). 102% = overtemperature warning (*A480 Motor cable overload*) 106% = overtemperature fault (*4000 Motor cable overload*) This parameter is read-only.	0.0%
	0.0 … 200.0%	Calculated temperature of motor cable.	1 = 1%
35.61	*Cable nominal current*	Specifies the continuous current of the motor cable for the thermal protection function in the control program. **WARNING!** The value entered in this parameter must be limited according to all factors affecting the loadability of the cable, such as ambient temperature, cabling arrangement, and shrouding. Refer to the technical data from the cable manufacturer.	10000.00 A
	0.00 … 10000.00 A	Continuous current-carrying capacity of motor cable.	1 = 1 A

No.	Name/Value	Description	Def/FbEq16
35.62	*Cable thermal rise time*	Specifies the thermal time of the motor cable for the thermal protection function in the control program. This value is defined as the time to reach 63% of the nominal cable temperature when the cable is loaded with nominal current (parameter *35.61 Cable nominal current*). 0 s = Thermal protection of motor cable disabled Refer to the technical data from the cable manufacturer.	1 s
			
	0 s	Thermal protection of motor cable disabled.	1 = 1 s
	1…50000 s	Motor cable thermal time constant.	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)
	Off	0 (function disabled).	0
	On	1.	1
	Running	Bit 6 of *06.16 Drive status word 1* (see page *206*).	2
	Other [bit]	Source selection (see *Terms and abbreviations* on page *187*).	-

No.	Name/Value	Description	Def/FbEq16
35.101	*DOL starter on delay*	Defines a start delay for the motor fan. The delay timer starts when the control source selected by parameter *35.100* switches on. After the delay, bit 1 of *35.105* switches on.	0 s
	0…42949673 s	Motor fan start delay.	1 = 1 s
35.102	*DOL starter off delay*	Defines a stop delay for the motor fan. The delay timer starts when the control source selected by parameter *35.100* switches off. After the delay, bit 1 of *35.105* switches off.	20 min
	0…715828 min	Motor fan stop delay.	1 = 1 min
35.103	*DOL starter feedback source*	Selects the input for motor fan feedback signal. 0 = Stopped 1 = Running After the fan is started (bit 1 of *35.105* switches on), feedback is expected within the time set by *35.104*.	*Not selected*; *DI5* (*95.20* b6)
	Not selected	0.	0
	Selected	1.	1
	DI1	Digital input DI1 (*10.02 DI delayed status*, bit 0).	2
	DI2	Digital input DI2 (*10.02 DI delayed status*, bit 1).	3
	DI3	Digital input DI3 (*10.02 DI delayed status*, bit 2).	4
	DI4	Digital input DI4 (*10.02 DI delayed status*, bit 3).	5
	DI5	Digital input DI5 (*10.02 DI delayed status*, bit 4).	6
	DI6	Digital input DI6 (*10.02 DI delayed status*, bit 5).	7
	DIO1	Digital input/output DIO1 (*11.02 DIO delayed status*, bit 0).	10
	DIO2	Digital input/output DIO2 (*11.02 DIO delayed status*, bit 1).	11
	Other [bit]	Source selection (see *Terms and abbreviations* on page *187*).	-
35.104	*DOL starter feedback delay*	Defines a feedback delay for the motor fan. The delay timer starts when bit 1 of *35.105* switches on. If no feedback is received from the fan until the delay elapses, the action selected by *35.106* is taken. **Note:** This delay is only applied at start. If the feedback signal is lost during run, the action selected by *35.106* is taken immediately.	0 s; 5 s (*95.20* b6)
	0…42949673 s	Motor fan start delay.	1 = 1 s

No.	Name/Value	Description	Def/FbEq16
35.105	*DOL starter status word*	Status of the motor fan control logic. Bit 1 is the control output for the fan, to be selected as the source of, for example, a digital or relay output. The other bits indicate the statuses of the selected control and feedback sources, and the fault status. This parameter is read-only.	-

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

No.	Name/Value	Description	Def/FbEq16
	0000b…1111b	Status of motor fan control logic.	1 = 1
35.106	*DOL starter event type*	Selects the action taken when missing fan feedback is detected by the motor fan control logic.	*Fault*
	No action	No action taken.	0
	Warning	The drive generates a warning (*A781 Motor fan*).	1
	Fault	Drive trips on *71B1 Motor fan*.	2
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.	10.0
	0.0...3600.0 min	Internal fan extended run time.	1 = 1 min
36 Load analyzer		Peak value and amplitude logger settings. See also section *Load analyzer* (page *180*).	
36.01	*PVL signal source*	Selects the signal to be monitored by the peak value logger. The signal is filtered using the filtering time specified by parameter *36.02 PVL filter time*. The peak value is stored, along with other pre-selected signals at the time, into parameters *36.10*…*36.15*. The peak value logger can be reset using parameter *36.09 Reset loggers*. The logger is also reset whenever the signal source is changed. The date and time of the last reset are stored into parameters *36.16* and *36.17* respectively.	*Power inu out*
	Zero	None (peak value logger disabled).	0
	Motor speed used	*01.01 Motor speed used* (page *192*).	1
	Output frequency	*01.06 Output frequency* (page *192*).	3

No.	Name/Value	Description	Def/FbEq16
	Motor current	*01.07 Motor current* (page *192*).	4
	Motor torque	*01.10 Motor torque* (page *192*).	6
	Dc-voltage	*01.11 DC voltage* (page *193*).	7
	Power inu out	*01.14 Output power* (page *193*).	8
	Speed ref ramp in	*23.01 Speed ref ramp input* (page *307*).	10
	Speed ref ramped	*23.02 Speed ref ramp output* (page *307*).	11
	Speed ref used	*24.01 Used speed reference* (page *314*).	12
	Torq ref used	*26.02 Torque reference used* (page *329*).	13
	Other	Source selection (see *Terms and abbreviations* on page *187*).	-
36.02	*PVL filter time*	Defines a filtering time for the peak value logger. See parameter *36.01 PVL signal source*.	2.00 s
	0.00 … 120.00 s	Peak value logger filtering time.	100 = 1 s
36.06	*AL2 signal source*	Selects the signal to be monitored by amplitude logger 2. The signal is sampled at 200 ms intervals, 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 is changed. The date and time of the last reset are stored into parameters *36.50* and *36.51* respectively.	*Ambient temperature*
	Zero	None (amplitude logger 2 disabled).	0
	Motor speed used	*01.01 Motor speed used* (page *192*).	1
	Output frequency	*01.06 Output frequency* (page *192*).	3
	Motor current	*01.07 Motor current* (page *192*).	4
	Motor torque	*01.10 Motor torque* (page *192*).	6
	DC voltage	*01.11 DC voltage* (page *193*).	7
	Power inu out	*01.14 Output power* (page *193*).	8
	Speed ref ramp in	*23.01 Speed ref ramp input* (page *307*).	10
	Speed ref ramped	*23.02 Speed ref ramp output* (page *307*).	11
	Speed ref used	*24.01 Used speed reference* (page *314*).	12
	Torq ref used	*26.02 Torque reference used* (page *329*).	13
	Freq ref used	-	14
	Process PID out	-	-
	Process PID fbk	-	-
	Process PID act	-	-
	Process PID dev	-	-
	Ambient temperature	*01.31 Ambient temperature* (page *194*). The amplitude range of 0…100% corresponds to 0…60 °C or 32…140 °F.	20
	Other	Source selection (see *Terms and abbreviations* on page *187*).	-

No.	Name/Value	Description	Def/FbEq16
36.07	*AL2 signal scaling*	Defines the signal value that corresponds to 100% amplitude.	100.00
	0.00 … 32767.00	Signal value corresponding to 100%.	1 = 1
36.08	*Logger function*	Determines whether amplitude loggers 1 and 2 are active continuously or only when the drive is modulating.	-

Bit	Name	Description
0	AL1	0 = Amplitude logger 1 active continuously 1 = Amplitude logger 1 active only when the drive is modulating
1	AL2	0 = Amplitude logger 2 active continuously 1 = Amplitude logger 2 active only when the drive is modulating
2…15	Reserved	

No.	Name/Value	Description	Def/FbEq16
	0000b…0011b	Amplitude logger activity selection.	1 = 1
36.09	*Reset loggers*	Resets the peak value logger and/or amplitude logger 2. (Amplitude logger 1 cannot be reset.)	*Done*
	Done	Reset completed or not requested (normal operation).	0
	All	Reset both the peak value logger and amplitude logger 2.	1
	PVL	Reset the peak value logger.	2
	AL2	Reset amplitude logger 2.	3
36.10	*PVL peak value*	Displays the peak value recorded by the peak value logger.	0.00
	-32768.00 … 32767.00	Peak value.	1 = 1
36.11	*PVL peak date*	Displays the date on which the peak value was recorded.	-
	-	Peak occurrence date.	-
36.12	*PVL peak time*	Displays the time at which the peak value was recorded.	-
	-	Peak occurrence time.	-
36.13	*PVL current at peak*	Displays the motor current at the moment the peak value was recorded.	0.00 A
	-32768.00 … 32767.00 A	Motor current at peak.	1 = 1 A
36.14	*PVL DC voltage at peak*	Displays the voltage in the intermediate DC circuit of the drive at the moment the peak value was recorded.	0.00 V
	0.00 … 2000.00 V	DC voltage at peak.	10 = 1 V
36.15	*PVL speed at peak*	Displays the motor speed at the moment the peak value was recorded.	0.00 rpm
	-32768.00 … 32767.00 rpm	Motor speed at peak.	See par. *46.01*
36.16	*PVL reset date*	Displays the date on which the peak value logger was last reset.	-
	-	Last reset date of the peak value logger.	-
36.17	*PVL reset time*	Displays the time at which the peak value logger was last reset.	-
	-	Last reset time of the peak value logger.	-

No.	Name/Value	Description	Def/FbEq16
36.20	AL1 below 10%	Displays the percentage of samples recorded by amplitude logger 1 that fall between 0 and 10%.	0.00%
	0.00 … 100.00%	Amplitude logger 1 samples between 0 and 10%.	1 = 1%
36.21	AL1 10 to 20%	Displays the percentage of samples recorded by amplitude logger 1 that fall between 10 and 20%.	0.00%
	0.00 … 100.00%	Amplitude logger 1 samples between 10 and 20%.	1 = 1%
36.22	AL1 20 to 30%	Displays the percentage of samples recorded by amplitude logger 1 that fall between 20 and 30%.	0.00%
	0.00 … 100.00%	Amplitude logger 1 samples between 20 and 30%.	1 = 1%
36.23	AL1 30 to 40%	Displays the percentage of samples recorded by amplitude logger 1 that fall between 30 and 40%.	0.00%
	0.00 … 100.00%	Amplitude logger 1 samples between 30 and 40%.	1 = 1%
36.24	AL1 40 to 50%	Displays the percentage of samples recorded by amplitude logger 1 that fall between 40 and 50%.	0.00%
	0.00 … 100.00%	Amplitude logger 1 samples between 40 and 50%.	1 = 1%
36.25	AL1 50 to 60%	Displays the percentage of samples recorded by amplitude logger 1 that fall between 50 and 60%.	0.00%
	0.00 … 100.00%	Amplitude logger 1 samples between 50 and 60%.	1 = 1%
36.26	AL1 60 to 70%	Displays the percentage of samples recorded by amplitude logger 1 that fall between 60 and 70%.	0.00%
	0.00 … 100.00%	Amplitude logger 1 samples between 60 and 70%.	1 = 1%
36.27	AL1 70 to 80%	Displays the percentage of samples recorded by amplitude logger 1 that fall between 70 and 80%.	0.00%
	0.00 … 100.00%	Amplitude logger 1 samples between 70 and 80%.	1 = 1%
36.28	AL1 80 to 90%	Displays the percentage of samples recorded by amplitude logger 1 that fall between 80 and 90%.	0.00%
	0.00 … 100.00%	Amplitude logger 1 samples between 80 and 90%.	1 = 1%
36.29	AL1 over 90%	Displays the percentage of samples recorded by amplitude logger 1 that exceed 90%.	0.00%
	0.00 … 100.00%	Amplitude logger 1 samples over 90%.	1 = 1%
36.40	AL2 below 10%	Displays the percentage of samples recorded by amplitude logger 2 that fall between 0 and 10%.	0.00%
	0.00 … 100.00%	Amplitude logger 2 samples between 0 and 10%.	1 = 1%
36.41	AL2 10 to 20%	Displays the percentage of samples recorded by amplitude logger 2 that fall between 10 and 20%.	0.00%
	0.00 … 100.00%	Amplitude logger 2 samples between 10 and 20%.	1 = 1%
36.42	AL2 20 to 30%	Displays the percentage of samples recorded by amplitude logger 2 that fall between 20 and 30%.	0.00%
	0.00 … 100.00%	Amplitude logger 2 samples between 20 and 30%.	1 = 1%
36.43	AL2 30 to 40%	Displays the percentage of samples recorded by amplitude logger 2 that fall between 30 and 40%.	0.00%
	0.00 … 100.00%	Amplitude logger 2 samples between 30 and 40%.	1 = 1%
36.44	AL2 40 to 50%	Displays the percentage of samples recorded by amplitude logger 2 that fall between 40 and 50%.	0.00%
	0.00 … 100.00%	Amplitude logger 2 samples between 40 and 50%.	1 = 1%

No.	Name/Value	Description	Def/FbEq16
36.45	AL2 50 to 60%	Displays the percentage of samples recorded by amplitude logger 2 that fall between 50 and 60%.	0.00%
	0.00 … 100.00%	Amplitude logger 2 samples between 50 and 60%.	1 = 1%
36.46	AL2 60 to 70%	Displays the percentage of samples recorded by amplitude logger 2 that fall between 60 and 70%.	0.00%
	0.00 … 100.00%	Amplitude logger 2 samples between 60 and 70%.	1 = 1%
36.47	AL2 70 to 80%	Displays the percentage of samples recorded by amplitude logger 2 that fall between 70 and 80%.	0.00%
	0.00 … 100.00%	Amplitude logger 2 samples between 70 and 80%.	1 = 1%
36.48	AL2 80 to 90%	Displays the percentage of samples recorded by amplitude logger 2 that fall between 80 and 90%.	0.00%
	0.00 … 100.00%	Amplitude logger 2 samples between 80 and 90%.	1 = 1%
36.49	AL2 over 90%	Displays the percentage of samples recorded by amplitude logger 2 that exceed 90%.	0.00%
	0.00 … 100.00%	Amplitude logger 2 samples over 90%.	1 = 1%
36.50	AL2 reset date	Displays the date on which amplitude logger 2 was last reset.	-
	-	Last reset date of amplitude logger 2.	-
36.51	AL2 reset time	Displays the time at which amplitude logger 2 was last reset.	-
	-	Last reset time of amplitude logger 2.	-

37 User load curve		Settings for user load curve. See also section *User load curve* (page 175).	
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.	-

Bit	Name	Information
0	Under load limit	1 = Monitored signal is below the underload curve
1	Reserved	
2	Over load limit	1 = Monitored signal is above the overload curve
3…15	Reserved	

	000b … 101b	Status of the monitored signal.	1 = 1
37.02	ULC supervision signal	Selects the signal to be monitored. The function compares the absolute value of the signal against the load curve.	Not selected
	Not selected	No signal selected (monitoring disabled).	0
	Motor current%	01.07 Motor current (see page 192).	2
	Motor torque%	01.10 Motor torque (see page 192).	3
	Output power% of motor nominal	01.15 Output power% of motor nom (see page 193).	4
	Other	Source selection (see *Terms and abbreviations* on page 187).	-

No.	Name/Value	Description	Def/FbEq16
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*
	Disabled	No action taken.	0
	Warning	The drive generates a warning (*A8BE ULC overload warning*).	1
	Fault	Drive trips on *8002 ULC overload fault*.	2
	Warning/Fault	The drive generates a warning (*A8BE ULC overload warning*) if the signal stays continuously above the overload curve for half of the time defined by *37.41 ULC overload timer*. The drive trips on *8002 ULC overload fault* 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*
	Disabled	No action taken.	0
	Warning	The drive generates a warning (*A8BF ULC underload warning*).	1
	Fault	Drive trips on *8001 ULC underload fault*.	2
	Warning/Fault	The drive generates a warning (*A8BF ULC underload warning*) if the signal stays continuously below the underload curve for half of the time defined by *37.42 ULC underload timer*. The drive trips on *8001 ULC underload fault* 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
	0.0 … 30000.0 rpm	Speed.	1 = 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
	0.0 … 30000.0 rpm	Speed.	1 = 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
	0.0 … 30000.0 rpm	Speed.	1 = 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
	0.0 … 30000.0 rpm	Speed.	1 = 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
	0.0 … 30000.0 rpm	Speed.	1 = 1 rpm

No.	Name/Value	Description	Def/FbEq16
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
	0.0 … 500.0 Hz	Frequency.	1 = 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
	0.0 … 500.0 Hz	Frequency.	1 = 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
	0.0 … 500.0 Hz	Frequency.	1 = 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
	0.0 … 500.0 Hz	Frequency.	1 = 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
	0.0 … 500.0 Hz	Frequency.	1 = 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%
	0.0 … 1600.0%	Underload point.	1 = 1%
37.22	*ULC underload point 2*	Defines the 2nd point of the underload curve.	15.0%
	0.0 … 1600.0%	Underload point.	1 = 1%
37.23	*ULC underload point 3*	Defines the 3rd point of the underload curve.	25.0%
	0.0 … 1600.0%	Underload point.	1 = 1%
37.24	*ULC underload point 4*	Defines the 4th point of the underload curve.	30.0%
	0.0 … 1600.0%	Underload point.	1 = 1%
37.25	*ULC underload point 5*	Defines the 5th point of the underload curve.	30.0%
	0.0 … 1600.0%	Underload point.	1 = 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%
	0.0 … 1600.0%	Overload point.	1 = 1%
37.32	*ULC overload point 2*	Defines the 2nd point of the overload curve.	300.0%
	0.0 … 1600.0%	Overload point.	1 = 1%
37.33	*ULC overload point 3*	Defines the 3rd point of the overload curve.	300.0%
	0.0 … 1600.0%	Overload point.	1 = 1%

No.	Name/Value	Description	Def/FbEq16
37.34	*ULC overload point 4*	Defines the 4th point of the overload curve.	300.0%
	0.0 … 1600.0%	Overload point.	1 = 1%
37.35	*ULC overload point 5*	Defines the 5th point of the overload curve.	300.0%
	0.0 … 1600.0%	Overload point.	1 = 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
	0.0 … 10000.0 s	Overload timer.	1 = 1 s
37.42	*ULC underload timer*	Defines the time for which the monitored signal must continuously stay below the underload curve before the drive takes the action selected by *37.04 ULC underload actions*.	20.0 s
	0.0 … 10000.0 s	Underload timer.	1 = 1 s

43 Brake chopper		Settings for the internal brake chopper. See also section *DC voltage control* (page *164*).	
43.01	*Braking resistor temperature*	Displays the estimated temperature of the brake resistor, or how close the brake resistor is to being too hot. The value is given in percent where 100% is the eventual temperature the resistor would reach when loaded long enough with its rated maximum load capacity (*43.09 Brake resistor Pmax cont*). 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.	-
	0.0 … 120.0%	Estimated brake resistor temperature.	1 = 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*
	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. 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/Value	Description	Def/FbEq16
	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*
	Off	0.	0
	On	1.	1
	Other [bit]	Source selection (see *Terms and abbreviations* on page *187*).	-
43.08	*Brake resistor thermal tc*	Defines the thermal time constant for the brake resistor thermal model.	0 s
	0 … 10000 s	Brake resistor thermal time constant, ie. the rated time to achieve 63% temperature.	1 = 1 s
43.09	*Brake resistor Pmax cont*	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
	0.00 … 10000.00 kW	Maximum continuous load of the brake resistor.	1 = 1 kW
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
	0.0 … 1000.0 ohm	Brake resistor resistance value.	1 = 1 ohm

No.	Name/Value	Description	Def/FbEq16
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 Pmax cont*.	105%
	0 … 150%	Brake resistor temperature fault limit.	1 = 1%
43.12	*Brake resistor warning limit*	Selects the warning limit for the brake resistor 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 Pmax cont*.	95%
	0 … 150%	Brake resistor temperature warning limit.	1 = 1%
44 Mechanical brake control		Configuration of mechanical brake control. See also section *DC voltage control* (page *164*).	
44.01	*Brake control status*	Displays the mechanical brake control status word. This parameter is read-only.	-

Bit	Name	Information
0	Open command	Close/open command to brake actuator (0 = close, 1 = open). Connect this bit to desired output.
1	Opening torque request	1 = Opening torque requested from drive logic
2	Hold stopped request	1 = Hold requested from drive logic
3	Ramp to stopped	1 = Ramping down to zero speed requested from drive logic
4	Enabled	1 = Brake control is enabled
5	Closed	1 = Brake control logic in Brake close state
6	Opening	1 = Brake control logic in Brake opening state
7	Open	1 = Brake control logic in Brake open state
8	Closing	1 = Brake control logic in Brake closing state
9…15	Reserved	

No.	Name/Value	Description	Def/FbEq16
	0000h…FFFFh	Mechanical brake control status word.	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 *44.200 Brake open torque source* and *44.201 Brake open torque*. A filtering time for this value can be defined using *44.21 Filter time brake torque memory*.	-
	-1600.0 … 1600.0%	Torque at brake closure.	See par. *46.03*

No.	Name/Value	Description	Def/FbEq16
44.03	*Brake open torque reference*	Displays the currently active brake open torque. See parameters *44.200 Brake open torque source* and *44.201 Brake open torque*. This parameter is read-only.	-
	-1600.0 … 1600.0%	Currently active brake open torque.	See par. *46.03*
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.	*Selected*
	Not selected	0.	0
	Selected	1.	1
	DI1	Digital input DI1 (*10.02 DI delayed status*, bit 0).	2
	DI2	Digital input DI2 (*10.02 DI delayed status*, bit 1).	3
	DI3	Digital input DI3 (*10.02 DI delayed status*, bit 2).	4
	DI4	Digital input DI4 (*10.02 DI delayed status*, bit 3).	5
	DI5	Digital input DI5 (*10.02 DI delayed status*, bit 4).	6
	DI6	Digital input DI6 (*10.02 DI delayed status*, bit 5).	7
	DIO1	Digital input/output DIO1 (*11.02 DIO delayed status*, bit 0).	10
	DIO2	Digital input/output DIO2 (*11.02 DIO delayed status*, bit 1).	11
	Other [bit]	Source selection (see *Terms and abbreviations* on page *187*).	-
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*
	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
	Other [bit]	Source selection (see *Terms and abbreviations* on page *187*).	-

No.	Name/Value	Description	Def/FbEq16
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
	0.00 … 5.00 s	Brake open delay.	100 = 1 s
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*
	Not selected	0.	0
	Selected	1.	1
	DI1	Digital input DI1 (*10.02 DI delayed status*, bit 0).	2
	DI2	Digital input DI2 (*10.02 DI delayed status*, bit 1).	3
	DI3	Digital input DI3 (*10.02 DI delayed status*, bit 2).	4
	DI4	Digital input DI4 (*10.02 DI delayed status*, bit 3).	5
	DI5	Digital input DI5 (*10.02 DI delayed status*, bit 4).	6
	DI6	Digital input DI6 (*10.02 DI delayed status*, bit 5).	7
	DIO1	Digital input/output DIO1 (*11.02 DIO delayed status*, bit 0).	10
	DIO2	Digital input/output DIO2 (*11.02 DIO delayed status*, bit 1).	11
	Other [bit]	Source selection (see *Terms and abbreviations* on page *187*).	-
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
	0.00 … 60.00 s	Brake close delay.	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
	0.00 … 1000.00 rpm	Brake close speed.	See par. *46.01*
44.15	*Brake close level delay*	Defines a brake close level delay. See parameter *44.14 Brake close level*.	0.00 s
	0.00 … 10.00 s	Brake close level delay.	100 = 1 s

No.	Name/Value	Description	Def/FbEq16
44.16	*Brake reopen delay*	Defines a minimum time between brake closure and a subsequent open command.	0.00 s
	0.00 … 10.00 s	Brake reopen delay.	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*
	Fault	The drive trips on a *71A2 Mechanical brake closing failed* / *71A3 Mechanical 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 Mechanical brake opening not allowed* fault if the brake open conditions cannot be fulfilled (for example, the required motor starting torque is not achieved).	0
	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 Mechanical 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 Mechanical brake 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
	0.00 … 60.00 s	Brake close fault delay.	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
	0...100 ms	Filtering time.	100 = 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*
	Zero	Zero	0
	AI1 scaled	*12.12 AI1 scaled value* (see page *240*).	1

No.	Name/Value	Description	Def/FbEq16
	AI2 scaled	*12.22 AI2 scaled value* (see page *242*).	2
	Brake torque memory	Parameter *44.02 Brake torque memory*.	7
	Brake open torque	Parameter *44.201 Brake open torque*.	8
	Other	Source selection (see *Terms and abbreviations* on page *187*).	-
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%
	-1600.0...1600.0%	Minimum torque at brake release.	10 = 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* on page *104*. **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 page *122*) • the drive is in Remote control • parameter *21.03 Stop mode* is set as Ramp. **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
	0.0...3600.0 s	Time period.	1 = 1
44.203	*Extended runtime sw*	Displays the status of the Extended runtime function. This parameter is read-only.	0b0000

Bit	Name	Information
0	Extended run in operation	0 = Extended run time not active. 1 = Extended run time is active after brake is closed.
1	Extended run enabled	0 = Extended run time is set to 0. 1 = Extended run time is set to > 0.
2…15	Reserved	

	0b...1b	Extended runtime status.	-

No.	Name/Value	Description	Def/FbEq16
44.204	*Winch brake status*	Displays the status of the brake.	0b0000

Bit	Name	Information
0	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.
1…15	Reserved	

No.	Name/Value	Description	Def/FbEq16
	0b...1b	Winch brake status.	-
44.209	*Analogue input as digital status*	Displays the analogue input level as digital status.	0b0000

Bit	Name	Information
0	AI1 level status	Analogue input 1 level status.
1	AI2 level status	Analogue input 2 level status.
2…15	Reserved	

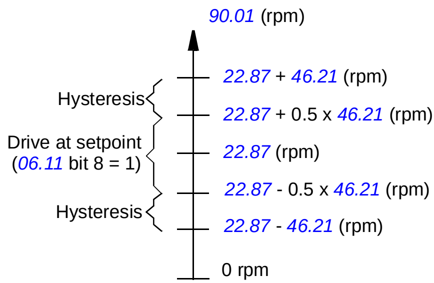
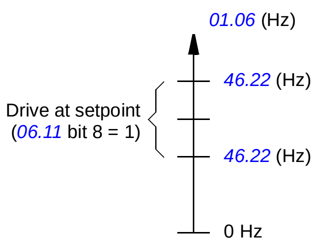
No.	Name/Value	Description	Def/FbEq16
	0b0000...1b1111	Analogue input as digital status.	-
45 Energy efficiency		Settings for the energy saving calculators. See also section *Energy saving calculators* (page *180*).	
45.01	*Saved GW hours*	Displays the energy saved in GWh compared to direct-on-line motor connection. This parameter is incremented when *45.02 Saved MW hours* rolls over. This parameter is read-only (see parameter *45.21 Energy calculations reset*).	-
	0…65535 GWh	Energy savings in GWh.	1 = 1 GWh
45.02	*Saved MW hours*	Displays the energy saved in MWh compared to direct-on-line motor connection. This parameter is incremented when *45.03 Saved kW hours* rolls over. When this parameter rolls over, parameter *45.01 Saved GW hours* is incremented. This parameter is read-only (see parameter *45.21 Energy calculations reset*).	-
	0…999 MWh	Energy savings in MWh.	1 = 1 MWh
45.03	*Saved kW hours*	Displays the energy saved in kWh compared to direct-on-line motor connection. If the internal brake chopper of the drive is enabled, all energy fed by the motor to the drive is assumed to be converted into heat, but the calculation still records savings made by controlling the speed. If the chopper is disabled, then regenerated energy from the motor is also recorded here. When this parameter rolls over, parameter *45.02 Saved MW hours* is incremented. This parameter is read-only (see parameter *45.21 Energy calculations reset*).	-
	0.0 … 999.9 kWh	Energy savings in kWh.	10 = 1 kWh

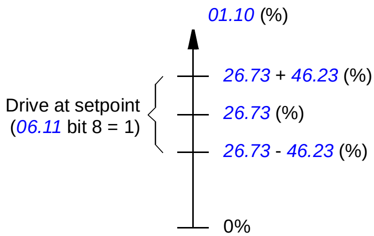
No.	Name/Value	Description	Def/FbEq16
45.05	*Saved money x1000*	Displays the monetary savings in thousands compared to direct-on-line motor connection. This parameter is incremented when *45.06 Saved money* rolls over. The currency is defined by parameter *45.17 Tariff currency unit*. This parameter is read-only (see parameter *45.21 Energy calculations reset*).	-
	0 EUR	Monetary savings in thousands of units.	-
45.06	*Saved money*	Displays the monetary savings compared to direct-on-line motor connection. This value is a calculated by multiplying the saved energy in kWh by the currently active energy tariff (*45.14 Tariff selection*). When this parameter rolls over, parameter *45.05 Saved money x1000* is incremented. The currency is defined by parameter *45.17 Tariff currency unit*. This parameter is read-only (see parameter *45.21 Energy calculations reset*).	-
	0.00 … 999.99 EUR	Monetary savings.	1 = 1 unit
45.08	*CO2 reduction in kilotons*	Displays the reduction in CO_2 emissions in metric kilotons compared to direct-on-line motor connection. This value is incremented when parameter *45.09 CO2 reduction in tons* rolls over. This parameter is read-only (see parameter *45.21 Energy calculations reset*).	-
	0…65535 metric kilotons	Reduction in CO_2 emissions in metric kilotons.	1 = 1 metric kiloton
45.09	*CO2 reduction in tons*	Displays the reduction in CO_2 emissions in metric tons compared to direct-on-line motor connection. This value is calculated by multiplying the saved energy in MWh by the value of parameter *45.18 CO2 conversion factor* (by default, 0.5 metric tons/MWh). When this parameter rolls over, parameter *45.08 CO2 reduction in kilotons* is incremented. This parameter is read-only (see parameter *45.21 Energy calculations reset*).	-
	0.0 … 999.9 metric tons	Reduction in CO_2 emissions in metric tons.	1 = 1 metric ton
45.11	*Energy optimizer*	Enables/disables the energy optimization function. The function optimizes the motor flux so that total energy consumption and motor noise level are reduced when the drive operates below the nominal load. The total efficiency (motor and drive) can be improved by 1…20% depending on load torque and speed. **Note:** With a permanent magnet motor or a synchronous reluctance motor, energy optimization is always enabled regardless of this parameter.	*Enable*
	Disable	Energy optimization disabled.	0
	Enable	Energy optimization enabled.	1

No.	Name/Value	Description	Def/FbEq16
45.12	*Energy tariff 1*	Defines energy tariff 1 (price of energy per kWh). Depending on the setting of parameter *45.14 Tariff selection*, either this value or *45.13 Energy tariff 2* is used for reference when monetary savings are calculated. The currency is defined by parameter *45.17 Tariff currency unit*. **Note:** Tariffs are read only at the instant of selection, and are not applied retroactively.	1.000 units
	0.000 … 4294967.295 units	Energy tariff 1.	-
45.13	*Energy tariff 2*	Defines energy tariff 2 (price of energy per kWh). See parameter *45.12 Energy tariff 1*.	2.000 units
	0.000 … 4294967.295 units	Energy tariff 2.	-
45.14	*Tariff selection*	Selects (or defines a source that selects) which pre-defined energy tariff is used. 0 = *45.12 Energy tariff 1* 1 = *45.13 Energy tariff 2*	*Energy tariff 1*
	Energy tariff 1	0.	0
	Energy tariff 2	1.	1
	DI1	Digital input DI1 (*10.02 DI delayed status*, bit 0).	2
	DI2	Digital input DI2 (*10.02 DI delayed status*, bit 1).	3
	DI3	Digital input DI3 (*10.02 DI delayed status*, bit 2).	4
	DI4	Digital input DI4 (*10.02 DI delayed status*, bit 3).	5
	DI5	Digital input DI5 (*10.02 DI delayed status*, bit 4).	6
	DI6	Digital input DI6 (*10.02 DI delayed status*, bit 5).	7
	DIO1	Digital input/output DIO1 (*11.02 DIO delayed status*, bit 0).	10
	DIO2	Digital input/output DIO2 (*11.02 DIO delayed status*, bit 1).	11
	Other [bit]	Source selection (see *Terms and abbreviations* on page *187*).	-
45.17	*Tariff currency unit*	Specifies the currency used for the savings calculations.	*EUR*
	Local currency	Local currency. The name of the currency can be edited by choosing Menu - Settings - Edit texts on the control panel.	100
	EUR	Euro.	101
	USD	US dollar.	102
45.18	*CO2 conversion factor*	Defines a factor for conversion of saved energy into CO_2 emissions (kg/kWh or tn/MWh).	0.500 tn/MWh
	0.000 … 65.535 tn/MWh	Factor for conversion of saved energy into CO_2 emissions.	1 = 1 tn/MWh

No.	Name/Value	Description	Def/FbEq16
45.19	*Comparison power*	Actual power that the motor absorbs when connected direct-on-line and operating the application. The value is used for reference when energy savings are calculated. **Note:** The accuracy of the energy savings calculation is directly dependent on the accuracy of this value. If nothing is entered here, then the nominal motor power is used by the calculation, but that may inflate the energy savings reported as many motors do not absorb nameplate power.	0.0 kW
	0.0 … 100000.0 kW	Motor power.	See par. *46.04*
45.21	*Energy calculations reset*	Resets the savings counter parameters *45.01*…*45.09*	*Done*
	Done	Reset not requested (normal operation), or reset complete.	0
	Reset	Reset the savings counter parameters. The value reverts automatically to *Done*.	1
46 Monitoring/scaling settings		Speed supervision settings; actual signal filtering; general scaling settings. **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*	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. **Note:** This parameter is read-only.	1500.00 rpm
	0.10 … 30000.00 rpm	Acceleration/deceleration terminal/initial speed.	1 = 1 rpm
46.02	*Frequency scaling*	Defines the maximum frequency value used to define the acceleration ramp rate and the initial frequency value used to define deceleration ramp rate. The frequency acceleration and deceleration ramp times are therefore related to this value (**not** to parameter *30.14 Maximum frequency*). Also defines the 16-bit scaling of frequency-related parameters. The value of this parameter corresponds to 20000 in fieldbus, master/follower etc. communication.	50.00 Hz 60.00 Hz (*95.20* b0)
	0.10 … 1000.00 Hz	Acceleration/deceleration terminal/initial frequency.	10 = 1 Hz
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	100.0%
	0.1 … 1000.0%	Torque corresponding to 10000 on fieldbus.	10 = 1%

No.	Name/Value	Description	Def/FbEq16
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
	0.10 … 30000.00 kW or 0.10 … 40214.48 hp	Power corresponding to 10000 on fieldbus.	1 = 1 unit
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
	0…30000 A	Current corresponding to 10000 on fieldbus.	1 = 1 A
46.06	*Speed ref zero scaling*	Defines a speed corresponding to a zero reference received from fieldbus (either the embedded fieldbus interface, or interface FBA A 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
	0.00 … 30000.00 rpm	Speed corresponding to minimum fieldbus reference.	1 = 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
	0.00 … 1000.00 Hz	Frequency corresponding to minimum fieldbus reference.	10 = 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
	2…20000 ms	Motor speed signal filter time.	1 = 1 ms
46.12	*Filter time output frequency*	Defines a filter time for signal *01.06 Output frequency*.	500 ms
	2…20000 ms	Output frequency signal filter time.	1 = 1 ms
46.13	*Filter time motor torque*	Defines a filter time for signal *01.10 Motor torque*.	100 ms
	2…20000 ms	Motor torque signal filter time.	1 = 1 ms
46.14	*Filter time power out*	Defines a filter time for signal *01.14 Output power*.	100 ms
	2…20000 ms	Output power signal filter time.	1 = 1 ms

No.	Name/Value	Description	Def/FbEq16
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
	0.00 … 30000.00 rpm	Limit for “at setpoint” indication in speed control.	See par. *46.01*
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
	0.00 … 1000.00 Hz	Limit for “at setpoint” indication in frequency control.	See par. *46.02*

No.	Name/Value	Description	Def/FbEq16
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%
	0.0 … 300.0%	Limit for “at setpoint” indication in torque control.	See par. *46.03*
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
	0.00 … 30000.00 rpm	“Above limit” indication trigger level for speed control.	See par. *46.01*
46.32	*Above frequency limit*	Defines the trigger level for “above limit” indication in frequency control. When actual frequency exceeds the limit, bit 10 of *06.17 Drive status word 2* is set.	50.00 Hz
	0.00 … 1000.00 Hz	“Above limit” indication trigger level for frequency control.	See par. *46.02*
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%
	0.0 … 1600.0%	“Above limit” indication trigger level for torque control.	See par. *46.03*
46.42	*Torque decimals*	Defines the number of decimal places of torque-related parameters.	1
	0…2	Number of decimal places of torque parameters.	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
	0.10... 30000.00 rpm	Acceleration/deceleration terminal/initial speed.	100 = 1rpm

No.	Name/Value	Description	Def/FbEq16
47 Data storage		Data storage parameters that can be written to and read from using other parameters' source and target settings. Note that there are different storage parameters for different data types. See also section *Data storage parameters* (page 184).	
47.01	Data storage 1 real32	Data storage parameter 1. Parameters 47.01…47.08 are real 32-bit numbers that can be used as source values of other parameters. Storage parameters 47.01…47.08 can be used as the target of received 16-bit data (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	0.000
	See par 47.31	32-bit data.	See par. 47.31
47.02	Data storage 2 real32	Data storage parameter 2. See also parameter *47.01 Data storage 1 real32*.	0.000
	See par 47.32	32-bit data.	See par. 47.32
47.03	Data storage 3 real32	Data storage parameter 3. See also parameter *47.01 Data storage 1 real32*.	0.000
	See par 47.33	32-bit data.	See par. 47.33
47.04	Data storage 4 real32	Data storage parameter 4. See also parameter *47.01 Data storage 1 real32*.	0.000
	See par 47.34	32-bit data.	See par. 47.34
47.05	Data storage 5 real32	Data storage parameter 5. See also parameter *47.01 Data storage 1 real32*.	0.000
	See par 47.35	32-bit data.	See par. 47.35
47.06	Data storage 6 real32	Data storage parameter 6. See also parameter *47.01 Data storage 1 real32*.	0.000
	See par 47.36	32-bit data.	See par. 47.36
47.07	Data storage 7 real32	Data storage parameter 7. See also parameter *47.01 Data storage 1 real32*.	0.000
	See par 47.37	32-bit data.	See par. 47.37
47.08	Data storage 8 real32	Data storage parameter 8. See also parameter *47.01 Data storage 1 real32*.	0.000
	See par 47.38	32-bit data.	See par. 47.38
47.11	Data storage 1 int32	Data storage parameter 9.	0
	-2147483648 … 2147483647	32-bit data.	-

No.	Name/Value	Description	Def/FbEq16
47.12	*Data storage 2 int32*	Data storage parameter 10.	0
	-2147483648 … 2147483647	32-bit data.	-
47.13	*Data storage 3 int32*	Data storage parameter 11.	0
	-2147483648 … 2147483647	32-bit data.	-
47.14	*Data storage 4 int32*	Data storage parameter 12.	0
	-2147483648 … 2147483647	32-bit data.	-
47.15	*Data storage 5 int32*	Data storage parameter 13.	0
	-2147483648 … 2147483647	32-bit data.	-
47.16	*Data storage 6 int32*	Data storage parameter 14.	0
	-2147483648 … 2147483647	32-bit data.	-
47.17	*Data storage 7 int32*	Data storage parameter 15.	0
	-2147483648 … 2147483647	32-bit data.	-
47.18	*Data storage 8 int32*	Data storage parameter 16.	0
	-2147483648 … 2147483647	32-bit data.	-
47.21	*Data storage 1 int16*	Data storage parameter 17.	0
	-32768 … 32767	16-bit data.	1 = 1
47.22	*Data storage 2 int16*	Data storage parameter 18.	0
	-32768 … 32767	16-bit data.	1 = 1
47.23	*Data storage 3 int16*	Data storage parameter 19.	0
	-32768 … 32767	16-bit data.	1 = 1
47.24	*Data storage 4 int16*	Data storage parameter 20.	0
	-32768 … 32767	16-bit data.	1 = 1
47.25	*Data storage 5 int16*	Data storage parameter 21.	0
	-32768 … 32767	16-bit data.	1 = 1
47.26	*Data storage 6 int16*	Data storage parameter 22.	0
	-32768 … 32767	16-bit data.	1 = 1
47.27	*Data storage 7 int16*	Data storage parameter 23.	0
	-32768 … 32767	16-bit data.	1 = 1
47.28	*Data storage 8 int16*	Data storage parameter 24.	0
	-32768 … 32767	16-bit data.	1 = 1

No.	Name/Value	Description	Def/FbEq16
47.31	*Data storage 1 real32 type*	Defines the scaling of parameter *47.01 Data storage 1 real32* to and from 16-bit integer format. This scaling is used when the data storage parameter is the target of received 16-bit data (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*
	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	*Data storage 2 real32 type*	Defines the 16-bit scaling of parameter *47.02 Data storage 2 real32*. See parameter *47.31 Data storage 1 real32 type*.	*Unscaled*
47.33	*Data storage 3 real32 type*	Defines the 16-bit scaling of parameter *47.03 Data storage 3 real32*. See parameter *47.31 Data storage 1 real32 type*.	*Unscaled*
47.34	*Data storage 4 real32 type*	Defines the 16-bit scaling of parameter *47.04 Data storage 4 real32*. See parameter *47.31 Data storage 1 real32 type*.	*Unscaled*
47.35	*Data storage 5 real32 type*	Defines the 16-bit scaling of parameter *47.05 Data storage 5 real32*. See parameter *47.31 Data storage 1 real32 type*.	*Unscaled*
47.36	*Data storage 6 real32 type*	Defines the 16-bit scaling of parameter *47.06 Data storage 6 real32*. See parameter *47.31 Data storage 1 real32 type*.	*Unscaled*
47.37	*Data storage 7 real32 type*	Defines the 16-bit scaling of parameter *47.07 Data storage 7 real32*. See parameter *47.31 Data storage 1 real32 type*.	*Unscaled*
47.38	*Data storage 8 real32 type*	Defines the 16-bit scaling of parameter *47.08 Data storage 8 real32*. See parameter *47.31 Data storage 1 real32 type*.	*Unscaled*
49 Panel port communication		Communication settings for the control panel port on the drive.	
49.01	*Node ID number*	Defines the node ID of the drive. All devices connected to the network must have a unique node ID. **Note:** For networked drives, it is advisable to reserve ID 1 for spare/replacement drives.	1
	1…32	Node ID.	1 = 1
49.03	*Baud rate*	Defines the transfer rate of the link.	*230.4 kbps*
	38.4 kbps	38.4 kbit/s.	1

No.	Name/Value	Description	Def/FbEq16
	57.6 kbps	57.6 kbit/s.	2
	86.4 kbps	86.4 kbit/s.	3
	115.2 kbps	115.2 kbit/s.	4
	230.4 kbps	230.4 kbit/s.	5
49.04	*Communication loss time*	Sets a timeout for control panel (or PC tool) communication. If a communication break lasts longer than the timeout, the action specified by parameter *49.05 Communication loss action* is taken.	10.0 s
	0.3 … 3000.0 s	Panel/PC tool communication timeout.	10 = 1 s
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 parameter *49.07 Panel comm supervision force* and *49.08 Secondary comm. loss action*.	*Fault*
	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
	Speed ref safe	Drive generates an *A7EE Control panel loss* warning and sets the speed to the speed defined by parameter *49.05 Communication loss action Speed ref safe*. 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*…*49.05*. **Note:** Refreshing may cause a communication break, so reconnecting the drive may be required.	*Done*
	Done	Refresh done or not requested.	0
	Refresh	Refresh parameters *49.01*…*49.05*. The value reverts automatically to *Done*.	1

No.	Name/Value	Description	Def/FbEq16
49.07	*Panel comm supervision force*	Activates control panel communication monitoring separately for each control location (see section *Local control vs. external control* on page *120*). 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.	0000b

Bit	Name	Value
0	Ext 1	1 = Communication monitoring active when Ext 1 is being used.
1	Ext 2	1 = Communication monitoring active when Ext 2 is being used.
2	Local	1 = Communication monitoring active when local control is being used.
3…15	Reserved	

No.	Name/Value	Description	Def/FbEq16
	0000b…0111b	Panel communication monitoring selection.	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*
	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*
	rpm	rpm.	0
	%	Percent of absolute value of *30.12 Maximum speed* or *30.11 Minimum speed*, whichever is greater.	1
49.15	*Minimum ext speed ref panel*	Defines a minimum limit for control panel speed reference in external control. In local control, the limits in parameter group *30 Limits* are in force. See section *Local control vs. external control* (page *120*).	-30000.00 rpm
	-30000.00 … 30000.00 rpm	Minimum speed reference.	See par. *46.01*
49.16	*Maximum ext speed ref panel*	Defines a maximum limit for control panel speed reference in external control. In local control, the limits in parameter group *30 Limits* are in force. See section *Local control vs. external control* (page *120*).	30000.00 rpm
	-30000.00 … 30000.00 rpm	Maximum speed reference.	See par. *46.01*

No.	Name/Value	Description	Def/FbEq16
49.17	*Minimum ext frequency ref panel*	Defines a minimum limit for control panel frequency reference in local control. In local control, the limits in parameter group *30 Limits* are in force. See section *Local control vs. external control* (page *120*).	-500.00 Hz
	-500.00 … 500.00 Hz	Minimum frequency reference.	See par. *46.02*
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 *120*).	500.00 Hz
	-500.00 … 500.00 Hz	Maximum frequency reference.	See par. *46.02*
49.24	*Panel actual score*	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	The active reference is displayed.	0
	Other	Source selection (see *Terms and abbreviations* on page *187*).	-

50 Fieldbus adapter (FBA)		Fieldbus communication configuration. See also chapter *Fieldbus control through a fieldbus adapter* (page *703*).	
50.01	*FBA A enable*	Enables/disables communication between the drive and fieldbus adapter A, and specifies the slot the adapter is installed into. **Note:** This parameter cannot be changed while the drive is running.	*Disable*
	Disable	Communication between drive and fieldbus adapter A disabled.	0
	Option slot 1	Communication between drive and fieldbus adapter A enabled. The adapter is in slot 1.	1
	Option slot 2	Communication between drive and fieldbus adapter A enabled. The adapter is in slot 2.	2
	Option slot 3	Communication between drive and fieldbus adapter A enabled. The adapter is in slot 3.	3
50.02	*FBA A comm loss func*	Selects how the drive reacts upon a fieldbus communication break. A time delay for the action can be defined by parameter *50.03 FBA A comm loss t out*. See also parameter *50.26 FBA A comm supervision force*.	*No action*
	No action	No action taken.	0
	Fault	The 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

No.	Name/Value	Description	Def/FbEq16
	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
	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 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*. ⚠ **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 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
	0.3 … 6553.5 s	Time delay.	1 = 1 s
50.04	*FBA A ref1 type*	Selects the type and scaling of reference 1 received from fieldbus adapter A. **Note:** Fieldbus-specific communication profiles may use different scalings. For more information, see the manual of the fieldbus adapter.	*Auto*
	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
	Torque	The scaling is defined by parameter *46.03 Torque scaling*.	3

No.	Name/Value	Description	Def/FbEq16
	Speed	The scaling is defined by parameter *46.01 Speed scaling*.	4
	Frequency	The scaling is defined by parameter *46.02 Frequency scaling*.	5
50.05	*FBA A ref2 type*	Selects the type and scaling of reference 2 received from fieldbus adapter A. See parameter *50.04 FBA A ref1 type*.	*Auto*
50.07	*FBA A actual 1 type*	Selects the type/source and scaling of actual value 1 transmitted to the fieldbus network through fieldbus adapter A. **Note:** Fieldbus-specific communication profiles may use different scalings. For more information, see the manual of the fieldbus adapter.	*Auto*
	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.	
	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.	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 and scaling of actual value 2 transmitted to the fieldbus network through fieldbus adapter A. See parameter *50.07 FBA A actual 1 type*	*Auto*
50.09	*FBA A SW transparent source*	Selects the source of the fieldbus status word when the fieldbus adapter is set to a transparent communication profile eg. by its configuration parameters (group *51 FBA A settings*).	*Not selected*
	Not selected	No source selected.	-
	Other	Source selection (see *Terms and abbreviations* on page *187*).	-
50.10	*FBA A act1 transparent source*	When parameter *50.07 FBA A actual 1 type* is set to *Transparent*, this parameter selects the source of actual value 1 transmitted to the fieldbus network through fieldbus adapter A.	*Not selected*
	Not selected	No source selected.	-
	Other	Source selection (see *Terms and abbreviations* on page *187*).	-
50.11	*FBA A act2 transparent source*	When parameter *50.08 FBA A actual 2 type* is set to *Transparent*, this parameter selects the source of actual value 2 transmitted to the fieldbus network through fieldbus adapter A.	*Not selected*
	Not selected	No source selected.	-

No.	Name/Value	Description	Def/FbEq16
	Other	Source selection (see *Terms and abbreviations* on page *187*).	-
50.12	*FBA A debug mode*	Enables the display of raw (unmodified) data received from and sent to fieldbus adapter A in parameters *50.13*…*50.18*. This functionality should only be used for debugging. **Note:** This parameter cannot be changed while the drive is running.	*Disable*
	Disable	Display of raw data from fieldbus adapter A disabled.	0
	Fast	Display of raw data from fieldbus adapter A enabled.	1
50.13	*FBA A control word*	Displays the raw (unmodified) control word sent by the master (PLC) to fieldbus adapter A if debugging is enabled by parameter *50.12 FBA A debug mode*. This parameter is read-only.	-
	00000000h … FFFFFFFFh	Control word sent by master to fieldbus adapter A.	-
50.14	*FBA A reference 1*	Displays raw (unmodified) reference REF1 sent by the master (PLC) to fieldbus adapter A if debugging is enabled by parameter *50.12 FBA A debug mode*. This parameter is read-only.	-
	-2147483648 … 2147483647	Raw REF1 sent by master to fieldbus adapter A.	-
50.15	*FBA A reference 2*	Displays raw (unmodified) reference REF2 sent by the master (PLC) to fieldbus adapter A if debugging is enabled by parameter *50.12 FBA A debug mode*. This parameter is read-only.	-
	-2147483648 … 2147483647	Raw REF2 sent by master to fieldbus adapter A.	-
50.16	*FBA A status word*	Displays the raw (unmodified) status word sent by fieldbus adapter A to the master (PLC) if debugging is enabled by parameter *50.12 FBA A debug mode*. This parameter is read-only.	-
	00000000h … FFFFFFFFh	Status word sent by fieldbus adapter A to master.	-
50.17	*FBA A actual value 1*	Displays raw (unmodified) actual value ACT1 sent by fieldbus adapter A to the master (PLC) if debugging is enabled by parameter *50.12 FBA A debug mode*. This parameter is read-only.	-
	-2147483648 … 2147483647	Raw ACT1 sent by fieldbus adapter A to master.	-
50.18	*FBA A actual value 2*	Displays raw (unmodified) actual value ACT2 sent by fieldbus adapter A to the master (PLC) if debugging is enabled by parameter *50.12 FBA A debug mode*. This parameter is read-only.	-
	-2147483648 … 2147483647	Raw ACT2 sent by fieldbus adapter A to master.	-

No.	Name/Value	Description	Def/FbEq16
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><tr><td>Selection</td><td>Cyclic high *</td><td>Cyclic low **</td></tr><tr><td>*Monitoring*</td><td>10 ms</td><td>2 ms</td></tr><tr><td>*Normal*</td><td>2 ms</td><td>10 ms</td></tr><tr><td>*Fast*</td><td>500 µs</td><td>2 ms</td></tr><tr><td>*Very fast*</td><td>250 µs</td><td>2 ms</td></tr></table> * Cyclic high data consists of fieldbus Status word, Act1 and Act2. ** Cyclic low data consists of the parameter data mapped to parameter groups *52 FBA A data in* and *53 FBA A data out*, and acyclic data. Control word, Ref1 and Ref2 are handled as interrupts generated on receipt of cyclic high messages. **Note:** This parameter cannot be changed while the drive is running.	*Normal*
	Normal	Normal speed.	0
	Fast	Fast speed.	1
	Very fast	Very fast speed.	2
	Monitoring	Low speed. Optimized for PC tool communication and monitoring usage.	3
50.26	*FBA A comm supervision force*	Activates fieldbus communication monitoring separately for each control location (see section *Local control vs. external control* on page *120*). 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. <table><tr><td>Bit</td><td>Name</td><td>Value</td></tr><tr><td>0</td><td>Ext 1</td><td>1 = Communication monitoring active when Ext 1 is being used.</td></tr><tr><td>1</td><td>Ext 2</td><td>1 = Communication monitoring active when Ext 2 is being used.</td></tr><tr><td>2</td><td>Local</td><td>1 = Communication monitoring active when local control is being used.</td></tr><tr><td>3…15</td><td>Reserved</td><td></td></tr></table>	0000b
	0000b…0111b	FBA A communication monitoring selection.	1 = 1
50.31	*FBA B enable*	Enables/disables communication between the drive and fieldbus adapter B, and specifies the slot the adapter is installed into. **Note:** This parameter cannot be changed while the drive is running.	*Disable*
	Disable	Communication between drive and fieldbus adapter B disabled.	0
	Option slot 1	Communication between drive and fieldbus adapter B enabled. The adapter is in slot 1.	1

No.	Name/Value	Description	Def/FbEq16
	Option slot 2	Communication between drive and fieldbus adapter B enabled. The adapter is in slot 2.	2
	Option slot 3	Communication between drive and fieldbus adapter B enabled. The adapter is in slot 3.	3
50.32	*FBA B comm loss func*	Selects how the drive reacts upon a fieldbus communication break. The 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*
	No action	No action taken.	0
	Fault	The 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
	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 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*. **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.	0.3 s
	0.3 … 6553.5 s	Time delay.	1 = 1 s

No.	Name/Value	Description	Def/FbEq16
50.34	*FBA B ref1 type*	Selects the type and scaling of reference 1 received from fieldbus adapter B. See parameter *50.04 FBA A ref1 type*.	*Auto*
50.35	*FBA B ref2 type*	Selects the type and scaling of reference 2 received from fieldbus adapter B. See parameter *50.04 FBA A ref1 type*.	*Auto*
50.37	*FBA B actual 1 type*	Selects the type and scaling of actual value 1 transmitted to the fieldbus network through fieldbus adapter B. See parameter *50.07 FBA A actual 1 type*.	*Auto*
50.38	*FBA B actual 2 type*	Selects the type and scaling of actual value 2 transmitted to the fieldbus network through fieldbus adapter B. For the selections, see parameter *50.07 FBA A actual 1 type*.	*Auto*
50.39	*FBA B SW transparent source*	Selects the source of the fieldbus status word when the fieldbus adapter is set to a transparent communication profile eg. by its configuration parameters (group *54 FBA B settings*).	*Not selected*
	Not selected	No source selected.	-
	Other	Source selection (see *Terms and abbreviations* on page *187*).	-
50.40	*FBA B act1 transparent source*	When parameter *50.37 FBA B actual 1 type* is set to *Transparent* or *General*, this parameter selects the source of actual value 1 transmitted to the fieldbus network through fieldbus adapter B.	*Not selected*
	Not selected	No source selected.	-
	Other	Source selection (see *Terms and abbreviations* on page *187*).	-
50.41	*FBA B act2 transparent source*	When parameter *50.38 FBA B actual 2 type* is set to *Transparent* or *General*, this parameter selects the source of actual value 2 transmitted to the fieldbus network through fieldbus adapter B.	*Not selected*
	Not selected	No source selected.	-
	Other	Source selection (see *Terms and abbreviations* on page *187*).	-
50.42	*FBA B debug enable*	Enables the display of raw (unmodified) data received from and sent to fieldbus adapter B in parameters *50.43*…*50.48*. This functionality should only be used for debugging. **Note:** This parameter cannot be changed while the drive is running.	*Disable*
	Disable	Display of raw data from fieldbus adapter B disabled.	0
	Enable	Display of raw data from fieldbus adapter B enabled.	1
50.43	*FBA B control word*	Displays the raw (unmodified) control word sent by the master (PLC) to fieldbus adapter B if debugging is enabled by parameter *50.42 FBA B debug enable*. This parameter is read-only.	-
	00000000h … FFFFFFFFh	Control word sent by master to fieldbus adapter B.	-

No.	Name/Value	Description	Def/FbEq16
50.44	*FBA B reference 1*	Displays raw (unmodified) reference REF1 sent by the master (PLC) to fieldbus adapter B if debugging is enabled by parameter *50.42 FBA B debug enable*. This parameter is read-only.	-
	-2147483648 … 2147483647	Raw REF1 sent by master to fieldbus adapter B.	-
50.45	*FBA B reference 2*	Displays raw (unmodified) reference REF2 sent by the master (PLC) to fieldbus adapter B if debugging is enabled by parameter *50.42 FBA B debug enable*. This parameter is read-only.	-
	-2147483648 … 2147483647	Raw REF2 sent by master to fieldbus adapter B.	-
50.46	*FBA B status word*	Displays the raw (unmodified) status word sent by fieldbus adapter B to the master (PLC) if debugging is enabled by parameter *50.42 FBA B debug enable*. This parameter is read-only.	-
	00000000h … FFFFFFFFh	Status word sent by fieldbus adapter B to master.	-
50.47	*FBA B actual value 1*	Displays raw (unmodified) actual value ACT1 sent by fieldbus adapter B to the master (PLC) if debugging is enabled by parameter *50.42 FBA B debug enable*. This parameter is read-only.	-
	-2147483648 … 2147483647	Raw ACT1 sent by fieldbus adapter B to master.	-
50.48	*FBA B actual value 2*	Displays raw (unmodified) actual value ACT2 sent by fieldbus adapter B to the master (PLC) if debugging is enabled by parameter *50.42 FBA B debug enable*. This parameter is read-only.	-
	-2147483648 … 2147483647	Raw ACT2 sent by fieldbus adapter B to master.	-
50.51	*FBA B timelevel sel*	Selects the communication time levels. In general, lower time levels of read/write services reduce CPU load. The table below shows the time levels of the read/write services for cyclic high and cyclic low data with each parameter setting. 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 * 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.	*Normal*
	Normal	Normal speed.	0
	Fast	Fast speed.	1

No.	Name/Value	Description	Def/FbEq16
	Very fast	Very fast speed.	2
	Monitoring	Low speed. Optimized for PC tool communication and monitoring usage.	3
50.56	*FBA B comm supervision force*	Activates fieldbus communication monitoring separately for each control location (see section *Local control vs. external control* on page *120*). The parameter is primarily intended for monitoring the communication with FBA B when it is connected to the application program and not selected as a control source by drive parameters.	0000b

Bit	Name	Value
0	Ext 1	1 = Communication monitoring active when Ext 1 is being used.
1	Ext 2	1 = Communication monitoring active when Ext 2 is being used.
2	Local	1 = Communication monitoring active when local control is being used.
3…15	Reserved	

No.	Name/Value	Description	Def/FbEq16
	0000b…0111b	FBA B communication monitoring selection.	1 = 1
50.99	*FBA automatic detection*	Enables/disables the FBA automatic detection. **Note:** FBA automatic detection works with one fieldbus adapter only..	*Enable*
	Disable	FBA automatic detection is disabled.	0
	Enable	FBA automatic detection is enabled.	1
51 FBA A settings		Fieldbus adapter A configuration.	
51.01	*FBA A type*	Displays the type of the connected fieldbus adapter module. **0** = Module is not found or is not properly connected, or is disabled by parameter *50.01 FBA A enable*; **1** = FPBA; **32** = FCAN; **37** = FDNA; **101** = FCNA, **128** = FENA-11/21; **135** = FECA; **136** = FEPL; **485** = FSCA. This parameter is read-only.	-
51.02	*FBA A Par2*	Parameters *51.02*…*51.26* are adapter module-specific. For more information, see the documentation of the fieldbus adapter module. Note that not all of these parameters are necessarily in use.	-
	0…65535	Fieldbus adapter configuration parameter.	1 = 1
…	…	…	…
51.26	*FBA A Par26*	See parameter *51.02 FBA A Par2*.	-
	0…65535	Fieldbus adapter configuration parameter.	1 = 1
51.27	*FBA A par refresh*	Validates any changed fieldbus adapter module configuration settings. After refreshing, the value reverts automatically to *Done*. **Note:** This parameter cannot be changed while the drive is running.	*Done*
	Done	Refreshing done.	0
	Refresh	Refreshing.	1

No.	Name/Value	Description	Def/FbEq16
51.28	*FBA A par table ver*	Displays the parameter table revision of the fieldbus adapter module mapping file (stored in the memory of the drive). In format axyz, where ax = major table revision number; yz = minor table revision number. This parameter is read-only.	-
		Parameter table revision of adapter module.	-
51.29	*FBA A drive type code*	Displays the drive type code in the fieldbus adapter module mapping file (stored in the memory of the drive). This parameter is read-only.	-
	0…65535	Drive type code stored in the mapping file.	1 = 1
51.30	*FBA A mapping file ver*	Displays the fieldbus adapter module mapping file revision stored in the memory of the drive in decimal format. This parameter is read-only.	-
	0…65535	Mapping file revision.	1 = 1
51.31	*D2FBA A comm status*	Displays the status of the fieldbus adapter module communication.	-
	Not configured	Adapter is not configured.	0
	Initializing	Adapter is initializing.	1
	Time out	A timeout has occurred in the communication between the adapter and the drive.	2
	Configuration error	Adapter configuration error: mapping file not found in the file system of the drive, or mapping file upload has failed more than three times.	3
	Off-line	Fieldbus communication is off-line.	4
	On-line	Fieldbus communication is on-line, or fieldbus adapter has been configured not to detect a communication break. For more information, see the documentation of the fieldbus adapter.	5
	Reset	Adapter is performing a hardware reset.	6
51.32	*FBA A comm SW ver*	Displays the patch and build versions of the adapter module firmware in format xxyy, where xx = patch version number, yy = build version number. Example: C802 = 200.02 (patch version 200, build version 2).	
		Patch and build versions of adapter module firmware.	-
51.33	*FBA A appl SW ver*	Displays the major and minor versions of the adapter module firmware in format xyy, where x = major revision number, yy = minor revision number. Example: 300 = 3.00 (major version 3, minor version 00).	
		Major and minor versions of adapter module firmware.	-

No.	Name/Value	Description	Def/FbEq16
52 FBA A data in		Selection of data to be transferred from drive to fieldbus controller through fieldbus adapter A. **Note:** 32-bit values require two consecutive parameters. Whenever a 32-bit value is selected in a data parameter, the next parameter is automatically reserved.	
52.01	*FBA A data in1*	Parameters *52.01*…*52.12* select data to be transferred from the drive to the fieldbus controller through fieldbus adapter A.	*None*
	None	None.	0
	CW 16bit	Control Word (16 bits)	1
	Ref1 16bit	Reference REF1 (16 bits)	2
	Ref2 16bit	Reference REF2 (16 bits)	3
	SW 16bit	Status Word (16 bits)	4
	Act1 16bit	Actual value ACT1 (16 bits)	5
	Act2 16bit	Actual value ACT2 (16 bits)	6
	CW 32bit	Control Word (32 bits)	11
	Ref1 32bit	Reference REF1 (32 bits)	12
	Ref2 32bit	Reference REF2 (32 bits)	13
	SW 32bit	Status Word (32 bits)	14
	Act1 32bit	Actual value ACT1 (32 bits)	15
	Act2 32bit	Actual value ACT2 (32 bits)	16
	SW2 16bit	Status Word 2 (16 bits)	24
	Other	Source selection (see *Terms and abbreviations* on page *187*).	-
…	…	…	…
52.12	*FBA A data in12*	See parameter *52.01 FBA A data in1*.	*None*
53 FBA A data out		Selection of data to be transferred from fieldbus controller to drive through fieldbus adapter A. **Note:** 32-bit values require two consecutive parameters. Whenever a 32-bit value is selected in a data parameter, the next parameter is automatically reserved.	
53.01	*FBA A data out1*	Parameters *53.01*…*53.12* select data to be transferred from the fieldbus controller to the drive through fieldbus adapter A.	*None*
	None	None.	0
	CW 16bit	Control Word (16 bits)	1
	Ref1 16bit	Reference REF1 (16 bits)	2
	Ref2 16bit	Reference REF2 (16 bits)	3
	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

No.	Name/Value	Description	Def/FbEq16
	Other	Source selection (see *Terms and abbreviations* on page *187*).	-
53.02	*FBA A data out2*	Parameters *53.01*…*53.12* select data to be transferred from the fieldbus controller to the drive through fieldbus adapter A.	*None*
	None	None.	0
	CW 16bit	Control Word (16 bits)	1
	Ref1 16bit	Reference REF1 (16 bits)	2
	Ref2 16bit	Reference REF2 (16 bits)	3
	CW 32bit	Control Word (32 bits)	11
	Ref1 32bit	Reference REF1 (32 bits)	12
	Ref2 32bit	Reference REF2 (32 bits)	13
	CW2 16bit	Control Word 2 (16 bits)	21
	Other	Source selection (see *Terms and abbreviations* on page *187*).	-
53.03	*FBA A data out3*	Parameters *53.01*…*53.12* select data to be transferred from the fieldbus controller to the drive through fieldbus adapter A.	*None*
	None	None.	0
	CW 16bit	Control Word (16 bits)	1
	Ref1 16bit	Reference REF1 (16 bits)	2
	Ref2 16bit	Reference REF2 (16 bits)	3
	CW 32bit	Control Word (32 bits)	11
	Ref1 32bit	Reference REF1 (32 bits)	12
	Ref2 32bit	Reference REF2 (32 bits)	13
	CW2 16bit	Control Word 2 (16 bits)	21
	Other	Source selection (see *Terms and abbreviations* on page *187*).	-
…	…	…	…
53.12	*FBA A data out12*	See parameter *53.01 FBA A data out1*.	*None*

54 FBA B settings		Fieldbus adapter B configuration.	
54.01	*FBA B type*	Displays the type of the connected fieldbus adapter module. **0** = Module is not found or is not properly connected, or is disabled by parameter *50.31 FBA B enable*; **1** = FPBA; **32** = FCAN; **37** = FDNA; **101** = FCNA, **128** = FENA-11/21; **135** = FECA; **136** = FEPL; **485** = FSCA. This parameter is read-only.	-

No.	Name/Value	Description	Def/FbEq16
54.02	*FBA B Par2*	Parameters *54.02*…*54.26* are adapter module-specific. For more information, see the documentation of the fieldbus adapter module. Note that not all of these parameters are necessarily in use.	-
	0…65535	Fieldbus adapter configuration parameter.	1 = 1
…	…	…	…
54.26	*FBA B Par26*	See parameter *54.02 FBA B Par2*.	-
	0…65535	Fieldbus adapter configuration parameter.	1 = 1
54.27	*FBA B par refresh*	Validates any changed fieldbus adapter module configuration settings. After refreshing, the value reverts automatically to *Done*. **Note:** This parameter cannot be changed while the drive is running.	*Done*
	Done	Refreshing done.	0
	Refresh	Refreshing.	1
54.28	*FBA B par table ver*	Displays the parameter table revision of the fieldbus adapter module mapping file (stored in the memory of the drive). In format axyz, where ax = major table revision number; yz = minor table revision number. This parameter is read-only.	-
		Parameter table revision of adapter module.	-
54.29	*FBA B drive type code*	Displays the drive type code in the fieldbus adapter module mapping file (stored in the memory of the drive). This parameter is read-only.	-
	0…65535	Drive type code stored in the mapping file.	1 = 1
54.30	*FBA B mapping file ver*	Displays the fieldbus adapter module mapping file revision stored in the memory of the drive in decimal format. This parameter is read-only.	-
	0…65535	Mapping file revision.	1 = 1
54.31	*D2FBA B comm status*	Displays the status of the fieldbus adapter module communication.	-
	Not configured	Adapter is not configured.	0
	Initializing	Adapter is initializing.	1
	Time out	A timeout has occurred in the communication between the adapter and the drive.	2
	Configuration error	Adapter configuration error: mapping file not found in the file system of the drive, or mapping file upload has failed more than three times.	3
	Off-line	Fieldbus communication is off-line.	4
	On-line	Fieldbus communication is on-line, or fieldbus adapter has been configured not to detect a communication break. For more information, see the documentation of the fieldbus adapter.	5
	Reset	Adapter is performing a hardware reset.	6

No.	Name/Value	Description	Def/FbEq16
54.32	*FBA B comm SW ver*	Displays the patch and build versions of the adapter module firmware in format xxyy, where xx = patch version number, yy = build version number. Example: C802 = 200.02 (patch version 200, build version 2).	
		Patch and build versions of adapter module firmware.	-
54.33	*FBA B appl SW ver*	Displays the major and minor versions of the adapter module firmware in format xyy, where x = major revision number, yy = minor revision number. Example: 300 = 3.00 (major version 3, minor version 00).	
		Major and minor versions of adapter module firmware.	-
55 FBA B data in		Selection of data to be transferred from drive to fieldbus controller through fieldbus adapter B.	
55.01	*FBA B data in1*	Parameters *55.01*…*55.12* select data to be transferred from the drive to the fieldbus controller through fieldbus adapter B.	*None*
	None	None.	0
	CW 16bit	Control Word (16 bits)	1
	Ref1 16bit	Reference REF1 (16 bits)	2
	Ref2 16bit	Reference REF2 (16 bits)	3
	SW 16bit	Status Word (16 bits)	4
	Act1 16bit	Actual value ACT1 (16 bits)	5
	Act2 16bit	Actual value ACT2 (16 bits)	6
	CW 32bit	Control Word (32 bits)	11
	Ref1 32bit	Reference REF1 (32 bits)	12
	Ref2 32bit	Reference REF2 (32 bits)	13
	SW 32bit	Status Word (32 bits)	14
	Act1 32bit	Actual value ACT1 (32 bits)	15
	Act2 32bit	Actual value ACT2 (32 bits)	16
	SW2 16bit	Status Word 2 (16 bits)	24
	Other	Source selection (see *Terms and abbreviations* on page *187*).	-
…	…	…	…
55.12	*FBA B data in12*	See parameter *55.01 FBA B data in1.*	*None*
56 FBA B data out		Selection of data to be transferred from fieldbus controller to drive through fieldbus adapter B.	
56.01	*FBA B data out1*	Parameters *56.01*…*56.12* select data to be transferred from the fieldbus controller to the drive through fieldbus adapter B.	*None*
	None	None.	0
	CW 16bit	Control Word (16 bits)	1
	Ref1 16bit	Reference REF1 (16 bits)	2
	Ref2 16bit	Reference REF2 (16 bits)	3
	CW 32bit	Control Word (32 bits)	11
	Ref1 32bit	Reference REF1 (32 bits)	12

No.	Name/Value	Description	Def/FbEq16
	Ref2 32bit	Reference REF2 (32 bits)	13
	CW2 16bit	Control Word 2 (16 bits)	21
	Other	Source selection (see *Terms and abbreviations* on page *187*).	-
…	…	…	…
56.12	*FBA B data out12*	See parameter *56.01 FBA B data out1*.	*None*
58 Embedded fieldbus		Configuration of the embedded fieldbus (EFB) interface. See also chapter *Fieldbus control through the embedded fieldbus interface (EFB)* (page *679*).	
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*
	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.	-
		Protocol ID and revision.	1 = 1
58.03	*Node address*	Defines the node address of the drive on the fieldbus link. Values 1…247 are allowable. Two devices with the same address are not allowed on-line. Changes to this parameter take effect after the control unit is rebooted or the new settings validated by parameter *58.06 Communication control*.	1
	0…255	Node address (values 1…247 are allowable).	1 = 1
58.04	*Baud rate*	Selects the transfer rate of the fieldbus link. Changes to this parameter take effect after the control unit is rebooted or the new settings validated by parameter *58.06 Communication control*.	*19.2 kbps*
	9.6 kbps	9.6 kbit/s.	2
	19.2 kbps	19.2 kbit/s.	3
	38.4 kbps	38.4 kbit/s.	4
	57.6 kbps	57.6 kbit/s.	5
	76.8 kbps	76.8 kbit/s.	6
	115.2 kbps	115.2 kbit/s.	7
58.05	*Parity*	Selects the type of parity bit and the number of stop bits. Changes to this parameter take effect after the control unit is rebooted or the new settings validated by parameter *58.06 Communication control*.	*8 EVEN 1*
	8 NONE 1	Eight data bits, no parity bit, one stop bit.	0
	8 NONE 2	Eight data bits, no parity bit, two stop bits.	1
	8 EVEN 1	Eight data bits, even parity bit, one stop bit.	2

No.	Name/Value	Description	Def/FbEq16
	8 ODD 1	Eight data bits, odd parity bit, one stop bit.	3
58.06	*Communication control*	Validates any changes in the EFB settings, or activates silent mode.	*Enabled*
	Enabled	Normal operation.	0
	Refresh settings	Validates any changed EFB configuration settings. Reverts automatically to *Enabled*.	1
	Silent mode	Activates silent mode (no messages are transmitted). Silent mode can be terminated by activating the *Refresh settings* selection of this parameter.	2
58.07	*Communication diagnostics*	Displays the status of the EFB communication. This parameter is read-only.	-

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

No.	Name/Value	Description	Def/FbEq16
	0000h…FFFFh	EFB communication status.	1 = 1
58.08	*Received packets*	Displays a count of valid packets addressed to the drive. During normal operation, this number increases constantly. Can be reset from the control panel by keeping Reset depressed for over 3 seconds.	-
	0…4294967295	Number of received packets addressed to the drive.	1 = 1
58.09	*Transmitted packets*	Displays a count of valid packets transmitted by the drive. During normal operation, this number increases constantly. Can be reset from the control panel by keeping Reset depressed for over 3 seconds.	-
	0…4294967295	Number of transmitted packets.	1 = 1

No.	Name/Value	Description	Def/FbEq16
58.10	*All packets*	Displays a count of valid packets addressed to any device on the bus. During normal operation, this number increases constantly. Can be reset from the control panel by keeping Reset depressed for over 3 seconds.	-
	0…4294967295	Number of all received packets.	1 = 1
58.11	*UART errors*	Displays a count of character errors received by the drive. An increasing count indicates a configuration problem on the bus. Can be reset from the control panel by keeping Reset depressed for over 3 seconds.	-
	0…4294967295	Number of UART errors.	1 = 1
58.12	*CRC errors*	Displays a count of packets with a CRC error received by the drive. An increasing count indicates interference on the bus. Can be reset from the control panel by keeping Reset depressed for over 3 seconds.	-
	0…4294967295	Number of CRC errors.	1 = 1
58.14	*Communication loss action*	Selects how the drive reacts to an EFB communication break. Changes to this parameter take effect after the control unit is rebooted or the new settings validated by parameter *58.06 Communication control*. See also parameters *58.15 Communication loss mode* and *58.16 Communication loss time*.	*Fault*
	No	No action taken (monitoring disabled).	0
	Fault	Drive trips on *6681 EFB comm loss*. This only occurs if control is expected from the EFB (EFB selected as source of start/stop/reference in the currently active location), or if supervision is forced using parameter *58.36 EFB comm supervision force*.	1
	Last speed	Drive generates an *A7CE EFB comm loss* warning and freezes the speed to the level the drive was operating at. This only occurs if control is expected from the EFB 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 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 comm loss*. This occurs even though no control is expected from the EFB.	4

No.	Name/Value	Description	Def/FbEq16
	Warning	Drive generates an *A7CE EFB comm loss* warning. This occurs even though no 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*
	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
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
	0.0 … 6000.0 s	EFB communication timeout.	1 = 1
58.17	*Transmit delay*	Defines a minimum response delay in addition to any fixed delay imposed by the protocol. Changes to this parameter take effect after the control unit is rebooted or the new settings validated by parameter *58.06 Communication control*.	0 ms
	0…65535 ms	Minimum response delay.	1 = 1
58.18	*EFB control word*	Displays the raw (unmodified) control word sent by the Modbus controller to the drive. For debugging purposes. This parameter is read-only.	-
	0000h…FFFFh	Control word sent by Modbus controller to the drive.	1 = 1
58.19	*EFB status word*	Displays the raw (unmodified) status word sent by the drive to the Modbus controller. For debugging purposes. This parameter is read-only.	-
	0000h…FFFFh	Status word sent by the drive to the Modbus controller.	1 = 1
58.25	*Control profile*	Defines the control profile used by the protocol.	*ABB Drives*
	ABB Drives	ABB Drives profile (with a 16-bit control word) with registers in the classic format for backward compatibility.	0
	Transparent	Transparent profile (16-bit or 32-bit control word) with registers in the classic format.	2

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

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

No.	Name/Value	Description	Def/FbEq16
	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.	4
	Frequency	*01.06 Output frequency* is sent as actual value 1. The scaling is defined by parameter *46.02 Frequency scaling*.	5

No.	Name/Value	Description	Def/FbEq16
	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*
	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
	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 2. 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*
	Not selected	None.	0
	Other	Source selection (see *Terms and abbreviations* on page *187*).	-
58.31	*EFB act1 transparent source*	Selects the source of actual value 1 when *58.28 EFB act1 type* is set to *Transparent* or *General*.	*Not selected*
	Not selected	None.	0
	Other	Source selection (see *Terms and abbreviations* on page *187*).	-
58.32	*EFB act2 transparent source*	Selects the source of actual value 1 when *58.29 EFB act2 type* is set to *Transparent* or *General*.	*Not selected*
	Not selected	None.	0
	Other	Source selection (see *Terms and abbreviations* on page *187*).	-
58.33	*Addressing mode*	Defines the mapping between parameters and holding registers in the 400101…465535 Modbus register range. Changes to this parameter take effect after the control unit is rebooted or the new settings validated by parameter *58.06 Communication control*.	*Mode 0*
	Mode 0	<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

No.	Name/Value	Description	Def/FbEq16
	Mode 1	16-bit values (groups 1…255, indexes 1…255): Register address = 400000 + 256 × parameter group + parameter index. For example, parameter 22.80 would be mapped to register 400000 + 5632 + 80 = 405712.	1
	Mode 2	32-bit values (groups 1…127, indexes 1…255): Register address = 400000 + 512 × parameter group + 2 × parameter index. For example, parameter 22.80 would be mapped to register 400000 + 11264 + 160 = 411424.	2
58.34	*Word order*	Selects in which order 16-bit registers of 32-bit parameters are transferred. For each register, the first byte contains the high order byte and the second byte contains the low order byte. Changes to this parameter take effect after the control unit is rebooted or the new settings validated by parameter *58.06 Communication control*.	*LO-HI*
	HI-LO	The first register contains the high order word, the second contains the low order word.	0
	LO-HI	The first register contains the low order word, the second contains the high order word.	1
58.36	*EFB comm supervision force*	Activates fieldbus communication monitoring separately for each control location (see section *Local control vs. external control* on page *120*). 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.	0000b

Bit	Name	Value
0	Ext 1	1 = Communication monitoring active when Ext 1 is being used.
1	Ext 2	1 = Communication monitoring active when Ext 2 is being used.
2	Local	1 = Communication monitoring active when local control is being used.
3…15	Reserved	

No.	Name/Value	Description	Def/FbEq16
	0000b…0111b	EFB communication monitoring selection.	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*
	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

No.	Name/Value	Description	Def/FbEq16
	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	Source selection (see *Terms and abbreviations* on page *187*).	-
58.102	*Data I/O 2*	Defines the address in the drive which the Modbus master accesses when it reads from or writes to register address 400002. For the selections, see parameter *58.101 Data I/O 1*.	*Ref1 16bit*
58.103	*Data I/O 3*	Defines the address in the drive which the Modbus master accesses when it reads from or writes to register address 400003. For the selections, see parameter *58.101 Data I/O 1*.	*Ref2 16bit*
58.104	*Data I/O 4*	Defines the address in the drive which the Modbus master accesses when it reads from or writes to register address 400004. For the selections, see parameter *58.101 Data I/O 1*.	*SW 16bit*
58.105	*Data I/O 5*	Defines the address in the drive which the Modbus master accesses when it reads from or writes to register address 400005. For the selections, see parameter *58.101 Data I/O 1*.	*Act1 16bit*
58.106	*Data I/O 6*	Defines the address in the drive which the Modbus master accesses when it reads from or writes to register address 400006. For the selections, see parameter *58.101 Data I/O 1*.	*Act2 16bit*
58.107	*Data I/O 7*	Parameter selector for Modbus register address 400007. For the selections, see parameter *58.101 Data I/O 1*.	*None*
…	…	…	…
58.124	*Data I/O 24*	Parameter selector for Modbus register address 400024. For the selections, see parameter *58.101 Data I/O 1*.	*None*

No.	Name/Value	Description	Def/FbEq16
60 DDCS communication		DDCS communication configuration. The DDCS protocol is used in the communication between • drives in a master/follower configuration (see page *129*), • the drive and an external controller such as the AC 800M (see page *136*), or • the drive (or more precisely, an inverter unit) and the supply unit of the drive system (see page *139*). 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 channel used for master/follower communication.	*Not in use*
	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
	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 *Drive application programming manual (IEC 61131-3)*, 3AUA0000127808 [English]).	7
	RDCO CH 2	Channel 2 on RDCO module (with BCU control unit only).	12
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
	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*
	Not in use	Master/follower functionality not active.	0
	DDCS master	The drive is the master on the master/follower (DDCS) link.	1

No.	Name/Value	Description	Def/FbEq16
	DDCS follower	The drive is a follower on the master/follower (DDCS) link.	2
	D2D master	The drive is the master on the drive-to-drive (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 *129*) through the XD2D connector, select *DDCS master* instead.	3
	D2D follower	The drive is a follower on the drive-to-drive (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 *129*) 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 drive-to-drive (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 *129*) 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 *129*) through the XD2D connector (as opposed to a fiber optic link).	*Ring*
	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
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 *136*).	10
	1…15	Light intensity.	
60.08	*M/F comm loss timeout*	Sets a timeout for master/follower (DDCS) 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
	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*
	No action	No action taken.	0

No.	Name/Value	Description	Def/FbEq16
	Warning	The drive generates an *A7CB MF 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 MF 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 MF 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*
	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).	
	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
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*
60.12	*M/F act1 type*	Selects the type and scaling of actual value 1 transmitted to the master/follower link.	*Auto*
	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.	
	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

No.	Name/Value	Description	Def/FbEq16
60.13	*M/F act2 type*	Selects the type/source and scaling of actual value ACT2 transmitted to the master/follower link.	*Auto*
	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	
	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*
	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
	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*
	FALSE	0.	0
	TRUE	1.	1
	Other [bit]	Source selection (see *Terms and abbreviations* on page *187*).	-
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*
	FALSE	0.	0
	TRUE	1.	1
	Other [bit]	Source selection (see *Terms and abbreviations* on page *187*).	-

No.	Name/Value	Description	Def/FbEq16
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 *61.01*…*61.03*. In the master, the corresponding target parameter (*62.04*…*62.12*) must be set to *Follower SW*.	*Fault*
	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
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 *61.01*…*61.03*. In the master, the corresponding target parameter (*62.04*…*62.12*) must be set to *Follower SW*.	*Always*
	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

No.	Name/Value	Description	Def/FbEq16
60.19	*M/F comm supervision sel 1*	Parameters *60.19…62.28* 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 *Drive (IEC 61131-3) application programming manual* (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*.	-

Bit	Name	Description
0	Follower 1	1 = Follower 1 is polled by the master.
1	Follower 2	1 = Follower 2 is polled by the master.
…	…	…
15	Follower 16	1 = Follower 16 is polled by the master.

No.	Name/Value	Description	Def/FbEq16
	0000h…FFFFh	Selection of followers for D2D communication supervision (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*.	-

Bit	Name	Description
0	Follower 17	1 = Follower 17 is polled by the master.
1	Follower 18	1 = Follower 18 is polled by the master.
…	…	…
15	Follower 32	1 = Follower 32 is polled by the master.

No.	Name/Value	Description	Def/FbEq16
	0000h…FFFFh	Selection of followers for D2D communication supervision (2).	1 = 1

No.	Name/Value	Description	Def/FbEq16
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 supv mode sel 1* and *60.28 M/F status supv 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*.	-

Bit	Name	Description
0	Follower 1	1 = Status of follower 1 is monitored.
1	Follower 2	1 = Status of follower 2 is monitored.
…	…	…
15	Follower 16	1 = Status of follower 16 is monitored.

No.	Name/Value	Description	Def/FbEq16
	0000h…FFFFh	D2D follower status supervision selection (followers 1…16).	1 = 1
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*.	-

Bit	Name	Description
0	Follower 17	1 = Status of follower 17 is monitored.
1	Follower 18	1 = Status of follower 18 is monitored.
…	…	…
15	Follower 32	1 = Status of follower 32 is monitored.

No.	Name/Value	Description	Def/FbEq16
	0000h…FFFFh	D2D follower status supervision selection (followers 17…32).	1 = 1

No.	Name/Value	Description	Def/FbEq16
60.27	*M/F status supv mode sel 1*	In the D2D, 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.	-

Bit	Name	Description
0	Follower 1	0 = Status of follower 1 is monitored continuously. 1 = Status of follower 1 is monitored only when it is in stopped state.
1	Follower 2	0 = Status of follower 2 is monitored continuously. 1 = Status of follower 2 is monitored only when it is in stopped state.
…	…	…
15	Follower 16	0 = Status of follower 16 is monitored continuously. 1 = Status of follower 16 is monitored only when it is in stopped state.

No.	Name/Value	Description	Def/FbEq16
	0000h…FFFFh	D2D status supervision mode selection 1.	1 = 1
60.28	*M/F status supv mode sel 2*	Selects the mode of status word monitoring of followers 17…32.	-

Bit	Name	Description
0	Follower 17	0 = Status of follower 17 is monitored continuously. 1 = Status of follower 17 is monitored only when it is in stopped state.
1	Follower 18	0 = Status of follower 18 is monitored continuously. 1 = Status of follower 18 is monitored only when it is in stopped state.
…	…	…
15	Follower 32	0 = Status of follower 32 is monitored continuously. 1 = Status of follower 32 is monitored only when it is in stopped state.

No.	Name/Value	Description	Def/FbEq16
	0000h…FFFFh	D2D status supervision mode selection 2.	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
	0.0 … 180.0 s	Master/follower wake-up delay.	10 = 1 s

No.	Name/Value	Description	Def/FbEq16
60.32	*M/F comm supervision force*	Activates master/follower communication monitoring separately for each control location (see section *Local control vs. external control* on page *120*). 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.	0000b

Bit	Name	Value
0	Ext 1	1 = Communication monitoring active when Ext 1 is being used.
1	Ext 2	1 = Communication monitoring active when Ext 2 is being used.
2	Local	1 = Communication monitoring active when local control is being used.
3…15	Reserved	

No.	Name/Value	Description	Def/FbEq16
	0000b…0111b	Master/follower communication monitoring selection.	1 = 1
60.41	*Extension adapter com port*	Selects the channel used for connecting an optional FEA-xx extension adapter.	*Not in use*
	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
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*
	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*
	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

No.	Name/Value	Description	Def/FbEq16
	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 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 Bus Manager 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 1×16 + 1 = 17.	1
	1…254	Node address.	
60.55	*DDCS controller HW connection*	Selects the topology of the fiber optic link with an external controller.	*Star*
	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
60.56	*DDCS controller baud rate*	Selects the communication speed of the channel selected by parameter *60.51 DDCS controller comm port*.	*4 mbps*
	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 *136*).	10
	1…15	Light intensity.	

No.	Name/Value	Description	Def/FbEq16
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. Notes: • 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
	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*
	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
	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 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

No.	Name/Value	Description	Def/FbEq16
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*
	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
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*
60.62	*DDCS controller act1 type*	Selects the type/source and scaling of actual value ACT1 transmitted to the external controller.	*Auto*
	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 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
60.63	*DDCS controller act2 type*	Selects the type/source and scaling of actual value ACT2 transmitted to the external controller.	*Auto*
	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

No.	Name/Value	Description	Def/FbEq16
60.64	*Mailbox dataset selection*	Selects the pair of data sets used by the mailbox service in the drive/controller communication. See section *External controller interface* (page *136*).	*Dataset 32/33*
	Dataset 32/33	Data sets 32 and 33.	0
	Dataset 24/25	Data sets 24 and 25.	1
60.65	*DDCS controller comm supervision force*	Activates DDCS controller communication monitoring separately for each control location (see section *Local control vs. external control* on page *120*). 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.	0000b

Bit	Name	Value
0	Ext 1	1 = Communication monitoring active when Ext 1 is being used.
1	Ext 2	1 = Communication monitoring active when Ext 2 is being used.
2	Local	1 = Communication monitoring active when local control is being used.
3…15	Reserved	

No.	Name/Value	Description	Def/FbEq16
	0000b…0111b	DDCS controller communication monitoring selection.	1 = 1
60.200	*Winch drive type*	Selects the winch 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*...*60.03*. These parameters are not allowed to change manually.	*Not selected*
	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 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
	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)	31

<table>
<tr><th>No.</th><th>Name/Value</th><th>Description</th><th>Def/FbEq16</th></tr>
<tr><td>60.201</td><td>Winch drive structure 1</td><td>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.</td><td>0h</td></tr>
<tr><td colspan="4">
<table>
<tr><th>Bit</th><th>Name</th><th>Value</th></tr>
<tr><td>0</td><td colspan="2">Reserved</td></tr>
<tr><td>1</td><td>Winch follower 1/ Sub master</td><td>0 = Used as Sub master drive, if available.
1 = Used as Follower of Main master drive.</td></tr>
<tr><td>2</td><td>Winch follower 2</td><td>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.</td></tr>
<tr><td>...</td><td>...</td><td>...</td></tr>
<tr><td>11</td><td>Winch follower 11</td><td>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.</td></tr>
<tr><td>12…13</td><td colspan="2">Reserved</td></tr>
<tr><td>14</td><td>All speed control mode</td><td>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.</td></tr>
<tr><td>15</td><td>All torque control mode</td><td>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.</td></tr>
</table>
</td></tr>
<tr><td></td><td>0000h…FFFFh</td><td>Winch D2D communication structure 1.</td><td>1 = 1</td></tr>
<tr><td>60.202</td><td>Winch drive structure 2</td><td>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.</td><td>0h</td></tr>
<tr><td></td><td>0000h…FFFFh</td><td>Winch D2D communication structure 2.</td><td>1 = 1</td></tr>
</table>

No.	Name/Value	Description	Def/FbEq16
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*
	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
	Other [bit]	Source selection (see *Terms and abbreviations* on page *187*).	-
60.208	*Winch M/F enable*	Enable master follower communication and configuration.	*Disabled*
	Disabled	Winch master follower communication disabled.	0
	Enabled	Winch master follower communication enabled.	1
	DI1	Digital input DI1	2
	DI2	Digital input DI2	3
	DI3	Digital input DI3	4
	DI4	Digital input DI4	5
	DI5	Digital input DI5	6
	DI6	Digital input DI6	7
	DIO1	Digital input/output DIO1	8
	DIO2	Digital input/output DIO2	9
	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]	Source selection (see *Terms and abbreviations* on page *187*).	-
60.210	*Winch drive type actual*	Displays the actual role of the drive defined in the D2D-link. This parameter is read-only.	*None*
	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
	-15000...15000	Master drive speed reference.	1 = 1

No.	Name/Value	Description	Def/FbEq16
60.212	*Master reference 2*	Displays the torque reference from master drive. This parameter is read-only.	0
	-1600...1600	Master drive torque reference.	1 = 1
60.213	*Master control word*	Displays the control word data from master drive. This parameter is read-only.	0b0000

Bit	**Name**	**Description**
0	Start	1 = Start command from master to follower
1	Modulating	1 = Master drive is modulating
2	Brake closed	1 = Master drive brake is closed
3	Start cmd	1 = Master drive start command status
4...6	Reserved	
7	Reset	1 = Master drive reset command (to do:new)
8...11	Reserved	
12	Anchor invert direction	1 = Anchor invert direction
13	Fault reset	1 = Fault reset command
14	Brake closed this drive	1 = Brake closed in this drive
15	Reserved	

No.	Name/Value	Description	Def/FbEq16
	0b0000...0b1111	Master drive control word.	-
60.214	*Master status word*	This status word is updated only in the master drive. This parameter is read-only.	0b0000

Bit	Name	Description
0	Drive ready	1 = All drives in the M/F D2D-link are ready.
1	Drive fault	1 = At least one drive in the M/F D2D-link is faulty.
2	Torque prove ok	1 = Torque proving is ok for all drives in the M/F D2D-link.
3	Drive running	1 = All drives in the M/F D2D-link are in running state.
4	Emergency off1 inactive	1 = Emergency stop signal is not active (mode off1) for at least one drive in the M/F D2D-link.
5	Emergency off2 inactive	1 = Emergency stop signal is not active (mode off2) for at least one drive in the M/F D2D-link.
6	Emergency off3 inactive	1 = Emergency stop signal is not active (mode off3) for at least one drive in the M/F D2D-link.
7...9	Reserved	
10	Run enable lost	1 = Run enable missing for at least one drive in the M/F D2D-link.
11	Start inhibit	1 = Start inhibit active in at least one drive in the M/F D2D-link.
12	Control location changed	1 = Control location changed in at least one drive in the M/F D2D-link.
13	Master faulted	1 = Master drive in the M/F D2D-link is faulty.
14	Ext2 active	1 = Control location EXT2 active for all drives in the M/f D2D-link.
15	Toggle bit	1 = Master communication toggle bit status.

No.	Name/Value	Description	Def/FbEq16
	0b0000...0b1111	Master drive status word.	-

No.	Name/Value	Description	Def/FbEq16
60.221	*Follower 1 status word*	Status data transferred from winch follower 1 drive. This parameter is read-only.	0b0000

Bit	Name	Description
0	Drive ready	1 = Follower 1 drive ready status.
1	Drive fault	1 = Follower 1 drive is faulty.
2	Torque prove ok	1 = Torque proving is ok in Follower 1 drive.
3	Drive running	1 = Follower 1 drive in running state.
4	Emergency off1 inactive	1 = Emergency stop signal is not active (mode off1) in Follower 1.
5	Emergency off2 inactive	1 = Emergency stop signal is not active (mode off2) in Follower 1.
6	Emergency off3 inactive	1 = Emergency stop signal is not active (mode off3) in Follower 1.
7...9	Reserved	
10	Run enable lost	1 = Run enable missing in Follower 1.
11	Start inhibit	1 = Start inhibit active in Follower 1.
12	Control location changed	1 = Control location changed in Follower 1.
13	Master faulted	1 = Follower 1 detection that Master is faulty.
14	Ext2 active	1 = Control location EXT2 active in Follower 1.
15	Toggle bit	1 = Follower 1 communication toggle bit status.

No.	Name/Value	Description	Def/FbEq16
	0b0000...0b1111	Winch follower 1 status.	-
60.222	*Follower 2 status word*	Status data transferred from winch follower 2 drive. See parameter *60.221 Follower 1 status word* (page *445*). This parameter is read-only.	0b0000
	0b0000...0b1111	Winch follower 2 status.	-
60.223	*Follower 3 status word*	Status data transferred from winch follower 3 drive. See parameter *60.221 Follower 1 status word* (page *445*). This parameter is read-only.	0b0000
	0b0000...0b1111	Winch follower 3 status.	-
60.224	*Follower 4 status word*	Status data transferred from winch follower 4 drive. See parameter *60.221 Follower 1 status word* (page *445*). This parameter is read-only.	0b0000
	0b0000...0b1111	Winch follower 4 status.	-
60.225	*Follower 5 status word*	Status data transferred from winch follower 5 drive. See parameter *60.221 Follower 1 status word* (page *445*). This parameter is read-only.	0b0000
	0b0000...0b1111	Winch follower 5 status.	-
60.226	*Follower 6 status word*	Status data transferred from winch follower 6 drive. See parameter *60.221 Follower 1 status word* (page *445*). This parameter is read-only.	0b0000
	0b0000...0b1111	Winch follower 6 status.	-
60.227	*Follower 7 status word*	Status data transferred from winch follower 7 drive. See parameter *60.221 Follower 1 status word* (page *445*). This parameter is read-only.	0b0000
	0b0000...0b1111	Winch follower 7 status.	-

No.	Name/Value	Description	Def/FbEq16
60.228	*Follower 8 status word*	Status data transferred from winch follower 8 drive. See parameter *60.221 Follower 1 status word* (page *445*). This parameter is read-only.	0b0000
	0b0000...0b1111	Winch follower 8 status.	-
60.229	*Follower 9 status word*	Status data transferred from winch follower 9 drive. See parameter *60.221 Follower 1 status word* (page *445*). This parameter is read-only.	0b0000
	0b0000...0b1111	Winch follower 9 status.	-
60.230	*Follower 10 status word*	Status data transferred from winch follower 10 drive. See parameter *60.221 Follower 1 status word* (page *445*). This parameter is read-only.	0b0000
	0b0000...0b1111	Winch follower 10 status.	-
60.231	*Follower 11 status word*	Status data transferred from winch follower 11 drive. See parameter *60.221 Follower 1 status word* (page *445*). This parameter is read-only.	0b0000
	0b0000...0b1111	Winch follower 11 status.	-
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
	0...32000 ms	D2D-link communication delay.	1 = 1 ms
60.238	*Communication loss 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.	0b0000

Bit	Name	Description
0	Master com lost	1 = Communication with Master lost.
1...11	Follower 1...11 com lost	1 = Communication with Follower 1...11 lost.
12...15	Reserved	

No.	Name/Value	Description	Def/FbEq16
	0b0000...0b1111	Communication loss status.	-
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 *129*).	*Follower CW*
	None	None.	0
	CW 16bit	Control Word (16 bits)	1
	SW 16bit	Status Word (16 bits)	4

No.	Name/Value	Description	Def/FbEq16
	Act1 16bit	Actual value ACT1 (16 bits)	5
	Act2 16bit	Actual value ACT2 (16 bits)	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 *314*).	6145
	Torque reference act 5	*26.75 Torque reference act 5* (page *336*).	6731
	Torque reference used	*26.02 Torque reference used* (page *329*).	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
	Other	Source selection (see *Terms and abbreviations* on page *187*).	-
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*.	*Used speed reference*
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*
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.	0
	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.	0
	0…65535	Data to be sent as word 2 in master/follower communication.	

No.	Name/Value	Description	Def/FbEq16
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.	0
	0…65535	Data to be sent as word 3 in master/follower communication.	
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*
	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	Source selection (see *Terms and abbreviations* on page *187*).	-
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*
61.47	*Data set 2 data 3 selection*	See parameter *61.45 Data set 2 data 1 selection*.	*None*
…	…	…	…
61.50	*Data set 4 data 3 selection*	See parameter *61.45 Data set 2 data 1 selection*.	*None*
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*
	None	None.	0
	CW 16bit	Control Word (16 bits)	1

No.	Name/Value	Description	Def/FbEq16
	SW 16bit	Status Word (16 bits)	4
	Act1 16bit	Actual value ACT1 (16 bits)	5
	Act2 16bit	Actual value ACT2 (16 bits)	6
	Other	Source selection (see *Terms and abbreviations* on page *187*).	-
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*
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*
61.54	*Data set 13 data 1 selection*	See parameter *61.51 Data set 11 data 1 selection*.	*None*
…	…	…	…
61.74	*Data set 25 data 3 selection*	See parameter *61.51 Data set 11 data 1 selection*.	*None*
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
	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
	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
	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
	0…65535	Data to be sent as word 3 of data set 4.	
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.	0
	0…65535	Data to be sent as word 1 of data set 11.	

No.	Name/Value	Description	Def/FbEq16
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.	0
	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.	0
	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.	0
	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.	0
	0…65535	Data to be sent as word 3 of data set 25.	

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 MF/D2D data 1 value*.	*None*
	None	None.	0
	CW 16bit	Control Word (16 bits)	1
	Ref1 16bit	Reference REF1 (16 bits)	2
	Ref2 16bit	Reference REF2 (16 bits)	3
	Other	Source selection (see *Terms and abbreviations* on page *187*).	-
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 MF/D2D data 2 value*. For the selections, see parameter *62.01 M/F data 1 selection*.	*None*
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 MF/D2D data 3 value*. For the selections, see parameter *62.01 M/F data 1 selection*.	*None*
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*.	*None*

No.	Name/Value	Description	Def/FbEq16
	None	None.	0
	Follower SW	Status word of the follower. See also parameter *60.18 Follower enable*.	26
	Other	Source selection (see *Terms and abbreviations* on page *187*).	-
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*
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*
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*
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*
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*
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*
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*
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*

No.	Name/Value	Description	Def/FbEq16
62.25	*MF/D2D 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.	0
	0…65535	Data received as word 1 in master/follower communication.	
62.26	*MF/D2D 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.	0
	0…65535	Data received as word 2 in master/follower communication.	
62.27	*MF/D2D 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.	0
	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.	0
	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.	0
	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.	0
	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.	0
	0…65535	Data received as word 1 from follower with node address 3.	

No.	Name/Value	Description	Def/FbEq16
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.	0
	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.	0
	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.	0
	0…65535	Data received as word 1 from follower with node address 4.	
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.	0
	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.	0
	0…65535	Data received as word 3 from follower with node address 4.	

No.	Name/Value	Description	Def/FbEq16
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.	-

Bit	Name	Description
0	Follower 1	1 (in the master) = Communication with follower 1 OK. 1 (in a follower) = Communication with master OK.
1	Follower 2	1 = Communication with follower 2 OK.
…	…	…
15	Follower 16	1 = Communication with follower 16 OK.

No.	Name/Value	Description	Def/FbEq16
	0000h…FFFFh	M/F communication status (followers 1…16).	1 = 1
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*.	-

Bit	Name	Description
0	Follower 17	1 = Communication with follower 17 OK.
1	Follower 18	1 = Communication with follower 18 OK.
…	…	…
15	Follower 32	1 = Communication with follower 32 OK.

No.	Name/Value	Description	Def/FbEq16
	0000h…FFFFh	M/F communication status (followers 17…32).	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*.	-

Bit	Name	Description
0	Follower 1	1 = Follower 1 ready.
1	Follower 2	1 = Follower 2 ready.
…	…	…
15	Follower 16	1 = Follower 16 ready.

No.	Name/Value	Description	Def/FbEq16
	0000h…FFFFh	Follower 1…16 ready status.	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*.	-

Bit	Name	Description
0	Follower 17	1 = Follower 17 ready.
1	Follower 18	1 = Follower 18 ready.
…	…	…
15	Follower 32	1 = Follower 32 ready.

No.	Name/Value	Description	Def/FbEq16
	0000h…FFFFh	Follower 17…32 ready status.	1 = 1

No.	Name/Value	Description	Def/FbEq16
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*
	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	Source selection (see *Terms and abbreviations* on page *187*).	-
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*
62.47	*Data set 1 data 3 selection*	See parameter *62.45 Data set 1 data 1 selection*.	*None*
…	…	…	…
62.50	*Data set 3 data 3 selection*	See parameter *62.45 Data set 1 data 1 selection*.	*None*
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*
	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	Source selection (see *Terms and abbreviations* on page *187*).	-
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*

No.	Name/Value	Description	Def/FbEq16
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*
62.54	*Data set 12 data 1 selection*	See parameter *62.51 Data set 10 data 1 selection*.	*None*
…	…	…	…
62.74	*Data set 24 data 3 selection*	See parameter *62.51 Data set 10 data 1 selection*.	*None*
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
	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
	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
	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
	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.	0
	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.	0
	0…65535	Data received as word 2 of data set 10.	

No.	Name/Value	Description	Def/FbEq16
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.	0
	0…65535	Data received as word 3 of data set 10.	
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.	0
	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.	0
	0…65535	Data received as word 3 of data set 24.	

74 Winch general		General settings for winch. See section *Anchor control* on page *47*.	
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 Automooring mode enable*.	*FALSE*
	FALSE	0	0
	TRUE	1	1
	DI1	Digital input DI1	2
	DI2	Digital input DI2	3
	DI3	Digital input DI3	4
	DI4	Digital input DI4	5
	DI5	Digital input DI5	6
	DI6	Digital input DI6	7
	DIO1	Digital input/output DIO1	8
	DIO2	Digital input/output DIO2	9
	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

No.	Name/Value	Description	Def/FbEq16
	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]	Source selection (see *Terms and abbreviations* on page *187*).	-
74.02	*Handmooring mode enable*	Enables/disables the Handmooring mode. When the source selected with this parameter is *ON*, and EXT2 is selected as control location, the Handmooring mode is active. It is possible to use the additional protective function provided with parameter group *79 Peak torque protection*. The current mode is displayed by winch actual signal *09.01 Winch status word 1*, bit 1. It is possible to select the enable source as AM setpoint switch inverted. In this way, it is possible to switch to Handmooring mode, if Automooring enable by switch list is *FALSE*.That is, when source selected with parameters *76.20 AM setpoint selector 1 srcA* to *76.28 AM setpoint selector 3 srcC* are all *FALSE* and also parameter *09.03 Winch status word 3*, bit 11 = 0. **Note:** Most suitable configuration must have a separate *DI* for enabling Anchor. For Handmooring / Automooring, use a *DI* that is directly used for Automooring and inverted value for Handmooring. For example, *74.02* = DI2 and *74.03* = DI2 inverted. *74.01 Anchor mode enable* has priority over this parameter.	*FALSE*
	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 Automooring* for configuration of setpoint selector switches.	2
	DI1	Digital input DI1	3
	DI2	Digital input DI2	4
	DI3	Digital input DI3	5
	DI4	Digital input DI4	6
	DI5	Digital input DI5	7
	DI6	Digital input DI6	8
	DIO1	Digital input/output DIO1	9
	DIO2	Digital input/output DIO2	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

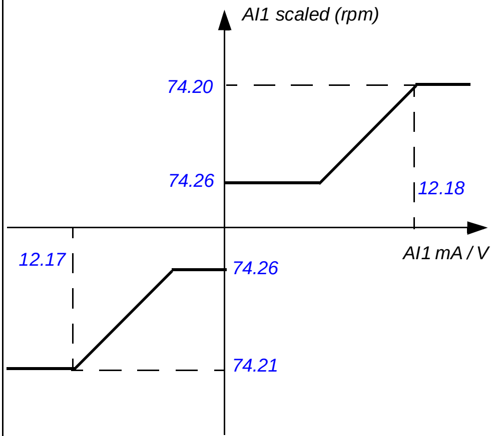
No.	Name/Value	Description	Def/FbEq16
	Other [bit]	Source selection (see *Terms and abbreviations* on page *187*).	-
74.03	*Automooring mode enable*	Enables/disables the Automooring mode. When the source selected with this parameter is *ON*, and EXT2 is selected as control location, the Automooring mode 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 Automooring* for configuration of setpoint selector switches. Parameters *74.01 Anchor mode enable* and *74.02 Handmooring mode enable* has priority over this parameter.	*FALSE*
	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 Automooring* for configuring setpoint selector switches.	2
	DI1	Digital input DI1	3
	DI2	Digital input DI2	4
	DI3	Digital input DI3	5
	DI4	Digital input DI4	6
	DI5	Digital input DI5	7
	DI6	Digital input DI6	8
	DIO1	Digital input/output DIO1	9
	DIO2	Digital input/output DIO2	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]	Source selection (see *Terms and abbreviations* on page *187*).	-
74.04	*Automooring triggering type*	Defines the type of signal required for enabling/disabling the Automooring mode.	*Switch*
	Switch	Automooring is enabled when the DI is *ON*, and disabled when the input is *OFF*.	0
	Pulse	The enable/disable state changes every time the DI is switched *ON*.	1

No.	Name/Value	Description	Def/FbEq16
74.09	*Winch configuration word*	Specifies winch software related options for certain features that are required to operate differently from their default behavior.	0b0010

Bit	Name	Description
0	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.
1	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.
2	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* & *74.29*. The parameter *74.24* is used as the torque limit in Anchor mode.
3	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 Load cell high start limit*.
4	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*.
5	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.
6	Rope tens mem zero AM stop	0 = Rope tension memorized retains its value when the drive is stopped in Automooring mode. 1 = Value of rope tension memorized becomes zero, when the drive is stopped in Automooring mode.
7	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.
8	Stop at HM AM change	0 = Possible to switch from Handmooring mode to Automooring mode or vice versa without stopping the drive. 1 = Drive stop when Mooring mode (Handmooring to Automooring or vice versa) is changed while the drive is running.
9	Rope tension zero in Anchor load cell	0 = Rope actual tension (parameter *09.23*) shows the value from the Load cell in Anchor mode. 1 = Rope actual tension (parameter *09.23*) shows zero in Anchor mode.
10...11	Reserved	
12	Disable handmooring overload	0 = The handmooring overload feature is enabled. See parameters *74.30* and *74.31*. 1 = The handmooring overload function is disabled. See parameters *74.30* and *74.31*. The parameter *74.34* is used as the torque limit in Handmooring mode.
13...15	Reserved	

No.	Name/Value	Description	Def/FbEq16
	0b0000...0b1111	Winch configuration word	-
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*
	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	3
	DI2	Digital input DI2	4
	DI3	Digital input DI3	5
	DI4	Digital input DI4	6
	DI5	Digital input DI5	7
	DI6	Digital input DI6	8
	DIO1	Digital input/output DIO1	9
	DIO2	Digital input/output DIO2	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]	Source selection (see *Terms and abbreviations* on page *187*).	-
74.11	*Chain length source*	Selects the method of measuring the length of the chain/rope.	*Not selected*
	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]	Source selection (see *Terms and abbreviations* on page *187*).	-

No.	Name/Value	Description	Def/FbEq16
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
	-2000.000... 2000.000 m	Chain absolute length.	1000 = 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
	0...18000 rpm	Anchor maximum speed heave.	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
	0...18000 rpm	Anchor max speed lower.	1 = 1 rpm
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.	3.0
	0.00...1800.00 s	Anchor acceleration time.	10 = 1s
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.	3.0
	0.00...1800.00 s	Anchor deceleration time.	10 = 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
	0.0...600.0%	Anchor maximum torque.	10 = 1%
74.25	*Anchor motoring power limit*	Defines maximum power limit in anchoring mode.	300.0
	0.0...600.0%	Anchor motoring power limit.	10 = 1%

No.	Name/Value	Description	Def/FbEq16
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
	0...18000 rpm	Anchor minimum speed in rpm.	1 = 1 rpm
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*
	Disabled	0	0
	Enabled	1	1
	DI1	Digital input DI1	2
	DI2	Digital input DI2	3
	DI3	Digital input DI3	4
	DI4	Digital input DI4	5
	DI5	Digital input DI5	6
	DI6	Digital input DI6	7
	DIO1	Digital input/output DIO1	8
	DIO2	Digital input/output DIO2	9
	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/Value	Description	Def/FbEq16
	DIO2 inverted	Digital input/output DIO2 inverted	17
	Other [bit]	Source selection (see *Terms and abbreviations* on page *187*).	-
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...1600%	Anchor overload 2 min.	1 = 1%
74.29	*Anchor overload speed limit*	Speed limit when anchor overload function gets disabled.	150
	0...30000 rpm	Anchor overload speed limit.	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
	0...18000 rpm	Speed reference in Handmooring mode (heave direction).	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
	0...18000 rpm	Speed reference in Handmooring mode (lower direction).	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
	0.00...1800.00 s	Acceleration time in Handmooring mode.	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
	0.00...1800.00 s	Deceleration time in Handmooring mode.	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
	0.0...600.0%	Maximum mooring torque for Handmooring.	1 = 1%
74.35	*Handmooring motoring power limit*	Defines maximum power limit in handmooring mode.	300.0
	0.0...600.0%	Motoring power limit for handmooring.	10 = 1%

No.	Name/Value	Description	Def/FbEq16
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
	0...18000 rpm	Minimum speed in Handmooring mode.	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
	0.0...600.0%	Anchor overload 2 min.	10 = 1%
74.39	*Handmooring overload speed limit*	Speed limit when Handmooring overload function gets disabled.	0
	0...18000 rpm	Anchor overload speed limit.	1 = 1 rpm
74.40	*Automooring speed ref*	Defines the maximum reference speed level in Automooring mode.	100
	0...18000 rpm	Speed level in rpm.	1 = 1 rpm
74.42	*Automooring acc time*	Defines acceleration time from zero speed to maximum speed defined with parameter *74.40 Automooring speed ref* when Automooring mode is active. See parameters *74.03 Automooring mode enable* and *09.01 Winch status word 1*, bit 2.	3.00
	0.00...1800.00 s	Acceleration time in seconds.	10 = 1 s
74.43	*Automooring dec time*	Defines deceleration time from maximum to zero speed defined with parameter *74.40 Automooring speed ref* when Automooring mode is active. See parameters *74.03 Automooring mode enable* and *09.01 Winch status word 1*, bit 2.	3.00
	0.00...1800.00 s	Deceleration time in seconds.	10 = 1 s
74.44	*Automooring max torque*	Defines the maximum torque to be used in Automooring mode. **Note:** Torque limits set in group *30 Limits* have priority over this parameter.	100.0
	0.0...600.0%	Maximum mooring torque for Automooring.	10 = 1%
74.47	*Automooring invert direction*	Enables/disables the Automooring invert direction. Inverts Automooring mode speed reference.	*Disabled*
	Disabled	0	0
	Enabled	1	1
	DI1	Digital input DI1	2
	DI2	Digital input DI2	3
	DI3	Digital input DI3	4
	DI4	Digital input DI4	5
	DI5	Digital input DI5	6
	DI6	Digital input DI6	7
	DIO1	Digital input/output DIO1	8
	DIO2	Digital input/output DIO2	9

No.	Name/Value	Description	Def/FbEq16
	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]	Source selection (see *Terms and abbreviations* on page *187*).	-
74.50	*Speed match enable*	Enables/disables the speed match protection. Selects the source for speed match protection.	*Disabled*
	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	5
	DI2	Digital input DI2	6
	DI3	Digital input DI3	7
	DI4	Digital input DI4	8
	DI5	Digital input DI5	9
	DI6	Digital input DI6	10
	DIO1	Digital input/output DIO1	11
	DIO2	Digital input/output DIO2	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]	Source selection (see *Terms and abbreviations* on page *187*).	-
74.51	*Speed steady deviation level*	Defines the absolute speed deviation level when the motor is running in steady state.	50.00
	0.00... 30000.00 rpm	Speed steady deviation level.	1 = 1 rpm

No.	Name/Value	Description	Def/FbEq16
74.52	*Speed ramp deviation level*	Defines the absolute speed deviation level for the ramping state (acceleration/deceleration).	50.00
	0.00... 30000.00 rpm	Speed ramp deviation level.	1 = 1 rpm
74.53	*Speed match action*	Determines how the drive reacts upon a speed match error.	*Warning*
	Warning	The drive displays speed match warning *D20C Speed match* on page *649*.	0
	Fault	The drive trips on a speed match fault *D104 Speed match* on page *671*.	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 *74.53 Speed match action*. For further information, see section *Speed matching* on page *105*.	1000
	0...30000 ms	Time delay for generating Speed match fault (*D104 Speed match* on page *671*).	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*. See *Winch control start-up* (page *31*).	*Done*
	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.	

Bit	**Name**	**Description**
0	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*.
1	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*.
2...15	Reserved	

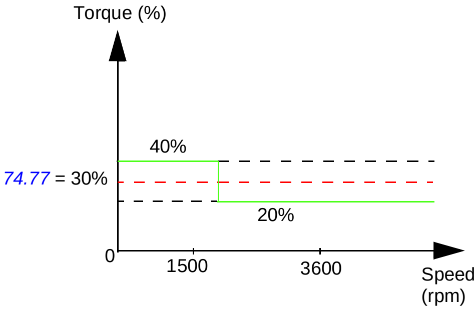
No.	Name/Value	Description	Def/FbEq16
74.62	*Rope tension configuration*	Specifies rope tension configuration related settings that can be enabled and disabled by toggling the specific bits.	

Bit	Name	Description
0	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*.
1	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*.
2...15	Reserved	

No.	Name/Value	Description	Def/FbEq16
74.63	*Rope tension filter number*	Defines the rope tension filter number.	10
	0...10000	Rope tension filter number.	1 = 1
74.64	*Speed change rate deadband*	Defines the speed change rate deadband.	3
	0...10000	Speed change rate deadband.	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
	0.00000... 1000.00000 kgm^2	Winch system inertia in kgm^2.	1 = 1
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
	0.0...300.0%	Winch system speed 1 torque.	1 = 1
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
	0.0...300.0%	Winch system speed 2 torque.	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
	0.0...300.0%	Winch system speed 3 torque.	1 = 1

No.	Name/Value	Description	Def/FbEq16
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
	0.0...300.0%	Winch system speed 4 torque.	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
	0.0...300.0%	Winch system speed 5 torque.	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
	0.0...18000.0 rpm	Winch system speed 1 in rpm.	1 = 1
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
	0.0...18000.0 rpm	Winch system speed 2 in rpm.	1 = 1
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
	0.0...18000.0 rpm	Winch system speed 3 in rpm.	1 = 1
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
	0.0...18000.0 rpm	Winch system speed 4 in rpm.	1 = 1
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
	0.0...18000.0 rpm	Winch system speed 5 in rpm.	1 = 1

No.	Name/Value	Description	Def/FbEq16
74.76	*Handmooring switch level*	Selects the speed levels for handmooring maximum speed based on the actual motor torque level (*01.10*). 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 (*01.10*) 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 (*01.10*) 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*
	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
	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

No.	Name/Value	Description	Def/FbEq16
74.77	*Handmooring switch level torque*	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 (*01.10*) 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 (*01.10*) is less than *74.77* - *74.78* longer than delay (*74.79*), *74.77* = 30% - 10% = 20%.	30.0
	0.0...600.0 %	Handmooring switch level torque	10 = 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
	0.0...100.0 %	Handmooring switch level hysteresis	10 = 1
74.79	*Handmooring switch level delay*	Defines delay time 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
	0.0...600.0 s	Handmooring switch level delay time	10 = 1

No.	Name/Value	Description	Def/FbEq16
74.80	Handmooring max speed sel sw	Displays the status of Handmooring maximum speed selections. This parameter is read-only.	0b0000

Bit	Name	Description
0	Handmooring sel source in 1	1 = Parameter 74.81 Handmooring max speed sel in 1 is selected.
1	Handmooring sel source in 2	1 = Parameter 74.82 Handmooring max speed sel in 2 is selected.
2...3	Reserved	
4	Default set used	1 = Speed reference scaling in Handmooring mode (heave/ lower direction) defined with par. 74.30 or par. 74.31 in use.
5	Set 1 used	1 = Parameter 74.83 Handmooring max speed heave set 1 or 74.84 Handmooring max speed lower set 1 is selected.
6	Set 2 used	1 = Parameter 74.85 Handmooring max speed heave set 2 or 74.86 Handmooring max speed lower set 2 is selected.
7	Set 3 used	1 = Parameter 74.87 Handmooring max speed heave set 3 or 74.88 Handmooring max speed lower set 3 is selected.
8...15	Reserved	

No.	Name/Value	Description	Def/FbEq16
	0b0000...0b1111	Handmooring maximum speed selection status word	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.	FALSE

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)

No.	Name/Value	Description	Def/FbEq16
	FALSE	0	0
	TRUE	1	1
	DI1	Digital input DI1	2
	DI2	Digital input DI2	3
	DI3	Digital input DI3	4
	DI4	Digital input DI4	5
	DI5	Digital input DI5	6
	DI6	Digital input DI6	7
	DIO1	Digital input/output DIO1	8
	DIO2	Digital input/output DIO2	9
	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

<table>
<tr><th>No.</th><th>Name/Value</th><th>Description</th><th>Def/FbEq16</th></tr>
<tr><td></td><td>DI6 inverted</td><td>Digital input DI6 inverted</td><td>15</td></tr>
<tr><td></td><td>DIO1 inverted</td><td>Digital input/output DIO1 inverted</td><td>16</td></tr>
<tr><td></td><td>DIO2 inverted</td><td>Digital input/output DIO2 inverted</td><td>17</td></tr>
<tr><td></td><td>Other [bit]</td><td>Source selection (see Terms and abbreviations on page187).</td><td>-</td></tr>
<tr><td>74.82</td><td>Handmooring max speed sel in 2</td><td>Source 2 to select the used Handmooring maximum speed in heave or lower direction.
Parameter 74.80 Handmooring max speed sel sw, bit 1 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></td><td>FALSE</td></tr>
<tr><td></td><td>FALSE</td><td>0</td><td>0</td></tr>
<tr><td></td><td>TRUE</td><td>1</td><td>1</td></tr>
<tr><td></td><td>DI1</td><td>Digital input DI1</td><td>2</td></tr>
<tr><td></td><td>DI2</td><td>Digital input DI2</td><td>3</td></tr>
<tr><td></td><td>DI3</td><td>Digital input DI3</td><td>4</td></tr>
<tr><td></td><td>DI4</td><td>Digital input DI4</td><td>5</td></tr>
<tr><td></td><td>DI5</td><td>Digital input DI5</td><td>6</td></tr>
<tr><td></td><td>DI6</td><td>Digital input DI6</td><td>7</td></tr>
<tr><td></td><td>DIO1</td><td>Digital input/output DIO1</td><td>8</td></tr>
<tr><td></td><td>DIO2</td><td>Digital input/output DIO2</td><td>9</td></tr>
<tr><td></td><td>DI1 inverted</td><td>Digital input DI1 inverted</td><td>10</td></tr>
<tr><td></td><td>DI2 inverted</td><td>Digital input DI2 inverted</td><td>11</td></tr>
<tr><td></td><td>DI3 inverted</td><td>Digital input DI3 inverted</td><td>12</td></tr>
<tr><td></td><td>DI4 inverted</td><td>Digital input DI4 inverted</td><td>13</td></tr>
<tr><td></td><td>DI5 inverted</td><td>Digital input DI5 inverted</td><td>14</td></tr>
<tr><td></td><td>DI6 inverted</td><td>Digital input DI6 inverted</td><td>15</td></tr>
<tr><td></td><td>DIO1 inverted</td><td>Digital input/output DIO1 inverted</td><td>16</td></tr>
<tr><td></td><td>DIO2 inverted</td><td>Digital input/output DIO2 inverted</td><td>17</td></tr>
<tr><td></td><td>Other [bit]</td><td>Source selection (see Terms and abbreviations on page 187).</td><td>-</td></tr>
</table>

No.	Name/Value	Description	Def/FbEq16
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* 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
	0...18000 rpm	Speed reference scaling in Handmooring mode.	1 = 1 rpm
74.84	*Handmooring max speed lower set 1*	Defines speed reference scaling in Handmooring mode (lower direction) when selected with parameter *74.81 Handmooring max speed sel 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
	0...18000 rpm	Speed reference scaling in Handmooring mode.	1 = 1 rpm
74.85	*Handmooring max speed heave set 2*	See description of parameter *74.83 Handmooring max speed sel in 1*.	1500
	0...18000 rpm	Speed reference scaling in Handmooring mode.	1 = 1 rpm
74.86	*Handmooring max speed lower set 2*	See description of parameter *74.84 Handmooring max speed sel in 2*.	1500
	0...18000 rpm	Speed reference scaling in Handmooring mode.	1 = 1 rpm
74.87	*Handmooring max speed heave set 3*	See description of parameter *74.83 Handmooring max speed sel in 1*.	1500
	0...18000 rpm	Speed reference scaling in Handmooring mode.	1 = 1 rpm
74.88	*Handmooring max speed lower set 3*	See description of parameter *74.84 Handmooring max speed sel in 2*.	1500
	0...18000 rpm	Speed reference scaling in Handmooring mode.	1 = 1 rpm

No.	Name/Value	Description	Def/FbEq16
74.89	*Torque high status word*	Torque high status word. Displays the status of high torque supervision functions for different control modes.	0b0000

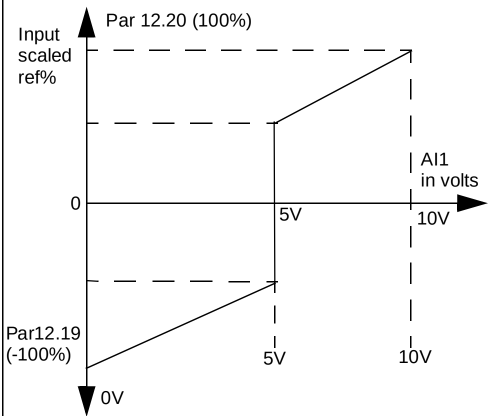
Bit	Name	Description
0	Handmooring high torque warning	1 = High torque warning condition detected in Handmooring mode. 0 = No warning condition
1	Handmooring high torque fault	1 = High torque active fault in Handmooring mode. 0 = No high torque fault in Handmooring mode.
2	Automooring high torque warning	1 = High torque warning condition detected in Automooring mode. 0 = No warning condition
3	Automooring high torque fault	1 = High torque active fault in automooring mode. 0 = No high torque fault in automooring mode.
4	Anchor mode high torque warning	1 = High torque warning condition detected in anchor mode. 0 = No warning condition
5	Anchor mode high torque fault	1 = High torque active fault in anchor mode. 0 = No high torque fault in anchor mode.
6...15	Reserved	

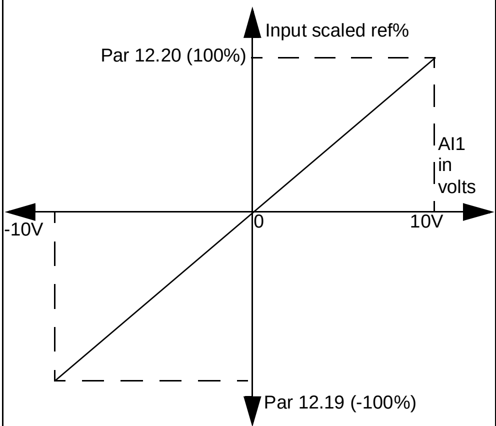
No.	Name/Value	Description	Def/FbEq16
	0b0000...0b1111	Torque high status word	1 = 1
74.90	*Handmooring high torque level supervision*	Activates handmooring high torque level supervision function. It also defines the function behavior if supervision conditions are fulfilled. The supervision function 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*
	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.	300.0
	0.0...600.0%	Handmooring high torque level limit	10 = 1%
74.92	*Handmooring high torque level delay*	Defines delay time for handmooring high torque level supervision function.	5.0 s
	0.0...1800.0 s	Handmooring high torque level delay time	10 = 1 s
74.95	*Automooring high torque level supervision*	Activates automooring 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 automooring mode and defines a reaction if torque level is higher than the Automooring high torque level limit (*74.96*) for the defined delay time (*74.97*).	*Not used*
	Not used	Function not used/disabled	0
	Warning	Function triggers the warning *D208 High automooring torque level*.	1

No.	Name/Value	Description	Def/FbEq16
	Fault	Function triggers the fault *D10B High automooring torque level*.	2
74.96	*Automooring high torque level limit*	Defines torque level limit for automooring high torque level supervision function.	300.0
	0.0...600.0%	Automooring high torque level limit	10 = 1%
74.97	*Automooring high torque level delay*	Defines delay time for automooring high torque level supervision function.	5.0 s
	0.0...1800.0 s	Automooring high torque level delay time	10 = 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 automooring high torque level limit (*74.101*) for the defined delay time (*74.102*).	*Not used*
	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.	300.0
	0.0...600.0%	Anchor high torque level limit	10 = 1%
74.102	*Anchor high torque level delay*	Defines delay time for anchor high torque level supervision function.	5.0 s
	0.0...1800.0 s	Anchor high torque level delay time	10 = 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%
	0.0...600.0%	Abnormal torque level	10 = 1%

75 Winch interface		Winch control stand configuration. See section *Winch control interface* on page *41*.	
75.01	*Control stand fault reset enable*	Activates automatic fault reset command after 5 seconds at every control stand selection.	*Disable*
	Disable	Auto fault reset command is disabled.	0
	Enable	Auto fault reset command is enabled.	1
	Other [bit]	Source selection (see *Terms and abbreviations* on page *187*).	-
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*
	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.	Name/Value	Description	Def/FbEq16
	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*
	Override old	No control stand has priority. A control stand can take over control from any other stand during run. Example: 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/lowers the 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
	Ignore new	Active control stand has the priority and control cannot be taken from that control stand. Example: 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

No.	Name/Value	Description	Def/FbEq16
75.04	*Control stand joystick mode*	Selects the type of control stand joystick AI signal.	*Unipolar*
	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/Value	Description	Def/FbEq16
	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
75.10	*Control stand 1 enable*	Selects the source for enabling control stand 1.	*DI1*
	FALSE	0	0
	TRUE	1	1
	DI1	Digital input DI1	2
	DI2	Digital input DI2	3
	DI3	Digital input DI3	4
	DI4	Digital input DI4	5
	DI5	Digital input DI5	6
	DI6	Digital input DI6	7
	DIO1	Digital input/output DIO1	8
	DIO2	Digital input/output DIO2	9
	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]	Source selection (see *Terms and abbreviations* on page *187*).	-

No.	Name/Value	Description	Def/FbEq16
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*
	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]	Source selection (see *Terms and abbreviations* on page *187*).	-
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*
	FALSE	0	0
	TRUE	1	1
	DI1	Digital input DI1	2
	DI2	Digital input DI2	3
	DI3	Digital input DI3	4
	DI4	Digital input DI4	5
	DI5	Digital input DI5	6
	DI6	Digital input DI6	7
	DIO1	Digital input/output DIO1	8
	DIO2	Digital input/output DIO2	9
	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]	Source selection (see *Terms and abbreviations* on page *187*).	-

No.	Name/Value	Description	Def/FbEq16
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*
	FALSE	0	0
	TRUE	1	1
	DI1	Digital input DI1	2
	DI2	Digital input DI2	3
	DI3	Digital input DI3	4
	DI4	Digital input DI4	5
	DI5	Digital input DI5	6
	DI6	Digital input DI6	7
	DIO1	Digital input/output DIO1	8
	DIO2	Digital input/output DIO2	9
	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]	Source selection (see *Terms and abbreviations* on page *187*).	-
75.14	*Control stand 2 enable*	See parameter *75.10 Control stand 1 enable*.	*FALSE*
75.15	*Control stand 2 reference*	See parameter *75.11 Control stand 1 reference*.	*Not selected*
75.16	*Control stand 2 heave*	See parameter *75.12 Control stand 1 heave*.	*FALSE*
75.17	*Control stand 2 lower*	See parameter *75.13 Control stand 1 lower*.	*FALSE*
75.18	*Control stand 3 enable*	See parameter *75.10 Control stand 1 enable*.	*FALSE*
75.19	*Control stand 3 reference*	See parameter *75.11 Control stand 1 reference*.	*Not selected*
75.20	*Control stand 3 heave*	See parameter *75.12 Control stand 1 heave*.	*FALSE*
75.21	*Control stand 3 lower*	See parameter *75.13 Control stand 1 lower*.	*FALSE*
75.22	*Include FB control stand*	Enables the fieldbus stand to participate in the control stand logic.	*No*
	No	Fieldbus control stand is not used.	0
	Yes	Fieldbus control stand is used.	1
	Other [bit]	Source selection (see *Terms and abbreviations* on page *187*).	-

No.	Name/Value	Description	Def/FbEq16
75.23	*Multi FB stand enable*	Enables multiple fieldbus stand to participate in the control stand logic.	*Winch FB CW bitEnable*
	FALSE	0	0
	TRUE	1	1
	Winch FB CW bitEnable	Parameter *09.09 Winch FB control word*, bit 0 activated. to do: new (check description)	2
	Winch FB CW bitHeave	Parameter *09.09 Winch FB control word*, bit 1 activated. to do: new (check description)	3
	Winch FB CW bitLower	Parameter *09.09 Winch FB control word*, bit 2 activated. to do: new (check description)	4
	Other [bit]	Source selection (see *Terms and abbreviations* on page *187*).	-
75.24	*Multi FB reference*	Selects a multiple fieldbus reference to participate in the control stand logic.	*FB A ref 2*
	Not selected	0	0
	FB A ref 1	Fieldbus adapter A reference 1 type selected. to do: new (check description)	1
	FB A ref 2	Fieldbus adapter A reference 2 type selected. to do: new (check description)	2
	FB B ref 1	Fieldbus adapter B reference 1 type selected. to do: new (check description)	3
	FB B ref 2	Fieldbus adapter B reference 2 type selected. to do: new (check description)	4
	Other [bit]	Source selection (see *Terms and abbreviations* on page *187*).	-
75.25	*Multi FB heave*	Enables multiple fieldbus stand to participate in the heave logic.	*Winch FB CW bitHeave*
	FALSE	0	0
	TRUE	1	1
	Winch FB CW bitEnable	Parameter *09.09 Winch FB control word*, bit 0 activated. to do: new (check description)	2
	Winch FB CW bitHeave	Parameter *09.09 Winch FB control word*, bit 1 activated. to do: new (check description)	3
	Winch FB CW bitLower	Parameter *09.09 Winch FB control word*, bit 2 activated. to do: new (check description)	4
	Other [bit]	Source selection (see *Terms and abbreviations* on page *187*).	-
75.26	*Multi FB lower*	Enables multiple fieldbus stand to participate in the lower logic.	*Winch FB CW bitLower*
	FALSE	0	0
	TRUE	1	1
	Winch FB CW bitEnable	Parameter *09.09 Winch FB control word*, bit 0 activated. to do: new (check description)	2
	Winch FB CW bitHeave	Parameter *09.09 Winch FB control word*, bit 1 activated. to do: new (check description)	3

No.	Name/Value	Description	Def/FbEq16
	Winch FB CW bitLower	Parameter *09.09 Winch FB control word*, bit 2 activated. to do: new (check description)	4
	Other [bit]	Source selection (see *Terms and abbreviations* on page *187*).	-
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*. See section *Step reference selection* on page *44*.	*FALSE*
	FALSE	0	0
	TRUE	1	1
	DI1	Digital input DI1	2
	DI2	Digital input DI2	3
	DI3	Digital input DI3	4
	DI4	Digital input DI4	5
	DI5	Digital input DI5	6
	DI6	Digital input DI6	7
	DIO1	Digital input/output DIO1	8
	DIO2	Digital input/output DIO2	9
	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]	Source selection (see *Terms and abbreviations* on page *187*).	-
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*
75.34	*Step reference 1*	Defines the step reference speed 1 in percentage of absolute maximum speed.	50.00
	0.00...100.00%	Step reference 1.	100 = 1%
75.35	*Step reference 2*	Defines the step reference speed 2 in percentage of absolute maximum speed.	70.00
	0.00...100.00%	Step reference 2	100 = 1%
75.36	*Step reference 3*	Defines the step reference speed 3 in percentage of absolute maximum speed.	100.00
	0.00...100.00%	Step reference 3.	100 = 1%

No.	Name/Value	Description	Def/FbEq16
76	***Automooring***	Settings for Automooring. See section *Automooring* on page *58*.	
76.01	*Automooring mode*	Selects the Automooring mode. See section *Automooring* on page *58*.	*Not used*
	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-mooring 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 Automooring setpoint.	3
	Continuous + Time control	The drive initially performs Continuous Automooring for a predefined time and then internally switches to Time control Automooring 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 Automooring *On*, in continuous Automooring mode, as a parallel functionality with the time control or load-cell Automooring mode. In special cases, this can be used as an emergency mode for starting Automooring.	*Disabled*
	Disabled	0	0
	Enabled	1	1
	DI1	Digital input DI1	2
	DI2	Digital input DI2	3
	DI3	Digital input DI3	4
	DI4	Digital input DI4	5
	DI5	Digital input DI5	6
	DI6	Digital input DI6	7
	DIO1	Digital input/output DIO1	8
	DIO2	Digital input/output DIO2	9
	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]	Source selection (see *Terms and abbreviations* on page *187*).	-
76.03	*Automooring style*	Selects the overall style of Automooring operation. See section *Automooring* on page *58*.	*AM Style 1*
	AM Style 1	This is classic ACS800 style of Automooring.	0

No.	Name/Value	Description	Def/FbEq16
	AM Style 2	In this method, the Automooring speed reference is varied linearly inside deadband zone until Inzone 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.	0b0000

Bit	Name	Description
0	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*.
1	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.
2	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.
3	AM flash fast at remooring 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.
4	AM flash medium at minimum 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.
5	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.
6	AM load cell enable limit check	0 = Automooring starts when load cell tension is outside hysteresis limits. 1 = Automooring starts when the drive switches from Handmooring to Automooring mode and if the load cell tension is within hysteresis limits.
7	AM adaptive start torque limit	0 = Brake open torque and torque proving reference are not limited by the active Automooring setpoint. 1 = Brake open torque and torque proving reference are limited by the active Automooring setpoint. That is, if the value of brake open torque selected with parameter *44.200* is greater than active Automooring setpoint, then the brake open torque is limited to Automooring setpoint. **Note:** This limitation is valid only in Automooring mode.
8…15	Reserved	

	0b0000...0b1111	Automooring config word.	

No.	Name/Value	Description	Def/FbEq16
76.05	*Automooring min tension*	Defines the minimum Automooring level (%); the rope tension level that must be present before Automooring 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
	0.0...100.0%	Automooring minimum start tension.	10 = 1%
76.06	*AM min protection mode*	Selects the mode of Automooring minimum level protection.	*Not used*
	Not used	No action is taken. The protection is disabled and Automooring started in all conditions.	0
	Always enabled	The protection is enabled in all conditions (after power *ON*, at start and between re-mooring times).	1
	Only at AM start	The protection is active only at start and not between re-mooring times.	2
	Limited nbr of starts	The protection is enabled and when the protection becomes active, the drive is started again after the re-mooring 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 Automooring min tension*.	*Warning*
	Warning	The drive generates a warning when the protection becomes active.	0
	Fault	The drive trips on fault when the protection becomes active.	1
	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 re-mooring delay. • In load cell mode, the drive remains stopped until the actual rope tension remains below minimum level.	2
76.09	*Automooring winch capacity*	Defines the additional scaling for parameter *74.44 Automooring max torque* and for Automooring 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 Automooring setpoint1* is set to 10%, then the final winch capacity will be 31 Nm for a motor with nominal torque (par.*01.30*) = 620 Nm.	100.0
	0.1...200.0%	Automooring winch capacity in percent.	10 = 1%
76.10	*Tension feedback source*	Defines the source for load feedback (rope tension sensor).	*Internal DTC*
	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

No.	Name/Value	Description	Def/FbEq16
	Other [bit]	Source selection (see *Terms and abbreviations* on page *187*).	-
76.11	*Min automooring setpoint level*	Defines the minimum Automooring set point level (%) that can be used. This parameter is a limitation to the Automooring set point if an external reference source is used.	0.0
	0.0...100.0%	Minimum Automooring set point level in percent.	10 = 1%
76.12	*Max automooring setpoint level*	Defines the maximum Automooring set point level (%) that can be used. This parameter is a limitation to the Automooring set point if an external reference source is used.	100.0
	0.0...300.0%	Maximum Automooring set point level in percent.	10 = 1%
76.13	*Automooring setpoint selection*	Selects the source for Automooring set point, that is, the torque limitation of the speed controller. Automooring set point is the rope tension reference.	*Setpoint 1*
	Not selected	No source is selected.	0
	AI1 scaled	The scaled value of external signal connected to AI1 is the source for Automooring set point.	1
	AI2 scaled	The scaled value of external signal connected to AI2 is the source for Automooring set point.	2
	Setpoint 1	The value in parameter *76.14 Automooring setpoint1* is the source for Automooring set point.	3
	Setpoint 2	The value in parameter *76.15 Automooring setpoint2* is the source for Automooring set point.	4
	Setpoint 3	The value in parameter *76.16 Automooring setpoint3* is the source for Automooring set point.	5
	Setpoint 4	The value in parameter *76.17 Automooring setpoint4* is the source for Automooring set point.	6
	Setpoint 5	The value in parameter *76.18 Automooring setpoint5* is the source for Automooring set point.	7
	AM setpoint switch output	The value in parameter *09.30 AM setpoint switch output* is the source for Automooring 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 Automooring setpoint. The rate of change of setpoint is set by parameter *76.71 AM motpot ramp time*.	9
	Other [bit]	Source selection (see *Terms and abbreviations* on page *187*).	-
76.14	*Automooring setpoint1*	Defines the constant value for Automooring setpoint1, that is, the torque limitation of the speed controller. Automooring set point is the rope tension reference.	20.0
	0.0...300.0%	Automooring set point in percent.	10 = 1%
76.15	*Automooring setpoint2*	Defines the constant value for Automooring setpoint2, that is, the torque limitation of the speed controller. Automooring set point is the rope tension reference.	40.0
	0.0...300.0%	Automooring set point in percent.	10 = 1%
76.16	*Automooring setpoint3*	Defines the constant value for Automooring setpoint3, that is, the torque limitation of the speed controller. Automooring set point is the rope tension reference.	60.0

<table>
<tr><th>No.</th><th>Name/Value</th><th>Description</th><th>Def/FbEq16</th></tr>
<tr><td></td><td>0.0...300.0%</td><td>Automooring set point in percent.</td><td>10 = 1%</td></tr>
<tr><td>76.17</td><td>Automooring setpoint4</td><td>Defines the constant value for Automooring setpoint4, that is, the torque limitation of the speed controller. Automooring set point is the rope tension reference.</td><td>80.0</td></tr>
<tr><td></td><td>0.0...300.0%</td><td>Automooring set point in percent.</td><td>10 = 1%</td></tr>
<tr><td>76.18</td><td>Automooring setpoint5</td><td>Defines the constant value for Automooring setpoint5, that is, the torque limitation of the speed controller. Automooring set point is the rope tension reference.</td><td>100.0</td></tr>
<tr><td></td><td>0.0...300.0%</td><td>Automooring set point in percent.</td><td>10 = 1%</td></tr>
<tr><td>76.19</td><td>AM setpoint ref ramp</td><td>Defines ramp time reference for Automooring setpoint.</td><td>0.00</td></tr>
<tr><td></td><td>0.00...30000.00 s</td><td>Automooring setpoint reference ramp time in seconds.</td><td>100 = 1 s</td></tr>
<tr><td>76.20</td><td>AM setpoint selector 1 srcA</td><td>Selects the source for Automooring 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 confC 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 confC 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 confC 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 confC 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 confC bit 5</td></tr>
</table>
</td><td>FALSE</td></tr>
<tr><td></td><td>FALSE</td><td>0</td><td>0</td></tr>
<tr><td></td><td>TRUE</td><td>1</td><td>1</td></tr>
<tr><td></td><td>DI1</td><td>Digital input DI1</td><td>2</td></tr>
<tr><td></td><td>DI2</td><td>Digital input DI2</td><td>3</td></tr>
<tr><td></td><td>DI3</td><td>Digital input DI3</td><td>4</td></tr>
<tr><td></td><td>DI4</td><td>Digital input DI4</td><td>5</td></tr>
<tr><td></td><td>DI5</td><td>Digital input DI5</td><td>6</td></tr>
<tr><td></td><td>DI6</td><td>Digital input DI6</td><td>7</td></tr>
<tr><td></td><td>DIO1</td><td>Digital input/output DIO1</td><td>8</td></tr>
<tr><td></td><td>DIO2</td><td>Digital input/output DIO2</td><td>9</td></tr>
<tr><td></td><td>DI1 inverted</td><td>Digital input DI1 inverted</td><td>10</td></tr>
<tr><td></td><td>DI2 inverted</td><td>Digital input DI2 inverted</td><td>11</td></tr>
<tr><td></td><td>DI3 inverted</td><td>Digital input DI3 inverted</td><td>12</td></tr>
<tr><td></td><td>DI4 inverted</td><td>Digital input DI4 inverted</td><td>13</td></tr>
</table>

No.	Name/Value	Description	Def/FbEq16
	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]	Source selection (see *Terms and abbreviations* on page *187*).	-
76.21	*AM setpoint selector 1 srcB*	See parameter *76.20 AM setpoint selector 1 srcA*.	*FALSE*
76.22	*AM setpoint selector 1 srcC*	See parameter *76.20 AM setpoint selector 1 srcA*.	*FALSE*
76.23	*AM setpoint selector 2 srcA*	See parameter *76.20 AM setpoint selector 1 srcA*.	*FALSE*
76.24	*AM setpoint selector 2 srcB*	See parameter *76.20 AM setpoint selector 1 srcA*.	*FALSE*
76.25	*AM setpoint selector 2 srcC*	See parameter *76.20 AM setpoint selector 1 srcA*.	*FALSE*
76.26	*AM setpoint selector 3 srcA*	See parameter *76.20 AM setpoint selector 1 srcA*.	*FALSE*
76.27	*AM setpoint selector 3 srcB*	See parameter *76.20 AM setpoint selector 1 srcA*.	*FALSE*
76.28	*AM setpoint selector 3 srcC*	See parameter *76.20 AM setpoint selector 1 srcA*.	*FALSE*
76.30	*Hysteresis high level*	Defines the Automooring hysteresis high; triggering level to start Automooring 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 Automooring mode (parameter *76.01 Automooring mode*). The final calculated value is shown in parameter *09.26 AM hysteresis high used*.	20.0
	0.0...100.0%	Value of limit in percent of Automooring set point value.	10 = 1%
76.31	*Hysteresis low level*	Defines the Automooring hysteresis low; triggering level to start Automooring 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 Automooring mode (parameter *76.01 Automooring mode*). The final calculated value is shown in parameter *09.27 AM hysteresis low used*.	20.0
	0.0...100.0%	Value of limit in percent of Automooring set point value.	10 = 1%
76.32	*Deadband high level*	Defines the Automooring dead band high; triggering level to stop Automooring after in-zone delay (parameter *76.34 In zone time delay*). This parameter is valid in the time-control or load-cell Automooring mode (parameter *76.01 Automooring mode*). The final calculated value is shown in parameter *09.28 AM deadband high used*.	10.0
	0.0...100.0%	Deadband high level in percent.	10 = 1%

No.	Name/Value	Description	Def/FbEq16
76.33	*Deadband low level*	Defines the Automooring dead band low; triggering level to stop Automooring after in-zone delay (parameter *76.34 In zone time delay*). This parameter is valid in the time-control or load-cell Automooring mode (parameter *76.01 Automooring mode*). The final calculated value is shown in parameter *09.29 AM deadband low used*.	10.0
	0.0...100.0%	Deadband low level	10 = 1%
76.34	*In zone time delay*	Defines the time delay before Automooring is stopped in case the Automooring dead band level is reached. This parameter is valid in the time-control or load-cell Automooring mode (parameter *76.01 Automooring mode*).	10
	0...3600 s	In zone time delay in seconds.	1 = 1 s
76.35	*Out zone time delay*	Defines the time delay before Automooring 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
	0...3600 s	Out zone time delay in seconds.	1 = 1 s
76.40	*Torque measuring mode*	Selects the mode for rope tension measurement in time control Automooring mode.	*Standstill mode*
	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
	0...3600 s	Torque measuring time in seconds.	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
	0...3600 rpm	Rotating mode speed in rpm.	1 = 1 rpm

No.	Name/Value	Description	Def/FbEq16
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
	0...3600 s	Rotating mode time in rpm.	1 = 1 s
76.44	*Torque 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*
	Average in out torq	The average torque measured during forward and reverse rotating cycle is the actual rope tension.	
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 Automooring mode*). During this time, the drive/motor is stopped and the mechanical brake is closed.	1.0
	0.0...3600.0 min	Re-mooring time interval 1.	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 Automooring mode*). During this time, the drive/motor is stopped and the mechanical brake is closed.	3.0
	0.0...3600.0 min	Re-mooring time interval 2.	1 = 1 min
76.52	*Re-mooring time 1/2 switch src*	Defines the source for Re-mooring time interval in time control Automooring mode. False = Re-mooring time 1 True = Re-mooring time 2	*Re-mooring time 1*
	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	3
	DI2	Digital input DI2	4
	DI3	Digital input DI3	5
	DI4	Digital input DI4	6
	DI5	Digital input DI5	7
	DI6	Digital input DI6	8
	DIO1	Digital input/output DIO1	9

No.	Name/Value	Description	Def/FbEq16
	DIO2	Digital input/output DIO2	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]	Source selection (see *Terms and abbreviations* on page *187*).	-
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
	0.0...3600.0 min	Re-mooring switchover time 1/2.	1 = 1 min
76.54	*Re-mooring wakeup level*	Change in Automooring setpoint is needed to restart the Automooring 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
	0.0...100.0%	Re-mooring wakeup level.	10 = 1%
76.55	*Cont to Time switch src*	Selects the source for switching to Time control mode from Continuous mode when Automooring mode is set to Continuous + Time control in parameter *76.01 Automooring mode*.	*Switchover timer*
	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	4
	DI2	Digital input DI2	5
	DI3	Digital input DI3	6
	DI4	Digital input DI4	7
	DI5	Digital input DI5	8
	DI6	Digital input DI6	9
	DIO1	Digital input/output DIO1	10
	DIO2	Digital input/output DIO2	11
	DI1 inverted	Digital input DI1 inverted	12
	DI2 inverted	Digital input DI2 inverted	13
	DI3 inverted	Digital input DI3 inverted	14

No.	Name/Value	Description	Def/FbEq16
	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]	Source selection (see *Terms and abbreviations* on page *187*).	-
76.56	*Cont to Time switchover time*	Defines the time that need to elapse before Automooring switches to Time control mode from the initial Continuous mode. This time is effective only when parameter *76.01 Automooring mode* is set to Time control + Continuous.	15.0
	0.0...3600.00 min	Continuous mode to Time mode switchover time.	1 = 1 min
76.60	*Max AM time*	Defines the maximum running time for the drive/motor. The value is used in protection against an abnormal Automooring 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
	0.0...3600.0 min	Max Automooring time.	1 = 1 min
76.61	*Max AM timeout function*	Selects the protection action when the maximum Automooring time (parameter *76.60 Max AM time*) is reached.	*Not used*
	Not used	No action is taken.	0
	Stop	Protection is enabled. The drive is stopped and the mechanical brake is closed when the maximum mooring time (parameter *76.60 Max AM time*) is reached. The drive is started again after the re-mooring delay (parameter *76.50 Re-mooring 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
	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
	0.0...600.0%	Load cell high start limit.	1 = 1%
76.70	*AM motpot force init*	When source selected with this parameter is *ON*, the Automooring setpoint is forced to the value in parameter *76.14 Automooring setpoint1*. This parameter is effective only when *76.13 Automooring setpoint selection* is set to Joystick motpot.	*FALSE*
	FALSE	0	0
	TRUE	1	1
	DI1	Digital input DI1	2
	DI2	Digital input DI2	3
	DI3	Digital input DI3	4
	DI4	Digital input DI4	5

No.	Name/Value	Description	Def/FbEq16
	DI5	Digital input DI5	6
	DI6	Digital input DI6	7
	DIO1	Digital input/output DIO1	8
	DIO2	Digital input/output DIO2	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]	Source selection (see *Terms and abbreviations* on page *187*).	-
76.71	*AM motpot ramp time*	Defines the change rate of the Automooring setpoint when joystick motpot is used to vary the Automooring setpoint. This parameter specifies the time required for the setpoint to change from minimum (parameter *76.11 Min automooring setpoint level*) to maximum (*76.12 Max automooring setpoint level*). The same change rate applies in both directions.	60.0
	0.0...3600.0 s	Automooring motpot ramp time.	1 = 1 s
76.72	*AM motpot init function*	Defines an initial value (starting point) for the Automooring setpoint on a mode change or power cycle. This parameter is effective only when *76.13 Automooring setpoint selection* is set to Joystick motpot.	*Min automooring setpoint*
	Min automooring setpoint	The initial value is the value set in parameter *76.11 Min automooring setpoint level*.	0
	Current rope tension	The initial value is the value stored in parameter *09.24 Rope tension memorized*.	1
	Last automooring setpoint	The initial value is the Automooring setpoint used during the previous Automooring cycle.	2
	Setpoint 1	The initial value is the value set in parameter *76.14 Automooring setpoint1*.	3

No.	Name/Value	Description	Def/FbEq16
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* (page *488*) 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.	

Bit	Name	Description
0	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.
1	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.
2	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.
3	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.
4	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.
5	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.
6...15	Reserved	

No.	Name/Value	Description	Def/FbEq16
76.76	*AM setpoint selector conf B*	Specifies the configuration word which allows the truth table in parameter *76.20 AM setpoint selector 1 srcA* (page *488*) 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.	

Bit	Name	Description
0	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.
1	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.
2	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.
3	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.
4	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.
5	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.
6...15	Reserved	

No.	Name/Value	Description	Def/FbEq16
76.77	*AM setpoint selector conf C*	Specifies the configuration word which allows the truth table in parameter *76.20 AM setpoint selector 1 srcA* (page *488*) 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.	

Bit	Name	Description
0	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.
1	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.
2	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.
3	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.
4	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.
5	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.
6...15	Reserved	

No.	Name/Value	Description	Def/FbEq16
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*
	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
	0...65535 s	Motoring power limit for handmooring.	1 = 1 s

No.	Name/Value	Description	Def/FbEq16
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
	0...30000	Automooring minimum protection maximum start.	1 = 1
77 Anchor stowing protection		Settings for anchor stowing protection. See section *Anchor stowing protection* on page *50*.	
77.01	*Anchor protection enable*	Enables/disables the anchor stowing protection. The function is used to decrease winching speed as the anchor is approaching its stowing position. The function is based on position measurement of the anchor as well as actual speed and torque, or a proximity switch. When the chain/rope length (*09.13 Chain length OUT*) reaches a pre-set limit (parameter *77.06 Activation chain length*), the speed reference is multiplied by the value of parameter *77.08 Limited max speed* and new (lower) torque limit (*77.07 Limited max torque*) is applied. When the source selected with this parameter is ON, and EXT2 is selected as control location, anchor stowing protection is in use.	*Disabled*
	Disabled	0	0
	Enabled	1	1
	In anchor mode	Enables anchor stowing protection when the anchoring mode is active. See parameters *74.01 Anchor mode enable* and *09.01 Winch status word 1*, bit 0.	2
	DI1	Digital input DI1	3
	DI2	Digital input DI2	4
	DI3	Digital input DI3	5
	DI4	Digital input DI4	6
	DI5	Digital input DI5	7
	DI6	Digital input DI6	8
	DIO1	Digital input/output DIO1	9
	DIO2	Digital input/output DIO2	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

No.	Name/Value	Description	Def/FbEq16
	Other [bit]	Source selection (see *Terms and abbreviations* on page*187*).	-
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*
	Disabled	0	0
	Enabled	1	1
	DI1	Digital input DI1	2
	DI2	Digital input DI2	3
	DI3	Digital input DI3	4
	DI4	Digital input DI4	5
	DI5	Digital input DI5	6
	DI6	Digital input DI6	7
	DIO1	Digital input/output DIO1	8
	DIO2	Digital input/output DIO2	9
	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]	Source selection (see *Terms and abbreviations* on page*187*).	-
77.03	*Disable time*	See parameter *77.02 Disable function*.	0.0
	0.0...3600.0 s	Disable time.	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*
	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*
	Heave	Anchor stowing protection is active only in the heave direction.	0
	Lower	Anchor stowing protection is active only in the lower direction.	1

No.	Name/Value	Description	Def/FbEq16
	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*.	4000.0
	-1000000.0... 1000000.0 mm	Protection activation chain length.	10 = 1 mm
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* has priority over this parameter.	100.0
	0.0...300.0%	Limited maximum torque.	10 = 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
	0.0...300.0%	Limited maximum speed	10 = 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
	0.00...1800.00 s	Acceleration time in protection.	10 = 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
	0.00...1800.00 s	Deceleration time in protection.	10 = 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*
	FALSE	0	0
	TRUE	1	1
	DI1	Digital input DI1	2
	DI2	Digital input DI2	3
	DI3	Digital input DI3	4
	DI4	Digital input DI4	5
	DI5	Digital input DI5	6
	DI6	Digital input DI6	7
	DIO1	Digital input/output DIO1	8
	DIO2	Digital input/output DIO2	9
	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/Value	Description	Def/FbEq16
	DIO1 inverted	Digital input/output DIO1 inverted	16
	DIO2 inverted	Digital input/output DIO2 inverted	17
	Other [bit]	Source selection (see *Terms and abbreviations* on page*187*).	-
78 Slip detection		Settings for slip detection. See section *Slip detection* on page *75*.	
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 *78.08 Activation torque 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*
	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	3
	DI2	Digital input DI2	4
	DI3	Digital input DI3	5
	DI4	Digital input DI4	6
	DI5	Digital input DI5	7
	DI6	Digital input DI6	8
	DIO1	Digital input/output DIO1	9
	DIO2	Digital input/output DIO2	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

No.	Name/Value	Description	Def/FbEq16
	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]	Source selection (see *Terms and abbreviations* on page*187*).	-
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*
	Disabled	0	0
	Enabled	1	1
	DI1	Digital input DI1	2
	DI2	Digital input DI2	3
	DI3	Digital input DI3	4
	DI4	Digital input DI4	5
	DI5	Digital input DI5	6
	DI6	Digital input DI6	7
	DIO1	Digital input/output DIO1	8
	DIO2	Digital input/output DIO2	9
	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]	Source selection (see *Terms and abbreviations* on page*187*).	-
78.03	*Disable time*	See parameter *78.02 Disable function*.	0.0
	0.0...3600.0 s	Disable time.	1 = 1 s
78.04	*Slip detection mode*	Defines the mode of slip detection function.	*Internal*
	Internal	Slip detection is based on parameters *78.05 Activation speed direction* to *78.08 Activation torque limit*.	0
	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*
	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

No.	Name/Value	Description	Def/FbEq16
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*.	10.00
	0.00... 18000.00 mm/s	Activation chain/rope speed limit.	1 = 1 mm/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
	0.0...18000.0 rpm	Activation drive speed limit.	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
	0.0...300.0%	Activation torque limit.	10 = 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
	0.0...3600.0 s	Activation delay time.	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
	0.0...300.0%	Limited max speed.	10 = 1%
78.11	*Slip external detection*	Selects the source for external detection of slippage.	*FALSE*
	FALSE	0	0
	TRUE	1	1
	DI1	Digital input DI1	2
	DI2	Digital input DI2	3
	DI3	Digital input DI3	4
	DI4	Digital input DI4	5
	DI5	Digital input DI5	6
	DI6	Digital input DI6	7
	DIO1	Digital input/output DIO1	8
	DIO2	Digital input/output DIO2	9
	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]	Source selection (see *Terms and abbreviations* on page*187*).	-

No.	Name/Value	Description	Def/FbEq16
79 Peak torque protection		Settings for peak torque protection. See section on page *Peak torque protection* on page *76*.	
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*
	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	3
	DI2	Digital input DI2	4
	DI3	Digital input DI3	5
	DI4	Digital input DI4	6
	DI5	Digital input DI5	7
	DI6	Digital input DI6	8
	DIO1	Digital input/output DIO1	9
	DIO2	Digital input/output DIO2	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]	Source selection (see *Terms and abbreviations* on page *187*).	-
79.02	*Activation speed direction*	Selects the running direction in which peak torque protection is active.	*Heave*
	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
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
	0.0...300.0%	Activation torque limit.	10 = 1%

No.	Name/Value	Description	Def/FbEq16
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
	0...18000 rpm	Activation speed limit.	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
	0.00...3600.00 s	Deceleration time to protection speed.	10 = 1 s
79.06	*Limited max speed*	Speed reference multiplier applied by the drive when peak torque protection is active.	33.0
	0.0...100.0%	Limited maximum speed.	10 = 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
	0.00...3600.00 s	Deceleration time to zero.	10 = 1 s

80 Power control		Settings for power control. See section *Power control* on page *78*.	
80.01	*Power control enable*	Enables/disables power control pointer.	*Disabled*
	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	4
	DI2	Digital input DI2	5
	DI3	Digital input DI3	6
	DI4	Digital input DI4	7
	DI5	Digital input DI5	8
	DI6	Digital input DI6	9
	DIO1	Digital input/output DIO1	10
	DIO2	Digital input/output DIO2	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

No.	Name/Value	Description	Def/FbEq16
	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]	Source selection (see *Terms and abbreviations* on page*187*).	-
80.02	*Set 1 torque level1*	Torque level for crosspoint 1 in forward operation (heaving the winch). 100% = winch motor nominal torque	0.0
	0.0...3000.0%	Level in percentage	10 = 1%
80.03	*Set 1 torque level2*	Torque level for crosspoint 2 in forward operation (heaving the winch). 100% = winch motor nominal torque	0.0
	0.0...3000.0%	Level in percentage	10 = 1%
80.04	*Set 1 torque level3*	Torque level for crosspoint 3 in forward operation (heaving the winch). 100% = winch motor nominal torque	0.0
	0.0...3000.0%	Level in percentage	10 = 1%
80.05	*Set 1 torque level4*	Torque level for crosspoint 4 in forward operation (heaving the winch). 100% = winch motor nominal torque	0.0
	0.0...3000.0%	Level in percentage	10 = 1%
80.06	*Set 1 torque level5*	Torque level for crosspoint 5 in forward operation (heaving the winch). 100% = winch motor nominal torque	0.0
	0.0...3000.0%	Level in percentage	10 = 1%
80.07	*Set 1 speed level1*	Speed limit for crosspoint 1 in forward operation (heaving the winch).	0.0
	0.0...18000.0 rpm	Speed	1 = 1 rpm
80.08	*Set 1 speed level2*	Speed limit for crosspoint 2 in forward operation (heaving the winch).	0.0
	0.0...18000.0 rpm	Speed	1 = 1 rpm
80.09	*Set 1 speed level3*	Speed limit for crosspoint 3 in forward operation (heaving the winch).	0.0
	0.0...18000.0 rpm	Speed	1 = 1 rpm
80.10	*Set 1 speed level4*	Speed limit for crosspoint 4 in forward operation (heaving the winch).	0.0
	0.0...18000.0 rpm	Speed	1 = 1 rpm
80.11	*Set 1 speed level5*	Speed limit for crosspoint 5 in forward operation (heaving the winch).	0.0
	0.0...18000.0 rpm	Speed	1 = 1 rpm
80.12	*Set 2 torque level1*	Torque level for crosspoint 1 in reverse operation (lowering the winch). 100% = winch motor nominal torque	0.0
	0.0...3000.0%	Level in percentage	10 = 1%

No.	Name/Value	Description	Def/FbEq16
80.13	*Set 2 torque level2*	Torque level for crosspoint 2 in reverse operation (lowering the winch). 100% = winch motor nominal torque	0.0
	0.0...3000.0%	Level in percentage	10 = 1%
80.14	*Set 2 torque level3*	Torque level for crosspoint 3 in reverse operation (lowering the winch). 100% = winch motor nominal torque	0.0
	0.0...3000.0%	Level in percentage	10 = 1%
80.15	*Set 2 torque level4*	Torque level for crosspoint 4 in reverse operation (lowering the winch). 100% = winch motor nominal torque	0.0
	0.0...3000.0%	Level in percentage	10 = 1%
80.16	*Set 2 torque level5*	Torque level for crosspoint 5 in reverse operation (lowering the winch). 100% = winch motor nominal torque	0.0
	0.0...3000.0%	Level in percentage	10 = 1%
80.17	*Set 2 speed level1*	Speed limit for crosspoint 1 in reverse operation (lowering the winch).	0.0
	0.0...18000.0 rpm	Speed	1 = 1 rpm
80.18	*Set 2 speed level2*	Speed limit for crosspoint 2 in reverse operation (lowering the winch).	0.0
	0.0...18000.0 rpm	Speed	1 = 1 rpm
80.19	*Set 2 speed level3*	Speed limit for crosspoint 3 in reverse operation (lowering the winch).	0.0
	0.0...18000.0 rpm	Speed	1 = 1 rpm
80.20	*Set 2 speed level4*	Speed limit for crosspoint 4 in reverse operation (lowering the winch).	0.0
	0.0...18000.0 rpm	Speed	1 = 1 rpm
80.21	*Set 2 speed level5*	Speed limit for crosspoint 5 in reverse operation (lowering the winch).	0.0
	0.0...18000.0 rpm	Speed	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	15.0
	0.0...18000.0%	Percentage	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	15.0
	0.0...18000.0%	Percentage	1 = 1%
80.24	*Power control filter time*	Power control filter for signal *09.21 Power control ref* to avoid oscillations between crosspoints.	0.000
	0.000...35.000 s	Filter time for signal *09.21 Power control ref*.	100 = 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
	0.00...100.00%	Power control hysteresis	100 = 1%

No.	Name/Value	Description	Def/FbEq16
80.26	*Torque acc time*	Defines torque acceleration time.	10.00
	0.00...30000.00 s	Torque acceleration time in seconds.	100 = 1 s
80.27	*Torque dec time*	Defines torque deceleration time.	10.00
	0.00...30000.00 s	Torque deceleration time in seconds.	100 = 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*
	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	4
	DI2	Digital input DI2	5
	DI3	Digital input DI3	6
	DI4	Digital input DI4	7
	DI5	Digital input DI5	8
	DI6	Digital input DI6	9
	DIO1	Digital input/output DIO1	10
	DIO2	Digital input/output DIO2	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]	Source selection (see *Terms and abbreviations* on page*187*).	-
80.31	*Torque source*	Selects the source of torque reference used in power control against the crosspoints.	*Not selected*
	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
	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*.	2
	Other [bit]	Source selection (see *Terms and abbreviations* on page*187*).	-

No.	Name/Value	Description	Def/FbEq16
81 Winch system check		Settings for torque proving and brake slip detection. See sections *Brake system checks – Torque proving* and *Brake system checks – Brake slip* on page *103*.	
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*
	Disabled	0	0
	Enabled	1	1
	DI1	Digital input DI1	2
	DI2	Digital input DI2	3
	DI3	Digital input DI3	4
	DI4	Digital input DI4	5
	DI5	Digital input DI5	6
	DI6	Digital input DI6	7
	DIO1	Digital input/output DIO1	8
	DIO2	Digital input/output DIO2	9
	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]	Source selection (see *Terms and abbreviations* on page *187*).	-
81.02	*Torque proving reference*	Defines the torque reference during the torque proving test.	30.0
	0.0...100.0%	Torque reference proving percentage	10 = 1%
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
	0.000...10.000 s	Winch system check time	1000 = 1 s

No.	Name/Value	Description	Def/FbEq16
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
	0.0...100.0 rpm	Speed (an absolute value)	10 = 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
	0.000...10.000 s	Time	1000 = 1 s

82 Clutch control		Settings for clutch control.	
82.01	*Clutch control enable*	Enables clutch control.	*Disabled*
	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*, bit 0.	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 Automooring is inactive. See parameters *74.03 Automooring mode enable* and parameter *09.01 Winch status word 1*, bit 2.	7

No.	Name/Value	Description	Def/FbEq16
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 *84.01 Synchro control*. **Note:** This parameter has priority over parameter *84.03 Sync corr mode*.	*Disabled*
	Disabled	0	0
	Enabled	1	1
	DI1	Digital input DI1	2
	DI2	Digital input DI2	3
	DI3	Digital input DI3	4
	DI4	Digital input DI4	5
	DI5	Digital input DI5	6
	DI6	Digital input DI6	7
	DIO1	Digital input/output DIO1	8
	DIO2	Digital input/output DIO2	9
	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]	Source selection (see *Terms and abbreviations* on page *187*).	-
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 *84.01 Synchro control*. **Note:** Parameter *84.02 Synchro sel* has priority over this parameter.	*Disabled*
	Disabled	0	0
	Enabled	1	1
	DI1	Digital input DI1	2
	DI2	Digital input DI2	3
	DI3	Digital input DI3	4
	DI4	Digital input DI4	5
	DI5	Digital input DI5	6
	DI6	Digital input DI6	7
	DIO1	Digital input/output DIO1	8
	DIO2	Digital input/output DIO2	9
	DI1 inverted	Digital input DI1 inverted	10
	DI2 inverted	Digital input DI2 inverted	11
	DI3 inverted	Digital input DI3 inverted	12

No.	Name/Value	Description	Def/FbEq16
	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]	Source selection (see *Terms and abbreviations* on page *187*).	-
82.04	*Clutch control speed 1*	Defines the clutch control speed 1. Positive or negative sign defines direction.	150.0
	-18000... 18000 rpm	Clutch control speed 1	1 = 1 rpm
82.05	*Clutch control speed 2*	Defines the clutch control speed 2. Positive or negative sign defines direction.	-150.0
	-18000... 18000 rpm	Clutch control speed 2	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
	0.0...600.0%	Maximum torque for clutch control.	10 = 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
	0.00...1800.00 s	Clutch acceleration time.	100 = 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
	0.00...1800.00 s	Clutch deceleration time.	100 = 1 s

84 Synchro control		Settings for synchro control. See description on page xx.	
84.01	*Synchro control*	Enables synchro control function.	*Off*
	Off	Synchro control function is disabled.	0
	On	Synchro control function is enabled.	1
	Other [bit]	Source selection (see *Terms and abbreviations* on page *187*).	-
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 *84.01 Synchro control*.	*No*
	No	Synchro selection command is not active.	0
	Select	Synchro selection command is active.	1
	Other [bit]	Source selection (see *Terms and abbreviations* on page *187*).	-

No.	Name/Value	Description	Def/FbEq16
84.03	*Sync corr mode*	Defines the synchronization correction mode used in Synchro command activation with parameter *84.02 Synchro sel*	*Direct*
	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
	0.00... 1000.00 rpm/unit	Correction rate	100 = 1 rpm/unit
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 hysteresys*. 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 hysteresys*).	0.00
	0.00... 32000.00 rpm	Minimum speed for synchro correction.	1 = 1 rpm

No.	Name/Value	Description	Def/FbEq16
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
	0.00...1000.00 unit	Position synchronization error limit.	100 = 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 *84.20 Actual position error* is greater or equal to parameter *84.06 Synchro err limit*.	2.0
	0.0...100.0 s	Synchronization error fault delay.	100 = 1 s
84.08	*Position hysteresys*	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
	0.00...1000.00 unit	Position hysteresis.	100 = 1 unit
84.09	*Position hysteresys 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
	0.00... 32000.00 rpm	Position hysteresis correction speed limit.	1 = 1 rpm
84.11	*Synchro sw*	Displays the status of synchro control function. This parameter is read only.	0b0000

Bit	Name	Value
0	Synchro on	Synchro control function is On.
1	Synchro sel	Synchro control function is selected and position correction logic can modify the speed reference.
2	Synchro fault	Fault condition tripped and still presented due to position difference going beyond limits defined in parameter *84.06 Synchro err limit*.
3…15	Reserved	

No.	Name/Value	Description	Def/FbEq16
	0b0000…0b1111	Synchro status word.	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
	-32000.00... 32000.00 unit	Actual position	100 = 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
	-32000.00... 32000.00 unit	Actual position error	100 = 1 unit

No.	Name/Value	Description	Def/FbEq16
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
	-32000.00... 32000.00 unit	Synchro control target position.	100 = 1 unit
84.22	*Offset value*	Displays the offset value. **Note**: This value can be adjusted manually, when parameter *84.02 Synchro sel* = Select.	0.00
	-32000.00... 32000.00 unit	Offset value.	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
	-32000.00... 32000.00 rpm	Synchro control speed reference correction.	1 = 1 rpm
84.40	*Target position source*	Selects the source of position reference for the synchro control function.	NULL
	NULL	None	0
	AI1	*12.11 AI1 actual value* (page *240*).	1
	AI2	*12.21 AI2 actual value* (page *242*).	2
	Position from D2D master	Value comes from parameter *84.50 Position from D2D master*.	3
	Other [bit]	Source selection (see *Terms and abbreviations* on page *187*).	-
84.50	*Position from D2D master*	Displays the position reference from currently used D2D master. This parameter is read only.	0.00
	-32000.00... 32000.00 unit	Position from D2D master	100 = 1 unit

90 Feedback selection		Motor and load feedback configuration. See also sections *Encoder support* (page *147*) and *Position counter* (page *148*), and the diagram on page *719*.	
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*). This parameter is read-only.	-
	-32768.00 … 32767.00 rpm	Motor speed used for control.	See par. *46.01*

No.	Name/Value	Description	Def/FbEq16
90.02	*Motor position*	Displays the motor position (within one revolution) received from the source selected by parameter *90.41 Motor feedback selection*. In case measured feedback is selected, it is also scaled by the motor gear function (*90.43 Motor gear numerator* and *90.44 Motor gear denominator*). This parameter is read-only.	-
	0.00000000 … 1.00000000 rev	Motor position.	32767 = 1 rev
90.03	*Load speed*	Displays the estimated or measured load speed that is used for motor control, ie. final load speed feedback selected by parameter *90.51 Load feedback selection* and filtered by parameter *90.52 Load speed filter time*. In case measured feedback is selected, it is also scaled by the load gear function (*90.53 Load gear numerator* and *90.54 Load gear denominator*). In case motor feedback or estimated feedback is used, it is inversely scaled by *90.61 Gear numerator* and *90.62 Gear denominator* (ie. *90.62* divided by *90.61*). This parameter is read-only.	-
	-32768.00 … 32767.00 rpm	Load speed.	See par. *46.01*
90.04	*Load position*	Displays the load position received from the source selected by parameter *90.51 Load feedback selection*. The value is multiplied as specified by parameter *90.57 Load position resolution*. In case measured feedback is selected, it is also scaled by the load gear function (*90.53 Load gear numerator* and *90.54 Load gear denominator*). In case motor feedback or estimated feedback is used, it is inversely scaled by *90.61 Gear numerator* and *90.62 Gear denominator* (ie. *90.62* divided by *90.61*). An offset can be defined by *90.56 Load position offset*. This parameter is read-only.	-
	-2147483648 … 2147483647	Load position.	-
90.05	*Load position scaled*	Displays the output of the position counter function. The position is relative to the initial position set by parameters *90.65*…*90.66*. The number of decimal places is defined by parameter *90.38 Pos counter decimals*. **Note:** This is a floating point parameter, and the accuracy is compromised near the ends of the range. Consider using parameter *90.07 Load position scaled int* instead of this parameter. This parameter is read-only.	-
	-2147483.648 … 2147483.647	Load position.	-

No.	Name/Value	Description	Def/FbEq16
90.06	*Motor position scaled*	Displays the calculated motor position. The axis mode (linear or rollover) and resolution are defined by parameters *90.48 Motor position axis mode* and *90.49 Motor position resolution* respectively. **Note:** The position value can be sent on a fast time level to the fieldbus controller by selecting *Position* in either *50.07 FBA A actual 1 type*, *50.08 FBA A actual 2 type*, *50.37 FBA B actual 1 type* or *50.38 FBA B actual 2 type*. This parameter is read-only.	-
	-2147483.648 … 2147483.647	Motor position.	-
90.07	*Load position scaled int*	Displays the output of the position counter function as an integer, enabling backwards compatibility with ACS 600 and ACS800 drives. The position is relative to the initial position set by parameters *90.58* and *90.59*. See section *Position counter* (page *148*), and the block diagram on page *720*. This parameter is read-only.	-
	-2147483648 … 2147483647	Scaled load position in integer format.	-
90.10	*Encoder 1 speed*	Displays encoder 1 speed in rpm. This parameter is read-only.	-
	-32768.00 … 32767.00 rpm	Encoder 1 speed.	See par. *46.01*
90.11	*Encoder 1 position*	Displays the actual position of encoder 1 within one revolution. This parameter is read-only.	-
	0.00000000 … 1.00000000 rev	Encoder 1 position within one revolution.	32767 = 1 rev
90.12	*Encoder 1 multiturn revolutions*	Displays the revolutions of (multiturn) encoder 1 within its value range (see parameter *92.14 Revolution data width*). This parameter is read-only.	-
	0…16777215	Encoder 1 revolutions.	-
90.13	*Encoder 1 revolution extension*	Displays the revolution count extension for encoder 1. With a single-turn encoder, the counter is incremented when encoder position (parameter *90.11*) wraps around in the positive direction, and decremented in the negative direction. With a multiturn encoder, the counter is incremented when the revolutions count (parameter *90.12*) exceeds the value range in the positive direction, and decremented in the negative direction. This parameter is read-only.	-
	-2147483648 … 2147483647	Encoder 1 revolution count extension.	-
90.14	*Encoder 1 position raw*	Displays the raw measurement data of encoder 1 position (within one revolution) as a 24-bit unsigned integer received from the encoder interface. This parameter is read-only.	-
	0…16777215	Raw encoder 1 position within one revolution.	-

No.	Name/Value	Description	Def/FbEq16
90.15	*Encoder 1 revolutions raw*	Displays the revolutions of (multiturn) encoder 1 within its value range (see parameter *92.14 Revolution data width*) as a raw measurement. This parameter is read-only.	-
	0…16777215	Raw encoder 1 revolution count.	-
90.20	*Encoder 2 speed*	Displays encoder 2 speed in rpm. This parameter is read-only.	-
	-32768.00 … 32767.00 rpm	Encoder 2 speed.	See par. *46.01*
90.21	*Encoder 2 position*	Displays the actual position of encoder 2 within one revolution. This parameter is read-only.	-
	0.00000000 … 1.00000000 rev	Encoder 2 position within one revolution.	-
90.22	*Encoder 2 multiturn revolutions*	Displays the revolutions of (multiturn) encoder 2 within its value range (see parameter *93.14 Revolution data width*). This parameter is read-only.	-
	0…16777215	Encoder 2 revolutions.	-
90.23	*Encoder 2 revolution extension*	Displays the revolution count extension for encoder 2. With a single-turn encoder, the counter is incremented when encoder position (parameter *90.21*) wraps around in the positive direction, and decremented in the negative direction. With a multiturn encoder, the counter is incremented when the revolutions count (parameter *90.22*) exceeds the value range in the positive direction, and decremented in the negative direction. This parameter is read-only.	-
	-2147483648 … 2147483647	Encoder 2 revolution count extension.	-
90.24	*Encoder 2 position raw*	Displays the raw measurement data of encoder 2 position (within one revolution) as a 24-bit unsigned integer received from the encoder interface. This parameter is read-only.	-
	0…16777215	Raw encoder 2 position within one revolution.	-
90.25	*Encoder 2 revolutions raw*	Displays the revolutions of (multiturn) encoder 2 within its value range (see parameter *93.14 Revolution data width*) as a raw measurement. This parameter is read-only.	-
	0…16777215	Raw encoder 2 revolution count.	-
90.26	*Motor revolution extension*	Displays the motor revolution count extension. The counter is incremented when the position selected by *90.41 Motor feedback selection* wraps around in the positive direction, and decremented in the negative direction. This parameter is read-only.	-
	-2147483648 … 2147483647	Motor revolution count extension.	-

No.	Name/Value	Description	Def/FbEq16
90.27	*Load revolution extension*	Displays the load revolution count extension. The counter is incremented when the position selected by *90.51 Load feedback selection* wraps around in the positive direction, and decremented in the negative direction. This parameter is read-only.	-
	-2147483648 … 2147483647	Load revolution count extension.	-
90.35	*Pos counter status*	Status information related to the position counter function. See section *Position counter* (page *148*). This parameter is read-only.	-

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

No.	Name/Value	Description	Def/FbEq16
	0000h…FFFFh	Position counter status word.	1 = 1
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
	0…9	Number of position counter decimal places.	1 = 1
90.41	*Motor feedback selection*	Selects the motor speed feedback value used during motor control. **Note:** With a permanent magnet motor, make sure an autophasing routine (see page *157*) is performed using the selected encoder. If necessary, set parameter *99.13 ID run requested* to *Autophasing* to request a fresh autophasing routine.	*Estimate*
	Estimate	A calculated speed estimate generated from the DTC core is used.	0

No.	Name/Value	Description	Def/FbEq16
	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
	0 … 10000 ms	Motor speed filter time.	1 = 1 ms
90.43	*Motor gear numerator*	Parameters *90.43* and *90.44* define a gear function between the motor speed feedback and motor control. The gear is used to correct a difference between the motor and encoder speeds for example if the encoder is not mounted directly on the motor shaft. $\frac{\text{90.43 Motor gear numerator}}{\text{90.44 Motor gear denominator}} = \frac{\text{Motor speed}}{\text{Encoder speed}}$ See also section *Load and motor feedback* (page *147*). **Note:** This parameter cannot be changed while the drive is running.	1
	-2147483648 … 2147483647	Motor gear numerator.	-
90.44	*Motor gear denominator*	See parameter *90.43 Motor gear numerator*. **Note:** This parameter cannot be changed while the drive is running.	1
	-2147483648 … 2147483647	Motor gear denominator.	-
90.45	*Motor feedback fault*	Selects how the drive reacts to loss of measured motor feedback.	*Fault*
	Fault	Drive trips on a *7301 Motor speed feedback* or *7381 Encoder* fault.	0
	Warning	Drive generates a *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
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*
	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 this case only selects the source of feedback for the speed controller).	1

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

No.	Name/Value	Description	Def/FbEq16
90.53	*Load gear numerator*	Parameters *90.53* and *90.54* define a gear function between the load (ie. driven equipment) speed and the encoder feedback selected by parameter *90.51 Load feedback selection*. The gear can be used to correct a difference between the load and encoder speeds for example if the encoder is not mounted directly on the rotated machinery. $$\frac{\textit{90.53 Load gear numerator}}{\textit{90.54 Load gear denominator}} = \frac{\text{Load speed}}{\text{Encoder speed}}$$ See also section *Load and motor feedback* (page *147*). **Note:** This parameter cannot be changed while the drive is running.	1
	-2147483648 … 2147483647	Load gear numerator.	-
90.54	*Load gear denominator*	See parameter *90.53 Load gear numerator*. **Note:** This parameter cannot be changed while the drive is running.	1
	-2147483648 … 2147483647	Load gear denominator.	-
90.55	*Load feedback fault*	Selects how the drive reacts to loss of load feedback.	*Fault*
	Fault	Drive trips on a *73A1 Load position feedback* fault.	0
	Warning	Drive generates a *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 rev
	-2147483648 … 2147483647 rev	Load-side position offset.	-
90.57	*Load position resolution*	Defines how many bits are used for load position count within one revolution. For example, with the setting of 16, the position value is multiplied by 65536 for display in parameter *90.04 Load position*.	16
	0…32	Load position resolution.	-
90.58	*Pos counter init value int*	Defines an initial position (or distance) for the position counter (as an integer value) when parameter *90.59 Pos counter init value int source* is set to *Pos counter init value int*. See also section *Position counter* (page *148*).	0
	-2147483648 … 2147483647	Initial integer value for position counter.	-
90.59	*Pos counter init value int source*	Selects the source of the initial position integer value. When the source selected by *90.67 Pos counter init cmd source* activates, the value selected in this parameter is assumed to be the position of the load.	*Pos counter init value int*
	Zero	0.	0
	Pos counter init value int	Parameter *90.58 Pos counter init value int*.	1
	Other [bit]	Source selection (see *Terms and abbreviations* on page *187*).	-

No.	Name/Value	Description	Def/FbEq16
90.60	*Pos counter error and boot action*	Selects how the position counter reacts to loss of load feedback.	*Request re-initialization*
	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. **WARNING!** 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*	Parameters *90.61* and *90.62* define a gear function between the motor and load speeds. $\dfrac{\textit{90.61 Gear numerator}}{\textit{90.62 Gear denominator}} = \dfrac{\text{Motor speed}}{\text{Load speed}}$ See also section *Load and motor feedback* (page *147*).	1
	-2147483648 … 2147483647	Gear numerator (motor-side).	-
90.62	*Gear denominator*	See parameter *90.61 Gear numerator*.	1
	-2147483648 … 2147483647	Gear denominator (load-side).	-
90.63	*Feed constant numerator*	Parameters *90.63* and *90.64* define the feed constant for the position calculation: $\dfrac{\textit{90.63 Feed constant numerator}}{\textit{90.64 Feed constant denominator}}$ The feed constant converts rotational motion into translatory motion. The feed constant is the distance the load moves during one turn of the motor shaft. The translatory load position is shown by parameter *90.05 Load position scaled*.	1
	-2147483648 … 2147483647	Feed constant numerator.	-
90.64	*Feed constant denominator*	See parameter *90.63 Feed constant numerator*.	1
	-2147483648 … 2147483647	Feed constant denominator.	-
90.65	*Pos counter init value*	Defines an initial position (or distance) for the position counter (as a decimal number) when parameter *90.66 Pos counter init value source* is set to *Pos counter init value*. The number of decimal places is defined by parameter *90.38 Pos counter decimals*.	0.000
	-2147483.648 … 2147483.647	Initial value for position counter.	-
90.66	*Pos counter init value source*	Selects the source of the initial position value. When the source selected by *90.67 Pos counter init cmd source* activates, the value selected in this parameter is assumed to be the position of the load.	*Pos counter init value*
	Zero	0.	0

No.	Name/Value	Description	Def/FbEq16
	Pos counter init value	Parameter *90.65 Pos counter init value*.	1
	Other	Source selection (see *Terms and abbreviations* on page *187*).	-
90.67	*Pos counter init cmd source*	Selects a digital source (for example, a limit switch connected to a digital input) that initializes the position counter. When the digital source activates, the value selected by *90.66 Pos counter init value source* is assumed to be the position of the load. **Note:** Position counter initialization can be prevented by parameter *90.68 Disable pos counter initialization*.	*Not selected*
	Not selected	0.	0
	Selected	1.	1
	DI1	Digital input DI1 (*10.02 DI delayed status*, bit 0).	2
	DI2	Digital input DI2 (*10.02 DI delayed status*, bit 1).	3
	DI3	Digital input DI3 (*10.02 DI delayed status*, bit 2).	4
	DI4	Digital input DI4 (*10.02 DI delayed status*, bit 3).	5
	DI5	Digital input DI5 (*10.02 DI delayed status*, bit 4).	6
	DI6	Digital input DI6 (*10.02 DI delayed status*, bit 5).	7
	DIO1	Digital input/output DIO1 (*11.02 DIO delayed status*, bit 0).	10
	DIO2	Digital input/output DIO2 (*11.02 DIO delayed status*, bit 1).	11
	Other [bit]	Source selection (see *Terms and abbreviations* on page *187*).	-
90.68	*Disable pos counter initialization*	Selects a source that prevents the initialization of the position counter.	*Not selected*
	Not selected	0.	0
	Selected	1.	1
	DI1	Digital input DI1 (*10.02 DI delayed status*, bit 0).	2
	DI2	Digital input DI2 (*10.02 DI delayed status*, bit 1).	3
	DI3	Digital input DI3 (*10.02 DI delayed status*, bit 2).	4
	DI4	Digital input DI4 (*10.02 DI delayed status*, bit 3).	5
	DI5	Digital input DI5 (*10.02 DI delayed status*, bit 4).	6
	DI6	Digital input DI6 (*10.02 DI delayed status*, bit 5).	7
	DIO1	Digital input/output DIO1 (*11.02 DIO delayed status*, bit 0).	10
	DIO2	Digital input/output DIO2 (*11.02 DIO delayed status*, bit 1).	11
	Other [bit]	Source selection (see *Terms and abbreviations* on page *187*).	-
90.69	*Reset pos counter init ready*	Selects a source that enables a new initialization of the position counter, ie. resets bit 4 of *90.35 Pos counter status*.	*Not selected*
	Not selected	0.	0
	Selected	1.	1
	DI1	Digital input DI1 (*10.02 DI delayed status*, bit 0).	2

No.	Name/Value	Description	Def/FbEq16
	DI2	Digital input DI2 (*10.02 DI delayed status*, bit 1).	3
	DI3	Digital input DI3 (*10.02 DI delayed status*, bit 2).	4
	DI4	Digital input DI4 (*10.02 DI delayed status*, bit 3).	5
	DI5	Digital input DI5 (*10.02 DI delayed status*, bit 4).	6
	DI6	Digital input DI6 (*10.02 DI delayed status*, bit 5).	7
	DIO1	Digital input/output DIO1 (*11.02 DIO delayed status*, bit 0).	10
	DIO2	Digital input/output DIO2 (*11.02 DIO delayed status*, bit 1).	11
	Other [bit]	Source selection (see *Terms and abbreviations* on page *187*).	-
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
	-2147483008... 2147483008	Pulse count.	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*.	0.0
	-8388610... 8388610.0	Load position.	10 = 1
90.202	*Proximity speed raw*	Displays the speed of the load drum in RPM calculated by estimating the frequency of pulses from the proximity switch.	0.00
	-32768.00... 32767.00	Load speed.	100 = 1
90.205	*Proximity switch mode*	Selects the mode for load position measurement when proximity switch is used for chain length measurement.	*SrcA & SrcB*
	SrcA & SrcB	Two proximity switches, A and B, which produces quadrature signals.	0
	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.	1
90.206	*Prox signal A source*	Selects a digital source for pulse signal from proximity switch A.	*False*
	False	0	0
	True	1	1
	DI1	Digital input DI1	2
	DI2	Digital input DI2	3
	DI3	Digital input DI3	4
	DI4	Digital input DI4	5
	DI5	Digital input DI5	6
	DI6	Digital input DI6	7
	DIO1	Digital input/output DIO1	8

No.	Name/Value	Description	Def/FbEq16
	DIO2	Digital input/output DIO2	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	18
	Other [bit]	Source selection (see *Terms and abbreviations* on page *187*).	-
90.207	*Prox signal B source*	Selects a digital source for pulse signal from proximity switch B.	*False*
	False	0	0
	True	1	1
	DI1	Digital input DI1	2
	DI2	Digital input DI2	3
	DI3	Digital input DI3	4
	DI4	Digital input DI4	5
	DI5	Digital input DI5	6
	DI6	Digital input DI6	7
	DIO1	Digital input/output DIO1	8
	DIO2	Digital input/output DIO2	9
	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]	Source selection (see *Terms and abbreviations* on page *187*).	-
90.208	*Pulses per drum revolution*	Defines the number of pulses generated per revolution from the proximity switch on the load side.	0
	0...65535	Pulses per revolution.	1 = 1
90.209	*Proximity switch anchor drop*	Selects a digital source for anchor drop signal from proximity switch.	*Disabled*
	Disabled	0	0
	Enabled	1	1
	DI1	Digital input DI1	2
	DI2	Digital input DI2	3
	DI3	Digital input DI3	4

No.	Name/Value	Description	Def/FbEq16
	DI4	Digital input DI4	5
	DI5	Digital input DI5	6
	DI6	Digital input DI6	7
	DIO1	Digital input/output DIO1	8
	DIO2	Digital input/output DIO2	9
	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]	Source selection (see *Terms and abbreviations* on page *187*).	-
90.210	*Rotary supervision status*	Status information of rotary supervision function. See section *Rotary supervision* (page *55*). This parameter is read-only.	-

Bit	Name	Value
0	Error condition detected	1 = Rotary supervision has detected an error condition 0 = Status OK or supervision disabled
1	Warning	1 = Rotary supervision triggered a warning 0 = Status IK or supervision disabled
2	Fault	1 = Rotary supervision triggered a fault 0 = Status IK or supervision disabled
3	A sensor failure	1 = Proximity sensor for source A malfunction 0 = Status OK or supervision disabled
4	B sensor failure	1 = Proximity sensor for source B malfunction 0 = Status OK or supervision disabled
5	Direction based supervision error	1 = Drum direction is different from expected one 0 = Status OK or supervision disabled
6	Time based supervision error	1 = No feedback signals received from proximity sensor during the defined delay time. 0 = Status OK or supervision disabled.
7…15	Reserved	

No.	Name/Value	Description	Def/FbEq16
	0000h…FFFFh	Rotary supervision status.	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*)	*Disabled*
	Not used	No action is taken. The supervision is disabled.	0
	Warning	Supervision triggers a warning *D21A Rotary supervision*, when error condition is detected.	1
	Fault	Supervision triggers a fault *D11A Rotary supervision*, when error condition is detected.	2

No.	Name/Value	Description	Def/FbEq16
90.212	*Rotary supervision delay*	Defines the time delay to receive the pulses from feedback sensor. The delay time counts as soon as the absolute value of *90.01 Motor speed for control* is greater than *21.06 Zero speed limit*.	10.0
	0.0... 600.0 s	Rotary supervision delay time.	10 = 1 s
91 Encoder module settings		Configuration of encoder interface modules.	
91.01	*FEN DI status*	Displays the status of the digital inputs of FEN-xx encoder interface modules. This parameter is read-only.	-

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

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

No.	Name/Value	Description	Def/FbEq16
91.06	*Module 2 temperature*	Displays the temperature measured through the sensor input of interface module 2. The unit is selected by parameter *96.16 Unit selection*. **Note:** With a PTC sensor, the unit is ohms. This parameter is read-only.	-
	0…1000 °C, °F or ohm	Temperature measured through interface module 2.	-
91.10	*Encoder parameter refresh*	Validates any changed encoder interface module parameters. This is needed for any parameter changes in groups 90…93 to take effect. After refreshing, the value reverts automatically to *Done*. Notes: • Permanent magnet motors only: The drive performs a fresh autophasing routine (see page *157*) at next start if the motor feedback encoder settings have been changed. • The parameter cannot be changed while the drive is running.	*Done*
	Done	Refreshing done.	0
	Refresh	Refreshing.	1
91.11	*Module 1 type*	Defines the type of the module used as interface module 1.	*None*
	None	None (communication disabled).	0
	FEN-01	FEN-01.	1
	FEN-11	FEN-11.	2
	FEN-21	FEN-21.	3
	FEN-31	FEN-31.	4
	FSE-31	Reserved.	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.	*Slot 2*
	Not selected	No slot is selected.	0
	Slot 1	Slot 1.	1
	Slot 2	Slot 2.	2
	Slot 3	Slot 3.	3
91.13	*Module 2 type*	Defines the type of the module used as interface module 2.	*None*
	None	None (communication disabled).	0
	FEN-01	FEN-01.	1
	FEN-11	FEN-11.	2
	FEN-21	FEN-21.	3
	FEN-31	FEN-31.	4
	FSE-31	Reserved.	5

No.	Name/Value	Description	Def/FbEq16
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.	*Slot 3*
	Not selected	No slot is selected.	0
	Slot 1	Slot 1.	1
	Slot 2	Slot 2.	2
	Slot 3	Slot 3.	3
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*
	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
	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*
	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
	0…10000 ms	Filtering time for temperature measurement.	-
91.31	*Module 1 TTL output source*	Selects the encoder input on interface module 1 whose signal is echoed by or emulated to the TTL output. See also section *Encoder support* (page *147*).	*Not selected*
	Not selected	TTL output not in use.	0
	Module input 1	Input 1 is echoed by or emulated to the TTL output.	1
	Module input 2	Input 2 is echoed by or emulated to the TTL output.	2
91.32	*Module 1 emulation pulses/rev*	Defines the number of TTL pulses per revolution for encoder emulation output of interface module 1.	0
	0…65535	Number of TTL pulses for emulation.	1 = 1

No.	Name/Value	Description	Def/FbEq16
91.33	*Module 1 emulated Z-pulse offset*	With interface module 1, defines when zero pulses are emulated in relation to zero position received from the encoder. For example, with a value of 0.50000, a zero pulse is emulated whenever the encoder position passes 0.5 revolutions. With a value of 0.00000, a zero pulse is emulated whenever the encoder position passes zero position.	0.00000
	0.00000 … 1.00000 rev	Position of emulated zero pulses.	32767 = 1 rev
91.41	*Module 2 TTL output source*	Selects the encoder input on interface module 2 whose signal is echoed by or emulated to the TTL output. See also section *Encoder support* (page *147*).	*Not selected*
	Not selected	TTL output not in use.	0
	Module input 1	Input 1 is echoed by or emulated to the TTL output.	1
	Module input 2	Input 2 is echoed by or emulated to the TTL output.	2
91.42	*Module 2 emulation pulses/rev*	Defines the number of TTL pulses per revolution for encoder emulation output of interface module 2.	0
	0…65535	Number of TTL pulses for emulation.	1 = 1
91.43	*Module 2 emulated Z-pulse offset*	With interface module 2, defines when zero pulses are emulated in relation to zero position received from the encoder. For example, with a value of 0.50000, a zero pulse is emulated whenever the encoder position passes 0.5 revolutions. With a value of 0.00000, a zero pulse is emulated whenever the encoder position passes zero position.	0
	0.00000 … 1.00000 rev	Position of emulated zero pulses.	32767 = 1 rev

92 Encoder 1 configuration		Settings for encoder 1. Notes: • The contents of the parameter group vary according to the selected encoder type. • It is recommended that encoder connection 1 (this group) is used whenever possible since the data received through that interface is fresher than the data received through connection 2 (group *93 Encoder 2 configuration*).	
92.01	*Encoder 1 type*	Activates the communication with optional encoder/resolver interface module 1.	*None configured*
	None configured	None.	0
	TTL	TTL. Module type (input): FEN-01 (X31), FEN-11 (X41) or FEN-21 (X51).	1
	TTL+	TTL+. 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

No.	Name/Value	Description	Def/FbEq16
92.02	Encoder 1 source	Selects the interface module that the encoder is connected to. (The physical locations and types of encoder interface modules are defined in parameter group 91 Encoder module settings.)	Module 1
	Module 1	Interface module 1.	0
	Module 2	Interface module 2.	1
92.10	Pulses/revolution	(Visible when TTL, TTL+ or HL encoder is selected) Defines the pulse number per revolution.	2048
	0…65535	Number of pulses.	-
92.10	Sine/cosine number	(Visible when an absolute encoder is selected) Defines the number of sine/cosine wave cycles within one revolution. **Note:** This parameter need not be set when an EnDat or SSI encoder is used in continuous mode. See parameter 92.30 Serial link mode.	0
	0…65535	Number of sine/cosine wave cycles within one revolution.	-
92.10	Excitation signal frequency	(Visible when a resolver is selected) 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
	1…20 kHz	Excitation signal frequency.	1 = 1 kHz
92.11	Pulse encoder type	(Visible when a TTL, TL+ or HTL encoder is selected) Selects the type of encoder.	Quadrature
	Quadrature	Quadrature encoder (with two channels, A and B)	0
	Single track	Single-track encoder (with one channel, A). **Note:** With this setting, the measured speed value is always positive regardless of direction of rotation.	1
92.11	Absolute position source	(Visible when an absolute encoder is selected) Selects the source of the absolute position information.	None
	None	Not selected.	0
	Commut signals	Commutation signals.	1
	EnDat	Serial interface: EnDat encoder.	2
	Hiperface	Serial interface: HIPERFACE encoder.	3
	SSI	Serial interface: SSI encoder.	4
	Tamagawa	Serial interface: Tamagawa 17/33-bit encoder.	5
92.11	Excitation signal amplitude	(Visible when a resolver is selected) Defines the rms amplitude of the excitation signal.	4.0 V
	4.0 … 12.0 V	Excitation signal amplitude.	10 = 1 V

<table>
<tr><th>No.</th><th>Name/Value</th><th>Description</th><th>Def/FbEq16</th></tr>
<tr><td>*92.12*</td><td>*Speed calculation mode*</td><td>(Visible when a TTL, TTL+ or HTL encoder is selected)
Selects the speed calculation mode.
*With a single-track encoder (parameter *92.11 Pulse encoder type* is set to *Single track*), the speed is always positive.</td><td>*Auto rising*</td></tr>
<tr><td></td><td>A&B all</td><td>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*.</td><td>0</td></tr>
<tr><td></td><td>A all</td><td>Channel A: Rising and falling edges are used for speed calculation.
*Channel B: Defines the direction of rotation.</td><td>1</td></tr>
<tr><td></td><td>A rising</td><td>Channel A: Rising edges are used for speed calculation.
*Channel B: Defines the direction of rotation.</td><td>2</td></tr>
<tr><td></td><td>A falling</td><td>Channel A: Falling edges are used for speed calculation.
*Channel B: Defines the direction of rotation.</td><td>3</td></tr>
<tr><td></td><td>Auto rising</td><td>One of the above modes is selected automatically depending on the pulse frequency as follows:
<table>
<tr><th>Pulse frequency of the channel(s)</th><th>Used mode</th></tr>
<tr><td>< 2442 Hz</td><td>*A&B all*</td></tr>
<tr><td>2442…4884 Hz</td><td>*A all*</td></tr>
<tr><td>> 4884 Hz</td><td>*A rising*</td></tr>
</table></td><td>4</td></tr>
<tr><td></td><td>Auto falling</td><td>One of the above modes is selected automatically depending on the pulse frequency as follows:
<table>
<tr><th>Pulse frequency of the channel(s)</th><th>Used mode</th></tr>
<tr><td>< 2442 Hz</td><td>*A&B all*</td></tr>
<tr><td>2442…4884 Hz</td><td>*A all*</td></tr>
<tr><td>> 4884 Hz</td><td>*A falling*</td></tr>
</table></td><td>5</td></tr>
<tr><td>*92.12*</td><td>*Zero pulse enable*</td><td>(Visible when an absolute encoder is selected)
Enables the encoder zero pulse for the absolute encoder input (X42) of the FEN-11 interface module.
Note: No zero pulse exists with serial interfaces, ie. when parameter *92.11 Absolute position source* is set to *EnDat*, *Hiperface*, *SSI* or *Tamagawa*.</td><td>*Disable*</td></tr>
<tr><td></td><td>Disable</td><td>Zero pulse disabled.</td><td>0</td></tr>
<tr><td></td><td>Enable</td><td>Zero pulse enabled.</td><td>1</td></tr>
<tr><td>*92.12*</td><td>*Resolver polepairs*</td><td>(Visible when a resolver is selected)
Defines the number of pole pairs of the resolver.</td><td>1</td></tr>
<tr><td></td><td>1…32</td><td>Number of resolver pole pairs.</td><td>1 = 1</td></tr>
<tr><td>*92.13*</td><td>*Position estimation enable*</td><td>(Visible when a TTL, TTL+ or HTL encoder is selected)
Selects whether position estimation is used with encoder 1 to increase position data resolution or not.</td><td>*Enable*</td></tr>
<tr><td></td><td>Disable</td><td>Measured position used. (The resolution is 4 × pulses per revolution for quadrature encoders, 2 × pulses per revolution for single-track encoders.)</td><td>0</td></tr>
</table>

No.	Name/Value	Description	Def/FbEq16
	Enable	Estimated position used. (Uses position interpolation; extrapolated at the time of data request.)	1
92.13	*Position data width*	(Visible when an absolute encoder is selected) Defines the number of bits used to indicate position within one revolution. For example, a setting of 15 bits corresponds to 32768 positions per revolution. The value is used when parameter *92.11 Absolute position source* is set to *EnDat*, *Hiperface* or *SSI*. When parameter *92.11 Absolute position source* is set to *Tamagawa*, this parameter is internally set to 17. **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
	0…32	Number of bits used in position indication within one revolution.	1 = 1
92.14	*Speed estimation enable*	(Visible when a TTL, TTL+ or HTL encoder is selected) Selects whether calculated or estimated speed is used. Estimation increases the speed ripple in steady state operation, but improves the dynamics. **Note:** This parameter is not effective with FEN-xx modules with FPGA version VIEx 2000 or later.	*Disable*
	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 an absolute encoder is selected) Defines the number of bits used in revolution counting with a multiturn encoder. For example, a setting of 12 bits would support counting up to 4096 revolutions. The value is used when parameter *92.11 Absolute position source* is set to *EnDat*, *Hiperface* or *SSI*. When parameter *92.11 Absolute position source* is set to *Tamagawa*, setting this parameter to a non-zero value activates multiturn data requesting. **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
	0…32	Number of bits used in revolution count.	1 = 1
92.15	*Transient filter*	(Visible when a TTL, TTL+ or HTL encoder is selected) Activates transient filtering for the encoder (changes in direction of rotation are ignored above the selected pulse frequency).	*4880 Hz*
	4880 Hz	Change in direction of rotation allowed below 4880 Hz.	0
	2440 Hz	Change in direction of rotation allowed below 2440 Hz.	1
	1220 Hz	Change in direction of rotation allowed below 1220 Hz.	2
	Disabled	Change in direction of rotation allowed at any pulse frequency.	3
92.17	*Accepted pulse freq of encoder 1*	(Visible when parameter *92.01 Encoder 1 type* = *HTL 1* or *HTL 2*) Defines the maximum pulse frequency of encoder 1.	0 kHz
	0…300 kHz	Pulse frequency.	1 = 1 kHz

No.	Name/Value	Description	Def/FbEq16
92.21	*Encoder cable fault mode*	(Visible when a TTL, TTL+ or HTL encoder is selected) Selects which encoder cable channels and wires are monitored for wiring faults.	*A, B*
	A, B	A and B.	0
	A, B, Z	A, B and Z.	1
	A+, A-, B+, B-	A+, A-, B+ and B-.	2
	A+, A-, B+, B-, Z+, Z-	A+, A-, B+, B-, Z+ and Z-.	3
92.23	*Maximum pulse waiting time*	(Visible when parameter *92.01 Encoder 1 type* = *TTL* or *HTL*) Determines a pulse waiting time used in speed calculation for the encoder interface. If no pulse edges are detected within this time, the measured speed is zeroed by the interface. Increasing the setting can improve measuring performance especially at low, near zero speeds. Notes: • The parameter is only supported by FEN-xx modules with FPGA version VIEx 2000 or later. On older modules, the pulse waiting time is fixed to 4 ms. • The parameter only affects speed measurement. Position is updated whenever a new pulse edge is detected. When the measured speed from the interface is zero, the drive updates its speed data based on position changes.	4
	1…200 ms	Maximum pulse waiting time.	1 = 1 ms
92.24	*Pulse edge filtering*	(Visible when parameter *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. Notes: • Pulse edge filtering is only supported by FEN-31 modules with FPGA version VIE3 2200 or later. • Pulse edge filtering decreases the maximum pulse frequency. With 2 µs filtering time, the maximum pulse frequency is 200 kHz.	*No filtering*
	No filtering	Filtering disabled.	0
	1 µs	Filtering time: 1 microsecond.	1
	2 µs	Filtering time: 2 microseconds.	2
92.25	*Pulse overfrequency function*	(Visible when parameter *92.01 Encoder 1 type* = *HTL*) Selects how the drive reacts when the encoder interface detects a pulse overfrequency condition. Note: This parameter is effective only with FEN-xx module FPGA version VIEx 2200 or later.	*Fault*
	Warning	The drive generates a warning, *7381 Encoder*. The FEN-xx module will continue to update speed and position data.	0
	Fault	The drive trips on fault *A7E1 Encoder*.	1
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*
	Initial position	Single position transfer mode (initial position).	0

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

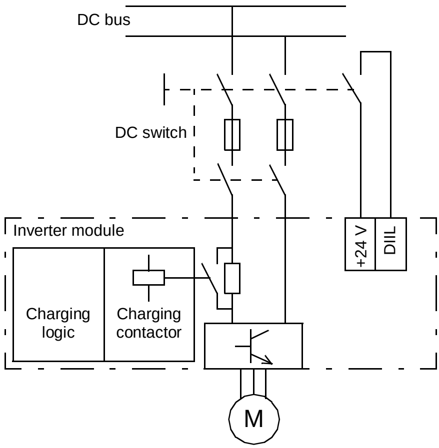
No.	Name/Value	Description	Def/FbEq16
	100 kBit/s	100 kbit/s.	2
	200 kBit/s	200 kbit/s.	3
	500 kBit/s	500 kbit/s.	4
	1000 kBit/s	1000 kbit/s.	5
92.40	*SSI zero phase*	(Visible when an absolute encoder is selected) Defines the phase angle within one sine/cosine signal period that corresponds to the value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

93 Encoder 2 configuration		Settings for encoder 2. Notes: • The contents of the parameter group vary according to the selected encoder type. • It is recommended that encoder connection 1 (group *92 Encoder 1 configuration*) is used whenever possible since the data received through that interface is fresher than the data received through connection 2 (this group).	
93.01	*Encoder 2 type*	Activates the communication with optional encoder/resolver interface module 2.	*None configured*
	None configured	Inactive.	0

No.	Name/Value	Description	Def/FbEq16
	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
	HTL1	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*
	Module 1	Interface module 1.	1
	Module 2	Interface module 2.	2
93.10	*Pulses/revolution*	(Visible when a TTL, TTL+ or HTL encoder is selected) See parameter *92.10 Pulses/revolution*.	2048
93.10	*Sine/cosine number*	(Visible when an absolute encoder is selected) See parameter *92.10 Sine/cosine number*.	0
93.10	*Excitation signal frequency*	(Visible when *93.01 Encoder 2 type* = *Resolver*) See parameter *92.10 Excitation signal frequency*.	1 kHz
93.11	*Pulse encoder type*	(Visible when a TTL, TTL+ or HTL encoder is selected) See parameter *92.11 Pulse encoder type*.	*Quadrature*
93.11	*Absolute position source*	(Visible when an absolute encoder is selected) See parameter *92.11 Absolute position source*.	*None*
93.11	*Excitation signal amplitude*	(Visible when a resolver is selected) See parameter *92.11 Excitation signal amplitude*.	4.0 V
93.12	*Speed calculation mode*	(Visible when a TTL, TTL+ or HTL encoder is selected) See parameter *92.12 Speed calculation mode*.	*Auto rising*
93.12	*Zero pulse enable*	(Visible when an absolute encoder is selected) See parameter *92.12 Zero pulse enable*.	*Disable*
93.12	*Resolver polepairs*	(Visible when a resolver is selected) See parameter *92.12 Resolver polepairs*.	1
93.13	*Position estimation enable*	(Visible when a TTL, TTL+ or HTL encoder is selected) See parameter *92.13 Position estimation enable*.	*Enable*
93.13	*Position data width*	(Visible when an absolute encoder is selected) See parameter *92.13 Position data width*.	0
93.14	*Speed estimation enable*	(Visible when a TTL, TTL+ or HTL encoder is selected) See parameter *92.14 Speed estimation enable*.	*Disable*
93.14	*Revolution data width*	(Visible when an absolute encoder is selected) See parameter *92.14 Revolution data width*.	0
93.15	*Transient filter*	(Visible when a TTL, TTL+ or HTL encoder is selected) See parameter *92.15 Transient filter*.	*4880 Hz*
93.17	*Accepted pulse freq of encoder 2*	(Visible when parameter *93.01 Encoder 2 type* = *HTL1* or *HTL 2*) See parameter *92.17 Accepted pulse freq of encoder 1*.	0 kHz

No.	Name/Value	Description	Def/FbEq16
93.21	*Encoder cable fault mode*	(Visible when a TTL, TTL+ or HTL encoder is selected)) See parameter *92.21 Encoder cable fault mode*.	*A, B*
93.23	*Maximum pulse waiting time*	(Visible when parameter *93.01 Encoder 2 type* = *TTL* or *HTL*) See parameter *92.23 Maximum pulse waiting time*.	4 ms
93.24	*Pulse edge filtering*	(Visible when parameter *93.01 Encoder 2 type* = *HTL*) See parameter *92.24 Pulse edge filtering*.	*No filtering*
93.25	*Pulse overfrequency function*	(Visible when parameter *93.01 Encoder 2 type* = *HTL*) See parameter *92.25 Pulse overfrequency function*.	*Fault*
93.30	*Serial link mode*	(Visible when an absolute encoder is selected) See parameter *92.30 Serial link mode*.	*Initial position*
93.31	*EnDat calc time*	(Visible when an absolute encoder is selected) See parameter *92.31 EnDat max calculation time*.	*50 ms*
93.32	*SSI cycle time*	(Visible when an absolute encoder is selected) See parameter *92.32 SSI cycle time*.	*100 us*
93.33	*SSI clock cycles*	(Visible when an absolute encoder is selected) See parameter *92.33 SSI clock cycles*.	2
93.34	*SSI position msb*	(Visible when an absolute encoder is selected) See parameter *92.34 SSI position msb*.	1
93.35	*SSI revolution msb*	(Visible when an absolute encoder is selected) See parameter *92.35 SSI revolution msb*.	1
93.36	*SSI data format*	(Visible when an absolute encoder is selected) See parameter *92.36 SSI data format*.	*Binary*
93.37	*SSI baud rate*	(Visible when an absolute encoder is selected) See parameter *92.37 SSI baud rate*.	*100 kBit/s*
93.40	*SSI zero phase*	(Visible when an absolute encoder is selected) See parameter *92.40 SSI zero phase*.	*315-45 deg*
93.45	*Hiperface parity*	(Visible when an absolute encoder is selected) See parameter *92.45 Hiperface parity*.	*Odd*
93.46	*Hiperface baud rate*	(Visible when an absolute encoder is selected) See parameter *92.46 Hiperface baud rate*.	*4800 bits/s*
93.47	*Hiperface node address*	(Visible when an absolute encoder is selected) See parameter *92.47 Hiperface node address*.	64

No.	Name/Value	Description	Def/FbEq16
95	***HW configuration***	Various hardware-related settings.	
95.01	*Supply voltage*	Selects the supply voltage range. This parameter is used by the drive to determine the nominal voltage of the supply network. The parameter also affects the current ratings and the DC voltage control functions (trip and brake chopper activation limits) of the drive. **WARNING!** An incorrect setting may cause the motor to rush uncontrollably, or the brake chopper or resistor to overload. Note: • The selections shown depend on the hardware of the drive. If only one voltage range is valid for the drive in question, it is selected by default. • This parameter cannot be changed while the drive is running.	-
	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 (*94.20 DC voltage reference*) 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.	*Disable*; *Enable* (*95.20* b15)
	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 the control unit and the setting of parameter *95.20*.	*Internal 24V*; *External 24V* (*95.20* b4)
	Internal 24V	The drive control unit is powered from the drive power unit it is connected to. Note: If reduced run (see page *184*) 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

No.	Name/Value	Description	Def/FbEq16
	Redundant external 24V	(Type BCU control units only) The drive control unit is powered from two redundant external power supplies. The loss of one of the supplies generates a warning (*AFEC External power signal missing*). The drive power unit and power unit link faults are masked when the drive is in stopped state, so the main circuit can be powered down without faults while the control unit is powered.	2
95.08	*DC switch monitoring*	(Only visible with a ZCU control unit) Enables/disables DC switch monitoring via the DIIL input. This setting is intended for use with inverter modules with an internal charging circuit that are connected to the DC bus through a DC switch. An auxiliary contact of the DC switch must be wired to the DIIL input so that the input switches off when the DC switch is opened.  If the DC switch is opened with the inverter running, the inverter is given a coast-to-stop command, and its charging circuit activated. Starting the inverter is prevented until the DC switch is closed and the DC circuit in the inverter unit recharged. Notes: • By default, DIIL is the input for the Run enable signal. Adjust *20.12 Run enable 1 source* if necessary. • An internal charging circuit is standard on some inverter module types but optional on others; check with your local ABB representative.	*Disable*; *Enable* (*95.20* b5)
	Disable	DC switch monitoring through the DIIL input disabled.	0
	Enable	DC switch monitoring through the DIIL input enabled.	1

No.	Name/Value	Description	Def/FbEq16
95.15	*Special HW settings*	Contains hardware-related settings that can be enabled and disabled by toggling the specific bits. **Note:** • The installation of the hardware specified by this parameter may require derating of drive output, or impose other limitations. Refer to the hardware manual of the drive. • This parameter cannot be changed while the drive is running.	-

Bit	Name	Information
0	EX motor	1 = The driven motor is an Ex motor provided by ABB for potentially explosive atmospheres. This sets the required minimum switching frequency for ABB Ex motors. **Note:** For non-ABB Ex motors, contact your local ABB representative.
1	ABB Sine filter	1 = An ABB sine filter is connected to the output of the drive/inverter.
2	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).
3	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*.
4…15	Reserved	

	000b…111b	Hardware options configuration word.	1 = 1

No.	Name/Value	Description	Def/FbEq16
95.20	*HW options word 1*	Specifies hardware-related options that require differentiated parameter defaults. Activating a bit in this parameter makes the necessary changes in other parameters – for example, activating an emergency stop option reserves a digital input. In many cases, the differentiated parameters will also be write-protected. This parameter, as well as the changes in other parameters implemented by it, are not affected by a parameter restore. **WARNING!** After switching any bits in this word, recheck the values of the affected parameters. **Note:** This parameter cannot be changed while the drive is running.	-

Bit	Name	Information
0	Supply frequency 60 Hz	0 = 50 Hz; 1 = 60 Hz. Affects parameters *11.45*, *11.59*, *12.20*, *13.18*, *30.11*, *30.12*, *30.13*, *30.14*, *31.26*, *31.27*, *46.01*, *46.02*.
1	Emergency stop Cat 0	1 = Emergency stop, Category 0, without FSO module. Affects *21.04*, *21.05*, *23.200*.
2	Emergency stop Cat 1	1 = Emergency stop, Category 1, without FSO module. Affects *10.24*, *21.04*, *21.05*, *23.200*.
3	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*.
4	Externally powered control unit	1 = Control unit powered externally. Affects *95.04*. (Only visible with a ZCU control unit)
5	DC supply switch	1 = DC switch monitoring active. Affects *20.12*, *31.03*, *95.08*. (Only visible with a ZCU control unit)
6	DOL motor switch	1 = Motor fan control active. Affects *10.24*, *35.100*, *35.103*, *35.104*.
7	Reserved	
8	Service switch or PTC/Pt100 relay	1 = Service switch or PTC/Pt100 relay connected. Affects *31.01*, *31.02*.
9	Output contactor	1 = Output contactor present. Affects *10.24*, *20.12*.
10	Brake resistor, sine filter, IP54 fan	1 = Status (eg. thermal) switches connected to DIIL input. Affects *20.11*, *20.12*.
11...12	Reserved	
13	du/dt filter activation	1 = Active: An external du/dt filter is connected to the drive/inverter output. The setting will limit the output switching frequency, and force the fan of the drive/inverter module to full speed. **Note:** This bit is to be left at 0 if the drive/inverter module is equipped with internal du/dt filtering (for example, frame R8i inverter modules with option +E205).
14	DOL fan activation	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.
15	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 *97*.

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

No.	Name/Value	Description	Def/FbEq16
95.21	*HW options word 2*	Specifies more hardware-related options that require differentiated parameter defaults. See parameter *95.20 HW options word 1*. **WARNING!** After switching any bits in this word, recheck the values of the affected parameters. **Note:** This parameter cannot be changed while the drive is running.	-

Bit	Name	Information
0	Dual use	1 = Dual use active. For drives with option +N8200. (Allows higher output speeds/frequencies and speed/frequency reference limits.)
1	SynRM	1 = Synchronous reluctance motor used. Affects parameters *25.02*, *25.03*, *25.15*, *99.03*.
2	Salient PM	1 = Salient-pole permanent magnet motor used. Affects parameters *25.02*, *25.03*, *25.15*, *99.03*.
3	LV Synchro	1 = Externally-excited synchronous motor used. Requires a license. Contact your local ABB representative for more information.
4	Aux fan 1 supervision	1 = Auxiliary fan 1 installed and supervised.
5	Aux fan 2 supervision	1 = Auxiliary fan 2 installed and supervised.
6…15	Reserved	

No.	Name/Value	Description	Def/FbEq16
	0000b…0111b	Hardware options configuration word 2.	1 = 1
95.40	*Transformation ratio*	Defines the ratio of the step-up transformer.	0.000
	0.000 … 100.000	Step-up transformer ratio.	1000 = 1
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. Notes: • Not all languages listed below are necessarily supported. • This parameter does not affect the languages visible in the Drive composer PC tool. (Those are specified under View – Settings.)	-
	Not selected	None.	0
	English	English.	1033
	Deutsch	German.	1031
	Italiano	Italian.	1040
	Español	Spanish.	3082
	Português	Portuguese.	2070
	Nederlands	Dutch.	1043
	Français	French.	1036
	Dansk	Danish.	1030
	Suomi	Finnish.	1035

No.	Name/Value	Description	Def/FbEq16
	Svenska	Swedish.	1053
	???????	Russian.	1049
	Polski	Polish.	1045
	?esky	Czech.	1029
	Chinese (Simplified, PRC)	Simplified Chinese.	2052
	Türkçe	Turkish.	1055
	Japanese	Japanese.	1041
96.02	*Pass code*	Pass codes can be entered into this parameter to activate further access levels (see parameter *96.03 Access levels active*) or to configure the user lock. • Entering "358" toggles the parameter lock, which prevents the changing of all other parameters through the control panel or the Drive composer PC tool. • In winch application, entering pass code 584 makes certain access levels active, for example, parameter **75.24 FB control stand reference** will be visible. After reading/using the hidden parameters, activate end user access level by entering pass code 1. This will hide parameter **75.24**. • Entering the user pass code (by default, "10000000") enables parameters *96.100*…*96.102*, which can be used to define a new user pass code and to select the actions that are to be prevented. • Entering an invalid pass code will close the user lock if open, ie. hide parameters *96.100*…*96.102*. After entering the code, check that the parameters are in fact hidden. If they are not, enter another (random) pass code. **Note:** You must change the default user pass code to maintain a high level of cybersecurity. <u>Store the code in a safe place – the protection cannot be disabled even by ABB if the code is lost</u>. See also section *User lock* (page *183*).	0
	0…99999999	Pass code.	-
96.03	*Access levels active*	Displays which access levels have been activated by pass codes entered into parameter *96.02 Pass code*. This parameter is read-only.	001b

Bit	Name
0	Full menu
1	Service
2	Advanced programmer
3…10	Reserved
11	Long menu
12	OEM 1
13	Short menu
14	Parameter lock
15	Reserved

No.	Name/Value	Description	Def/FbEq16
	0000h…FFFFh	Active access levels.	-

No.	Name/Value	Description	Def/FbEq16
96.04	*Macro select*	Selects the application macro. See chapter *Default control connections* (page *85*) for more information. After a selection is made, the parameter reverts automatically to *Done*. **Note:** This parameter cannot be changed while the drive is running.	*Done*
	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*	Displays which application macro is currently selected. See chapter *Default control connections* (page *85*) for more information. To change the macro, use parameter *96.04 Macro select*.	*Factory*
	Factory	Factory macro.	0
	Hand/Auto	Hand/Auto macro.	1
	PID-CTRL	PID control macro.	2
	T-CTRL	Torque control macro.	3
	Sequence control	Sequential control macro.	4
	FIELDBUS	Reserved.	5
96.06	*Parameter restore*	Restores the original settings of the control program, ie. parameter default values. **Note:** This parameter cannot be changed while the drive is running.	*Done*
	Done	Restoring is completed.	0
	Restore defaults	All editable parameter values are restored to default values, except • motor data and ID run results • parameter *31.42 Overcurrent fault limit* • control panel/PC communication settings • I/O extension module settings • fieldbus adapter settings • encoder configuration data • application macro selection and the parameter defaults implemented by it • parameter *95.01 Supply voltage* • parameter *95.09 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/Value	Description	Def/FbEq16
	Clear all	All editable parameter values are restored to default values, except • control panel/PC communication settings • application macro selection and the parameter defaults implemented by it • parameter *95.01 Supply voltage* • parameter *95.09 Switch fuse controller* • differentiated defaults implemented by parameters *95.20 HW options word 1* and *95.21 HW options word 2*. • user lock configuration parameters *96.100*...*96.102*. PC tool communication is interrupted during the restoring. **Note:** Activating this selection will restore the default settings of the fieldbus adapter if one is connected, potentially including settings that cannot be accessed through drive parameters.	62
	Reset all fieldbus settings	Fieldbus adapter and embedded fieldbus interface settings (parameter groups 50…58) are restored to default values. This will also restore the default settings of the fieldbus adapter if one is connected, potentially including settings that cannot be accessed through drive parameters.	32
96.07	*Parameter save manually*	Saves the valid parameter values to permanent memory. This parameter should be used to store values sent from a fieldbus, or when using an external power supply to the control board as the supply might have a very short hold-up time when powered off. **Note:** A new parameter value is saved automatically when changed from the PC tool or control panel but not when altered through a fieldbus adapter connection.	*Done*
	Done	Save completed.	0
	Save	Save in progress.	1
96.08	*Control board boot*	Changing the value of this parameter to 1 reboots the control unit (without requiring a power off/on cycle of the complete drive module). The value reverts to 0 automatically. **Note:** This parameter cannot be changed while the drive is running.	0
	0…1	1 = Reboot the control unit.	1 = 1
96.09	*FSO reboot*	Changing the value of this parameter to 1 reboots the optional FSO-xx safety functions module. The value reverts to 0 automatically.	*False*
	False	0.	0
	True	1.	1
	Other [bit]	Source selection (see *Terms and abbreviations* on page *187*).	-
96.10	*User set status*	Displays the status of the user parameter sets. This parameter is read-only. See also section *User parameter sets* (page *182*).	-
	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

<table>
<tr><th>No.</th><th>Name/Value</th><th>Description</th><th>Def/FbEq16</th></tr>
<tr><td></td><td>Faulted</td><td>Invalid parameter set.</td><td>3</td></tr>
<tr><td></td><td>User set 1</td><td>User set 1 has been loaded.</td><td>4</td></tr>
<tr><td></td><td>User set 2</td><td>User set 2 has been loaded.</td><td>5</td></tr>
<tr><td></td><td>User set 3</td><td>User set 3 has been loaded.</td><td>6</td></tr>
<tr><td></td><td>User set 4</td><td>User set 4 has been loaded.</td><td>7</td></tr>
<tr><td>96.11</td><td>User set save/load</td><td>Enables the saving and restoring of up to four custom sets of parameter settings. See section User parameter sets (page 182).
The set that was in use before powering down the drive is in use after the next power-up.
Notes:
• Hardware configuration settings such as I/O extension module, fieldbus and encoder configuration parameters (groups 14…16, 51…56, 58 and 92…93, part of group 95, 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.
• Parameter changes made after loading a set are not automatically stored – they must be saved using this parameter.
• If no sets have been saved, attempting to load a set will create all sets from the currently active parameter settings.
• Switching between sets is only possible with the drive stopped.</td><td>No action</td></tr>
<tr><td></td><td>No action</td><td>Load or save operation complete; normal operation.</td><td>0</td></tr>
<tr><td></td><td>User set I/O mode</td><td>Load user parameter set using parameters 96.12 User set I/O mode in1 and 96.13 User set I/O mode in2.</td><td>1</td></tr>
<tr><td></td><td>Load set 1</td><td>Load user parameter set 1.</td><td>2</td></tr>
<tr><td></td><td>Load set 2</td><td>Load user parameter set 2.</td><td>3</td></tr>
<tr><td></td><td>Load set 3</td><td>Load user parameter set 3.</td><td>4</td></tr>
<tr><td></td><td>Load set 4</td><td>Load user parameter set 4.</td><td>5</td></tr>
<tr><td></td><td>Save to set 1</td><td>Save user parameter set 1.</td><td>18</td></tr>
<tr><td></td><td>Save to set 2</td><td>Save user parameter set 2.</td><td>19</td></tr>
<tr><td></td><td>Save to set 3</td><td>Save user parameter set 3.</td><td>20</td></tr>
<tr><td></td><td>Save to set 4</td><td>Save user parameter set 4.</td><td>21</td></tr>
<tr><td>96.12</td><td>User set I/O mode in1</td><td>When parameter 96.11 User set save/load is set to User set I/O mode, selects the user parameter set together with parameter 96.13 User set I/O mode in2 as follows:
<table>
<tr><th>Status of source defined by par. 96.12</th><th>Status of source defined by par. 96.13</th><th>User parameter set selected</th></tr>
<tr><td>0</td><td>0</td><td>Set 1</td></tr>
<tr><td>1</td><td>0</td><td>Set 2</td></tr>
<tr><td>0</td><td>1</td><td>Set 3</td></tr>
<tr><td>1</td><td>1</td><td>Set 4</td></tr>
</table></td><td>Not selected</td></tr>
<tr><td></td><td>Not selected</td><td>0.</td><td>0</td></tr>
</table>

No.	Name/Value	Description	Def/FbEq16
	Selected	1.	1
	DI1	Digital input DI1 (*10.02 DI delayed status*, bit 0).	2
	DI2	Digital input DI2 (*10.02 DI delayed status*, bit 1).	3
	DI3	Digital input DI3 (*10.02 DI delayed status*, bit 2).	4
	DI4	Digital input DI4 (*10.02 DI delayed status*, bit 3).	5
	DI5	Digital input DI5 (*10.02 DI delayed status*, bit 4).	6
	DI6	Digital input DI6 (*10.02 DI delayed status*, bit 5).	7
	DIO1	Digital input/output DIO1 (*11.02 DIO delayed status*, bit 0).	10
	DIO2	Digital input/output DIO2 (*11.02 DIO delayed status*, bit 1).	11
	Other [bit]	Source selection (see *Terms and abbreviations* on page *187*).	-
96.13	*User set I/O mode in2*	See parameter *96.12 User set I/O mode in1*.	*Not selected*
96.16	*Unit selection*	Selects the unit of parameters indicating power, temperature and torque.	0000 0000b

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

	0000h … FFFFh	Unit selection word.	1 = 1
96.20	*Time synchronization source*	Defines the 1st priority external source for synchronization of the drive's time and date.	*DDCS Controller*
	Internal	No external source selected.	0
	DDCS Controller	External controller.	1
	Fieldbus A or B	Fieldbus interface A or B.	2
	Fieldbus A	Fieldbus interface A.	3
	Fieldbus B	Fieldbus interface B.	4
	D2D or M/F	The master station on a master/follower or drive-to-drive link.	5
	Embedded FB	Reserved.	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

No.	Name/Value	Description	Def/FbEq16
96.23	*M/F and D2D clock synchronization*	In the master drive, activates clock synchronization for master/follower and drive-to-drive communication.	*Inactive*
	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 via the parameter interface from a fieldbus or application program. This may be necessary if the fieldbus protocol does not support time synchronization.	-
	1…59999 days	Days since beginning of 1980.	1 = 1 day
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
	1…1439 min	Minutes since midnight.	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
	0…59999 ms	Number of milliseconds since last minute.	1 = 1 ms

No.	Name/Value	Description	Def/FbEq16
96.29	*Time sync source status*	Time source status word. This parameter is read-only.	-

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

No.	Name/Value	Description	Def/FbEq16
	0000h…FFFFh	Time source status word 1.	1 = 1
96.31	*Drive ID number*	Specifies an ID number for the drive. The ID can be read by an external controller through DDCS, for example, for comparison with an ID contained by the controller's application.	0
	0…32767	ID number.	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*
	Disable	Power-up event logging disabled.	0
	Enable	Power-up event logging enabled.	1
96.51	*Clear fault and event logger*	Clears the contents of the event logs. See section *Event logs* (page *627*).	-
	0…65535	00001 = Clear the event logs. (The value will automatically revert to 00000.)	1 = 1

No.	Name/Value	Description	Def/FbEq16
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*. 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 *182*).	0h
	00000000h… 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*
	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.	00000000b

Bit	Name	Description
0	Approved checksum 1	1 = Enabled: Checksum 1 (*96.56*) is observed.
1	Approved checksum 2	1 = Enabled: Checksum 2 (*96.57*) is observed.
2	Approved checksum 3	1 = Enabled: Checksum 3 (*96.58*) is observed.
3	Approved checksum 4	1 = Enabled: Checksum 4 (*96.59*) is observed.
4	Set approved checksum 1	1 = Set: Copy value of *96.53* into *96.56*.
5	Set approved checksum 2	1 = Set: Copy value of *96.53* into *96.57*.
6	Set approved checksum 3	1 = Set: Copy value of *96.53* into *96.58*.
7	Set approved checksum 4	1 = Set: Copy value of *96.53* into *96.59*.
8…15	Reserved	

No.	Name/Value	Description	Def/FbEq16
	00000000b… 11111111b	Checksum control word.	1 = 1
96.56	*Approved checksum 1*	Approved (reference) checksum 1.	0h
	00000000h… FFFFFFFFh	Approved checksum 1.	-
96.57	*Approved checksum 2*	Approved (reference) checksum 2.	0h
	00000000h… FFFFFFFFh	Approved checksum 2.	-

No.	Name/Value	Description	Def/FbEq16
96.58	*Approved checksum 3*	Approved (reference) checksum 3.	0h
	00000000h… FFFFFFFFh	Approved checksum 3.	-
96.59	*Approved checksum 4*	Approved (reference) checksum 4.	0h
	00000000h… FFFFFFFFh	Approved checksum 4.	-
96.61	*User data logger status word*	Provides status information on the user data logger (see page *627*). This parameter is read-only.	0000b

Bit	Name	Description
0	Running	1 = The user data logger is running. The bit is cleared after the post-trigger time has passed.
1	Triggered	1 = The user data logger has been triggered. The bit is cleared when the logger is restarted.
2	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.
3	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.
4…15	Reserved	

No.	Name/Value	Description	Def/FbEq16
	0000b…1111b	User data logger status word.	1 = 1
96.63	*User data logger trigger*	Triggers, or selects a source that triggers, the user data logger.	*Off*
	Off	0.	0
	On	1.	1
	Other [bit]	Source selection (see *Terms and abbreviations* on page *187*).	-
96.64	*User data logger start*	Starts, or selects a source that starts, the user data logger.	*Off*
	Off	0.	0
	On	1.	1
	Other [bit]	Source selection (see *Terms and abbreviations* on page *187*).	-
96.65	*Factory data logger time level*	Selects the sampling interval for the factory data logger (see page *627*).	*500us*
	500us	500 microseconds.	500
	2ms	2 milliseconds.	2000
	10ms	10 milliseconds.	10000
96.70	*Disable adaptive program*	Enables/disables the adaptive program (if present). See also section *Adaptive programming* (page *125*). **Note:** This parameter cannot be changed while the drive is running.	*No*
	No	Adaptive program enabled.	0
	Yes	Adaptive program disabled.	1

No.	Name/Value	Description	Def/FbEq16
96.100	*Change user pass code*	(Visible when user lock is open) To change the current user pass code, enter a new code into this parameter as well as *96.101 Confirm user pass code*. A warning will be active until the new pass code is confirmed. To cancel changing the pass code, close the user lock without confirming. To close the lock, enter an invalid pass code in parameter *96.02 Pass code*, activate parameter *96.08 Control board boot*, or cycle the power. See also section *User lock* (page *183*).	10000000
	10000000… 99999999	New user pass code.	-
96.101	*Confirm user pass code*	(Visible when user lock is open) Confirms the new user pass code entered in *96.100 Change user pass code*.	
	10000000… 99999999	Confirmation of new user pass code.	-

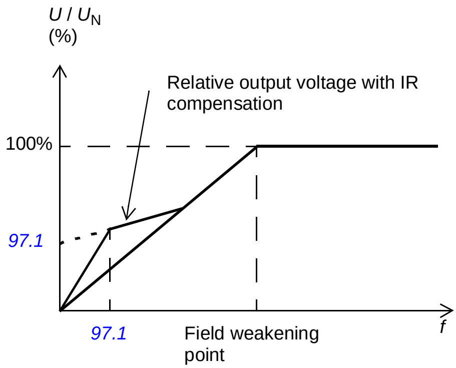
No.	Name/Value	Description	Def/FbEq16
96.102	*User lock functionality*	(Visible when user lock is open) Selects the actions or functionalities to be prevented by the user lock. Note that the changes made take effect only when the user lock is closed. See parameter *96.02 Pass code*. **Note:** We recommend you select all the actions and functionalities unless otherwise required by the application.	1000b

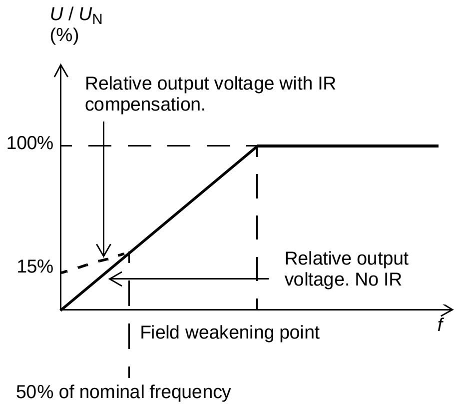
Bit	Name	Information
0	Disable ABB access levels	1 = ABB access levels (service, advanced programmer, etc.; see *96.03*) disabled
1	Freeze parameter lock state	1 = Changing the parameter lock state prevented, ie. pass code 358 has no effect
2	Disable file download	1 = Loading of files to drive prevented. 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.
3	Disable FB write to hidden	1 = Access to parameters on disabled access levels from fieldbus prevented.
4…5	Reserved	
6	Protect AP	1 = Creating a backup and restoring from a backup prevented.
7	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.
8…10	Reserved	
11	Disable OEM access level 1	1 = OEM access level 1 disabled.
12	Disable OEM access level 2	1 = OEM access level 2 disabled.
13	Disable OEM access level 3	1 = OEM access level 3 disabled.
14…15	Reserved	

No.	Name/Value	Description	Def/FbEq16
	0000h…FFFFh	Selection of actions to be prevented by user lock.	-
97 Motor control		Motor model settings.	
97.01	*Switching frequency reference*	When parameter *97.09 Switching freq mode* is set to Custom, defines the switching frequency when it is not otherwise being internally limited. **Note:** This is an expert level parameter and should not be adjusted without appropriate skill.	4.500 kHz
	0.000...24.000 kHz	Switching frequency reference.	1000 = 1 kHz

No.	Name/Value	Description	Def/FbEq16
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. **Notes**: • This is an expert level parameter and should not be adjusted without appropriate skill. • The drive has internal switching frequency limits that may override the value entered here.	1.500 kHz
	0.000...24.000 kHz	Minimum switching frequency.	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%
	0 … 200%	Slip gain.	1 = 1%
97.04	*Voltage reserve*	Defines the minimum allowed voltage reserve. When the voltage reserve has decreased to the set value, the drive enters the field weakening area. **Note:** This is an expert level parameter and should not be adjusted without appropriate skill. If the intermediate circuit DC voltage U_{dc} = 550 V and the voltage reserve is 5%, the RMS value of the maximum output voltage in steady-state operation is 0.95 × 550 V / sqrt(2) = 369 V The dynamic performance of the motor control in the field weakening area can be improved by increasing the voltage reserve value, but the drive enters the field weakening area earlier.	-2%
	-4 … 50%	Voltage reserve.	1 = 1%
97.05	*Flux braking*	Defines the level of flux braking power. (Other stopping and braking modes can be configured in parameter group *21 Start/stop mode*). See section *Flux braking* (page *160*). **Note:** This is an expert level parameter and should not be adjusted without appropriate skill.	*Disabled*
	Disabled	Flux braking is disabled.	0
	Moderate	Flux level is limited during the braking. Deceleration time is longer compared to full braking.	1
	Full	Maximum braking power. Almost all available current is used to convert the mechanical braking energy to thermal energy in the motor.	2
97.06	*Flux reference select*	Defines the source of flux reference. **Note:** This is an expert level parameter and should not be adjusted without appropriate skill.	*User flux reference*
	Zero	None.	0
	User flux reference	Parameter *97.07 User flux reference*.	1

No.	Name/Value	Description	Def/FbEq16
	Other [bit]	Source selection (see *Terms and abbreviations* on page *187*).	-
97.07	*User flux reference*	Defines the flux reference when parameter *97.06 Flux reference select* is set to *User flux reference*.	100.00%
	0.00 … 200.00%	User-defined flux reference.	100 = 1%
97.08	*Optimizer minimum torque*	This parameter can be used to improve the control dynamics of a synchronous reluctance motor or a salient permanent magnet synchronous motor. As a rule of thumb, define a level to which the output torque must rise with minimum delay. This will increase the motor current and improve the torque response at low speeds.	0.0%
	0.0...1600.0%	Optimizer torque limit.	10 = 1%
97.09	*Switching freq mode*	An optimization setting for balancing between control performance and motor noise level. **Note:** • This is an expert level parameter and should not be adjusted without appropriate skill. • Other settings than *Normal* may require derating. Refer to the rating data in the Hardware manual of the drive.	*Normal*
	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 the anti-cogging function: a high-frequency alternating signal is injected to the motor in the low speed region to improve the stability of torque control. This removes the “cogging” that can sometimes be seen as the rotor passes the motor magnetic poles. Anti-cogging can be enabled with different amplitude levels. **Notes**: • This is an expert level parameter and should not be adjusted without appropriate skill. • Use as low a level as possible that gives satisfactory performance. • Signal injection cannot be applied to asynchronous motors.	*Disabled*
	Disabled	Anti-cogging disabled.	0
	Enabled (5%)	Anti-cogging enabled with amplitude level of 5%.	1
	Enabled (10%)	Anti-cogging enabled with amplitude level of 10%.	2
	Enabled (15%)	Anti-cogging enabled with amplitude level of 15%.	3
	Enabled (20%)	Anti-cogging enabled with amplitude level of 20%.	4

No.	Name/Value	Description	Def/FbEq16
97.11	*TR tuning*	Rotor time constant tuning. This parameter can be used to improve torque accuracy in closed-loop control of an induction motor. Normally, the motor identification run provides sufficient torque accuracy, but manual fine-tuning can be applied in exceptionally demanding applications to achieve optimal performance. **Note:** This is an expert level parameter and should not be adjusted without appropriate skill.	100%
	25…400%	Rotor time constant tuning.	1 = 1%
97.12	*IR comp step-up frequency*	IR compensation (ie. output voltage boost) can be used in step-up applications to compensate for resistive losses in the step-up transformer, cabling and motor. As voltage cannot be fed through a step-up transformer at 0 Hz, a specific type of IR compensation should be used. This parameter adds a frequency breakpoint for parameter *97.13 IR compensation* as shown below.  0.0 Hz = Breakpoint disabled. **Note:** This parameter cannot be changed while the drive is running.	0.0 Hz
	0.0 … 50.0 Hz	IR compensation breakpoint for step-up applications.	1 = 1 Hz

No.	Name/Value	Description	Def/FbEq16
97.13	*IR compensation*	Defines the relative output voltage boost at zero speed (IR compensation). The function is useful in applications with a high break-away torque where direct torque control (DTC mode) cannot be applied.  See also section *IR compensation for scalar motor control* on page *156*.	0.00%
	0.00 … 50.00%	Voltage boost at zero speed in percent of nominal motor voltage.	1 = 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*
	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, ie. above the limit defined by parameter *97.19 Hexagonal field weakening point*. See also section *Hexagonal motor flux pattern* (page *163*).	*Off*
	Off	The rotating flux vector follows a circular pattern.	0
	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, ie. the frequency at which maximum output voltage is reached). See parameter *97.18 Hexagonal field weakening*.	120.0%
	0.0...500.0%	Activation limit for hexagonal field weakening.	1 = 1%

No.	Name/Value	Description	Def/FbEq16
97.32	*Motor torque unfiltered*	Unfiltered motor torque in percent of the nominal motor torque. This parameter is read-only.	-
	-1600.0 … 1600.0%	Unfiltered motor torque.	See par. *46.03*
97.33	*Speed estimate filter time*	Defines a filtering time for estimated speed. See the diagram on page *719*.	5.00 ms
	0.00 … 100.00 ms	Filtering time for estimated speed.	1 = 1 ms

98 User motor parameters		Motor values supplied by the user that are used in the motor model. These parameters are useful for non-standard motors, or to just get more accurate motor control of the motor on site. A better motor model always improves the shaft performance.	
98.01	*User motor model mode*	Activates the motor model parameters *98.02*…*98.14* and the rotor angle offset parameter *98.15*. **Notes**: • Parameter value is automatically set to zero when ID run is selected by parameter *99.13 ID run requested*. The values of parameters *98.02*…*98.15* are then updated according to the motor characteristics identified during the ID run. • Measurements made directly from the motor terminals during the ID run are likely to produce slightly different values than those on a datasheet from a motor manufacturer. • This parameter cannot be changed while the drive is running.	*Not selected*
	Not selected	The values detected during the ID run are being used.	0
	Motor parameters	The values of parameters *98.02*…*98.14* are used as the motor model.	1
	Position offset	The value of parameter *98.15* is used as the rotor angle offset. Parameters *98.02*…*98.14* are inactive.	2
	Motor parameters & position offset	The values of parameters *98.02*…*98.14* are used as the motor model, and the value of parameter *98.15* is used as the rotor angle offset.	3
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 p.u.
	0.00000 … 0.50000 p.u.	Stator resistance in per unit.	-
98.03	*Rr user*	Defines the rotor resistance R_R of the motor model. Resistance value is given at 20 °C (68 °F). **Note:** This parameter is valid only for asynchronous motors.	0.00000 p.u.
	0.00000 … 0.50000 p.u.	Rotor resistance in per unit.	-

No.	Name/Value	Description	Def/FbEq16
98.04	*Lm user*	Defines the main inductance L_M of the motor model. **Note:** This parameter is valid only for asynchronous motors.	0.00000 p.u.
	0.00000 … 10.00000 p.u.	Main inductance in per unit.	-
98.05	*SigmaL user*	Defines the leakage inductance σL_S. **Note:** This parameter is valid only for asynchronous motors.	0.00000 p.u.
	0.00000 … 1.00000 p.u.	Leakage inductance in per unit.	-
98.06	*Ld user*	Defines the direct axis (synchronous) inductance. **Note:** This parameter is valid only for permanent magnet motors.	0.00000 p.u.
	0.00000 … 10.00000 p.u	Direct axis inductance in per unit.	-
98.07	*Lq user*	Defines the quadrature axis (synchronous) inductance. **Note:** This parameter is valid only for permanent magnet motors.	0.00000 p.u.
	0.00000 … 10.00000 p.u	Quadrature axis inductance in per unit.	-
98.08	*PM flux user*	Defines the permanent magnet flux. **Note:** This parameter is valid only for permanent magnet motors.	0.00000 p.u.
	0.00000 … 2.00000 p.u	Permanent magnet flux in per unit.	-
98.09	*Rs user SI*	Defines the stator resistance R_S of the motor model. Resistance value is given at 20 °C (68 °F).	0.00000 ohm
	0.00000 … 100.00000 ohm	Stator resistance.	-
98.10	*Rr user SI*	Defines the rotor resistance R_R of the motor model. Resistance value is given at 20 °C (68 °F). **Note:** This parameter is valid only for asynchronous motors.	0.00000 ohm
	0.00000 … 100.00000 ohm	Rotor resistance.	-
98.11	*Lm user SI*	Defines the main inductance L_M of the motor model. **Note:** This parameter is valid only for asynchronous motors.	0.00 mH
	0.00 … 100000.00 mH	Main inductance.	1 = 10 mH
98.12	*SigmaL user SI*	Defines the leakage inductance σL_S. **Note:** This parameter is valid only for asynchronous motors.	0.00 mH
	0.00 … 100000.00 mH	Leakage inductance.	1 = 10 mH
98.13	*Ld user SI*	Defines the direct axis (synchronous) inductance. **Note:** This parameter is valid only for permanent magnet motors.	0.00 mH
	0.00 … 100000.00 mH	Direct axis inductance.	1 = 10 mH

No.	Name/Value	Description	Def/FbEq16
98.14	*Lq user SI*	Defines the quadrature axis (synchronous) inductance. **Note:** This parameter is valid only for permanent magnet motors.	0.00 mH
	0.00 … 100000.00 mH	Quadrature axis inductance.	1 = 10 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*. Notes: • The value is in electrical degrees. The electrical angle equals the mechanical angle multiplied by the number of motor pole pairs. • This parameter is valid only for permanent magnet motors.	0 deg
	0…360 deg	Angle offset.	1 = 1 deg

99 Motor data		Motor configuration settings.	
99.03	*Motor type*	Selects the motor type. **Note:** This parameter cannot be changed while the drive is running.	*Asynchronous motor*; *SynRM* (*95.21* b1); *Permanent magnet motor* (*95.21* b2)
	Asynchronous motor	Standard squirrel cage AC induction motor (asynchronous induction motor).	0
	Permanent magnet motor	Permanent magnet motor. Three-phase AC synchronous motor with permanent magnet rotor and sinusoidal BackEMF voltage.	1
	SynRM	Synchronous reluctance motor. Three-phase AC synchronous motor with salient pole rotor without permanent magnets.	2

No.	Name/Value	Description	Def/FbEq16
99.04	*Motor control mode*	Selects the motor control mode. **Note:** This parameter cannot be changed while the drive is running.	*DTC*
	DTC	Direct torque control. This mode is suitable for most applications. **Note:** Instead of direct torque control, scalar control is also available, and should be used in the following situations: • with multimotor applications 1) if the load is not equally shared between the motors, 2) if the motors are of different sizes, or 3) if the motors are going to be changed after the motor identification (ID run) • if the nominal current of the motor is less than 1/6 of the nominal output current of the drive • if the drive is used with no motor connected (for example, for test purposes). See also section *Operating modes of the drive* (page *122*).	0
	Scalar	Scalar control. The outstanding motor control accuracy of DTC cannot be achieved in scalar control. Refer to the *DTC* selection above for a list of applications where scalar control should definitely be used. Notes: • 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 *156*), and section *Operating modes of the drive* (page *122*).	1
99.06	*Motor nominal current*	Defines the nominal motor current. Must be equal to the value on the motor rating plate. If multiple motors are connected to the drive, enter the total current of the motors. Notes: • Correct motor operation requires that the magnetizing current of the motor does not exceed 90% of the nominal current of the drive. • This parameter cannot be changed while the drive is running.	0.0 A
	0.0 … 6400.0 A	Nominal current of the motor. The allowable range is 1/6…2 × I_N of the drive (0…2 × I_N with scalar control mode).	1 = 1 A

No.	Name/Value	Description	Def/FbEq16
99.07	*Motor nominal voltage*	Defines the nominal motor voltage supplied to the motor. This setting must match the value on the rating plate of the motor. Notes: • With permanent magnet motors, the nominal voltage is the BackEMF voltage at nominal speed of the motor. If the voltage is given as voltage per rpm, e.g. 60 V per 1000 rpm, the voltage for a nominal speed of 3000 rpm is 3 × 60 V = 180 V. 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). • The stress on the motor insulation is always dependent on the drive supply voltage. This also applies to the case where the motor voltage rating is lower than that of the drive and the supply. • This parameter cannot be changed while the drive is running.	0.0 V
	0.0 … 800.0 V	Nominal voltage of the motor. The allowable range is 1/6…2 × UN (nominal voltage) of the drive. UN equals the upper bound of the supply voltage range selected by parameter *95.01 Supply voltage*.	10 = 1 V
99.08	*Motor nominal frequency*	Defines the nominal motor frequency. This setting must match the value on the rating plate of the motor. **Note:** This parameter cannot be changed while the drive is running.	50.00 Hz
	0.00 … 1000.00 Hz	Nominal frequency of the motor.	10 = 1 Hz
99.09	*Motor nominal speed*	Defines the nominal motor speed. The setting must match the value on the rating plate of the motor. **Note:** This parameter cannot be changed while the drive is running.	0 rpm
	0 … 30000 rpm	Nominal speed of the motor.	1 = 1 rpm
99.10	*Motor nominal power*	Defines the nominal motor power. The setting must match the value on the rating plate of the motor. If multiple motors are connected to the drive, enter the total power of the motors. The unit is selected by parameter *96.16 Unit selection*. **Note:** This parameter cannot be changed while the drive is running.	0.00 kW or hp
	0.00 … 10000.00 kW or 0.00 … 13404.83 hp	Nominal power of the motor.	1 = 1 unit
99.11	*Motor nominal cos ?*	Defines the cosphi of the motor for a more accurate motor model. The value is not obligatory, but is useful with an asynchronous motor, especially when performing a standstill identification run. With a permanent magnet or synchronous reluctance motor, this value is not needed. **Notes:** • Do not enter an estimated value. If you do not know the exact value, leave the parameter at zero. • This parameter cannot be changed while the drive is running.	0.00
	0.00 … 1.00	Cosphi of the motor.	100 = 1

No.	Name/Value	Description	Def/FbEq16
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*. Notes: • This setting is an alternative to the nominal power value (*99.10*). If both are entered, *99.12* takes priority. • This parameter cannot be changed while the drive is running.	0.000 N·m or lb·ft
	0.000… 4000000.000 N·m or lb·ft	Nominal motor torque.	1 = 1 unit
99.13	*ID run requested*	Selects the type of the motor identification routine (ID run) performed at the next start of the drive. During the ID run, the drive will identify the characteristics of the motor for optimum motor control. If no ID run has been performed yet (or if default parameter values have been restored using parameter *96.06 Parameter restore*), this parameter is automatically set to *Standstill*, signifying that an ID run must be performed. After the ID run, the drive stops and this parameter is automatically set to *None*. Notes: • For the *Advanced* ID run, the machinery must always be de-coupled from the motor. • With a permanent magnet or synchronous reluctance motor, a *Normal*, *Reduced* or *Standstill* ID run requires that the motor shaft is NOT locked and the load torque is less than 10%. • Configure motor temperature measurement (if used) in parameter group *35 Motor thermal protection* before activating the ID run. • 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*. • With scalar control mode (*99.04 Motor control mode* = *Scalar*), the ID run is not requested automatically. However, an ID run can be performed for more accurate torque estimation. • Once the ID run is activated, it can be canceled by stopping the drive. • The ID run must be performed every time any of the motor parameters (*99.04*, *99.06*…*99.12*) have been changed. • Ensure that the Safe torque off and emergency stop circuits (if any) are closed during the ID run. • Mechanical brake (if present) is not opened by the logic for the ID run. • This parameter cannot be changed while the drive is running.	*None*; *Standstill* (*95.21* b1/b2)
	None	No motor ID run is requested. This mode can be selected only if the ID run (*Normal*, *Reduced*, *Standstill*, *Advanced*, *Advanced Standstill*) has already been performed once.	0

No.	Name/Value	Description	Def/FbEq16
	Normal	Normal ID run. Guarantees good control accuracy for all cases. The ID run takes about 90 seconds. This mode should be selected whenever it is possible. Notes: • If the load torque will be higher than 20% of motor nominal torque, or if the machinery is not able to withstand the nominal torque transient during the ID run, then the driven machinery must be de-coupled from the motor during a Normal ID run. • Check the direction of rotation of the motor before starting the ID run. During the run, the motor will rotate in the forward direction. **WARNING!** The motor will run at up to approximately 50…100% of the nominal speed during the ID run. ENSURE THAT IT IS SAFE TO RUN THE MOTOR BEFORE PERFORMING THE ID RUN!	1
	Reduced	Reduced ID run. This mode should be selected instead of the *Normal* or *Advanced* ID Run if • mechanical losses are higher than 20% (i.e. the motor cannot be de-coupled from the driven equipment), or if • flux reduction is not allowed while the motor is running (i.e. in case of a motor with an integrated brake supplied from the motor terminals). With this ID run mode, the resultant motor control in the field weakening area or at high torques is not necessarily as accurate as motor control following a Normal ID run. Reduced ID run is completed faster than the Normal ID Run (< 90 seconds). **Note:** Check the direction of rotation of the motor before starting the ID run. During the run, the motor will rotate in the forward direction. **WARNING!** The motor will run at up to approximately 50…100% of the nominal speed during the ID run. ENSURE THAT IT IS SAFE TO RUN THE MOTOR BEFORE PERFORMING THE ID RUN!	2
	Standstill	Standstill ID run. The motor is injected with DC current. With an AC induction (asynchronous) motor, the motor shaft is not rotated. With a permanent magnet motor or synchronous reluctance motor, the shaft can rotate up to half a revolution. **Note:** A standstill ID run should be selected only if the *Normal*, *Reduced* or *Advanced* ID run is not possible due to the restrictions caused by the connected mechanics. See also selection *Advanced Standstill*.	3

No.	Name/Value	Description	Def/FbEq16
	Autophasing	The autophasing routine determines the start angle of a permanent magnet or synchronous reluctance motor (see page *157*). 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. Notes: • This setting can only be used after a *Normal*, *Reduced*, *Standstill*, *Advanced* or *Advanced Standstill* ID run has already been performed. • Depending on the selected autophasing mode, the shaft can rotate during autophasing. See parameter *21.13 Autophasing mode*.	4
	Current measurement calibration	Requests current measurement calibration, ie. identification of current measurement offset and gain errors. The calibration will be performed at next start.	5
	Advanced	Advanced ID run. Guarantees the best possible control accuracy. The ID run can take a couple of minutes. This mode should be selected when top performance is needed across the whole operating area. Note: The driven machinery must be de-coupled from the motor because of high torque and speed transients that are applied. **WARNING!** The motor may run at up to the maximum (positive) and minimum (negative) allowed speed during the ID run. Several accelerations and decelerations are done. The maximum torque, current and speed allowed by the limit parameters may be utilized. ENSURE THAT IT IS SAFE TO RUN THE MOTOR BEFORE PERFORMING THE ID RUN!	6
	Advanced Standstill	Advanced Standstill ID run. This selection is recommended with AC induction motors up to 75 kW instead of the *Standstill* ID run if • the exact nominal ratings of the motor are not known, or • the control performance of the motor is not satisfactory after a *Standstill* ID run. **Note:** The time it takes for the *Advanced Standstill* ID run to complete varies according to motor size. With a small motor, the ID run typically completes within 5 minutes; with a large motor, the ID run may take up to an hour.	7
99.14	*Last ID run performed*	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*
	None	No ID run has been performed.	0
	Normal	*Normal* ID run.	1
	Reduced	*Reduced* ID run.	2
	Standstill	*Standstill* ID run.	3

No.	Name/Value	Description	Def/FbEq16
	Autophasing	*Autophasing*.	4
	Current measurement calibration	*Current measurement calibration*.	
	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
	0…1000	Number of pole pairs.	1 = 1
99.16	*Motor phase order*	Switches the rotation direction of motor. This parameter can be used if the motor turns in the wrong direction (for example, because of the wrong phase order in the motor cable), and correcting the cabling is considered impractical. Notes: • Changing this parameter does not affect speed reference polarities, so positive speed reference will rotate the motor forward. The phase order selection just ensures that “forward” is in fact the correct direction. • After changing this parameter, the sign of encoder feedback (if any) must be checked. This can be done by setting parameter *90.41 Motor feedback selection* to *Estimate*, and comparing the sign of *90.01 Motor speed for control* to *90.10 Encoder 1 speed* (or *90.20 Encoder 2 speed*). If the sign of the measurement is incorrect, the encoder wiring must be corrected or the sign of *90.43 Motor gear numerator* reversed. • This parameter cannot be changed while the drive is running.	*U V W*
	U V W	Normal.	0
	U W V	Reversed rotation direction.	1

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

8

Additional parameter data

What this chapter contains

This chapter lists the parameters with some additional data such as their ranges and 32-bit fieldbus scaling. For parameter descriptions, see chapter *Parameters* (page *187*).

Parameter list view

Parameters are visible based on access levels. See the description of *Parameter access levels* on page *16*.

In the below parameters table, index of those parameters that are visible in the short menu (pass code 1) are shaded Grey.

Terms and abbreviations

Term	Definition
FbEq32	32-bit fieldbus equivalent: The scaling between the integer used in communication and the value shown on the panel. The corresponding 16-bit scalings are listed in chapter *Parameters* (page *187*).
int16	16-bit integer value (15 bits + sign).
int32	32-bit integer value (31 bits + sign).
No.	Parameter number.
real32	32-bit floating point number.
uint16	16-bit unsigned integer.
uint32	32-bit unsigned integer.
Type	Parameter type. See *int16*, *int32*, *real32*, *uint16*, *uint32*.

Fieldbus addresses

Refer to the *User's manual* of the fieldbus adapter.

Parameter groups 1…9

Note: Grey shaded parameter index indicates that the parameter is visible in the short menu (pass code 1).

No.	Name	Type	Range	Unit	FbEq32
01 Actual values					
01.01	Motor speed used	*real32*	-30000.00 … 30000.00	rpm	100 = 1 rpm
01.02	Motor speed estimated	*real32*	-30000.00 … 30000.00	rpm	100 = 1 rpm
01.03	Motor speed%	*real32*	-1000.00...1000.00	%	100 = 1%
01.04	Encoder 1 speed filtered	*real32*	-30000.00 … 30000.00	rpm	100 = 1 rpm
01.05	Encoder 2 speed filtered	*real32*	-30000.00 … 30000.00	rpm	100 = 1 rpm
01.06	Output frequency	*real32*	-600.00 … 600.00	Hz	100 = 1 Hz
01.07	Motor current	*real32*	0.00 … 30000.00	A	100 = 1 A
01.08	Motor current% of motor nom	*real32*	0.0...1000.0	%	10 = 1%
01.10	Motor torque	*real32*	-1600.0 … 1600.0	%	10 = 1%
01.11	DC voltage	*real32*	0.00 … 2000.00	V	100 = 1 V
01.13	Output voltage	*real32*	0…2000	V	1 = 1 V
01.14	Output power	*real32*	-32768.00 … 32767.00	kW or hp	100 = 1 unit
01.15	Output power% of motor nom	*real32*	-300.00...300.00	%	10 = 1%
01.17	Motor shaft power	*real32*	-32768.00... 32767.00	kW or hp	100 = 1 unit
01.18	Inverter GWh motoring	*int16*	0…32767	GWh	1 = 1 GWh
01.19	Inverter MWh motoring	*int16*	0…1000	MWh	1 = 1 MWh
01.20	Inverter kWh motoring	*real32*	0…1000	kWh	1 = 1 kWh
01.21	U-phase current	*real32*	-30000.00 … 30000.00	A	100 = 1 A
01.22	V-phase current	*real32*	-30000.00 … 30000.00	A	100 = 1 A
01.23	W-phase current	*real32*	-30000.00 … 30000.00	A	100 = 1 A
01.24	Flux actual%	*real32*	0…200	%	1 = 1%
01.25	INU momentary cos Φ	*real32*	-1.00 … 1.00	-	100 = 1
01.29	Speed change rate	*real32*	-15000 … 15000	rpm/s	1 = 1 rpm/s
01.30	Nominal torque scale	*uint32*	0.000…4000000.000	N·m or lb·ft	1000 = 1 unit
01.31	Ambient temperature	*real32*	-40.0 … 200.0	°C or °F	10 = 1°
01.32	Inverter GWh regenerating	*int16*	0…32767	GWh	1 = 1 GWh
01.33	Inverter MWh regenerating	*int16*	0…1000	MWh	1 = 1 MWh
01.34	Inverter kWh regenerating	*real32*	0…1000	kWh	1 = 1 kWh
01.35	Mot - regen energy GWh	*int16*	-32768 … 32767	GWh	1 = 1 GWh
01.36	Mot - regen energy MWh	*int16*	-1000…1000	MWh	1 = 1 MWh
01.37	Mot - regen energy kWh	*real32*	-1000…1000	kWh	1 = 1 kWh
01.61	Abs motor speed used	*real32*	0.00 … 30000.00	rpm	100 = 1 rpm
01.62	Abs motor speed%	*real32*	0.00 … 1000.00	%	100 = 1%
01.63	Abs output frequency	*real32*	0.00 … 600.00	Hz	100 = 1 Hz
01.64	Abs motor torque	*real32*	0.0 … 1600.0	%	10 = 1%
01.65	Abs output power	*real32*	0.00 … 32767.00	kW or hp	100 = 1 unit

No.	Name	Type	Range	Unit	FbEq32
01.66	Abs output power% motor nom	*real32*	0.00 … 300.00	%	10 = 1%
01.68	Abs motor shaft power	*real32*	0.00 … 32767.00	kW or hp	100 = 1 unit
01.70	Ambient temperature%	*real32*	-200.00...200.00	%	100 = 1%
01.71	Step-up motor current	*real32*	0.00 … 30000.00	A	100 = 1 A
01.72	U-phase RMS current	*real32*	0.00 … 30000.00	A	100 = 1 A
01.73	V-phase RMS current	*real32*	0.00 … 30000.00	A	100 = 1 A
01.74	W-phase RMS current	*real32*	0.00 … 30000.00	A	100 = 1 A
03 Input references					
03.01	Panel reference	*real32*	-100000.00 … 100000.00	-	100 = 1
03.02	Panel reference 2	*real32*	-30000.00 … 30000.00	-	100 = 1
03.05	FB A reference 1	*real32*	-100000.00 … 100000.00	-	100 = 1
03.06	FB A reference 2	*real32*	-100000.00 … 100000.00	-	100 = 1
03.07	FB B reference 1	*real32*	-100000.00 … 100000.00	-	100 = 1
03.08	FB B reference 2	*real32*	-100000.00 … 100000.00	-	100 = 1
03.09	EFB reference 1	*real32*	-30000.00 … 30000.00	-	100 = 1
03.10	EFB reference 2	*real32*	-30000.00 … 30000.00	-	100 = 1
03.11	DDCS controller ref 1	*real32*	-30000.00 … 30000.00	-	100 = 1
03.12	DDCS controller ref 2	*real32*	-30000.00 … 30000.00	-	100 = 1
03.13	M/F or D2D ref1	*real32*	-30000.00 … 30000.00	-	100 = 1
03.14	M/F or D2D ref2	*real32*	-30000.00 … 30000.00	-	100 = 1
03.30	FB A reference 1 int32	*int32*	-2147483648...2147483647	-	1 = 1
03.31	FB A reference 2 int32	*int32*	-2147483648...2147483647	-	1 = 1
04 Warnings and faults					
04.01	Tripping fault	*uint16*	0000h…FFFFh	-	1 = 1
04.02	Active fault 2	*uint16*	0000h…FFFFh	-	1 = 1
04.03	Active fault 3	*uint16*	0000h…FFFFh	-	1 = 1
04.04	Active fault 4	*uint16*	0000h…FFFFh	-	1 = 1
04.05	Active fault 5	*uint16*	0000h…FFFFh	-	1 = 1
04.06	Active warning 1	*uint16*	0000h…FFFFh	-	1 = 1
04.07	Active warning 2	*uint16*	0000h…FFFFh	-	1 = 1
04.08	Active warning 3	*uint16*	0000h…FFFFh	-	1 = 1
04.09	Active warning 4	*uint16*	0000h…FFFFh	-	1 = 1
04.10	Active warning 5	*uint16*	0000h…FFFFh	-	1 = 1
04.11	Latest fault	*uint16*	0000h…FFFFh	-	1 = 1
04.12	2nd latest fault	*uint16*	0000h…FFFFh	-	1 = 1
04.13	3rd latest fault	*uint16*	0000h…FFFFh	-	1 = 1
04.14	4th latest fault	*uint16*	0000h…FFFFh	-	1 = 1
04.15	5th latest fault	*uint16*	0000h…FFFFh	-	1 = 1
04.16	Latest warning	*uint16*	0000h…FFFFh	-	1 = 1
04.17	2nd latest warning	*uint16*	0000h…FFFFh	-	1 = 1
04.18	3rd latest warning	*uint16*	0000h…FFFFh	-	1 = 1

No.	Name	Type	Range	Unit	FbEq32
04.19	4th latest warning	*uint16*	0000h…FFFFh	-	1 = 1
04.20	5th latest warning	*uint16*	0000h…FFFFh	-	1 = 1
04.21	Fault word 1	*uint16*	0000h…FFFFh	-	1 = 1
04.22	Fault word 2	*uint16*	0000h…FFFFh	-	1 = 1
04.31	Warning word 1	*uint16*	0000h…FFFFh	-	1 = 1
04.32	Warning word 2	*uint16*	0000h…FFFFh	-	1 = 1
04.40	Event word 1	*uint16*	0000h…FFFFh	-	1 = 1
04.41	Event word 1 bit 0 code	*uint16*	0000h…FFFFh	-	1 = 1
04.42	Event word 1 bit 0 aux code	*uint32*	0000 0000h … FFFF FFFFh	-	1 = 1
04.43	Event word 1 bit 1 code	*uint16*	0000h…FFFFh	-	1 = 1
04.44	Event word 1 bit 1 aux code	*uint32*	0000 0000h … FFFF FFFFh	-	1 = 1
…	…	…	…	…	
04.71	Event word 1 bit 15 code	*uint16*	0000h…FFFFh	-	1 = 1
04.72	Event word 1 bit 15 aux code	*uint32*	0000 0000h … FFFF FFFFh	-	1 = 1
04.120	Fault/Warning word compatibility	*uint16*	0…1	-	1 = 1
05 Diagnostics					
05.01	On-time counter	*uint16*	0…65535	d	1 = 1 d
05.02	Run-time counter	*uint16*	0…65535	d	1 = 1 d
05.04	Fan on-time counter	*uint16*	0…65535	d	1 = 1 d
05.09	Time from power-up	*uint32*	0…4294967295	-	1 = 1
05.11	Inverter temperature	*real32*	-40.0 … 160.0	%	10 = 1%
05.22	Diagnostic word 3	*uint16*	0000h…FFFFh	-	
05.41	Main fan service counter	*real32*	0…150	%	1 = 1%
05.42	Aux. fan service counter	*real32*	0…150	%	1 = 1%
06 Control and status words					
06.01	Main control word	*uint16*	0000h…FFFFh	-	1 = 1
06.02	Application control word	*uint16*	0000h…FFFFh	-	1 = 1
06.03	FBA A transparent control word	*uint32*	00000000h…FFFFFFFFh	-	1 = 1
06.04	FBA B transparent control word	*uint32*	00000000h…FFFFFFFFh	-	
06.05	EFB transparent control word	*uint32*	00000000h…FFFFFFFFh	-	
06.11	Main status word	*uint16*	0000h…FFFFh	-	1 = 1
06.16	Drive status word 1	*uint16*	0b0000...1b1111	-	1 = 1
06.17	Drive status word 2	*uint16*	0b0000...1b1111	-	1 = 1
06.18	Start inhibit status word	*uint16*	0b0000...1b1111	-	1 = 1
06.19	Speed control status word	*uint16*	0b0000...1b1111	-	1 = 1
06.20	Constant speed status word	*uint16*	0b0000...1b1111	-	1 = 1

No.	Name	Type	Range	Unit	FbEq32
06.21	Drive status word 3	*uint16*	0b0000...1b1111	-	1 = 1
06.25	Drive inhibit status word 2	*uint16*	0b0000...1b1111	-	1 = 1
06.29	MSW bit 10 sel	*uint32*	-	-	1 = 1
06.30	MSW bit 11 sel	*uint32*	-	-	1 = 1
06.31	MSW bit 12 sel	*uint32*	-	-	1 = 1
06.32	MSW bit 13 sel	*uint32*	-	-	1 = 1
06.33	MSW bit 14 sel	*uint32*	-	-	1 = 1
06.45	Follower CW user bit 0 selection	*uint32*	-	-	1 = 1
06.46	Follower CW user bit 1 selection	*uint32*	-	-	1 = 1
06.47	Follower CW user bit 2 selection	*uint32*	-	-	1 = 1
06.48	Follower CW user bit 3 selection	*uint32*	-	-	1 = 1
06.50	User status word 1	*uint16*	0b0000...1b1111	-	1 = 1
06.60	User status word 1 bit 0 sel	*uint32*	-	-	1 = 1
06.61	User status word 1 bit 1 sel	*uint32*	-	-	1 = 1
06.62	User status word 1 bit 2 sel	*uint32*	-	-	1 = 1
06.63	User status word 1 bit 3 sel	*uint32*	-	-	1 = 1
06.64	User status word 1 bit 4 sel	*uint32*	-	-	1 = 1
06.65	User status word 1 bit 5 sel	*uint32*	-	-	1 = 1
06.66	User status word 1 bit 6 sel	*uint32*	-	-	1 = 1
06.67	User status word 1 bit 7 sel	*uint32*	-	-	1 = 1
06.68	User status word 1 bit 8 sel	*uint32*	-	-	1 = 1
06.69	User status word 1 bit 9 sel	*uint32*	-	-	1 = 1
06.70	User status word 1 bit 10 sel	*uint32*	-	-	1 = 1
06.71	User status word 1 bit 11 sel	*uint32*	-	-	1 = 1
06.72	User status word 1 bit 12 sel	*uint32*	-	-	1 = 1
06.73	User status word 1 bit 13 sel	*uint32*	-	-	1 = 1
06.74	User status word 1 bit 14 sel	*uint32*	-	-	1 = 1
06.75	User status word 1 bit 15 sel	*uint32*	-	-	1 = 1
06.100	User control word 1	*uint16*	0000h…FFFFh	-	1 = 1
06.101	User control word 2	*uint16*	0000h…FFFFh	-	1 = 1
07 System info					
07.03	Drive rating id	*uint16*	-	-	1 = 1
07.04	Firmware name	*uint32*	-	-	1 = 1
07.05	Firmware version	*uint32*	0.00.0.0...255.255.255.255	-	1 = 1
07.06	Loading package name	*uint32*	-	-	1 = 1
07.07	Loading package version	*uint32*	0.00.0.0...255.255.255.255	-	1 = 1
07.08	Bootloader version	*uint32*	0.00.0.0...255.255.255.255	-	1 = 1
07.11	Cpu usage	*uint32*	0…100	%	1 = 1%

No.	Name	Type	Range	Unit	FbEq32
07.13	PU logic version number	*uint16*	-	-	1 = 1
07.15	FPGA logic version number	*uint16*	0000h…FFFFh	-	1 = 1
(Parameters 07.21...07.24 only visible with option +N8010 [application programmability])					
07.21	Application environment status 1	*uint16*	0b0000...1b1111	-	1 = 1
07.22	Application environment status 2	*uint16*	0b0000...1b1111	-	1 = 1
07.23	Application name	*uint32*	-	-	1 = 1
07.24	Application version	*uint32*	0.00.0.0...255.255.255.255	-	1 = 1
07.25	Customization package name	*uint32*	-	-	1 = 1
07.26	Customization package version	*uint32*	0.00.0.0...255.255.255.255	-	1 = 1
07.30	Adaptive program status	*uint16*	0000h…FFFFh	-	1 = 1
(Parameters 07.40...07.41 only visible with option +N8010 [application programmability])					
07.40	IEC application Cpu usage peak	*real32*	0.0 … 100.0	%	10 = 1%
07.41	IEC application Cpu load average	*real32*	0.0 … 100.0	%	10 = 1%
07.51	Slot 1 option module	*uint16*	-	-	1 = 1
07.52	Slot 2 option module	*uint16*	-	-	1 = 1
07.53	Slot 3 option module	*uint16*	-	-	1 = 1
09 Winch actual signals					
09.01	Winch status word 1	*uint16*	0b0000...1b1111	-	1 = 1
09.02	Winch status word 2	*uint16*	0b0000...1b1111	-	1 = 1
09.03	Winch status word 3	*uint16*	0b0000...1b1111	-	1 = 1
09.04	Winch status word 4	*uint16*	0b0000...1b1111	-	1 = 1
09.05	Winch abnormal condition status	*uint16*	0b0000...1b1111	-	1 = 1
09.06	Winch M/F status	*uint16*	-	-	-
09.07	Winch actual status	*uint16*	-	-	-
09.09	Winch FB control word	*uint16*	0b0000...1b1111	-	1 = 1
09.11	Chain actual speed	*real32*	-2000.000....2000.000	m/s	10 = 1
09.13	Chain length OUT	*real32*	-2000.000....2000.000	m	10 = 1
09.14	Chain length IN	*real32*	-2000.000....2000.000	m	10 = 1
09.15	Chain actual speed m/min	*real32*	-120000.000...120000.000	m/min	10 = 1
09.17	Winch motor torque	*real32*	-600.0...600.0	%	10 = 1
09.20	Winch speed ref	*real32*	-15000...15000	rpm	1 = 1
09.21	Power control ref	*real32*	-600.00...600.00	%	100 = 1%
09.22	Automooring actual setpoint	*real32*	0.0...1000000.0	%	10 = 1%
09.23	Rope actual tension	*real32*	0.0...32767.0	%	10 = 1%
09.24	Rope tension memorized	*real32*	0.0...32767.0	%	10 = 1%
09.25	Automooring control deviation	*real32*	-32768.0...32767.0	%	10 = 1%
09.26	AM hysteresis high used	*real32*	0.0...32767.0	%	10 = 1%

No.	Name	Type	Range	Unit	FbEq32
09.27	AM hysteresis low used	*real32*	0.0...32767.0	%	10 = 1%
09.28	AM deadband high used	*real32*	0.0...32767.0	%	10 = 1%
09.29	AM deadband low used	*real32*	0.0...32767.0	%	10 = 1%
09.30	AM setpoint switch output	*real32*	0.0...1000000.0	%	10 = 1%
09.31	Rotating mode rope tension	*real32*	0.0...32767.0	%	10 = 1%
09.32	Winch scaled tension	*real32*	0.0...32767.0	%	10 = 1%
09.33	AM joystick motpot output	*real32*	0.0...1000000.0	%	10 = 1%
09.35	Step reference output	*real32*	0.00...100.00	%	100 = 1%
09.36	AM scaled setpoint	*real32*	0.0...1000000.0	%	10 = 1%
09.37	AM combined setpoint/actual	*real32*	0.0...1000000.0	%	10 = 1%
09.40	Winch operating time	*uint16*	0...1100000	hours	1 = 1 h
09.41	Number of power on	*uint16*	0...65535	-	1 = 1
09.42	Number of brake open	*uint16*	0...4294967295	-	1 = 1
09.200	CC Winch SW 1	*uint16*	0000h…FFFFh	-	1 = 1

Parameter groups 10…99

No.	Name	Type	Range	Unit	FbEq32
10 Standard DI, RO					
10.01	DI status	*uint16*	0b0000...1b1111	-	1 = 1
10.02	DI delayed status	*uint16*	0b0000...1b1111	-	1 = 1
10.03	DI force selection	*uint16*	0b0000...1b1111	-	1 = 1
10.04	DI force data	*uint16*	0b0000...1b1111	-	1 = 1
10.05	DI1 ON delay	*uint32*	0.0 … 3000.0	s	10 = 1 s
10.06	DI1 OFF delay	*uint32*	0.0 … 3000.0	s	10 = 1 s
10.07	DI2 ON delay	*uint32*	0.0 … 3000.0	s	10 = 1 s
10.08	DI2 OFF delay	*uint32*	0.0 … 3000.0	s	10 = 1 s
10.09	DI3 ON delay	*uint32*	0.0 … 3000.0	s	10 = 1 s
10.10	DI3 OFF delay	*uint32*	0.0 … 3000.0	s	10 = 1 s
10.11	DI4 ON delay	*uint32*	0.0 … 3000.0	s	10 = 1 s
10.12	DI4 OFF delay	*uint32*	0.0 … 3000.0	s	10 = 1 s
10.13	DI5 ON delay	*uint32*	0.0 … 3000.0	s	10 = 1 s
10.14	DI5 OFF delay	*uint32*	0.0 … 3000.0	s	10 = 1 s
10.15	DI6 ON delay	*uint32*	0.0 … 3000.0	s	10 = 1 s
10.16	DI6 OFF delay	*uint32*	0.0 … 3000.0	s	10 = 1 s
10.21	RO status	*uint16*	0b0000...1b1111	-	1 = 1
10.24	RO1 source	*uint32*	-	-	-
10.25	RO1 ON delay	*uint32*	0.0 … 3000.0	s	10 = 1 s
10.26	RO1 OFF delay	*uint32*	0.0 … 3000.0	s	10 = 1 s
10.27	RO2 source	*uint32*	-	-	-
10.28	RO2 ON delay	*uint32*	0.0 … 3000.0	s	10 = 1 s
10.29	RO2 OFF delay	*uint32*	0.0 … 3000.0	s	10 = 1 s
10.30	RO3 source	*uint32*	-	-	-
10.31	RO3 ON delay	*uint32*	0.0 … 3000.0	s	10 = 1 s
10.32	RO3 OFF delay	*uint32*	0.0 … 3000.0	s	10 = 1 s
10.51	DI filter time	*uint32*	0.3 … 100.0	ms	10 = 1 ms
10.90	IO time level selection	*uint32*	-	-	-
10.99	RO/DIO control word	*uint16*	0b0000...1b1111	-	1 = 1
11 Standard DIO, FI, FO					
11.01	DIO status	*uint16*	0b0000...1b1111	-	1 = 1
11.02	DIO delayed status	*uint16*	0b0000...1b1111	-	1 = 1
11.05	DIO1 function	*uint16*	0…2	-	1 = 1
11.06	DIO1 output source	*uint32*	-		1 = 1
11.07	DIO1 ON delay	*uint32*	0.0 … 3000.0	s	10 = 1 s
11.08	DIO1 OFF delay	*uint32*	0.0 … 3000.0	s	10 = 1 s
11.09	DIO2 function	*uint16*	0…2	-	1 = 1
11.10	DIO2 output source	*uint32*	-		1 = 1

No.	Name	Type	Range	Unit	FbEq32
11.11	DIO2 ON delay	*uint32*	0.0 … 3000.0	s	10 = 1 s
11.12	DIO2 OFF delay	*uint32*	0.0 … 3000.0	s	10 = 1 s
11.38	Freq in 1 actual value	*real32*	0…16000	Hz	1 = 1 Hz
11.39	Freq in 1 scaled	*real32*	-32768.000 … 32767.000	-	1000 = 1
11.42	Freq in 1 min	*real32*	0…16000	Hz	1 = 1 Hz
11.43	Freq in 1 max	*real32*	0…16000	Hz	1 = 1 Hz
11.44	Freq in 1 at scaled min	*real32*	-32768.000 … 32767.000	-	1000 = 1
11.45	Freq in 1 at scaled max	*real32*	-32768.000 … 32767.000	-	1000 = 1
11.54	Freq out 1 actual value	*real32*	0…16000	Hz	1 = 1 Hz
11.55	Freq out 1 source	*uint32*	-	-	1 = 1
11.58	Freq out 1 src min	*real32*	-32768.000 … 32767.000	-	1000 = 1
11.59	Freq out 1 src max	*real32*	-32768.000 … 32767.000	-	1000 = 1
11.60	Freq out 1 at src min	*real32*	0…16000	Hz	1 = 1 Hz
11.61	Freq out 1 at src max	*real32*	0…16000	Hz	1 = 1 Hz
11.81	DIO filter time	*uint32*	0.3...100.0	ms	10 = 1 ms
12 Standard AI					
12.01	AI tune	*uint16*	0...4	-	
12.03	AI supervision function	*uint16*	0…4	-	-
12.04	AI supervision selection	*uint16*	0b0000...1b1111	-	1 = 1
12.05	AI supervision force	*uint16*	0b0000...1b1111	-	1 = 1
12.11	AI1 actual value	*real32*	-22.000 … 22.000	mA or V	1000 = 1 unit
12.12	AI1 scaled value	*real32*	-32768.000 … 32767.000	-	1000 = 1
12.15	AI1 unit selection	*uint16*	-	-	1 = 1
12.16	AI1 filter time	*real32*	0.000 … 30.000	s	1000 = 1 s
12.17	AI1 min	*real32*	-22.000 … 22.000	mA or V	1000 = 1 mA or V
12.18	AI1 max	*real32*	-22.000 … 22.000	mA or V	1000 = 1 mA or V
12.19	AI1 scaled at AI1 min	*real32*	-32768.000 … 32767.000	-	1000 = 1
12.20	AI1 scaled at AI1 max	*real32*	-32768.000 … 32767.000	-	1000 = 1
12.21	AI2 actual value	*real32*	-22.000 … 22.000	mA or V	1000 = 1 mA or V
12.22	AI2 scaled value	*real32*	-32768.000 … 32767.000	-	1000 = 1
12.25	AI2 unit selection	*uint16*	-	-	1 = 1
12.26	AI2 filter time	*real32*	0.000 … 30.000	s	1000 = 1 s
12.27	AI2 min	*real32*	-22.000 … 22.000	mA or V	1000 = 1 mA or V
12.28	AI2 max	*real32*	-22.000 … 22.000	mA or V	1000 = 1 mA or V
12.29	AI2 scaled at AI2 min	*real32*	-32768.000 … 32767.000	-	1000 = 1
12.30	AI2 scaled at AI2 max	*real32*	-32768.000 … 32767.000	-	1000 = 1
12.200	EXT1 scaled AI reference	*real32*	-30000.00...30000.00	rpm	1 = 1 rpm

No.	Name	Type	Range	Unit	FbEq32
12.201	EXT1 scaled AI reference source	*uint32*	-	-	1 = 1
13 Standard AO					
13.11	AO1 actual value	*real32*	0.000 … 22.000	mA	1000 = 1 mA
13.12	AO1 source	*uint32*	-	-	1 = 1
13.16	AO1 filter time	*real32*	0.000 … 30.000	s	1000 = 1 s
13.17	AO1 source min	*real32*	-32768.0 … 32767.0	-	10 = 1
13.18	AO1 source max	*real32*	-32768.0 … 32767.0	-	10 = 1
13.19	AO1 out at AO1 src min	*real32*	0.000 … 22.000	mA	1000 = 1 mA
13.20	AO1 out at AO1 src max	*real32*	0.000 … 22.000	mA	1000 = 1 mA
13.21	AO2 actual value	*real32*	0.000 … 22.000	mA	1000 = 1 mA
13.22	AO2 source	*uint32*	-	-	1 = 1
13.26	AO2 filter time	*real32*	0.000 … 30.000	s	1000 = 1 s
13.27	AO2 source min	*real32*	-32768.0 … 32767.0	-	10 = 1
13.28	AO2 source max	*real32*	-32768.0 … 32767.0	-	10 = 1
13.29	AO2 out at AO2 src min	*real32*	0.000 … 22.000	mA	1000 = 1 mA
13.30	AO2 out at AO2 src max	*real32*	0.000 … 22.000	mA	1000 = 1 mA
13.91	AO1 data storage	*real32*	-327.68 … 327.67	-	100 = 1
13.92	AO2 data storage	*real32*	-327.68 … 327.67	-	100 = 1
14 I/O extension module 1					
14.01	Module 1 type	*uint16*	0…4	-	1 = 1
14.02	Module 1 location	*uint16*	1…254	-	1 = 1
14.03	Module 1 status	*uint16*	0…4	-	1 = 1
DIx (14.01 Module 1 type = FDIO-01)					
14.05	DI status	*uint16*	00000000h…FFFFFFFFh	-	1 = 1
14.06	DI delayed status	*uint16*	00000000h…FFFFFFFFh	-	1 = 1
14.08	DI filter time	*real32*	0.8 … 100.0	ms	10 = 1 ms
14.12	DI1 ON delay	*real32*	0.00 … 3000.00	s	100 = 1 s
14.13	DI1 OFF delay	*real32*	0.00 … 3000.00	s	100 = 1 s
14.17	DI2 ON delay	*real32*	0.00 … 3000.00	s	100 = 1 s
14.18	DI2 OFF delay	*real32*	0.00 … 3000.00	s	100 = 1 s
14.22	DI3 ON delay	*real32*	0.00 … 3000.00	s	100 = 1 s
14.23	DI3 OFF delay	*real32*	0.00 … 3000.00	s	100 = 1 s
Common parameters for DIOx (14.01 Module 1 type = FIO-01 or *FIO-11)*					
14.05	DIO status	*uint16*	00000000h…FFFFFFFFh	-	1 = 1
14.06	DIO delayed status	*uint16*	00000000h…FFFFFFFFh	-	1 = 1
DIO1/DIO2 (14.01 Module 1 type = FIO-01 or *FIO-11)*					
14.08	DIO filter time	*real32*	0.8...100.0	ms	10 = 1 ms
14.09	DIO1 function	*uint16*	0…1	-	1 = 1
14.11	DIO1 output source	*uint32*	-	-	1 = 1
14.12	DIO1 ON delay	*real32*	0.00 … 3000.00	s	100 = 1 s

No.	Name	Type	Range	Unit	FbEq32
14.13	DIO1 OFF delay	*real32*	0.00 … 3000.00	s	100 = 1 s
14.14	DIO2 function	*uint16*	0…1	-	1 = 1
14.16	DIO2 output source	*uint32*	-	-	1 = 1
14.17	DIO2 ON delay	*real32*	0.00 … 3000.00	s	100 = 1 s
14.18	DIO2 OFF delay	*real32*	0.00 … 3000.00	s	100 = 1 s
DIO3/DIO4 (14.01 Module 1 type = FIO-01)					
14.19	DIO3 function	*uint16*	0…1	-	1 = 1
14.21	DIO3 output source	*uint32*	-	-	1 = 1
14.22	DIO3 ON delay	*real32*	0.00 … 3000.00	s	100 = 1 s
14.23	DIO3 OFF delay	*real32*	0.00 … 3000.00	s	100 = 1 s
14.24	DIO4 function	*uint16*	0…1	-	1 = 1
14.26	DIO4 output source	*uint32*	-	-	1 = 1
14.27	DIO4 ON delay	*real32*	0.00 … 3000.00	s	100 = 1 s
14.28	DIO4 OFF delay	*real32*	0.00 … 3000.00	s	100 = 1 s
RO1/RO2 (14.01 Module 1 type = FIO-01 or *FDIO-01)*					
14.31	RO status	*uint16*	0000h…FFFFh	-	1 = 1
14.34	RO1 source	*uint32*	-	-	1 = 1
14.35	RO1 ON delay	*real32*	0.00 … 3000.00	s	100 = 1 s
14.36	RO1 OFF delay	*real32*	0.00 … 3000.00	s	100 = 1 s
14.37	RO2 source	*uint32*	-	-	1 = 1
14.38	RO2 ON delay	*real32*	0.00 … 3000.00	s	10 = 1 s
14.39	RO2 OFF delay	*real32*	0.00 … 3000.00	s	10 = 1 s
Common parameters for AIx (14.01 Module 1 type = FIO-11 or *FAIO-01)*					
14.19	AI supervision function	*uint16*	0…4	-	1 = 1
14.20	AI supervision selection	*uint16*	0000h…FFFFh	-	1 = 1
14.21	AI tune	*uint16*	0…6 (*FIO-11*) 0…4 (*FAIO-01*)	-	1 = 1
14.22	AI force selection	*uint16*	0000h…FFFFh	-	1 = 1
AI1/AI2 (14.01 Module 1 type = FIO-11 or *FAIO-01)*					
14.26	AI1 actual value	*real32*	-22.000 … 22.000	mA or V	1000 = 1 unit
14.27	AI1 scaled value	*real32*	-32768.000 … 32767.000	-	1000 = 1
14.28	AI1 force data	*real32*	-22.000 … 22.000	mA or V	1000 = 1 unit
14.29	AI1 HW switch position	*uint16*	-	-	1 = 1
14.30	AI1 unit selection	*uint16*	-	-	1 = 1
14.31	AI1 filter gain	*uint16*	0…7	-	1 = 1
14.32	AI1 filter time	*real32*	0.000 … 30.000	s	1000 = 1 s
14.33	AI1 min	*real32*	-22.000 … 22.000	mA or V	1000 = 1 mA or V
14.34	AI1 max	*real32*	-22.000 … 22.000	mA or V	1000 = 1 mA or V
14.35	AI1 scaled at AI1 min	*real32*	-32768.000 … 32767.000	-	1000 = 1
14.36	AI1 scaled at AI1 max	*real32*	-32768.000 … 32767.000	-	1000 = 1

No.	Name	Type	Range	Unit	FbEq32
14.41	AI2 actual value	*real32*	-22.000 … 22.000	mA or V	1000 = 1 unit
14.42	AI2 scaled value	*real32*	-32768.000 … 32767.000	-	1000 = 1
14.43	AI2 force data	*real32*	-22.000 … 22.000	mA or V	1000 = 1 unit
14.44	AI2 HW switch position	*uint16*	-	-	1 = 1
14.45	AI2 unit selection	*uint16*	-	-	1 = 1
14.46	AI2 filter gain	*uint16*	0…7	-	1 = 1
14.47	AI2 filter time	*real32*	0.000 … 30.000	s	1000 = 1 s
14.48	AI2 min	*real32*	-22.000 … 22.000	mA or V	1000 = 1 mA or V
14.49	AI2 max	*real32*	-22.000 … 22.000	mA or V	1000 = 1 mA or V
14.50	AI2 scaled at AI2 min	*real32*	-32768.000 … 32767.000	-	1000 = 1
14.51	AI2 scaled at AI2 max	*real32*	-32768.000 … 32767.000	-	1000 = 1
AI3 (14.01 Module 1 type = FIO-11)					
14.56	AI3 actual value	*real32*	-22.000 … 22.000	mA or V	1000 = 1 unit
14.57	AI3 scaled value	*real32*	-32768.000 … 32767.000	-	1000 = 1
14.58	AI3 force data	*real32*	-22.000 … 22.000	mA or V	1000 = 1 unit
14.59	AI3 HW switch position	*uint16*	-	-	1 = 1
14.60	AI3 unit selection	*uint16*	-	-	1 = 1
14.61	AI3 filter gain	*uint16*	0…7	-	1 = 1
14.62	AI3 filter time	*real32*	0.000 … 30.000	s	1000 = 1 s
14.63	AI3 min	*real32*	-22.000 … 22.000	mA or V	1000 = 1 mA or V
14.64	AI3 max	*real32*	-22.000 … 22.000	mA or V	1000 = 1 mA or V
14.65	AI3 scaled at AI3 min	*real32*	-32768.000 … 32767.000	-	1000 = 1
14.66	AI3 scaled at AI3 max	*real32*	-32768.000 … 32767.000	-	1000 = 1
Common parameters for AOx (14.01 Module 1 type = FIO-11 or *FAIO-01)*					
14.71	AO force selection	*uint16*	00000000h…FFFFFFFFh	-	1 = 1
AO1 (14.01 Module 1 type = FIO-11 or *FAIO-01)*					
14.76	AO1 actual value	*real32*	0.000 … 22.000	mA	1000 = 1 mA
14.77	AO1 source	*uint32*	-	-	1 = 1
14.78	AO1 force data	*real32*	0.000 … 22.000	mA	1000 = 1 mA
14.79	AO1 filter time	*real32*	0.000 … 30.000	s	1000 = 1 s
14.80	AO1 source min	*real32*	-32768.0 … 32767.0	-	10 = 1
14.81	AO1 source max	*real32*	-32768.0 … 32767.0	-	10 = 1
14.82	AO1 out at AO1 src min	*real32*	0.000 … 22.000	mA	1000 = 1 mA
14.83	AO1 out at AO1 src max	*real32*	0.000 … 22.000	mA	1000 = 1 mA
AO2 (14.01 Module 1 type = FAIO-01)					
14.86	AO2 actual value	*real32*	0.000 … 22.000	mA	1000 = 1 mA
14.87	AO2 source	*uint32*	-	-	1 = 1
14.88	AO2 force data	*real32*	0.000 … 22.000	mA	1000 = 1 mA

No.	Name	Type	Range	Unit	FbEq32
14.89	AO2 filter time	*real32*	0.000 … 30.000	s	1000 = 1 s
14.90	AO2 source min	*real32*	-32768.0 … 32767.0	-	10 = 1
14.91	AO2 source max	*real32*	-32768.0 … 32767.0	-	10 = 1
14.92	AO2 out at AO2 src min	*real32*	0.000 … 22.000	mA	1000 = 1 mA
14.93	AO2 out at AO2 src max	*real32*	0.000 … 22.000	mA	1000 = 1 mA
15 I/O extension module 2					
15.01	Module 2 type	*uint16*	0…4	-	1 = 1
15.02	Module 2 location	*uint16*	1…254	-	1 = 1
15.03	Module 2 status	*uint16*	0…2	-	1 = 1
DIx (15.01 Module 2 type = FDIO-01)					
15.05	DI status	*uint16*	00000000h…FFFFFFFFh	-	1 = 1
15.06	DI delayed status	*uint16*	00000000h…FFFFFFFFh	-	1 = 1
15.08	DI filter time	*real32*	0.8 … 100.0	ms	10 = 1 ms
15.12	DI1 ON delay	*real32*	0.00 … 3000.00	s	100 = 1 s
15.13	DI1 OFF delay	*real32*	0.00 … 3000.00	s	100 = 1 s
15.17	DI2 ON delay	*real32*	0.00 … 3000.00	s	100 = 1 s
15.18	DI2 OFF delay	*real32*	0.00 … 3000.00	s	100 = 1 s
15.22	DI3 ON delay	*real32*	0.00 … 3000.00	s	100 = 1 s
15.23	DI3 OFF delay	*real32*	0.00 … 3000.00	s	100 = 1 s
Common parameters for DIOx (15.01 Module 2 type = FIO-01 or FIO-11)					
15.05	DIO status	*uint16*	00000000h…FFFFFFFFh	-	1 = 1
15.06	DIO delayed status	*uint16*	00000000h…FFFFFFFFh	-	1 = 1
DIO1/DIO2 (15.01 Module 2 type = FIO-01 or FIO-11)					
15.08	DIO filter time	*real32*	0.8...100.0	ms	10 = 1 ms
15.09	DIO1 function	*uint16*	0…1	-	1 = 1
15.11	DIO1 output source	*uint32*	-	-	1 = 1
15.12	DIO1 ON delay	*real32*	0.00 … 3000.00	s	100 = 1 s
15.13	DIO1 OFF delay	*real32*	0.00 … 3000.00	s	100 = 1 s
15.14	DIO2 function	*uint16*	0…1	-	1 = 1
15.16	DIO2 output source	*uint32*	-	-	1 = 1
15.17	DIO2 ON delay	*real32*	0.00 … 3000.00	s	100 = 1 s
15.18	DIO2 OFF delay	*real32*	0.00 … 3000.00	s	100 = 1 s
DIO3/DIO4 (15.01 Module 2 type = FIO-01)					
15.19	DIO3 function	*uint16*	0…1	-	1 = 1
15.21	DIO3 output source	*uint32*	-	-	1 = 1
15.22	DIO3 ON delay	*real32*	0.00 … 3000.00	s	100 = 1 s
15.23	DIO3 OFF delay	*real32*	0.00 … 3000.00	s	100 = 1 s
15.24	DIO4 function	*uint16*	0…1	-	1 = 1
15.26	DIO4 output source	*uint32*	-	-	1 = 1
15.27	DIO4 ON delay	*real32*	0.00 … 3000.00	s	100 = 1 s
15.28	DIO4 OFF delay	*real32*	0.00 … 3000.00	s	100 = 1 s

No.	Name	Type	Range	Unit	FbEq32
RO1/RO2 (15.01 Module 2 type = FIO-01 or FDIO-01)					
15.31	RO status	*uint16*	0000h…FFFFh	-	1 = 1
15.34	RO1 source	*uint32*	-	-	1 = 1
15.35	RO1 ON delay	*real32*	0.00 … 3000.00	s	100 = 1 s
15.36	RO1 OFF delay	*real32*	0.00 … 3000.00	s	100 = 1 s
15.37	RO2 source	*uint32*	-	-	1 = 1
15.38	RO2 ON delay	*real32*	0.00 … 3000.00	s	100 = 1 s
15.39	RO2 OFF delay	*real32*	0.00 … 3000.00	s	100 = 1 s
Common parameters for AIx (15.01 Module 2 type = FIO-11 or FAIO-01)					
15.19	AI supervision function	*uint16*	0…4	-	1 = 1
15.20	AI supervision selection	*uint16*	0000h…FFFFh	-	1 = 1
15.21	AI tune	*uint16*	0...6 (*FIO-11*) 0...4 (*FAIO-01*)	-	1 = 1
15.22	AI force selection	*uint16*	00000000h…FFFFFFFFh	-	1 = 1
AI1/AI2 (15.01 Module 2 type = FIO-11 or FAIO-01)					
15.26	AI1 actual value	*real32*	-22.000 … 22.000	mA or V	1000 = 1 unit
15.27	AI1 scaled value	*real32*	-32768.000 … 32767.000	-	1000 = 1
15.28	AI1 force data	*real32*	-22.000 … 22.000	mA or V	1000 = 1 unit
15.29	AI1 HW switch position	*uint16*	-	-	1 = 1
15.30	AI1 unit selection	*uint16*	-	-	1 = 1
15.31	AI1 filter gain	*uint16*	0…7	-	1 = 1
15.32	AI1 filter time	*real32*	0.000 … 30.000	s	1000 = 1 s
15.33	AI1 min	*real32*	-22.000 … 22.000	mA or V	1000 = 1 mA or V
15.34	AI1 max	*real32*	-22.000 … 22.000	mA or V	1000 = 1 mA or V
15.35	AI1 scaled at AI1 min	*real32*	-32768.000 … 32767.000	-	1000 = 1
15.36	AI1 scaled at AI1 max	*real32*	-32768.000 … 32767.000	-	1000 = 1
15.41	AI2 actual value	*real32*	-22.000 … 22.000	mA or V	1000 = 1 unit
15.42	AI2 scaled value	*real32*	-32768.000 … 32767.000	-	1000 = 1
15.43	AI2 force data	*real32*	-22.000 … 22.000	mA or V	1000 = 1 unit
15.44	AI2 HW switch position	*uint16*	-	-	1 = 1
15.45	AI2 unit selection	*uint16*	-	-	1 = 1
15.46	AI2 filter gain	*uint16*	0…7	-	1 = 1
15.47	AI2 filter time	*real32*	0.000 … 30.000	s	1000 = 1 s
15.48	AI2 min	*real32*	-22.000 … 22.000	mA or V	1000 = 1 mA or V
15.49	AI2 max	*real32*	-22.000 … 22.000	mA or V	1000 = 1 mA or V
15.50	AI2 scaled at AI2 min	*real32*	-32768.000 … 32767.000	-	1000 = 1
15.51	AI2 scaled at AI2 max	*real32*	-32768.000 … 32767.000	-	1000 = 1
AI3 (15.01 Module 2 type = FIO-11)					
15.56	AI3 actual value	*real32*	-22.000 … 22.000	mA or V	1000 = 1 unit

No.	Name	Type	Range	Unit	FbEq32
15.57	AI3 scaled value	*real32*	-32768.000 … 32767.000	-	1000 = 1
15.58	AI3 force data	*real32*	-22.000 … 22.000	mA or V	1000 = 1 unit
15.59	AI3 HW switch position	*uint16*	-	-	1 = 1
15.60	AI3 unit selection	*uint16*	-	-	1 = 1
15.61	AI3 filter gain	*uint16*	0…7	-	1 = 1
15.62	AI3 filter time	*real32*	0.000 … 30.000	s	1000 = 1 s
15.63	AI3 min	*real32*	-22.000 … 22.000	mA or V	1000 = 1 mA or V
15.64	AI3 max	*real32*	-22.000 … 22.000	mA or V	1000 = 1 mA or V
15.65	AI3 scaled at AI3 min	*real32*	-32768.000 … 32767.000	-	1000 = 1
15.66	AI3 scaled at AI3 max	*real32*	-32768.000 … 32767.000	-	1000 = 1
Common parameters for AOx (15.01 Module 2 type = FIO-11 or FAIO-01)					
15.71	AO force selection	*real32*	00000000h…FFFFFFFFh	-	1 = 1
AO1 (15.01 Module 2 type = FIO-11 or FAIO-01)					
15.76	AO1 actual value	*real32*	0.000 … 22.000	mA	1000 = 1 mA
15.77	AO1 source	*uint32*	-	-	1 = 1
15.78	AO1 force data	*real32*	0.000 … 22.000	mA	1000 = 1 mA
15.79	AO1 filter time	*real32*	0.000 … 30.000	s	1000 = 1 s
15.80	AO1 source min	*real32*	-32768.0 … 32767.0	-	10 = 1
15.81	AO1 source max	*real32*	-32768.0 … 32767.0	-	10 = 1
15.82	AO1 out at AO1 src min	*real32*	0.000 … 22.000	mA	1000 = 1 mA
15.83	AO1 out at AO1 src max	*real32*	0.000 … 22.000	mA	1000 = 1 mA
AO2 (15.01 Module 2 type = FAIO-01)					
15.86	AO2 actual value	*real32*	0.000 … 22.000	mA	1000 = 1 mA
15.87	AO2 source	*uint32*	-	-	1 = 1
15.88	AO2 force data	*real32*	0.000 … 22.000	mA	1000 = 1 mA
15.89	AO2 filter time	*real32*	0.000 … 30.000	s	1000 = 1 s
15.90	AO2 source min	*real32*	-32768.0 … 32767.0	-	10 = 1
15.91	AO2 source max	*real32*	-32768.0 … 32767.0	-	10 = 1
15.92	AO2 out at AO2 src min	*real32*	0.000 … 22.000	mA	1000 = 1 mA
15.93	AO2 out at AO2 src max	*real32*	0.000 … 22.000	mA	1000 = 1 mA
16 I/O extension module 3					
16.01	Module 3 type	*uint16*	0…4	-	1 = 1
16.02	Module 3 location	*uint16*	1…254	-	1 = 1
16.03	Module 3 status	*uint16*	0…2	-	1 = 1
DIx (16.01 Module 3 type = FDIO-01)					
16.05	DI status	*uint16*	00000000h…FFFFFFFFh	-	1 = 1
16.06	DI delayed status	*uint16*	00000000h…FFFFFFFFh	-	1 = 1
16.08	DI filter time	*real32*	0.8 … 100.0	ms	10 = 1 ms
16.12	DI1 ON delay	*real32*	0.00 … 3000.00	s	100 = 1 s
16.13	DI1 OFF delay	*real32*	0.00 … 3000.00	s	100 = 1 s

No.	Name	Type	Range	Unit	FbEq32
16.17	DI2 ON delay	*real32*	0.00 … 3000.00	s	100 = 1 s
16.18	DI2 OFF delay	*real32*	0.00 … 3000.00	s	100 = 1 s
16.22	DI3 ON delay	*real32*	0.00 … 3000.00	s	100 = 1 s
16.23	DI3 OFF delay	*real32*	0.00 … 3000.00	s	100 = 1 s
Common parameters for DIOx (16.01 Module 3 type = FIO-01 or *FIO-11)*					
16.05	DIO status	*uint16*	00000000h…FFFFFFFFh	-	1 = 1
16.06	DIO delayed status	*uint16*	00000000h…FFFFFFFFh	-	1 = 1
DIO1/DIO2 (16.01 Module 3 type = FIO-01 or *FIO-11)*					
16.08	DIO filter time	*real32*	0.8...100.0	ms	10 = 1 ms
16.09	DIO1 function	*uint16*	0…1	-	1 = 1
16.11	DIO1 output source	*uint32*	-	-	1 = 1
16.12	DIO1 ON delay	*real32*	0.00 … 3000.00	s	100 = 1 s
16.13	DIO1 OFF delay	*real32*	0.00 … 3000.00	s	100 = 1 s
16.14	DIO2 function	*uint16*	0…1	-	1 = 1
16.16	DIO2 output source	*uint32*	-	-	1 = 1
16.17	DIO2 ON delay	*real32*	0.00 … 3000.00	s	100 = 1 s
16.18	DIO2 OFF delay	*real32*	0.00 … 3000.00	s	100 = 1 s
DIO3/DIO4 (16.01 Module 3 type = FIO-01)					
16.19	DIO3 function	*uint16*	0…1	-	1 = 1
16.21	DIO3 output source	*uint32*	-	-	1 = 1
16.22	DIO3 ON delay	*real32*	0.00 … 3000.00	s	100 = 1 s
16.23	DIO3 OFF delay	*real32*	0.00 … 3000.00	s	100 = 1 s
16.24	DIO4 function	*uint16*	0…1	-	1 = 1
16.26	DIO4 output source	*uint32*	-	-	1 = 1
16.27	DIO4 ON delay	*real32*	0.00 … 3000.00	s	100 = 1 s
16.28	DIO4 OFF delay	*real32*	0.00 … 3000.00	s	100 = 1 s
RO1/RO2 (16.01 Module 3 type = FIO-01 or *FDIO-01)*					
16.31	RO status	*uint16*	0000h…FFFFh	-	1 = 1
16.34	RO1 source	*uint32*	-	-	1 = 1
16.35	RO1 ON delay	*real32*	0.00 … 3000.00	s	100 = 1 s
16.36	RO1 OFF delay	*real32*	0.00 … 3000.00	s	100 = 1 s
16.37	RO2 source	*uint32*	-	-	1 = 1
16.38	RO2 ON delay	*real32*	0.00 … 3000.00	s	100 = 1 s
16.39	RO2 OFF delay	*real32*	0.00 … 3000.00	s	100 = 1 s
Common parameters for AIx (16.01 Module 3 type = FIO-11 or *FAIO-01)*					
16.19	AI supervision function	*uint16*	0…4	-	1 = 1
16.20	AI supervision selection	*uint16*	0000h…FFFFh	-	1 = 1
16.21	AI tune	*uint16*	0...6 (*FIO-11*) 0...4 (*FAIO-01*)	-	1 = 1
16.22	AI force selection	*uint16*	00000000h…FFFFFFFFh	-	1 = 1

No.	Name	Type	Range	Unit	FbEq32
AI1/AI2 (16.01 Module 3 type = FIO-11 or FAIO-01)					
16.26	AI1 actual value	*real32*	-22.000 … 22.000	mA or V	1000 = 1 unit
16.27	AI1 scaled value	*real32*	-32768.000 … 32767.000	-	1000 = 1
16.28	AI1 force data	*real32*	-22.000 … 22.000	mA or V	1000 = 1 unit
16.29	AI1 HW switch position	*uint16*	-	-	1 = 1
16.30	AI1 unit selection	*uint16*	-	-	1 = 1
16.31	AI1 filter gain	*uint16*	0…7	-	1 = 1
16.32	AI1 filter time	*real32*	0.000 … 30.000	s	1000 = 1 s
16.33	AI1 min	*real32*	-22.000 … 22.000	mA or V	1000 = 1 mA or V
16.34	AI1 max	*real32*	-22.000 … 22.000	mA or V	1000 = 1 mA or V
16.35	AI1 scaled at AI1 min	*real32*	-32768.000 … 32767.000	-	1000 = 1
16.36	AI1 scaled at AI1 max	*real32*	-32768.000 … 32767.000	-	1000 = 1
16.41	AI2 actual value	*real32*	-22.000 … 22.000	mA or V	1000 = 1 unit
16.42	AI2 scaled value	*real32*	-32768.000 … 32767.000	-	1000 = 1
16.43	AI2 force data	*real32*	-22.000 … 22.000	mA or V	1000 = 1 unit
16.44	AI2 HW switch position	*uint16*	-	-	1 = 1
16.45	AI2 unit selection	*uint16*	-	-	1 = 1
16.46	AI2 filter gain	*uint16*	0…7	-	1 = 1
16.47	AI2 filter time	*real32*	0.000 … 30.000	s	1000 = 1 s
16.48	AI2 min	*real32*	-22.000 … 22.000	mA or V	1000 = 1 mA or V
16.49	AI2 max	*real32*	-22.000 … 22.000	mA or V	1000 = 1 mA or V
16.50	AI2 scaled at AI2 min	*real32*	-32768.000 … 32767.000	-	1000 = 1
16.51	AI2 scaled at AI2 max	*real32*	-32768.000 … 32767.000	-	1000 = 1
AI3 (16.01 Module 3 type = FIO-11)					
16.56	AI3 actual value	*real32*	-22.000 … 22.000	mA or V	1000 = 1 unit
16.57	AI3 scaled value	*real32*	-32768.000 … 32767.000	-	1000 = 1
16.58	AI3 force data	*real32*	-22.000 … 22.000	mA or V	1000 = 1 unit
16.59	AI3 HW switch position	*uint16*	-	-	1 = 1
16.60	AI3 unit selection	*uint16*	-	-	1 = 1
16.61	AI3 filter gain	*uint16*	0…7	-	1 = 1
16.62	AI3 filter time	*real32*	0.000 … 30.000	s	1000 = 1 s
16.63	AI3 min	*real32*	-22.000 … 22.000	mA or V	1000 = 1 mA or V
16.64	AI3 max	*real32*	-22.000 … 22.000	mA or V	1000 = 1 mA or V
16.65	AI3 scaled at AI3 min	*real32*	-32768.000 … 32767.000	-	1000 = 1
16.66	AI3 scaled at AI3 max	*real32*	-32768.000 … 32767.000	-	1000 = 1
Common parameters for AOx (16.01 Module 3 type = FIO-11 or FAIO-01)					
16.71	AO force selection	*uint16*	00000000h…FFFFFFFFh	-	1 = 1

No.	Name	Type	Range	Unit	FbEq32
AO1 (16.01 Module 3 type = FIO-11 or FAIO-01)					
16.76	AO1 actual value	*real32*	0.000 … 22.000	mA	1000 = 1 mA
16.77	AO1 source	*uint32*	-	-	1 = 1
16.78	AO1 force data	*real32*	0.000 … 22.000	mA	1000 = 1 mA
16.79	AO1 filter time	*real32*	0.000 … 30.000	s	1000 = 1 s
16.80	AO1 source min	*real32*	-32768.0 … 32767.0	-	10 = 1
16.81	AO1 source max	*real32*	-32768.0 … 32767.0	-	10 = 1
16.82	AO1 out at AO1 src min	*real32*	0.000 … 22.000	mA	1000 = 1 mA
16.83	AO1 out at AO1 src max	*real32*	0.000 … 22.000	mA	1000 = 1 mA
AO2 (16.01 Module 3 type = FAIO-01)					
16.86	AO2 actual value	*real32*	0.000 … 22.000	mA	1000 = 1 mA
16.87	AO2 source	*uint32*	-	-	1 = 1
16.88	AO2 force data	*real32*	0.000 … 22.000	mA	1000 = 1 mA
16.89	AO2 filter time	*real32*	0.000 … 30.000	s	1000 = 1 s
16.90	AO2 source min	*real32*	-32768.0 … 32767.0	-	10 = 1
16.91	AO2 source max	*real32*	-32768.0 … 32767.0	-	10 = 1
16.92	AO2 out at AO2 src min	*real32*	0.000 … 22.000	mA	1000 = 1 mA
16.93	AO2 out at AO2 src max	*real32*	0.000 … 22.000	mA	1000 = 1 mA
19 Operation mode					
19.01	Actual operation mode	*uint16*	-	-	1 = 1
19.11	Ext1/Ext2 selection	*uint32*	-	-	1 = 1
19.12	Ext1 control mode	*uint16*	1…7	-	1 = 1
19.14	Ext2 control mode	*uint16*	1…7	-	1 = 1
19.16	Local control mode	*uint16*	0…1	-	1 = 1
19.17	Local control disable	*uint16*	0…1	-	1 = 1
19.20	Scalar control reference unit	*uint16*	0…1	-	1 = 1
20 Start/stop/direction					
20.01	Ext1 commands	*uint16*	-	-	1 = 1
20.02	Ext1 start trigger type	*uint16*	0…1	-	1 = 1
20.03	Ext1 in1 source	*uint32*	-	-	1 = 1
20.04	Ext1 in2 source	*uint32*	-	-	1 = 1
20.05	Ext1 in3 source	*uint32*	-	-	1 = 1
20.06	Ext2 commands	*uint16*	-	-	1 = 1
20.07	Ext2 start trigger type	*uint16*	0…1	-	1 = 1
20.08	Ext2 in1 source	*uint32*	-	-	1 = 1
20.09	Ext2 in2 source	*uint32*	-	-	1 = 1
20.10	Ext2 in3 source	*uint32*	-	-	1 = 1
20.11	Run enable stop mode	*uint16*	0…2	-	1 = 1
20.12	Run enable 1 source	*uint16*	-	-	1 = 1
20.19	Enable start command	*uint32*	-	-	1 = 1
20.23	Positive speed enable	*uint32*	-	-	1 = 1

No.	Name	Type	Range	Unit	FbEq32
20.24	Negative speed enable	*uint32*	-	-	1 = 1
20.25	Jogging enable	*uint32*	-	-	1 = 1
20.26	Jogging 1 start source	*uint32*	-	-	1 = 1
20.27	Jogging 2 start source	*uint32*	-	-	1 = 1
20.29	Local start trigger type	*uint16*	0…1	-	1 = 1
20.30	Enable signals warning function	*uint16*	00b…11b	-	1 = 1
20.200	Power on acknowledge	*uint32*	-	-	-
20.201	Power on ackn reset delay	*real32*	0...30000	ms	
21 Start/stop mode					
21.01	Start mode	*uint16*	0…3	-	1 = 1
21.02	Magnetization time	*uint16*	0…10000	ms	1 = 1 ms
21.03	Stop mode	*uint16*	0…2	-	1 = 1
21.04	Emergency stop mode	*uint16*	0…2	-	1 = 1
21.05	Emergency stop source	*uint32*	-	-	1 = 1
21.06	Zero speed limit	*real32*	0.00 … 30000.00	rpm	100 = 1 rpm
21.07	Zero speed delay	*real32*	0…30000	ms	1 = 1 ms
21.08	DC current control	*uint16*	00b…11b	-	1 = 1
21.09	DC hold speed	*real32*	0.00 … 1000.00	rpm	100 = 1 rpm
21.10	DC current reference	*real32*	0.0 … 100.0	%	10 = 1%
21.11	Post magnetization time	*uint32*	0…3000	s	1 = 1 s
21.13	Autophasing mode	*real32*	0…3	-	1 = 1
21.14	Pre-heating input source	*uint32*	-	-	1 = 1
21.15	Pre-heating time delay	*real32*	10 … 3000	s	1 = 1 s
21.16	Pre-heating current	*real32*	0.0 … 30.0	%	10 = 1%
21.18	Auto restart time	*real32*	0.0, 0.1 … 5.0	s	10 = 1 s
21.19	Scalar start mode	*real32*	0…2	-	1 = 1
21.20	Follower force ramp stop	*uint32*	-	-	1 = 1
21.37	Motor temperature estimation	*uint32*	-	-	1 = 1
21.38	Motor temperature estimation time	*real32*	0.5 … 20.0	s	10 = 1 s
22 Speed reference selection					
22.01	Speed ref unlimited	*real32*	-30000.00 … 30000.00	rpm	100 = 1 rpm
22.11	Speed ref1 source	*uint32*	-	-	1 = 1
22.12	Speed ref2 source	*uint32*	-	-	1 = 1
22.13	Speed ref1 function	*uint16*	0…5	-	1 = 1
22.14	Speed ref1/2 selection	*uint32*	-	-	1 = 1
22.15	Speed additive 1 source	*uint32*	-	-	1 = 1
22.16	Speed share	*real32*	-8.000 … 8.000	-	1000 = 1
22.17	Speed additive 2 source	*uint32*	-	-	1 = 1
22.41	Speed ref safe	*real32*	-30000.00 … 30000.00	rpm	100 = 1 rpm
22.42	Jogging 1 ref	*real32*	-30000.00 … 30000.00	rpm	100 = 1 rpm

No.	Name	Type	Range	Unit	FbEq32
22.43	Jogging 2 ref	*real32*	-30000.00 … 30000.00	rpm	100 = 1 rpm
22.51	Critical speed function	*uint16*	00b…11b	-	1 = 1
22.52	Critical speed 1 low	*real32*	-30000.00 … 30000.00	rpm	100 = 1 rpm
22.53	Critical speed 1 high	*real32*	-30000.00 … 30000.00	rpm	100 = 1 rpm
22.54	Critical speed 2 low	*real32*	-30000.00 … 30000.00	rpm	100 = 1 rpm
22.55	Critical speed 2 high	*real32*	-30000.00 … 30000.00	rpm	100 = 1 rpm
22.56	Critical speed 3 low	*real32*	-30000.00 … 30000.00	rpm	100 = 1 rpm
22.57	Critical speed 3 high	*real32*	-30000.00 … 30000.00	rpm	100 = 1 rpm
22.71	Motor potentiometer function	*uint16*	0…2	-	1 = 1
22.72	Motor potentiometer initial value	*real32*	-32768.00 … 32767.00	-	100 = 1
22.73	Motor potentiometer up source	*uint32*	-	-	1 = 1
22.74	Motor potentiometer down source	*uint32*	-	-	1 = 1
22.75	Motor potentiometer ramp time	*real32*	0.0 … 3600.0	s	10 = 1 s
22.76	Motor potentiometer min value	*real32*	-32768.00 … 32767.00	-	100 = 1
22.77	Motor potentiometer max value	*real32*	-32768.00 … 32767.00	-	100 = 1
22.80	Motor potentiometer ref act	*real32*	-32768.00 … 32767.00	-	100 = 1
22.81	Speed reference act 1	*real32*	-30000.00 … 30000.00	rpm	100 = 1 rpm
22.82	Speed reference act 2	*real32*	-30000.00 … 30000.00	rpm	100 = 1 rpm
22.83	Speed reference act 3	*real32*	-30000.00 … 30000.00	rpm	100 = 1 rpm
22.84	Speed reference act 4	*real32*	-30000.00 … 30000.00	rpm	100 = 1 rpm
22.85	Speed reference act 5	*real32*	-30000.00 … 30000.00	rpm	100 = 1 rpm
22.86	Speed reference act 6	*real32*	-30000.00 … 30000.00	rpm	100 = 1 rpm
22.87	Speed reference act 7	*real32*	-30000.00 … 30000.00	rpm	100 = 1 rpm
23 Speed reference ramp					
23.01	Speed ref ramp input	*real32*	-30000.00 … 30000.00	rpm	100 = 1 rpm
23.02	Speed ref ramp output	*real32*	-30000.00 … 30000.00	rpm	100 = 1 rpm
23.16	Shape time acc 1	*real32*	0.000 …1800.000	s	1000 = 1 s
23.17	Shape time acc 2	*real32*	0.000 …1800.000	s	1000 = 1 s
23.18	Shape time dec 1	*real32*	0.000 …1800.000	s	1000 = 1 s
23.19	Shape time dec 2	*real32*	0.000 …1800.000	s	1000 = 1 s
23.20	Acc time jogging	*real32*	0.000 …1800.000	s	1000 = 1 s
23.21	Dec time jogging	*real32*	0.000 …1800.000	s	1000 = 1 s
23.23	Emergency stop time	*real32*	0.000 …1800.000	s	1000 = 1 s
23.26	Ramp out balancing enable	*uint32*	-	-	1 = 1
23.27	Ramp out balancing ref	*real32*	-30000.00 … 30000.00	rpm	100 = 1 rpm
23.28	Variable slope enable	*uint32*	0…1	-	1 = 1
23.29	Variable slope rate	*real32*	2…30000	ms	1 = 1 ms
23.39	Follower speed correction out	*real32*	-30000.00 … 30000.00	rpm	100 = 1 rpm

No.	Name	Type	Range	Unit	FbEq32
23.40	Follower speed correction enable	*uint32*	-	-	1 = 1
23.41	Follower speed correction gain	*real32*	0.00 … 100.00	%	100 = 1%
23.42	Follower speed corr torq source	*uint32*	-	-	1 = 1
23.200	Ramp set selection	*uint32*	-	-	1 = 1
23.201	Enable winch ramps	*uint32*	-	-	1 = 1
23.202	Acceleration time 1	*real32*	0.00...1800.00	-	100 = 1
23.203	Deceleration time 1	*real32*	0.00...1800.00	-	100 = 1
23.204	Acceleration time 2	*real32*	0.00...1800.00	-	100 = 1
23.205	Deceleration time 2	*real32*	0.00...1800.00	-	100 = 1
24 Speed reference conditioning					
24.01	Used speed reference	*real32*	-30000.00 … 30000.00	rpm	100 = 1 rpm
24.02	Used speed feedback	*real32*	-30000.00 … 30000.00	rpm	100 = 1 rpm
24.03	Speed error filtered	*real32*	-30000.0 … 30000.0	rpm	100 = 1 rpm
24.04	Speed error inverted	*real32*	-30000.0 … 30000.0	rpm	100 = 1 rpm
24.12	Speed error filter time	*real32*	0…10000	ms	1 = 1 ms
24.13	RFE speed filter	*uint16*	0…1	-	1 = 1
24.14	Frequency of zero	*real32*	0.50 … 500.00	Hz	10 = 1 Hz
24.15	Damping of zero	*real32*	-1.000 … 1.000	-	100 = 1
24.16	Frequency of pole	*real32*	0.50 … 500.00	Hz	10 = 1 Hz
24.17	Damping of pole	*real32*	-1.000 … 1.000	-	100 = 1
24.41	Speed error window control enable	*uint32*	-	-	1 = 1
24.42	Speed window control mode	*uint16*	0...1	-	1 = 1
24.43	Speed error window high	*real32*	0.00 … 3000.00	rpm	100 = 1 rpm
24.44	Speed error window low	*real32*	0.00 … 3000.00	rpm	100 = 1 rpm
24.46	Speed error step	*real32*	-3000.00 … 3000.00	rpm	100 = 1 rpm
24.200	Speed correction	*real32*	-10000.00 … 10000.00	rpm	10 = 1 rpm
25 Speed control					
25.01	Torque reference speed control	*real32*	-1600.0 … 1600.0	%	10 = 1%
25.02	Speed proportional gain	*real32*	0.00 … 250.00	-	100 = 1
25.03	Speed integration time	*real32*	0.00 … 1000.00	s	100 = 1 s
25.04	Speed derivation time	*real32*	0.000 … 10.000	s	1000 = 1 s
25.05	Derivation filter time	*real32*	0…10000	ms	1 = 1 ms
25.06	Acc comp derivation time	*real32*	0.00 … 1000.00	s	100 = 1 s
25.07	Acc comp filter time	*real32*	0.0 … 1000.0	ms	10 = 1 ms
25.08	Drooping rate	*real32*	0.00 … 100.00	%	100 = 1%
25.13	Min torq sp ctrl em stop	*real32*	-1600 … 0	%	10 = 1%
25.14	Max torq sp ctrl em stop	*real32*	0…1600	%	10 = 1%
25.15	Proportional gain em stop	*real32*	1.00 … 250.00	-	100 = 1

No.	Name	Type	Range	Unit	FbEq32
25.18	Speed adapt min limit	*real32*	0…30000	rpm	1 = 1 rpm
25.19	Speed adapt max limit	*real32*	0…30000	rpm	1 = 1 rpm
25.21	Kp adapt coef at min speed	*real32*	0.000 … 10.000	-	1000 = 1
25.22	Ti adapt coef at min speed	*real32*	0.000 … 10.000	-	1000 = 1
25.25	Torque adapt max limit	*real32*	0.0 … 1600.0	%	10 = 1%
25.26	Torque adapt filt time	*real32*	0.000 … 100.000	s	1000 = 1 s
25.27	Kp adapt coef at min torque	*real32*	0.000 … 10.000	-	1000 = 1
25.30	Flux adaption enable	*uint16*	0…1	-	1 = 1
25.33	Speed controller autotune	*uint32*	-	-	1 = 1
25.34	Speed controller autotune mode	*uint16*	0...2	-	1 = 1
25.37	Mechanical time constant	*real32*	0.00...1000.00	s	100 = 1 s
25.38	Autotune torque step	*real32*	0.00...100.00	%	100 = 1%
25.39	Autotune speed step	*real32*	0.00...100.00	%	100 = 1%
25.40	Autotune repeat times	*uint16*	1...10	-	1 = 1
25.41	Torque reference Autotune2	*real32*	-1600.0...1600.0	%	10 = 1%
25.42	Integral term enable	*uint32*	-	-	1 = 1
25.53	Torque prop reference	*real32*	-30000.0 … 30000.0	%	10 = 1%
25.54	Torque integral reference	*real32*	-30000.0 … 30000.0	%	10 = 1%
25.55	Torque deriv reference	*real32*	-30000.0 … 30000.0	%	10 = 1%
25.56	Torque acc compensation	*real32*	-30000.0 … 30000.0	%	10 = 1%
25.57	Torque reference unbalanced	*real32*	-30000.0 … 30000.0	%	10 = 1%
26 Torque reference chain					
26.01	Torque reference to TC	*real32*	-1600.0 … 1600.0	%	10 = 1%
26.02	Torque reference used	*real32*	-1600.0 … 1600.0	%	10 = 1%
26.08	Minimum torque ref	*real32*	-1000.0 … 0.0	%	10 = 1%
26.09	Maximum torque ref	*real32*	0.0 … 1000.0	%	10 = 1%
26.11	Torque ref1 source	*uint32*	-	-	1 = 1
26.12	Torque ref2 source	*uint32*	-	-	1 = 1
26.13	Torque ref1 function	*uint16*	0…5	-	1 = 1
26.14	Torque ref1/2 selection	*uint32*	-	-	1 = 1
26.15	Load share	*real32*	-8.000 … 8.000	-	1000 = 1
26.16	Torque additive 1 source	*uint32*	-	-	1 = 1
26.17	Torque ref filter time	*real32*	0.000 … 30.000	s	1000 = 1 s
26.18	Torque ramp up time	*real32*	0.000 … 60.000	s	1000 = 1 s
26.19	Torque ramp down time	*real32*	0.000 … 60.000	s	1000 = 1 s
26.25	Torque additive 2 source	*uint32*	-	-	1 = 1
26.26	Force torque ref add 2 zero	*uint32*	-	-	1 = 1
26.27	Torque limit filter time	*real32*	0 … 100	-	1 = 1
26.41	Torque step	*real32*	-300.0 … 300.0	%	10 = 1%
26.42	Torque step enable	*uint32*	0…1	-	1 = 1

No.	Name	Type	Range	Unit	FbEq32
26.43	Torque step pointer enable	*uint32*	-	-	1 = 1
26.44	Torque step source	*uint32*	-	-	1 = 1
26.51	Oscillation damping	*uint32*	-	-	1 = 1
26.52	Oscillation damping out enable	*uint32*	-	-	1 = 1
26.53	Oscillation compensation input	*uint32*	0…1	-	1 = 1
26.55	Oscillation damping frequency	*real32*	0.1 … 60.0	Hz	10 = 1 Hz
26.56	Oscillation damping phase	*real32*	0…360	deg	1 = 1 deg
26.57	Oscillation damping gain	*real32*	0.0 … 100.0	%	10 = 1%
26.58	Oscillation damping output	*real32*	-1600.000 … 1600.000	%	1000 = 1%
26.70	Torque reference act 1	*real32*	-1600.0 … 1600.0	%	10 = 1%
26.71	Torque reference act 2	*real32*	-1600.0 … 1600.0	%	10 = 1%
26.72	Torque reference act 3	*real32*	-1600.0 … 1600.0	%	10 = 1%
26.73	Torque reference act 4	*real32*	-1600.0 … 1600.0	%	10 = 1%
26.74	Torque ref ramp out	*real32*	-1600.0 … 1600.0	%	10 = 1%
26.75	Torque reference act 5	*real32*	-1600.0 … 1600.0	%	10 = 1%
26.76	Torque reference act 6	*real32*	-1600.0 … 1600.0	%	10 = 1%
26.77	Torque ref add A actual	*real32*	-1600.0 … 1600.0	%	10 = 1%
26.78	Torque ref add B actual	*real32*	-1600.0 … 1600.0	%	10 = 1%
26.81	Rush control gain	*real32*	1.0 … 10000.0	-	10 = 1
26.82	Rush control integration time	*real32*	0.1 … 10.0	s	10 = 1 s
30 Limits					
30.01	Limit word 1	*uint16*	0000h…FFFFh	-	1 = 1
30.02	Torque limit status	*uint16*	0000h…FFFFh	-	1 = 1
30.11	Minimum speed	*real32*	-30000.00 … 30000.00	rpm	100 = 1 rpm
30.12	Maximum speed	*real32*	-30000.00 … 30000.00	rpm	100 = 1 rpm
30.13	Minimum frequency	*real32*	-500.00 … 500.00	Hz	100 = 1 Hz
30.14	Maximum frequency	*real32*	-500.00 … 500.00	Hz	100 = 1 Hz
30.15	Maximum start current enable	*uint16*	0…1	-	1 = 1
30.16	Maximum start current	*real32*	0.00 … 30000.00	A	100 = 1 A
30.17	Maximum current	*real32*	0.00 … 30000.00	A	100 = 1 A
30.18	Minimum torque sel	*uint32*	-	-	1 = 1
30.19	Minimum torque 1	*real32*	-1600.0 … 0.0	%	10 = 1%
30.20	Maximum torque 1	*real32*	0.0 … 1600.0	%	10 = 1%
30.21	Minimum torque 2 source	*uint32*	-	-	1 = 1
30.22	Maximum torque 2 source	*uint32*	-	-	1 = 1
30.23	Minimum torque 2	*real32*	-1600.0 … 0.0	%	10 = 1%
30.24	Maximum torque 2	*real32*	0.0 … 1600.0	%	10 = 1%
30.25	Maximum torque sel	*uint32*	-	-	1 = 1
30.26	Power motoring limit	*real32*	0.00 … 600.00	%	100 = 1%
30.27	Power generating limit	*real32*	-600.00 … 0.00	%	100 = 1%
30.30	Overvoltage control	*uint16*	0…1	-	1 = 1

No.	Name	Type	Range	Unit	FbEq32
30.31	Undervoltage control	*uint16*	0…1	-	1 = 1
30.35	Thermal current limitation	*uint16*	0…1	-	1 = 1
31 Fault functions					
31.01	External event 1 source	*uint32*	-	-	1 = 1
31.02	External event 1 type	*uint16*	0…3	-	1 = 1
31.03	External event 2 source	*uint32*	-	-	1 = 1
31.04	External event 2 type	*uint16*	0…3	-	1 = 1
31.05	External event 3 source	*uint32*	-	-	1 = 1
31.06	External event 3 type	*uint16*	0…3	-	1 = 1
31.07	External event 4 source	*uint32*	-	-	1 = 1
31.08	External event 4 type	*uint16*	0…3	-	1 = 1
31.09	External event 5 source	*uint32*	-	-	1 = 1
31.10	External event 5 type	*uint16*	0…3	-	1 = 1
31.11	Fault reset selection	*uint32*	-	-	1 = 1
31.12	Autoreset selection	*uint16*	0000h…FFFFh	-	1 = 1
31.13	User selectable fault	*uint32*	0000h…FFFFh	-	1 = 1
31.14	Number of trials	*uint32*	0…5	-	1 = 1
31.15	Total trials time	*real32*	1.0 … 600.0	s	10 = 1 s
31.16	Delay time	*real32*	0.0 … 120.0	s	10 = 1 s
31.19	Motor phase loss	*uint16*	0…1	-	1 = 1
31.20	Earth fault	*uint16*	0…2	-	1 = 1
31.22	STO indication run/stop	*uint16*	0…5	-	1 = 1
31.23	Wiring or earth fault	*uint16*	0…1	-	1 = 1
31.24	Stall function	*uint16*	0…2	-	1 = 1
31.25	Stall current limit	*real32*	0.0 … 1600.0	%	10 = 1%
31.26	Stall speed limit	*real32*	0.00 … 10000.00	rpm	100 = 1 rpm
31.27	Stall frequency limit	*real32*	0.00 … 500.00	Hz	100 = 1 Hz
31.28	Stall time	*real32*	0…3600	s	1 = 1 s
31.30	Overspeed trip margin	*real32*	0.00 … 10000.00	rpm	100 = 1 rpm
31.32	Emergency ramp supervision	*real32*	0…300	%	1 = 1%
31.33	Emergency ramp supervision delay	*real32*	0…100	s	1 = 1 s
31.35	Main fan fault function	*uint16*	0…2	-	1 = 1
(Parameter 31.36 only visible with a ZCU control unit)					
31.36	Aux fan fault function	*uint16*	0…1	-	1 = 1
31.37	Ramp stop supervision	*real32*	0…300	%	1 = 1%
31.38	Ramp stop supervision delay	*real32*	0…32767	s	1 = 1 s
31.40	Disable warning messages	*uint16*	0000h…FFFFh	-	1 = 1
31.42	Overcurrent fault limit	*real32*	0.00 … 30000.00	A	100 = 1 A
31.54	Fault action	*uint16*	0…1	-	1 = 1
31.55	Ext I/O comm loss event	*uint16*	0…2	-	1 = 1

No.	Name	Type	Range	Unit	FbEq32
31.202	Inverter overload selection	*uint16*	0000h…FFFFh	-	1 = 1
31.203	User limit bit selection	*uint32*	-	-	1 = 1
31.204	Inverter overload delay	*real32*	0...30000	ms	1 = 1
32 Supervision					
32.01	Supervision status	*uint16*	000b…111b	-	1 = 1
32.05	Supervision 1 function	*uint16*	0…6	-	1 = 1
32.06	Supervision 1 action	*uint16*	0…3	-	1 = 1
32.07	Supervision 1 signal	*uint32*	-	-	1 = 1
32.08	Supervision 1 filter time	*real32*	0.000 … 30.000	s	1000 = 1 s
32.09	Supervision 1 low	*real32*	-21474830.00 … 21474830.00	-	100 = 1
32.10	Supervision 1 high	*real32*	-21474830.00 … 21474830.00	-	100 = 1
32.15	Supervision 2 function	*uint16*	0…6	-	1 = 1
32.16	Supervision 2 action	*uint16*	0…3	-	1 = 1
32.17	Supervision 2 signal	*uint32*	-	-	1 = 1
32.18	Supervision 2 filter time	*real32*	0.000 … 30.000	s	1000 = 1 s
32.19	Supervision 2 low	*real32*	-21474830.00 … 21474830.00	-	100 = 1
32.20	Supervision 2 high	*real32*	-21474830.00 … 21474830.00	-	100 = 1
32.25	Supervision 3 function	*uint16*	0…6	-	1 = 1
32.26	Supervision 3 action	*uint16*	0…3	-	1 = 1
32.27	Supervision 3 signal	*uint32*	-	-	1 = 1
32.28	Supervision 3 filter time	*real32*	0.000 … 30.000	s	1000 = 1 s
32.29	Supervision 3 low	*real32*	-21474830.00 … 21474830.00	-	100 = 1
32.30	Supervision 3 high	*real32*	-21474830.00 … 21474830.00	-	100 = 1
33 Generic timer & counter					
33.01	Counter status	*uint16*	000000b…111111b	-	1 = 1
33.10	On-time 1 actual	*uint32*	0…4294967295	s	1 = 1 s
33.11	On-time 1 warn limit	*uint32*	0…4294967295	s	1 = 1 s
33.12	On-time 1 function	*uint16*	00b…11b	-	1 = 1
33.13	On-time 1 source	*uint32*	-	-	1 = 1
33.14	On-time 1 warn message	*uint32*	-	-	1 = 1
33.20	On-time 2 actual	*uint32*	0…4294967295	s	1 = 1 s
33.21	On-time 2 warn limit	*uint32*	0…4294967295	s	1 = 1 s
33.22	On-time 2 function	*uint16*	00b…11b	-	1 = 1
33.23	On-time 2 source	*uint32*	-	-	1 = 1
33.24	On-time 2 warn message	*uint32*	-	-	1 = 1
33.30	Edge counter 1 actual	*uint32*	0…4294967295	-	1 = 1
33.31	Edge counter 1 warn limit	*uint32*	0…4294967295	-	1 = 1

No.	Name	Type	Range	Unit	FbEq32
33.32	Edge counter 1 function	*uint16*	0000b…1111b	-	1 = 1
33.33	Edge counter 1 source	*uint32*	-	-	1 = 1
33.34	Edge counter 1 divider	*uint32*	1…4294967295	-	1 = 1
33.35	Edge counter 1 warn message	*uint32*	-	-	1 = 1
33.40	Edge counter 2 actual	*uint32*	0…4294967295	-	1 = 1
33.41	Edge counter 2 warn limit	*uint32*	0…4294967295	-	1 = 1
33.42	Edge counter 2 function	*uint16*	0000b…1111b	-	1 = 1
33.43	Edge counter 2 source	*uint32*	-	-	1 = 1
33.44	Edge counter 2 divider	*uint32*	1…4294967295	-	1 = 1
33.45	Edge counter 2 warn message	*uint32*	-	-	1 = 1
33.50	Value counter 1 actual	*real32*	-2147483008 … 2147483008	-	1 = 1
33.51	Value counter 1 warn limit	*real32*	-2147483008 … 2147483008	-	1 = 1
33.52	Value counter 1 function	*uint16*	00b…11b	-	1 = 1
33.53	Value counter 1 source	*uint32*	-	-	1 = 1
33.54	Value counter 1 divider	*real32*	0.001 … 2147483.000	-	1000 = 1
33.55	Value counter 1 warn message	*uint32*	-	-	1 = 1
33.60	Value counter 2 actual	*real32*	-2147483008 … 2147483008	-	1 = 1
33.61	Value counter 2 warn limit	*real32*	-2147483008 … 2147483008	-	1 = 1
33.62	Value counter 2 function	*uint16*	00b…11b	-	1 = 1
33.63	Value counter 2 source	*uint32*	-	-	1 = 1
33.64	Value counter 2 divider	*real32*	0.001 … 2147483.000	-	1000 = 1
33.65	Value counter 2 warn message	*uint32*	-	-	1 = 1
33.200	Reset winch counters	*uint32*	-	-	1 = 1
33.201	Winch operating time preset value	*real32*	0...1100000	h	1 = 1
33.202	Number of power on preset value	*real32*	0...65535	-	1 = 1
33.203	Number of brake open preset value	*real32*	0...4294967295	-	1 = 1
35 Motor thermal protection					
35.01	Motor estimated temperature	*real32*	-60 … 1000	°C or °F	1 = 1°
35.02	Measured temperature 1	*real32*	-60 … 1000 °C, -76 … 1832 °F, 0…5000 ohm	°C, °F or ohm	1 = 1 unit
35.03	Measured temperature 2	*real32*	-60 … 1000 °C, -76…1832 °F, 0...5000 ohm	°C, °F or ohm	1 = 1 unit
35.04	FPTC status word	*uint16*	0000h...FFFFh	-	1 = 1
35.05	Motor overload level	*real32*	0.0 … 300.0	%	10 = 1%

No.	Name	Type	Range	Unit	FbEq32
35.09	Temperature Calibration status word	*uint16*	0000h...FFFFh	-	1 = 1
35.11	Temperature 1 source	*uint16*	0…11	-	1 = 1
35.12	Temperature 1 fault limit	*real32*	-60 … 1000 °C, -76 … 1832 °F, 0…5000 ohm	°C, °F or ohm	1 = 1 unit
35.13	Temperature 1 warning limit	*real32*	-60 … 1000 °C, -76 … 1832 °F, 0…5000 ohm	°C, °F or ohm	1 = 1 unit
35.14	Temperature 1 AI source	*uint32*	-	-	1 = 1
35.17	Temperature 1 calibration	*real32*	-30 … 1000 °C	°C	1 = 1 unit
35.21	Temperature 2 source	*uint16*	0…11	-	1 = 1
35.22	Temperature 2 fault limit	*real32*	-60 … 1000 °C, -76 … 1832 °F, 0…5000 ohm	°C, °F or ohm	1 = 1 unit
35.23	Temperature 2 warning limit	*real32*	-60 … 1000 °C, -76 … 1832 °F, 0…5000 ohm	°C, °F or ohm	1 = 1 unit
35.24	Temperature 2 AI source	*uint32*	-	-	1 = 1
35.27	Temperature 2 calibration	*real32*	-30 … 1000 °C	°C	1 = 1 unit
35.30	FPTC configuration word	*uint16*	0000h…FFFFh	-	1 = 1
35.50	Motor ambient temperature	*int16*	-60…100	°C	1 = 1 °C
35.51	Motor load curve	*uint16*	50…150	%	1 = 1%
35.52	Zero speed load	*uint16*	50…150	%	1 = 1%
35.53	Break point	*uint16*	1.00 … 500.00	Hz	100 = 1 Hz
35.54	Motor nominal temperature rise	*uint16*	0…300 °C or 32…572 °F	°C or °F	1 = 1°
35.55	Motor thermal time constant	*uint16*	100…10000	s	1 = 1 s
35.56	Motor overload action	*uint16*	0…2	-	1 = 1
35.57	Motor overload class	*uint16*	0…4	-	1 = 1
35.60	Cable temperature	*real32*	0.0 … 200.0	%	10 = 1%
35.61	Cable nominal current	*real32*	0.00 … 10000.0	A	100 = 1 A
35.62	Cable thermal rise time	*uint16*	0…50000	s	1 = 1 s
35.100	DOL starter control source	*uint32*	-	-	1 = 1
35.101	DOL starter on delay	*uint32*	0…42949673	s	1 = 1 s
35.102	DOL starter off delay	*uint32*	0…715828	min	1 = 1 min
35.103	DOL starter feedback source	*uint32*	-	-	1 = 1
35.104	DOL starter feedback delay	*uint32*	0…42949673	s	1 = 1 s
35.105	DOL starter status word	*uint16*	0000b…1111b	-	1 = 1
35.106	DOL starter event type	*uint16*	0…2	-	1 = 1
35.200	Internal fan extended run time	*real32*	0.0…3600.0	min	10 = 1
36 Load analyzer					
36.01	PVL signal source	*uint32*	-	-	1 = 1

No.	Name	Type	Range	Unit	FbEq32
36.02	PVL filter time	*real32*	0.00 … 120.00	s	100 = 1 s
36.06	AL2 signal source	*uint32*	-	-	1 = 1
36.07	AL2 signal scaling	*real32*	0.00 … 32767.00	-	100 = 1
36.08	Logger function	*uint16*	00b...11b	-	1 = 1
36.09	Reset loggers	*uint16*	0…3	-	1 = 1
36.10	PVL peak value	*real32*	-32768.00 … 32767.00	-	100 = 1
36.11	PVL peak date	*uint16*	-	-	1 = 1
36.12	PVL peak time	*uint32*	-	-	1 = 1
36.13	PVL current at peak	*real32*	-32768.00 … 32767.00	A	100 = 1 A
36.14	PVL DC voltage at peak	*real32*	0.00 … 2000.00	V	100 = 1 V
36.15	PVL speed at peak	*real32*	-32768.00 … 32767.00	rpm	100 = 1 rpm
36.16	PVL reset date	*uint16*	-	-	1 = 1
36.17	PVL reset time	*uint32*	-	-	1 = 1
36.20	AL1 below 10%	*real32*	0.00 … 100.00	%	100 = 1%
36.21	AL1 10 to 20%	*real32*	0.00 … 100.00	%	100 = 1%
36.22	AL1 20 to 30%	*real32*	0.00 … 100.00	%	100 = 1%
36.23	AL1 30 to 40%	*real32*	0.00 … 100.00	%	100 = 1%
36.24	AL1 40 to 50%	*real32*	0.00 … 100.00	%	100 = 1%
36.25	AL1 50 to 60%	*real32*	0.00 … 100.00	%	100 = 1%
36.26	AL1 60 to 70%	*real32*	0.00 … 100.00	%	100 = 1%
36.27	AL1 70 to 80%	*real32*	0.00 … 100.00	%	100 = 1%
36.28	AL1 80 to 90%	*real32*	0.00 … 100.00	%	100 = 1%
36.29	AL1 over 90%	*real32*	0.00 … 100.00	%	100 = 1%
36.40	AL2 below 10%	*real32*	0.00 … 100.00	%	100 = 1%
36.41	AL2 10 to 20%	*real32*	0.00 … 100.00	%	100 = 1%
36.42	AL2 20 to 30%	*real32*	0.00 … 100.00	%	100 = 1%
36.43	AL2 30 to 40%	*real32*	0.00 … 100.00	%	100 = 1%
36.44	AL2 40 to 50%	*real32*	0.00 … 100.00	%	100 = 1%
36.45	AL2 50 to 60%	*real32*	0.00 … 100.00	%	100 = 1%
36.46	AL2 60 to 70%	*real32*	0.00 … 100.00	%	100 = 1%
36.47	AL2 70 to 80%	*real32*	0.00 … 100.00	%	100 = 1%
36.48	AL2 80 to 90%	*real32*	0.00 … 100.00	%	100 = 1%
36.49	AL2 over 90%	*real32*	0.00 … 100.00	%	100 = 1%
36.50	AL2 reset date	*uint16*	-	-	1 = 1
36.51	AL2 reset time	*uint32*	-	-	1 = 1
37 User load curve					
37.01	ULC output status word	*uint16*	0000h…FFFFh	-	1 = 1
37.02	ULC supervision signal	*uint32*	-	-	1 = 1
37.03	ULC overload actions	*uint16*	0…3	-	1 = 1
37.04	ULC underload actions	*uint16*	0…3	-	1 = 1
37.11	ULC speed table point 1	*real32*	0.0 … 30000.0	rpm	10 = 1 rpm

No.	Name	Type	Range	Unit	FbEq32
37.12	ULC speed table point 2	*real32*	0.0 … 30000.0	rpm	10 = 1 rpm
37.13	ULC speed table point 3	*real32*	0.0 … 30000.0	rpm	10 = 1 rpm
37.14	ULC speed table point 4	*real32*	0.0 … 30000.0	rpm	10 = 1 rpm
37.15	ULC speed table point 5	*real32*	0.0 … 30000.0	rpm	10 = 1 rpm
37.16	ULC frequency table point 1	*real32*	0.0 … 500.0	Hz	10 = 1 Hz
37.17	ULC frequency table point 2	*real32*	0.0 … 500.0	Hz	10 = 1 Hz
37.18	ULC frequency table point 3	*real32*	0.0 … 500.0	Hz	10 = 1 Hz
37.19	ULC frequency table point 4	*real32*	0.0 … 500.0	Hz	10 = 1 Hz
37.20	ULC frequency table point 5	*real32*	0.0 … 500.0	Hz	10 = 1 Hz
37.21	ULC underload point 1	*real32*	0.0 … 1600.0	%	10 = 1%
37.22	ULC underload point 2	*real32*	0.0 … 1600.0	%	10 = 1%
37.23	ULC underload point 3	*real32*	0.0 … 1600.0	%	10 = 1%
37.24	ULC underload point 4	*real32*	0.0 … 1600.0	%	10 = 1%
37.25	ULC underload point 5	*real32*	0.0 … 1600.0	%	10 = 1%
37.31	ULC overload point 1	*real32*	0.0 … 1600.0	%	10 = 1%
37.32	ULC overload point 2	*real32*	0.0 … 1600.0	%	10 = 1%
37.33	ULC overload point 3	*real32*	0.0 … 1600.0	%	10 = 1%
37.34	ULC overload point 4	*real32*	0.0 … 1600.0	%	10 = 1%
37.35	ULC overload point 5	*real32*	0.0 … 1600.0	%	10 = 1%
37.41	ULC overload timer	*real32*	0.0 … 10000.0	s	10 = 1 s
37.42	ULC underload timer	*real32*	0.0 … 10000.0	s	10 = 1 s
43 Brake chopper					
43.01	Braking resistor temperature	*real32*	0.0 … 120.0	%	10 = 1%
43.06	Brake chopper function	*uint16*	0…3	-	1 = 1
43.07	Brake chopper run enable	*uint32*	-	-	1 = 1
43.08	Brake resistor thermal tc	*real32*	0…10000	s	1 = 1 s
43.09	Brake resistor Pmax cont	*real32*	0.00 … 10000.00	kW	100 = 1 kW
43.10	Brake resistance	*real32*	0.0 … 1000.0	ohm	10 = 1 ohm
43.11	Brake resistor fault limit	*real32*	0…150	%	1 = 1%
43.12	Brake resistor warning limit	*real32*	0…150	%	1 = 1%
44 Mechanical brake control					
44.01	Brake control status	*uint16*	00000000b…11111111b	-	1 = 1
44.02	Brake torque memory	*real32*	-1600.0 … 1600.0	%	10 = 1%
44.03	Brake open torque reference	*real32*	-1600.0 … 1600.0	%	10 = 1%
44.06	Brake control enable	*uint32*	-	-	1 = 1
44.07	Brake acknowledge selection	*uint32*	-	-	1 = 1
44.08	Brake open delay	*real32*	0.00 … 5.00	s	100 = 1 s
44.11	Keep brake closed	*uint32*	-	-	1 = 1
44.13	Brake close delay	*real32*	0.00 … 60.00	s	100 = 1 s
44.14	Brake close level	*real32*	0.0 … 1000.0	rpm	100 = 1 rpm
44.15	Brake close level delay	*real32*	0.00 … 10.00	s	100 = 1 s

No.	Name	Type	Range	Unit	FbEq32
44.16	Brake reopen delay	*real32*	0.00 … 10.00	s	100 = 1 s
44.17	Brake fault function	*uint16*	0…2	-	1 = 1
44.18	Brake fault delay	*real32*	0.00 … 60.00	s	100 = 1 s
44.21	Filter time brake torque memory	*real32*	0...100	ms	1 = 1 ms
44.200	Brake open torque source	*uint32*	-	-	1 = 1
44.201	Brake open torque	*real32*	-1600.0...1600.0	%	10 = 1%
44.202	Extended runtime	*real32*	0.0...3600.0	s	10 = 1 s
44.203	Extended runtime sw	*uint16*	0b0000… 0b1111 1111 1111 1111	-	1 = 1
44.204	Winch brake status	*uint16*	0b0000… 0b1111 1111 1111 1111	-	1 = 1
44.209	Analogue input as digital status	*uint16*	0b0000… 0b1111 1111 1111 1111	-	1 = 1
45 Energy efficiency					
45.01	Saved GW hours	*uint16*	0…65535	GWh	1 = 1 GWh
45.02	Saved MW hours	*uint16*	0…999	MWh	1 = 1 MWh
45.03	Saved kW hours	*uint16*	0.0 … 999.0	kWh	10 = 1 kWh
45.05	Saved money x1000	*uint32*	0…4294967295	thousand	1 = 1 thousand
45.06	Saved money	*uint32*	0.00 … 999.99	(selecta-ble)	100 = 1 unit
45.08	CO2 reduction in kilotons	*uint16*	0…65535	metric kiloton	1 = 1 metric kiloton
45.09	CO2 reduction in tons	*uint16*	0.0 … 999.9	metric ton	10 = 1 metric ton
45.11	Energy optimizer	*uint16*	0…1	-	1 = 1
45.12	Energy tariff 1	*uint32*	0.000 … 4294967.295	(selecta-ble)	1000 = 1 unit
45.13	Energy tariff 2	*uint32*	0.000 … 4294967.295	(selecta-ble)	1000 = 1 unit
45.14	Tariff selection	*uint32*	-	-	1 = 1
45.17	Tariff currency unit	*uint16*	100…102	-	1 = 1
45.18	CO2 conversion factor	*uint16*	0.000 … 65.535	metric ton/ MWh	1000 = 1 metric ton/MWh
45.19	Comparison power	*real32*	0.0 … 100000.0	kW	10 = 1 kW
45.21	Energy calculations reset	*uint16*	0…1	-	1 = 1
46 Monitoring/scaling settings					
46.01	Speed scaling	*real32*	0.10...30000.00	rpm	100 = 1 rpm
46.02	Frequency scaling	*real32*	0.10 … 1000.00	Hz	100 = 1 Hz
46.03	Torque scaling	*real32*	0.1 … 1000.0	%	10 = 1%
46.04	Power scaling	*real32*	0.10 … 30000.00 kW or 0.10 … 40214.48 hp	kW or hp	100 = 1 unit
46.05	Current scaling	*real32*	0…30000	A	1 = 1 A
46.06	Speed ref zero scaling	*real32*	0.00 … 30000.00	rpm	100 = 1 rpm

No.	Name	Type	Range	Unit	FbEq32
46.07	Frequency ref zero scaling	*real32*	0.00 … 1000.00	Hz	100 = 1 Hz
46.11	Filter time motor speed	*real32*	2…20000	ms	1 = 1 ms
46.12	Filter time output frequency	*real32*	2…20000	ms	1 = 1 ms
46.13	Filter time motor torque	*real32*	2…20000	ms	1 = 1 ms
46.14	Filter time power out	*real32*	2…20000	ms	1 = 1 ms
46.21	At speed hysteresis	*real32*	0.00 … 30000.00	rpm	100 = 1 rpm
46.22	At frequency hysteresis	*real32*	0.00 … 1000.00	Hz	100 = 1 Hz
46.23	At torque hysteresis	*real32*	0.0 … 300.0	%	1 = 1%
46.31	Above speed limit	*real32*	0.00 … 30000.00	rpm	100 = 1 rpm
46.32	Above frequency limit	*real32*	0.00 … 1000.00	Hz	100 = 1 Hz
46.33	Above torque limit	*real32*	0.0 … 1600.0	%	10 = 1%
46.42	Torque decimals	*uint16*	0…2	-	1 = 1
46.200	Speed scaling stand alone	*real32*	0.10...30000.00	rpm	100 = 1 rpm
47 Data storage					
47.01	Data storage 1 real32	*real32*	Defined by *47.31*	-	1000 = 1
47.02	Data storage 2 real32	*real32*	Defined by *47.32*	-	1000 = 1
47.03	Data storage 3 real32	*real32*	Defined by *47.33*	-	1000 = 1
47.04	Data storage 4 real32	*real32*	Defined by *47.34*	-	1000 = 1
47.05	Data storage 5 real32	*real32*	Defined by *47.35*	-	1000 = 1
47.06	Data storage 6 real32	*real32*	Defined by *47.36*	-	1000 = 1
47.07	Data storage 7 real32	*real32*	Defined by *47.37*	-	1000 = 1
47.08	Data storage 8 real32	*real32*	Defined by *47.38*	-	1000 = 1
47.11	Data storage 1 int32	*int32*	-2147483648 … 2147483647	-	1 = 1
47.12	Data storage 2 int32	*int32*	-2147483648 … 2147483647	-	1 = 1
47.13	Data storage 3 int32	*int32*	-2147483648 … 2147483647	-	1 = 1
47.14	Data storage 4 int32	*int32*	-2147483648 … 2147483647	-	1 = 1
47.15	Data storage 5 int32	*int32*	-2147483648 … 2147483647	-	1 = 1
47.16	Data storage 6 int32	*int32*	-2147483648 … 2147483647	-	1 = 1
47.17	Data storage 7 int32	*int32*	-2147483648 … 2147483647	-	1 = 1
47.18	Data storage 8 int32	*int32*	-2147483648 … 2147483647	-	1 = 1
47.21	Data storage 1 int16	*int16*	-32768 … 32767	-	1 = 1
47.22	Data storage 2 int16	*int16*	-32768 … 32767	-	1 = 1
47.23	Data storage 3 int16	*int16*	-32768 … 32767	-	1 = 1
47.24	Data storage 4 int16	*int16*	-32768 … 32767	-	1 = 1
47.25	Data storage 5 int16	*int16*	-32768 … 32767	-	1 = 1
47.26	Data storage 6 int16	*int16*	-32768 … 32767	-	1 = 1

No.	Name	Type	Range	Unit	FbEq32
47.27	Data storage 7 int16	*int16*	-32768 … 32767	-	1 = 1
47.28	Data storage 8 int16	*int16*	-32768 … 32767	-	1 = 1
47.31	Data storage 1 real32 type	*uint16*	0...5	-	1 = 1
47.32	Data storage 2 real32 type	*uint16*	0...5	-	1 = 1
47.33	Data storage 3 real32 type	*uint16*	0...5	-	1 = 1
47.34	Data storage 4 real32 type	*uint16*	0...5	-	1 = 1
47.35	Data storage 5 real32 type	*uint16*	0...5	-	1 = 1
47.36	Data storage 6 real32 type	*uint16*	0...5	-	1 = 1
47.37	Data storage 7 real32 type	*uint16*	0...5	-	1 = 1
47.38	Data storage 8 real32 type	*uint16*	0...5	-	1 = 1
49 Panel port communication					
49.01	Node ID number	*uint32*	1…32	-	1 = 1
49.03	Baud rate	*uint32*	1…5	-	1 = 1
49.04	Communication loss time	*uint32*	0.3 … 3000.0	s	10 = 1 s
49.05	Communication loss action	*uint16*	0…5	-	1 = 1
49.06	Refresh settings	*uint16*	0…1	-	1 = 1
49.07	Panel comm supervision force	*uint16*	0000h…FFFFh	-	1 = 1
49.08	Secondary comm. loss action	*uint16*	0…5	-	1 = 1
49.14	Panel speed reference unit	*uint16*	0…1	-	1 = 1
49.15	Minimum ext speed ref panel	*real32*	-30000.00 … 30000.00	mm	100 = 1 mm
49.16	Maximum ext speed ref panel	*real32*	-30000.00 … 30000.00	rpm	100 = 1 rpm
49.17	Minimum ext frequency ref panel	*real32*	-500.00 … 500.00	Hz	100 = 1 Hz
49.18	Maximum ext frequency ref panel	*real32*	-500.00 … 500.00	Hz	100 = 1 Hz
49.24	Panel actual score	*uint32*	-	-	1 = 1
50 Fieldbus adapter (FBA)					
50.01	FBA A enable	*uint16*	0…3	-	1 = 1
50.02	FBA A comm loss func	*uint16*	0…5	-	1 = 1
50.03	FBA A comm loss t out	*uint16*	0.3 … 6553.5	s	10 = 1 s
50.04	FBA A ref1 type	*uint16*	0…5	-	1 = 1
50.05	FBA A ref2 type	*uint16*	0…5	-	1 = 1
50.07	FBA A actual 1 type	*uint16*	0…5	-	1 = 1
50.08	FBA A actual 2 type	*uint16*	0…5	-	1 = 1
50.09	FBA A SW transparent source	*uint32*	-	-	1 = 1
50.10	FBA A act1 transparent source	*uint32*	-	-	1 = 1
50.11	FBA A act2 transparent source	*uint32*	-	-	1 = 1
50.12	FBA A debug mode	*uint16*	0…1	-	1 = 1
50.13	FBA A control word	*uint32*	00000000h … FFFFFFFFh	-	1 = 1
50.14	FBA A reference 1	*int32*	-2147483648 … 2147483647	-	1 = 1

No.	Name	Type	Range	Unit	FbEq32
50.15	FBA A reference 2	*int32*	-2147483648 … 2147483647	-	1 = 1
50.16	FBA A status word	*uint32*	00000000h … FFFFFFFFh	-	1 = 1
50.17	FBA A actual value 1	*int32*	-2147483648 … 2147483647	-	1 = 1
50.18	FBA A actual value 2	*int32*	-2147483648 … 2147483647	-	1 = 1
50.21	FBA A timelevel sel	*uint16*	0…3	-	1 = 1
50.26	FBA A comm supervision force	*uint16*	0000h...FFFFh	-	1 = 1
50.31	FBA B enable	*uint16*	0…1	-	1 = 1
50.32	FBA B comm loss func	*uint16*	0…5	-	1 = 1
50.33	FBA B comm loss timeout	*uint16*	0.3 … 6553.5	s	10 = 1 s
50.34	FBA B ref1 type	*uint16*	0…5	-	1 = 1
50.35	FBA B ref2 type	*uint16*	0…5	-	1 = 1
50.37	FBA B actual 1 type	*uint16*	0…5	-	1 = 1
50.38	FBA B actual 2 type	*uint16*	0…5	-	1 = 1
50.39	FBA B SW transparent source	*uint32*	-	-	1 = 1
50.40	FBA B act1 transparent source	*uint32*	-	-	1 = 1
50.41	FBA B act2 transparent source	*uint32*	-	-	1 = 1
50.42	FBA B debug enable	*uint16*	0…1	-	1 = 1
50.43	FBA B control word	*uint32*	00000000h … FFFFFFFFh	-	1 = 1
50.44	FBA B reference 1	*int32*	-2147483648 … 2147483647	-	1 = 1
50.45	FBA B reference 2	*int32*	-2147483648 … 2147483647	-	1 = 1
50.46	FBA B status word	*uint32*	00000000h … FFFFFFFFh	-	1 = 1
50.47	FBA B actual value 1	*int32*	-2147483648 … 2147483647	-	1 = 1
50.48	FBA B actual value 2	*int32*	-2147483648 … 2147483647	-	1 = 1
50.51	FBA B timelevel sel	*uint16*	0…3	-	1 = 1
50.56	FBA B comm supervision force	*uint16*	0000h...FFFFh	-	1 = 1
50.99	FBA automatic detection	*uint16*	0…2	-	1 = 1
51 FBA A settings					
51.01	FBA A type	*uint16*	-	-	1 = 1
51.02	FBA A Par2	*uint16*	0…65535	-	1 = 1
…	…	…	…	…	
51.26	FBA A Par26	*uint16*	0…65535	-	1 = 1
51.27	FBA A par refresh	*uint16*	0…1	-	1 = 1
51.28	FBA A par table ver	*uint16*	-	-	1 = 1
51.29	FBA A drive type code	*uint16*	0…65535	-	1 = 1
51.30	FBA A mapping file ver	*uint16*	0…65535	-	1 = 1
51.31	D2FBA A comm status	*uint16*	0…6	-	1 = 1

No.	Name	Type	Range	Unit	FbEq32
51.32	FBA A comm SW ver	*uint16*	-	-	1 = 1
51.33	FBA A appl SW ver	*uint16*	-	-	1 = 1
52 FBA A data in					
52.01	FBA A data in1	*uint32*	-	-	1 = 1
…	…	…	…	…	
52.12	FBA A data in12	*uint32*	-	-	1 = 1
53 FBA A data out					
53.01	FBA A data out1	*uint32*	-	-	1 = 1
53.02	FBA A data out2	*uint32*	-	-	1 = 1
53.03	FBA A data out3	*uint32*	-	-	1 = 1
…	…	…	…	…	
53.12	FBA A data out12	*uint32*	-	-	1 = 1
54 FBA B settings					
54.01	FBA B type	*uint16*			
54.02	FBA B Par2	*uint16*	0…65535	-	
…	…	…	…	…	
54.26	FBA B Par26	*uint16*	0…65535	-	
54.27	FBA B par refresh	*uint16*	0…1	-	
54.28	FBA B par table ver	*uint16*	0…65535	-	
54.29	FBA B drive type code	*uint16*	0…65535	-	
54.30	FBA B mapping file ver	*uint16*	0…65535	-	
54.31	D2FBA B comm status	*uint16*	0…6	-	
54.32	FBA B comm SW ver	*uint16*	0…65535	-	
54.33	FBA B appl SW ver	*uint16*	0…65535	-	
55 FBA B data in					
55.01	FBA B data in1	*uint32*	-	-	1 = 1
…	…	…	…	…	
55.12	FBA B data in12	*uint32*	-	-	1 = 1
56 FBA B data out					
56.01	FBA B data out1	*uint32*	-	-	1 = 1
…	…	…	…	…	
56.12	FBA B data out12	*uint32*	-	-	1 = 1
58 Embedded fieldbus					
58.01	Protocol enable	*uint16*	0…1	-	1 = 1
58.02	Protocol ID	*uint16*	0000h…FFFFh	-	1 = 1
58.03	Node address	*uint16*	0…255	-	1 = 1
58.04	Baud rate	*uint16*	2…7	-	1 = 1
58.05	Parity	*uint16*	0…3	-	1 = 1
58.06	Communication control	*uint16*	0…2	-	1 = 1
58.07	Communication diagnostics	*uint16*	0000h…FFFFh	-	1 = 1
58.08	Received packets	*uint32*	0…4294967295	-	1 = 1

No.	Name	Type	Range	Unit	FbEq32
58.09	Transmitted packets	*uint32*	0…4294967295	-	1 = 1
58.10	All packets	*uint32*	0…4294967295	-	1 = 1
58.11	UART errors	*uint32*	0…4294967295	-	1 = 1
58.12	CRC errors	*uint32*	0…4294967295	-	1 = 1
58.14	Communication loss action	*uint16*	0…5	-	1 = 1
58.15	Communication loss mode	*uint16*	1…2	-	1 = 1
58.16	Communication loss time	*uint16*	0.0 … 6000.0	s	10 = 1 s
58.17	Transmit delay	*uint16*	0…65535	ms	1 = 1 ms
58.18	EFB control word	*uint32*	0000h…FFFFh	-	1 = 1
58.19	EFB status word	*uint32*	0000h…FFFFh	-	1 = 1
58.25	Control profile	*uint16*	0, 2	-	1 = 1
58.26	EFB ref1 type	*uint16*	0…5	-	1 = 1
58.27	EFB ref2 type	*uint16*	0…5	-	1 = 1
58.28	EFB act1 type	*uint16*	0…6	-	1 = 1
58.29	EFB act2 type	*uint16*	0…6	-	1 = 1
58.30	EFB status word transparent source	*uint32*	-	-	1 = 1
58.31	EFB act1 transparent source	*uint32*	-	-	1 = 1
58.32	EFB act2 transparent source	*uint32*	-	-	1 = 1
58.33	Addressing mode	*uint16*	0…2	-	1 = 1
58.34	Word order	*uint16*	0…1	-	1 = 1
58.36	EFB comm supervision force	*uint16*	0000h…FFFFh	-	1 = 1
58.101	Data I/O 1	*uint32*	-	-	1 = 1
58.102	Data I/O 2	*uint32*	-	-	1 = 1
58.103	Data I/O 3	*uint32*	-	-	1 = 1
58.104	Data I/O 4	*uint32*	-	-	1 = 1
58.105	Data I/O 5	*uint32*	-	-	1 = 1
58.106	Data I/O 6	*uint32*	-	-	1 = 1
58.107	Data I/O 7	*uint32*	-	-	1 = 1
…	…	…	…	…	
58.124	Data I/O 24	*uint32*	-	-	1 = 1
60 DDCS communication					
60.01	M/F communication port	*uint16*	-	-	-
60.02	M/F node address	*real32*	1…254	-	-
60.03	M/F mode	*uint16*	0…6	-	-
60.05	M/F HW connection	*uint16*	0…1	-	-
60.07	M/F link control	*uint16*	1…15	-	-
60.08	M/F comm loss timeout	*uint16*	0…65535	ms	-
60.09	M/F comm loss function	*uint16*	0…3	-	-
60.10	M/F ref1 type	*uint16*	0…10	-	-
60.11	M/F ref2 type	*uint16*	0…10	-	-

No.	Name	Type	Range	Unit	FbEq32
60.12	M/F act1 type	*uint16*	0…10	-	-
60.13	M/F act2 type	*uint16*	0…10	-	-
60.14	M/F follower selection	*uint32*	0…16	-	-
60.15	Force master	*uint32*	-	-	1 = 1
60.16	Force follower	*uint32*	-	-	1 = 1
60.17	Follower fault action	*uint16*	0…2	-	-
60.18	Follower enable	*uint16*	0…6	-	-
60.19	M/F comm supervision sel 1	*uint16*	0000h…FFFFh	-	1 = 1
60.20	M/F comm supervision sel 2	*uint16*	0000h…FFFFh	-	1 = 1
60.23	M/F status supervision sel 1	*uint16*	0000h…FFFFh	-	1 = 1
60.24	M/F status supervision sel 2	*uint16*	0000h…FFFFh	-	1 = 1
60.27	M/F status supv mode sel 1	*uint16*	0000h…FFFFh	-	1 = 1
60.28	M/F status supv mode sel 2	*uint16*	0000h…FFFFh	-	1 = 1
60.31	M/F wake up delay	*uint16*	0.0 … 180.0	s	10 = 1 s
60.32	M/F comm supervision force	*uint16*	0000h...FFFFh	-	1 = 1
60.41	Extension adapter com port	*uint16*	-	-	-
60.50	DDCS controller drive type	*uint16*	0....1	-	-
60.51	DDCS controller comm port	*uint16*	-	-	-
60.52	DDCS controller node address	*uint16*	1…254	-	-
60.55	DDCS controller HW connection	*uint16*	0…1	-	-
60.56	DDCS controller baud rate	*uint16*	1, 2, 4, 8	-	-
60.57	DDCS controller link control	*uint16*	1…15	-	-
60.58	DDCS controller comm loss time	*uint16*	0…60000	ms	-
60.59	DDCS controller comm loss function	*uint16*	0…5	-	-
60.60	DDCS controller ref1 type	*uint16*	0…10	-	-
60.61	DDCS controller ref2 type	*uint16*	0…10	-	-
60.62	DDCS controller act1 type	*uint16*	0…10	-	-
60.63	DDCS controller act2 type	*uint16*	0…10	-	-
60.64	Mailbox dataset selection	*uint16*	0…1	-	-
60.65	DDCS controller comm supervision force	*uint16*	0000h...FFFFh	-	1 = 1
60.200	Winch drive type	*uint16*	-	-	-
60.201	Winch drive structure 1	*uint16*	-	-	-
60.202	Winch drive structure 2	*uint16*	-	-	-
60.205	Winch drive structure sel	*uint16*	-	-	-
60.208	Winch M/F enable	*uint16*	-	-	-
60.209	Temp ref to followers	*uint16*	-	-	-
60.210	Winch drive type actual	*uint16*	-	-	-
60.211	Master reference 1	*real32*	-15000...15000	-	1 = 1

No.	Name	Type	Range	Unit	FbEq32
60.212	Master reference 2	*real32*	-1600...1600	-	1 = 1
60.213	Master control word	*uint16*	0000h...FFFFh	-	-
60.214	Master status word	*uint16*	0000h...FFFFh	-	-
60.221	Follower 1 status word	*uint16*	0000h…FFFFh	-	1 = 1
60.222	Follower 2 status word	*uint16*	0000h…FFFFh	-	1 = 1
60.223	Follower 3 status word	*uint16*	0000h…FFFFh	-	1 = 1
60.224	Follower 4 status word	*uint16*	0000h…FFFFh	-	1 = 1
60.225	Follower 5 status word	*uint16*	0000h…FFFFh	-	1 = 1
60.226	Follower 6 status word	*uint16*	0000h…FFFFh	-	1 = 1
60.227	Follower 7 status word	*uint16*	0000h…FFFFh	-	1 = 1
60.228	Follower 8 status word	*uint16*	0000h…FFFFh	-	1 = 1
60.229	Follower 9 status word	*uint16*	0000h…FFFFh	-	1 = 1
60.230	Follower 10 status word	*uint16*	0000h…FFFFh	-	1 = 1
60.231	Follower 11 status word	*uint16*	0000h…FFFFh	-	1 = 1
60.237	Comm loss delay	*real32*	0...32000	ms	1 = 1
60.238	Communication loss status	*uint16*	0000h…FFFFh	-	1 = 1
61 D2D and DDCS transmit data					
61.01	M/F data 1 selection	*uint32*	-	-	-
61.02	M/F data 2 selection	*uint32*	-	-	-
61.03	M/F data 3 selection	*uint32*	-	-	-
61.25	M/F data 1 value	*uint16*	0…65535	-	-
61.26	M/F data 2 value	*uint16*	0…65535	-	-
61.27	M/F data 3 value	*uint16*	0…65535	-	-
61.45	Data set 2 data 1 selection	*uint32*	-	-	-
61.46	Data set 2 data 2 selection	*uint32*	-	-	-
61.47	Data set 2 data 3 selection	*uint32*	-	-	-
61.48	Data set 4 data 1 selection	*uint32*	-	-	-
61.49	Data set 4 data 2 selection	*uint32*	-	-	-
61.50	Data set 4 data 3 selection	*uint32*	-	-	-
61.51	Data set 11 data 1 selection	*uint32*	-	-	-
61.52	Data set 11 data 2 selection	*uint32*	-	-	-
61.53	Data set 11 data 3 selection	*uint32*	-	-	-
61.54	Data set 13 data 1 selection	*uint32*	-	-	-
61.55	Data set 13 data 2 selection	*uint32*	-	-	-
61.56	Data set 13 data 3 selection	*uint32*	-	-	-
61.57	Data set 15 data 1 selection	*uint32*	-	-	-
61.58	Data set 15 data 2 selection	*uint32*	-	-	-
61.59	Data set 15 data 3 selection	*uint32*	-	-	-
61.60	Data set 17 data 1 selection	*uint32*	-	-	-
61.61	Data set 17 data 2 selection	*uint32*	-	-	-
61.62	Data set 17 data 3 selection	*uint32*	-	-	-

No.	Name	Type	Range	Unit	FbEq32
61.63	Data set 19 data 1 selection	*uint32*	-	-	-
61.64	Data set 19 data 2 selection	*uint32*	-	-	-
61.65	Data set 19 data 3 selection	*uint32*	-	-	-
61.66	Data set 21 data 1 selection	*uint32*	-	-	-
61.67	Data set 21 data 2 selection	*uint32*	-	-	-
61.68	Data set 21 data 3 selection	*uint32*	-	-	-
61.69	Data set 23 data 1 selection	*uint32*	-	-	-
61.70	Data set 23 data 2 selection	*uint32*	-	-	-
61.71	Data set 23 data 3 selection	*uint32*	-	-	-
61.72	Data set 25 data 1 selection	*uint32*	-	-	-
61.73	Data set 25 data 2 selection	*uint32*	-	-	-
61.74	Data set 25 data 3 selection	*uint32*	-	-	-
61.95	Data set 2 data 1 value	*uint16*	0…65535	-	-
61.96	Data set 2 data 2 value	*uint16*	0…65535	-	-
61.97	Data set 2 data 3 value	*uint16*	0…65535	-	-
61.98	Data set 4 data 1 value	*uint16*	0…65535	-	-
61.99	Data set 4 data 2 value	*uint16*	0…65535	-	-
61.100	Data set 4 data 3 value	*uint16*	0…65535	-	-
61.101	Data set 11 data 1 value	*uint16*	0…65535	-	-
61.102	Data set 11 data 2 value	*uint16*	0…65535	-	-
61.103	Data set 11 data 3 value	*uint16*	0…65535	-	-
61.104	Data set 13 data 1 value	*uint16*	0…65535	-	-
61.105	Data set 13 data 2 value	*uint16*	0…65535	-	-
61.106	Data set 13 data 3 value	*uint16*	0…65535	-	-
61.107	Data set 15 data 1 value	*uint16*	0…65535	-	-
61.108	Data set 15 data 2 value	*uint16*	0…65535	-	-
61.109	Data set 15 data 3 value	*uint16*	0…65535	-	-
61.110	Data set 17 data 1 value	*uint16*	0…65535	-	-
61.111	Data set 17 data 2 value	*uint16*	0…65535	-	-
61.112	Data set 17 data 3 value	*uint16*	0…65535	-	-
61.113	Data set 19 data 1 value	*uint16*	0…65535	-	-
61.114	Data set 19 data 2 value	*uint16*	0…65535	-	-
61.115	Data set 19 data 3 value	*uint16*	0…65535	-	-
61.116	Data set 21 data 1 value	*uint16*	0…65535	-	-
61.117	Data set 21 data 2 value	*uint16*	0…65535	-	-
61.118	Data set 21 data 3 value	*uint16*	0…65535	-	-
61.119	Data set 23 data 1 value	*uint16*	0…65535	-	-
61.120	Data set 23 data 2 value	*uint16*	0…65535	-	-
61.121	Data set 23 data 3 value	*uint16*	0…65535	-	-
61.122	Data set 25 data 1 value	*uint16*	0…65535	-	-
61.123	Data set 25 data 2 value	*uint16*	0…65535	-	-

No.	Name	Type	Range	Unit	FbEq32
61.124	Data set 25 data 3 value	uint16	0…65535	-	-
62 D2D and DDCS receive data					
62.01	M/F data 1 selection	uint32	-	-	-
62.02	M/F data 2 selection	uint32	-	-	-
62.03	M/F data 3 selection	uint32	-	-	-
62.04	Follower node 2 data 1 sel	uint32	-	-	-
62.05	Follower node 2 data 2 sel	uint32	-	-	-
62.06	Follower node 2 data 3 sel	uint32	-	-	-
62.07	Follower node 3 data 1 sel	uint32	-	-	-
62.08	Follower node 3 data 2 sel	uint32	-	-	-
62.09	Follower node 3 data 3 sel	uint32	-	-	-
62.10	Follower node 4 data 1 sel	uint32	-	-	-
62.11	Follower node 4 data 2 sel	uint32	-	-	-
62.12	Follower node 4 data 3 sel	uint32	-	-	-
62.25	MF/D2D data 1 value	uint16	0…65535	-	-
62.26	MF/D2D data 2 value	uint16	0…65535	-	-
62.27	MF/D2D data 3 value	uint16	0…65535	-	-
62.28	Follower node 2 data 1 value	uint16	0…65535	-	-
62.29	Follower node 2 data 2 value	uint16	0…65535	-	-
62.30	Follower node 2 data 3 value	uint16	0…65535	-	-
62.31	Follower node 3 data 1 value	uint16	0…65535	-	-
62.32	Follower node 3 data 2 value	uint16	0…65535	-	-
62.33	Follower node 3 data 3 value	uint16	0…65535	-	-
62.34	Follower node 4 data 1 value	uint16	0…65535	-	-
62.35	Follower node 4 data 2 value	uint16	0…65535	-	-
62.36	Follower node 4 data 3 value	uint16	0…65535	-	-
62.37	M/F communication status 1	uint16	0000h…FFFFh	-	1 = 1
62.38	M/F communication status 2	uint16	0000h…FFFFh	-	1 = 1
62.41	M/F follower ready status 1	uint16	0000h…FFFFh	-	1 = 1
62.42	M/F follower ready status 2	uint16	0000h…FFFFh	-	1 = 1
62.45	Data set 1 data 1 selection	uint32	-	-	-
62.46	Data set 1 data 2 selection	uint32	-	-	-
62.47	Data set 1 data 3 selection	uint32	-	-	-
62.48	Data set 3 data 1 selection	uint32	-	-	-
62.49	Data set 3 data 2 selection	uint32	-	-	-
62.50	Data set 3 data 3 selection	uint32	-	-	-
62.51	Data set 10 data 1 selection	uint32	-	-	-
62.52	Data set 10 data 2 selection	uint32	-	-	-
62.53	Data set 10 data 3 selection	uint32	-	-	-
62.54	Data set 12 data 1 selection	uint32	-	-	-
62.55	Data set 12 data 2 selection	uint32	-	-	-

No.	Name	Type	Range	Unit	FbEq32
62.56	Data set 12 data 3 selection	*uint32*	-	-	-
62.57	Data set 14 data 1 selection	*uint32*	-	-	-
62.58	Data set 14 data 2 selection	*uint32*	-	-	-
62.59	Data set 14 data 3 selection	*uint32*	-	-	-
62.60	Data set 16 data 1 selection	*uint32*	-	-	-
62.61	Data set 16 data 2 selection	*uint32*	-	-	-
62.62	Data set 16 data 3 selection	*uint32*	-	-	-
62.63	Data set 18 data 1 selection	*uint32*	-	-	-
62.64	Data set 18 data 2 selection	*uint32*	-	-	-
62.65	Data set 18 data 3 selection	*uint32*	-	-	-
62.66	Data set 20 data 1 selection	*uint32*	-	-	-
62.67	Data set 20 data 2 selection	*uint32*	-	-	-
62.68	Data set 20 data 3 selection	*uint32*	-	-	-
62.69	Data set 22 data 1 selection	*uint32*	-	-	-
62.70	Data set 22 data 2 selection	*uint32*	-	-	-
62.71	Data set 22 data 3 selection	*uint32*	-	-	-
62.72	Data set 24 data 1 selection	*uint32*	-	-	-
62.73	Data set 24 data 2 selection	*uint32*	-	-	-
62.74	Data set 24 data 3 selection	*uint32*	-	-	-
62.95	Data set 1 data 1 value	*uint16*	0…65535	-	-
62.96	Data set 1 data 2 value	*uint16*	0…65535	-	-
62.97	Data set 1 data 3 value	*uint16*	0…65535	-	-
62.98	Data set 3 data 1 value	*uint16*	0…65535	-	-
62.99	Data set 3 data 2 value	*uint16*	0…65535	-	-
62.100	Data set 3 data 3 value	*uint16*	0…65535	-	-
62.101	Data set 10 data 1 value	*uint16*	0…65535	-	-
62.102	Data set 10 data 2 value	*uint16*	0…65535	-	-
62.103	Data set 10 data 3 value	*uint16*	0…65535	-	-
62.104	Data set 12 data 1 value	*uint16*	0…65535	-	-
62.105	Data set 12 data 2 value	*uint16*	0…65535	-	-
62.106	Data set 12 data 3 value	*uint16*	0…65535	-	-
62.107	Data set 14 data 1 value	*uint16*	0…65535	-	-
62.108	Data set 14 data 2 value	*uint16*	0…65535	-	-
62.109	Data set 14 data 3 value	*uint16*	0…65535	-	-
62.110	Data set 16 data 1 value	*uint16*	0…65535	-	-
62.111	Data set 16 data 2 value	*uint16*	0…65535	-	-
62.112	Data set 16 data 3 value	*uint16*	0…65535	-	-
62.113	Data set 18 data 1 value	*uint16*	0…65535	-	-
62.114	Data set 18 data 2 value	*uint16*	0…65535	-	-
62.115	Data set 18 data 3 value	*uint16*	0…65535	-	-
62.116	Data set 20 data 1 value	*uint16*	0…65535	-	-

No.	Name	Type	Range	Unit	FbEq32
62.117	Data set 20 data 2 value	*uint16*	0…65535	-	-
62.118	Data set 20 data 3 value	*uint16*	0…65535	-	-
62.119	Data set 22 data 1 value	*uint16*	0…65535	-	-
62.120	Data set 22 data 2 value	*uint16*	0…65535	-	-
62.121	Data set 22 data 3 value	*uint16*	0…65535	-	-
62.122	Data set 24 data 1 value	*uint16*	0…65535	-	-
62.123	Data set 24 data 2 value	*uint16*	0…65535	-	-
62.124	Data set 24 data 3 value	*uint16*	0…65535	-	-
74 Winch general					
74.01	Anchor mode enable	*uint32*	-	-	-
74.02	Handmooring mode enable	*uint32*	-	-	-
74.03	Automooring mode enable	*uint32*	-	-	-
74.04	Automooring triggering type	*uint32*	-	-	-
74.09	Winch configuration word	*uint32*	-	-	-
74.10	Chain length calc enable	*uint32*	-	-	-
74.11	Chain length source	*uint32*	-	-	-
74.12	Chain absolute length	*real32*	-1000000.0...1000000.0	mm	10 = 1 mm
74.20	Anchor max speed heave	*real32*	-18000...18000	rpm	1 = 1 rpm
74.21	Anchor max speed lower	*real32*	-18000...18000	rpm	1 = 1 rpm
74.22	Anchor acc time	*real32*	0.00...1800.00	s	100 = 1 s
74.23	Anchor dec time	*real32*	0.00...1800.00	s	100 = 1 s
74.24	Anchor max torque	*real32*	0.0...600.0	%	10 = 1%
74.25	Anchor motoring power limit	*real32*	0.0...600.0	%	10 = 1%
74.26	Anchor min speed	*real32*	0...18000	rpm	1 = 1 rpm
74.27	Anchor invert direction	*uint32*	-	-	-
74.28	Anchor overload torque limit	*real32*	0...1600	%	1 = 1%
74.29	Anchor overload speed limit	*real32*	0...30000	rpm	1 = 1 rpm
74.30	Handmooring max speed heave	*real32*	0...18000	rpm	1 = 1 rpm
74.31	Handmooring max speed lower	*real32*	0...18000	-	1 = 1
74.32	Handmooring acc time	*real32*	0.00...1800.00	s	100 = 1 s
74.33	Handmooring dec time	*real32*	0.00...1800.00	s	100 = 1 s
74.34	Handmooring max torque	*real32*	0.0...600.0	%	10 = 1%
74.35	Handmooring motoring power limit	*real32*	0.0...600.0	%	10 = 1%
74.36	Handmooring min speed	*real32*	0...18000	rpm	1 = 1 rpm
74.38	Handmooring overload torque limit	*real32*	0.0...600.0	%	10 = 1%
74.39	Handmooring overload speed limit	*real32*	0...18000	rpm	1 = 1 rpm
74.40	Automooring speed ref	*real32*	0...18000	rpm	1 = 1 rpm
74.42	Automooring acc time	*real32*	0.00...1800.00	s	100 = 1 s

No.	Name	Type	Range	Unit	FbEq32
74.43	Automooring dec time	*real32*	0.00...1800.00	s	100 = 1 s
74.44	Automooring max torque	*real32*	0.0...600.0	%	10 = 1%
74.47	Automooring invert direction	*uint32*	-	-	-
74.50	Speed match enable	*uint32*	-	-	-
74.51	Speed steady deviation level	*real32*	0.00...30000.00	rpm	100 = 1 rpm
74.52	Speed ramp deviation level	*real32*	0.00...30000.00	rpm	100 = 1 rpm
74.53	Speed match action	*uint32*	-	-	-
74.54	Speed match action delay	*real32*	0...30000	ms	1 = 1 ms
74.60	Winch system ID-run enable	*uint32*	-	-	-
74.61	Winch system ID-run configuration	*uint32*	-	-	-
74.62	Rope tension configuration	*uint32*	-	-	-
74.63	Rope tension filter number	*real32*	0...10000	-	1 = 1
74.64	Speed change rate deadband	*real32*	0...10000	-	1 = 1
74.65	Winch system inertia	*real32*	0.00000...1000.00000	kgm^2	100000 = 1
74.66	Winch system speed 1 torque	*real32*	0.0...300.0	%	10 = 1
74.67	Winch system speed 2 torque	*real32*	0.0...300.0	%	10 = 1
74.68	Winch system speed 3 torque	*real32*	0.0...300.0	%	10 = 1
74.69	Winch system speed 4 torque	*real32*	0.0...300.0	%	10 = 1
74.70	Winch system speed 5 torque	*real32*	0.0...300.0	%	10 = 1
74.71	Winch system speed 1	*real32*	0.0...18000.0	rpm	10 = 1
74.72	Winch system speed 2	*real32*	0.0...18000.0	rpm	10 = 1
74.73	Winch system speed 3	*real32*	0.0...18000.0	rpm	10 = 1
74.74	Winch system speed 4	*real32*	0.0...18000.0	rpm	10 = 1
74.75	Winch system speed 5	*real32*	0.0...18000.0	rpm	10 = 1
74.76	Handmooring switch level	*uint32*	-	-	-
74.77	Handmooring switch level torque	*real32*	0.0...600.0	%	10 = 1
74.78	Handmooring switch level hysteresis	*real32*	0.0...100.0	%	10 = 1
74.79	Handmooring switch level delay	*real32*	0.0...600.0	s	10 = 1
74.80	Handmooring max speed sel sw	*uint32*	-	-	-
74.81	Handmooring max speed sel in 1	*uint32*	-	-	-
74.82	Handmooring max speed sel in 2	*uint32*	-	-	-
74.83	Handmooring max speed heave set 1	*real32*	0...18000	rpm	1 = 1
74.84	Handmooring max speed lower set 1	*real32*	0...18000	rpm	1 = 1

No.	Name	Type	Range	Unit	FbEq32
74.85	Handmooring max speed heave set 2	real32	0...18000	rpm	1 = 1
74.86	Handmooring max speed lower set 2	real32	0...18000	rpm	1 = 1
74.87	Handmooring max speed heave set 3	real32	0...18000	rpm	1 = 1
74.88	Handmooring max speed lower set 3	real32	0...18000	rpm	1 = 1
74.89	Torque high status word	uint32	-	-	-
74.90	Handmooring high torque level supervision	uint32	-	-	-
74.91	Handmooring high torque level limit	real32	0.0...600.0	%	10 = 1
74.92	Handmooring high torque level delay	real32	0.0...1800.0	s	10 = 1
74.95	Automooring high torque level supervision	uint32	-	-	-
74.96	Automooring high torque level limit	real32	0.0...600.0	%	10 = 1
74.97	Automooring high torque level delay	real32	0.0...1800.0	s	10 = 1
74.100	Anchor high torque level supervision	uint32	-	-	-
74.101	Anchor high torque level limit	real32	0.0...600.0	%	10 = 1
74.102	Anchor high torque level delay	real32	0.0...1800.0	s	10 = 1
74.110	Abnormal torque level	real32	0.0...600.0	%	10 = 1
75 Winch interface					
75.01	Control stand fault reset enable	uint32	-	-	-
75.02	Control stand enable mode	uint32	-	-	-
75.03	Control stand priority selection	uint32	-	-	-
75.04	Control stand joystick mode	uint32	-	-	-
75.10	Control stand 1 enable	uint32	-	-	-
75.11	Control stand 1 reference	uint32	-	-	-
75.12	Control stand 1 heave	uint32	-	-	-
75.13	Control stand 1 lower	uint32	-	-	-
75.14	Control stand 2 enable	uint32	-	-	-
75.15	Control stand 2 reference	uint32	-	-	-
75.16	Control stand 2 heave	uint32	-	-	-
75.17	Control stand 2 lower	uint32	-	-	-
75.18	Control stand 3 enable	uint32	-	-	-
75.19	Control stand 3 reference	uint32-	-	-	-
75.20	Control stand 3 heave	uint32	-	-	-
75.21	Control stand 3 lower	uint32	-	-	-
75.22	Include FB control stand	uint32	-	-	-

No.	Name	Type	Range	Unit	FbEq32
75.23	Multi FB stand enable	*uint32*	-	-	-
75.24	Multi FB reference	*uint32*	-	-	-
75.25	Multi FB heave	*uint32*	-	-	-
75.26	Multi FB lower	*uint32*	-	-	-
75.30	Step reference selector 2	*uint32*	-	-	-
75.31	Step reference selector 3	*uint32*	-	-	-
75.34	Step reference 1	*real32*	0.00...100.00	%	100 = 1%
75.35	Step reference 2	*real32*	0.00...100.00	%	100 = 1%
75.36	Step reference 3	*real32*	0.00...100.00	%	100 = 1%
76 Automooring					
76.01	Automooring mode	*uint32*	-	-	-
76.02	Override control	*uint32*	-	-	-
76.03	Automooring style	*uint32*	-	-	-
76.04	Automooring config word	*uint16*	0000h…FFFFh	-	1 = 1
76.05	Automooring min tension	*real32*	0.0...100.0	%	10 = 1%
76.06	AM min protection mode	*uint32*	-	-	-
76.07	AM min protection action	*uint32*	-	-	-
76.09	Automooring winch capacity	*real32*	0.0...200.0	%	10 = 1%
76.10	Tension feedback source	*uint32*-	-	-	-
76.11	Min automooring setpoint level	*real32*	0.0...100.0	%	10 = 1%
76.12	Max automooring setpoint level	*real32*	0.0...300.0	%	10 = 1%
76.13	Automooring setpoint selection	*uint32*	-	-	-
76.14	Automooring setpoint1	*real32*	0.0...300.0	%	10 = 1%
76.15	Automooring setpoint2	*real32*	0.0...300.0	%	10 = 1%
76.16	Automooring setpoint3	*real32*	0.0...300.0	%	10 = 1%
76.17	Automooring setpoint4	*real32*	0.0...300.0	%	10 = 1%
76.18	Automooring setpoint5	*real32*	0.0...300.0	%	10 = 1%
76.19	AM setpoint ref ramp	*real32*	0.00...30000.00	s	100 = 1 s
76.20	AM setpoint selector 1 srcA	*uint32*	-	-	-
76.21	AM setpoint selector 1 srcB	*uint32*	-	-	-
76.22	AM setpoint selector 1 srcC	*uint32*			-
76.23	AM setpoint selector 2 srcA	*uint32*	-	-	-
76.24	AM setpoint selector 2 srcB	*uint32*	-	-	-
76.25	AM setpoint selector 2 srcC	*uint32*			-
76.26	AM setpoint selector 3 srcA	*uint32*	-	-	-
76.27	AM setpoint selector 3 srcB	*uint32*	-	-	-
76.28	AM setpoint selector 3 srcC	*uint32*	-	-	-
76.30	Hysteresis high level	*real32*	0.0...100.0	%	10 = 1%
76.31	Hysteresis low level	*real32*	0.0...100.0	%	10 = 1%
76.32	Deadband high level	*real32*	0.0...100.0	%	10 = 1%

No.	Name	Type	Range	Unit	FbEq32
76.33	Deadband low level	*real32*	0.0...100.0	%	10 = 1%
76.34	In zone time delay	*real32*	0...3600	s	1 = 1 s
76.35	Out zone time delay	*real32*	0...3600	s	1 = 1 s
76.40	Torque measuring mode	*uint32*	-	-	-
76.41	Torque measuring time	*real32*	0...3600	s	1 = 1 s
76.42	Rotating mode speed	*real32*	0...3000	rpm	1 = 1 rpm
76.43	Rotating mode time	*real32*	0...3600	s	1 = 1 s
76.44	Torque mode calculation	*uint32*	-	-	-
76.50	Re-mooring time interval 1	*real32*	0...3600	min	1 = 1 min
76.51	Re-mooring time interval 2	*real32*	0...3600	min	1 = 1 min
76.52	Re-mooring time 1/2 switch src	*uint32*	-	-	-
76.53	Re-mooring switchover time 1/2	*real32*	0.0...3600.0	min	10 = 1 min
76.54	Re-mooring wakeup level	*real32*	0.0...100.0	%	10 = 1%
76.55	Cont to Time switch src	*uint32*	-	-	-
76.56	Cont to Time switchover time	*real32*	0.0...3600.00	min	100 = 1 min
76.60	Max AM time	*real32*	0.0...3600.0	min	10 = 1 min
76.61	Max AM timeout function	*uint32*	-	-	1 = 1
76.65	Load cell high start limit	*real32*	0.0...600.0	%	10 = 1%
76.70	AM motpot force init	*uint32*	-	-	-
76.71	AM motpot ramp time	*real32*	0.0...3600.0	s	10 = 1 s
76.72	AM motpot init function	*uint32*	-	-	-
76.75	AM setpoint selector conf A	*uint16*	0000h…FFFFh	-	1 = 1
76.76	AM setpoint selector conf B	*uint16*	0000h…FFFFh	-	1 = 1
76.77	AM setpoint selector conf C	*uint16*	0000h…FFFFh	-	1 = 1
76.81	Frequent start supervision action	*uint32*	-	-	1 = 1
76.82	Frequent start time window	*real32*	0...65535	s	1 = 1
76.85	AM min prot max starts	*real32*	0...30000	-	1 = 1
77 Anchor stowing protection					
77.01	Anchor protection enable	*uint32*	-	-	-
77.02	Disable function	*uint32*	-	-	-
77.03	Disable time	*real32*	0.0...3600.0	s	10 = 1 s
77.04	Protection mode	*uint32*	-	-	-
77.05	Activation speed direction	*uint32*	-	-	-
77.06	Activation chain length	*real32*	-1000000.0...1000000.0	mm	10 = 1 mm
77.07	Limited max torque	*real32*	0.0...300.0	%	10 = 1%
77.08	Limited max speed	*real32*	0.0...300.0	%	10 = 1%
77.09	Acc time in protection	*real32*	0.00...1800.00	s	100 = 1 s
77.10	Dec time in protection	*real32*	0.00...1800.00	s	100 = 1 s
77.11	Anchor external detection	*uint32*	-	-	-
78 Slip detection					

No.	Name	Type	Range	Unit	FbEq32
78.01	Slip detection enable	*uint32*	-	-	-
78.02	Disable function	*uint32*	-	-	-
78.03	Disable time	*real32*	0.0...3600.0	s	10 = 1 s
78.04	Slip detection mode	*uint32*	-	-	-
78.05	Activation speed direction	*uint32*	-	-	-
78.06	Activation chain speed limit	*real32*	0.00...18000.00	mm/s	100 = 1 mm/s
78.07	Activation drive speed limit	*real32*	0.0...18000.0	rpm	10 = 1 rpm
78.08	Activation torque limit	*real32*	0.0...300.0	%	10 = 1%
78.09	Activation delay time	*real32*	0.0...3600.0	s	10 = 1 s
78.10	Limited max speed	*real32*	0.0...300.0	%	10 = 1%
78.11	Slip external detection	*uint32*	-	-	-
79 Peak torque protection					
79.01	Peak torque protection enable	*uint32*	-	-	-
79.02	Activation speed direction	*uint32*	-	-	-
79.03	Activation torque limit	*real32*	0.0...300.0	%	10 = 1%
79.04	Activation speed limit	*real32*	0...18000	rpm	1 = 1 rpm
79.05	Dec time to protection speed	*real32*	0.00...3600.00	s	100 = 1 s
79.06	Limited max speed	*real32*	0.0...100.0	%	10 = 1%
79.07	Dec time to zero	*real32*	0.00...3600.00	s	100 = 1 s
80 Power control					
80.01	Power control enable	*uint32*	-	-	-
80.02	Set 1 torque level1	*real32*	0.0...3000.0	%	10 = 1%
80.03	Set 1 torque level2	*real32*	0.0...3000.0	%	10 = 1%
80.04	Set 1 torque level3	*real32*	0.0...3000.0	%	10 = 1%
80.05	Set 1 torque level4	*real32*	0.0...3000.0	%	10 = 1 %
80.06	Set 1 torque level5	*real32*	0.0...3000.0	%	10 = 1%
80.07	Set 1 speed level1	*real32*	0.0...18000.0	rpm	10 = 1 rpm
80.08	Set 1 speed level2	*real32*	0.0...18000.0	rpm	10 = 1 rpm
80.09	Set 1 speed level3	*real32*	0.0...18000.0	rpm	10 = 1 rpm
80.10	Set 1 speed level4	*real32*	0.0...18000.0	rpm	10 = 1 rpm
80.11	Set 1 speed level5	*real32*	0.0...18000.0	rpm	10 = 1 rpm
80.12	Set 2 torque level1	*real32*	0.0...3000.0	%	10 = 1%
80.13	Set 2 torque level2	*real32*	0.0...3000.0	%	10 = 1%
80.14	Set 2 torque level3	*real32*	0.0...3000.0	%	10 = 1%
80.15	Set 2 torque level4	*real32*	0.0...3000.0	%	10 = 1%
80.16	Set 2 torque level5	*real32*	0.0...3000.0	%	10 = 1%
80.17	Set 2 speed level1	*real32*	0.0...18000.0	rpm	10 = 1 rpm
80.18	Set 2 speed level2	*real32*	0.0...18000.0	rpm	10 = 1 rpm
80.19	Set 2 speed level3	*real32*	0.0...18000.0	rpm	10 = 1 rpm
80.20	Set 2 speed level4	*real32*	0.0...18000.0	rpm	10 = 1 rpm
80.21	Set 2 speed level5	*real32*	0.0...18000.0	rpm	10 = 1 rpm

No.	Name	Type	Range	Unit	FbEq32
80.22	Acc torque buffer	*real32*	0.0...18000.0	%	10 = 1%
80.23	Dec torque buffer	*real32*	0.0...18000.0	%	10 = 1%
80.24	Power control filter time	*real32*	0.000...35.000	s	1000 = 1 s
80.25	Power control hysteresis	*real32*	0.00...100.00	%	100 = 1%
80.26	Torque acc time	*real32*	0.00...30000.00	s	100 = 1 s
80.27	Torque dec time	*real32*	0.00...30000.00	s	100 = 1 s
80.30	Set1/Set2 switch	*uint32*	-	-	-
80.31	Torque source	*uint32*	-	-	-
81 Winch system check					
81.01	Torque proving enable	*uint32*	-	-	-
81.02	Torque proving reference	*real32*	0.0...100.0	%	10 = 1%
81.03	Winch system check time	*real32*	0.000...10.000	s	1000 = 1 s
81.04	Brake slip speed limit	*real32*	0.0...100.0	rpm	10 = 1 rpm
81.05	Brake slip fault delay	*real32*	0.000...10.000	s	1000 = 1 s
82 Clutch control					
82.01	Clutch control enable	*uint32*	-	-	-
82.02	Clutch control 1 selection	*uint32*	-	-	-
82.03	Clutch control 2 selection	*uint32*	-	-	-
82.04	Clutch control speed 1	*real32*	-18000...18000	rpm	1 = 1 rpm
82.05	Clutch control speed 2	*real32*	-18000...18000	rpm	1 = 1 rpm
82.06	Clutch control max torque	*real32*	0.0...600.0	%	10 = 1%
82.08	Clutch acc time	*real32*	0.00...30000.00	s	100 = 1 s
82.09	Clutch dec time	*real32*	0.00...30000.00	s	100 = 1 s
84 Synchro control					
84.01	Synchro control	*uint32*	-	-	-
84.02	Synchro sel	*uint32*	-	-	-
84.03	Sync corr mode	*uint32*	-	-	-
84.04	Synchro corr rate	*real32*	0.00...1000.00	rpm/unit	1 = 1 rpm/unit
84.05	Synchro corr min speed	*real32*	0.00...32000.00	rpm	1 = 1 rpm
84.06	Synchro err limit	*real32*	0.00...1000.00	unit	100 = 1 unit
84.07	Synchro err fault delay	*real32*	0.0...100.0	s	10 = 1 s
84.08	Position hysteresys	*real32*	0.00...1000.00	unit	100 = 1 unit
84.09	Position hysteresys corr speed limit	*real32*	0.00...32000.00	rpm	1 = 1 rpm
84.11	Synchro sw	*uint32*	000000b…111111b	-	1 = 1
84.19	Actual position	*real32*	-32000.00 … 32000.00	unit	100 = 1 unit
84.20	Actual position error	*real32*	-32000.00 … 32000.00	unit	100 = 1 unit
84.21	Target position	*real32*	-32000.00 … 32000.00	unit	100 = 1 unit
84.22	Offset value	*real32*	-32000.00 … 32000.00	unit	100 = 1 unit
84.23	Correction speed ref	*real32*	-32000.00 … 32000.00	unit	100 = 1 unit
84.40	Target position source	*uint32*	-	-	-

No.	Name	Type	Range	Unit	FbEq32
84.50	Position from D2D master	*real32*	-32000.000 … 32000.000	unit	1000 = 1 unit
90 Feedback selection					
90.01	Motor speed for control	*real32*	-32768.00 … 32767.00	rpm	100 = 1 rpm
90.02	Motor position	*real32*	0.00000000 … 1.00000000	rev	100000000 = 1 rev
90.03	Load speed	*real32*	-32768.00 … 32767.00	rpm	100 = 1 rpm
90.04	Load position	*int32*	-2147483648 … 2147483647	rev	1 = 1 rev
90.05	Load position scaled	*real32*	-2147483.264 … 2147483.264	-	100000 = 1
90.06	Motor position scaled	*int32*	-2147483.648 … 2147483.647	-	1000 = 1
90.07	Load position scaled int	*int32*	-2147483.648 … 2147483.647	-	1 = 1
90.10	Encoder 1 speed	*real32*	-32768.00 … 32767.00	rpm	100 = 1 rpm
90.11	Encoder 1 position	*real32*	0.00000000 … 1.00000000	rev	100000000 = 1 rev
90.12	Encoder 1 multiturn revolutions	*uint32*	0…16777215	-	1 = 1
90.13	Encoder 1 revolution extension	*int32*	-2147483648 … 2147483647	-	1 = 1
90.14	Encoder 1 position raw	*uint32*	0…16777215	-	1 = 1
90.15	Encoder 1 revolutions raw	*int32*	0…16777215	-	1 = 1
90.20	Encoder 2 speed	*real32*	-32768.00 … 32767.00	rpm	100 = 1 rpm
90.21	Encoder 2 position	*real32*	0.00000000 … 1.00000000	rev	100000000 = 1 rev
90.22	Encoder 2 multiturn revolutions	*uint32*	0…16777215	-	1 = 1
90.23	Encoder 2 revolution extension	*int32*	-2147483648 … 2147483647	-	1 = 1
90.24	Encoder 2 position raw	*uint32*	0…16777215	-	1 = 1
90.25	Encoder 2 revolutions raw	*uint32*	0…16777215	-	1 = 1
90.26	Motor revolution extension	*int32*	-2147483648 … 2147483647	-	1 = 1
90.27	Load revolution extension	*int32*	-2147483648 … 2147483647	-	1 = 1
90.35	Pos counter status	*uint16*	000000b…111111b	-	1 = 1
90.38	Pos counter decimals	*uint16*	0…9	-	1 = 1
90.41	Motor feedback selection	*uint16*	0…2	-	1 = 1
90.42	Motor speed filter time	*real32*	0…10000	ms	1 = 1 ms
90.43	Motor gear numerator	*int32*	-32768…32767	-	1 = 1
90.44	Motor gear denominator	*int32*	-32768…32767	-	1 = 1
90.45	Motor feedback fault	*uint16*	0…1	-	1 = 1
90.46	Force open loop	*uint16*	0…1	-	1 = 1
90.48	Motor position axis mode	*uint16*	0…1	-	1 = 1

No.	Name	Type	Range	Unit	FbEq32
90.49	Motor position resolution	*uint16*	0…31	-	1 = 1
90.51	Load feedback selection	*uint16*	0…4	-	1 = 1
90.52	Load speed filter time	*real32*	0…10000	ms	1 = 1 ms
90.53	Load gear numerator	*int32*	-2147483648 … 2147483647	-	1 = 1
90.54	Load gear denominator	*int32*	-2147483648 … 2147483647	-	1 = 1
90.55	Load feedback fault	*uint16*	0…1	-	1 = 1
90.56	Load position offset	*int32*	-32768 … 32767	rev	1 = 1 rev
90.57	Load position resolution	*uint16*	0…32	-	1 = 1
90.58	Pos counter init value int	*int32*	-2147483648 … 2147483647	-	1 = 1
90.59	Pos counter init value int source	*uint32*	-	-	1 = 1
90.60	Pos counter error and boot action	*uint16*	0...1	-	1 = 1
90.61	Gear numerator	*int32*	-2147483648 … 2147483647	-	1 = 1
90.62	Gear denominator	*int32*	-2147483648 … 2147483647	-	1 = 1
90.63	Feed constant numerator	*int32*	-2147483648 … 2147483647	-	1 = 1
90.64	Feed constant denominator	*int32*	-2147483648 … 2147483647	-	1 = 1
90.65	Pos counter init value	*real32*	-2147483.648 … 2147483.647	-	1 = 1
90.66	Pos counter init value source	*uint32*	-	-	1 = 1
90.67	Pos counter init cmd source	*uint32*	-	-	1 = 1
90.68	Disable pos counter initialization	*uint32*	-	-	1 = 1
90.69	Reset pos counter init ready	*uint32*	-	-	1 = 1
90.200	Proximity switch pulse count	*real32*	-2147483008...2147483008	-	1 = 1
90.201	Proximity switch load position scaled	*real32*	-8388610.0...8388610.0	-	10 = 1
90.202	Proximity speed raw	*real32*	-32768...32767.00		100 = 1 rpm
90.205	Proximity switch mode	*uint32*	-	-	1 = 1
90.206	Prox signal A source	*uint32*	-	-	1 = 1
90.207	Prox signal B source	*uint32*	-	-	1 = 1
90.208	Pulses per drum revolution	*real32*	0...65535	-	1 = 1
90.209	Proximity switch anchor drop	*uint32*	-	-	1 = 1
90.210	Rotary supervision status	*uint16*	000000b…111111b	-	1 = 1
90.211	Rotary supervision	*uint32*	-	-	1 = 1
90.212	Rotary supervision delay	*real32*	0.0...600.0	-	10 = 1

No.	Name	Type	Range	Unit	FbEq32
91 Encoder module settings					
91.01	FEN DI status	*uint16*	000000b…111111b	-	1 = 1
91.02	Module 1 status	*uint16*	-	-	1 = 1
91.03	Module 2 status	*uint16*	-	-	1 = 1
91.04	Module 1 temperature	*real32*	0…1000	°C, °F or ohm	1 = 1 unit
91.06	Module 2 temperature	*real32*	0…1000	°C, °F or ohm	1 = 1 unit
91.10	Encoder parameter refresh	*uint16*	0…1	-	1 = 1
91.11	Module 1 type	*uint16*	0…5	-	1 = 1
91.12	Module 1 location	*uint16*	1…254	-	1 = 1
91.13	Module 2 type	*uint16*	0…5	-	1 = 1
91.14	Module 2 location	*uint16*	1…254	-	1 = 1
91.21	Module 1 temp sensor type	*uint16*	0…2	-	1 = 1
91.22	Module 1 temp filter time	*real32*	0…10000	ms	1 = 1 ms
91.24	Module 2 temp sensor type	*uint16*	0…2	-	1 = 1
91.25	Module 2 temp filter time	*real32*	0…10000	ms	1 = 1 ms
91.31	Module 1 TTL output source	*uint16*	0…2	-	1 = 1
91.32	Module 1 emulation pulses/rev	*uint16*	0…65535	-	1 = 1
91.33	Module 1 emulated Z-pulse offset	*real32*	0.00000 … 1.00000	rev	100000 = 1 rev
91.41	Module 2 TTL output source	*uint16*	0…2	-	1 = 1
91.42	Module 2 emulation pulses/rev	*uint16*	0…65535	-	1 = 1
91.43	Module 2 emulated Z-pulse offset	*real32*	0.00000 … 1.00000	rev	100000 = 1 rev
92 Encoder 1 configuration					
92.01	Encoder 1 type	*uint16*	0...9	-	1 = 1
92.02	Encoder 1 source	*uint16*	1…2	-	1 = 1
Other parameters in this group when a TTL, TTL+ and HTL encoder is selected (92.17, 92.23...92.25 visible depending on encoder type selection)					
92.10	Pulses/revolution	*uint16*	0…65535	-	1 = 1
92.11	Pulse encoder type	*uint16*	0…1	-	1 = 1
92.12	Speed calculation mode	*uint16*	0…5	-	1 = 1
92.13	Position estimation enable	*uint16*	0…1	-	1 = 1
92.14	Speed estimation enable	*uint16*	0…1	-	1 = 1
92.15	Transient filter	*uint16*	0…3	-	1 = 1
92.17	Accepted pulse freq of encoder 1	*uint16*	0…300	kHz	1 = 1 kHz
92.21	Encoder cable fault mode	*uint16*	0…3	-	1 = 1
92.23	Maximum pulse waiting time	*real32*	1…200	ms	1 = 1 ms
92.24	Pulse edge filtering	*uint16*	0…2	-	1 = 1
92.25	Pulse overfrequency function	*uint16*	0…1	-	1 = 1

No.	Name	Type	Range	Unit	FbEq32
Other parameters in this group when an absolute encoder is selected					
92.10	Sine/cosine number	*uint16*	0…65535	-	1 = 1
92.11	Absolute position source	*uint16*	0…5	-	1 = 1
92.12	Zero pulse enable	*uint16*	0…1	-	1 = 1
92.13	Position data width	*uint16*	0…32	-	1 = 1
92.14	Revolution data width	*uint16*	0…32	-	1 = 1
92.30	Serial link mode	*uint16*	0…1	-	1 = 1
92.31	EnDat max calculation time	*uint16*	0…3	-	1 = 1
92.32	SSI cycle time	*uint16*	0…5	-	1 = 1
92.33	SSI clock cycles	*uint16*	2…127	-	1 = 1
92.34	SSI position msb	*uint16*	1…126	-	1 = 1
92.35	SSI revolution msb	*uint16*	1…126	-	1 = 1
92.36	SSI data format	*uint16*	0…1	-	1 = 1
92.37	SSI baud rate	*uint16*	0…5	-	1 = 1
92.40	SSI zero phase	*uint16*	0…3	-	1 = 1
92.45	Hiperface parity	*uint16*	0…1	-	1 = 1
92.46	Hiperface baud rate	*uint16*	0…3	-	1 = 1
92.47	Hiperface node address	*uint16*	0…255	-	1 = 1
Other parameters in this group when a resolver is selected					
92.10	Excitation signal frequency	*uint16*	1…20	kHz	1 = 1 kHz
92.11	Excitation signal amplitude	*uint16*	4.0 … 12.0	V	10 = 1 V
92.12	Resolver polepairs	*uint16*	1…32	-	1 = 1
93 Encoder 2 configuration					
93.01	Encoder 2 type	*uint16*	0...9	-	1 = 1
93.02	Encoder 2 source	*uint16*	1…2	-	1 = 1
Other parameters in this group: when parameter 93.01 Encoder 2 type = TTL, TTL+ or HTL is selected. (93.17, 93.23...93.25 visible depending on encoder type selection)					
93.10	Pulses/revolution	*uint16*	0…65535	-	1 = 1
93.11	Pulse encoder type	*uint16*	0…1	-	1 = 1
93.12	Speed calculation mode	*uint16*	0…5	-	1 = 1
93.13	Position estimation enable	*uint16*	0…1	-	1 = 1
93.14	Speed estimation enable	*uint16*	0…1	-	1 = 1
93.15	Transient filter	*uint16*	0…3	-	1 = 1
93.17	Accepted pulse freq of encoder 2	*uint16*	0…300	kHz	1 = 1 kHz
93.21	Encoder cable fault mode	*uint16*	0…3	-	1 = 1
93.23	Maximum pulse waiting time	*real32*	1…200	ms	1 = 1 ms
93.24	Pulse edge filtering	*uint16*	0…2	-	1 = 1
93.25	Pulse overfrequency function	*uint16*	0…1	-	1 = 1
Other parameters in this group: when parameter 93.01 Encoder 2 type = Absolute encoder					
93.10	Sine/cosine number	*uint16*	0…65535	-	1 = 1
93.11	Absolute position source	*uint16*	0…5	-	1 = 1

No.	Name	Type	Range	Unit	FbEq32
93.12	Zero pulse enable	*uint16*	0…1	-	1 = 1
93.13	Position data width	*uint16*	0…32	-	1 = 1
93.14	Revolution data width	*uint16*	0…32	-	1 = 1
93.30	Serial link mode	*uint16*	0…1	-	1 = 1
93.31	EnDat calc time	*uint16*	0…3	-	1 = 1
93.32	SSI cycle time	*uint16*	0…5	-	1 = 1
93.33	SSI clock cycles	*uint16*	2…127	-	1 = 1
93.34	SSI position msb	*uint16*	1…126	-	1 = 1
93.35	SSI revolution msb	*uint16*	1…126	-	1 = 1
93.36	SSI data format	*uint16*	0…1	-	1 = 1
93.37	SSI baud rate	*uint16*	0…5	-	1 = 1
93.40	SSI zero phase	*uint16*	0…3	-	1 = 1
93.45	Hiperface parity	*uint16*	0…1	-	1 = 1
93.46	Hiperface baud rate	*uint16*	0…3	-	1 = 1
93.47	Hiperface node address	*uint16*	0…255	-	1 = 1
Other parameters in this group when parameter 93.01 Encoder 2 type = Resolver					
93.10	Excitation signal frequency	*uint16*	1…20	kHz	1 = 1 kHz
93.11	Excitation signal amplitude	*uint16*	4.0 … 12.0	V	10 = 1 V
93.12	Resolver polepairs	*uint16*	1…32	-	1 = 1
95 HW configuration					
95.01	Supply voltage	*uint16*	0…6	-	1 = 1
95.02	Adaptive voltage limits	*uint16*	0…1	-	1 = 1
95.04	Control board supply	*uint16*	0…2	-	1 = 1
(Parameters 95.08 only visible with a ZCU control unit)					
95.08	DC switch monitoring	*uint16*	0…1	-	1 = 1
95.15	Special HW settings	*uint16*	0000h…FFFFh	-	1 = 1
95.20	HW options word 1	*uint16*	0000h…FFFFh	-	1 = 1
95.21	HW options word 2	*uint16*	0000h...FFFFh	-	1 = 1
95.40	Transformation ratio	*real32*	0.000...100.000	-	1000 = 1
96 System					
96.01	Language	*uint16*	-	-	1 = 1
96.02	Pass code	*uint32*	0…99999999	-	1 = 1
96.03	Access levels active	*uint16*	0000h…FFFFh	-	1 = 1
96.04	Macro select	*uint16*	0…6	-	1 = 1
96.05	Macro active	*uint16*	1…6	-	1 = 1
96.06	Parameter restore	*uint16*	-	-	1 = 1
96.07	Parameter save manually	*uint16*	0…1	-	1 = 1
96.08	Control board boot	*uint16*	0…1	-	1 = 1
96.09	FSO reboot	*uint32*	-	-	-
96.10	User set status	*uint16*	-	-	-
96.11	User set save/load	*uint16*	-	-	-

No.	Name	Type	Range	Unit	FbEq32
96.12	User set I/O mode in1	*uint32*	-	-	-
96.13	User set I/O mode in2	*uint32*	-	-	-
96.16	Unit selection	*uint16*	0000h…FFFFh	-	1 = 1
96.20	Time synchronization source	*uint16*	0…9	-	1 = 1
96.23	M/F and D2D clock synchronization	*uint16*	0…1	-	1 = 1
96.24	Full days since 1st Jan 1980	*uint16*	1…59999	-	1 = 1
96.25	Time in minutes within 24 h	*uint16*	0…1439	-	1 = 1
96.26	Time in ms within one minute	*uint16*	0…59999	-	1 = 1
96.29	Time sync source status	*uint16*	0000h…FFFFh	-	1 = 1
96.31	Drive ID number	*uint16*	0…32767	-	1 = 1
96.39	Power up event logging	*uint16*	0...1	-	1 = 1
96.51	Clear fault and event logger	*uint16*	0…65535	-	1 = 1
96.53	Actual checksum	*uint32*	00000000h…FFFFFFFFh	-	1 = 1
96.54	Checksum action	*uint16*	0…4	-	1 = 1
96.55	Checksum control word	*uint16*	0000h…FFFFh	-	1 = 1
96.56	Approved checksum 1	*uint32*	00000000h…FFFFFFFFh	-	1 = 1
96.57	Approved checksum 2	*uint32*	00000000h…FFFFFFFFh	-	1 = 1
96.58	Approved checksum 3	*uint32*	00000000h…FFFFFFFFh	-	1 = 1
96.59	Approved checksum 4	*uint32*	00000000h…FFFFFFFFh	-	1 = 1
96.61	User data logger status word	*uint16*	0000h…FFFFh	-	1 = 1
96.63	User data logger trigger	*uint32*	-	-	-
96.64	User data logger start	*uint32*	-	-	-
96.65	Factory data logger time level	*uint16*	-	-	1 = 1
96.70	Disable adaptive program	*uint16*	0…1	-	1 = 1
96.100	Change user pass code	*uint32*	10000000…99999999	-	1 = 1
96.101	Confirm user pass code	*uint32*	10000000…99999999	-	1 = 1
96.102	User lock functionality	*uint16*	0000h…FFFFh	-	1 = 1
97 Motor control					
97.01	Switching frequency reference	*real32*	0.000...24.000	kHz	1000 = 1%
97.02	Minimum switching frequency	*real32*	0.000...24.000	kHz	1000 = 1%
97.03	Slip gain	*real32*	0…200	%	1 = 1%
97.04	Voltage reserve	*real32*	-4…50	%	1 = 1%
97.05	Flux braking	*uint16*	0…2	-	1 = 1
97.06	Flux reference select	*uint32*	-	-	1 = 1
97.07	User flux reference	*real32*	0.00 … 200.00	%	100 = 1%
97.08	Optimizer minimum torque	*real32*	0.0...1600.0	%	10 = 1%
97.09	Switching freq mode	*uint16*	0…3	-	1 = 1
97.10	Signal injection	*uint16*	0…4	-	1 = 1
97.11	TR tuning	*real32*	25…400	%	1 = 1%
97.12	IR comp step-up frequency	*real32*	0.0...50.0	Hz	10 = 1 Hz

No.	Name	Type	Range	Unit	FbEq32
97.13	IR compensation	*real32*	0.00 … 50.00	%	100 = 1%
97.15	Motor model temperature adaptation	*uint16*	0…3	-	1 = 1
97.18	Hexagonal field weakening	*uint16*	0...1	-	1 = 1
97.19	Hexagonal field weakening point	*real32*	0.0...500.0	%	10 = 1%
97.32	Motor torque unfiltered	*real32*	-1600.0 … 1600.0	%	10 = 1%
97.33	Speed estimate filter time	*real32*	0.00 … 100.00	ms	100 = 1 ms
98 User motor parameters					
98.01	User motor model mode	*uint16*	0…3	-	1 = 1
98.02	Rs user	*real32*	0.0000 … 0.50000	p.u.	100000 = 1 p.u.
98.03	Rr user	*real32*	0.0000 … 0.50000	p.u.	100000 = 1 p.u.
98.04	Lm user	*real32*	0.00000 … 10.00000	p.u.	100000 = 1 p.u.
98.05	SigmaL user	*real32*	0.00000 … 1.00000	p.u.	100000 = 1 p.u.
98.06	Ld user	*real32*	0.00000 … 10.00000	p.u.	100000 = 1 p.u.
98.07	Lq user	*real32*	0.00000 … 10.00000	p.u.	100000 = 1 p.u.
98.08	PM flux user	*real32*	0.00000 … 2.00000	p.u.	100000 = 1 p.u.
98.09	Rs user SI	*real32*	0.00000 … 100.00000	ohm	100000 = 1 p.u.
98.10	Rr user SI	*real32*	0.00000 … 100.00000	ohm	100000 = 1 p.u.
98.11	Lm user SI	*real32*	0.00 … 100000.00	mH	100 = 1 mH
98.12	SigmaL user SI	*real32*	0.00 … 100000.00	mH	100 = 1 mH
98.13	Ld user SI	*real32*	0.00 … 100000.00	mH	100 = 1 mH
98.14	Lq user SI	*real32*	0.00 … 100000.00	mH	100 = 1 mH
98.15	Position offset user	*real32*	0…360	degrees electrical	1 = 1 deg
99 Motor data					
99.03	Motor type	*uint16*	0…2	-	1 = 1
99.04	Motor control mode	*uint16*	0…1	-	1 = 1
99.06	Motor nominal current	*real32*	0.0 … 6400.0	A	10 = 1 A
99.07	Motor nominal voltage	*real32*	0.0 … 800.0	V	10 = 1 V
99.08	Motor nominal frequency	*real32*	0.00 … 1000.00	Hz	10 = 1 Hz
99.09	Motor nominal speed	*real32*	0 … 30000	rpm	1 = 1 rpm
99.10	Motor nominal power	*real32*	-10000.00 … 10000.00 kW or -13404.83 … 13404.83 hp	kW or hp	100 = 1 unit
99.11	Motor nominal cos Φ	*real32*	0.00 … 1.00	-	100 = 1

No.	Name	Type	Range	Unit	FbEq32
99.12	Motor nominal torque	*uint32*	0.000 … 4000000.000	N·m or lb·ft	1000 = 1 unit
99.13	ID run requested	*uint16*	0…7	-	1 = 1
99.14	Last ID run performed	*uint16*	0…7	-	1 = 1
99.15	Motor polepairs calculated	*uint16*	0…1000	-	1 = 1
99.16	Motor phase order	*uint16*	0…1	-	1 = 1
200 Safety					
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, an ABB service representative should be contacted.

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

Safety

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

Indications

Warnings and faults

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 (see parameter *31.11 Fault reset selection*) such as the control panel, Drive composer PC tool, the digital inputs of the drive, or fieldbus. After the fault is 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 sections

- *Programmable digital inputs and outputs* (page *126*)
- *Programmable relay outputs* (page *127*), and
- *Programmable I/O extensions* (page *127*).

Pure events

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

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.

By default, approximately 700 samples recorded immediately before and after a fault are saved to the memory unit of the drive. 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 *197*). 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 messages

Note: The list also contains events that only appear in the Event log.

Code (hex)	Warning	Cause	What to do
A2A1	Current calibration	Current offset and gain measurement calibration will occur at next start.	Informative warning. (See parameter *99.13 ID run requested*.)
A2B3	Earth leakage Programmable fault: *31.20 Earth fault*)	Drive has detected load unbalance typically due to earth fault in motor or motor cable.	Check there are no power factor correction capacitors or surge absorbers in motor cable. Check for an earth fault in motor or motor cables by measuring the insulation resistances of motor and motor cable. Try running the motor in scalar control mode if allowed. (See parameter *99.04 Motor control mode*.) If no earth fault can be detected, contact your local ABB representative.
A2B4	Short circuit	Short-circuit in motor cable(s) or motor.	Check motor and motor cable for cabling errors. Check there are no power factor correction capacitors or surge absorbers in motor cable.
A2BA	IGBT overload	Excessive IGBT junction to case temperature. This warning protects the IGBT(s) and can be activated by a short circuit in the motor cable.	Check motor cable. Check ambient conditions. Check air flow and fan operation. Check heatsink fins for dust pick-up. Check motor power against drive power.
A3A1	DC link overvoltage	Intermediate circuit DC voltage too high (when the drive is stopped).	Check the supply voltage setting (parameter *95.01 Supply voltage*). Note that the wrong setting of the parameter may cause the motor to rush uncontrollably, or may overload the brake chopper or resistor. Check the supply voltage. If the problem persists, contact your local ABB representative.
A3A2	DC link undervoltage	Intermediate circuit DC voltage too low (when the drive is stopped).	
A3AA	DC not charged	The voltage of the intermediate DC circuit has not yet risen to operating level.	
A480	Motor cable overload	Calculated motor cable temperature has exceeded warning limit.	Check the settings of parameters *35.61* and *35.62*. Check the dimensioning of the motor cable in regard to required load.
A490	Incorrect temperature sensor setup	Problem with motor temperature measurement.	Check the auxiliary code (format 0XYY ZZZZ). "X" takes the values 1 and 2 instead of 0 and 1. “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*.

Code (hex)	Warning	Cause	What to do
	0002	Temperature under limit	Check parameters *35.11*...*35.14*/*35.21*...*35.24* (and *91.21*/*91.24* if sensor is connected to an encoder interface). Check the sensor and its wiring.
	0003	Short circuit	
	0004	Open circuit	
A491	External temperature 1 (Editable message text)	Measured temperature 1 has exceeded warning limit.	Check the value of parameter *35.02 Measured temperature 1*. Check the cooling of the motor (or other equipment whose temperature is being measured). Check the value of *35.13 Temperature 1 warning limit*.
A492	External temperature 2 (Editable message text)	Measured temperature 2 has exceeded warning limit.	Check the value of parameter *35.03 Measured temperature 2*. Check the cooling of the motor (or other equipment whose temperature is being measured). Check the value of *35.23 Temperature 2 warning limit*.
A497	Motor temperature 1 (Editable message text)	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 (Editable message text)	The thermistor protection module installed in slot 2 indicates overtemperature.	
A499	Motor temperature 3 (Editable message text)	The thermistor protection module installed in slot 3 indicates overtemperature.	
A4A0	Control board temperature	Control unit temperature is excessive.	Check the auxiliary code. See actions for each code below.
	1	Temperature above warning limit	Check ambient conditions. Check air flow and fan operation. Check heatsink fins for dust pick-up.
	2	Thermistor broken	Contact an ABB service representative for control unit replacement.
A4A1	IGBT overtemperature	Estimated drive IGBT temperature is excessive.	Check ambient conditions. Check air flow and fan operation. Check heatsink fins for dust pick-up. Check motor power against drive power.
A4A9	Cooling	Drive module temperature is excessive.	Check ambient temperature. If it exceeds 40 °C (104 °F), ensure that load current does not exceed derated load capacity of drive. See appropriate *Hardware manual.* Check drive module cooling air flow and fan operation. Check inside of cabinet and heatsink of drive module for dust pick-up. Clean whenever necessary.

Code (hex)	Warning	Cause	What to do
A4B0	Excess temperature	Power unit 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 *634*).
A4B1	Excess temperature difference	High temperature difference between the IGBTs of different phases.	Check the motor cabling. Check cooling of drive module(s). Check the auxiliary code (format XXXY YYZZ). “XXX” indicates the source of difference (**0:** Single module, difference between phase IGBTs, **1:** 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]).
A4B2	PCB space cooling	Temperature difference between ambient and drive module PCB space is excessive.	Check the cooling fan inside the PCB space. With parallel-connected modules, check the auxiliary code (format XXXY YYZZ). “Y YY” specifies through which BCU control unit channel the fault was received.
A4F6	IGBT temperature	Drive IGBT temperature is excessive.	Check ambient conditions. Check air flow and fan operation. Check heatsink fins for dust pick-up. Check motor power against drive power.

Code (hex)	Warning	Cause	What to do
A580	PU communication	Communication errors detected between the drive control unit and the power unit.	Check the connections between the drive control unit and the power unit. Check the auxiliary code (format XXXY YYZZ). With parallel-connected modules, “Y YY” specifies the affected BCU control unit channel (0: broadcast). “ZZ” specifies the error source (8: Transmission errors in PSL link [see “XXX”], 9: Transmitter FIFO warning limit hit). “XXX” specifies the transmission error direction and detailed warning code (0: Rx/communication error, 1: Tx/Reed-Solomon symbol error, 2: Tx/no synchronization error, 3: Tx/Reed-Solomon decoder failures, 4: Tx/Manchester coding errors). Read the PSL2 data log. In Drive composer pro, check the time stamp of the A580 fault. Load the log with the same date and time. When the file opens, click “Show fault log”. Check the power unit hardware
A581	Fan Programmable warning: *31.35 Main fan fault function*	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, **02:** normal). “Y” specifies the index of the inverter module connected to BCU (**0…n**, always **0** for ZCU control units). “Z” specifies the index of the fan (**1:** Main fan 1, **2:** Main fan 2, **3:** Main fan 3). 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 Programmable warning: *31.36 Aux fan fault function*	An auxiliary cooling fan (connected to the fan connectors on the control unit) is stuck or disconnected.	The auxiliary code identifies the fan (**1:** Auxiliary fan 1, **2:** Auxiliary fan 2). Check that the auxiliary fan supervision selection in parameter *95.21 HW options word 2* matches the hardware. Make sure the front cover of the drive module is in place and tightened. Check auxiliary fan(s) and connection(s). Replace faulty fan.
A5A0	Safe torque off Programmable warning: *31.22 STO indication run/stop*	Safe torque off function is active, i.e. safety circuit signal(s) connected to connector XSTO is lost.	Check safety circuit connections. For more information, see appropriate drive hardware manual and description of parameter *31.22 STO indication run/stop* (page *349*).

Code (hex)	**Warning**	**Cause**	**What to do**
A5EA	Measurement circuit temperature	Problem with internal temperature measurement of the drive.	Check the auxiliary code (format XXXY YYZZ). “Y YY” specifies through which BCU control unit channel the fault was received (“0 00” with a ZCU control unit). “ZZ” specifies the location (**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)).
A5EB	PU board powerfail	Power unit power supply failure.	Contact your local ABB representative.
A5EC	PU communication internal	Communication errors detected between the drive control unit and the power unit.	Check the connections between the drive control unit and the power unit.
A5ED	Measurement circuit ADC	Problem with measurement circuit of power unit (analog to digital converter).	Contact your local ABB representative.
A5EE	Measurement circuit DFF	Problem with current or voltage measurement of power unit.	Contact your local ABB representative.
A5EF	PU state feedback	State feedback from output phases does not match control signals.	Contact your local ABB representative.
A5F0	Charging feedback	Charging in process.	Informative warning. Wait until charging finishes before starting the inverter unit.
A5F3	Switching frequency below requested	Adequate motor control at requested output frequency cannot be reached because of limited switching frequency (eg. by parameter *95.15*).	Informative warning.
A5F4	Control unit battery	The battery of the control unit is low.	Replace control unit battery. This warning can be suppressed using parameter *31.40*.
A682	Flash erase speed exceeded	The flash memory (in the memory unit) has been erased too frequently, compromising the lifetime of the memory.	Avoid forcing unnecessary parameter saves by parameter *96.07* or cyclic parameter writes (such as user logger triggering through parameters). Check the auxiliary code (format XYYY YZZZ). “X” specifies the source of warning (**1:** generic flash erase supervision). “ZZZ” specifies the flash subsector number that generated the warning.
A683	Data saving to power unit	An error in saving data to the power unit.	Check the auxiliary code. See actions for each code below.
	0	An error is preventing saving from initializing.	Cycle the power to the drive. If the control unit is externally powered, also reboot the control unit (using parameter *96.08 Control board boot*) or by cycling its power. If the problem persists, contact your local ABB representative
	1		
	2	Write error.	

Code (hex)	Warning	Cause	What to do
A684	SD card	Error related to SD card used to store data (BCU control unit only).	Check the event log for an auxiliary code. See actions for each code below.
	1	No SD card	Insert a compatible, writable SD card into the SD CARD slot of the BCU control unit.
	2	SD card write-protected	
	3	SD card unreadable	
A685	Power fail saving	Power fail saving is requested too frequently. Because of the limited saving interval, some of the requests do not trigger the saving and power fail data may be lost. This may be caused by DC voltage oscillation.	Check the supply voltage.
A686	Checksum mismatch Programmable warning: *96.54 Checksum action*	The calculated parameter checksum does not match any enabled reference checksum.	Check that all necessary approved (reference) checksums (*96.56*…*96.59*) are enabled in *96.55 Checksum control word*. Check the parameter configuration. Using *96.55 Checksum control word*, enable a checksum parameter and copy the actual checksum into that parameter.
A687	Checksum configuration	An action has been defined for a parameter checksum mismatch but the feature has not been configured.	Contact your local ABB representative for configuring the feature, or disable the feature in *96.54 Checksum action*.
A688	Parameter map configuration	Too much data in parameter mapping table created in Drive customizer.	See the *Drive customizer PC tool user's manual* (3AUA0000104167 [English]).
A689	Mapped parameter value cut	Parameter value saturated eg. by the scaling specified in parameter mapping table (created in Drive customizer).	Check parameter scaling and format in parameter mapping table. See the *Drive customizer PC tool user's manual* (3AUA0000104167 [English]).
A6A4	Motor nominal value	The motor parameters are set incorrectly. The drive is not dimensioned correctly.	Check the auxiliary code. See actions for each code below.
	1	Slip frequency is too small	Check the settings of the motor configuration parameters in groups 98 and 99. Check that the drive is sized correctly for the motor.
	2	Synchronous and nominal speeds differ too much	
	3	Nominal speed is higher than synchronous speed with 1 pole pair	
	4	Nominal current is outside limits	
	5	Nominal voltage is outside limits	
	6	Nominal power is higher than apparent power	
	7	Nominal power not consistent with nominal speed and torque	

Code (hex)	Warning	Cause	What to do
A6A5	No motor data	Parameters in group 99 have not been set.	Check that all the required parameters in group 99 have been set. **Note:** It is normal for this warning to appear during the start-up and continue until the motor data is entered.
A6A6	Supply voltage unselected	The supply voltage has not been defined.	Set supply voltage in parameter *95.01 Supply voltage*.
A6B0	User lock is open	The user lock is open, ie. user lock configuration parameters *96.100*…*96.102* are visible.	Close the user lock by entering an invalid pass code in parameter *96.02 Pass code*. See section *User lock* (page *183*).
A6B1	User pass code not confirmed	A new user pass code has been entered in parameter *96.100* but not confirmed in *96.101*.	Confirm the new pass code by entering the same code in *96.101*. To cancel, close the user lock without confirming the new code. See section *User lock* (page *183*).
A6D1	FBA A parameter conflict	The drive does not have a functionality requested by a PLC, or requested functionality has not been activated.	Check PLC programming. Check settings of parameter groups *50 Fieldbus adapter (FBA)* and *51 FBA A settings*.
A6D2	FBA B parameter conflict	The drive does not have a functionality requested by a PLC, or requested functionality has not been activated.	Check PLC programming. Check settings of parameter groups *50 Fieldbus adapter (FBA)* and *54 FBA B settings*.
A6DA	Reference source parametrization	A reference source is simultaneously connected to multiple parameters with different units.	Check the reference source selection parameters. 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, **03** = torque reference chain [*26.11*, *26.16*], **04** = other torque-related parameters [*26.25*, *30.21*, *30.22*], **05** = process PID control parameters). “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	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 Control board boot*) is required to validate any changes in the hardware settings.
A6E6	ULC configuration	User load curve configuration error.	Check the auxiliary code (format XXXX ZZZZ). “ZZZZ” indicates the problem (see actions for each code below).

Code (hex)	Warning	Cause	What to do
	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.	
A780	Motor stall Programmable warning: *31.24 Stall function*	Motor is operating in stall region because of e.g. excessive load or insufficient motor power.	Check motor load and drive ratings. Check fault function parameters.
A781	Motor fan Programmable warning: *35.106 DOL starter event type*	No feedback received from external fan.	Check external fan (or other equipment controlled) by the logic. Check settings of parameters *35.100*…*35.106*.
A782	FEN temperature	Error in temperature measurement when temperature sensor (KTY or PTC) connected to encoder interface FEN-xx is used.	Check that parameter *35.11 Temperature 1 source* / *35.21 Temperature 2 source* setting corresponds to actual encoder interface installation. Check the settings of parameters *91.21* and *91.24*. Check that the corresponding module is activated in parameters *91.11*…*91.14*. Use parameter *91.10* Encoder parameter refresh to validate any changes in the settings.
		Error in temperature measurement when KTY sensor connected to encoder interface FEN-01 is used.	FEN-01 does not support temperature measurement with KTY sensor. Use PTC sensor or other encoder interface module.
A783	Motor overload Programmable warning: *35.56 Motor overload action*	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	Brake resistor broken or not connected.	Check that a brake resistor has been connected. Check the condition of the brake resistor.
A793	BR excess temperature	Brake resistor temperature has exceeded warning limit defined by parameter *43.12 Brake resistor warning limit*.	Stop drive. Let resistor cool down. Check resistor overload protection function settings (parameter group *43 Brake chopper*). Check warning limit setting, parameter *43.12 Brake resistor warning limit*. Check that the resistor has been dimensioned correctly. Check that braking cycle meets allowed limits.
A794	BR data	Brake resistor data has not been given.	One or more of the resistor data settings (parameters *43.08*…*43.10*) are incorrect. The parameter is specified by the auxiliary code.

Code (hex)	Warning	Cause	What to do
	0000 0001	Resistance value too low.	Check value of *43.10*.
	0000 0002	Thermal time constant not given.	Check value of *43.08*.
	0000 0003	Maximum continuous power not given.	Check value of *43.09*.
A797	Speed feedback configuration	Speed feedback configuration has changed.	Check the auxiliary code (format XXYY ZZZZ). "XX" specifies the number of the encoder interface module (**01**: *91.11*/*91.12*, **02**: *91.13*/*91.14*), "YY" specifies the encoder (**01:** *92 Encoder 1 configuration*, **02:** *93 Encoder 2 configuration*). "ZZZZ" indicates the problem (see actions for each code below).
	0001	Adapter not found in specified slot.	Check module location (*91.12* or *91.14*).
	0002	Detected type of interface module does not match parameter setting.	Check the module type (*91.11* or *91.13*) against status (*91.02* or *91.03*).
	0003	Logic version too old.	Contact your local ABB representative.
	0004	Software version too old.	Contact your local ABB representative.
	0006	Encoder type incompatible with interface module type.	Check module type (*91.11* or *91.13*) against encoder type (*92.01* or *93.01*).
	0007	Adapter not configured.	Check module location (*91.12* or *91.14*).
	0008	Speed feedback configuration has changed.	Use parameter *91.10 Encoder parameter refresh* to validate any changes in the settings.
	0009	No encoders configured to encoder module	Configure the encoder in group *92 Encoder 1 configuration* or *93 Encoder 2 configuration*.
	000A	Non-existing emulation input.	Check input selection (*91.31* or *91.41*).
	000B	Echo not supported by selected input (for example, resolver or absolute encoder).	Check input selection (*91.31* or *91.41*), interface module type, and encoder type.
	000C	Emulation in continuous mode not supported.	Check input selection (*91.31* or *91.41*) and serial link mode (*92.30* or *93.30*) settings.
A798	Encoder option comm loss	Encoder feedback not used as actual feedback, or measured motor feedback lost (and parameter *90.45*/*90.55* is set to *Warning*).	Check that the encoder is selected as feedback source in parameter *90.41* or *90.51*. Check that the encoder interface module is properly seated in its slot. Check that the encoder interface module or slot connectors are not damaged. To pinpoint the problem, try installing the module into a different slot. 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.

Code (hex)	Warning	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 Programmable warning: *31.55 Ext I/O comm loss event*	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.	
	00 0004	Configuration of module failed.	
A79B	BC short circuit	Short circuit in brake chopper IGBT	Replace brake chopper if external. Drives with internal choppers will need to be returned to ABB. Ensure brake resistor is connected and not damaged.
A79C	BC IGBT excess temperature	Brake chopper IGBT temperature has exceeded internal warning limit.	Let chopper cool down. Check for excessive ambient temperature. Check for cooling fan failure. Check for obstructions in the air flow. Check the dimensioning and cooling of the cabinet. Check resistor overload protection function settings (parameters *43.06*…*43.10*). Check minimum allowed resistor value for the chopper being used. Check that braking cycle meets allowed limits. Check that drive supply AC voltage is not excessive.

Code (hex)	Warning	Cause	What to do
A7A1	Mechanical brake closing failed Programmable warning: *44.17 Brake fault function*	Status of mechanical brake acknowledgment 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 Programmable warning: *44.17 Brake fault function*	Status of mechanical brake acknowledgment 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.
A7A5	Mechanical brake opening not allowed Programmable warning: *44.17 Brake fault function*	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	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 0000 XXYY). "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 0000 0101), the hardware current/voltage setting on the module is shown by parameter *14.29*. The corresponding parameter setting is *14.30*. Adjust either the hardware setting on the module or the parameter to solve the mismatch. **Note:** Control board reboot (either by cycling the power or through parameter *96.08 Control board boot*) is required to validate any changes in the hardware settings.
A7AB	Extension I/O configuration failure	The I/O extension module types and locations specified by parameters do not match the detected configuration.	Check the type and location settings of the modules (parameters *14.01*, *14.02*, *15.01*, *15.02*, *16.01* and *16.02*). Check that the modules are properly installed. Check the auxiliary code. See *Drive application programming manual (IEC 61131-3)* (3AUA0000127808 [English]).
A7B0	Motor speed feedback Programmable warning: *90.45 Motor feedback fault*	No motor speed feedback is received.	Check the auxiliary code (format XXYY ZZZZ). "XX" specifies the number of the encoder interface module (**01**: *91.11*/*91.12*, **02**: *91.13*/*91.14*), "YY" specifies the encoder (**01:** *92 Encoder 1 configuration*, **02:** *93 Encoder 2 configuration*). "ZZZZ" indicates the problem (see actions for each code below).

Code (hex)	Warning	Cause	What to do
	0001	Motor gear definition invalid or outside limits.	Check motor gear settings (*90.43* and *90.44*).
	0002	Encoder not configured.	Check encoder settings (*92 Encoder 1 configuration* or *93 Encoder 2 configuration*). Use parameter *91.10 Encoder parameter refresh*) to validate any changes in the settings.
	0003	Encoder stopped working.	Check encoder status.
	0004	Encoder drift detected.	Check for slippage between encoder and motor.
A7B1	Load speed feedback Programmable warning: *90.55 Load feedback fault*	No load speed feedback is received.	Check the event log for an 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.
A7C1	FBA A communication Programmable warning: *50.02 FBA A comm loss func*	Cyclical communication between drive and fieldbus adapter module A or between PLC and fieldbus adapter module A is lost.	Check status of fieldbus communication. See user documentation of fieldbus interface. Check settings of parameter groups *50 Fieldbus adapter (FBA)*, *51 FBA A settings*, *52 FBA A data in* and *53 FBA A data out*. Check cable connections. Check if communication master is able to communicate.
A7C2	FBA B communication Programmable warning: *50.32 FBA B comm loss func*	Cyclical communication between drive and fieldbus adapter module B or between PLC and fieldbus adapter module B is lost.	Check status of fieldbus communication. See user documentation of fieldbus interface. Check settings of parameter group *50 Fieldbus adapter (FBA)*. Check cable connections. Check if communication master is able to communicate.
A7CA	DDCS controller comm loss Programmable warning: *60.59 DDCS controller comm loss function*	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.

Code (hex)	Warning	Cause	What to do
A7CB	MF comm loss Programmable warning: *60.09 M/F comm loss function*	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 Programmable warning: *58.14 Communication loss action*	Communication break in embedded fieldbus (EFB) communication.	Check the status of the fieldbus master (online/offline/error etc.). Check cable connections to the XD2D connector on the control unit.
A7E1	Encoder Programmable warning: *90.45 Motor feedback fault*	Encoder error.	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	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.

Code (hex)	Warning	Cause	What to do
	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 Programmable warning: *49.05 Communication loss action*	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 Programmable warnings: *33.14 On-time 1 warn message* *33.24 On-time 2 warn message* *33.55 Value counter 1 warn message* *33.65 Value counter 2 warn message*	Warning generated by an on-time timer or a value counter.	Check the auxiliary code. Check the source of the warning corresponding to the code: 0: *33.13 On-time 1 source* 1: *33.23 On-time 2 source* 4: *33.53 Value counter 1 source* 5: *33.63 Value counter 2 source*.
A881	Output relay	Warning generated by an edge counter. Programmable warnings: *33.35 Edge counter 1 warn message* *33.45 Edge counter 2 warn message*	Check the auxiliary code. Check the source of the warning corresponding to the code: 2: *33.33 Edge counter 1 source* 3: *33.43 Edge counter 2 source*.
A882	Motor starts		
A883	Power ups		
A884	Main contactor		
A885	DC charge		
A886	On-time 1 (Editable message text) Programmable warning: *33.14 On-time 1 warn message*	Warning generated by on-time timer 1.	Check the source of the warning (parameter *33.13 On-time 1 source*).
A887	On-time 2 (Editable message text) Programmable warning: *33.24 On-time 2 warn message*	Warning generated by on-time timer 2.	Check the source of the warning (parameter *33.23 On-time 2 source*).
A888	Edge counter 1 (Editable message text) Programmable warning: *33.35 Edge counter 1 warn message*	Warning generated by edge counter 1.	Check the source of the warning (parameter *33.33 Edge counter 1 source*).
A889	Edge counter 2 (Editable message text) Programmable warning: *33.45 Edge counter 2 warn message*	Warning generated by edge counter 2.	Check the source of the warning (parameter *33.43 Edge counter 2 source*).
A88A	Value counter 1 (Editable message text) Programmable warning: *33.55 Value counter 1 warn message*	Warning generated by value counter 1.	Check the source of the warning (parameter *33.53 Value counter 1 source*).
A88B	Value counter 2 (Editable message text) Programmable warning: *33.65 Value counter 2 warn message*	Warning generated by value counter 2.	Check the source of the warning (parameter *33.63 Value counter 2 source*).

Code (hex)	Warning	Cause	What to do
A88C	Device clean	Warning generated by an on-time timer. Programmable warnings: *33.14 On-time 1 warn message* *33.24 On-time 2 warn message*	Check the auxiliary code. Check the source of the warning corresponding to the code: 0: *33.13 On-time 1 source* 1: *33.23 On-time 2 source* 10: *05.04 Fan on-time counter*.
A88D	DC capacitor		
A88E	Cabinet fan		
A88F	Cooling fan		
A890	Additional cooling		
A8A0	AI supervision Programmable warning: *12.03 AI supervision function*	An analog signal is outside the limits specified for the analog input.	Check the auxiliary code (format XYY). “X” specifies the location of the input (**0**: AI on control unit; **1**: I/O extension module 1, etc.), “YY” specifies the input and limit (**01:** AI1 under minimum, **02:** AI1 over maximum, **03:** AI2 under minimum, **04:** AI2 over maximum). Check signal level at the analog input. Check the wiring connected to the input. Check the minimum and maximum limits of the input in parameter group *12 Standard AI*, *14 I/O extension module 1*, *15 I/O extension module 2* or *16 I/O extension module 3*.
A8B0	Signal supervision (Editable message text) Programmable warning: *32.06 Supervision 1 action*	Warning generated by the signal supervision 1 function.	Check the source of the warning (parameter *32.07 Supervision 1 signal*).
A8B1	Signal supervision 2 (Editable message text) Programmable warning: *32.16 Supervision 2 action*	Warning generated by the signal supervision 2 function.	Check the source of the warning (parameter *32.17 Supervision 2 signal*).
A8B2	Signal supervision 3 (Editable message text) Programmable warning: *32.26 Supervision 3 action*	Warning generated by the signal supervision 3 function.	Check the source of the warning (parameter *32.27 Supervision 3 signal*).
A8BE	ULC overload warning Programmable fault: *37.03 ULC overload actions*	Selected signal has exceeded the user overload curve.	Check for any operating conditions increasing the monitored signal (for example, the loading of the motor if the torque or current is being monitored). Check the definition of the load curve (parameter group *37 User load curve*).
A8BF	ULC underload warning Programmable fault: *37.04 ULC underload actions*	Selected signal has fallen below the user underload curve.	Check for any operating conditions decreasing the monitored signal (for example, loss of load if the torque or current is being monitored). Check the definition of the load curve (parameter group *37 User load curve*).
A8C0	Fan service counter	A cooling fan has reached the end of its estimated lifetime. See parameters *05.41* and *05.42*.	Check the auxiliary code. The code indicates which fan is to be replaced. 0: Main cooling fan 1: Auxiliary cooling fan 2: Auxiliary cooling fan 2 3: Cabinet cooling fan 4: PCB compartment fan Refer to the hardware manual of the drive for fan replacement instructions.

Code (hex)	Warning	Cause	What to do
A981	External warning 1 (Editable message text) Programmable warning: *31.01 External event 1 source* *31.02 External event 1 type*	Fault in external device 1.	Check the external device. Check setting of parameter *31.01 External event 1 source*.
A982	External warning 2 (Editable message text) Programmable warning: *31.03 External event 2 source* *31.04 External event 2 type*	Fault in external device 2.	Check the external device. Check setting of parameter *31.03 External event 2 source*.
A983	External warning 3 (Editable message text) Programmable warning: *31.05 External event 3 source* *31.06 External event 3 type*	Fault in external device 3.	Check the external device. Check setting of parameter *31.05 External event 3 source*.
A984	External warning 4 (Editable message text) Programmable warning: *31.07 External event 4 source* *31.08 External event 4 type*	Fault in external device 4.	Check the external device. Check setting of parameter *31.07 External event 4 source*.
A985	External warning 5 (Editable message text) Programmable warning: *31.09 External event 5 source* *31.10 External event 5 type*	Fault in external device 5.	Check the external device. Check setting of parameter *31.09 External event 5 source*.
AF80	INU-LSU comm loss Programmable warning: *60.79 INU-LSU comm loss function*	DDCS (fiber optic) communication between converters (for example, the inverter unit and the supply unit) is lost.	Check status of other converter (parameters *06.36* and *06.39*). 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	The supply unit (or other converter) has generated a warning.	The auxiliary code specifies the original warning code in the supply unit control program. See section *Auxiliary codes for line-side converter warnings* (page *673*).
AF90	Speed controller autotuning	The speed controller autotune routine did not complete successfully.	Check the auxiliary code (format XXXX YYYY). “YYYY” indicates the problem (see actions for each code below).
	0000	The drive was stopped before the autotune routine finished.	Repeat autotune until successful.
	0001	The drive was started but was not ready to follow the autotune command.	Make sure the prerequisites of the autotune run are fulfilled. See section *Before activating the autotune routine* (page *142*).

Code (hex)	Warning	Cause	What to do
	0002	Required torque reference could not be reached before the drive reached maximum speed.	Decrease torque step (parameter *25.38*) or increase speed step (*25.39*).
	0003	Motor could not accelerate/decelerate to maximum/minimum speed.	Increase torque step (parameter *25.38*) or decrease speed step (*25.39*).
	0005	Motor could not decelerate with full autotune torque.	Decrease torque step (parameter *25.38*) or speed step (*25.39*).
AFAA	Autoreset	A fault is about to be autoreset.	Informative warning. See the settings in parameter group *31 Fault functions*.
AFE1	Emergency stop (off2)	Drive has received an emergency stop (mode selection off2) 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).
		(Follower drive in a master/follower configuration) Drive has received a stop command from the master.	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)	Drive has received an emergency stop (mode selection off1 or off3) command.	Check that it is safe to continue operation. Reset the source of the emergency stop signal (such as an emergency stop push button). Restart drive. If the emergency stop was unintentional, check the source of the stop signal (for example, *21.05 Emergency stop source*, or control word received from an external control system).
AFE7	Follower	A follower drive has tripped.	Check the auxiliary code. Add 2 to the code to find out the node address of the faulted drive. Correct the fault in the follower drive.
AFEA	Enable start signal missing (Editable message text)	No enable start signal received.	Check the setting of (and the source selected by) parameter *20.19 Enable start command*.
AFEB	Run enable missing	No run enable signal is received.	Check setting of parameter *20.12 Run enable 1 source*. Switch signal on (e.g. in the fieldbus Control Word) or check wiring of selected source.
AFEC	External power signal missing	*95.04 Control board supply* is set to *External 24V* but no voltage is connected to the XPOW connector of the control unit.	Check the external 24 V DC power supply to the control unit, or change the setting of parameter *95.04*.

Code (hex)	Warning	Cause	What to do
AFF6	Identification run	Motor ID run will occur at next start or is in progress.	Informative warning.
AFF7	Autophasing	Autophasing will occur at next start.	Informative warning.
B5A0	STO event Programmable event: *31.22 STO indication run/stop*	Safe torque off function is active, i.e. safety circuit signal(s) connected to connector XSTO is lost.	Check safety circuit connections. For more information, see appropriate drive hardware manual and description of parameter *31.22 STO indication run/stop* (page *349*).
B5A2	Power up Programmable event: *96.39 Power up event logging*	The drive has been powered up.	Informative event.
B5A4	SW internal diagnostics	Control unit rebooted unexpectedly.	Informative event.
B686	Checksum mismatch Programmable event: *31.22 STO indication run/stop*	The calculated parameter checksum does not match any enabled reference checksum.	See *A686 Checksum mismatch* (page *635*).
D200	Anchor protection active	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	Automooring min level not reached	Actual rope tension is below the Minimum Automooring level when Automooring is activated. The ropes are slack when Automooring is activated.	Tighten the rope in Handmooring mode. Check the setting of parameter *76.05 Automooring min tension*.
D202	Automooring max time reached	Automooring 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 Automooring set point. Pre-tighten the rope in Handmooring mode to avoid slack in the rope.
D203	Peak torque protection active	During Handmooring mode, torque and speed exceed pre-set 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.

Code (hex)	Warning	Cause	What to do
D204	Slip protection active	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	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	Master and follower are not in the same control location.	Check that the master and the follower are both in control location EXT2.
D207	High handmooring torque level	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 automooring torque level	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*.
D209	D2D M/F comm	Master/follower communication is lost.	Check *60.238 Communication loss status* to verify the reason. Check *60.237 Comm loss delay* settings may be too short.
D210	High anchor torque level	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	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.
D212	Follower 2 faulted	Follower drive 2 has tripped on a fault. This fault message is displayed in the master drive only.	See the follower drive 2 for more detailed fault description.
D213	Follower 3 faulted	Follower drive 3 has tripped on a fault. This fault message is displayed in the master drive only.	See the follower drive 3 for more detailed fault description.
D214	Follower 4 faulted	Follower drive 4 has tripped on a fault. This fault message is displayed in the master drive only.	See the follower drive 4 for more detailed fault description.

Code (hex)	Warning	Cause	What to do
D215	Follower 5 faulted	Follower drive 5 has tripped on a fault. This fault message is displayed in the master drive only.	See the follower drive 5 for more detailed fault description.
D216	Follower 6 faulted	Follower drive 6 has tripped on a fault. This fault message is displayed in the master drive only.	See the follower drive 6 for more detailed fault description.
D217	Follower 7 faulted	Follower drive 7 has tripped on a fault. This fault message is displayed in the master drive only.	See the follower drive 7 for more detailed fault description.
D218	Follower 8 faulted	Follower drive 8 has tripped on a fault. This fault message is displayed in the master drive only.	See the follower drive 8 for more detailed fault description.
D219	Follower 9 faulted	Follower drive 9 has tripped on a fault. This fault message is displayed in the master drive only.	See the follower drive 9 for more detailed fault description.
D220	Follower 10 faulted	Follower drive 10 has tripped on a fault. This fault message is displayed in the master drive only.	See the follower drive 10 for more detailed fault description.
D221	Follower 11 faulted	Follower drive 11 has tripped on a fault. This fault message is displayed in the master drive only.	See the follower drive 11 for more detailed fault description.
D20A	Master faulted	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.
D20B	Wrong start sequence	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	The load speed error is higher than parameter *74.51 Speed steady deviation level* in a steady state or parameter *74.52 Speed ramp deviation level* in ramping state, for longer than the duration of parameter *74.54 Speed match action delay*.	Check the motor and load coupling mechanism.

Code (hex)	Warning	Cause	What to do
D20E	Winch system ID run active	Winch system ID run will occur at next start or in progress.	Informative warning.
D20F	Winch system ID run done	Winch system ID run is completed successfully.	Remove the start command.
D21A	Rotary supervision	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.

Fault messages

Code (hex)	Fault	Cause	What to do
2281	Calibration	Measured offset of output phase current measurement or difference between output phase U2 and W2 current measurement is too great (the values are updated during current calibration).	Try performing the current calibration again (select *Current measurement calibration* at parameter *99.13*). If the fault persists, contact your local ABB representative.
2310	Overcurrent	Output current has exceeded internal fault limit.	Check motor load. Check acceleration times in parameter group *23 Speed reference ramp* (speed control), *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: Vphase, 4: W-phase, 3/5/6/7: multiple phases).
2330	Earth leakage Programmable fault: *31.20 Earth 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. (See 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.

Code (hex)	Fault	Cause	What to do
2340	Short circuit	Short-circuit in motor cable(s) or motor.	Check motor and motor cable for cabling errors. If the control unit is externally powered, check the setting of parameter *95.04 Control board supply*. Check that parameter *99.10 Motor nominal power* has been set correctly. Check there are no power factor correction capacitors or surge absorbers in motor cable. Check the auxiliary code (format XXXY YYZZ). With parallel-connected inverter modules, "Y YY" specifies through which BCU control unit channel the fault was received. "ZZ" indicates the location of the short circuit (**0:** No detailed information available, **1:** Upper branch of U-phase, **2:** Lower branch of U-phase, **4:** Upper branch of V-phase, **8:** Lower branch of V-phase, **10:** Upper branch of W-phase, **20:** Lower branch of W-phase). After correcting the cause of the fault, reboot the control unit (using parameter *96.08 Control board boot*) or by cycling power.
2381	IGBT overload	Excessive IGBT junction to case temperature. This fault protects the IGBT(s) and can be activated by a short circuit in the motor cable.	Check motor cable. Check ambient conditions. Check air flow and fan operation. Check heatsink fins for dust pick-up. Check motor power against drive power.
2391	BU current difference	AC phase current difference between parallel-connected inverter modules is excessive.	Check motor cabling. Check there are no power factor correction capacitors or surge absorbers in motor cable. Check the auxiliary code (format XXXY YYZZ). "XXX" specifies the source of the first error (see "YYY"). "YYY", when converted to binary, specifies through which BCU control unit channel(s) the fault was received (for example, **001:** Channel 1, **002:** Channel 2, **003:** Channels 1 and 2, **004:** Channel 3, etc.). "ZZ" indicates the phase (**1:** U, **2:** V, **3:** W).
2392	BU earth leakage	Total earth leakage of inverter modules is excessive.	Check there are no power factor correction capacitors or surge absorbers in motor cable. Measure insulation resistances of motor cables and motor. Contact your local ABB representative.
3000	Invalid voltage chain datapoints	Parametrization of the speed/torque limitation curve (in the DC voltage reference chain) are inconsistent.	Check that the speed points of the curve (defined by *29.70*…*29.79*) are in increasing order.

Code (hex)	Fault	Cause	What to do
3130	Input phase loss	Intermediate circuit DC voltage is oscillating due to missing input power line phase or blown fuse.	Check input power line fuses. Check for loose power cable connections. Check for input power supply imbalance.
3180	Charge relay lost	No acknowledgement received from charge relay.	Contact your local ABB representative.
3181	Wiring or earth fault Programmable fault: *31.23 Wiring or earth fault*	The drive hardware is supplied from a common DC bus.	Switch off the protection in parameter *31.23*.
		Incorrect input power and motor cable connection (i.e. input power cable is connected to the motor connection).	Check the power connections. Check the input fuses.
		Drive has detected load unbalance typically due to earth fault in motor or motor cable.	Check there are no power factor correction capacitors or surge absorbers in motor cable. Check for an earth fault in motor or motor cables by measuring the insulation resistances of motor and motor cable. Try running the motor in scalar control mode if allowed. (See parameter *99.04 Motor control mode*.)
3210	DC link overvoltage	Excessive intermediate circuit DC voltage.	Check that overvoltage control is on (parameter *30.30 Overvoltage control*). Check that the supply voltage matches the nominal input voltage of the drive. Check the supply line for static or transient overvoltage. Check brake chopper and resistor (if present). Check deceleration time. Use coast-to-stop function (if applicable). Retrofit drive with brake chopper and brake resistor. With parallel-connected modules, check the auxiliary code (format XXXY YYZZ). “Y YY” specifies through which BCU control unit channel the fault was received.
3220	DC link undervoltage	Intermediate circuit DC voltage is not sufficient because of a missing supply phase, blown fuse or fault in the rectifier bridge.	Check supply cabling, fuses and switchgear. With parallel-connected modules, check the auxiliary code (format XXXY YYZZ). “Y YY” specifies through which BCU control unit channel the fault was received.
3280	Standby timeout	Automatic restart failed (see section *Automatic restart* on page *165*).	Check the condition of the supply (voltage, cabling, fuses, switchgear).

Code (hex)	Fault	Cause	What to do
3291	BU DC link difference	Difference in DC voltages between parallel-connected inverter modules.	Check the auxiliary code (format XXXY YYZZ). "XXX" specifies the source of the first error (see "YYY"). "YYY", when converted to binary, specifies through which BCU control unit channel(s) the fault was received (for example, **001:** Channel 1, **002:** Channel 2, **003:** Channels 1 and 2, **004:** Channel 3, etc.).
3381	Output phase loss Programmable fault: *31.19 Motor phase loss*	Motor circuit fault due to missing motor connection (all three phases are not connected).	Connect motor cable.
3385	Autophasing	Autophasing routine (see section *Autophasing* on page *157*) has failed.	For more information, check the auxiliary code. Check that the motor ID run has been successfully completed. Clear parameter *98.15 Position offset user*. Check the setting of parameter *99.03 Motor type*.
	0001	Estimated and measured positions have opposite signs.	Check the signs of measured and estimated speeds. Reverse encoder cable phasing or edit parameter *99.16*. Check that the load torque is not too high for the Turning mode (must be less than 5%).
	0002	Motor is rotating during autophasing.	Check that the motor is not already rotating when the autophasing routine starts.
	0003	Too much difference between measured and estimated positions	Check that encoder is not slipping. Check parameter *98.15* several times to verify that the autophasing routine gives consistent results. Check the motor model parameters.
	0004	Rotor did not rotate as expected between zero pulses.	Check that the zero pulses are given correctly.
	0005	Position estimate did not stabilize.	Check that the selected mode (parameter *21.13*) is appropriate for the motor.
	0006	Measured position status information changed.	Check that parameter *90.41* is not changed to *Estimate* during the routine.
	0007	General autophasing failure	Contact your local ABB representative.
	0008	Selected mode not supported.	Check that the selected mode (parameter *21.13*) is supported by the motor type.
	0009	(LV-Synchro) Standstill failure.	Contact your local ABB representative.
4000	Motor cable overload	Calculated motor cable temperature has exceeded warning limit.	Check the settings of parameters *35.61* and *35.62*. Check the dimensioning of the motor cable in regard to required load.

Code (hex)	Fault	Cause	What to do
4210	IGBT overtemperature	Estimated drive IGBT temperature is excessive.	Check ambient conditions. Check air flow and fan operation. Check heatsink fins for dust pick-up. Check motor power against drive power.
4290	Cooling	Drive module temperature is excessive.	Check ambient temperature. If it exceeds 40 °C (104 °F), ensure that load current does not exceed derated load capacity of drive. See appropriate *Hardware manual.* Check drive module cooling air flow and fan operation. Check inside of cabinet and heatsink of drive module for dust pick-up. Clean whenever necessary.
42F1	IGBT temperature	Drive IGBT temperature is excessive.	Check ambient conditions. Check air flow and fan operation. Check heatsink fins for dust pick-up. Check motor power against drive power.
4310	Excess temperature	Power unit module temperature is excessive.	See *A4B0 Excess temperature* (page 632).
4380	Excess temperature difference	High temperature difference between the IGBTs of different phases.	See *A4B1 Excess temperature difference* (page 632).
4981	External temperature 1 (Editable message text)	Measured temperature 1 has exceeded fault limit.	Check the value of parameter *35.02 Measured temperature 1*. Check the cooling of the motor (or other equipment whose temperature is being measured). Check the value of parameter *35.12 Temperature 1 fault limit*.
4982	External temperature 2 (Editable message text)	Measured temperature 2 has exceeded fault limit.	Check the value of parameter *35.03 Measured temperature 2*. Check the cooling of the motor (or other equipment whose temperature is being measured). Check the value of parameter *35.22 Temperature 2 fault limit*.
4990	FPTC not found	A thermistor protection module has been activated by parameter *35.30* but cannot be detected.	Power down the control unit and check that the module is properly inserted in the correct slot. The last digit of the auxiliary code identifies the slot.
4991	Safe motor temperature 1 (Editable message text)	The 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 (Editable message text)	The thermistor protection module installed in slot 2 indicates overtemperature.	
4993	Safe motor temperature 3 (Editable message text)	The thermistor protection module installed in slot 3 indicates overtemperature.	
5080	Fan Programmable fault: *31.35 Main fan fault function*	Cooling fan feedback missing.	See *A581 Fan* (page 633).

Code (hex)	Fault	Cause	What to do
5081	Auxiliary fan not running Programmable fault: *31.36 Aux fan fault function*	An auxiliary cooling fan (connected to the fan connectors on the control unit) is stuck or disconnected.	See *A582 Auxiliary fan not running* (page *633*).
5090	STO hardware failure	Safe torque off hardware failure.	Contact your local ABB representative, quoting the auxiliary code. The code contains location information, especially with parallel-connected inverter modules. When converted into a 32-bit binary number, the bits of the code indicate the following: 31…28: Number of faulty inverter module (0…11 decimal). 1111: STO_ACT states of control unit and inverter modules in conflict 27: STO_ACT state of inverter modules 26: STO_ACT state of control unit 25: STO1 of control unit 24: STO2 of control unit 23…12: STO1 of inverter modules 12…1 (Bits of non-existing modules set to 1) 11…0: STO2 of inverter modules 12…1 (Bits of non-existing modules set to 1).
5091	Safe torque off Programmable fault: *31.22 STO indication run/stop*	Safe torque off function is active, i.e. safety circuit signal(s) connected to connector XSTO is broken during start or run.	Check safe torque off circuit connections. For more information, see appropriate drive hardware manual and description of parameter *31.22 STO indication run/stop* (page *349*).
5092	PU logic error	Power unit memory has cleared.	Cycle the power to the drive. If the control unit is externally powered, also reboot the control unit (using parameter *96.08 Control board boot*) or by cycling its power. If the problem persists, contact your local ABB representative.

Code (hex)	Fault	Cause	What to do
5093	Rating ID mismatch	The hardware of the drive does not match the information stored in the memory unit. This may occur eg. after a firmware update or memory unit replacement.	Cycle the power to the drive. Check the auxiliary code. The auxiliary code categories are as follows: 1 = PU and CU ratings not the same. Rating ID has changed. 2 = Parallel connection rating ID has changed. 3 = PU types not the same in all power units. 4 = Parallel connection rating ID is active in a single power unit setup. 5 = It is not possible to implement the selected rating with the current PUs. 6 = PU rating ID is 0. 7 = Reading PU rating ID or PU type failed on PU connection. 8 = PU not supported (illegal rating ID). 9 = Incompatible module current rating (unit contains a module with too low a current rating). 10 = Selected parallel rating ID not found from database. With parallel connection faults (BCU control unit), the format of the auxiliary code is 0X0Y. “Y” indicates the auxiliary code category, “X” indicates the first faulty PU channel in hexadecimal (1…C). (With a ZCU control unit, “X” can be 1 or 2 but this is irrelevant to the fault.)
5094	Measurement circuit temperature	Problem with internal temperature measurement of the drive.	See *A5EA Measurement circuit temperature* (page *634*).
5681	PU communication	The way the control unit is powered does not correspond to parameter setting.	Check setting of *95.04 Control board supply*.
		Communication errors detected between the drive control unit and the power unit.	Check the connection between the control unit and the power unit. Check the auxiliary code (format XXXY YYZZ). With parallel-connected modules, “Y YY” specifies the affected BCU control unit channel (**0:** broadcast). “ZZ” specifies the error source (**1:** Transmitter side [link error], **2:** Transmitter side [no communication], **3:** Receiver side [link error], **4:** Receiver side [no communication], **5:** Transmitter FIFO error [see “XXX”], **6:** Module [xINT board] not found, **7:** BAMU board not found). “XXX” specifies the transmitter FIFO error code (**1:** Internal error [invalid call parameter], **2:** Internal error [configuration not supported], **3:** Transmission buffer full).
5682	Power unit lost	Connection between the drive control unit and the power unit is lost.	Check the connection between the control unit and the power unit.

Code (hex)	Fault	Cause	What to do
5690	PU communication internal	Internal communication error.	Contact your local ABB representative.
5691	Measurement circuit ADC	Measurement circuit fault.	If the control unit is externally powered, check the setting of parameter *95.04 Control board supply*. Contact your local ABB representative, quoting the auxiliary code stored in the event log.
5692	PU board powerfail	Power unit power supply failure.	Check the auxiliary code (format ZZZY YYXX). “YY Y” specifies the affected inverter module (**0…C**, always **0** for ZCU control units). “XX” specifies the affected power supply (**1:** Power supply 1, **2:** Power supply 2, **3:** both supplies).
5693	Measurement circuit DFF	Measurement circuit fault.	Contact your local ABB representative, quoting the auxiliary code.
5694	PU communication configuration	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.
5695	Reduced run	Number of inverter modules detected does not match the value of parameter *95.13 Reduced run mode.*	Check that the value of *95.13 Reduced run mode* corresponds to the number of inverter modules present. Check that the modules present are powered from the DC bus and connected by fiber optic cables to the BCU control unit. If all modules of the inverter unit are in fact available (eg. maintenance work has been completed), check that parameter *95.13* is set to 0 (reduced run function disabled).
5696	PU state feedback	State feedback from output phases does not match control signals.	Contact your local ABB representative, quoting the auxiliary code stored in the event log.

Code (hex)	Fault	Cause	What to do
5697	Charging feedback	Incorrect parameter setting.	Check the setting of *95.09 Switch fuse controller*. The parameter should be enabled only if an xSFC charging controller is installed.
		The charging switch and DC switch were operated out of sequence, or a start command was issued before the unit was ready.	The normal power-up sequence is: 1. Close charging switch. 2. After charging finishes (charging OK lamp lights), close DC switch. 3. Open charging switch.
		Charging circuit fault.	Check the charging circuit. With a frame R6i/R7i inverter module, the auxiliary code “FA” indicates that the charging contactor status feedback does not match the control signal. With parallel-connected frame R8i modules, the auxiliary code (format XX00), “XX” specifies the affected BCU control unit channel.
		Brake circuit fault.	Check the wiring and condition of brake resistor.
5698	Unknown power unit fault	Unidentified power unit logic fault.	Check power unit logic and firmware compatibility. Contact your local ABB representative.
6000	Internal SW error	Internal error.	Contact your local ABB representative. Quote the auxiliary code.
6181	FPGA version incompatible	Firmware and FPGA file version in the power unit are incompatible.	Reboot the control unit (using parameter *96.08 Control board boot*) or by cycling power. If the problem persists, contact your local ABB representative.
		Update of power unit logic failed.	Retry.
6200	Checksum mismatch Programmable fault: *96.54 Checksum action*	The calculated parameter checksum does not match any enabled reference checksum.	See *A686 Checksum mismatch* (page *635*).
6306	FBA A mapping file	Fieldbus adapter A mapping file read error.	Contact your local ABB representative.
6307	FBA B mapping file	Fieldbus adapter B mapping file read error.	Contact your local ABB representative.
6481	Task overload	Internal fault.	Reboot the control unit (using parameter *96.08 Control board boot*) or by cycling power. If the problem persists, contact your local ABB representative.
6487	Stack overflow	Internal fault.	Reboot the control unit (using parameter *96.08 Control board boot*) or by cycling power. If the problem persists, contact your local ABB representative.
64A1	Internal file load	File read error.	Reboot the control unit (using parameter *96.08 Control board boot*) or by cycling power. If the problem persists, contact your local ABB representative.
64A2	Internal record load	Internal record load error.	Contact your local ABB representative.

Code (hex)	Fault	Cause	What to do
64A3	Application loading	Application file incompatible or corrupted.	Check the auxiliary code. See actions for each code below.
	8006	Not enough memory for the application.	Reduce the size of the application. Reduce the number of parameter mappings. See the drive-specific log generated by Automation Builder.
	8007	The application contains the wrong library version.	Update the system library or reinstall Automation Builder. See the drive-specific log generated by Automation Builder.
	8008	The application is empty.	In Automation Builder, give a “Clean” command and reload the application.
	8009	The application contains invalid tasks.	In Automation Builder, check application task configuration, give a “Clean all” command, and reload the application.
	800A	The application contains an unknown target (system) library function.	Update the system library or reinstall Automation Builder. See the drive-specific log generated by Automation Builder.
64A5	Licensing fault	Running the control program is prevented either because a restrictive license exists, or because a required license is missing.	Record the auxiliary codes of all active licensing faults and contact your product vendor for further instructions.
64A6	Adaptive program	Error running the adaptive program.	Check the auxiliary code (format XXXX YYYY). “XXXX” specifies the number of the function block (**0000** = generic error). “YYYY” indicates the problem (see actions for each code below).
	000A	Program corrupted or block non-existent	Restore the template program or download the program to the drive.
	000C	Required block input missing	Check the inputs of the block.
	000E	Program corrupted or block non-existent	Restore the template program or download the program to the drive.
	0011	Program too large.	Remove blocks until the error stops.
	0012	Program is empty.	Correct the program and download it to the drive.
	001C	A nonexisting parameter or block is used in the program.	Edit the program to correct the parameter reference, or to use an existing block.
	001D	Parameter type invalid for selected pin.	Edit the program to correct the parameter reference.
	001E	Output to parameter failed because the parameter was write-protected.	Check the parameter reference in the program. Check for other sources affecting the target parameter.
	0023 0024	Program file incompatible with current firmware version.	Adapt the program to current block library and firmware version.

Code (hex)	Fault	Cause	What to do
	002A	Too many blocks.	Edit the program to reduce the number of blocks.
	Other	–	Contact your local ABB representative, quoting the auxiliary code.
64B0	Memory unit detached	The memory unit was detached when the control unit was powered.	Switch off the power to the control unit and reinstall the memory unit. In case the memory unit was not actually removed when the fault occurred, check that the memory unit is properly inserted into its connector and its mounting screw is tight. Reboot the control unit (using parameter *96.08 Control board boot*) or by cycling power. If the problem persists, contact your local ABB representative.
64B1	Internal SSW fault	Internal fault.	Reboot the control unit (using parameter *96.08 Control board boot*) or by cycling power. If the problem persists, contact your local ABB representative.
64B2	User set fault	Loading of user parameter set failed because • set is not compatible with control program • drive was switched off during loading.	Ensure that a valid user parameter set exists. Reload if uncertain.
64E1	Kernel overload	Operating system error.	Reboot the control unit (using parameter *96.08 Control board boot*) or by cycling power. If the problem persists, contact your local ABB representative.
64FF	Fault reset	Informative fault	An active fault has been reset.
6581	Parameter system	Parameter load or save failed.	Try forcing a save using parameter *96.07 Parameter save manually*. Retry.
65A1	FBA A parameter conflict	The drive does not have a functionality requested by PLC, or requested functionality has not been activated.	Check PLC programming. Check settings of parameter groups *50 Fieldbus adapter (FBA)* and *51 FBA A settings*.
65A2	FBA B parameter conflict	The drive does not have a functionality requested by PLC, or requested functionality has not been activated.	Check PLC programming. Check settings of parameter groups *50 Fieldbus adapter (FBA)* and *54 FBA B settings*.
65B1	Reference source parametrization	A reference source is simultaneously connected to multiple parameters with different units.	See *A6DA Reference source parametrization* (page *636*).
6681	EFB comm loss Programmable fault: *58.14 Communication loss action*	Communication break in embedded fieldbus (EFB) communication.	Check the status of the fieldbus master (online/offline/error etc.). Check cable connections to the XD2D connector on the control unit.
6682	EFB config file	Embedded fieldbus (EFB) configuration file could not be read.	Contact your local ABB representative.

Code (hex)	Fault	Cause	What to do
6683	EFB invalid parameterization	Embedded fieldbus (EFB) parameter settings inconsistent or not compatible with selected protocol.	Check the settings in parameter group *58 Embedded fieldbus*.
6684	EFB load fault	Embedded fieldbus (EFB) protocol firmware could not be loaded.	Contact your local ABB representative.
		Version mismatch between EFB protocol firmware and drive firmware.	
6881	Text data overflow	Internal fault.	Reset the fault. Contact your local ABB representative if the fault persists.
6882	Text 32-bit table overflow	Internal fault.	Reset the fault. Contact your local ABB representative if the fault persists.
6883	Text 64-bit table overflow	Internal fault.	Reset the fault. Contact your local ABB representative if the fault persists.
6885	Text file overflow	Internal fault.	Reset the fault. Contact your local ABB representative if the fault persists.
7080	Option module comm loss	Communication between drive and an option module is lost.	See *A798 Encoder option comm loss* (page *638*).
7081	Control panel loss Programmable fault: *49.05 Communication loss action*	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	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.

Code (hex)	Fault	Cause	What to do
	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.	
	00 0004	Configuration of module failed.	
7083	Panel reference conflict	Use of saved control panel reference in multiple control modes attempted.	The control panel reference can only be saved for one reference type at a time. Consider the possibility of using a copied reference instead of saved reference (see the reference selection parameter).
7084	Panel/PC tool version conflict	The current version of the control panel and/or PC tool does not support a function. (For example, older panel versions cannot be used as a source of external reference.)	Update control panel and/or PC tool. Contact your local ABB representative if necessary.
7085	Incompatible option module	Option module not supported. (For example, type Fxxx-xx-M fieldbus adapter modules are not supported.)	Check the auxiliary code. The code specifies the interface to which the unsupported module is connected: **1:** Fieldbus interface A, **2:** Fieldbus interface B. Replace the module with a supported type.
7121	Motor stall Programmable fault: *31.24 Stall function*	Motor is operating in stall region because of e.g. excessive load or insufficient motor power.	Check motor load and drive ratings. Check fault function parameters.
7122	Motor overload Programmable fault: *35.56 Motor overload action*	Motor current is too high.	Check for overloaded motor. Adjust the parameters used for the motor overload function (*35.51*…*35.53*) and *35.55*…*35.56*.
7181	Brake resistor	DC overvoltage detected during braking.	Check that a brake resistor has been connected. Check the condition of the brake resistor. Check the dimensioning of the brake chopper and resistor.
7183	BR excess temperature	Brake resistor temperature has exceeded fault limit defined by parameter *43.11 Brake resistor fault limit*.	Stop drive. Let resistor cool down. Check resistor overload protection function settings (parameter group *43 Brake chopper*). Check fault limit setting, parameter *43.11 Brake resistor fault limit*. Check that braking cycle meets allowed limits.

Code (hex)	Fault	Cause	What to do
7184	Brake resistor wiring	Brake resistor short circuit or brake chopper control fault.	Check brake chopper and brake resistor connection. Ensure brake resistor is not damaged. After correcting the cause of the fault, reboot the control unit (using parameter *96.08 Control board boot*) or by cycling power.
7191	BC short circuit	Short circuit in brake chopper IGBT.	Ensure brake resistor is connected and not damaged. Check the electrical specifications of the brake resistor against the *Hardware manual*. Replace brake chopper (if replaceable). After correcting the cause of the fault, reboot the control unit (using parameter *96.08 Control board boot*) or by cycling power.
7192	BC IGBT excess temperature	Brake chopper IGBT temperature has exceeded internal fault limit.	Let chopper cool down. Check for excessive ambient temperature. Check for cooling fan failure. Check for obstructions in the air flow. Check the dimensioning and cooling of the cabinet. Check resistor overload protection function settings (parameter group *43 Brake chopper*). Check that braking cycle meets allowed limits. Check that drive supply AC voltage is not excessive.
71A2	Mechanical brake closing failed Programmable fault: *44.17 Brake fault function*	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	Mechanical brake opening failed Programmable fault: *44.17 Brake fault function*	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	Mechanical brake opening not allowed Programmable fault: *44.17 Brake fault function*	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 acknowledgment signal (if used) matches actual status of brake.
71B1	Motor fan Programmable fault: *35.106 DOL starter event type*	No feedback received from external fan.	Check external fan (or other equipment controlled) by the logic. Check settings of parameters *35.100*…*35.106*.

Code (hex)	Fault	Cause	What to do
7301	Motor speed feedback Programmable fault: *90.45 Motor feedback fault*	No motor speed feedback received.	See *A7B0 Motor speed feedback* (page *640*).
7310	Overspeed	Motor is turning faster than highest allowed speed due to incorrectly set minimum/maximum speed, insufficient braking torque or changes in load when using torque reference.	Check minimum/maximum speed settings, parameters *30.11 Minimum speed*, *30.12 Maximum speed* and *31.30 Overspeed trip margin*. Check adequacy of motor braking torque. Check applicability of torque control. Check need for brake chopper and resistor(s).
		Incorrect estimated speed.	Check the status of motor current measurement. Perform a *Normal*, *Advanced* or *Advanced Standstill* ID run instead of, for example, a *Reduced* or *Standstill* ID run. See parameter *99.13 ID run requested* (page *565*).
7380	Encoder internal	Internal fault.	Contact your local ABB representative.
7381	Encoder Programmable fault: *90.45 Motor feedback fault*	Encoder feedback fault.	See *A7E1 Encoder* (page *642*).
73A0	Speed feedback configuration	Speed feedback configuration incorrect.	See *A797 Speed feedback configuration* (page *638*).
73A1	Load position feedback Programmable fault: *90.55 Load feedback fault*	No load feedback received.	Check the event log for an 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	Motor/load gear definition invalid or outside limits.	Check motor/load gear settings (*90.61* and *90.62*).
	0004	Encoder not configured.	Check encoder settings (*92 Encoder 1 configuration* or *93 Encoder 2 configuration*). Use parameter *91.10 Encoder parameter refresh*) to validate any changes in the settings.
	0005	Encoder stopped working.	Check encoder status.
73B0	Emergency ramp failed	Emergency stop did not finish within expected time.	Check the settings of parameters *31.32 Emergency ramp supervision* and *31.33 Emergency ramp supervision delay*. Check the predefined ramp times (*23.200*…*23.205* for mode Off1, *23.23* for mode Off3).

Code (hex)	Fault	Cause	What to do
73B1	Stop failed	Ramp stop did not finish within expected time.	Check the settings of parameters *31.37 Ramp stop supervision* and *31.38 Ramp stop supervision delay*. Check the predefined ramp times in parameter *23 Speed reference ramp*.
73F0	Overfrequency	Maximum allowed output frequency exceeded.	Without a dual-use license, the fault limit is 598 Hz. Contact your local ABB representative for dual-use licensing information.
7510	FBA A communication Programmable fault: *50.02 FBA A comm loss func*	Cyclical communication between drive and fieldbus adapter module A or between PLC and fieldbus adapter module A is lost.	Check status of fieldbus communication. See user documentation of fieldbus interface. Check settings of parameter groups *50 Fieldbus adapter (FBA)*, *51 FBA A settings*, *52 FBA A data in* and *53 FBA A data out*. Check cable connections. Check if communication master is able to communicate.
7520	FBA B communication Programmable fault: *50.32 FBA B comm loss func*	Cyclical communication between drive and fieldbus adapter module B or between PLC and fieldbus adapter module B is lost.	Check status of fieldbus communication. See user documentation of fieldbus interface. Check settings of parameter group *50 Fieldbus adapter (FBA)*. Check cable connections. Check if communication master is able to communicate.
7580	INU-LSU comm loss Programmable fault: *60.79 INU-LSU comm loss function*	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 Programmable fault: *60.59 DDCS controller comm loss function*	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	MF comm loss Programmable fault: *60.09 M/F comm loss function*	Master/follower communication is lost.	See *A7CB MF comm loss* (page *642*).
7583	Line side unit faulted	The supply unit (or other converter) connected to the inverter unit has generated a fault.	The auxiliary code specifies the original fault code in the supply unit control program. See section *Auxiliary codes for line-side converter faults* (page *675*).

Code (hex)	Fault	Cause	What to do
7584	LSU charge failed	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 setting of parameter *94.10 LSU max charging time*. Check that the supply unit is enabled, allowed to start, and can be controlled by the inverter unit (eg. not in local control mode).
8001	ULC underload fault Programmable fault: *37.04 ULC underload actions*	Selected signal has fallen below the user underload curve.	See *A8BF ULC underload warning* (page *644*).
8002	ULC overload fault Programmable fault: *37.03 ULC overload actions*	Selected signal has exceeded the user overload curve.	See *A8BE ULC overload warning* (page *644*).
80A0	AI supervision Programmable fault: *12.03 AI supervision function*	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 (Editable message text) Programmable fault: *32.06 Supervision 1 action*	Fault generated by the signal supervision 1 function.	Check the source of the fault (parameter *32.07 Supervision 1 signal*).
80B1	Signal supervision 2 (Editable message text) Programmable fault: *32.16 Supervision 2 action*	Fault generated by the signal supervision 2 function.	Check the source of the fault (parameter *32.17 Supervision 2 signal*).
80B2	Signal supervision 3 (Editable message text) Programmable fault: *32.26 Supervision 3 action*	Fault generated by the signal supervision 3 function.	Check the source of the fault (parameter *32.27 Supervision 3 signal*).
9081	External fault 1 (Editable message text) Programmable fault: *31.01 External event 1 source* *31.02 External event 1 type*	Fault in external device 1.	Check the external device. Check setting of parameter *31.01 External event 1 source*.
9082	External fault 2 (Editable message text) Programmable fault: *31.03 External event 2 source* *31.04 External event 2 type*	Fault in external device 2.	Check the external device. Check setting of parameter *31.03 External event 2 source*.

Code (hex)	Fault	Cause	What to do
9083	External fault 3 (Editable message text) Programmable fault: *31.05 External event 3 source* *31.06 External event 3 type*	Fault in external device 3.	Check the external device. Check setting of parameter *31.05 External event 3 source*.
9084	External fault 4 (Editable message text) Programmable fault: *31.07 External event 4 source* *31.08 External event 4 type*	Fault in external device 4.	Check the external device. Check setting of parameter *31.07 External event 4 source*.
9085	External fault 5 (Editable message text) Programmable fault: *31.09 External event 5 source* *31.10 External event 5 type*	Fault in external device 5.	Check the external device. Check setting of parameter *31.09 External event 5 source*.
B680	SW internal diagnostics	SW internal malfunction.	Contact your local ABB representative quoting the auxiliary code.
FA81	Safe torque off 1 loss	Safe torque off function is active, ie. STO circuit 1 is broken.	Check safety circuit connections. For more information, see appropriate drive hardware manual and description of parameter *31.22 STO indication run/stop* (page *349*). Check the auxiliary code, The code contains location information, especially with parallel-connected inverter modules. When converted into a 32-bit binary number, the bits of the code indicate the following: 31…28: Number of faulty inverter module (0…11 decimal). 1111: STO_ACT states of control unit and inverter modules in conflict 27: STO_ACT state of inverter modules 26: STO_ACT state of control unit 25: STO1 of control unit 24: STO2 of control unit 23…12: STO1 of inverter modules 12…1 (Bits of non-existing modules set to 1) 11…0: STO2 of inverter modules 12…1 (Bits of non-existing modules set to 1).
FA82	Safe torque off 2 loss	Safe torque off function is active, ie. STO circuit 2 is broken.	
FA90	STO diagnostics failure	SW internal malfunction.	Contact your local ABB representative.
FB11	Memory unit missing	No memory unit is attached to the control unit.	Power down the control unit. Check that the memory unit is properly inserted into the control unit.
		The memory unit attached to the control unit is empty.	Power down the control unit. Attach a memory unit (with the appropriate firmware) to the control unit.
FB12	Memory unit incompatible	The memory unit attached to the control unit is incompatible.	Power down the control unit. Attach a compatible memory unit.
FB13	Memory unit FW incompatible	The firmware on the attached memory unit is incompatible with the drive.	Power down the control unit. Attach a memory unit with compatible firmware.

Code (hex)	Fault	Cause	What to do
FB14	Memory unit FW load failed	The firmware on the attached memory unit could not be loaded to the drive.	Recycle the power to the control unit. Check the sticker on the memory unit to confirm that the firmware is compatible with the control unit (ZCU-1x/BCU-x2). Connect Drive composer PC tool (version 2.3 or later) to the drive. Select Tools - Recover drive. If the problem persists, replace the memory unit.
FF61	ID run	Motor ID run was not completed successfully.	Check the nominal motor values in parameter group *99 Motor data*. Check that no external control system is connected to the drive. Cycle the power to the drive (and its control unit, if powered separately). Check that the motor shaft is not locked. Check the event log for an auxiliary code. The second number of the code indicates the problem (see actions for each code below).
	0001	Maximum current limit too low.	Check settings of parameters *99.06 Motor nominal current* and *30.17 Maximum current*. Make sure that *30.17* > *99.06*. Check that the drive is dimensioned correctly according to the motor.
	0002	Maximum speed limit or calculated field weakening point too low.	Check settings of parameters • *30.11 Minimum speed* • *30.12 Maximum speed* • *99.07 Motor nominal voltage* • *99.08 Motor nominal frequency* • *99.09 Motor nominal speed*. Make sure that • *30.12* > (0.55 × *99.09*) > (0.50 × synchronous speed) • *30.11* ≤ 0, and • supply voltage ≥ (0.66 × *99.07*).
	0003	Maximum torque limit too low.	Check settings of parameter *99.12 Motor nominal torque*, and the torque limits in group *30 Limits*. Make sure that the maximum torque limit in force is greater than 100%.
	0004	Current measurement calibration did not finish within reasonable time.	Contact your local ABB representative.
	0005…0008	Internal error.	Contact your local ABB representative.
	0009	(Asynchronous motors only) Acceleration did not finish within reasonable time.	Contact your local ABB representative.
	000A	(Asynchronous motors only) Deceleration did not finish within reasonable time.	Contact your local ABB representative.

Code (hex)	Fault	Cause	What to do
	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.
FF7E	Follower	A follower drive has tripped.	Check the auxiliary code. Add 2 to the code to find out the node address of the faulted drive. Correct the fault in the follower drive.
FF81	FB A force trip	A fault trip command has been received through fieldbus adapter A.	Check the fault information provided by the PLC.
FF82	FB B force trip	A fault trip command has been received through fieldbus adapter B.	Check the fault information provided by the PLC.
FF8E	EFB force trip	A fault trip command has been received through the embedded fieldbus interface.	Check the fault information provided by the Modbus controller.
D100	Automooring min level not reached	Actual rope tension is below the Minimum Automooring level when Automooring is activated. The ropes are slack when Automooring is enabled.	Tighten the rope in the Handmooring mode. Check the setting of parameter *76.05 Automooring min tension*.
D101	Automooring max time reached	Automooring maximum running time limit detected. Automooring 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 Automooring set point.
D102	Torque prove failed	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	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.

Code (hex)	Fault	Cause	What to do
D104	Speed match	The load speed error is higher than parameter *74.51 Speed steady deviation level* in a steady state or parameter *74.52 Speed ramp deviation level* in ramping state, for longer than the duration of parameter *74.54 Speed match action delay*.	Check the motor and load coupling mechanism.
D105	Frequent AM start supervision	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*.
D106	Inverter overload	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 handmooring torque level	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 automooring torque level	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*.
D109	D2D M/F comm	Master/follower communication is lost.	Check *60.238 Communication loss status* to verify the reason. Check *60.237 Comm loss delay* settings may be too short.
D10A	High anchor torque level	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*.

Code (hex)	Fault	Cause	What to do
D10B	Synchron 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	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.

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)	Warning / Aux. code	Cause	What to do
AE01	Overcurrent	Output current has exceeded internal fault limit.	Check supply voltage. Check that there are no power factor correction capacitors or surge absorbers in supply cable. Check motor load and acceleration times. Check power semiconductors (IGBTs) and current transducers.
AE02	Earth leakage Programmable warning: *31.120 LSU earth fault*	IGBT supply has detected load unbalance.	Check AC fuses. Check for earth leakages. Check supply cabling. Check power modules. Check there are no power factor correction capacitors or surge absorbers in supply cable.
AE04	IGBT overload	Excessive IGBT junction to case temperature.	Check supply cable.
AE05	BU current difference	Current difference detected by the branching unit (BU).	Check converter fuses. Check converter(s). Check inverter(s). Check LCL filter.
AE06	BU earth leakage	Earth leakage detected by the branching unit: sum of all currents exceeds the level.	Check AC fuses. Check for earth leakages. Check supply cabling. Check power modules. Check there are no power factor correction capacitors or surge absorbers in supply cable.
AE09	DC link overvoltage	Excessive intermediate circuit DC voltage. **Note:** This warning can be shown only when the IGBT supply unit is not modulating.	Check that parameter *95.01 Supply voltage* is set according to the supply voltage in use.
AE0A	DC link undervoltage	Intermediate circuit DC voltage is not sufficient due to missing phase in supply voltage, blown fuse or rectifier bridge internal fault. **Note:** This warning can be shown only when the IGBT supply unit is not modulating.	Check supply and fuses. Check that parameter *95.01 Supply voltage* is set according to the supply voltage in use.
AE0B	DC not charged	The voltage of the intermediate DC circuit has not yet risen to operating level.	Check the input voltage setting in parameter *95.01 Supply voltage*. Check the input voltage. If the problem persists, contact your local ABB representative.

Code (hex)	Warning / Aux. code	Cause	What to do
AE0C	BU DC link difference	DC link voltage difference detected by the branching unit.	Check DC fuses. Check converter module connections to DC link.
AE0D	BU voltage difference	Main voltage difference detected by the branching unit.	Check AC fuses. Check supply cable.
AE14	Excess temperature	Power unit module temperature is excessive.	Check ambient conditions. Check air flow and fan operation. Check heatsink fins for dust pick-up. Check motor power against IGBT supply unit power.
AE15	Excess temperature difference	High temperature difference between the IGBTs of different phases.	Check the cabling. Check cooling of power module(s).
AE16	IGBT temperature	IGBT temperature is excessive.	Check ambient conditions. Check air flow and fan operation. Check heatsink fins for dust pick-up. Check motor power against IGBT supply unit power.
AE24	Voltage category unselected	The supply voltage range has not been defined.	Define the supply voltage range (parameter *95.01 Supply voltage*).
AE5F	Temperature Warning	Supply module temperature is excessive due to eg, module overload or fan failure.	Check module cooling air flow and fan operation. Check ambient temperature. If it exceeds 40 °C (104 °F), ensure that load current does not exceed derated load capacity. See appropriate hardware manual. Check inside of cabinet and heatsink of supply module for dust pick-up. Clean whenever necessary.
AE73	Fan	Cooling fan is stuck or disconnected.	Check the auxiliary code in the line-side converter program to identify the fan. Check fan operation and connection. Replace fan if faulty.
AE78	Net lost	Net lost is detected.	Resynchronize the IGBT supply unit to the grid after net lost.
AE85	Charging count	There are too many DC link charging attempts.	Two attempts in five minutes is allowed to prevent charging circuit overheating.

Auxiliary codes for line-side converter faults

The table below lists the auxiliary codes of *7583 Line side unit faulted*. For advanced troubleshooting, see the firmware manual of the line converter.

Code (hex)	Fault / Aux. code	Cause	What to do
2E00	Overcurrent	Output current has exceeded internal fault limit.	Check supply voltage. Check that there are no power factor correction capacitors or surge absorbers in supply cable. Check motor load and acceleration times. Check power semiconductors (IGBTs) and current transducers.
2E01	Earth leakage Programmable fault: *31.120 LSU earth 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	IGBT supply unit has detected short circuit.	Check supply cable. Check there are no power factor correction capacitors or surge absorbers in supply cable. After correcting the cause of the fault, reboot the control unit (using parameter *96.08 Control board boot*) or by cycling power.
2E04	IGBT overload	Excessive IGBT junction to case temperature.	Check the load.
2E05	BU current difference	Current difference detected by the branching unit (BU).	Check converter fuses. Check converter(s). Check inverter(s). Check LCL filter. Power off all boards. If the fault persists, contact your local ABB representative.
2E06	BU earth leakage	Earth leakage detected by the branching unit: sum of all currents exceeds the level.	Check AC fuses. Check for earth leakages. Check supply cabling. Check power modules. Check there are no power factor correction capacitors or surge absorbers in supply cable. If no earth fault can be detected, contact your local ABB representative.

Code (hex)	Fault / Aux. code	Cause	What to do
3E00	Input phase loss Programmable fault: *31.121 LSU supply phase loss*	Input phase loss detected by the IGBT bridge.	Check the auxiliary code. Check the source of the fault corresponding to the code: 1: Phase A 2: Phase B 4: Phase C 8: Phase cannot be detected Check the AC fuses. Check for input power supply imbalance.
3E04	DC link overvoltage	Excessive intermediate circuit DC voltage.	Check that parameter *95.01 Supply voltage* is set according to the supply voltage in use.
3E05	DC link undervoltage	Intermediate circuit DC voltage is not sufficient because of a missing supply phase or blown fuse.	Check supply cabling, fuses and switchgear. Check that parameter *95.01 Supply voltage* is set according to the supply voltage in use.
3E06	BU DC link difference	Difference in DC voltages between parallel-connected supply modules.	Check the DC fuses. Check the connection to the DC bus. If the problem persists, contact your local ABB representative.
3E07	BU voltage difference	Difference in main voltages between parallel-connected supply modules.	Check the supply network connections. Check the AC fuses. If the problem persists, contact your local ABB representative.
3E08	LSU charging	DC link voltage is not high enough after charging.	Check parameter *95.01 Supply voltage*. Check supply voltage and fuses. Check the connection from the relay output to the charging contactor. Check that the DC voltage measuring circuit is working correctly.
4E01	Cooling	Power module temperature is excessive.	Check ambient temperature. If it exceeds 40 °C (104 °F), ensure that load current does not exceed derated load capacity. See appropriate hardware manual. Check power module cooling air flow and fan operation. Check inside of cabinet and heatsink of power module for dust pick-up. Clean whenever necessary.
4E02	IGBT temperature	IGBT temperature is excessive.	Check ambient conditions. Check air flow and fan operation. Check heatsink fins for dust pick-up. Check motor power against IGBT supply unit power.
4E03	Excess temperature	Power unit module temperature is excessive.	Check ambient conditions. Check air flow and fan operation. Check heatsink fins for dust pick-up.

Code (hex)	Fault / Aux. code	Cause	What to do
4E04	Excess temperature difference	High temperature difference between the IGBTs of different phases. The amount of available temperatures depends on the frame size.	See *AE15 Excess temperature difference* (page 674).
4E06	Cabinet or LCL overtemperature	Overtemperature detected either in cabinet, LCL filter or auxiliary transformer.	Check the cooling of the cabinet, LCL filter and auxiliary transformer.
5E05	Rating ID mismatch	The hardware of the supply unit does not match the information stored in the memory unit. This may occur eg, after a firmware update or memory unit replacement.	Cycle the power to the supply unit. If the control unit is externally powered, reboot the control unit (using parameter *96.108 LSU control board boot* or by cycling its power. If the problem persists, contact your local ABB representative.
5E06	Main contactor Fault	Control program does not receive main contactor on (1) acknowledgement through digital input even control program has closed the contactor control circuit with relay output. Main contactor / main breaker is not functioning properly, or there is a loose / bad connection.	Check main contactor / main breaker control circuit wiring. Check the status of other switches connected to contactor control circuit. See the delivery-specific circuit diagrams. Check main contactor operating voltage level (should be 230 V). Check digital input DI3 connections.
6E19	Synchronization fault	Synchronization to supply network has failed.	Monitor possible network transients.
6E1A	Rating ID fault	Rating ID load error.	Contact your local ABB representative.
6E1F	Licensing fault	There are two types of licenses being used in ACS880 drives: licenses that need to be found from the unit which allow the firmware to be executed, and licenses that prevent the firmware from running.The license is indicated by the value of the auxiliary code field. The license is Nxxxx, where xxxx is indicated by the 4-digit value of the auxiliary code field.	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, or using parameter *96.108 LSU control board boot*.
	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.	Contact your product vendor for further instructions.
7E01	Panel loss	Control panel or PC tool selected as active control location has ceased communicating.	Check PC tool or control panel connection. Check control panel connector. Replace control panel in mounting platform.

Code (hex)	Fault / Aux. code	Cause	What to do
8E07	Net lost	Net lost is detected. Duration of net lost is too long.	Resynchronize the IGBT supply unit to the grid after net lost.

10

Fieldbus control through the embedded fieldbus interface (EFB)

What this chapter contains

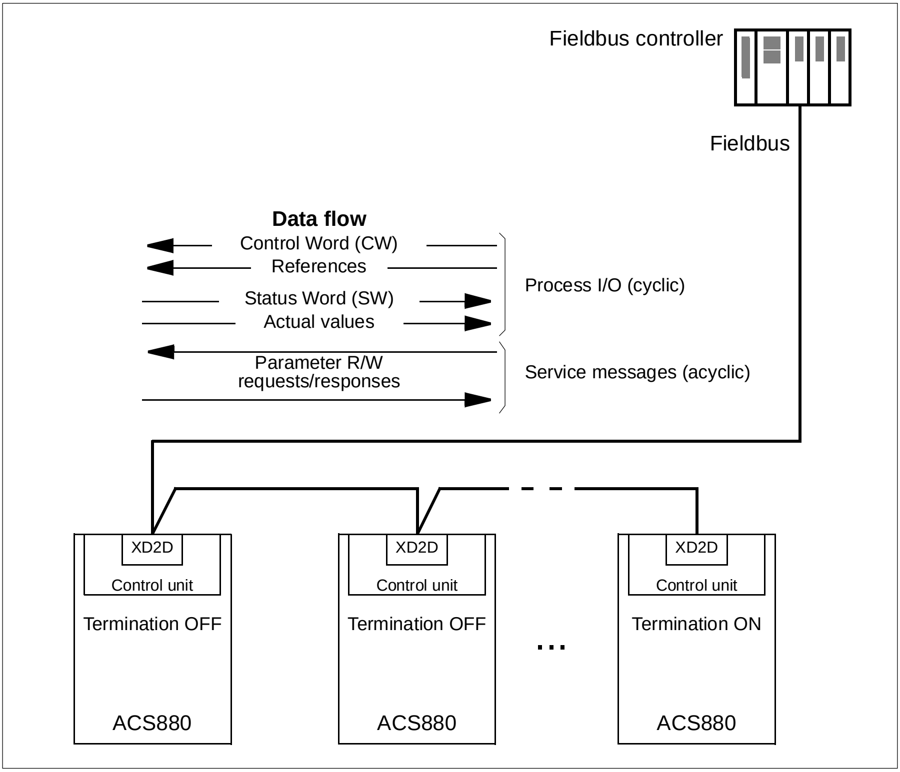
The chapter describes how the drive can be controlled by external devices over a communication network (fieldbus) using the embedded fieldbus interface.

System overview

The drive can be connected to an external control system through a communication link using either a fieldbus adapter or the embedded fieldbus interface.

The embedded fieldbus interface supports the Modbus RTU protocol. The drive control program can handle 10 Modbus registers in a 10-millisecond time level. For example, if the drive receives a request to read 20 registers, it will start its response within 22 ms of receiving the request – 20 ms for processing the request and 2 ms overhead for handling the bus. The actual response time depends on other factors as well, such as the baud rate (a parameter setting in the drive).

The drive can be set to receive all of its control information through the fieldbus interface, or the control can be distributed between the embedded fieldbus interface and other available sources, for example, digital and analog inputs.



Connecting the fieldbus to the drive

Connect the fieldbus to terminal XD2D on the control unit of the drive. See the appropriate *Hardware Manual* for more information on the connection, chaining and termination of the link.

Note: If the XD2D connector is reserved by the embedded fieldbus interface (parameter *58.01 Protocol enable* is set to *Modbus RTU*), the drive-to-drive link functionality is automatically disabled.

Setting up the embedded fieldbus interface

Set the drive up for the embedded fieldbus communication with the parameters shown in the table below. The **Setting for fieldbus control** column gives either the value to use or the default value. The **Function/Information column** gives a description of the parameter.

Parameter	Setting for fieldbus control	Function/Information
COMMUNICATION INITIALIZATION		
58.01 Protocol enable	*Modbus RTU*	Initializes embedded fieldbus communication. Drive-to-drive link operation is automatically disabled.
EMBEDDED MODBUS CONFIGURATION		
58.03 Node address	1 (default)	Node address. There must be no two nodes with the same node address online.
58.04 Baud rate	*19.2 kbps* (default)	Defines the communication speed of the link. Use the same setting as in the master station.
58.05 Parity	*8 EVEN 1* (default)	Selects the parity and stop bit setting. Use the same setting as in the master station.
58.14 Communication loss action	*Fault* (default)	Defines the action taken when a communication loss is detected.
58.15 Communication loss mode	*Cw / Ref1 / Ref2* (default)	Enables/disables communication loss monitoring and defines the means for resetting the counter of the communication loss delay.
58.16 Communication loss time	3.0 s (default)	Defines the timeout limit for the communication monitoring.
58.17 Transmit delay	0 ms (default)	Defines a response delay for the drive.
58.25 Control profile	*ABB Drives* (default), *Transparent*	Selects the control profile used by the drive. See section *Basics of the embedded fieldbus interface* (page *684*).
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*	Defines the source of status word when *58.25 Control profile* = *Transparent*.
58.31 EFB act1 transparent source	*Other*	Defines the source of actual value 1 when *58.28 EFB act1 type* = *Transparent* or *General*.
58.32 EFB act2 transparent source	*Other*	Defines the source of actual value 2 when *58.29 EFB act2 type* = *Transparent* or *General*.

Parameter	Setting for fieldbus control	Function/Information
58.33 Addressing mode	eg. *Mode 0* (default)	Defines the mapping between parameters and holding registers in the 400001…465536 (100…65535) Modbus register range.
58.34 Word order	*LO-HI* (default)	Defines the order of the data words in the Modbus message frame.
58.101 Data I/O 1 … *58.124 Data I/O 24*	For example, the default settings (I/Os 1…6 contain the control word, the status word, two references and two actual values)	Define the address of the drive parameter which the Modbus master accesses when it reads from or writes to the register address corresponding to Modbus In/Out parameters. Select the parameters that you want to read or write through the Modbus I/O words.
	RO/DIO control word, *AO1 data storage*, *AO2 data storage*	These settings write the incoming data into storage parameters *10.99 RO/DIO control word*, *13.91 AO1 data storage*, *13.92 AO2 data storage*.
58.06 Communication control	*Refresh settings*	Validates the settings of the configuration parameters.

The new settings will take effect when the drive is powered up the next time, or when they are validated by parameter *58.06 Communication control*.

Setting the drive control parameters

After the embedded fieldbus interface has been set up, check and adjust the drive control parameters listed in the table below. The **Setting for fieldbus control** column gives the value or values to use when the embedded fieldbus signal is the desired source or destination for that particular drive control signal. The **Function/Information** column gives a description of the parameter.

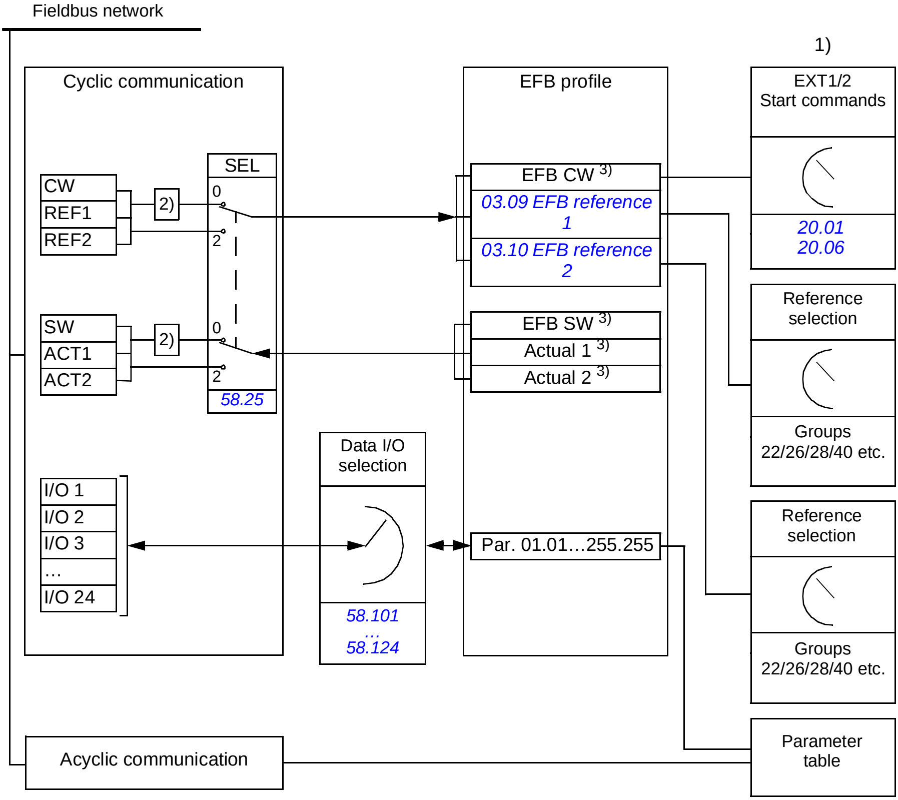
Parameter	Setting for fieldbus control	Function/Information
CONTROL COMMAND SOURCE SELECTION		
20.01 Ext1 commands	*Embedded fieldbus*	Selects fieldbus as the source for the start and stop commands when EXT1 is selected as the active control location.
20.02 Ext2 commands	*Embedded fieldbus*	Selects fieldbus as the source for the start and stop commands when EXT2 is selected as the active control location.
SPEED REFERENCE SELECTION		
22.11 Speed ref1 source	*EFB ref1* or *EFB ref2*	Selects a reference received through the embedded fieldbus interface as speed reference 1.

Parameter	Setting for fieldbus control	Function/Information
22.12 Speed ref2 source	*EFB ref1* or *EFB ref2*	Selects a reference received through the embedded fieldbus interface as speed reference 2.
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*, then either *03.09 EFB reference 1* or *03.10 EFB reference 2*.		
CONTROL OF RELAY OUTPUTS, ANALOG OUTPUTS AND DIGITAL INPUT/OUTPUTS		
10.24 RO1 source	*RO/DIO control word bit0*	Connects bit 0 of storage parameter *10.99 RO/DIO control word* to relay output RO1.
10.27 RO2 source	*RO/DIO control word bit1*	Connects bit 1 of storage parameter *10.99 RO/DIO control word* to relay output RO2.
10.30 RO3 source	*RO/DIO control word bit2*	Connects bit 2 of storage parameter *10.99 RO/DIO control word* to relay output RO3.
11.05 DIO1 function *11.09 DIO2 function*	*Output* (default)	Sets the digital input/output to output mode.
11.06 DIO1 output source	*RO/DIO control word bit8*	Connects bit 8 of storage parameter *10.99 RO/DIO control word* to digital input/output DIO1.
11.10 DIO2 output source	*RO/DIO control word bit9*	Connects bit 9 of storage parameter *10.99 RO/DIO control word* to digital input/output DIO2.
13.12 AO1 source	*AO1 data storage*	Connects storage parameter *13.91 AO1 data storage* to analog output AO1.
13.22 AO2 source	*AO2 data storage*	Connects storage parameter *13.92 AO2 data storage* to analog output AO2.
SYSTEM CONTROL INPUTS		
96.07 Parameter save manually	*Save* (reverts to *Done*)	Saves parameter value changes (including those made through fieldbus control) to permanent memory.

Basics of the embedded fieldbus interface

The cyclic communication between a fieldbus system and the drive consists of 16-bit data words or 32-bit data words (with the transparent control profiles).

The diagram below illustrates the operation of the embedded fieldbus interface. The signals transferred in the cyclic communication are explained further below the diagram.



1. See also other parameters which can be controlled through fieldbus.
2. Data conversion if parameter *58.25 Control profile* is set to *ABB Drives*. See section *About the control profiles* (page *687*).
3. If parameter *58.25 Control profile* is set to *Transparent*,
- the sources of the status word and actual values are selected by parameters *58.30*…*58.32* (otherwise, actual values 1 and 2 are automatically selected according to reference type), and
- the control word is displayed by *06.05 EFB transparent control word*.

Control word and Status word

The Control Word (CW) is a 16-bit or 32-bit packed boolean word. It is the principal means of controlling the drive from a fieldbus system. The CW is sent by the fieldbus controller to the drive. By drive parameters, the user selects the EFB CW as the source of drive control commands (such as start/stop, emergency stop, selection between external control locations 1/2, or fault reset). The drive switches between its states according to the bit-coded instructions of the CW.

The fieldbus CW is either written to the drive as it is (see parameter *06.05 EFB transparent control word*), or the data is converted. See section *About the control profiles* (page *687*).

The fieldbus Status Word (SW) is a 16-bit or 32-bit packed boolean word. It contains status information from the drive to the fieldbus controller. The drive SW is either written to the fieldbus SW as it is or the data is converted. See section *About the control profiles* (page *687*).

References

EFB references 1 and 2 are 16-bit or 32-bit signed integers. The contents of each reference word can be used as the source of virtually any signal, such as the speed, frequency, torque or process reference. In embedded fieldbus communication, references 1 and 2 are displayed by *03.09 EFB reference 1* and *03.10 EFB reference 2* respectively. Whether the references are scaled or not depends on the settings of *58.26 EFB ref1 type* and *58.27 EFB ref2 type*. See section *About the control profiles* (page *687*).

Actual values

Fieldbus actual signals (ACT1 and ACT2) are 16-bit or 32-bit signed integers. They convey selected drive parameter values from the drive to the master. Whether the actual values are scaled or not depends on the settings of *58.28 EFB act1 type* and *58.29 EFB act2 type*. See section *About the control profiles* (page *687*).

Data input/outputs

Data input/outputs are 16-bit or 32-bit words containing selected drive parameter values. Parameters *58.101 Data I/O 1* … *58.124 Data I/O 24* define the addresses from which the master either reads data (input) or to which it writes data (output).

Control of drive outputs through EFB

The address selection parameters of the data input/outputs have a setting with which the data can be written into a storage parameter in the drive. These storage parameters are readily selectable as signal sources of the drive outputs.

The desired values of the relay outputs (RO) and digital input/outputs (DIO) can be written in a 16-bit word into *10.99 RO/DIO control word*, which is then selected as the source of those outputs. Each of the analog outputs (AO) of the drive have a dedicated storage parameter (*13.91 AO1 data storage* and *13.92 AO2 data storage*), which are available in the source selection parameters *13.12 AO1 source* and *13.22 AO2 source*.

Register addressing

The address field of Modbus requests for accessing holding registers is 16 bits. This allows the Modbus protocol to support addressing of 65536 holding registers.

Historically, Modbus master devices used 5-digit decimal addresses from 40001 to 49999 to represent holding register addresses. The 5-digit decimal addressing limited to 9999 the number of holding registers that could be addressed.

Modern Modbus master devices typically provide a means to access the full range of 65536 Modbus holding registers. One of these methods is to use 6-digit decimal addresses from 400001 to 465536. This manual uses 6-digit decimal addressing to represent Modbus holding register addresses.

Modbus master devices that are limited to the 5-digit decimal addressing may still access registers 400001 to 409999 by using 5-digit decimal addresses 40001 to 49999. Registers 410000 to 465536 are inaccessible to these masters.

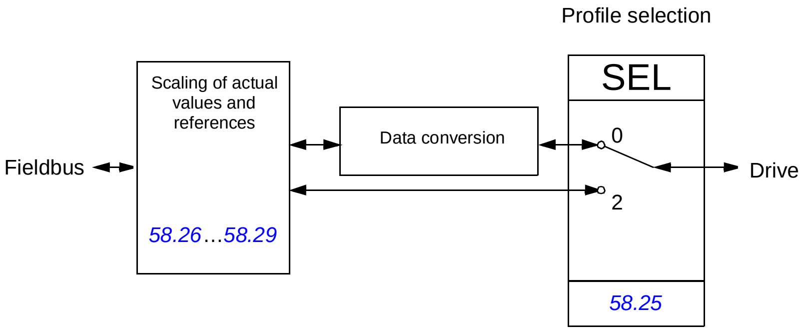
Note: Register addresses of 32-bit parameters cannot be accessed by using 5-digit register numbers.

About the control profiles

A control profile defines the rules for data transfer between the drive and the fieldbus master, for example:

- if packed boolean words are converted and how
- how drive register addresses are mapped for the fieldbus master.

You can configure the drive to receive and send messages according to the ABB Drives profile or the Transparent profile. With the ABB Drives profile, the embedded fieldbus interface of the drive converts the control word and status word to and from the native data used in the drive. The Transparent profile involves no data conversion. The figure below illustrates the effect of the profile selection.



Control profile selection with parameter *58.25 Control profile*:
- (0) *ABB Drives*
- (2) *Transparent*

Note that scaling of references and actual values can be selected independent of the profile selection by parameters *58.26*…*58.29*.

The ABB Drives profile

Control Word

The table below shows the contents of the fieldbus Control Word for the ABB Drives control profile. The embedded fieldbus interface converts this word to the form in which it is used in the drive. The upper case boldface text refers to the states shown in *State transition diagram* on page *691*.

Bit	Name	Value	STATE/Description
0	OFF1_ CONTROL	1	Proceed to READY TO OPERATE.
		0	Stop along currently active deceleration ramp. Proceed to **OFF1 ACTIVE**; proceed to **READY TO SWITCH ON** unless other interlocks (OFF2, OFF3) are active.
1	OFF2_ CONTROL	1	Continue operation (OFF2 inactive).
		0	Emergency OFF, coast to stop. Proceed to **OFF2 ACTIVE**, proceed to **SWITCH-ON INHIBITED**.
2	OFF3_ CONTROL	1	Continue operation (OFF3 inactive).
		0	Emergency stop, stop within time defined by drive parameter. Proceed to OFF3 ACTIVE; proceed to SWITCH-ON INHIBITED. Warning: Ensure that the motor and driven machine can be stopped using this stop mode.
3	INHIBIT_ OPERATION	1	Proceed to **OPERATION ENABLED**. **Note:** Run enable signal must be active; see the drive documentation. If the drive is set to receive the Run enable signal from the fieldbus, this bit activates the signal.
		0	Inhibit operation. Proceed to **OPERATION INHIBITED**.
4	RAMP_OUT_ ZERO	1	Normal operation. Proceed to **RAMP FUNCTION GENERATOR: OUTPUT ENABLED**.
		0	Force Ramp Function Generator output to zero. Drive ramps to stop (current and DC voltage limits in force).
5	RAMP_HOLD	1	Enable ramp function. Proceed to **RAMP FUNCTION GENERATOR: ACCELERATOR ENABLED**.
		0	Halt ramping (Ramp Function Generator output held).
6	RAMP_IN_ ZERO	1	Normal operation. Proceed to **OPERATING**. **Note:** This bit is effective only if the fieldbus interface is set as the source for this signal by drive parameters.
		0	Force Ramp Function Generator input to zero.
7	RESET	0=>1	Fault reset if an active fault exists. Proceed to **SWITCH-ON INHIBITED**. **Note:** This bit is effective only if the fieldbus interface is set as the source for this signal by drive parameters.
		0	Continue normal operation.

Bit	Name	Value	STATE/Description
8	JOGGING_1	1	Accelerate to jogging 1 reference. **Notes:** • Bits 4…6 must be 0. • See also section *Jogging* (page *153*).
		0	Jogging 1 disabled.
9	JOGGING_2	1	Accelerate to jogging 2 reference. See notes at bit 8.
		0	Jogging 2 disabled.
10	REMOTE_ CMD	1	Fieldbus control enabled.
		0	Control word and reference will not get through to the drive, except for CW bits OFF1, OFF2 and OFF3.
11	EXT_CTRL_ LOC	1	Select External Control Location EXT2. Effective if the control location is parameterized to be selected from the fieldbus.
		0	Select External Control Location EXT1. Effective if the control location is parameterized to be selected from the fieldbus.
12…15	Reserved		

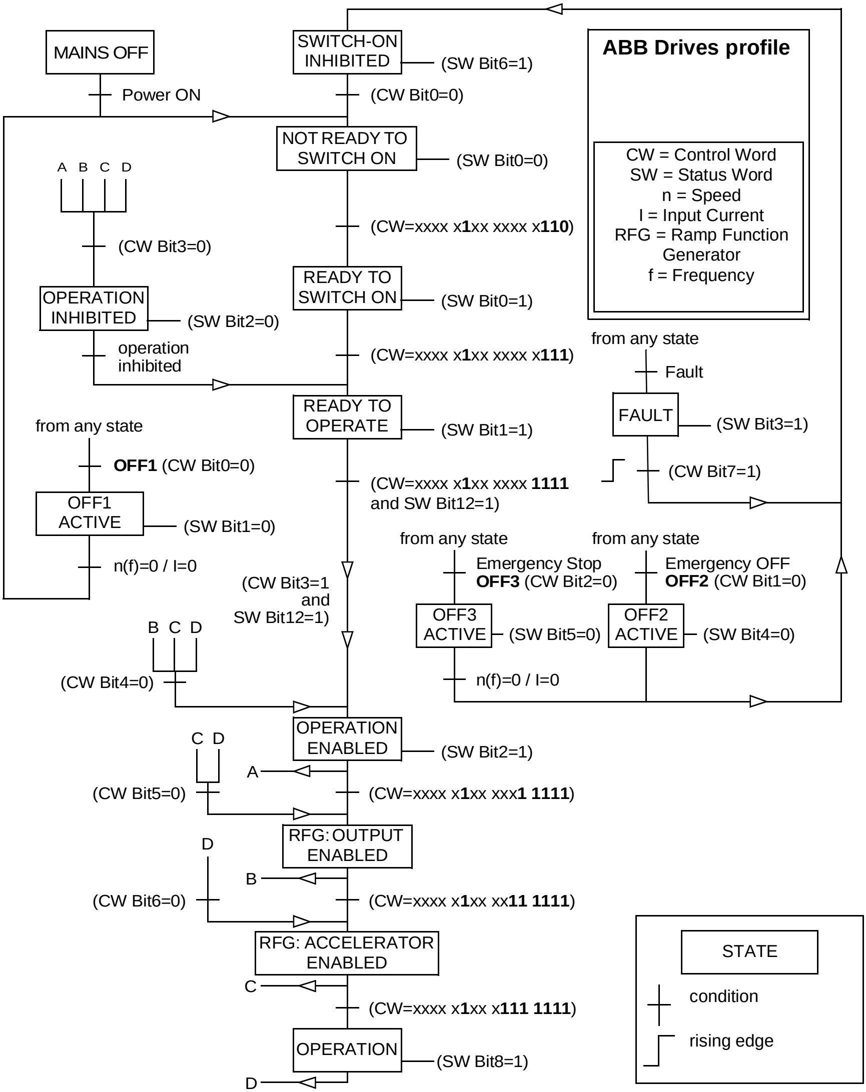
Status Word

The table below shows the fieldbus Status Word for the ABB Drives control profile. The embedded fieldbus interface converts the drive Status Word into this form for the fieldbus. The upper case boldface text refers to the states shown in *State transition diagram* on page *691*.

Bit	Name	Value	STATE/Description
0	RDY_ON	1	READY TO SWITCH ON.
		0	NOT READY TO SWITCH ON.
1	RDY_RUN	1	READY TO OPERATE.
		0	OFF1 ACTIVE.
2	RDY_REF	1	OPERATION ENABLED.
		0	OPERATION INHIBITED.
3	TRIPPED	1	FAULT.
		0	No fault.
4	OFF_2_STA	1	OFF2 inactive.
		0	OFF2 ACTIVE.
5	OFF_3_STA	1	OFF3 inactive.
		0	OFF3 ACTIVE.
6	SWC_ON_ INHIB	1	SWITCH-ON INHIBITED.
		0	–
7	ALARM	1	Warning/Alarm.
		0	No warning/alarm.
8	AT_ SETPOINT	1	OPERATING. Actual value equals Reference = is within tolerance limits, i.e. in speed control, speed error is 10% max. of nominal motor speed.
		0	Actual value differs from Reference = is outside tolerance limits.
9	REMOTE	1	Drive control location: REMOTE (EXT1 or EXT2).
		0	Drive control location: LOCAL.
10	ABOVE_ LIMIT	1	Actual frequency or speed equals or exceeds supervision limit (set by drive parameter). Valid in both directions of rotation.
		0	Actual frequency or speed within supervision limit.
11	USER_0		S
12	EXT_RUN_ ENABLE	1	External Run enable signal received.
		0	No external Run enable signal received.
13…15	Reserved		

State transition diagram

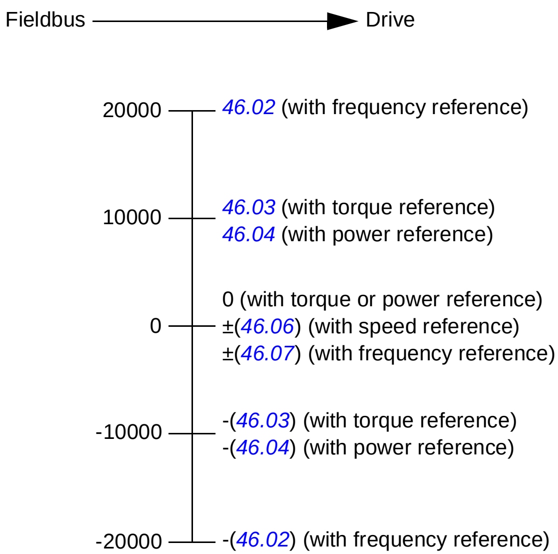
The diagram below shows the state transitions in the drive when the drive is using the ABB Drives profile, and configured to follow the commands of the control word from the embedded fieldbus interface. The upper case texts refer to the states which are used in the tables representing the fieldbus Control and Status words. See sections *Control Word* on page *688* and *Status Word* on page *690*.



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 *46.02…46.07*; which scaling is in use depends on the setting of *58.26 EFB ref1 type* and *58.27 EFB ref2 type* (see page *425*).

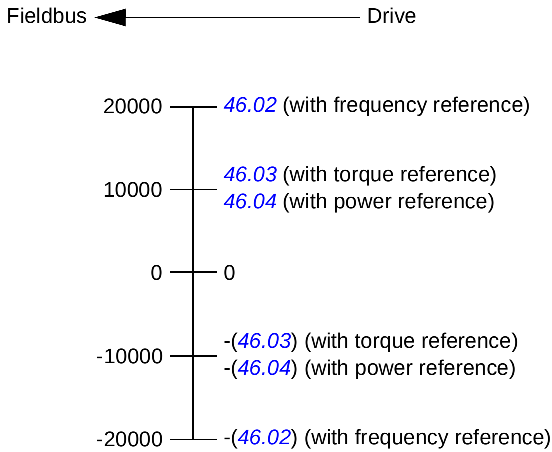


The scaled references are shown by parameters *03.09 EFB reference 1* and *03.10 EFB reference 2*.

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 *46.02…46.04*; which scaling is in use depends on the setting of parameters *58.28 EFB act1 type* and *58.29 EFB act2 type* (see page *425*).



Modbus holding register addresses

The table below shows the default Modbus holding register addresses for drive data. This profile provides a converted 16-bit access to the data.

Register address	**Register data (16-bit words)**
400001	Control word. See section *Control Word* (page *688*). The selection can be changed using parameter *58.101 Data I/O 1*.
400002	Reference 1 (REF1). The selection can be changed using parameter *58.102 Data I/O 2*.
400003	Reference 2 (REF2). The selection can be changed using parameter *58.103 Data I/O 3*.
400004	Status Word (SW). See section *Status Word* (page *690*). The selection can be changed using parameter *58.104 Data I/O 4*.
400005	Actual value 1 (ACT1). The selection can be changed using parameter *58.105 Data I/O 5*.
400006	Actual value 2 (ACT2). The selection can be changed using parameter *58.106 Data I/O 6*.
400007…400024	Data in/out 7…24. Selected by parameters *58.107 Data I/O 7* … *58.124 Data I/O 24*.
400025...400089	Unused
400090...400100	Error code access. See section *Error code registers (holding registers 400090…400100)* (page *701*).
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 *694*).

Modbus function codes

The table below shows the Modbus function codes supported by the embedded fieldbus interface.

Code	Function name	Description
01h	Read Coils	Reads the 0/1 status of coils (0X references).
02h	Read Discrete Inputs	Reads the 0/1 status of discrete inputs (1X references).
03h	Read Holding Registers	Reads the binary contents of holding registers (4X references).
05h	Write Single Coil	Forces a single coil (0X reference) to 0 or 1.
06h	Write Single Register	Writes a single holding register (4X reference).
08h	Diagnostics	Provides a series of tests for checking the communication, or for checking various internal error conditions. Supported subcodes: • 00h Return Query Data: Echo/loopback test. • 01h Restart Comm Option: Restarts and initializes the EFB, clears communications event counters. • 04h Force Listen Only Mode • 0Ah Clear Counters and Diagnostic Register • 0Bh Return Bus Message Count • 0Ch Return Bus Comm. Error Count • 0Dh Return Bus Exception Error Count • 0Eh Return Slave Message Count • 0Fh Return Slave No Response Count • 10h Return Slave NAK (negative acknowledge) Count • 11h Return Slave Busy Count • 12h Return Bus Character Overrun Count • 14h Clear Overrun Counter and Flag
0Bh	Get Comm Event Counter	Returns a status word and an event count.
0Fh	Write Multiple Coils	Forces a sequence of coils (0X references) to 0 or 1.
10h	Write Multiple Registers	Writes the contents of a contiguous block of holding registers (4X references).
16h	Mask Write Register	Modifies the contents of a 4X register using a combination of an AND mask, an OR mask, and the register's current contents.
17h	Read/Write Multiple Registers	Writes the contents of a contiguous block of 4X registers, then reads the contents of another group of registers (the same or different than those written) in a server device.

Code	Function name	Description
2Bh / 0Eh	Encapsulated Interface Transport	Supported subcodes: • 0Eh Read Device Identification: Allows reading the identification and other information. Supported ID codes (access type): • 00h: Request to get the basic device identification (stream access) • 04h: Request to get one specific identification object (individual access) Supported Object IDs: • 00h: Vendor Name (“ABB”) • 01h: Product Code (for example, “AINFX”) • 02h: Major Minor Revision (combination of contents of parameters *07.05 Firmware version* and *58.02 Protocol ID*). • 03h: Vendor URL (“www.abb.com”) • 04h: Product name (for example, “ACS880”)

Exception codes

The table below shows the Modbus exception codes supported by the embedded fieldbus interface.

Code	Name	Description
01h	ILLEGAL FUNCTION	The function code received in the query is not an allowable action for the server.
02h	ILLEGAL DATA ADDRESS	The data address received in the query is not an allowable address for the server.
03h	ILLEGAL DATA VALUE	The requested Quantity of Registers is larger than the drive can handle. **Note:** This error does not mean that a value written to a drive parameter is outside the valid range.
04h	SLAVE DEVICE FAILURE	The value written to a drive parameter is outside the valid range. See section *Error code registers (holding registers 400090…400100)* on page *701*.
06h	SLAVE DEVICE BUSY	The server is engaged in processing a long-duration program command.

Coils (0xxxx reference set)

Coils are 1-bit read/write values. Control Word bits are exposed with this data type. The table below summarizes the Modbus coils (0xxxx reference set).

Reference	ABB drives profile	Transparent profile
00001	OFF1_CONTROL	Control Word bit 0
00002	OFF2_CONTROL	Control Word bit 1
00003	OFF3_CONTROL	Control Word bit 2
00004	INHIBIT_OPERATION	Control Word bit 3
00005	RAMP_OUT_ZERO	Control Word bit 4
00006	RAMP_HOLD	Control Word bit 5
00007	RAMP_IN_ZERO	Control Word bit 6
00008	RESET	Control Word bit 7
00009	JOGGING_1	Control Word bit 8
00010	JOGGING_2	Control Word bit 9
00011	REMOTE_CMD	Control Word bit 10
00012	EXT_CTRL_LOC	Control Word bit 11
00013	User-defined (0)	Control Word bit 12
00014	User-defined (1)	Control Word bit 13
00015	User-defined (2)	Control Word bit 14
00016	User-defined (3)	Control Word bit 15
00017	Reserved	Control Word bit 16
00018	Reserved	Control Word bit 17
00019	Reserved	Control Word bit 18
00020	Reserved	Control Word bit 19
00021	Reserved	Control Word bit 20
00022	Reserved	Control Word bit 21
00023	Reserved	Control Word bit 22
00024	Reserved	Control Word bit 23
00025	Reserved	Control Word bit 24
00026	Reserved	Control Word bit 25
00027	Reserved	Control Word bit 26
00028	Reserved	Control Word bit 27
00029	Reserved	Control Word bit 28
00030	Reserved	Control Word bit 29
00031	Reserved	Control Word bit 30
00032	Reserved	Control Word bit 31
00033	Reserved	*10.99 RO/DIO control word*, bit 0
00034	Reserved	*10.99 RO/DIO control word*, bit 1

Reference	ABB drives profile	Transparent profile
00035	Reserved	*10.99 RO/DIO control word*, bit 2
00036	Reserved	*10.99 RO/DIO control word*, bit 3
00037	Reserved	*10.99 RO/DIO control word*, bit 4
00038	Reserved	*10.99 RO/DIO control word*, bit 5
00039	Reserved	*10.99 RO/DIO control word*, bit 6
00040	Reserved	*10.99 RO/DIO control word*, bit 7
00041	Reserved	*10.99 RO/DIO control word*, bit 8
00042	Reserved	*10.99 RO/DIO control word*, bit 9

Discrete inputs (1xxxx reference set)

Discrete inputs are 1-bit read-only values. Status Word bits are exposed with this data type. The table below summarizes the Modbus discrete inputs (1xxxx reference set).

Reference	ABB drives profile	Transparent profile
10001	RDY_ON	Status Word bit 0
10002	RDY_RUN	Status Word bit 1
10003	RDY_REF	Status Word bit 2
10004	TRIPPED	Status Word bit 3
10005	OFF_2_STA	Status Word bit 4
10006	OFF_3_STA	Status Word bit 5
10007	SWC_ON_INHIB	Status Word bit 6
10008	ALARM	Status Word bit 7
10009	AT_SETPOINT	Status Word bit 8
10010	REMOTE	Status Word bit 9
10011	ABOVE_LIMIT	Status Word bit 10
10012	User-defined (0)	Status Word bit 11
10013	User-defined (1)	Status Word bit 12
10014	User-defined (2)	Status Word bit 13
10015	User-defined (3)	Status Word bit 14
10016	Reserved	Status Word bit 15
10017	Reserved	Status Word bit 16
10018	Reserved	Status Word bit 17
10019	Reserved	Status Word bit 18
10020	Reserved	Status Word bit 19
10021	Reserved	Status Word bit 20
10022	Reserved	Status Word bit 21
10023	Reserved	Status Word bit 22
10024	Reserved	Status Word bit 23

Reference	ABB drives profile	Transparent profile
10025	Reserved	Status Word bit 24
10026	Reserved	Status Word bit 25
10027	Reserved	Status Word bit 26
10028	Reserved	Status Word bit 27
10029	Reserved	Status Word bit 28
10030	Reserved	Status Word bit 29
10031	Reserved	Status Word bit 30
10032	Reserved	Status Word bit 31
10033	Reserved	*10.02 DI delayed status*, bit 0
10034	Reserved	*10.02 DI delayed status*, bit 1
10035	Reserved	*10.02 DI delayed status*, bit 2
10036	Reserved	*10.02 DI delayed status*, bit 3
10037	Reserved	*10.02 DI delayed status*, bit 4
10038	Reserved	*10.02 DI delayed status*, bit 5
10039	Reserved	*10.02 DI delayed status*, bit 6
10040	Reserved	*10.02 DI delayed status*, bit 7
10041	Reserved	*10.02 DI delayed status*, bit 8
10042	Reserved	*10.02 DI delayed status*, bit 9
10043	Reserved	*10.02 DI delayed status*, bit 10
10044	Reserved	*10.02 DI delayed status*, bit 11
10045	Reserved	*10.02 DI delayed status*, bit 12
10046	Reserved	*10.02 DI delayed status*, bit 13
10047	Reserved	*10.02 DI delayed status*, bit 14
10048	Reserved	*10.02 DI delayed status*, bit 15

Error code registers (holding registers 400090…400100)

These registers contain information about the last query. The error register is cleared when a query has finished successfully.

Reference	Name	Description
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.
95	Last Register Read Successfully	The last register that was read successfully.

11

Fieldbus control through a fieldbus adapter

What this chapter contains

This chapter describes how the drive can be controlled by external devices over a communication network (fieldbus) through an optional fieldbus adapter module.

The fieldbus control interface of the drive is described first, followed by a configuration example.

System overview

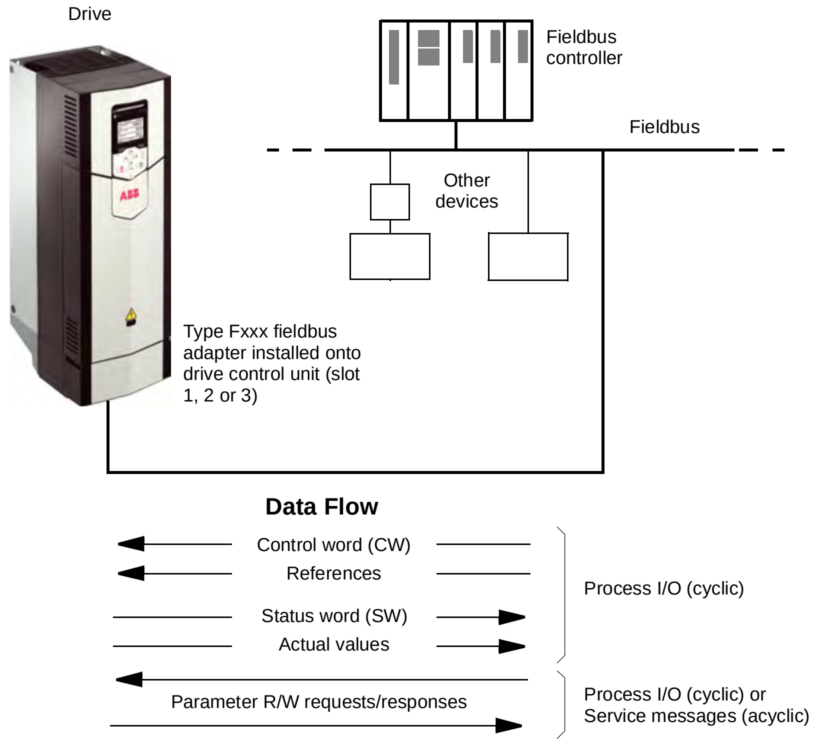
The drive can be connected to an external control system through an optional fieldbus adapter mounted onto the control unit of the drive. The drive actually has two independent interfaces for fieldbus connection, called “fieldbus adapter A” (FBA A) and “fieldbus adapter B” (FBA B). The drive can be configured to receive all of its control information through the fieldbus interface(s), or the control can be distributed between the fieldbus interface(s) and other available sources such as digital and analog inputs, depending on how control locations EXT1 and EXT2 are configured.

Note: The text and examples in this chapter describe the configuration of one fieldbus adapter (FBA A) by parameters *50.01*…*50.21* and parameter groups 51…53. The second adapter (FBA B), if present, is configured in a similar fashion by parameters *50.31*…*50.51* and parameter groups 54…56.It is recommended that the FBA B interface is only used for monitoring.

Fieldbus adapters are available for various communication systems and protocols, for example

- CANopen (FCAN-01 adapter)
- ControlNet (FCNA-01 adapter)
- DeviceNet (FDNA-01 adapter)
- EtherCAT® (FECA-01 adapter)
- EtherNet/IP™ (FENA-11 adapter or FENA-21 adapter)
- Modbus/RTU (FSCA-01 adapter)
- Modbus/TCP (FENA-11 or FENA-21 adapter)
- POWERLINK (FEPL-02 adapter)
- PROFIBUS DP (FPBA-01 adapter)
- PROFINET IO (FENA-11 or FENA-21 adapter).

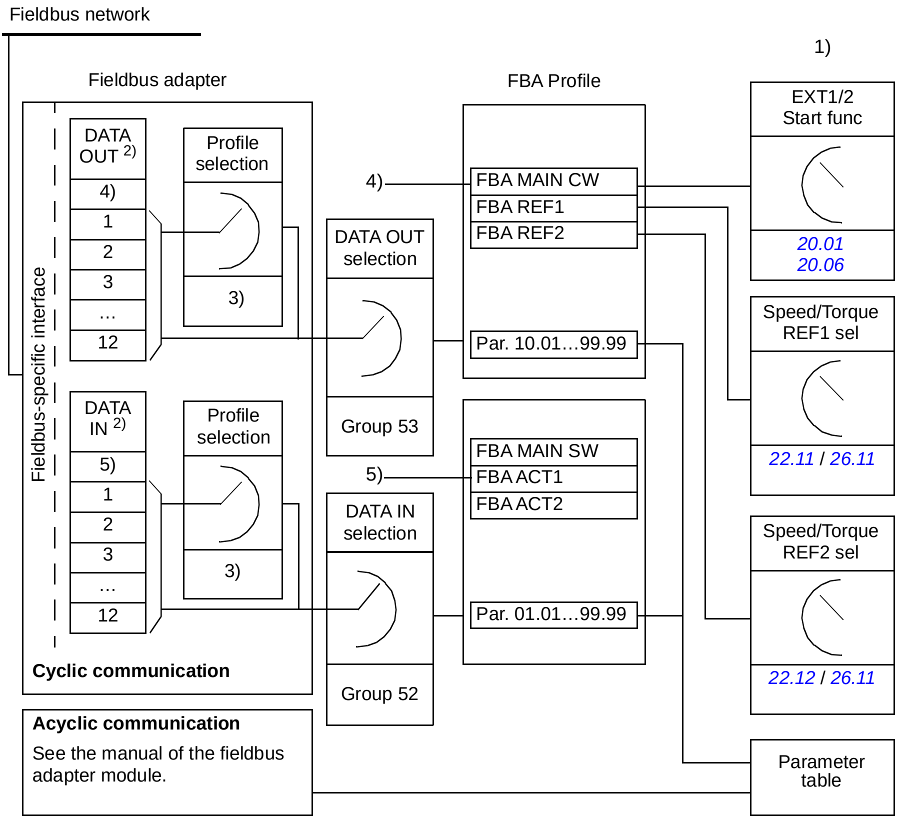
Note: Fieldbus adapters with the suffix “M” (eg. FPBA-01-M) are not supported.



Basics of the fieldbus control interface

The cyclic communication between a fieldbus system and the drive consists of 16- or 32-bit input and output data words. The drive is able to support a maximum of 12 data words (16 bits) in each direction.

Data transmitted from the drive to the fieldbus controller is defined by parameters *52.01 FBA A data in1* … *52.12 FBA A data in12*. The data transmitted from the fieldbus controller to the drive is defined by parameters *53.01 FBA A data out1* … *53.12 FBA A data out12*.



1) See also other parameters which can be controlled from fieldbus.
2) The maximum number of data words used is protocol-dependent.
3) Profile/instance selection parameters. Fieldbus module specific parameters. For more information, see the *User's Manual* of the appropriate fieldbus adapter module.
4) With DeviceNet, the control part is transmitted directly.
5) With DeviceNet, the actual value part is transmitted directly.

Control word and Status word

The Control word is the principal means for controlling the drive from a fieldbus system. It is sent by the fieldbus master station to the drive through the adapter module. The drive switches between its states according to the bit-coded instructions in the Control word, and returns status information to the master in the Status word.

For the ABB drives communication profile, the contents of the Control word and the Status word are detailed on pages *709* and *710* respectively. The drive states are presented in the state diagram (page *711*).

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*.

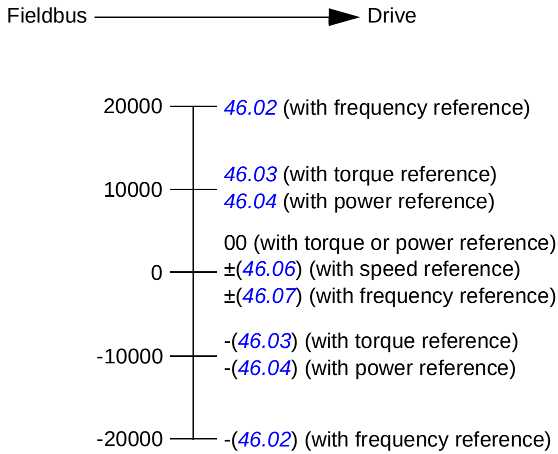
Debugging the network words

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 *46.02…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*.

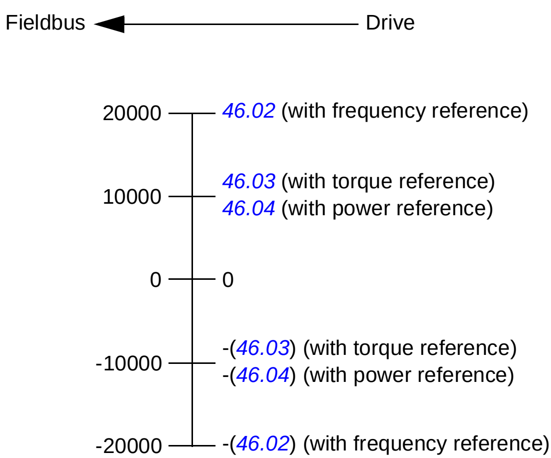
Debugging the network words

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 *46.02*…*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 *711*).

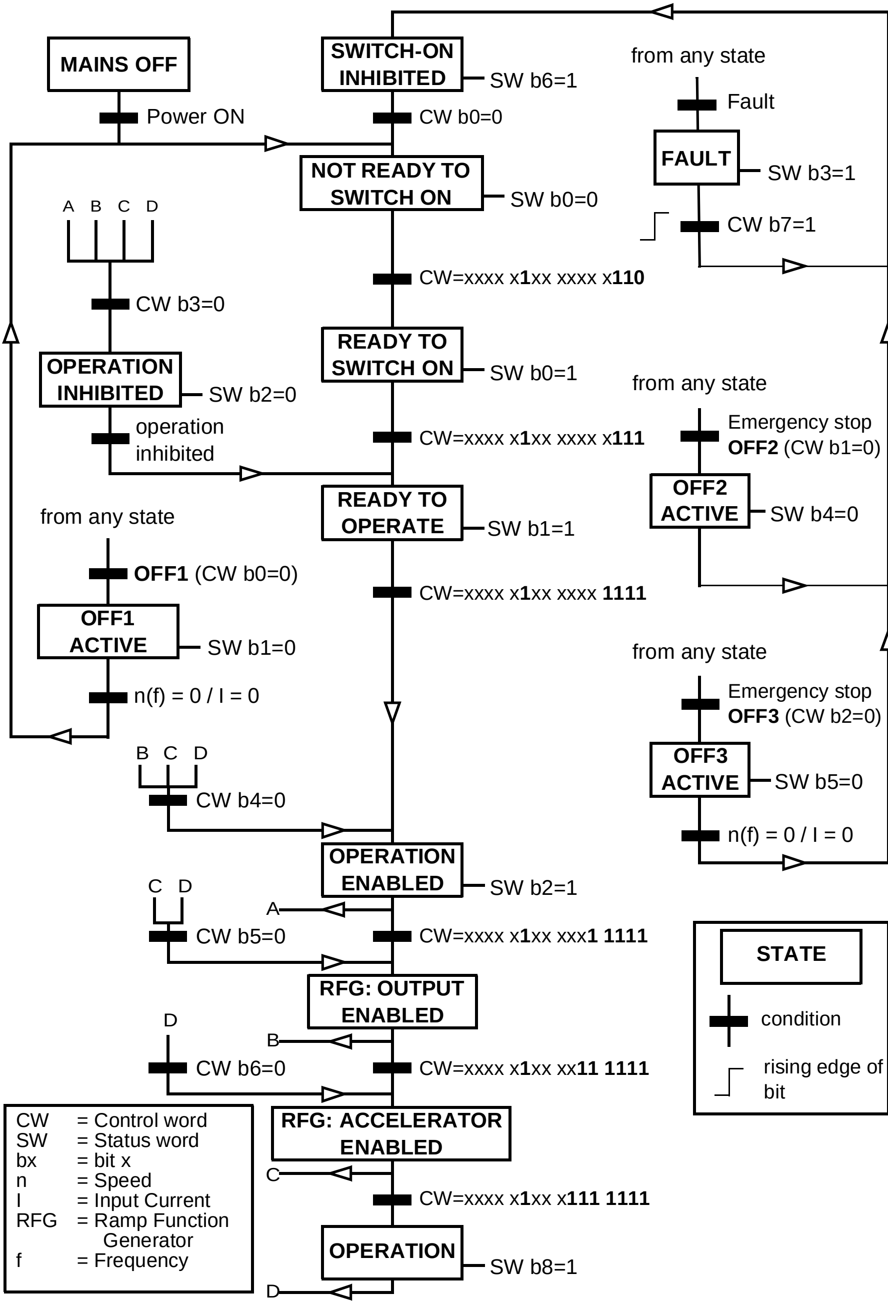
Bit	Name	Value	STATE/Description
0	Off1 control	1	Proceed to **READY TO OPERATE**.
		0	Stop along currently active deceleration ramp. Proceed to **OFF1 ACTIVE**; proceed to **READY TO SWITCH ON** unless other interlocks (OFF2, OFF3) are active.
1	Off2 control	1	Continue operation (OFF2 inactive).
		0	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).
6	Ramp in zero	1	Normal operation. Proceed to **OPERATING**. **Note:** This bit is effective only if the fieldbus interface is set as the source for this signal by drive parameters.
		0	Force Ramp function generator input to zero.
7	Reset	0=>1	Fault reset if an active fault exists. Proceed to **SWITCH-ON INHIBITED**. **Note:** This bit is effective only if the fieldbus interface is set as the source of the reset signal by drive parameters.
		0	Continue normal operation.
8	Inching 1	1	Accelerate to inching (jogging) setpoint 1. **Notes:** • Bits 4…6 must be 0. • See also section *Jogging* (page *153*).
		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 711).

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.

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
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

Drive parameter	Setting for ACS880 drives	Description
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 (stooped)
  - 47Fh (1151 decimal) ⟶ OPERATING (running)

12

Control chain diagrams

What this chapter contains

The chapter presents the reference chains of the drive and the winch control program. The control chain diagrams can be used to trace how parameters interact and where parameters have an effect within the drive parameter system.

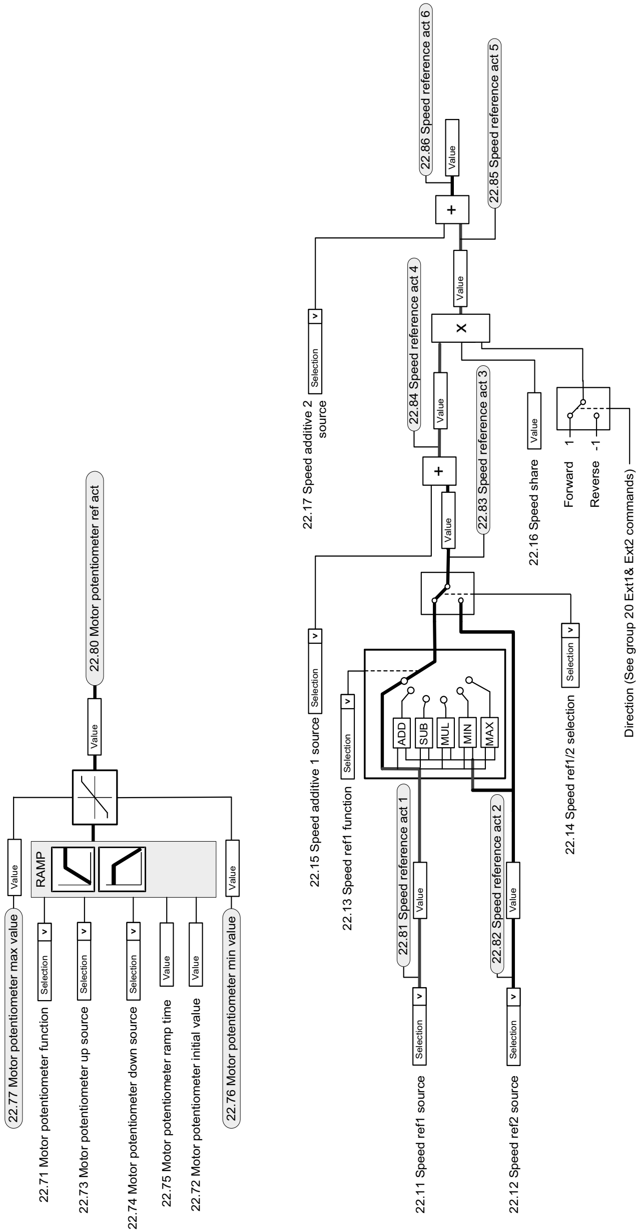
For a more general diagram, see section *Operating modes of the drive* (page *122*).

- *Drive control diagrams* (page *716*)
- *Winch control diagrams* (page *733*)

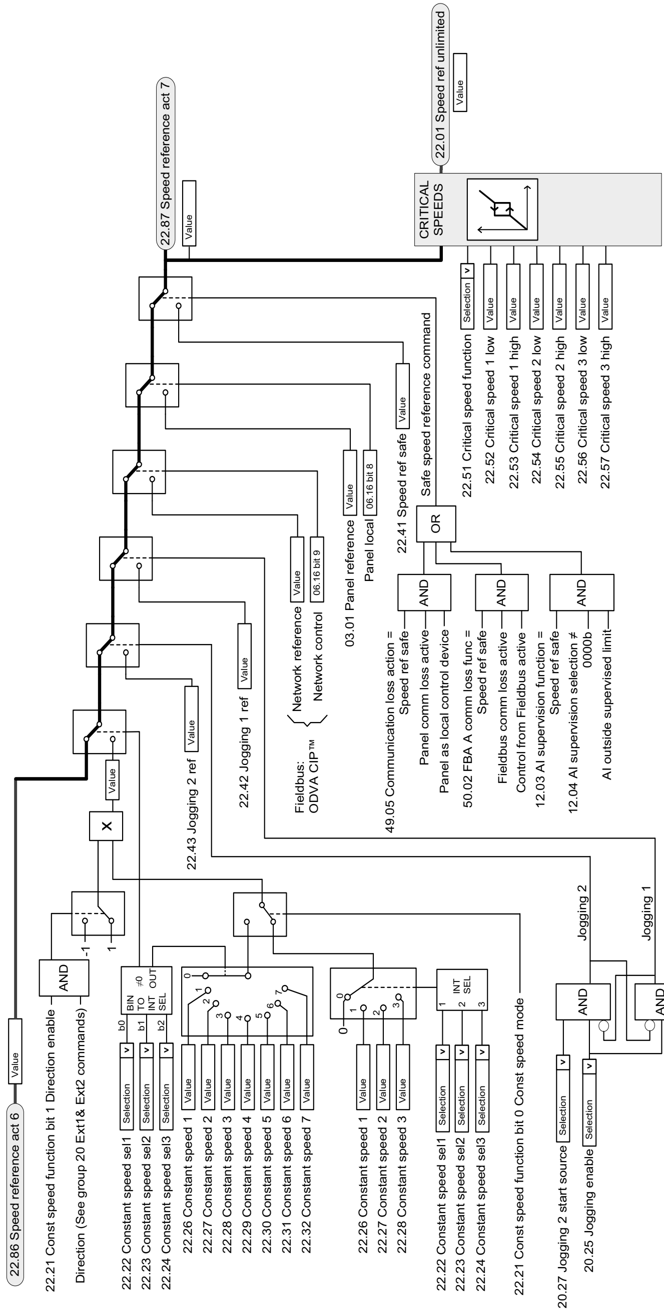
Note: Winch control diagrams are available through Drive Composer (pro) PC tool, when connected to a winch drive.

Drive control diagrams

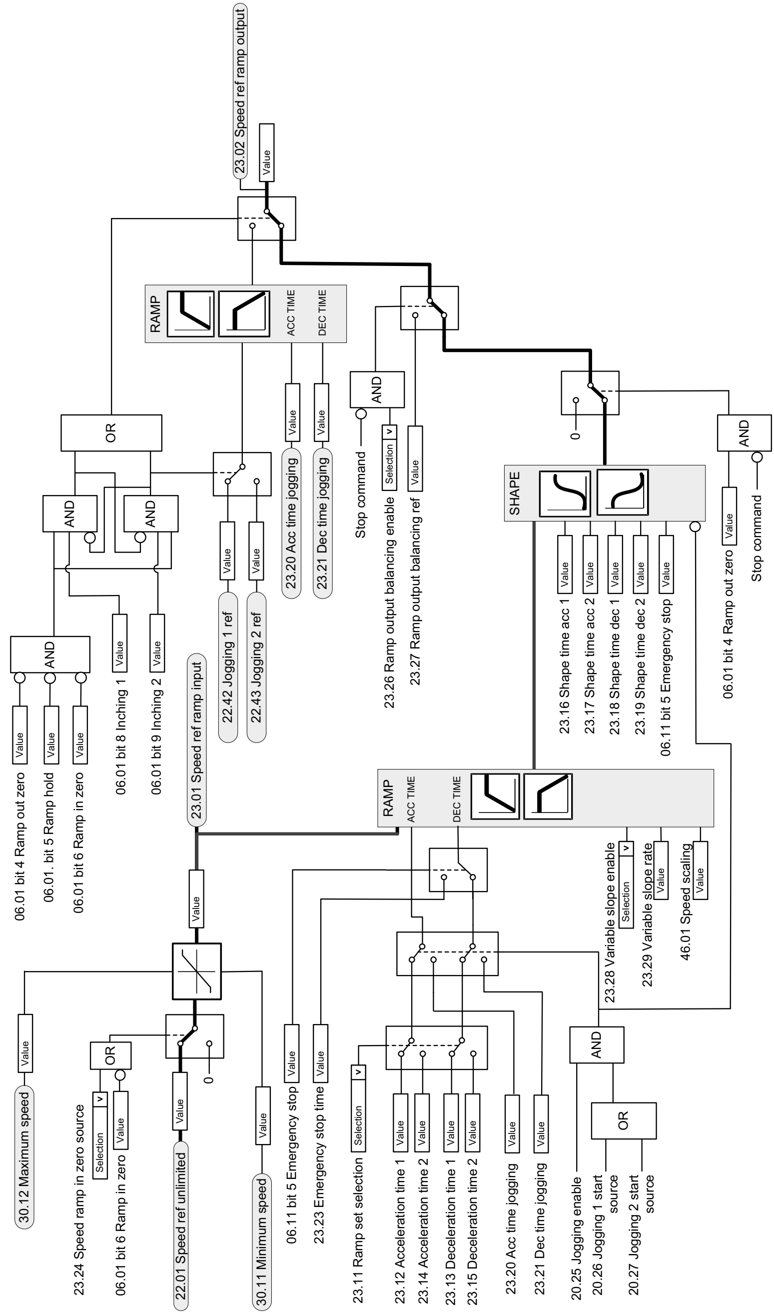
Speed reference source selection I



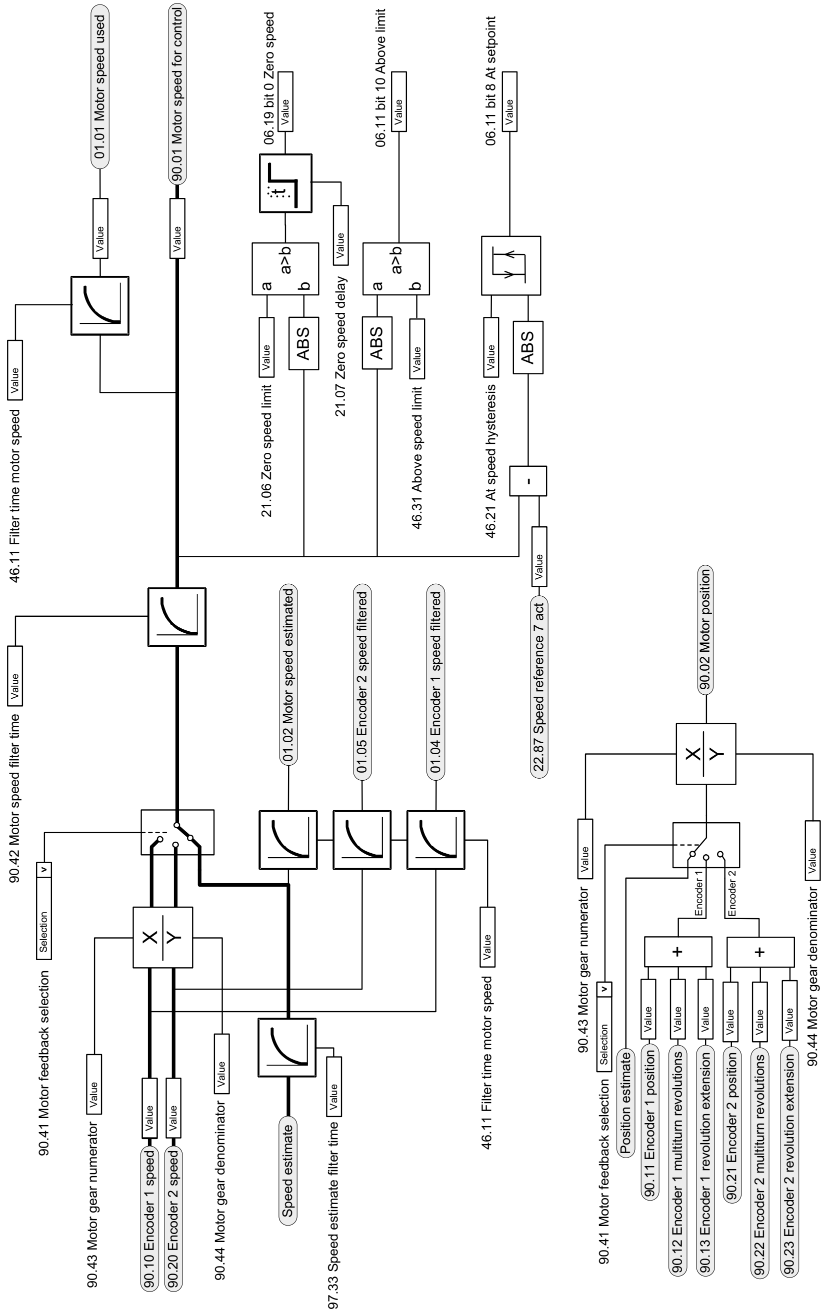
Speed reference source selection II



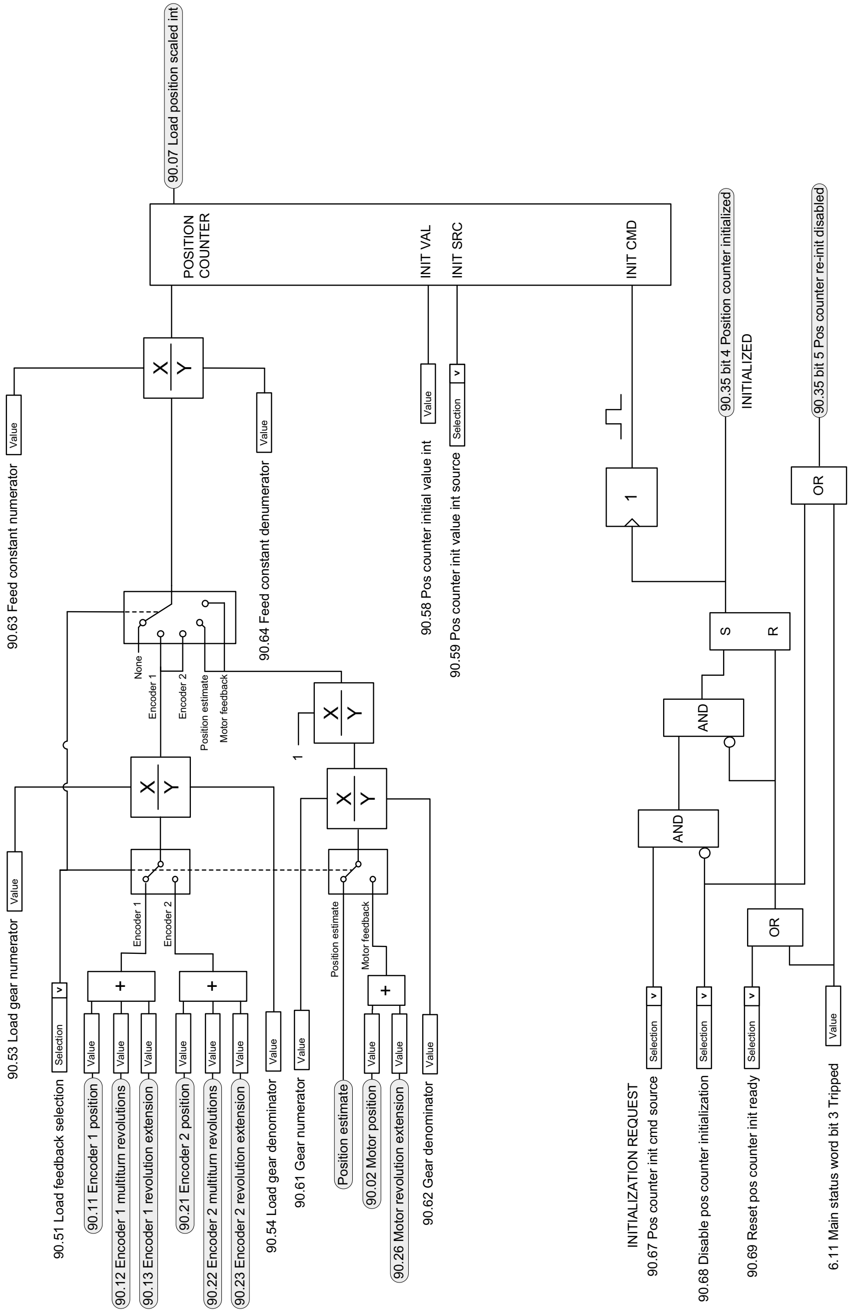
Speed reference ramping and shaping



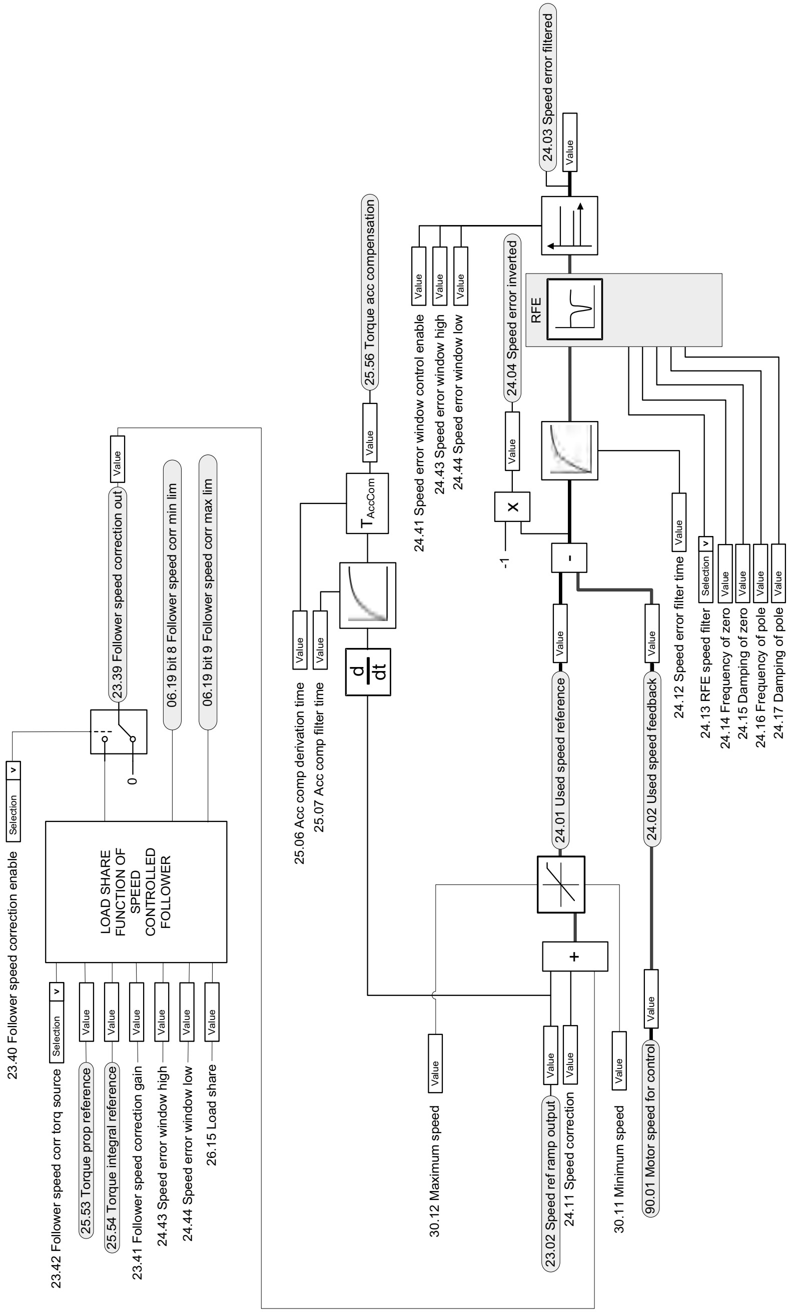
Motor feedback configuration



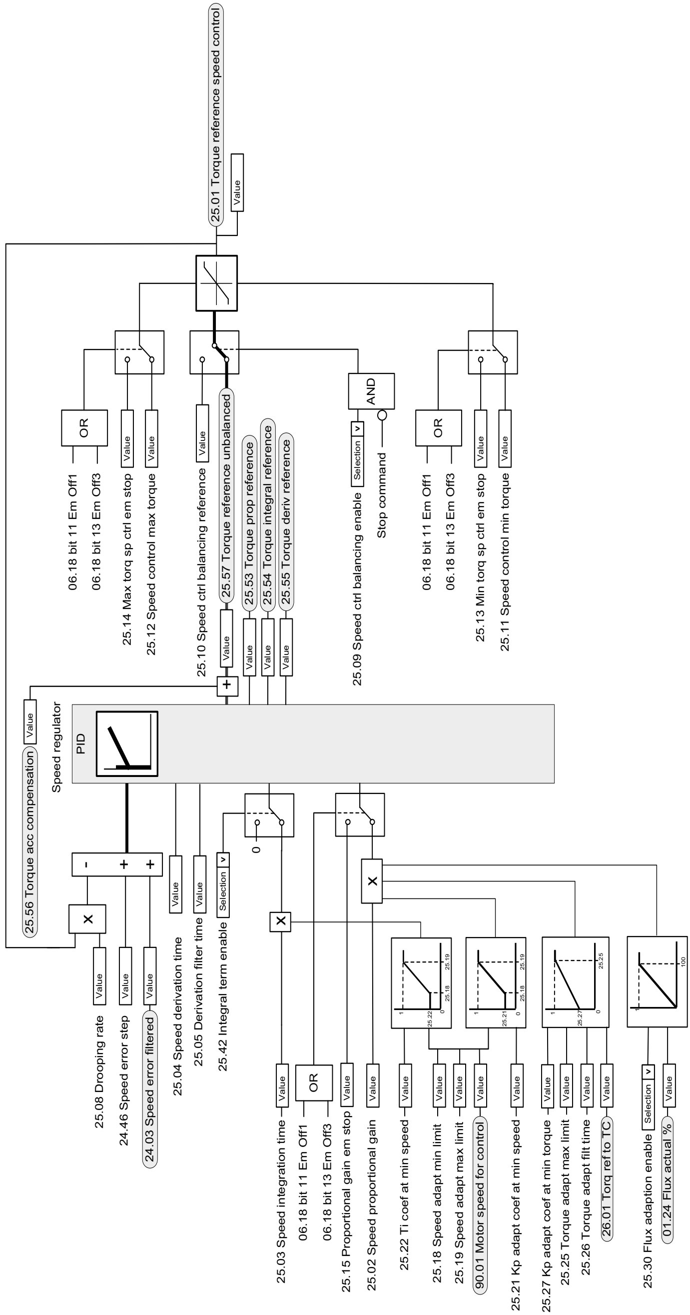
Load feedback and position counter configuration



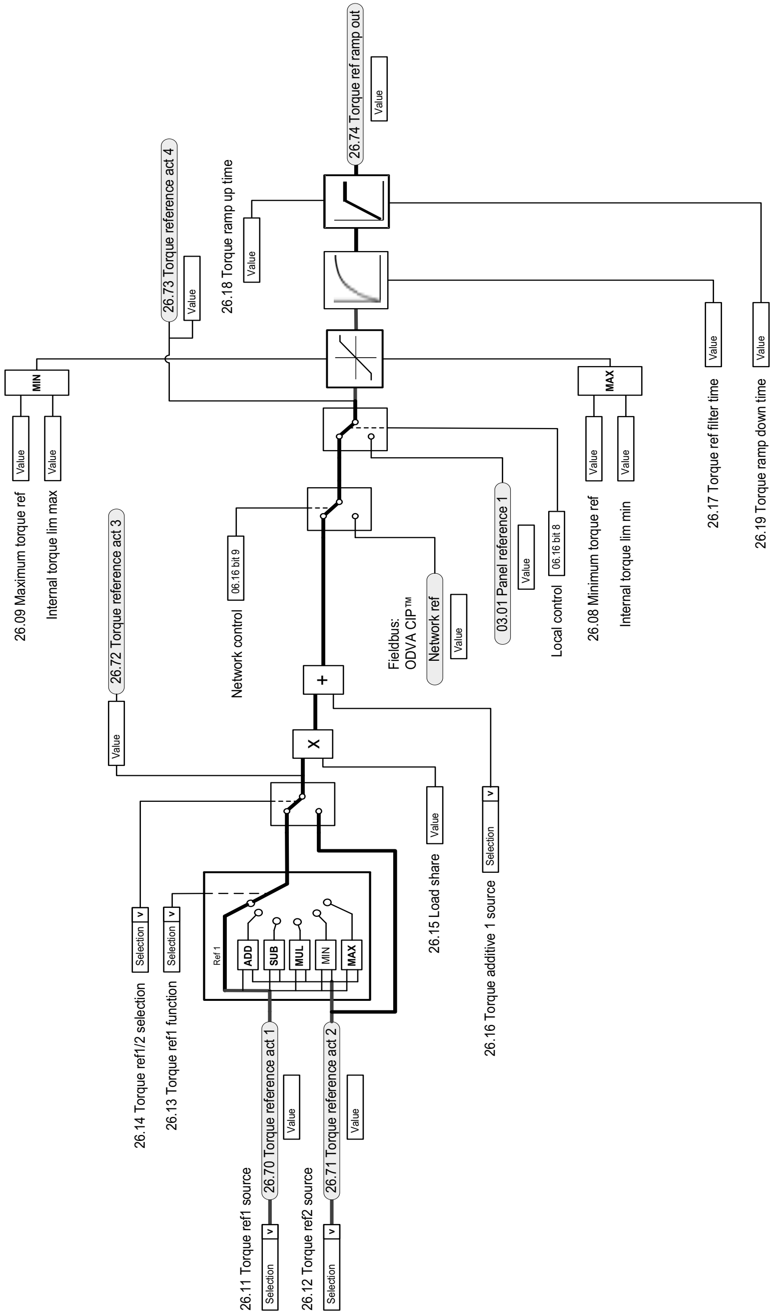
Speed error calculation



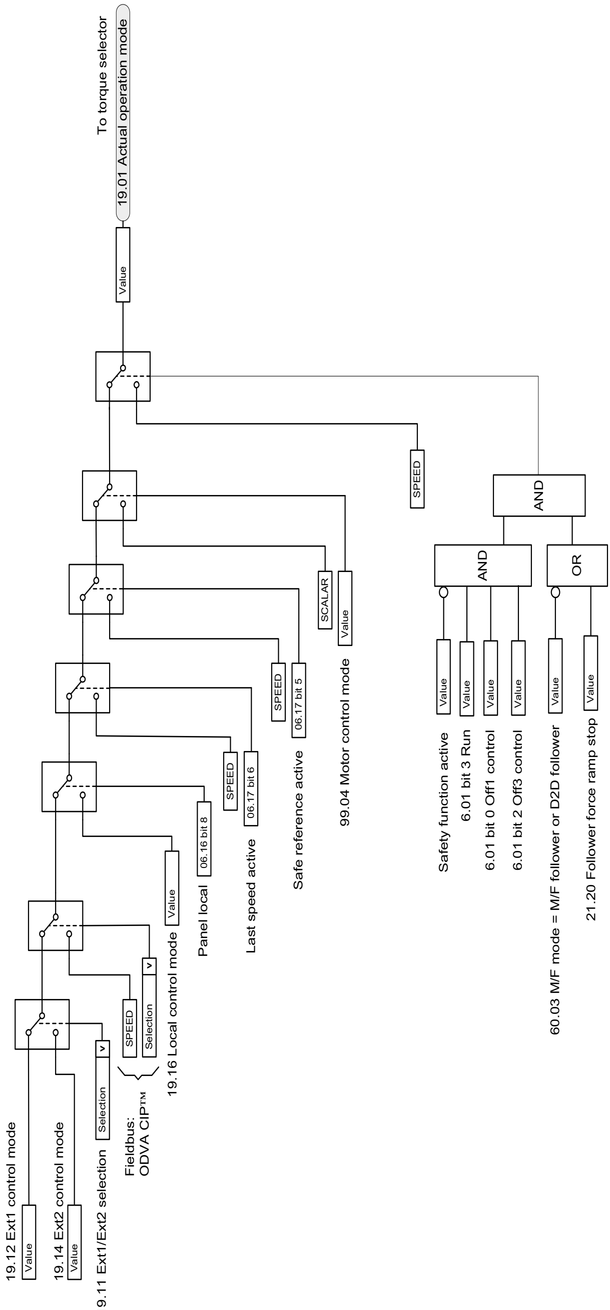
Speed controller



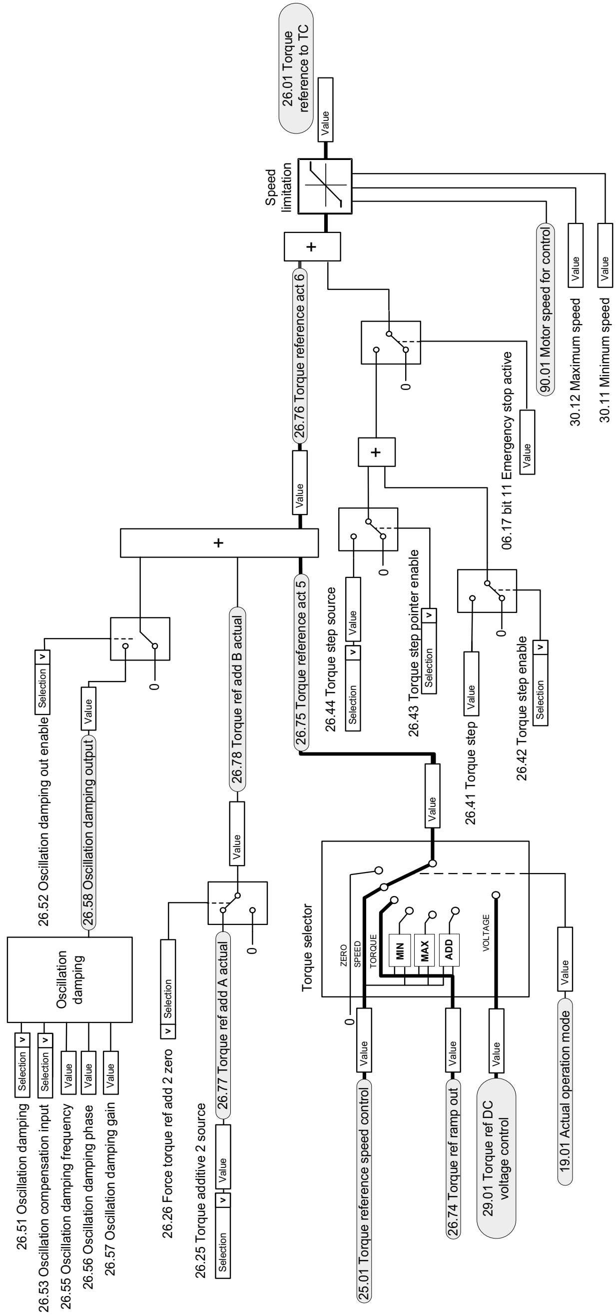
Torque reference source selection and modification



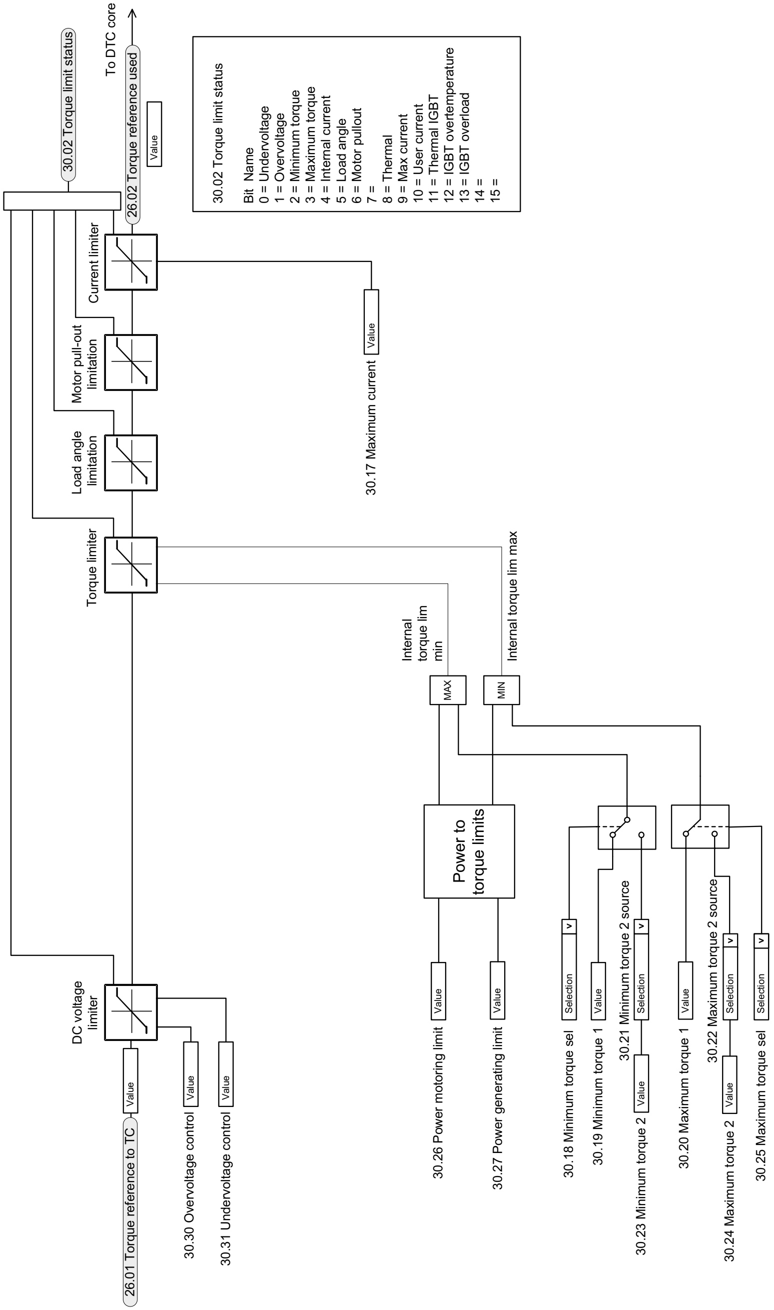
Operating mode selection



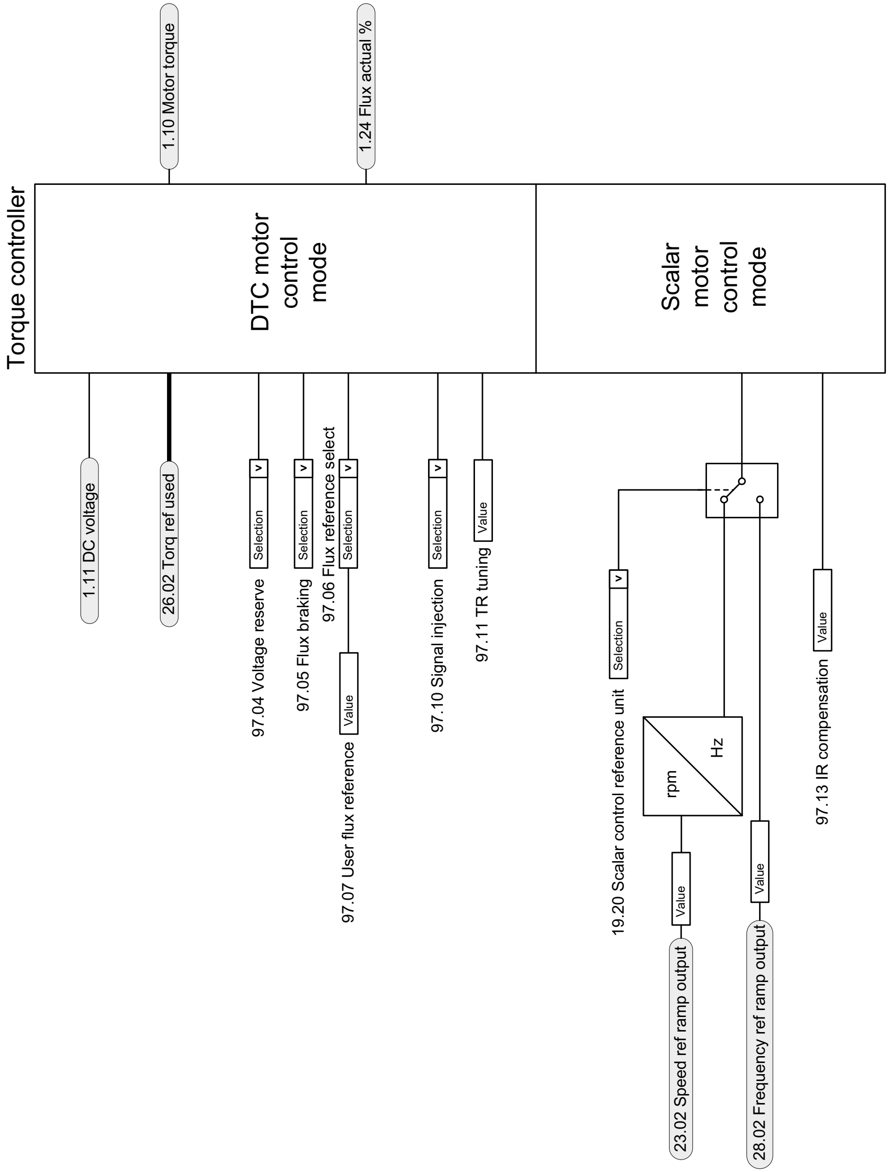
Reference selection for torque controller



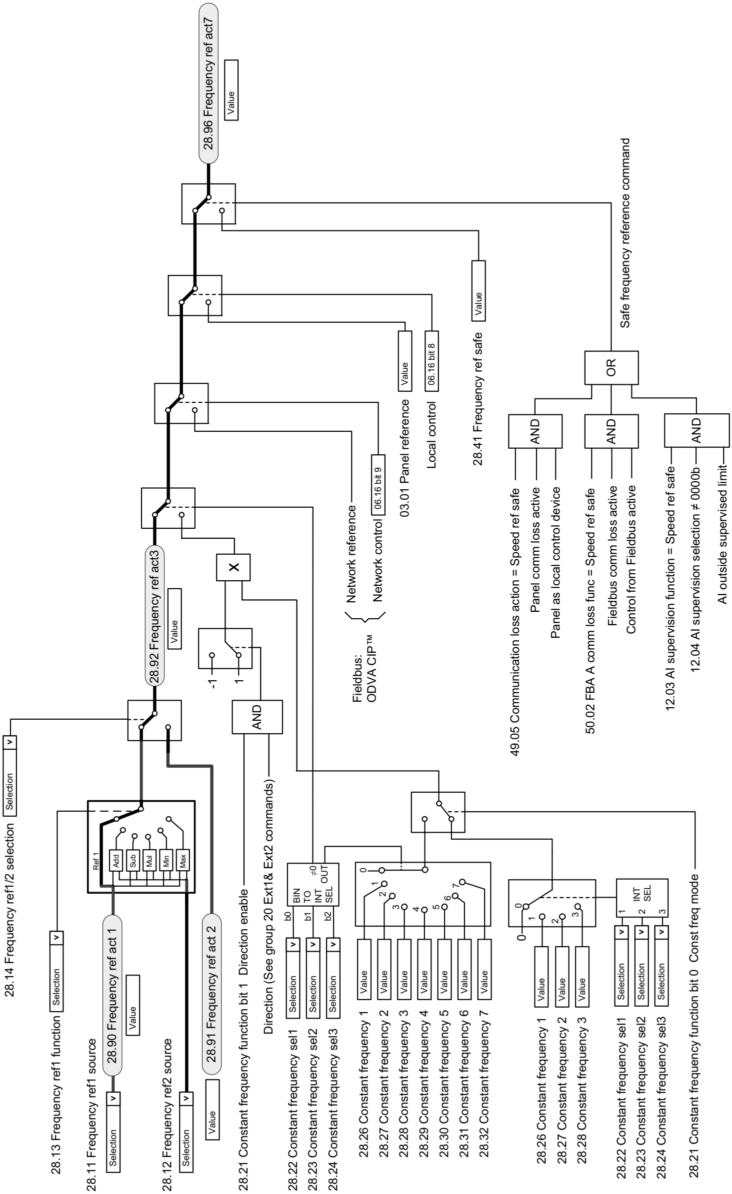
Torque limitation



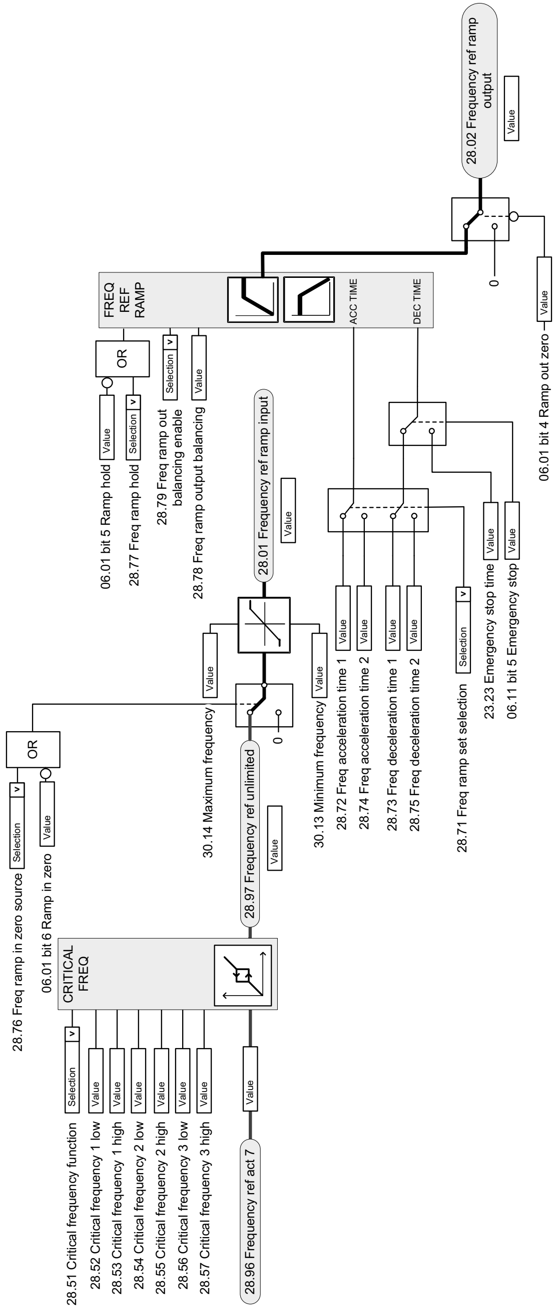
Torque controller



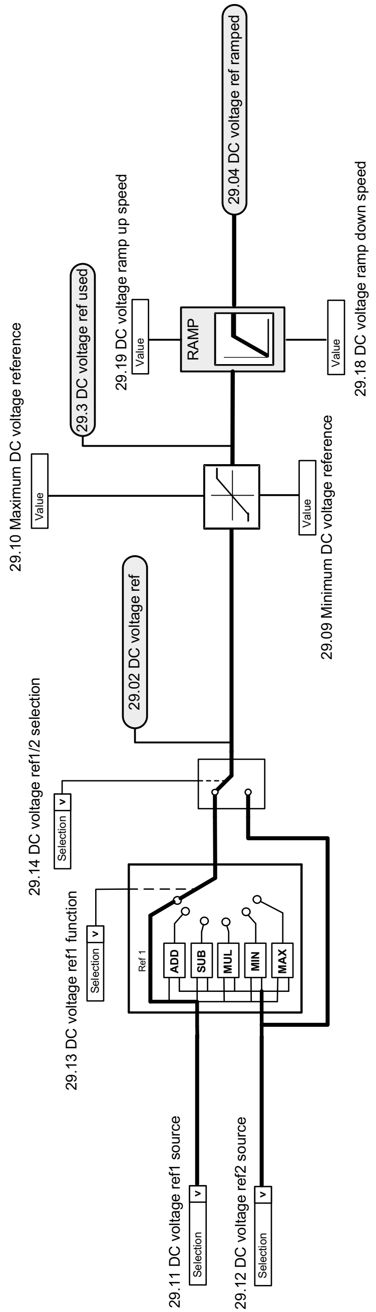
Frequency reference selection



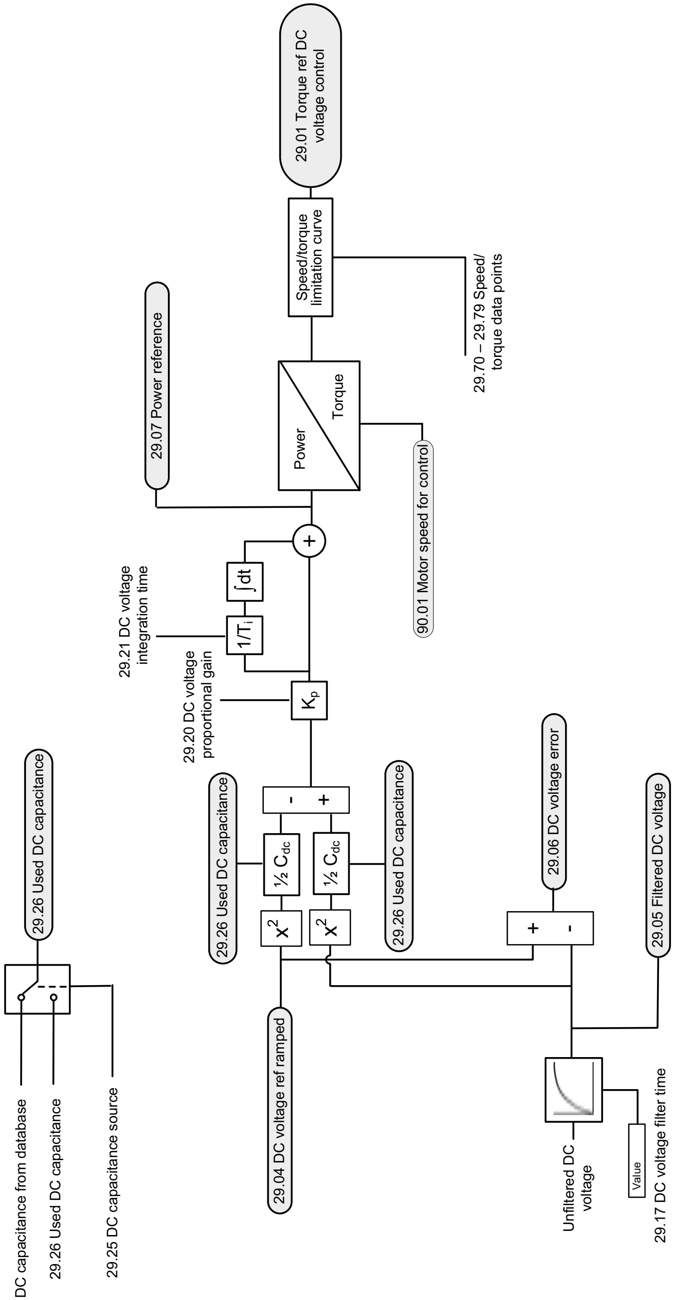
Frequency reference modification



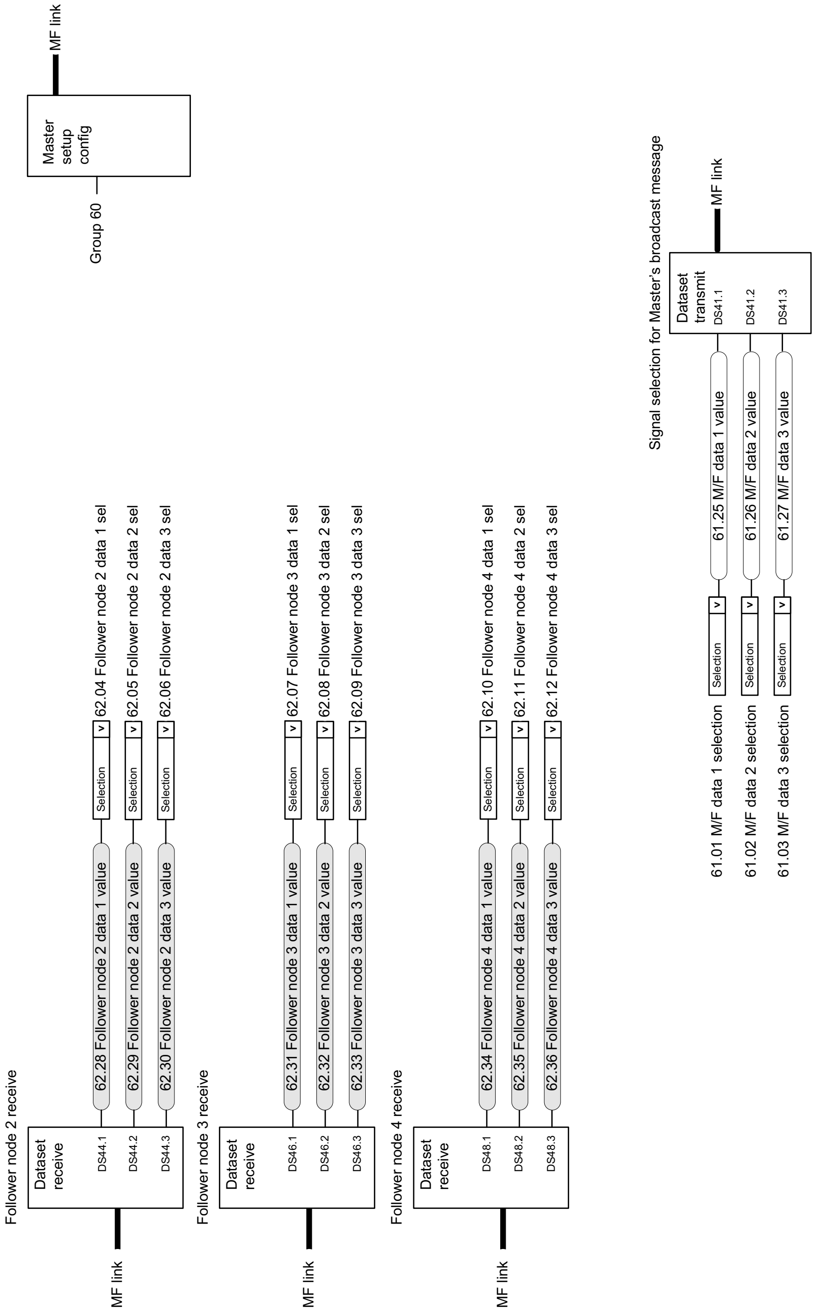
DC voltage reference selection



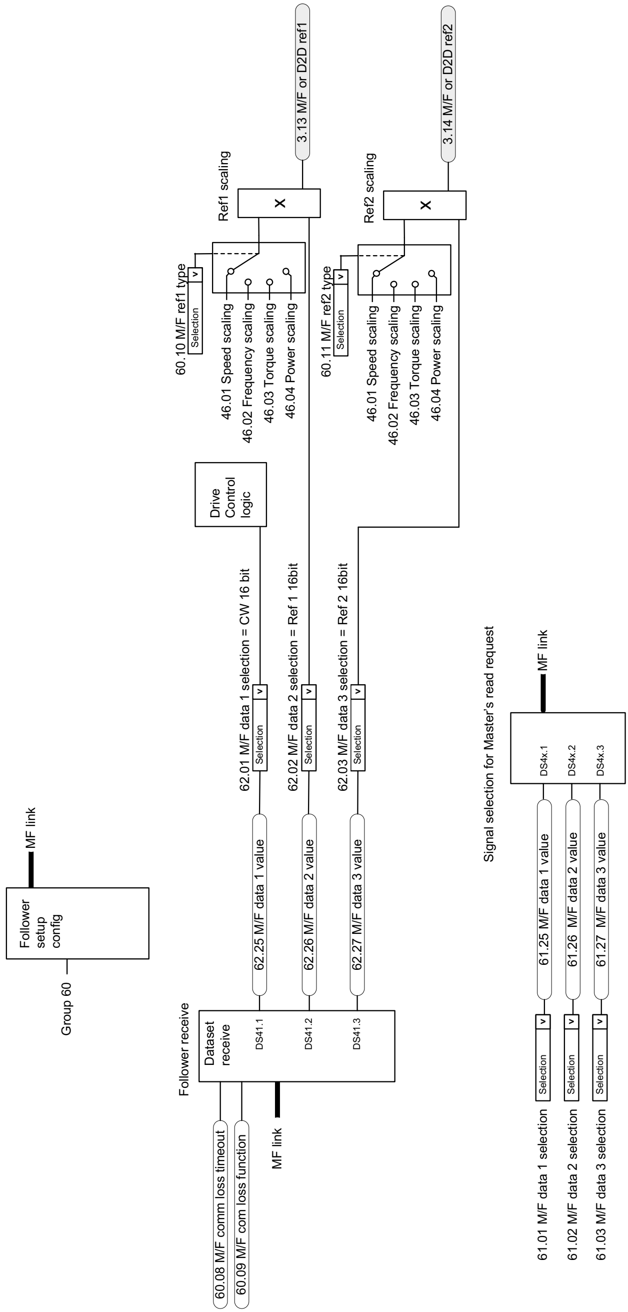
DC voltage reference modification



Master/Follower communication I (Master)

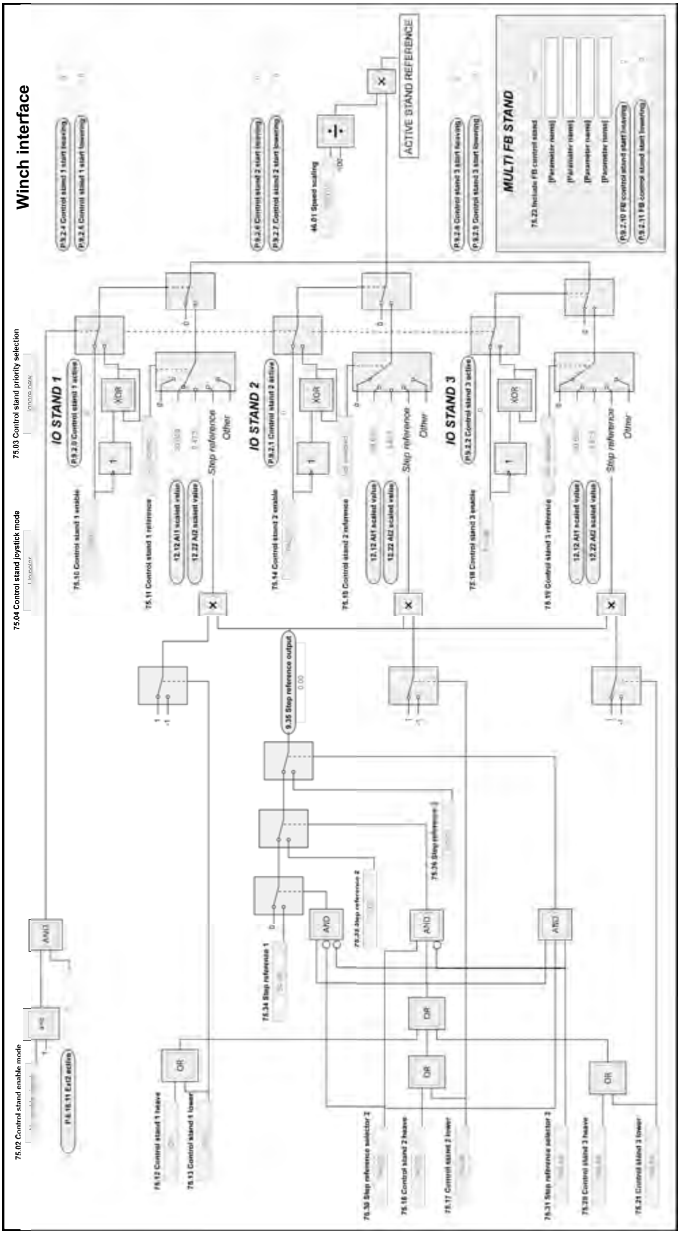


Master/Follower communication II (Follower)

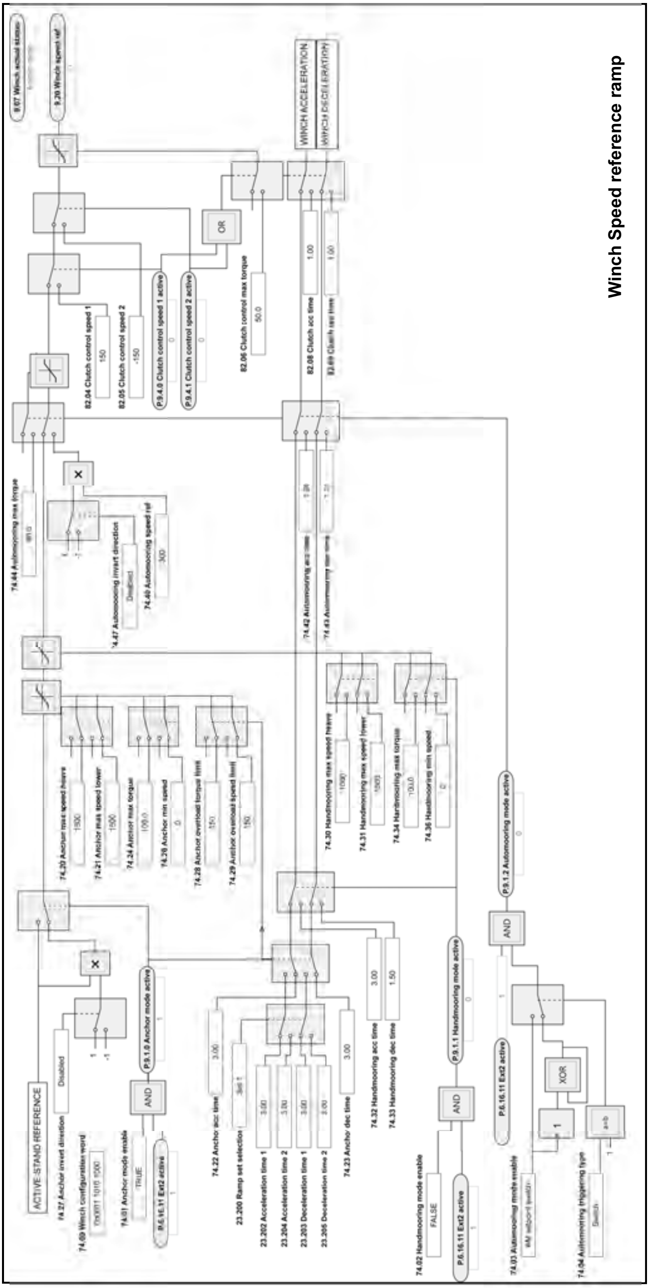


Winch control diagrams

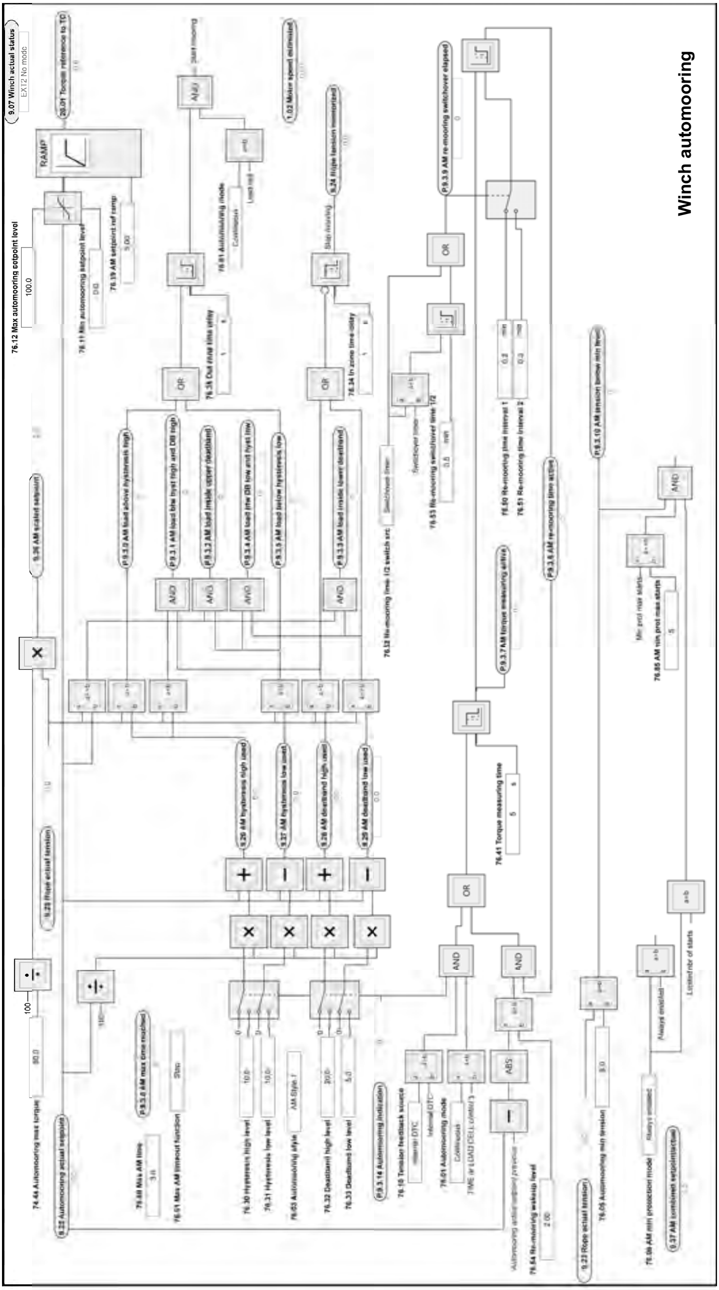
Winch interface logic



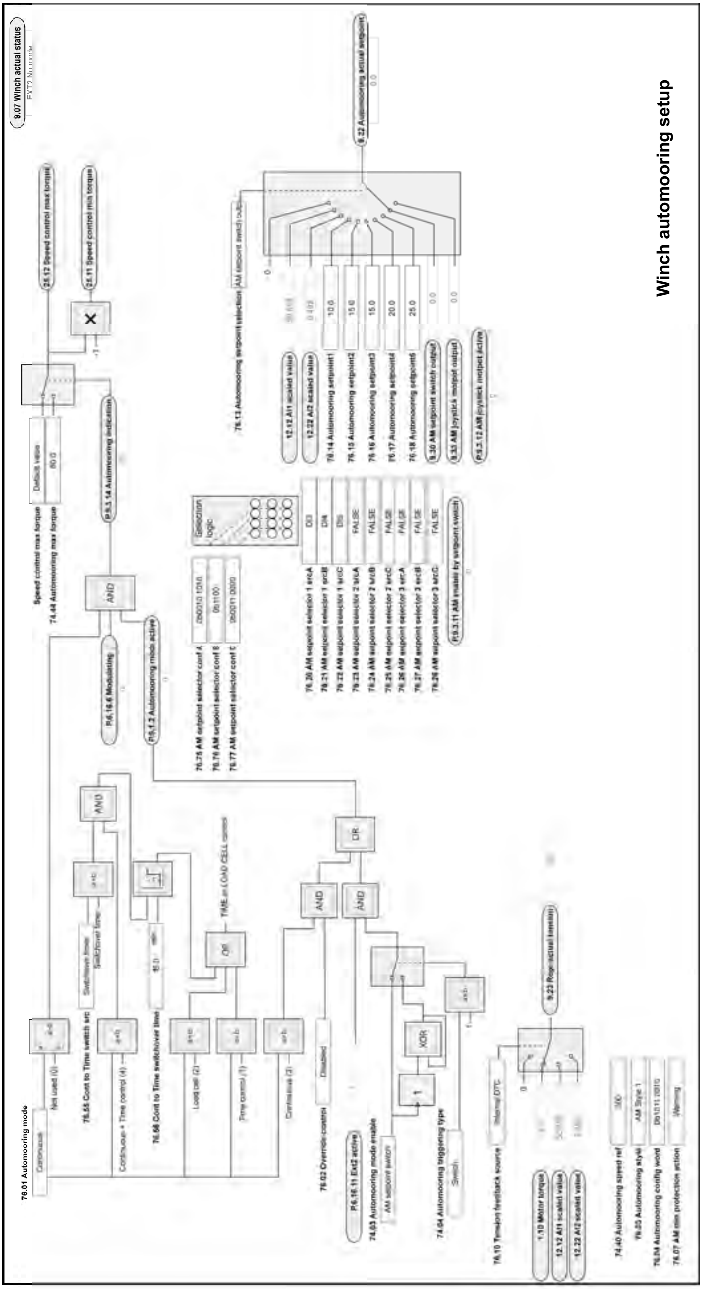
Winch speed reference ramp



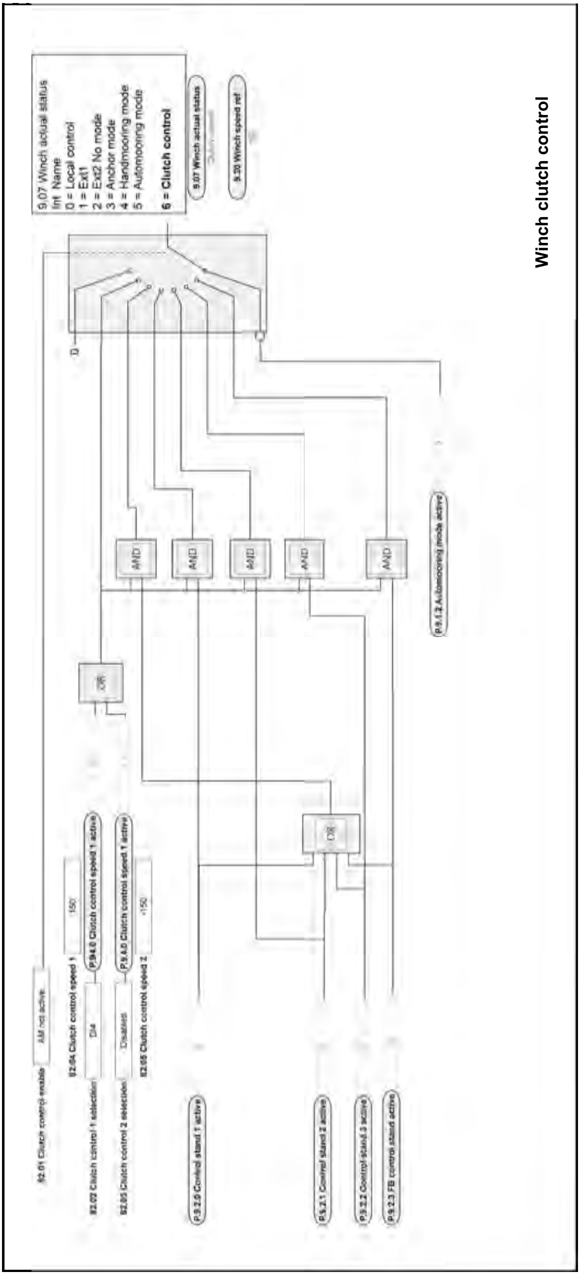
Winch automooring logic



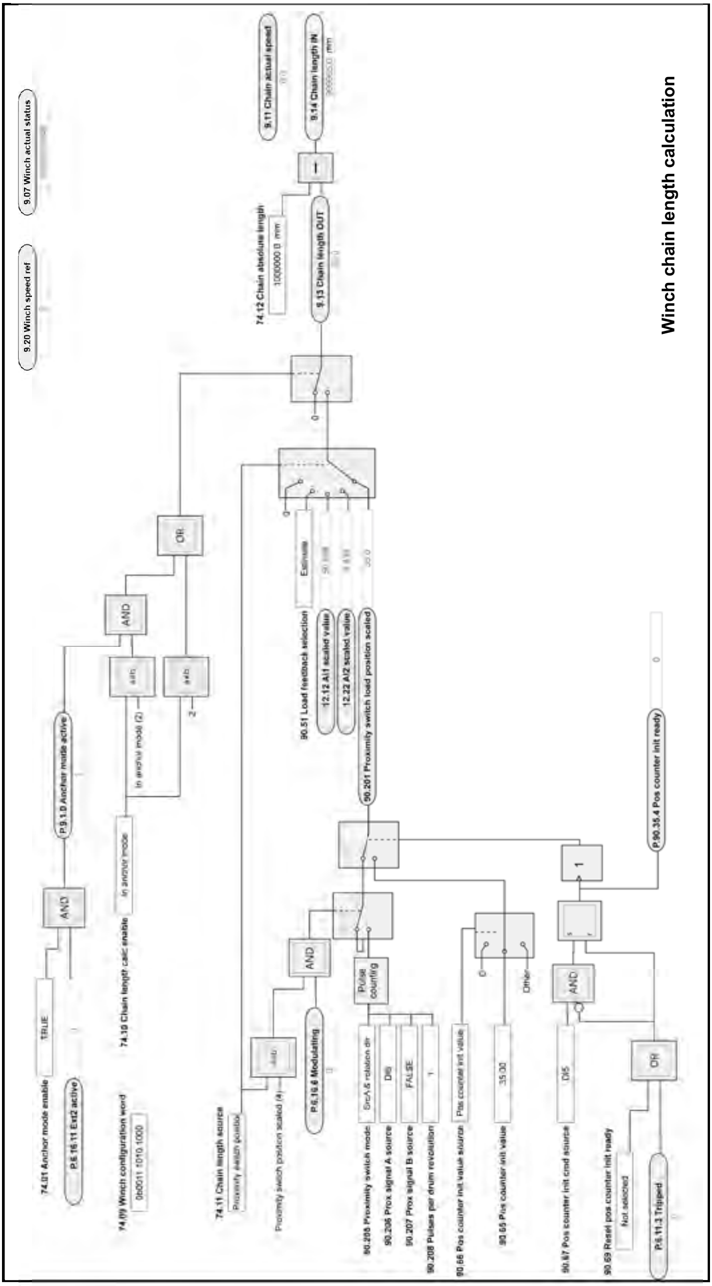
Winch automooring setup



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 abb.com/searchchannels.

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