ABB industrial drives

Firmware manual
ACS880 crane control program (option +N5050)

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List of related manuals

Drive hardware manuals	Code (English)
**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	
Adaptive programming application guide	3AXD50000028574
Drive (IEC 61131-3) application programming manual	3AUA0000127808
SynRM motor control program (+N7502) supplement	3AXD50000026332

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

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

*A list of links to all manuals applicable to this product is available in the Document library:

Product	Code
ACS880-01 drives	9AKK105408A7004
ACS880-04 drive modules (200 to 710 kW, 300 to 700 hp)	9AKK105713A4819
ACS880-07 drives (45 to 630 kW, 50 to 700 hp)	9AKK105408A8149
ACS880-07 drives (560 to 2800 kW)	9AKK105713A6663
ACS880-17 drives	9AKK106354A1499
ACS880-37 drives	9AKK106354A1500

Firmware manual

ACS880 crane control program (option +N5050)

3AXD50000027678 Rev C
EN
EFFECTIVE: 2016-02-10

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Introduction to the manual

Contents of this chapter

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 crane control program (option +N5050), application version 3.00 (loading package ACRLX 3.0.0.0) or later, and primary control version 2.31 or later.

You can see firmware and loading package versions in parameters.

Example:

Parameter	**Loading package version**
07.04 Firmware name	AINF2 or AINF6
07.05 Firmware version	2.31.0.0
07.06 Loading package name	ACRL2 or ACRL6
07.07 Loading package version	3.0.0.0

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

Target audience

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

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*.

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 on using the control panel.
- *Crane program features* describes the program features specific to the crane application.
- *Standard program features* describes the control locations and operation modes, as well as the program features that are not specific to crane applications.
- *Default control connections* presents the default connection diagram.
- *Parameters* describes the parameters of 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.
- *Drive-to-drive link* describes the communication between drives connected together by the drive-to-drive (D2D) link.
- *Control chain diagrams* shows the parameter structure within the drive.
- *Example circuit diagrams* shows the circuit connections for the crane application to use with hoist, trolley and long travel cranes.

Related documents

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

Terms and abbreviations

Term/abbreviation	Definition
AC 800M	Type of programmable controller manufactured by ABB.
ACS800	A product family of ABB drives
ACS-AP-I	Type of control panel used with ACS880 drives
AI	Analog input; interface for analog input signals
AO	Analog output; interface for analog output signals
BCU	Type of control unit used in ACS880 drives, primarily those with parallel-connected inverter or supply modules.
DC link	DC circuit between rectifier and inverter
DDCS	Distributed drives communication system; a protocol used in communication between ABB drive equipment.
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. ACS880 crane 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 *156*.
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
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

Term/abbreviation	Definition
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 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 identifies 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	In large drives (> 500 kW approx.), the part of the drive that converts DC to AC for the motor. Consists of one or more inverter modules and their auxiliary components.
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.
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/-21 Ethernet adapter module User's manual* (3AUA0000093568 [English]).
Parameter	User-adjustable operation instruction to the drive, or signal measured or calculated by the drive
PID controller	Proportional–integral–derivative controller. Drive speed control is based on PID algorithm.

Term/abbreviation	Definition
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.
PTC	Positive temperature coefficient
RDCO-0x	Optional 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	In large drives (> 500 kW approx.), the part of the drive that converts AC to DC. Consists of one or more supply modules and their auxiliary components. 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.

Cyber security disclaimer

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

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. See following sections:

- *Drive start-up* on page 20
- *Crane control start-up* on page 27

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*.

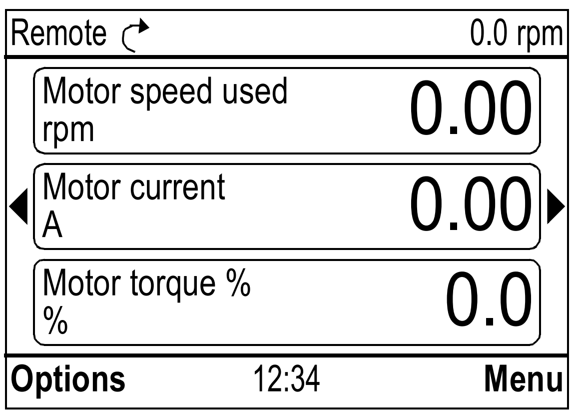
Safety

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

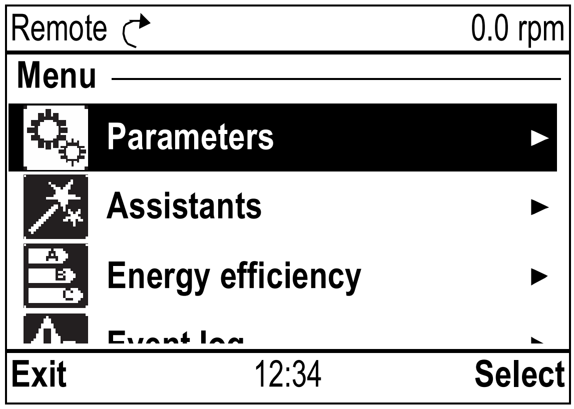
Never work on the drive, the brake chopper circuit, the motor cable or the motor when power is applied to the drive. Always make sure by measuring that no voltage is actually present.

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.

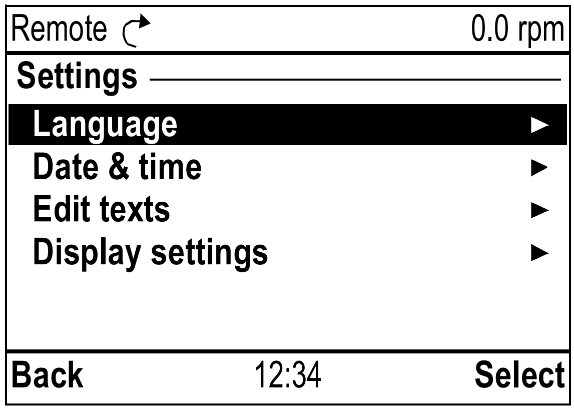
Drive start-up

<table>
<tr><th colspan="3">Safety</th></tr>
<tr><td colspan="3">WARNING! Obey all safety instructions for the drive. Only qualified electricians are allowed to start up the drive.</td></tr>
<tr><td>☐</td><td colspan="2">Check the installation. See the installation checklist in the appropriate Hardware manual.</td></tr>
<tr><td>☐</td><td colspan="2">Check that the starting of the motor does not cause any danger.
De-couple the driven machine if
• there is a risk of damage in case of an incorrect direction of rotation, or
• a Normal ID run is required during the drive start-up, when the load torque is higher than 20% or the machinery is not able to withstand the nominal torque transient during the ID run.</td></tr>
<tr><th colspan="3">1 – Power-up, date and time settings</th></tr>
<tr><td>☐</td><td>Power up the drive.
Note: It is normal that warning messages appear at various points along the start-up process. To hide a message and to resume the start-up process, press .
Hide any warnings now to enter the Home view (shown on the right).
The two commands at the bottom of the display (in this case, Options and Menu), show the functions of the two softkeys and located below the display. The commands assigned to the softkeys vary depending on the context.</td><td>
</td></tr>
</table>

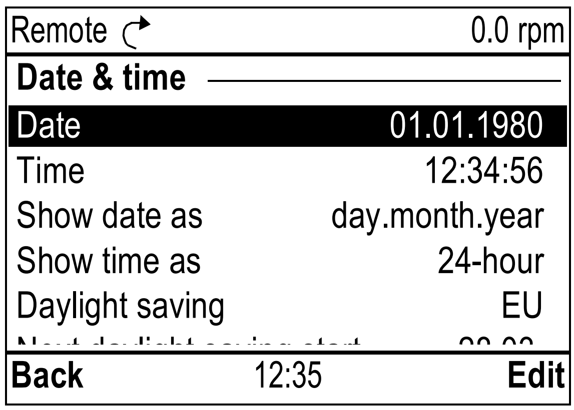
☐ In the **Home** view, press (**Menu**). The main **Menu** (right) appears.



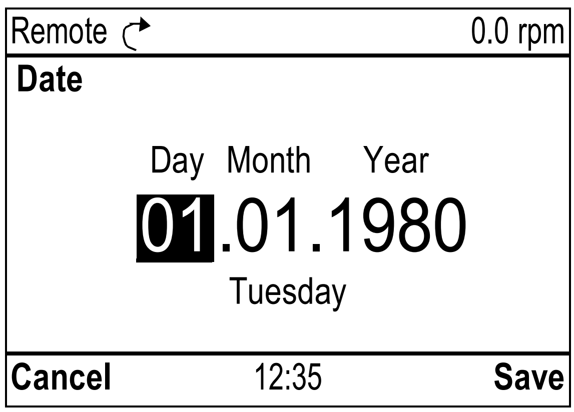
☐ Highlight **Settings** on the menu using and and press (**Select**).



☐ 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**).



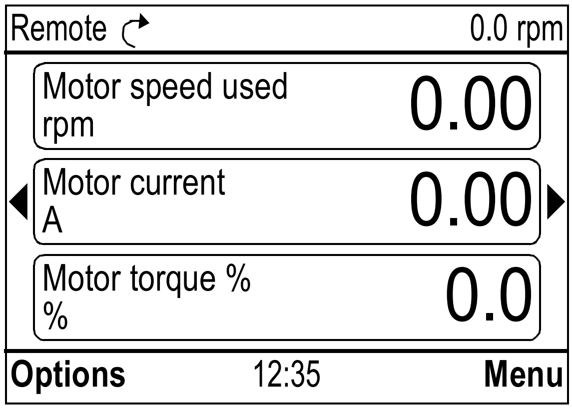
☐ Set the correct date:

- 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.

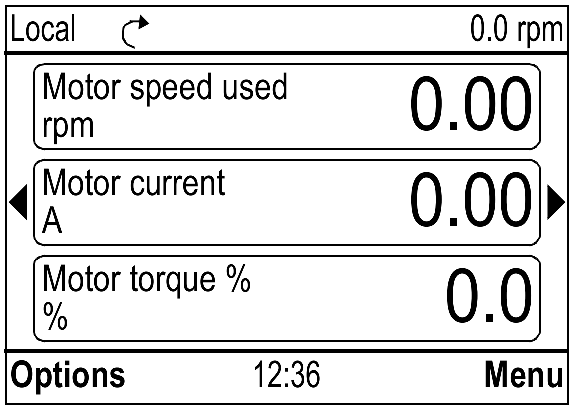
The **Show clock** setting determines whether the time is shown at all times in the bottom pane of the display.

After you have made the settings, press (**Back** or **Exit**) repeatedly until the **Home** view (right) reappears.

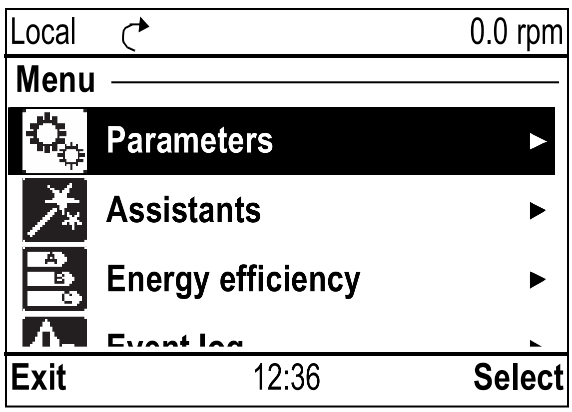


2 – Supply voltage and motor data settings

☐ 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**).



☐	Highlight **Parameters** and press (**Select**).	Local 0.0 rpm **Parameters** **Favorites** ► **By function** ► **Complete list** ► **Modified** ► **Back** 12:36 **Select**
☐	Highlight **Complete list** using and and press (**Select**). A listing of parameter groups is displayed.	Local 0.0 rpm **Complete list** 01 Actual values ► 03 Input references ► 04 Warnings and faults ► 05 Diagnostics ► 06 Control and status words ► 07 System info **Back** 12:36 **Select**
☐	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.	Local 0.0 rpm 95 **HW configuration** 95.01 Supply voltage Not given 95.02 Adaptive voltage limits Disable 95.04 Control board supply Internal 24V **Back** 12:36 **Edit**
☐	Highlight parameter *95.01 Supply voltage* (if not already highlighted) and press (**Edit**). The available parameter settings are listed.	Local 0.0 rpm 95.01 **Supply voltage** [0] Not given [1] 208…240 V [2] 380…415 V [3] 440…480 V [4] 500 V **Cancel** 12:36 **Save**

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

```
Local ↻                          0.0 rpm
95 HW configuration ────────────────────
95.01 Supply voltage          380…415 V
95.02 Adaptive voltage limits   Disable
95.04 Control board supply Internal 24V


Back            12:36              Edit
```

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

☐ Set parameter *99.04 Motor control mode*.

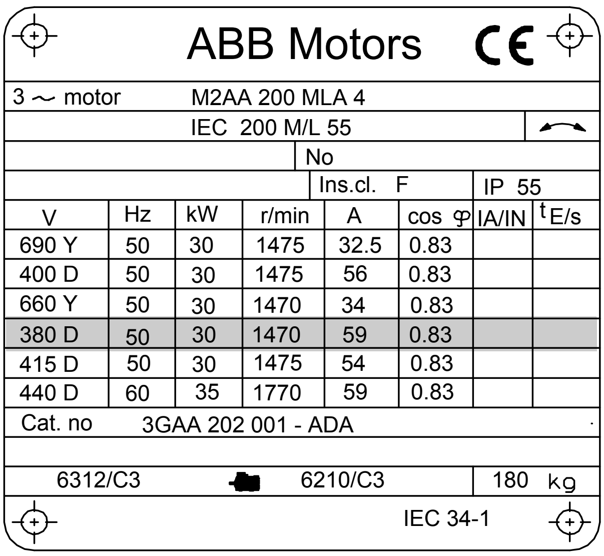
DTC = Direct torque control; *Scalar*

DTC is suitable for most cases. Scalar mode is recommended if

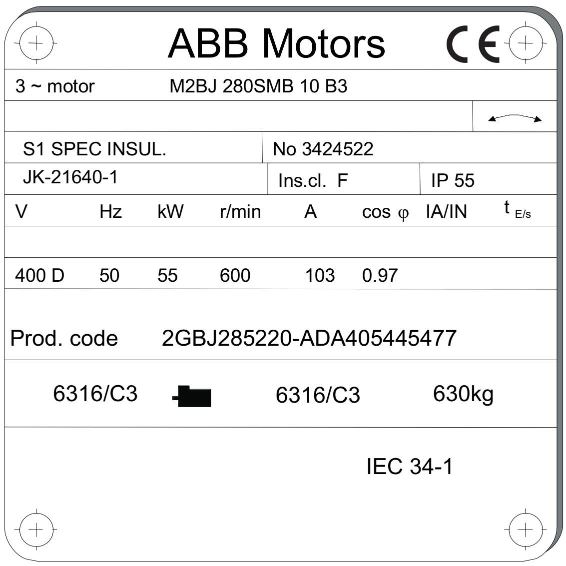
- the nominal current of the motor is less than 1/6 of the nominal current of the drive,
- the drive is used for test purposes with no motor connected, or
- the drive controls multiple motors and the number of motors connected is variable.

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

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



Example of a nameplate of a permanent magnet motor:



☐ *99.06 Motor nominal current*

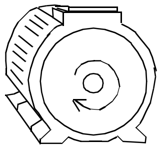
The allowable range is

- in DTC mode: $1/6 \times I_{Hd}$ … $2 \times I_{Hd}$ 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 Φ* *99.12 Motor nominal torque* These values are not required, but can be entered to improve control accuracy. If not known, leave at 0.	
☐	*99.13 ID run requested* This parameter selects the mode of the identification run (DTC motor control mode only). **Note**: The drive must be in local control for the identification run. **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. This mode is recommended for hoist drives. The driven machinery must be de-coupled from the motor if • the load torque is higher than 20%, or • the machinery is not able to withstand the nominal torque transient during the identification run. **Reduced* mode should be selected if the mechanical losses are higher than 20%, ie. the load cannot be de-coupled, or full flux is required to keep the motor brake open (eg. with conical motors). The *Standstill* mode should be selected if neither the **Normal* or **Reduced* mode can be used. This mode is recommended for trolley and long travel motions with which it is very difficult or impossible to disconnect the motor from the mechanical system. **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 (forward direction shown below). With a positive speed reference, the motor has to run to the direction of lifting a load.  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*.

Crane control start-up

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

- *Control through the I/O interface using a joystick* (page *28*)
- *Control through the I/O interface using the step reference logic* (page *31*)
- *Control through the fieldbus interface using the fieldbus control word* (page *34*)
- *Control through the fieldbus interface using the crane control word and a joystick* (page *37*).

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

- *Configuring Mechanical brake control* (page *41*)
- *Configuring Slowdown inputs and limits* (page *42*)
- *Configuring speed feedback using a HTL encoder* (page *43*)
- *Configuring Lifetime monitor function* (page *44*)
- *Lifetime monitor maintenance* (page *45*).

Control through the I/O interface using a joystick

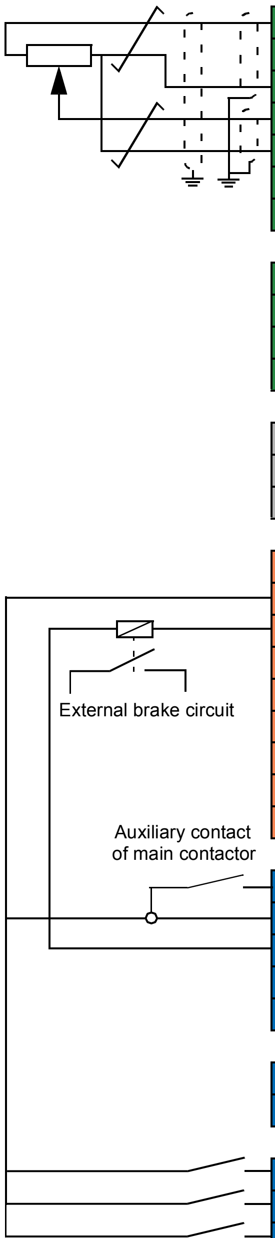
This section describes how to set up the drive for control through the I/O interface using a joystick.

Safety	
	WARNING! Obey all safety instructions for the drive. Only qualified electricians are allowed to start up the drive.
Preliminary actions	
☐	Make sure that you have completed the basic start-up sequence of the drive. See *Drive start-up* on page *20*.
☐	Power up the drive and wait for 10 seconds. This is to make sure that all the boards are powered and the application is running.
☐	Switch to local control by pressing the Loc/Rem key, or alternatively, use the Drive composer PC tool.
Brake circuit check	
☐	Make sure that you can safely do the brake circuit check. For example, make sure that the load is not hanging from a hook.
☐	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 (44.210.0).
Control signal settings	
☐	Select the signal sources for start and stop control. *20.01 Ext1 commands* = *In1 Start fwd; In2 Start rev* *20.03 Ext1 in1 source* = *DI1* *20.04 Ext1 in2 source* = *DI2*
☐	Select the signal source for speed reference 1. *22.11 Speed ref1 source* = *AI1 scaled*
☐	Define the analog input AI1 scales. *12.15 AI1 unit selection* = *V* *12.17 AI1 min* = 0 V *12.18 AI1 max* = 10 V *12.19 AI1 scaled at AI1 min* = The required maximum speed for reverse direction *12.20 AI1 scaled at AI1 max* = The required maximum speed for forward direction
☐	Set the required ramp times. *23.201 Crane acc time 1* *23.202 Crane dec tme 1* *23.203 Crane acc time 2* *23.204 Crane dec time 2*

☐	Set the speed limits. *30.11 Minimum speed* = The same value as for *12.19 AI1 scaled at AI1 min* *30.12 Maximum speed* = The same value as for *12.20 AI1 scaled at AI1 max*
☐	Set the torque and current limits. *30.17 Maximum current* = Nominal motor current [A] *30.19 Minimum torque 1* = Nominal motor torque (for example, -100%) *30.20 Maximum torque 1* = Nominal motor torque (for example, 100%) **Note:** After the trial run, you must set the above limits according to the application requirements.
Brake and limit switches settings	
☐	Configure these functions: • Mechanical brake control (see page *41*) • Upper and lower limits and Slowdown (see page *42*).
Trial run	
☐	Do a trial run with an empty hook.
☐	Make sure that the brake and safety circuits are working.
☐	Do a trial run with real load.

Control connections

This figure shows the control connections for the joystick set-up described on page *28*.



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	***Open brake command*** (Par. *44.210*, b0)	
2	COM	250 V AC / 30 V DC	
3	NO	2 A	
1	NC	Watchdog ok (Par. *32.227*, b0)	
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. *20.212*) / 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***: ***Open brake command***	
2	DIO2	Output: Not in use.	
XDI	Digital inputs		
1	DI1	Start forward (= positive speed = lifting load)	
2	DI2	Start reverse (= negative speed = lowering load)	
3	DI3	Fault reset	
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		

Control through the I/O interface using the step reference logic

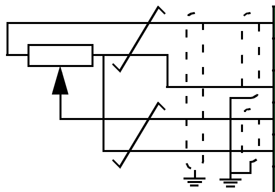
This section describes how to set up the drive for control through the I/O interface using the step reference logic.

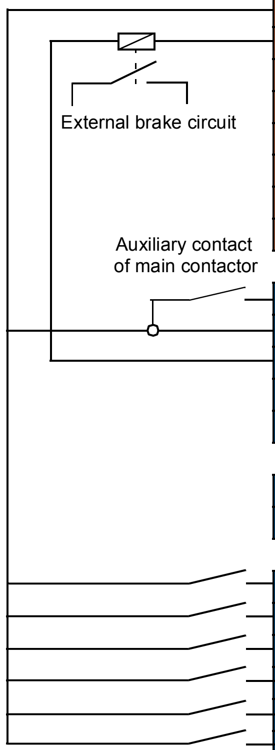
Safety	
⚠	**WARNING!** Obey all safety instructions for the drive. Only qualified electricians are allowed to start up the drive.
Preliminary actions	
☐	Make sure that you have completed the basic start-up sequence of the drive. See *Drive start-up* on page *20*.
☐	Power up the drive and wait for 10 seconds. This is to make sure that all the boards are powered and the application is running.
☐	Switch to local control by pressing the Loc/Rem key, or alternatively, use the Drive composer PC tool.
Brake circuit check	
☐	Make sure that you can safely do the brake circuit check. For example, make sure that the load is not hanging from a hook.
☐	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 (44.210.0).
Control signal settings	
☐	Select the signal sources for start and stop control. *20.01 Ext1 commands* = *In1 Start fwd; In2 Start rev* *20.03 Ext1 in1 source* = *DI1* *20.04 Ext1 in2 source* = *DI2*
☐	Define the Step reference logic. *22.203 Step reference mode* = Enabled *22.204 Step reference select 2* = Pointer xx.xx (DI4) *22.205 Step reference select 3* = Pointer xx.xx (DI5) *22.206 Step reference select 4* = Pointer xx.xx (DI6) *22.207 Step reference 1* = Reference 1 according to the application speed *22.208 Step reference 2* = Reference 2 according to the application speed *22.209 Step reference 3* = Reference 3 according to the application speed *22.210 Step reference 4* = Reference 4 according to the application speed
☐	Set the required ramp times. *23.201 Crane acc time 1* *23.202 Crane dec tme 1* *23.203 Crane acc time 2* *23.204 Crane dec time 2*

☐	Set the speed limits so that they correspond to the step references 1…4. *30.11 Minimum speed* *30.12 Maximum speed*
☐	Set the torque and current limits. *30.17 Maximum current* = Nominal motor current [A] *30.19 Minimum torque 1* = Nominal motor torque (for example, -100%) *30.20 Maximum torque 1* = Nominal motor torque (for example, 100%) **Note:** After the trial run, you must set the above limits according to the application requirements.
Brake and limit switches settings	
☐	Configure these functions: • Mechanical brake control (see page *41*) • Upper and lower limits and Slowdown (see page *42*).
Trial run	
☐	Do a trial run with an empty hook.
☐	Make sure that the brake and safety circuits are working.
☐	Do a trial run with real load.

Control connections

This figure shows the control connections for the step reference set-up described on page *31*.





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	***Open brake command*** (Par. *44.210*, b0)
	2	COM	
	3	NO	250 V AC / 30 V DC
	1	NC	Watchdog ok (Par. *32.227*, b0)
	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. *20.212*) / 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*: *Open brake command***
	2	DIO2	Output: Not in use
XDI			Digital inputs
	1	DI1	Start forward (= positive speed = lifting load)
	2	DI2	Start reverse (= negative speed = lowering load)
	3	DI3	Fault reset
	4	DI4	Step reference 2 selection. See par. *22.204*.
	5	DI5	Step reference 3 selection. See par. *22.205*.
	6	DI6	Step reference 4 selection. See par. *22.206*.
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

Control through the fieldbus interface using the fieldbus control word

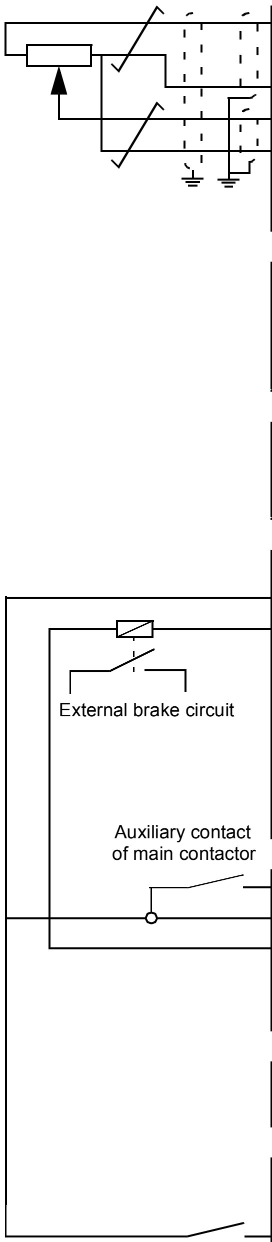
This section describes how to set up the drive for control through the fieldbus interface using the fieldbus control word.

Safety	
⚠	**WARNING!** Obey all safety instructions for the drive. Only qualified electricians are allowed to start up the drive.
Preliminary actions	
☐	Make sure that you have completed the basic start-up sequence of the drive. See *Drive start-up* on page *20*.
☐	Power up the drive and wait for 10 seconds. This is to make sure that all the boards are powered and the application is running.
☐	Switch to local control by pressing the Loc/Rem key, or alternatively, use the Drive composer PC tool.
Brake circuit check	
☐	Make sure that you can safely do the brake circuit check. For example, make sure that the load is not hanging from a hook.
☐	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 (44.210.0).
Fieldbus communication settings	
Start up the fieldbus adapter module. See the appropriate fieldbus adapter module user's manual. An example of the FPBA-01 start-up procedure is given below.	
☐	*50.01 FBA A enable* = *Option slot x* *50.02 FBA A comm loss func* = *Fault* *50.03 FBA A comm loss t out* = 1 s *50.04 FBA A ref1 type* = *Speed* *46.01 Speed scaling* = According to the maximum speed of the application
☐	Set the adapter module configuration parameters in group 51. At the minimum, set the required node address in parameter *51.02 Node address* and the communication profile in *51.05 Profile*.
☐	*52.01 FBA A data in1* = *SW 16bit* *52.02 FBA A data in2* = *1.1 [16]* *53.01 FBA A data out1* = *CW 16bit* *53.02 FBA A data out2* = *Ref1 16bit* *53.03 FBA A data out3* = *Ref2 16bit* *46.01 Speed scaling* = According to the maximum speed of the application

☐	Save the valid parameter values to the permanent memory. *96.07 Parameter save manually* = *Save*
☐	Validate the settings made in parameter groups 51, 52 and 53. *51.27 FBA A par refresh* = *Refresh*
☐	Switch power off and on.
☐	Make sure that the settings in parameter group 51 are correct (type of the fieldbus adapter module, node address, and so on).
☐	Define the start and stop control sources. *20.01 Ext1 commands* = *Fieldbus A*
☐	Select the source for the speed reference. *22.11 Speed ref1 source* = *FB A ref1*
☐	Set the required ramp times. *23.201 Crane acc time 1* *23.202 Crane dec tme 1* *23.203 Crane acc time 2* *23.204 Crane dec time 2*
☐	Set the speed limits. *30.11 Minimum speed* *30.12 Maximum speed*
☐	Set the torque and current limits. *30.17 Maximum current* = Nominal motor current [A] *30.19 Minimum torque 1* = Nominal motor torque (for example, -100%) *30.20 Maximum torque 1* = Nominal motor torque (for example, 100%) **Note:** After the trial run, you must set the above limits according to the application requirements.
Brake and limit switches settings	
☐	Configure these functions: • Mechanical brake control (see page *41*) • Upper and lower limits and Slowdown (see page *42*).
Trial run	
☐	Do a trial run with an empty hook.
☐	Make sure that the brake and safety circuits are working before.
☐	Do a trial run with real load.

Control connections

This figure shows the control connections for the fieldbus control word set-up described on page 34.



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	***Open brake command*** (Par. *44.210*, b0)
2	COM	
3	NO	250 V AC / 30 V DC
1	NC	Watchdog ok (Par. *32.227*, b0)
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. *20.212*) / 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*: *Open brake command***
2	DIO2	Output: Not in use
XDI	Digital inputs	
1	DI1	
2	DI2	
3	DI3	Fault reset
4	DI4	
5	DI5	
6	DI6	
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	

Control through the fieldbus interface using the crane control word and a joystick

This section describes how to set up the drive for control through the fieldbus interface using the crane control word and a joystick.

Safety	
⚠	**WARNING!** Obey all safety instructions for the drive. Only qualified electricians are allowed to start up the drive.
Preliminary actions	
☐	Make sure that you have completed the basic start-up sequence of the drive. See *Drive start-up* on page *20*.
☐	Power up the drive and wait for 10 seconds. This is to make sure that all the boards are powered and the application is running.
☐	Switch to local control by pressing the Loc/Rem key, or alternatively, use the Drive composer PC tool.
Brake circuit check	
☐	Make sure that you can safely do the brake circuit check. For example, make sure that the load is not hanging from a hook.
☐	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 (44.210.0).
Fieldbus communication settings	
Start up the fieldbus adapter module. See the appropriate fieldbus adapter module user's manual. An example of the FPBA-01 start-up procedure is given below.	
☐	*50.01 FBA A enable* = *Option slot x* *50.02 FBA A comm loss func* = *Fault* *50.03 FBA A comm loss t out* = 1 s *50.04 FBA A ref1 type* = *Speed* or *Frequency* *50.05 FBA A ref2 type* = *Speed* or *Frequency* *46.01 Speed scaling* = According to the maximum speed of the application
☐	Set the adapter module configuration parameters in group 51. At the minimum, set the required node address in parameter *51.02 Node address* and the communication profile in *51.05 Profile*.
☐	*52.01 FBA A data in1* = *SW 16bit* *52.02 FBA A data in2* = *1.1 [16]* *53.01 FBA A data out1* = *CW 16bit* *53.02 FBA A data out2* = *Ref1 16bit* *53.03 FBA A data out3* = *Other -> 20.216* *46.01 Speed scaling* = According to the maximum speed of the application

- [ ] Save the valid parameter values to the permanent memory.
  96.07 Parameter save manually = *Save*
- [ ] Validate the settings made in parameter groups 51, 52 and 53.
  51.27 FBA A par refresh = *Refresh*
- [ ] Switch power off and on.
- [ ] Make sure that the settings in parameter group 51 are correct (type of the fieldbus adapter module, node address, and so on).
- [ ] Define the start and stop control sources.
  20.01 Ext1 commands = *In1 Start fwd; In2 Start rev*
  20.03 Ext1 in1 source = P.20.216.0
  20.04 Ext1 in2 source = P.20.216.1

  Contents of par. *20.216 Crane control word 1*:

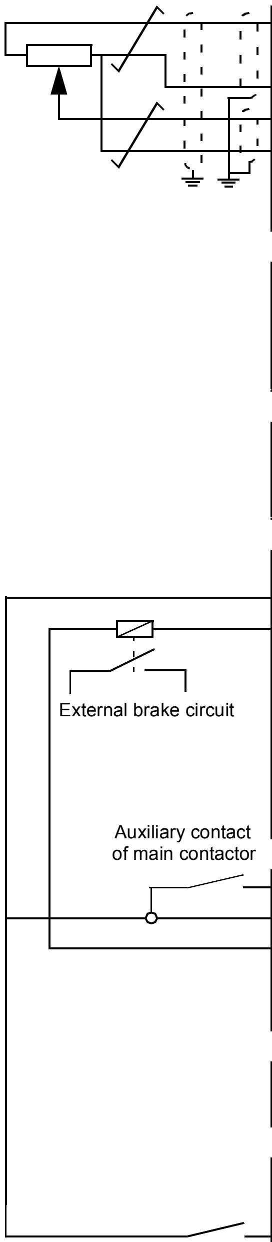
Bit	Name	Value
0	0 = Start forward	0
1	1 = Start reverse	0
2	2 = Fault reset	0
3	3 = Step reference mode	0
4	4 = Step reference select 2	0
5	5 = Step reference select 3	0
6	6 = Step reference select 4	0
7	7 = Slowdown input 1	1
8	8 = Slowdown input 2	1
9	9 = Upper limit	1
10	10 = Lower limit	1
11	11 = Fast stop	1
12	12 = Synchronizing mode	0
13	13 = Homing select	0
14	14 = Homing acknowledge	0
15	15 = Position preset	0

- [ ] Select the source for the speed reference.
  22.11 Speed ref1 source = *FB A ref1*
- [ ] Set the required ramp times.
  23.201 Crane acc time 1
  23.202 Crane dec tme 1
  23.203 Crane acc time 2
  23.204 Crane dec time 2
- [ ] Set the speed limits.
  30.11 Minimum speed
  30.12 Maximum speed
- [ ] Set the torque and current limits.
  30.17 Maximum current = Nominal motor current [A]
  30.19 Minimum torque 1 = Nominal motor torque (for example, -100%)
  30.20 Maximum torque 1 = Nominal motor torque (for example, 100%)

Brake and limit switches settings	
☐	Configure these functions: • Mechanical brake control (see page *41*) • Upper and lower limits and Slowdown (see page *42*).
Trial run	
☐	Do a trial run with an empty hook.
☐	Make sure that the brake and safety circuits are working.
☐	Do a trial run with real load.

Control connections

This figure shows the control connections for the crane control word set-up described on page 37.



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	***Open brake command*** (Par. *44.210*, b0)
2	COM	
3	NO	250 V AC / 30 V DC
1	NC	Watchdog ok (Par. *32.227*, b0)
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. *20.212*) / 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*: *Open brake command***
2	DIO2	Output: Not in use
XDI	Digital inputs	
1	DI1	
2	DI2	
3	DI3	Fault reset
4	DI4	
5	DI5	
6	DI6	
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	

Configuring Mechanical brake control

Safety	
☐	⚠ **WARNING!** Obey all safety instructions for the drive. Only qualified electricians are allowed to start up the drive.
Parameter settings	
☐	Activate the brake control logic. *44.06 Brake control enable* = *Selected* *10.24 RO1 source* = 44.210.0
☐	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, *DI3* or *No acknowledge*.
☐	Select the source for the brake opening torque. At first, select the following: *44.09 Brake open torque source* = *Brake open torque* *44.200 Brake open torque* = 50% After the trial run, select the brake opening torque source according to the application requirements. **Note**: In scalar motor control, disable Torque proving and Brake open torque. Select the following: *44.09 Brake open torque source* = *Zero* *44.200 Brake open torque* = 0% *44.202 Torque proving* = *Disable*
☐	If a pulse encoder does not exist in the system, activate the Brake safe closure function in parameter *44.207 Safety close select*.
Trial run	
☐	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.

Configuring Slowdown inputs and limits

Safety	
☐	⚠ **WARNING!** Obey all safety instructions for the drive. Only qualified electricians are allowed to start up the drive.
Parameter settings	
☐	Select the Slowdown inputs and reference. *20.200 Slowdown select* = Either select one incoming signal in both directions, or two inputs, one input for each direction. *20.201 Slowdown input 1* *20.202 Slowdown input 2* (If necessary) *22.200 Slowdown reference* = According to the application requirements
☐	Define the upper and lower limits. *20.205 Upper limit* *20.206 Lower limit*
Trial run	
☐	Test the connected inputs and outputs in the local control mode before the final trial run.

Configuring speed feedback using a HTL encoder

Safety	
☐	⚠ **WARNING!** Obey all safety instructions for the drive. Only qualified electricians are allowed to start up the drive.
Parameter settings	
☐	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*).
☐	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.
☐	Specify the interface module that the encoder is connected to (*92.02 Encoder 1 source* = *Module 1*).
☐	Set the number of pulses according to encoder nameplate (*92.10 Pulses/revolution*).
☐	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*.
☐	Set parameter *91.10 Encoder parameter refresh* to *Refresh* to apply the new parameter settings. The parameter will automatically revert to *Done.*
☐	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.
☐	Start the motor with a reference of, for example, 400 rpm.
☐	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*).
☐	Specify the action taken in case the feedback signal is lost (*90.45 Motor feedback fault*).

Configuring Lifetime monitor function

Safety	
☐	⚠ **WARNING!** Obey all safety instructions for the drive. Only qualified electricians are allowed to start up the drive.
Preliminary actions	
☐	Make sure that you have made the Lifetime monitor parameters visible using the user lock pass code *584* in parameter *96.02 Pass code*.
☐	Configure parameters as in *Parameter settings*, but set parameter *75.70 Start lifetime monitor* = *Off*.
Parameter settings	
☐	⚠ **WARNING!** Incorrect values can cause wrong results of lifetime calculation, that can further lead to accidents and injuries. The functionality should be verified by a commissioning engineer together with the customer.
☐	Define the hoist nominal values: *75.03 Motor base speed* *75.31 Hoist nominal load* *75.32 Hoist nominal speed* *75.33 Hoist maximum speed*
☐	Tune the hoist lost weight calculation as per the instructions on page *108*.
☐	Set the lifetime monitor parameters: *75.71 Crane lifetime* *75.74 Lifetime speed scaling*
☐	Start the Lifetime monitor function: *75.70 Start lifetime monitor* = *On*
☐	After setting the parameters, hide the Lifetime monitor function parameters with *96.02 Pass code* = 1.
☐	Monitor the values in the signals: *09.10 Lifetime left* *09.11 Lifetime left in percent* *09.12 Load spectrum factor* *09.13 Lifetime sw* *75.80 Lifetime used* Warnings or maintenance indicators can be taken from *09.13 Lifetime sw*, bit 1. When the bit is set to 1, the drive generates the warning *D216 Liftetime left less 10%*, for example to the relay output ROxx.

Lifetime monitor maintenance

The following maintenance tasks can be done if any changes are recorded in the load spectrum of the crane system.

- *Copying old values to new system* (page *45*)
- *Reseting the load spectrum recorder* (page *46*)

Copying old values to new system

If you replaced a control board or a complete drive, copy the old values to the new system (e.g. from the parameter file). Follow the instructions below:

	Safety
☐	⚠ **WARNING!** Obey all safety instructions for the drive. Only qualified electricians are allowed to start up the drive.
	Preliminary actions
☐	Make sure that you have made the Lifetime monitor parameters visible using the user lock pass code *584* in parameter *96.02 Pass code*.
☐	Configure parameters as in *Parameter settings*, but set parameter *75.70 Start lifetime monitor* = *Off*.
	Parameter settings
☐	Crane operating hours (run with open brake): 1. Copy the value from parameter *09.20 Crane operation hours* into parameter *33.201 Crane operation hrs init value*. 2. Activate the set command with parameter *33.200 Set crane operation hours*.
☐	Lifetime monitor actual values: 1. Copy the value from parameter *09.12 Load spectrum factor* into parameter *75.73 Preset value of load spectrum*. 2. Activate *75.72 Reset load spectrum* = *Reset*.
☐	Re-start the Lifetime monitor function: *75.70 Start lifetime monitor* = *On*
☐	After setting the parameters, hide the Lifetime monitor function parameters with *96.02 Pass code* = 1.

Reseting the load spectrum recorder

If you did some maintenance work on a hoist unit, reset the load spectrum recorder to its starting values. Follow the instructions below:

	Safety
☐	**WARNING!** Obey all safety instructions for the drive. Only qualified electricians are allowed to start up the drive.
	Preliminary actions
☐	Make sure that you have made the Lifetime monitor parameters visible using the user lock pass code *584* in parameter *96.02 Pass code*.
☐	Configure parameters as in *Parameter settings*, but set parameter *75.70 Start lifetime monitor* = *Off*.
	Parameter settings
☐	Crane operating hours (run with open brake): 1. Set parameter *33.201 Crane operation hrs init value* = 0. 2. Activate the set command with parameter *33.200 Set crane operation hours*.
☐	Lifetime monitor actual values: 1. Set parameter *75.73 Preset value of load spectrum* = 0. 2. Activate *75.72 Reset load spectrum* = *Reset*.
☐	Re-start the Lifetime monitor function: *75.70 Start lifetime monitor* = *On*
☐	After setting the parameters, hide the Lifetime monitor function parameters with *96.02 Pass code* = 1.

3

Using the control panel

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

4

Crane program features

Contents of this chapter

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

Overview of the control program

ABB industrial drive modules with the crane control program can be used in cranes that require independent movements, both in

- indoor electric overhead traveling (EOT) cranes and
- outdoor tower cranes.

Indoor cranes like EOT cranes typically have such motions as hoist, trolley and long travel. Outdoor cranes like tower cranes typically have such motions as hoist and trolley.

The start, stop and control signals can be analog, digital or fieldbus-based from a programmable logic controller (PLC). See a typical crane control interface in section *Crane control interface* on page *50*.

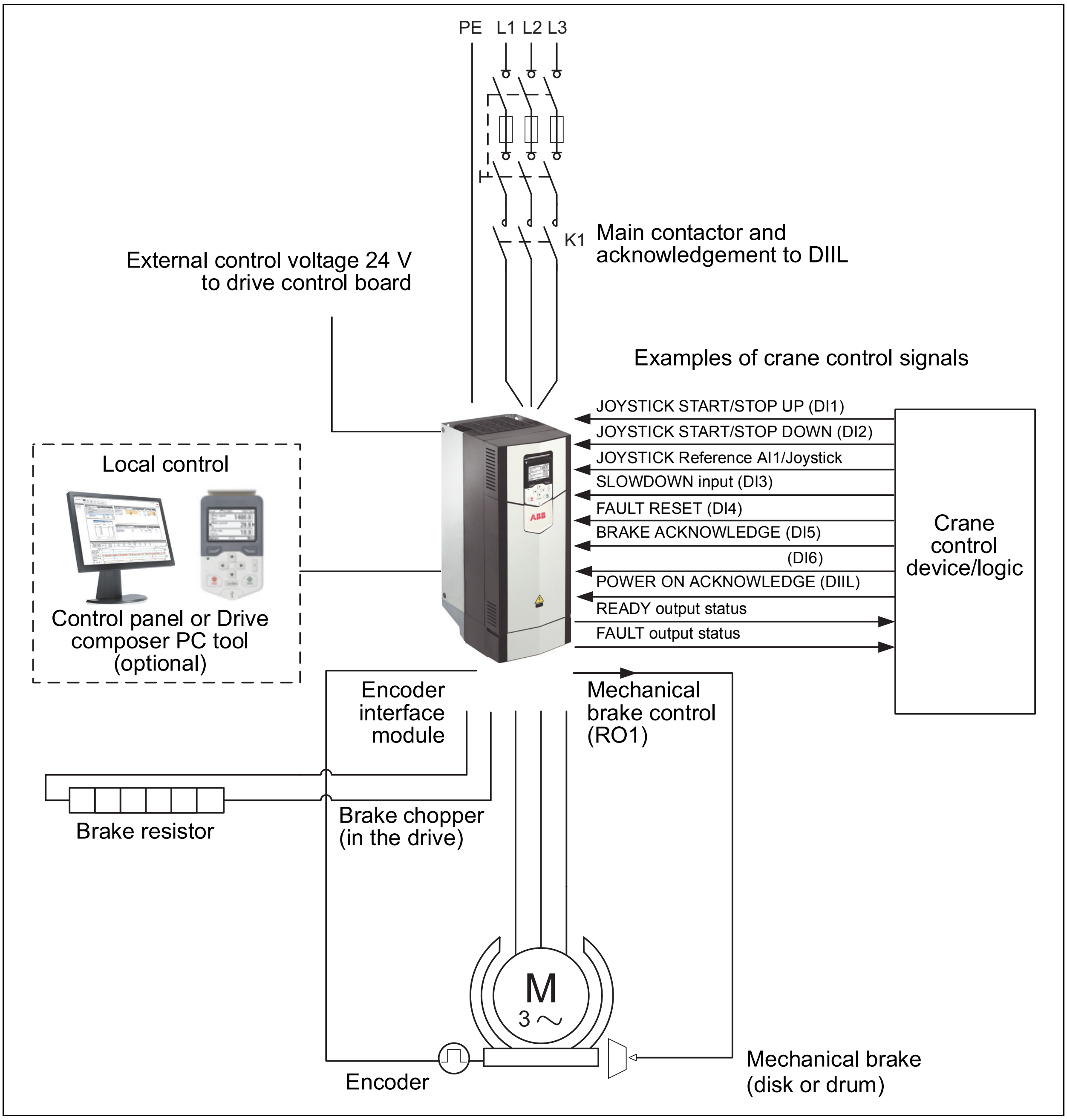
The control program includes four different user parameter sets for customizing the parameter settings. Each set includes two different control places and an overriding emergency control place. For more information, see section *User parameter sets* on page *192*.

ABB product offering for cranes highlights safety and performance. With a crane drive, every component that increases safety must be used. For example, in hoist drives, closed loop control (encoder or external supervision) must be used for safe speed supervision.

Crane control interface

The control program includes external control locations EXT1 and EXT2 for normal operation. For temporary overriding control, the control program includes an emergency control mode. For more information on the external control locations, see section *Local control vs. external control* on page *134*. For more information the emergency control mode, see section *Emergency control mode* on page *51*.

Overview diagram of a crane drive and its control interfaces



Emergency control mode

The Emergency control mode overrides control locations EXT1 and EXT2 when the drive is in external control.

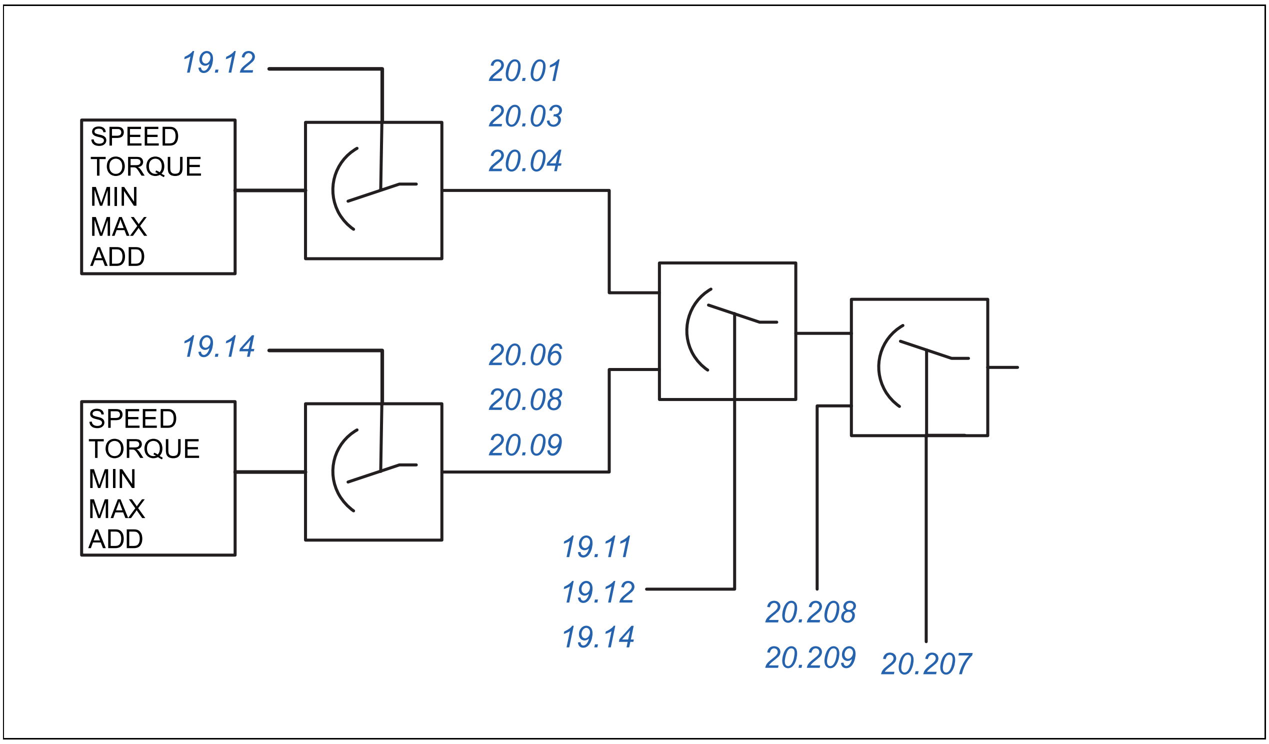
Note: If you have, for example, a control panel in local control, the Emergency control mode does not override it.

The end-user can use the Emergency control mode as the last control possibility to safely operate the crane, for example, if control locations EXT1 and EXT2 are not working. The Emergency control mode is not meant to be used in normal operation.

When the drive operates in the Emergency control mode, it uses the emergency control speed reference (*22.202*) and the active acceleration and deceleration times.

See also section *Speed reference priorities* on page *82*.

Function block diagram



Settings

Parameters: *20.207 Emergency control enable*, *20.208 Emergency control forward*, *20.209 Emergency control reverse*, *22.202 Emergency control reference*, *23.23 Emergency stop time*

Signals: *09.02 Crane SW2*

Warnings: -

Faults: -

Start/stop interlocking

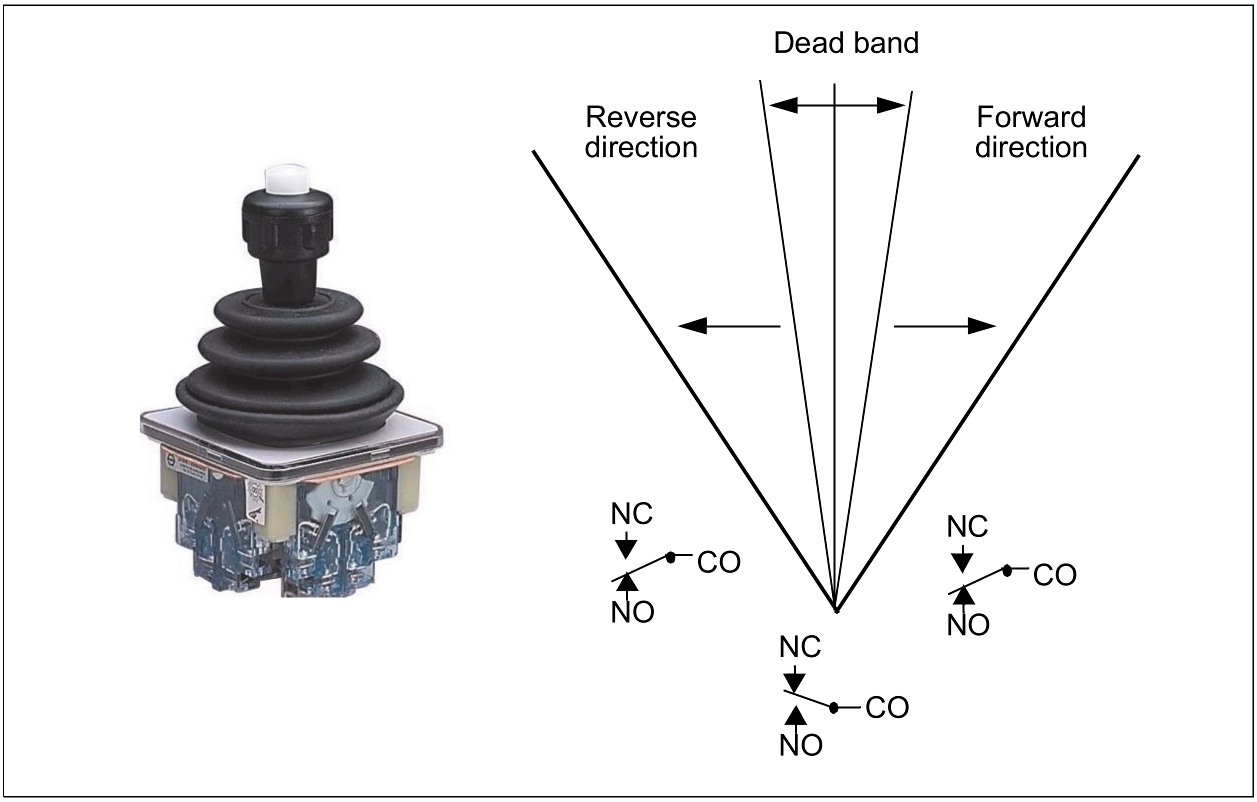
The Start/stop interlocking function of the control program lets the end-user start the crane only when the drive is ready to operate. The Start/stop interlocking function includes:

- *Joystick zero position interlocking*
- *Joystick reference interlocking*
- *Pending start interlocking*.

Joystick zero position interlocking

This function supervises the zero position of the joystick while the drive is running and a stop command is given, or if the drive trips on a fault. A falling edge of the zero position input (*20.214*) must occur before the end-user can give a new start command after stopping or tripping. If the drive logic does not detect a falling edge (that is, the signal remains high) before a new start command is given, the drive generates a warning (*D209*).

This figure shows how the joystick works with NO (normally open) contact elements for start/stop in the forward and reverse directions and one NC (normally closed) contact element for the zero position.

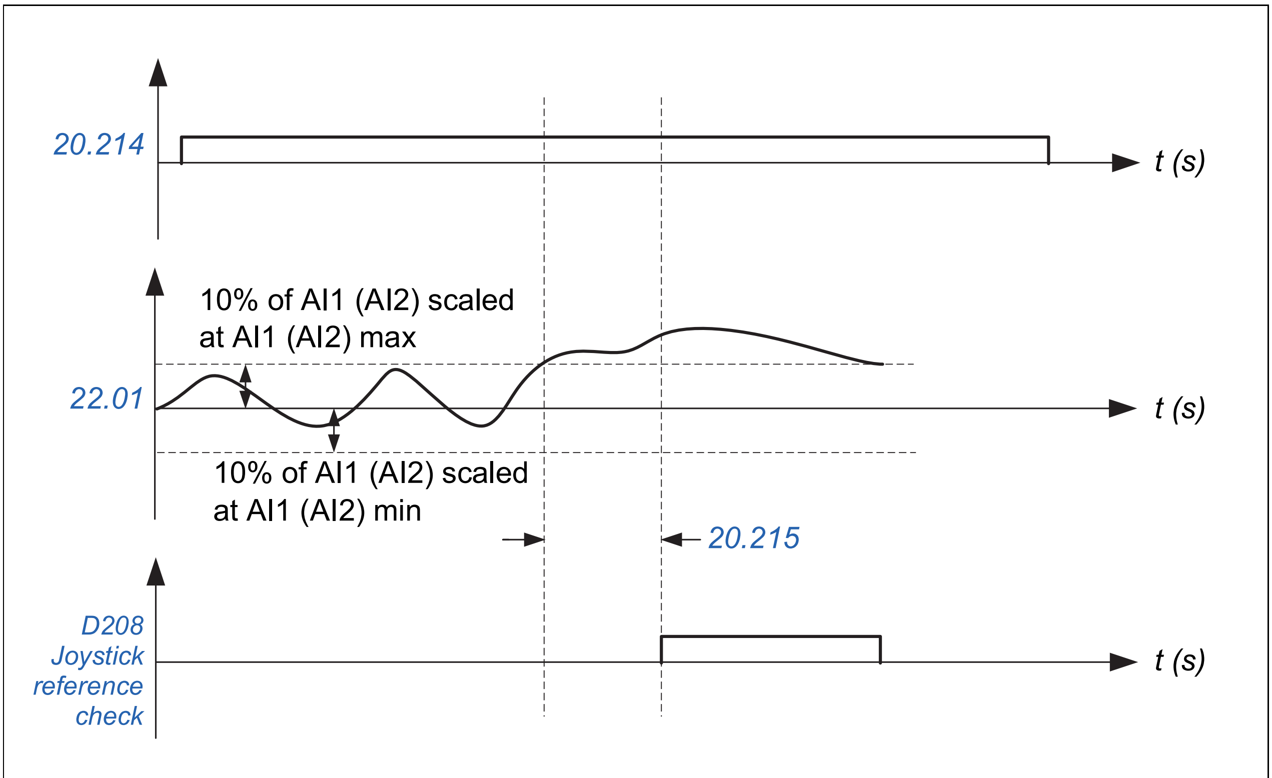


Joystick reference interlocking

This function can be used for checking the analog reference coming from the joystick. If the joystick zero position input (*20.214*) is active and the speed reference or torque reference is greater than +/- 10% of the minimum or maximum scaled value of the used reference, the drive generates a warning (*D208*) after a time delay (*20.215*).

Timing diagram

The diagram shows the operation of the *Joystick reference check* warning.



Pending start interlocking

When the joystick zero position input (*20.214*) is not used for Joystick zero position interlocking (page *52*), the drive generates a warning (*D207*) when it trips on a fault or stops in some condition, and the start request remains active.

Settings

Parameters: *20.214 Joystick zero position*, *20.215 Joystick warning delay*

Signals: *09.01 Crane SW1*

Warnings: *D207 Wrong start sequence*, *D208 Joystick reference check*, *D209 Joystick zero position2*

Faults: -

Master/follower communication in crane application

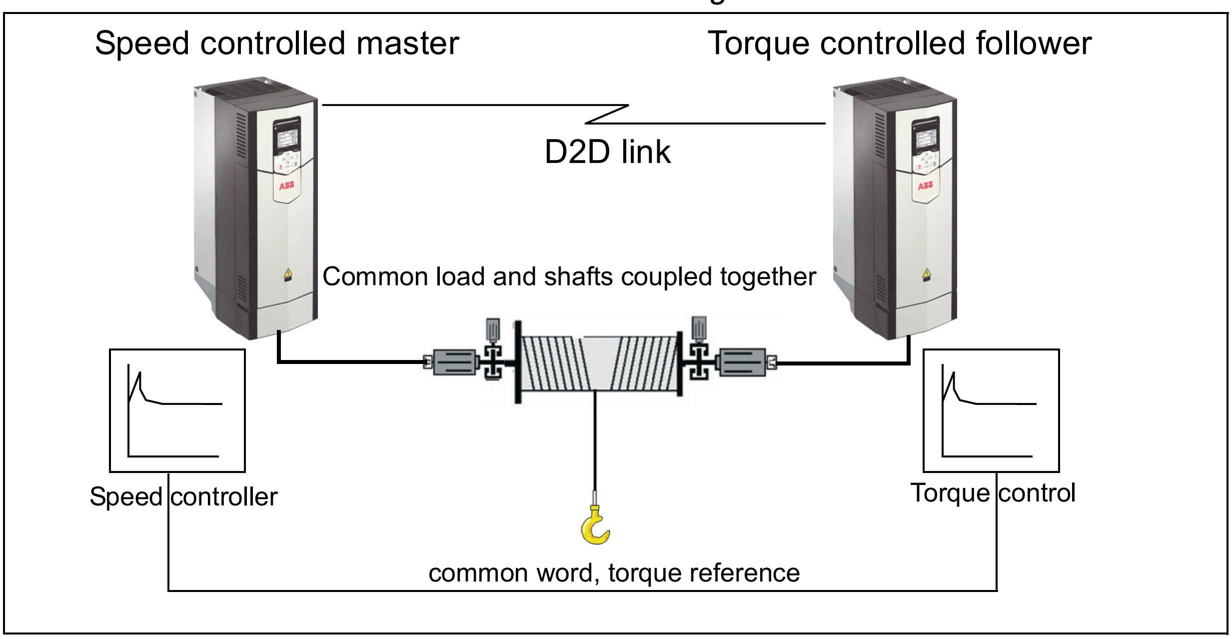
The master/follower function in the crane application is implemented in the application program instead of the primary control program and also uses D2D-link instead of optical link, because it contains more number of nodes and more interlock signals. The program uses the same D2D-link for antisway communication between the hoist, trolley and long travel drives. See the D2D-link configuration diagram on page 56.

M/F communication types in crane application

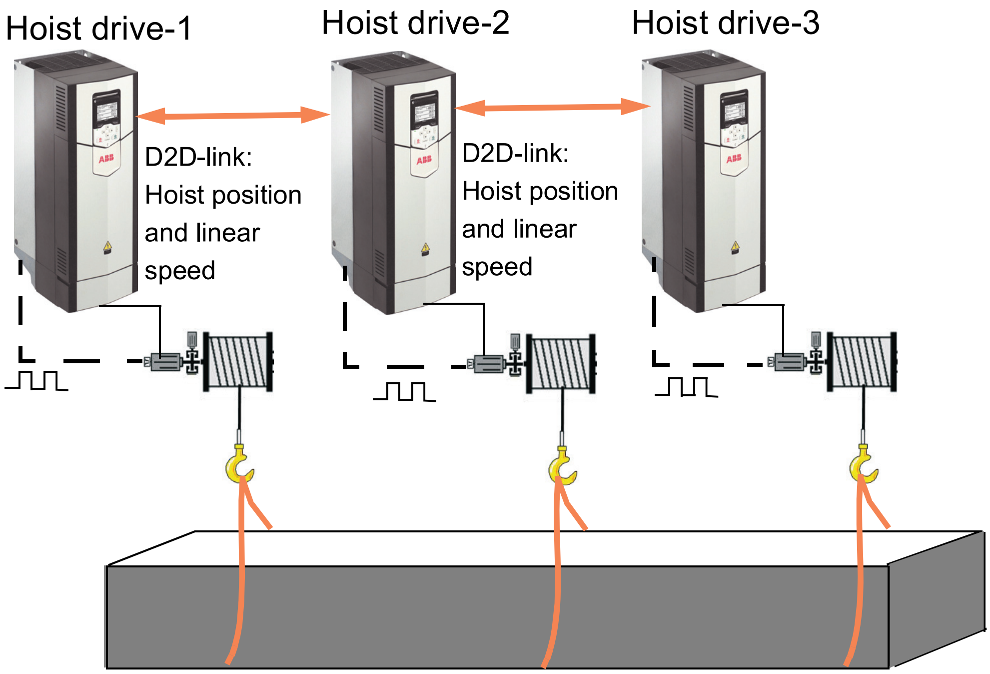
The following M/F connections are possible in a crane application:

- 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. So the follower drive as torque control, for example, a hoist with two drives and motors run a common drum. See figure *M/F communication for drives with shafts running a common load* below.
- 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, for example, two trolleys in a common bridge. See figure *M/F communication for drives with separate drums and shaft synchro* below.
- In a shaft synchro (electrical shaft), 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 follower position is compared with the position of the master and required speed correction is added to its own speed reference chain. See *Shaft synchro* on page 61.

M/F communication for drives with shafts running a common load



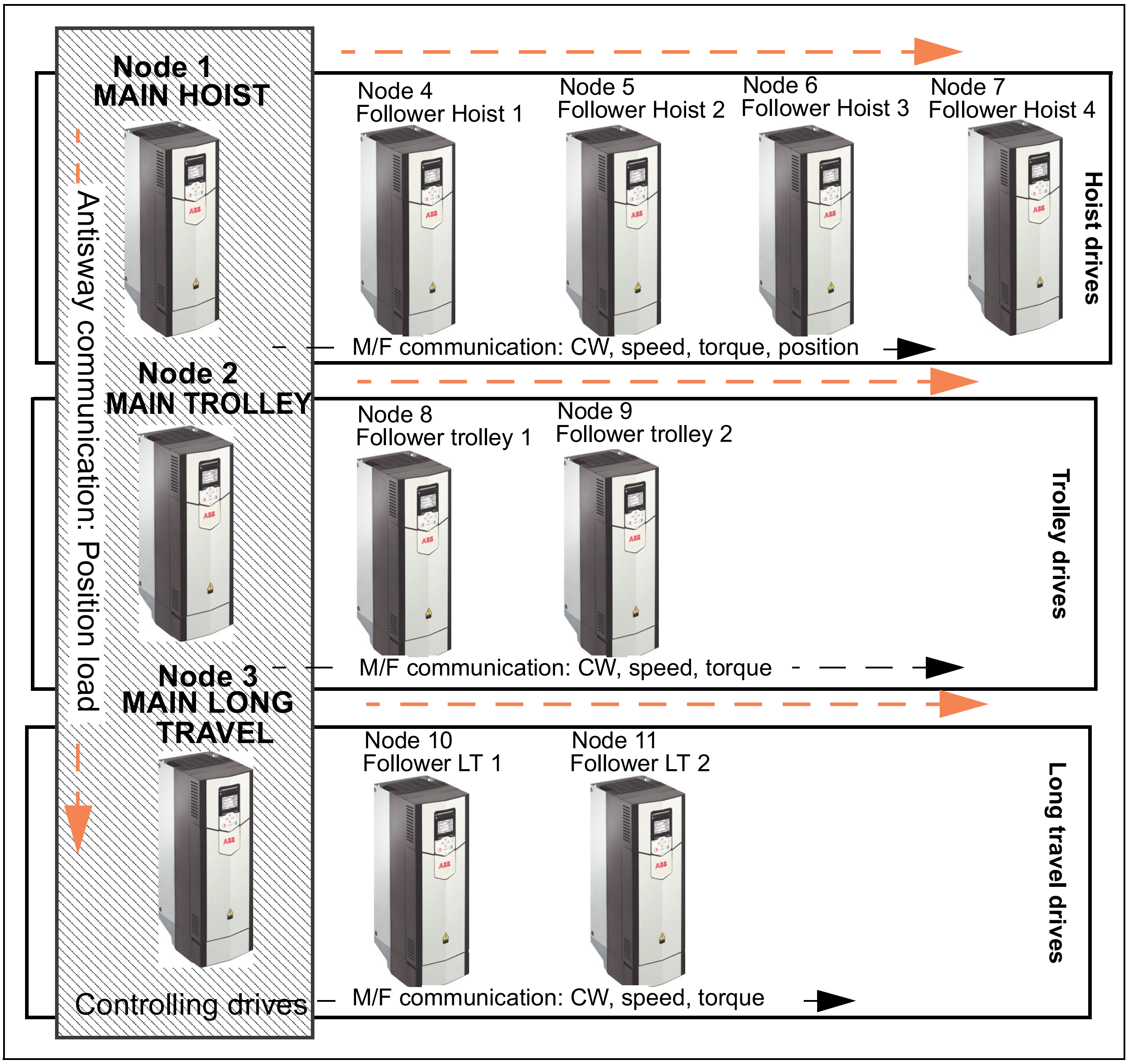
M/F communication for drives with separate drums and shaft synchro



Note: In trolley and long travel drives, speed control is achieved with speed correction (±) from the synchro control function. See description in section Shaft synchro control function.

D2D-link configuration in crane application

The figure below shows the D2D-link configuration.



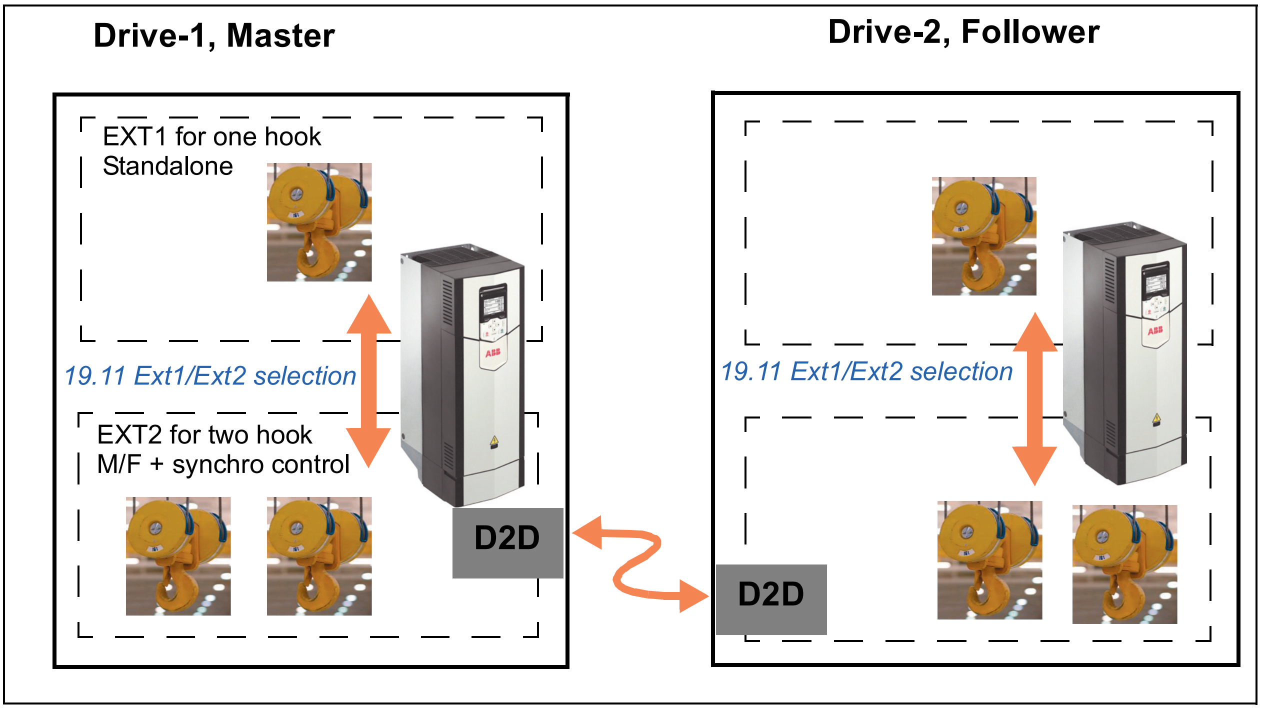
The total number of the drives in the crane master-follower/D2D-link is 11:

- Main hoist and 4 followers
- Main trolley and 2 followers
- Main long travel and 2 followers

Main hoist is the master for the full communication network, which must exist always in the system.

M/F communication: From the main drives (main hoist, main trolley, main long travel) to the followers, communication happens through command and status words, interlocks and references. This communication works only when both the master and the follower(s) are in external control location 2 (EXT2).

Both master and follower drives must have the same control location EXT2, when the master received a start order. See figure below. If the drives have wrong control locations, the warning *D20E M/F control location mismatch* appears.



Antisway communication: In this communication, the main hoist drive transmits antisway data, for example, position and load to the main trolley and long travel drives. This communication works also in control location EXT1.

D2D-link: In each drive, M/F communication or antisway communication in the D2D-link is activated with parameter *60.200 Crane drive type* (main hoist, main trolley, etc.) by selecting the appropriate drive type. The application then sets all the needed parameters in the D2D-link. **User should not set any** of these parameters manually in the parameter groups *60 DDCS communication*, *61 D2D and DDCS transmit data* and *62 D2D and DDCS receive data*.

Communication supervision is activated with parameter *60.201 Crane drives structure* in the main drives. Each of the main drives supervises its respective followers. Setting in main hoist can be *60.201* = 0000000001111000, bits 3, 4, 5 and 6 are set, Follower hoist 1…4 are supervised.

Example of parameter settings for D2D-link configuration: Speed-to-speed setup

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

Parameter	Master	Follower	Notes
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 Crane 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 Crane drives structure	bit 3 = Follower hoist 1 = 1 Rest of the bits = 0	Not needed	Setup the bits of used drives in the master drive.
Setting reference signals parameters			
22.12 Speed ref2 source	AI1 scaled	Not needed	If reference comes from AI1.
22.14 Speed ref1/2 selection	Follow Ext1/Ext2	Follow Ext1/Ext2	
Setting Start/Stop/Direction parameters			
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

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

Example of parameter settings for D2D-link configuration: Speed-to-torque setup

The below table shows the master-follower settings for speed-to-torque setup:

Parameter	**Master**	**Follower**	**Notes**
Selecting the control location			
19.11 Ext1/Ext2 selection	DI6	DI6	Or another source
19.14 Ext2 control mode	Speed	Torque	-
Setting D2D communication parameters			
60.200 Crane 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 Crane drives structure	bit 3 = Follower hoist 1 = 1 Rest of the bits = 0	Not needed	Setup the bits of used drives in the master drive.
Setting reference signals parameters			
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	
26.14 Torque ref1/2 selection	Not needed	Torque reference 2	EXT2, then torque reference 2
Setting Start/Stop/Direction parameters			
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

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

Example of parameter settings for antisway communication: From host to main trolley

The below table shows the master-follower settings for antisway communication from host to main trolley:

Parameter	Master (Hoist)	Antisway drive (trolley)	Notes
Selecting the control location			
The control location in both drives is selected according to the control circuit diagram and application requirements.			The hoist and antisway drives work independently from each other.
Setting D2D communication parameters			
60.200 Crane drive type	Main hoist	Main trolley	• Main hoist is D2D master. • D2D communication can be established only if the main hoist drive exists.
60.201 Crane drives structure	bit 1 = Main trolley = 1 Rest of the bits = 0	Not needed	Setup the bits of used drives in the D2D master drive in case supervision of D2D communication is needed.
77.20 Pendulum length source	Par *90.05 Load position scaled*	D2D	In the hoist drive, configure settings for scaling and position counter.
77.30 Load signal source	Not needed	D2D	In the antisway drive, configure settings if load information is needed. For example, offset steps.
77.80 Load to antisway selection	Internal = *77.81 Hoist load from torque act*, Other = *75.40 Relative hoist load*	Not needed	In hoist drive, configure settings if load signal is needed in the antisway drive. If *75.40 Relative hoist load* is used, configure required settings in group *75 Hoist speed optimization*.

Note:

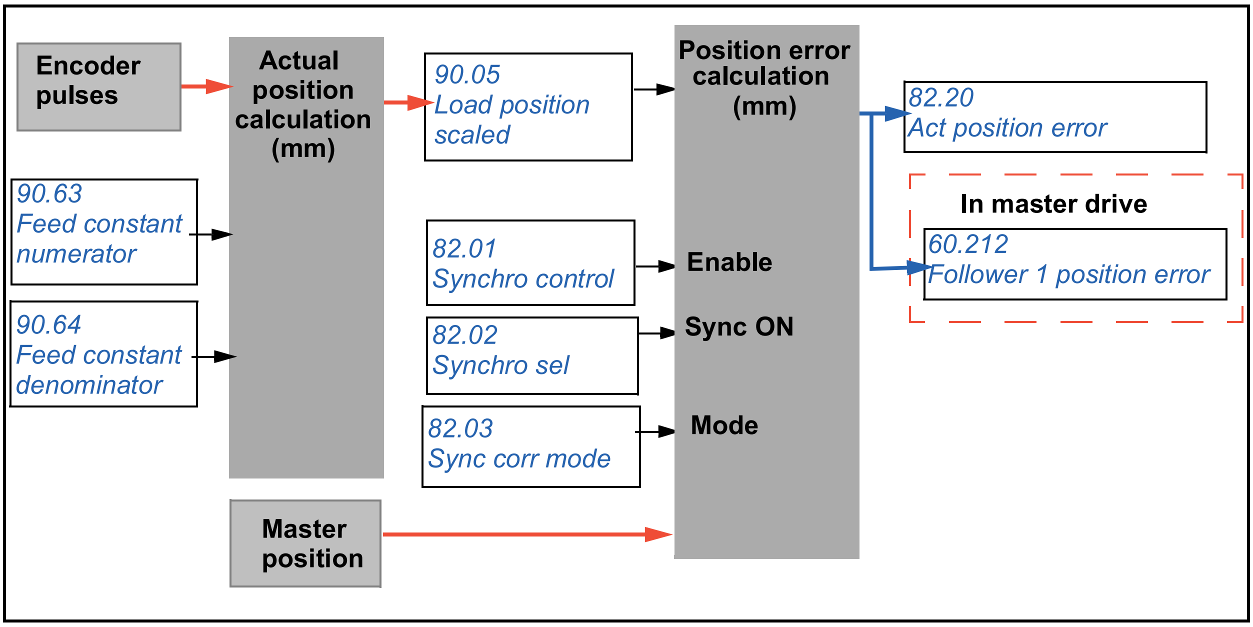
- Similar settings are used for long travel drive. See (trolley) column. Set parameter *60.200 Crane drive type* = *Main long travel*.
- Do not change any other parameters in group 60 than listed here. The selections in parameter *60.200 Crane drive type* automatically changes the rest of communication parameters.

Shaft synchro

The Shaft synchro function synchronises the master and follower drives when the drives are in the master/follower mode (see *M/F communication types in crane application* on page *54*). However, synchronisation is used only when the drives are set to speed control mode and have control location EXT2 active. Through the D2D-link the master drive position is transferred to the follower. The follower uses the difference between the positions as the speed correction factor in the speed control loop of the follower drive.

Synchro control - basic function block diagram

The diagram shows the basic functionality of the synchro control function. For full functionality, see the *Synchro control - full function block diagram* on page *63*.



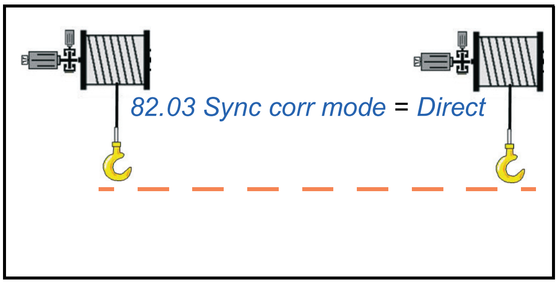
The parameter *82.01 Synchro control* = *On* activates the execution of the Shaft synchro function in the master and follower drives. The master sends linear rope speed instead of motor rotation speed reference. In both, master and follower position calculation must be set to corresponding real linear speed, see *Position counter initialization and scaling for crane control program* on page *124*.

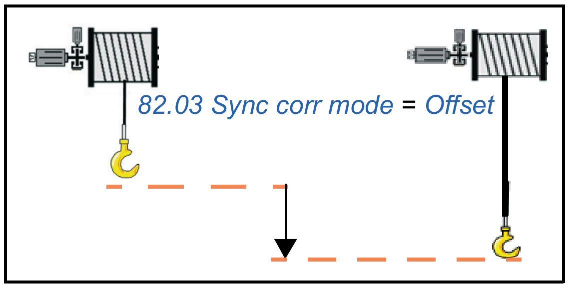
With parameter *82.02 Synchro sel* the source is defined to activate position error calculation and speed correction to reference chain in follower drive.

Normally both the hoist drives are driven in standalone mode (EXT1) to the right position separately. Then switchover to EXT 2 happens and master/follower communication is activated between the drives. Finally with parameter *82.02 Synchro sel* position calculation and corrections are activated according to the selected correction mode. Correction modes are defined with parameter *82.03 Sync corr mode*.

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

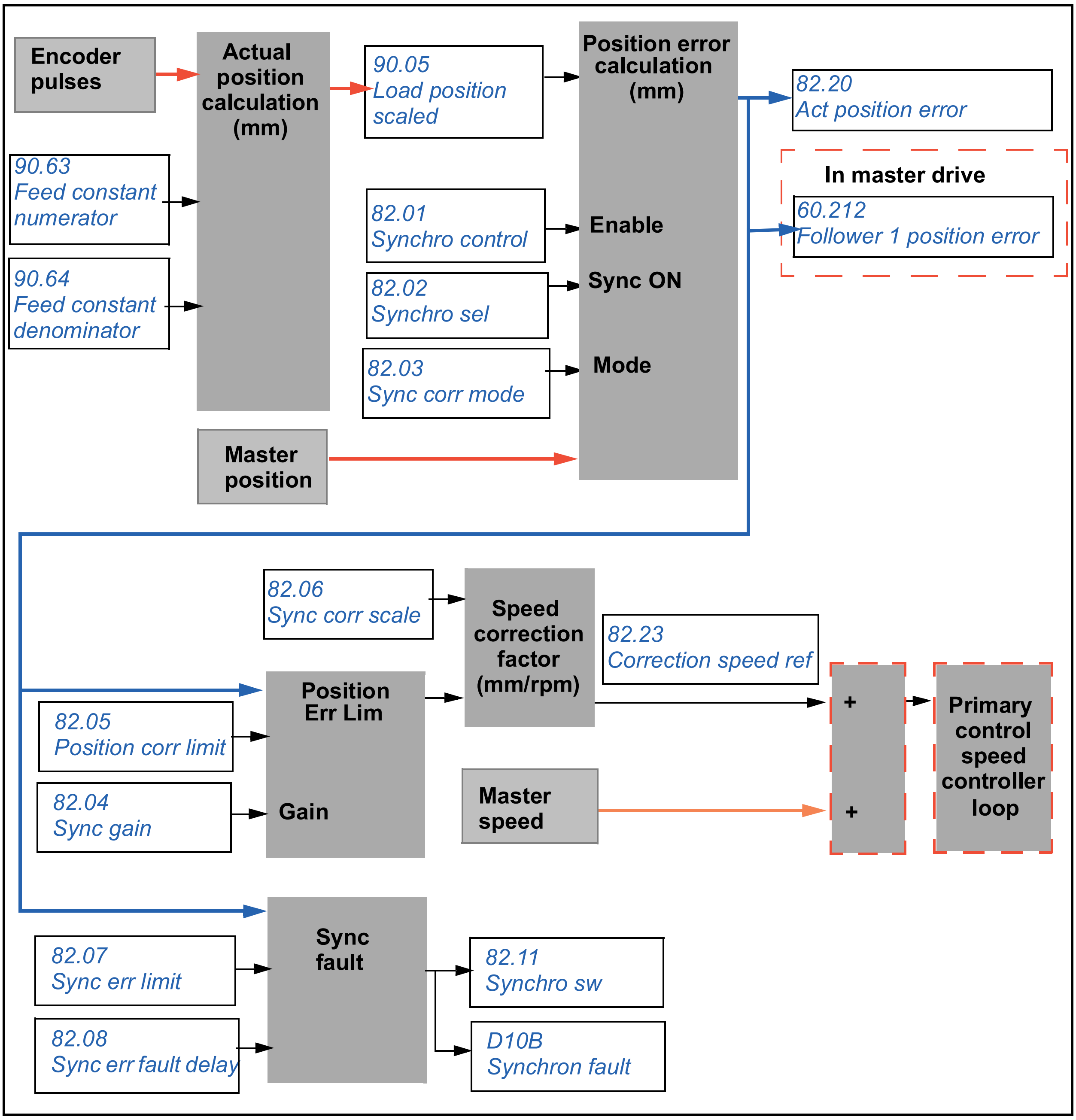
Offset mode = In this mode, the position difference (offset) between the master and follower drives at the time of activating *82.02 Synchro sel* is the controlled manner. See figure below.





Synchro control - full function block diagram

The full functionality of synchro control is a combination of the basic function and the synchro correction. See the elongated block diagram below.



The first part of the synchro control function is the basic function described in *Synchro control - basic function block diagram* on page *61*. The second part of the synchro control function is the synchro correction. Parameter *82.05 Position corr limit* is used for limiting the speed correction in millimeters. If the detected error exceeds this parameter, the speed correction is limited to these parameter values.

When detected absolute error is greater than the value defined in *82.07 Sync err limit* for a period longer than *82.08 Sync err fault delay*, the drive trips on *D10B Synchron fault* and *82.11 Synchro sw*, bit 3 is set.

To reset the fault, deactivate *82.02 Synchro sel* (example, DIx).

Example 1: Parameter settings for Synchro control (Speed-speed+position) setup

The example below shows the parameter settings of the system with main hoist and follower hoist1 (linear speed - linear speed + position)

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 Crane 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 Crane drives structure	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			
82.01 Synchro control	ON	ON	Or pointer to DI
82.02 Synchro sel	Select	Select	Or pointer to DI
82.03 Sync corr mode	Offset	Offset	Or Direct
82.04 Sync gain	Not needed	2	P controller tunning

Parameter	Master	Follower	Remarks
82.05 Position corr limit	Not needed	100	Maximum position error value that is used by P-controller.
82.06 Sync corr scale	Not needed	3 rpm/mm	Position to speed coefficient that is used by P-controller.
82.07 Sync err limit	Not needed	50 mm	Allowed position error difference that triggers the fault delay timer.
82.08 Sync err fault delay	Not needed	5 s	Delay time before the detected Sync error appears.
82.09 Position hysteresis	Not needed	10 mm	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

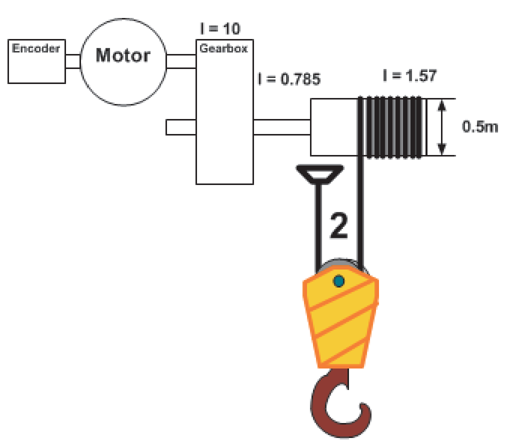
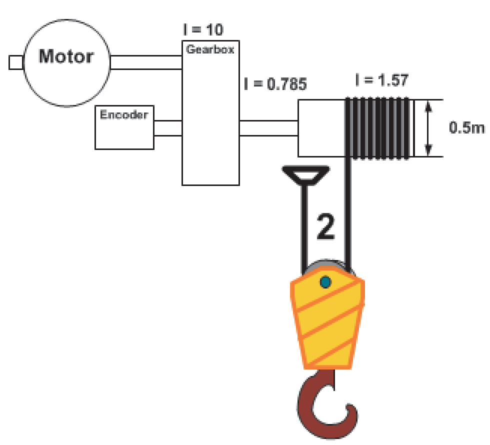
Note: Do not change any other parameters in group 60 than listed here. The selections in parameter *60.200 Crane drive type* automatically changes the rest of communication parameters.

Example 2: Parameter settings for encoder mounted/not mounted on motor shaft

The Synchro function uses same set of parameters for speed reference scaling and position scaling, due to which it is needed to configure additional parameters when the encoder is not mounted on a motor shaft. Parameter settings are based on the mechanics of the crane.

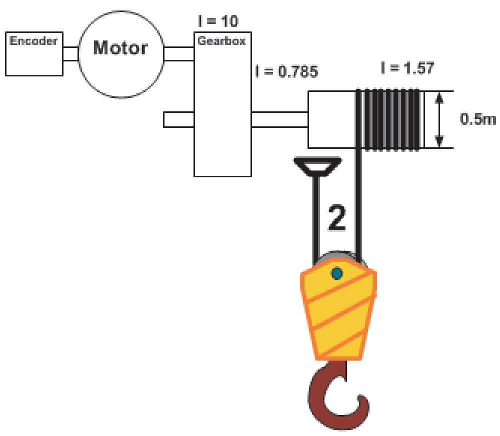
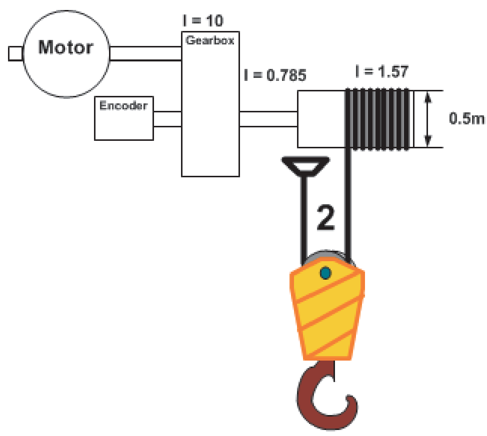
- If the crane mechanics are identical and when encoder is mounted/not mounted on a motor shaft, use *Simplified settings (identical mechanics)* on page *66*.
- If the crane mechanics are not identical and when encoder is mounted/not mounted on a motor shaft, use *Complete settings (non-identical mechanics)* on page *68*.

Simplified settings (identical mechanics)

Encoder mounted on motor shaft	Encoder not mounted on motor shaft (is on the drum shaft)
Common for both conditions	
Used speed reference = 1000 rpm Drum diameter: 500 mm = 0.5 m One turn of the drum causes the rope to shift by: 3.14 x Drum diameter = 3.14 x 0.5 m = 1.57 m Polyspast number 2 (two ropes), then one turn of the drum shifts the hook by: 1.57 m/2 = 0.785 m Gearbox (motor to drum), I = 10, then one turn of the motor causes: 0.785 m/10 = 0.0785 m	
	

Encoder mounted on motor shaft	**Encoder not mounted on motor shaft (is on the drum shaft)**
Master drive settings	
Set the following parameters for the Synchro control function, to scale the rotation of the motor to linear speed of the hook: *90.63 Feed constant numerator* = 785 *90.64 Feed constant denominator* = 100000 Position calculation: Scaling = 0.0785 Speed of the motor = 1000 rpm Speed of the encoder = 1000 rpm Position = 0.0785 meter/motor revolution Linear speed reference to follower = 1000 x 0.0785 = 78.5 mpm (meter/minute)	Set the following parameters for the Synchro control function, to scale the rotation of the encoder shaft to linear speed of the hook: *90.63 Feed constant numerator* = 785 *90.64 Feed constant denominator* = 1000 Position calculation: Scaling = 0.785 Speed of the motor = 1000 rpm Speed of the encoder = 1000/10 = 100 rpm Position = 0.785/10 meter/motor revolution Linear speed reference to follower = 1000 x 0.785 = 785 mpm (meter/minute) **Note**: Linear speed is calculated in relation to encoder (if encoder speed reference was 1000 rpm).
Follower drive settings	
In follower drive, set the following parameters for Synchro control function, to convert linear speed of the master drive to rotational speed reference for the follower motor: *90.63 Feed constant numerator* = 785 *90.64 Feed constant denominator* = 10000 Linear speed of master = 78.5 mpm Speed reference for motor = 78.5/ 0.0785 = 1000 rpm Position = 0.0785 meter/motor revolution	In follower drive, set the following parameters for Synchro control function, to convert linear speed of master drive to rotational speed reference for the follower motor: *90.63 Feed constant numerator* = 785 *90.64 Feed constant denominator* = 1000 Linear speed of master = 785 mpm Speed reference of motor = 785/0.785 = 1000 rpm Position = 0.785/10 meter/motor revolution

Complete settings (non-identical mechanics)

<table>
<tr><th>Encoder mounted on motor shaft</th><th>Encoder not mounted on motor shaft (is on the drum shaft)</th></tr>
<tr><td colspan="2">Common for both conditions</td></tr>
<tr><td colspan="2">Used speed reference = 1000 rpm
Drum diameter: 500 mm = 0.5 m
One turn of the drum causes the rope to shift by: 3.14 x Drum diameter = 3.14 x 0.5 m = 1.57 m
Polyspast number 2 (two ropes), then one turn of the drum shifts the hook by: 1.57 m/2 = 0.785 m
Gearbox (motor to drum), I = 10, then one turn of the motor causes: 0.785 m/10 = 0.0785 m</td></tr>
<tr><td>
</td><td>
</td></tr>
</table>

Encoder mounted on motor shaft	**Encoder not mounted on motor shaft (is on the drum shaft)**
Master/Follower drive settings	
Set the following parameters for the Synchro control function, to scale the rotation of the motor to linear speed of the hook: *90.63 Feed constant numerator* = 785 *90.64 Feed constant denominator* = 100000 Set the following parameters to compensate the difference in rotation between the encoder shaft and motor shaft: **Note**: When the encoder is mounted on motor shaft, value in parameters *90.53* and *90.54* is 1. *90.53 Load gear numerator* = 1 *90.54 Load gear denominator* = 1 <u>Position calculation</u>: Position = Encoder revolutions * (*90.63*/*90.64*) * (*90.53*/*90.54*) Position scaling = 0.0785 Speed of motor = 1000 rpm Speed of encoder = 1000 rpm Position = 0.0785 m/motor revolution Position = 0.0785 m/encoder revolution	Set the following parameters for the Synchro control function, to scale the rotation of the motor shaft to linear speed of the hook: *90.63 Feed constant numerator* = 785 *90.64 Feed constant denominator* = 10000 Set the following parameters to compensate the difference in rotation between the encoder shaft and motor shaft: *90.53 Load gear numerator* = 10 *90.54 Load gear denominator* = 1 <u>Position calculation</u>: Position = Encoder revolutions * (*90.63*/*90.64*) * (*90.53*/*90.54*) Position scaling = 0.0785 * 10 = 0.785 Speed of motor = 1000 rpm Speed of encoder = 1000/10 = 100 rpm Position = 0.0785 m/motor revolution Position = 0.785 m/encoder revolution
Master drive results	
Linear speed reference to follower = Used speed reference * (*90.63*/*90.64*) Linear speed reference to follower = 1000 * 0.0785 = 78.5 m/min	Linear speed reference to follower = Used speed reference * (*90.63*/*90.64*) Linear speed reference to follower = 1000 * 0.0785 = 78.5 m/min
Follower drive results	
Speed reference for motor = Linear speed reference from master/(*90.63*/*90.64*) Speed reference for motor = 78.5/0.0785 = 1000 rpm	Speed reference for motor = Linear speed reference from master/(*90.63*/*90.64*) Speed reference for motor = 78.5/0.0785 = 1000 rpm

Settings

Parameters: *82.01 Synchro control*, *82.02 Synchro sel*, *82.03 Sync corr mode*, *82.04 Sync gain*, *82.05 Position corr limit*, *82.06 Sync corr scale*, *82.07 Sync err limit*, *82.08 Sync err fault delay*, *82.09 Position hysteresis*, *90.53 Load gear numerator*, *90.54 Load gear denominator*, *90.63 Feed constant numerator*, *90.64 Feed constant denominator*

Signals: *82.11 Synchro sw*, *82.20 Act position error*, *82.21 Master position*, *82.22 Offset value*, *82.23 Correction speed ref*, *82.24 Master linear speed ref*.

Warnings: *D20E M/F control location mismatch*

Faults: *D10B Synchron fault*, *D10C M/F comm loss*

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 logic observes the settings of parameter group *44 Mechanical brake control* as well as several external signals. The *Brake control timing diagram* on page *72* shows an example of a close-open-close sequence.

Inputs of the brake control logic

Signals that affect the state of the control logic are

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

The brake control is, by default, enabled without supervision (*44.07 Brake acknowledge selection* = *No acknowledge*).

Outputs of the brake control logic

The mechanical brake is controlled by bit 0 of parameter *44.210 Crane brake status*. This bit is selected by default as the source of the relay output RO1 and digital input/output DIO1. See the wiring example on page *73*.

The brake control logic, in various states, requests the drive control logic to hold the motor, increase the torque, or ramp down the speed. These requests are visible in parameter *44.210 Crane brake status*.

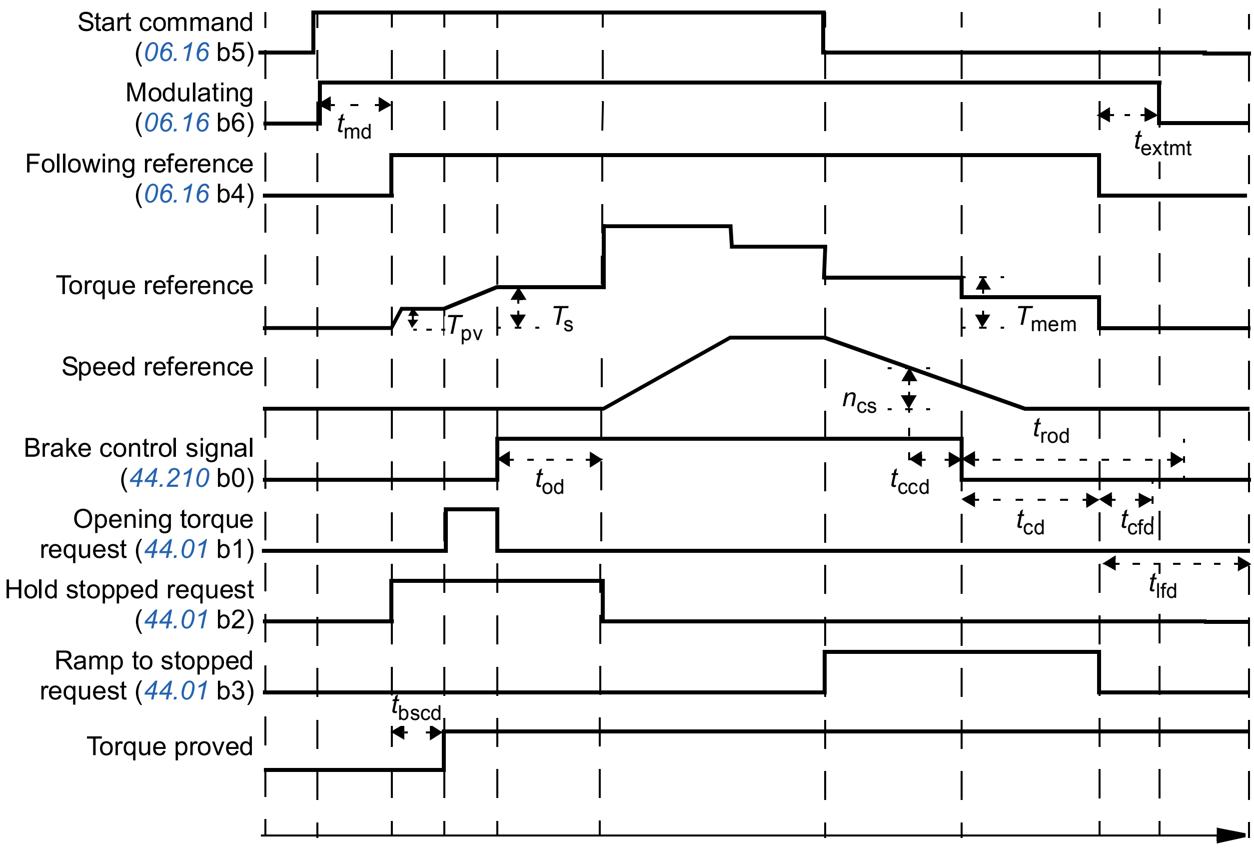
Settings

Parameters: *44 Mechanical brake control*

Signals: *09.01 Crane SW1*

Brake control timing diagram

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



T_{pv}	Torque proving reference (parameter *44.203 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 *44.204 Brake system check time*)
t_{extmt}	Extended run time (parameter *44.211 Extended runtime*)
t_{lfd}	Brake long fall delay (parameter *44.213 Brake long fall delay*)

Wiring example

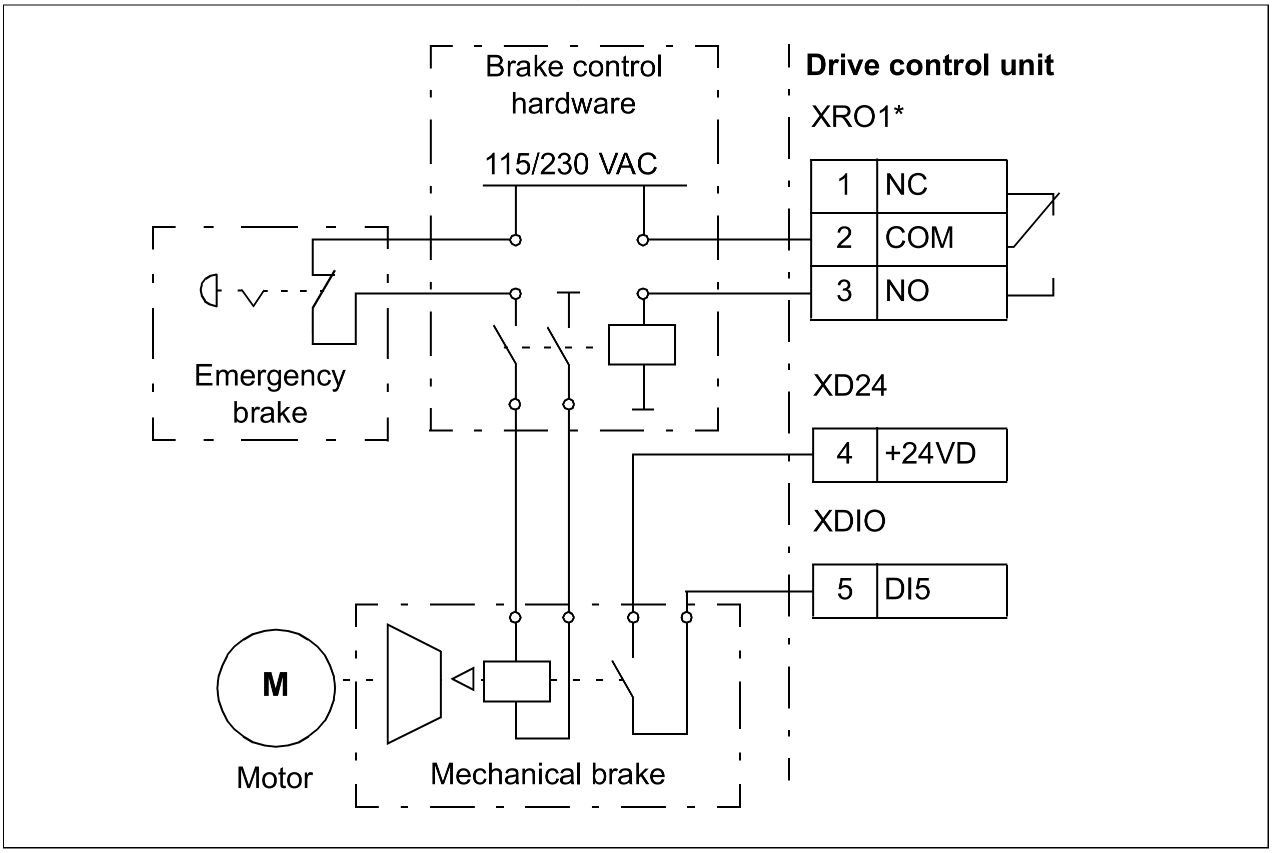
The figure below shows a brake control wiring example. The brake control hardware and wiring is to be acquired and installed by the customer.

WARNING! 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.

WARNING! Make sure that the machinery into which the drive with brake control function is integrated fulfills the personnel safety regulations.
Use relay output RO1 for brake control in the crane control program. Make sure that parameter *10.24 RO1 source* = P.44.210.0.

The brake is controlled by bit 0 of parameter *44.210 Crane brake status*. 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 *44.210 Crane 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. *44.210*.

Brake system checks – overview

The brake system checks consist of electrical and mechanical tests.

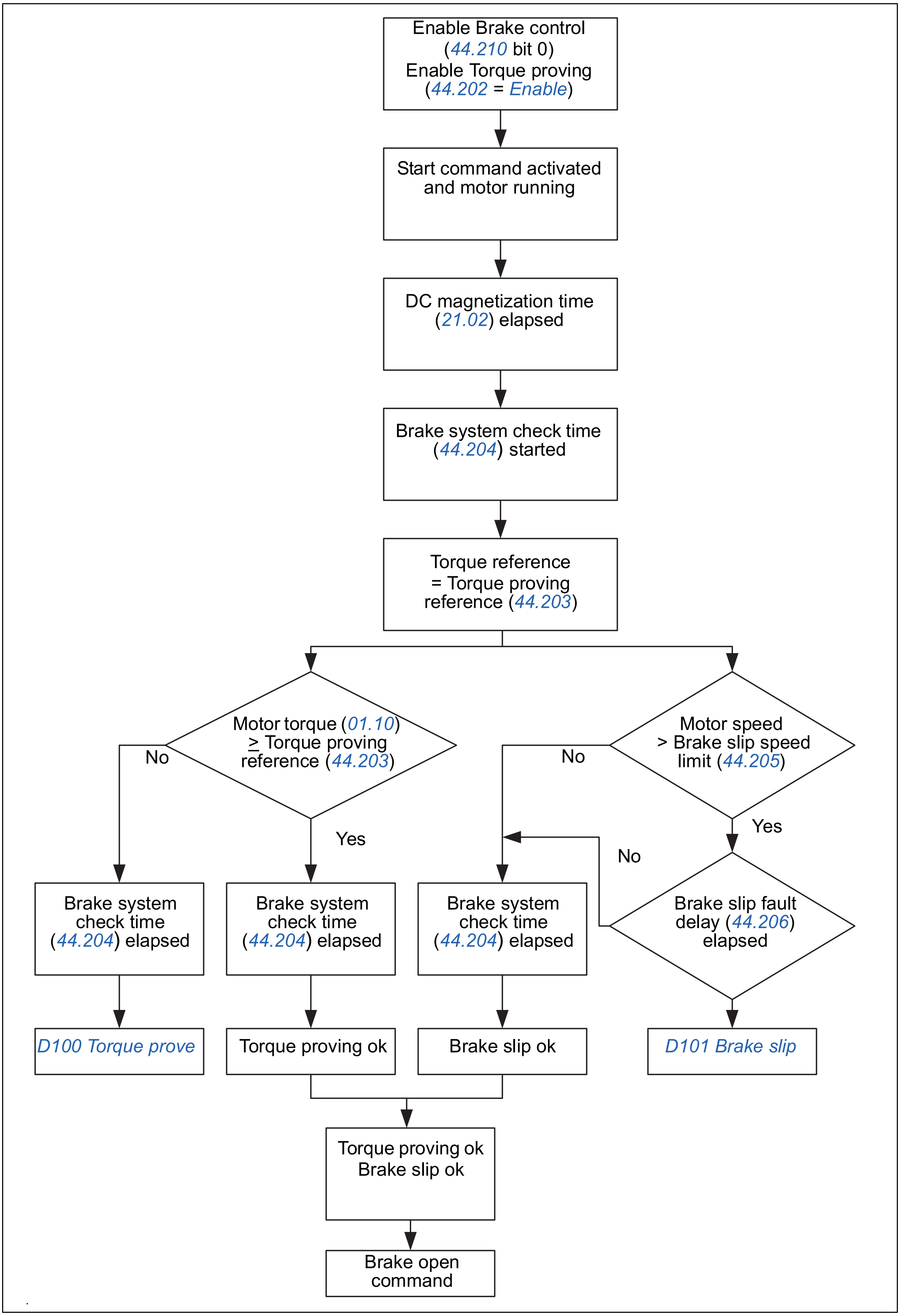
- The electrical test makes sure that the drive can produce torque before it releases the brake and starts the crane operation. That is, electrical components like the drive, motor cable and motor itself are ready to start.
- The mechanical test makes sure that the motor brake is not slipping.

Both tests are done in parallel (at the same time) during a check time (*44.204*). If both tests are performed successfully during the check time, the drive opens the brake, and the crane hoist motion starts.

For more detailed information on the tests, see sections:

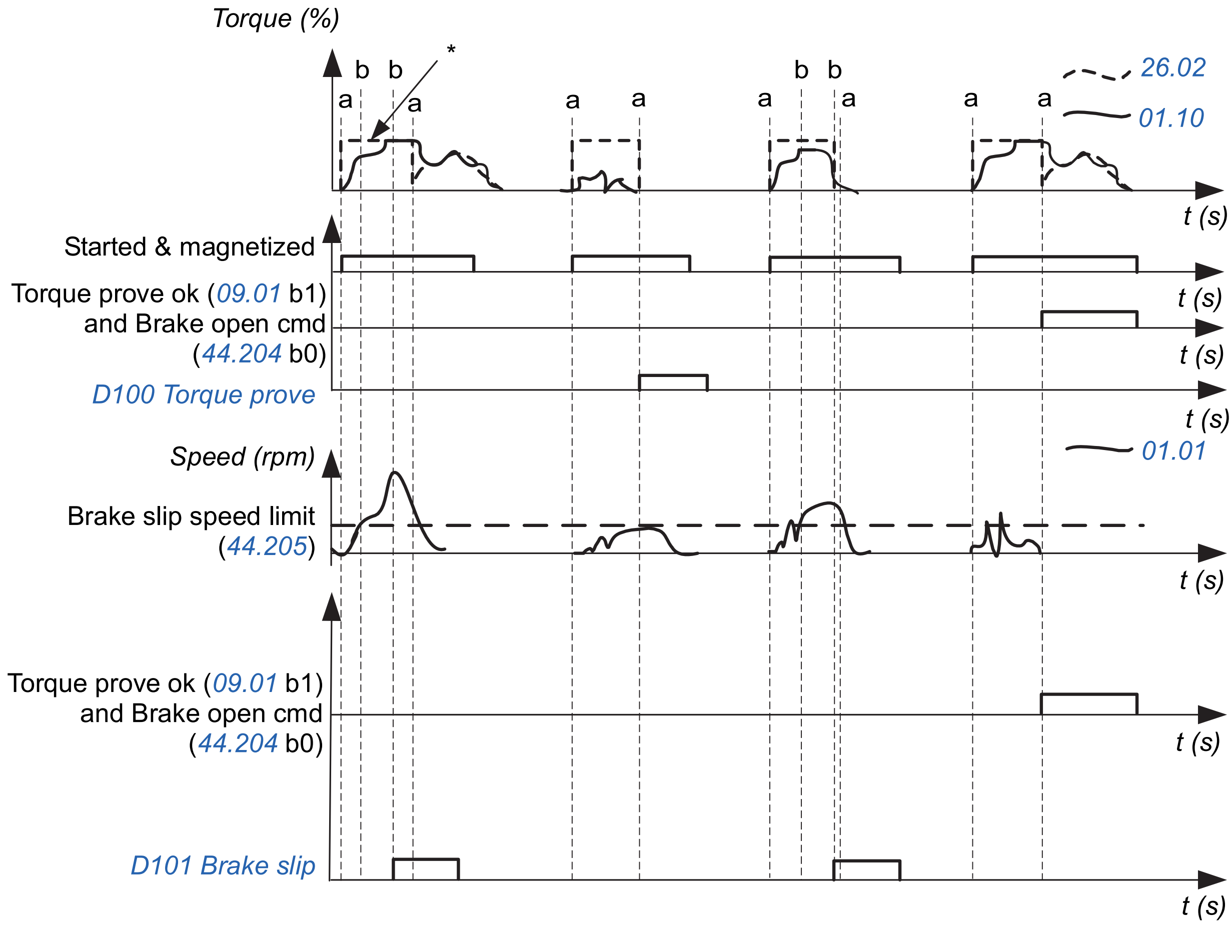
- *Brake system checks – Torque proving* on page *76*
- *Brake system checks – Brake slip* on page *77*.

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 (44.204)
b	Brake slip fault delay (44.206)

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

Brake system checks – Torque proving

Torque proving makes sure that the drive can produce torque before it releases the brake and starts the crane operation. The function is mainly intended for hoist drives, but you can also activate it in drives that control other crane motions if the drives have encoder feedback in use.

Torque proving gives a positive or negative torque reference against a closed mechanical brake. If torque proving is successful, in other words, the actual torque of the drive reaches the reference level (44.203), the drive lets the brake open and starts the next step in the starting sequence.

You can select the direction of the torque proving with a parameter (*44.201*). By default, the setting is False, which means that the torque is applied in the hoisting direction.

A time delay (*44.204*) defines the time during which the torque reference (*44.203*) is active and the electrical and mechanical tests of the crane system are completed. Unsuccessful torque proving trips the drive (*D100*).

See also the *Timing diagram* on page *76*.

Settings

Parameters: *44.201 Torque proving sign*, *44.202 Torque proving*, *44.203 Torque proving reference*, *44.204 Brake system check time*

Signals: *09.01 Crane SW1*, *09.03 Crane FW1*

Warnings: -

Faults: *D100 Torque prove*

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 (*44.205*) during a check time (*44.204*), and stays there for longer than a time delay (*44.206*), the drive trips on a fault (*D101*).

See also the *Timing diagram* on page *76*.

Settings

Parameters: *44.204 Brake system check time*, *44.205 Brake slip speed limit*, *44.206 Brake slip fault delay*

Signals: *09.03 Crane FW1*

Warnings: -

Faults: *D101 Brake slip*

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 (*44.200*)
- 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 a parameter (*44.201*). By default, the parameter is set to False, which means that the torque is applied in the hoisting direction.

Settings

Parameters: *44.09 Brake open torque source*, *44.200 Brake open torque*, *44.201 Torque proving sign*

Signals: -

Warnings: -

Faults: -

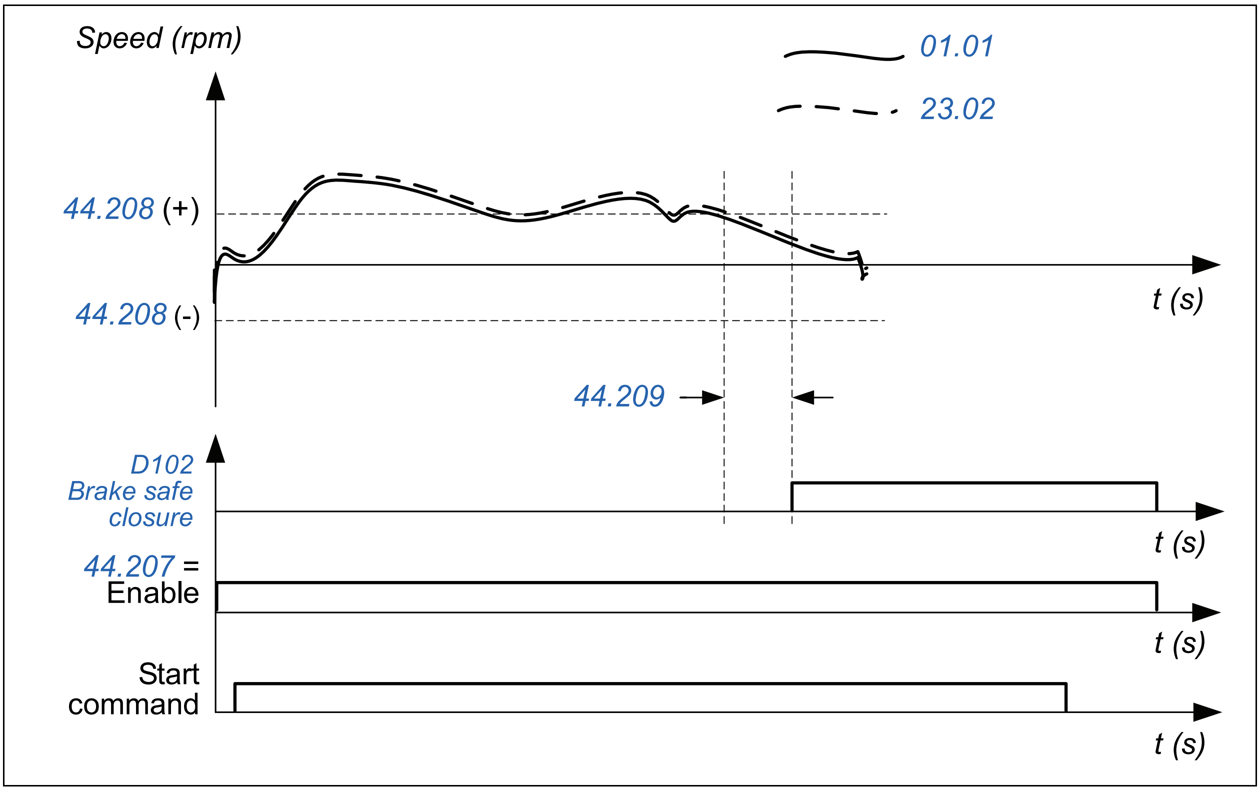
Brake safe closure

The Brake safe closure function performs a forced closure of the brake and prevents the end-user from operating the drive at very low speeds. We recommend this function especially in hoist drives which, for some reason, have no pulse encoder. (As a safety measure, a speed feedback device is highly recommended in hoist drives.)

The Brake safe closure function monitors the motor speed estimate when the drive is running. When both the estimated motor speed (*01.01*) and the ramped and shaped speed reference (*23.02*) are below a user-defined speed limit (*44.208*) longer than a user-defined delay (*44.209*), the drive trips on a fault (*D102*) and closes the motor brake.

Timing diagram

A diagram shows the operation of the *Brake safe closure* fault.



Settings

Parameters: *44.207 Safety close select*, *44.208 Safety close speed*, *44.209 Safety close delay*

Signals: *09.03 Crane FW1*

Warnings: -

Faults: *D102 Brake safe closure*

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 *174*) and torque proving (page *76*).

The function works based on timer off module using the inverted signal BRAKE CLOSED state as input (parameter *44.01*, Bit 5). When this input signal goes low, the Extended run time operation (parameter *44.212*, Bit 1) is activated and connects to parameter *21.12 Continuous magnetization command*, which keeps the drive modulating for the time defined in parameter *44.211 Extended runtime* after the brake is closed.

If the drive trips during the extended run time operation, the function timer resets.

Refer the *Brake control timing diagram* (page *72*), to see the operation of the Extended run time function.

Note: The Extended run time function is available only in DTC motor control mode (see page *136*) when the drive is in Remote mode and only when parameter *21.03 Stop mode* is set as *Ramp*.

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

Settings

Parameters: *44.211 Extended runtime*, *21.12 Continuous magnetization command*,

Signals: *44.01 Brake control status*, *44.212 Extended runtime sw*

Warnings: -

Faults: -

Speed reference handling

Possible control devices

The user can give speed reference through any of the following:

- 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. One option is to use the zero position signal for the joystick (that is, the neutral position of the joystick).

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, + or -. One digital input is needed for starting the crane.

To use a bipolar joystick, set parameter *20.01 Ext1 commands* to *In1 Start*.

Step reference selection

You can select between four step reference speeds. The polarity of the references depends on the direction in which the end-user gives the start command using digital inputs (*20.03 Ext1 in1 source* and *20.04 Ext1 in2 source*).

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 (*22.207*).

22.203 Step reference mode	*22.204 Step reference select 2*	*22.205 Step reference select 3*	*22.206 Step reference select 4*	Used reference
1	0	0	0	*22.207 Step reference 1*
1	1	0	0	*22.208 Step reference 2*
1	1	1	0	*22.209 Step reference 3*
1	1	1	1	*22.210 Step reference 4*

See also section *Speed reference priorities* on page *82*.

Settings

Parameters: *22.203 Step reference mode*, *22.204 Step reference select 2* ... *22.206 Step reference select 4*, *22.207 Step reference 1* … *22.210 Step reference 4*

Signals: -

Warnings: -

Faults: -

Speed reference priorities

The speed references of the control program have the following priorities. The lowest priority is the first one and the highest priority the last one on the list.

- The primary speed reference is the one selected in parameters *22.11*, *22.12* and *22.14*.
- If the speed reference source is an analog signal, the speed reference is scaled based on the dead-band forward and reverse settings (*30.203*, *30.204*).
- If the Constant speed function is selected, the drive uses the constant speeds (*22.21*…*22.32*) as the speed reference.
- If the Step reference mode is enabled (*22.203*) and the drive is not in local control, the drive uses the step reference (*22.207*…*22.210*) as the speed reference.
- If the Emergency control mode is active (*20.207*), the drive uses the emergency control reference (*22.202*) as the speed reference with the polarity based on parameters *20.208* and *20.209*.

The speed reference selected according to the previous principle is limited as follows:

- If the External speed limitation command is active (*30.200*), the drive limits the speed reference to a predefined value (*30.201* or *30.202*).
- If the Hoist speed optimization function is active (*75.01*), the drive limits the speed reference to the value calculated by the function (*09.05*).
- If the Slowdown function is active (*20.200*), the drive limits the speed reference to the slowdown reference (*22.202*).

The value that results is the final speed reference used by the crane system (*09.06*).

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

- *Dead-band function* on page *83*
- *Constant speeds* on page *157*
- *Step reference selection* on page *81*
- *Emergency control mode* on page *51*
- *External speed limitation* on page *86*
- *Hoist speed optimization* on page *104*
- *Slowdown* on page *91*

Dead-band function

The accuracy of an analog input signal near zero is poor. With the Dead-band function, you can freeze the speed reference for a defined band area (that is, dead band) or ignore a low speed reference caused by possible crane vibrations on the joystick.

The function re-scales the analog signal based on the dead-band settings, and then calculates a new speed reference.

See also section *Speed reference priorities* on page *82*.

Example

In the example:

- Analog input reference (AI1) comes from the joystick:
  - Par. *12.18 AI1 max* = 10 V
  - Par. *12.17 AI1 min* = 0 V
  - Par. *12.20 AI1 scaled at AI1 max* = 1500
- 0…5 V gives the reverse speed reference.
- 5 V is the joystick zero position.
- 5…10 V gives the forward speed reference.

When parameter *30.203 Deadband forward* is set to 2%, it means that there is a deadband area of 30 rpm (2% of par. *12.20 AI1 scaled at AI1 max* = 1500 rpm) in the forward direction. Inside this deadband area, the resulting speed reference is zero. Actual signal *09.06 Crane speed reference* shows the final speed reference used, and when the speed reference is outside this dead-band area. In this case, actual signal *09.06* starts to show a positive reference starting from the point where the scaled value of analog input AI1 (*12.12 AI1 scaled value*) exceeds 30 rpm.

Settings

Parameters: *30.203 Deadband forward*, *30.204 Deadband reverse*

Signals: *09.06 Crane speed reference*

Warnings: -

Faults: -

Parabolic speed reference

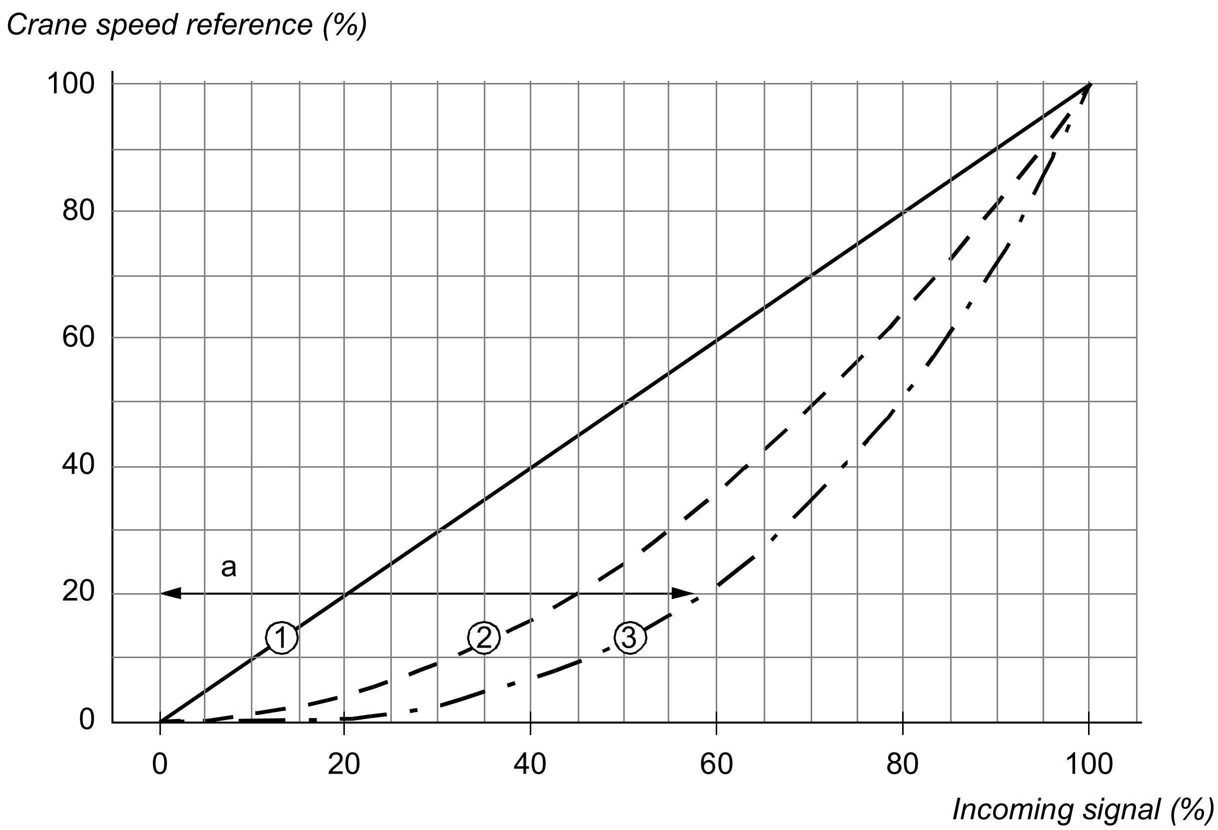
Normally, joystick movements cause a linear change to the speed reference: a 50% change in position gives a 50% speed reference. Quite often accurate load handling is needed in lower speed areas, for example, when the end-user needs to position the load manually, or when the lack of space causes limitations. In such situations, the end-user can control joystick movements more accurately with a parabolic speed reference instead of a linear reference.

The Parabolic speed reference function (*22.211*) changes the interrelationship of the incoming signal (that is, the joystick movement) and the speed reference according a mathematical function. The mathematical functions available are X^2 (= *Parabolic 1*), X^3 (= *Parabolic 2*) and linear interrelationship (= *Linear*). The joystick has parameters for setting the deadband in the forward (*30.203*) and reverse (*30.204*) directions.

Besides the joystick, the source of a parabolic speed reference can also be an analog signal from an external device.

Operation chart

This graph shows the parabolic reference curves compared to the linear speed reference curve.



Symbol	Description
1	Linear interrelationship (*Linear*)
2	X^2 (*Parabolic 1*)
3	X^3 (*Parabolic 2*)
a	Most affected area

Settings

Parameters: *22.211 Speed reference shape*

Signals: *09.06 Crane speed reference*

Warnings: -

Faults: -

Speed reference ramping

The control program has two user-selectable acceleration and deceleration ramps. You can adjust the acceleration/deceleration times and the ramp shape, and control switching between the two ramps via a digital input.

Based on the ramp set selection (par. *23.200*) different ramp times are used:

- *Acc/Dec 1* means acceleration time 1 (par. *23.201*) and deceleration time 1 (par. *23.202*) are used.
- *Acc/Dec 2* means acceleration time 2 (par. *23.203*) and deceleration time 2 (par. *23.204*) are used.
- *Acc/Dec Direction* means acceleration time 1 (par. *23.201*) and deceleration time 1 (par. *23.202*) are used when motor is running in the forward direction, and acceleration time 2 (par. *23.203*) and deceleration time 2 (par. *23.204*) are used when motor is running in the reverse direction.

Settings

Parameters: *23.16 Shape time acc 1* … *23.19 Shape time dec 2*, *23.200 Crane ramp set selection* … *23.206 Crane dec time 2*, *46.01 Speed scaling*

Signals: -

Warnings: -

Faults: -

External speed limitation

The External speed limitation function limits the speed reference to a predefined value while the External speed limitation command (*30.200*) is active. The source of the command can be a digital input, a PLC digital input using fieldbus communication, or any other signal bit.

If the External speed limitation command is activated when the motor is running in the forward direction, the drive limits the speed reference to the maximum limit (*30.202*). If the command is activated when the motor is running in the reverse direction, the drive limits the speed reference to the minimum limit (*30.201*).

See also section *Speed reference priorities* on page *82*.

Settings

Parameters: *30.200 External speed limits*, *30.201 External min speed limit*, *30.202 External max speed limit*

Signals: *09.02 Crane SW2*

Warnings: *D20D External speed limit2*

Faults: -

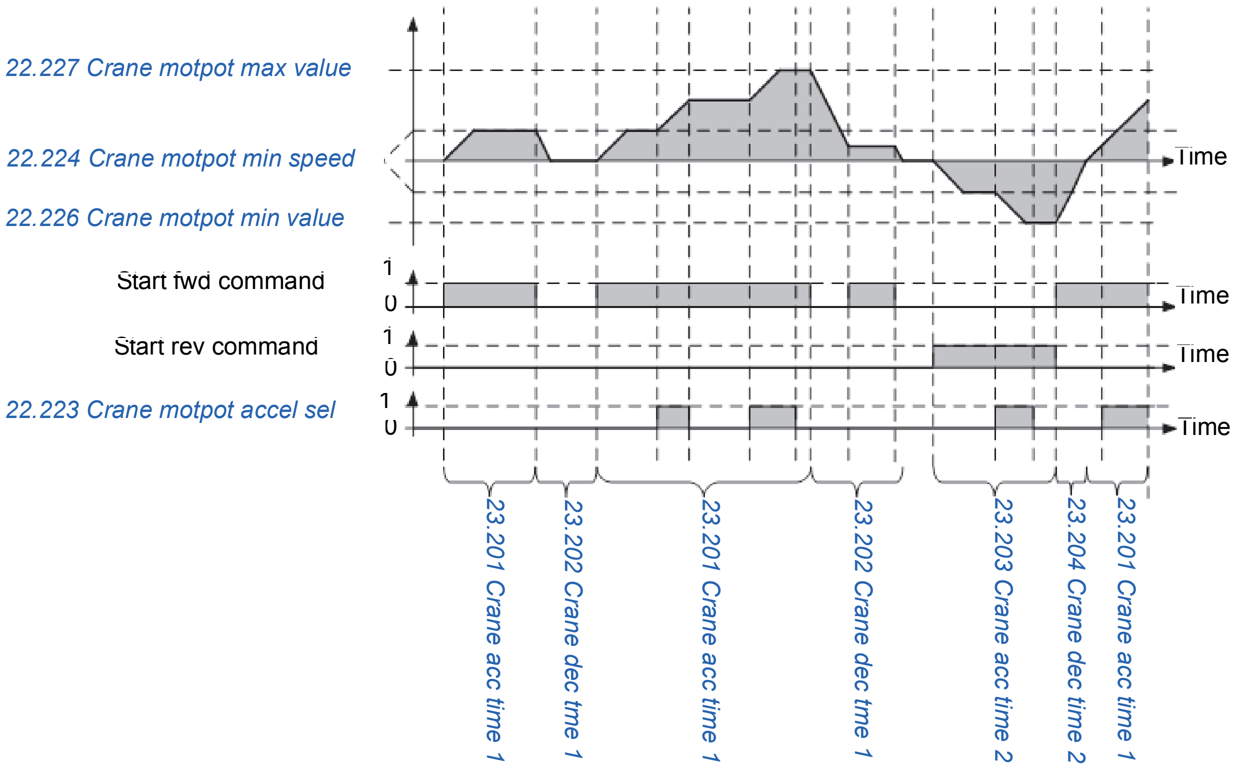
Crane motor potentiometer

The crane motor potentiometer function can be used in retrofit cases with older controllers. The function is used instead of the normal motor potentiometer which contains separate incoming signals for increasing and decreasing the reference.

Note: If you prefer to use the normal motor potentiometer, open the user lock with parameter *96.02 Pass code* using the code *584*. The motor potentiometer parameters *22.71*...*22.80* are then visible. After you used these parameters, set back the user lock to hide the parameters by setting parameter *96.02* to pass code *1.*

Note that these signals have no effect when the drive is stopped. You can enable the function with parameter *22.220 Crane motpot enable*.

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



The function uses three signals, start forward, start reverse, and accelerate as shown in the above diagram.

Forward direction

You can increase the motor potentiometer reference (parameter *22.80 Motor potentiometer ref act*) with any of these two methods:

- Activating the forward command, increases the motor potentiometer reference (*22.80*) to the crane motor potentiometer minimum speed (parameter *22.224 Crane motpot min speed*).

  or

- Activating the crane motor potentiometer acceleration command (parameter *22.223 Crane motpot accel sel*) together with forward command, increases the motor potentiometer reference (*22.80*).

  Note that when you release the acceleration command (*22.223*), the motor potentiometer reference (*22.80*) remains in the last reached level. If the existing motor potentiometer reference (*22.80*) is less than the reference maximum value (parameter *22.227 Crane motpot max value*), further acceleration is possible by activating the acceleration command (parameter *22.223*) again.

Removing the forward command immediately starts decreasing the motor potentiometer reference (*22.80*). Activating the forward command at any point again, starts increasing the motor potentiometer reference (*22.80*) till it reaches the last reached level.

The motor potentiometer reference (*22.80*) uses the following ramp time:

- When *22.80 Motor potentiometer ref act* is more than 0, it is uses the ramp time in parameters *23.201 Crane acc time 1* and *23.202 Crane dec tme 1*.
- When *22.80 Motor potentiometer ref act* is less than 0, it is uses the ramp time in parameters *23.203 Crane acc time 2* and *23.206 Crane dec time 2*.

Reverse direction

You can decrease the motor potentiometer reference (parameter *22.80 Motor potentiometer ref act*) with either of the two methods:

- Activating the reverse command, decreases the motor potentiometer reference (*22.80*) to the negative value of the crane motor potentiometer minimum speed (parameter *22.224 Crane motpot min speed*).

  or
- Activating the crane motor potentiometer acceleration command (parameter *22.223 Crane motpot accel sel*) together with reverse command, decreases the motor potentiometer reference (*22.80*).

Note that when you release the acceleration command (*22.223*), the motor potentiometer reference (*22.80*) remains in the last reached level. If the existing motor potentiometer reference (*22.80*) is more than the reference maximum value (parameter *22.226 Crane motpot min value*), further acceleration is possible by activating the acceleration command (*22.223*) again.

Removing the reverse command immediately starts increasing the motor potentiometer reference (*22.80*). Activating the reverse command at any point again, starts decreasing the motor potentiometer reference (*22.80*) till it reaches the last reached level.

The motor potentiometer reference (*22.80*) uses the following ramp time:

- When *22.80 Motor potentiometer ref act* is more than 0, it is uses the ramp time in parameters *23.201 Crane acc time 1* and *23.202 Crane dec tme 1*.
- When *22.80 Motor potentiometer ref act* is less than 0, it is uses the ramp time in parameters *23.203 Crane acc time 2* and *23.204 Crane dec time 2*.

Direction change

- If the actual motor potentiometer reference (*22.80*) is negative, then activating the forward command starts increasing until it reaches 0 using the ramp time defined in parameter *23.204 Crane dec time 2* and after 0 it uses the ramp time defined in parameter *23.201 Crane acc time 1*.
- If the actual motor potentiometer reference (*22.80*) is positive, then activating the reverse command starts decreasing until it reaches 0 using the ramp time defined in parameter *23.202 Crane dec tme 1* and after 0 it uses the ramp time defined in parameter *23.203 Crane acc time 2*.

Settings

Parameters: *22.220 Crane motpot enable 22.223 Crane motpot accel sel*, *22.224 Crane motpot min speed*, *22.226 Crane motpot min value*, *22.227 Crane motpot max value*, *23.201 Crane acc time 1*, *23.202 Crane dec tme 1*, *23.203 Crane acc time 2*, *23.204 Crane dec time 2*

Signals: *22.80 Motor potentiometer ref act*, *22.225 Crane motpot sw*

Warnings: -

Faults: -

Supervision and limit switch logic

Upper and lower limits

The upper and lower limits logic of the control program enables you to connect sensors directly to the drive to make the crane stop safely when it reaches the end position of its travel. If one of the two limits is active, the function activates an emergency stop command.

You can set two limits, upper limit (*20.205*) and lower limit (*20.206*) for the forward (up) and reverse (down) direction, respectively. The two limits are independent of each other. You must wire the upper limit input to the forward (up) limit switch and the lower limit input to the reverse (down) limit switch.

The upper limit is active when:

- the upper limit is False, in other words, when the normally-closed limit switch is off (0).

The upper limit is inactive when:

- the upper limit is True, in other words, the normally-closed limit switch is on (1). This is the case in the normal operation range of the crane.

The same applies to the lower limit.

If the upper limit is activated while the drive is running in the forward (up) direction, the function activates an emergency stop command (Em stop off3). The drive then decelerates according to the defined emergency stop time (*23.23*). The upper limit input must be back to inactive before the end-user can start the drive in the forward direction. However, the end-user can run the drive in the reverse (down) direction even when the upper limit is active. When the upper limit command is activated, the drive also generates a warning (*D205*).

The lower limit operates in the same way in the reverse (down) direction.

Settings

Parameters: *20.205 Upper limit*, *20.206 Lower limit*

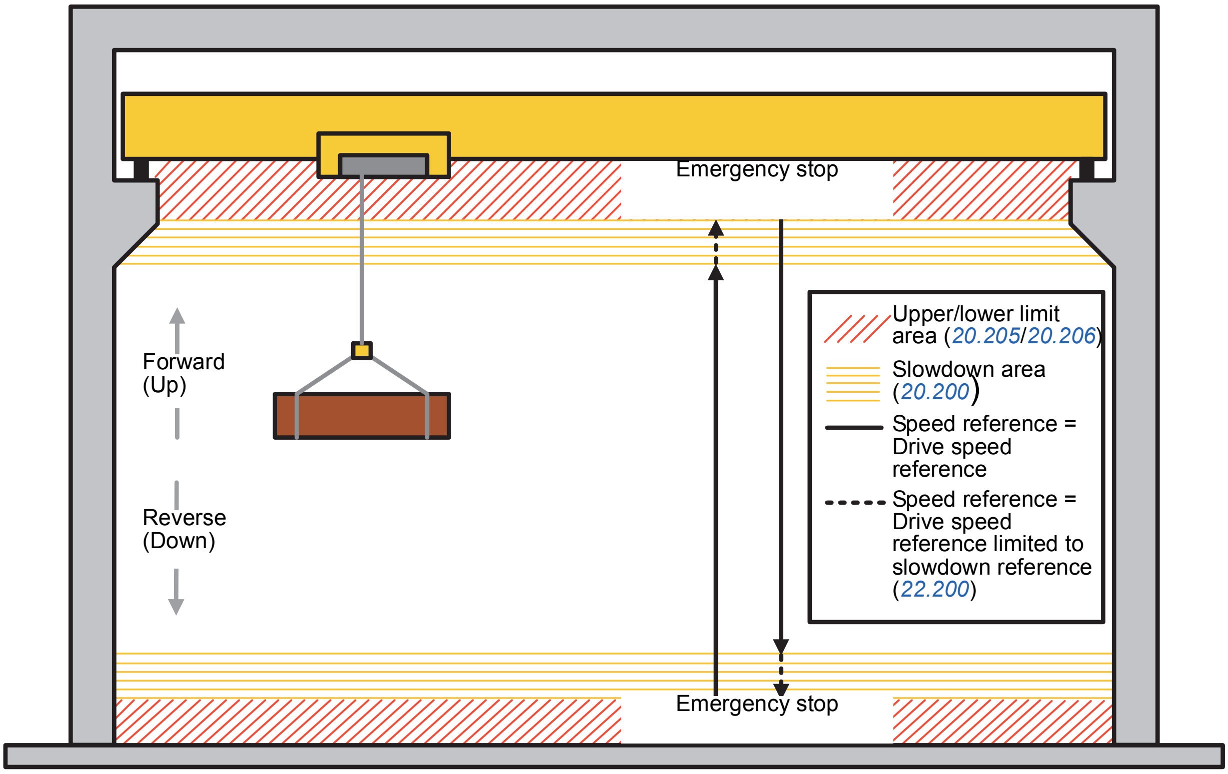
Signals: *09.01 Crane SW1*, *09.03 Crane FW1*

Warnings: *D205 Upper limit2*, *D206 Lower limit2*

Faults: *D108 End limits I/O error*

Slowdown

The Slowdown function limits the speed reference when the crane is operating in the slowdown area.



The Slowdown function has four modes:

- *Slowdown with direction*
- *Slowdown without direction (safe zone)*
- *Slowdown double bit*
- *Slowdown position*.

See also section *Speed reference priorities* on page 82.

Slowdown with direction

This mode is activated when Slowdown input 1 (*20.201*) changes from 1 (True) to 0 (False). The function then limits the speed reference to the slowdown reference limit (*22.200*) in the direction of motion at the time of the activation. As long as the supply voltage is not switched off, the drive remembers the direction of motion and allows full speed in the opposite direction.

If the Slowdown command is activated after the drive has stopped, the function allows only slow speed in both directions. The function also limits the speed reference in both directions if the Slowdown command is activated when the drive is being powered up.

Slowdown without direction (safe zone)

Like *Slowdown with direction*, the Slowdown without direction mode is activated by Slowdown input 1 (*20.201*), but the speed reference is limited in both forward and reverse directions instead of just one direction. You can use this mode to create a safe zone, for example, for trolley and long-travel movements.

Slowdown double bit

In this mode, two switches are used through two inputs. Slowdown input 1 (*20.201*) is used for the Slowdown command in the forward direction, while slowdown input 2 (*20.202*) is used for the Slowdown command in the reverse direction. When the Slowdown command is activated (*20.201* or *20.202* = 0), the function limits the speed reference to the slowdown reference limit (*22.200*).

Slowdown position

In this mode, two position limits (*20.203 Slowdown up position* or *20.204 Slowdown dn position*) are used:

- Slowdown up position limit (*20.203*) - used for the Slowdown command in the forward direction
- Slowdown down position limit (*20.204*) - used for the Slowdown command in the reverse direction.

The function activates the slowdown command and limits the speed reference to the slowdown reference limit defined in parameter *22.200 Slowdown select*, based on any of these conditions:

- when *90.05 Load position scaled* is greater than the slowdown up position limit (*20.203*) in the forward direction

  or
- when *90.05 Load position scaled* is less than the slowdown down position limit (*20.204*) in the reverse direction.

Settings

Parameters: *20.200 Slowdown select*, *20.201 Slowdown input 1*, *20.202 Slowdown input 2*, *20.203 Slowdown up position*, *20.204 Slowdown dn position*, *22.200 Slowdown reference*

Signals: *09.01 Crane SW1*

Warnings: *D201 Slowdown up*, *D202 Slowdown down*, *D20C Slowdown safe zone*

Faults: -

Fast stop

The Fast stop function stops the drive extremely fast from high speed. It can be used, for example, to stop the swift downward movement of a bucket crane before the ropes unwind and pile up on top of the crane. The Fast stop function is not an emergency stop function.

The function has three modes:

- **Ramping and mechanical braking** - In this mode the drive decelerates to zero speed according to a defined ramp time. The mechanical brake closes when the drive reaches the brake close speed.
- **Torque limit and mechanical braking** - In this mode the drive decelerates to zero speed against the drive torque limits. The mechanical brake closes when the drive reaches the brake close speed.
- **Mechanical braking only** - In this mode the function forces the mechanical brake to close.

When the function is activated, the drive generates a warning (*D20A*).

Settings

Parameters: *20.210 Fast stop input*, *20.211 Fast stop mode*, *23.206 Fast stop deceleration time*

Signals: *09.01 Crane SW1*

Warnings: *D20A Fast stop*

Faults: -

Speed matching

The Speed matching function compares the crane speed reference continuously to the actual motor speed to detect any differences. The function makes sure that the motor follows the speed reference when stopped, during acceleration or deceleration, and when running at the constant speed. The function also makes sure that the brake does not slip when the drive has stopped with the brake closed.

The function has two deviation levels:

- one for checking the speed deviation during a ramping state, that is, acceleration and deceleration (*74.03*)
- one for checking the speed deviation during a constant speed (*74.02*).

The drive trips on a fault (*D105*) if the drive is running, and

- the motor is running in a steady state, and the difference between the motor actual speed (*01.01*) and the ramped and shaped speed reference (*23.02*) is greater than the steady state deviation level for longer than a delay (*74.04*)

  or

- the motor is accelerating or decelerating, and the difference between the motor actual speed (*01.01*) and the ramped and shaped speed reference (*23.02*) is greater than the ramping state deviation level for longer than a delay (*74.04*).

The drive generates a warning (*D200*) if the drive is stopped, and

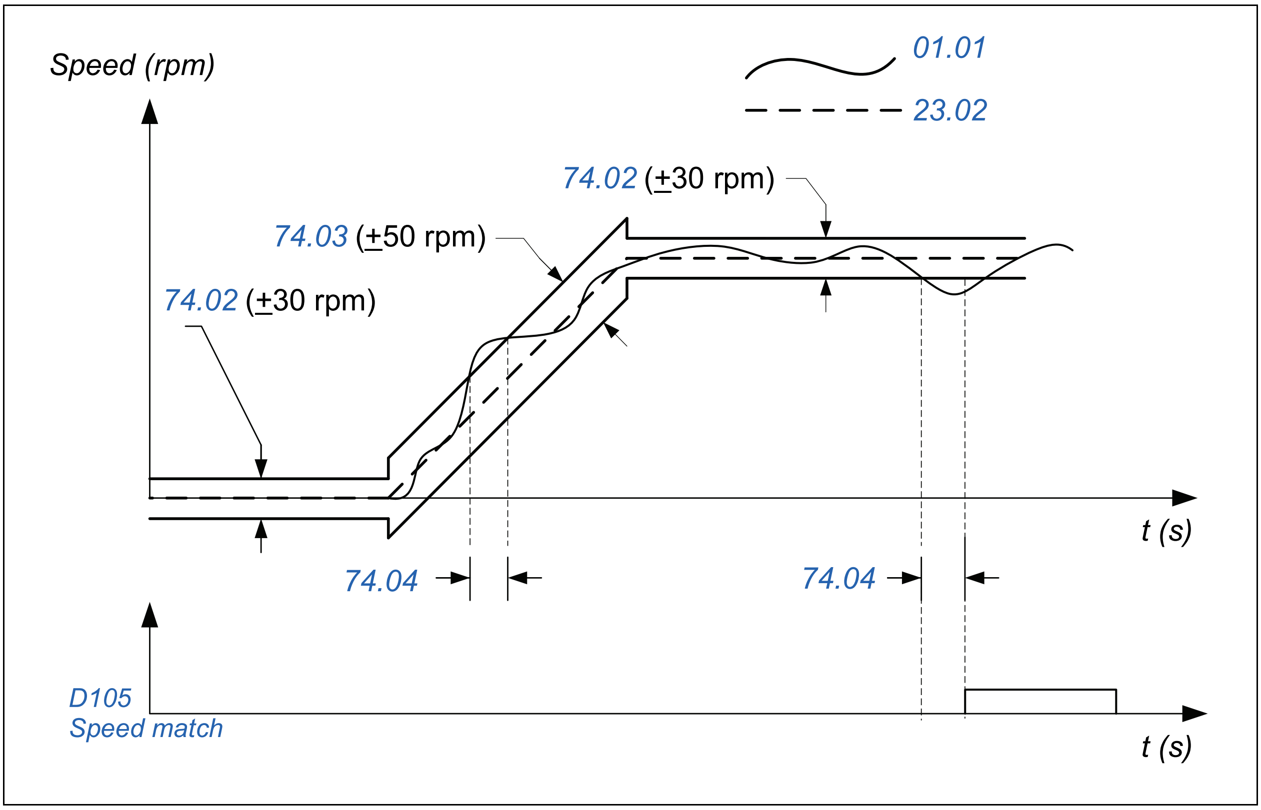
- the difference between the motor actual speed and the speed reference is greater than the steady state deviation level for longer than a delay (*74.04*)

  and

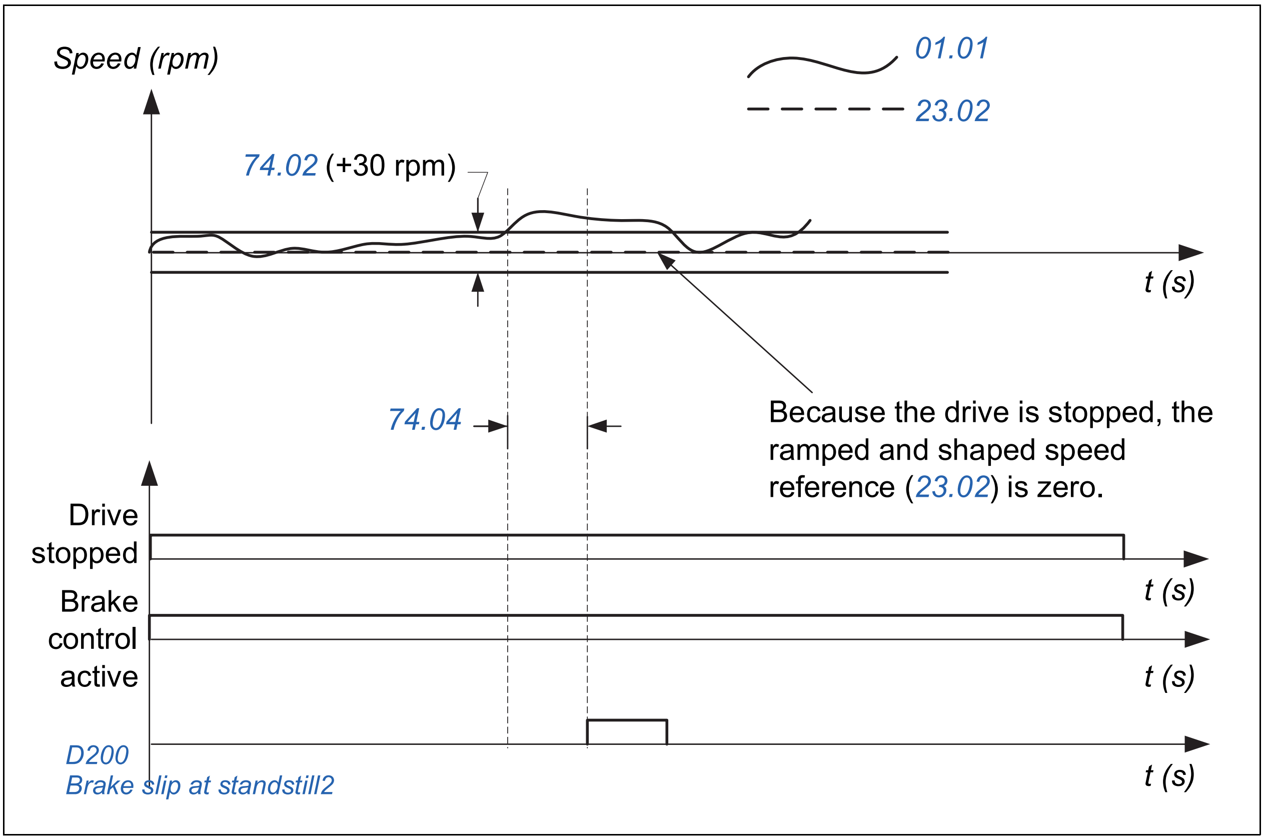
- the brake control is active and the brake is closed.

Timing diagrams

The diagram shows the operation of the *Speed match* fault.



The diagram shows the operation of the *Brake slip at standstill2* warning.



Settings

Parameters: *74 Speed matching*

Signals: *09.01 Crane SW1*, *09.03 Crane FW1*

Warnings: *D200 Brake slip at standstill2*

Faults: *D105 Speed match*

Motor overspeed monitoring

The Motor overspeed monitoring function is an internal protection function. It supervises the motor speed and trips the drive at motor overspeed.

If the motor speed exceeds the defined level (*31.200*), and a time delay (*31.201*) elapses, the drive trips on a fault (*D104*), stops and closes the brake.

Settings

Parameters: *31.200 Motor overspeed level*, *31.201 Motor overspeed level delay*

Signals: *09.03 Crane FW1*

Warnings: -

Faults: *D104 Over speed*

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 mainly for hoist motion.

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 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

Parameters: *31.202 Inverter overload selection*, *31.203 User limit bit selection*, *31.204 Inverter overload delay*

Signals: *09.03 Crane FW1*, *30.02 Torque limit status*

Warnings: -

Faults: *D106 Inverter overload*

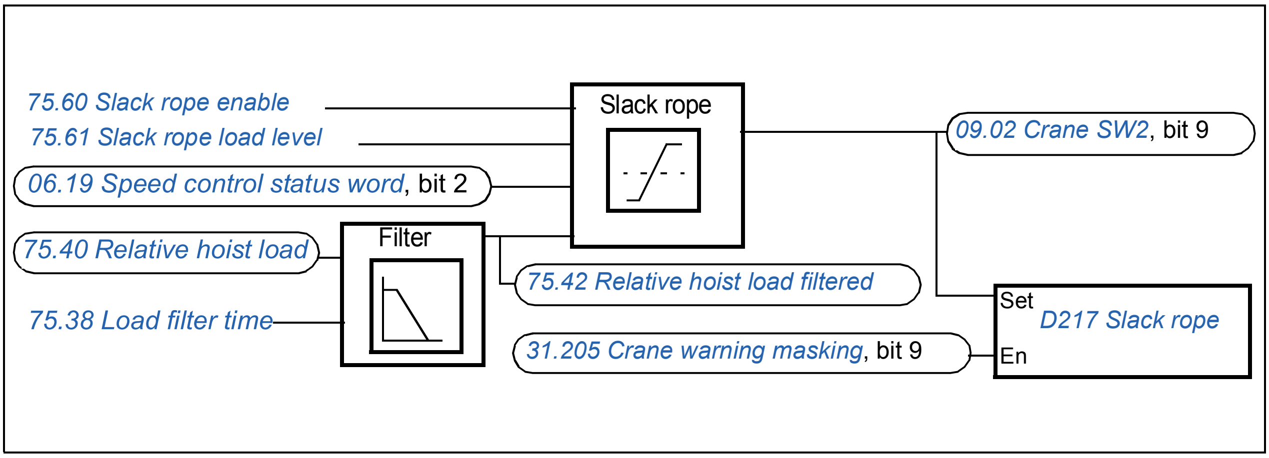
Slack rope

The Slack rope function provides warnings against any slackness in the rope which may result when the boom is thrust upwards by heavy and strong wind in outdoor cranes or when the hook jams in a mechanical structure in indoor industrial cranes.

The function can be enabled with parameter *75.60 Slack rope enable* and by setting the slack rope load level with parameter *75.61 Slack rope load level* to different than -400%.

The function detects a slack rope condition if value in parameter *75.42 Relative hoist load filtered* is less than slack rope load level (*75.61*), at the time of lowering the crane. Parameter *09.02 Crane SW2*, bit 9, shows the slack rope detected status.

When a slack rope condition is detected, drive generates the warning *D217 Slack rope*. The warning can be masked with parameter *31.205 Crane warning masking*, bit 9 to 0.



Settings

Parameters: *75.60 Slack rope enable*, *75.61 Slack rope load level*, *75.42 Relative hoist load filtered*, *75.38 Load filter time*, *75.40 Relative hoist load*

Signals: *09.02 Crane SW2*, *31.205 Crane warning masking*

Warnings: *D217 Slack rope*

Faults: -

Watchdog

The Watchdog function monitors the drive critical warnings (alarm)s and opens the relay output RO2 (default settings) of the drive, when any of the monitored warnings or when the watchdog user bit in parameter *32.225 Watchdog user bit* is active. The watchdog signal (parameter *32.227 Watchdog sw*) can be used for safety, emergency interlocks or controlling the main contactor.

The critical warnings can be selected with parameter *32.226 Watchdog mask*. When a selected warning in the list is activated, the drive opens the relay output RO2 (default settings) of the drive. Unselected warnings are ignored.

Bit	Warning	Warning code
0	Fb A comm	*A7C1 FBA A communication*
1	Fb B comm	*A7C2 FBA B communication*
2	M/F comm	*A7CB MF comm loss*
3	Braking resistor failure	*A791 Brake resistor*
4	Braking resistor temp	*A793 BR excess temperature*
5	Braking chopper failure	*A79B BC short circuit*
6	Brake chopper temp	*A79C BC IGBT excess temperature*
7	Brake closing failure	*A7A1 Mechanical brake closing failed*
15	User bit 1	-

Note that the Watchdog function requires external 24 V to be connected to the drive control board.

Watchdog test

The Watchdog test function performs periodical tests to check the condition of the watchdog circuit. The circuit consists of one digital input for Power on acknowledgement signal (parameter *20.212*) and watchdog relay output RO2 (parameter *32.227 Watchdog sw*, bit 1). You can enable the function with parameter *32.221 Watchdog test*.

The testing of watchdog circuit starts after the main contactor has been closed, as indicated by the Power on acknowledgement signal (*20.212*) and the delay time defined with parameter *32.222 Watchdog test delay* has elapsed.

After the test, the watchdog relay output RO2 opens for a fixed time of 0.5 s and closes back again. If the Power on acknowledgement signal (*20.212*) does not deactivate and reactivate within the time defined with parameter *32.224 Watchdog fault delay*, the function generates *D10D Watchdog test fault*.

If the crane is powered up frequently, parameter *32.223 Watchdog re test delay* can be used to prevent the test from starting every time the main contractor is closed. The next watchdog test sequence executes only after the re test delay time is passed.

Note: The Watchdog test function can be used only when the drive is powered using an external power supply. Else, the drive performs the watchdog test every time the drive is powered up without considering the value of parameter *32.223 Watchdog re test delay*.

Settings

Parameters: *32.221 Watchdog test*, *32.222 Watchdog test delay*, *32.223 Watchdog re test delay*, *32.224 Watchdog fault delay*, *32.225 Watchdog user bit*,

Signals: *20.212 Power on acknowledge*,*32.227 Watchdog sw*, *32.226 Watchdog mask*

Warnings: *D215 Watchdog warning*

Faults: *D10D Watchdog test fault*

Lifetime monitoring and maintenance

The Lifetime of lifting equipment on a crane system can be monitored to determine maintenance needs. This can be done by several ways. One possible way is to do with the inverter. The operating inverter monitors all the working cycles of the hoist, considering the operating time, the lifting and lowering speed and the load. All these values are known signals for the operating inverter or from the sizing of the hoist.

The Crane lifetime monitor function indicates how much is left of the crane hoist mechanical lifetime. See signals *09.10 Lifetime left* and *09.11 Lifetime left in percent*.

There are other signals supporting the function:

- Total operating time (brake open time) of the drive - *09.20 Crane operation hours*
- Continuously calculated actual hoist load - *75.43 Absolute hoist load filtered*
- Load spectrum factor Km (function of load and time) - *09.12 Load spectrum factor*

To get a correct load signal, the weight calculation can be defined according to the *Tunning procedure* on page *108*, which is part of commissioning the hoist speed optimization.

The function can be activated with the parameter *75.70 Start lifetime monitor* and the lifetime hours can be defined with parameter *75.71 Crane lifetime*. See also instructions for *Configuring Lifetime monitor function* on page *44*.

During the lifetime of the crane installation, it is needed to record the changes to the load spectrum as a consequence of inverter replacement or any maintenance work on the hoist unit. A set of protected (hidden) parameters in the control program can be used to record these changes.

⚠ Parameters used for maintenance records are protected with password to prevent operation and manipulation by any unauthorized personnel.
Only authorized personnel shall work on the protected (hidden) parameters.

Maintenance work

- If you replaced a control board or a complete drive, then copy the old values to the new system, for example, from the parameter file. See instructions for *Copying old values to new system* on page *45*.
- If you did some maintenance work on a hoist unit, reset the load spectrum recorder to its starting values. See instructions for *Reseting the load spectrum recorder* on page *46*.

Settings

Parameters: *75.70 Start lifetime monitor*, *75.71 Crane lifetime*, *75.72 Reset load spectrum*, *75.73 Preset value of load spectrum*, *75.74 Lifetime speed scaling*, *75.75 Lifetime factor*

Signals: *09.10 Lifetime left*, *09.11 Lifetime left in percent*, *09.12 Load spectrum factor*, *09.13 Lifetime sw*, *09.20 Crane operation hours*, *75.43 Absolute hoist load filtered*

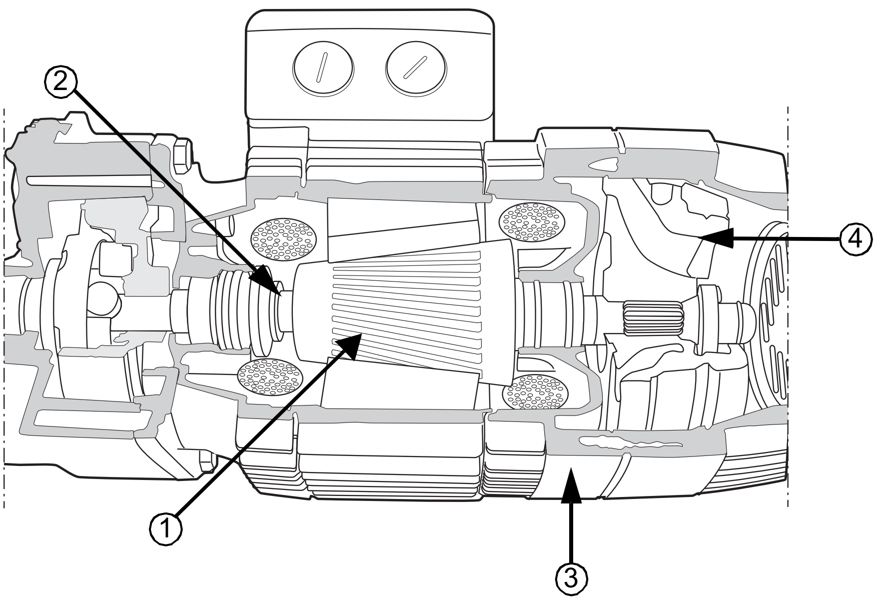
Warnings: *D216 Liftetime left less 10%*

Faults: -

Conical motor control

This function handles the brake control for conical motors, which do not have a external mechanical brake. A conical motor has an internal brake, which opens or closes according to the motor flux level. The brake opens when the motor flux level is higher than the normal flux level and closes when the flux is below the normal flux level. You can find the opening and closing flux levels on the motor rating plate or ask the motor manufacturer for the levels. The opening flux level has to be kept active for a certain period of time. The time depends on the motor.

When a conical motor is switched on, axial force is created as a result of the electromagnetic field (flux) and the air gap between the cone-shaped rotor and stator. This axial force overcomes the return force of the brake spring and moves the rotor shaft and brake disc in an axial direction. The brake is then released, allowing the motor to start up. After the motor is switched off or if the voltage fails, the magnetic force collapses, and the motor mechanically brakes to a standstill by the return force of the brake spring.



No.	Description
1	Conical rotor
2	Brake rotor spring
3	Motor housing
4	Internal brake

Notes:

- Mechanical brake control (*44.06*) must be active when the Conical motor control function is used. If mechanical brake control is not active, the drive trips on a fault (*D10A*).
- Brake close delay (*44.13*) must be greater than 0 seconds.

When the Conical motor control function is enabled and the start command is given, the motor flux ramps up over the normal level (100%) to the start flux level (*76.02*) during a flux ramp-up time (*76.05*). The ramp-up time makes sure that the brake opens faster and there is minimal roll-back that can cause a load dip. The start flux level is kept as the reference for a hold time (*76.04*) to make sure that there is enough time for the brake to open.

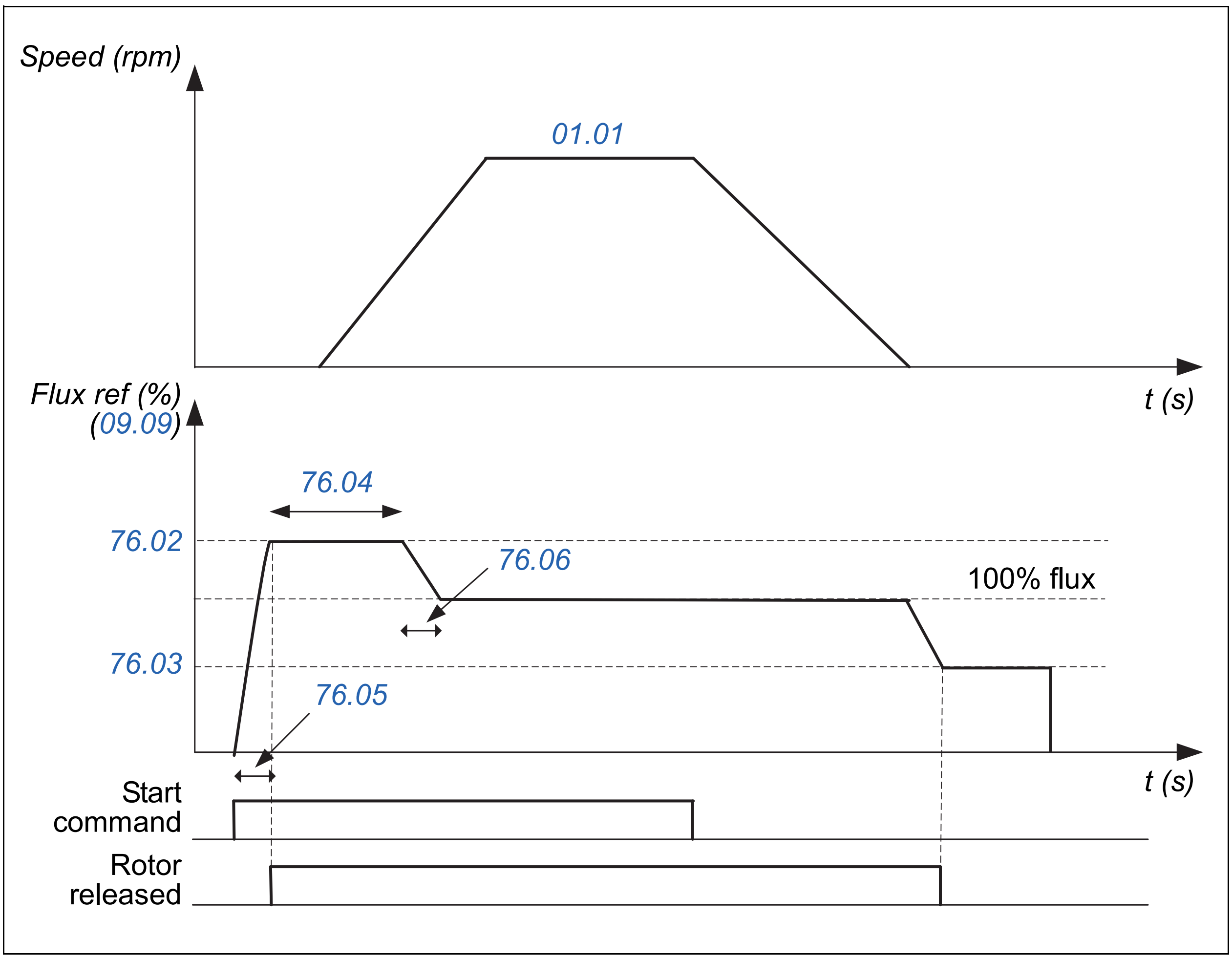
After the start flux hold time is over, the normal flux level (100%) is activated for normal running. The flux ramps down from the start flux level to the normal level (100%) during a flux ramp-down time (*76.06*).

When the stop command is given, the drive decelerates the motor. When the motor speed (*01.01*) decreases below the zero speed limit (*21.06*), the motor starts to use the stop flux level (*76.03*) as the flux reference. The flux ramps down from the normal level (100%) to the stop flux level during the ramp-down time. When the actual motor flux reaches the stop flux level, the brake closes.

See also section *Speed reference priorities* on page *82*.

Timing diagram

This diagram shows brake opening and closing as well as the normal running flux levels.



Settings

Parameters: *76 Conical motor*

Signals: *09.01 Crane SW1*, *09.09 Flux reference*

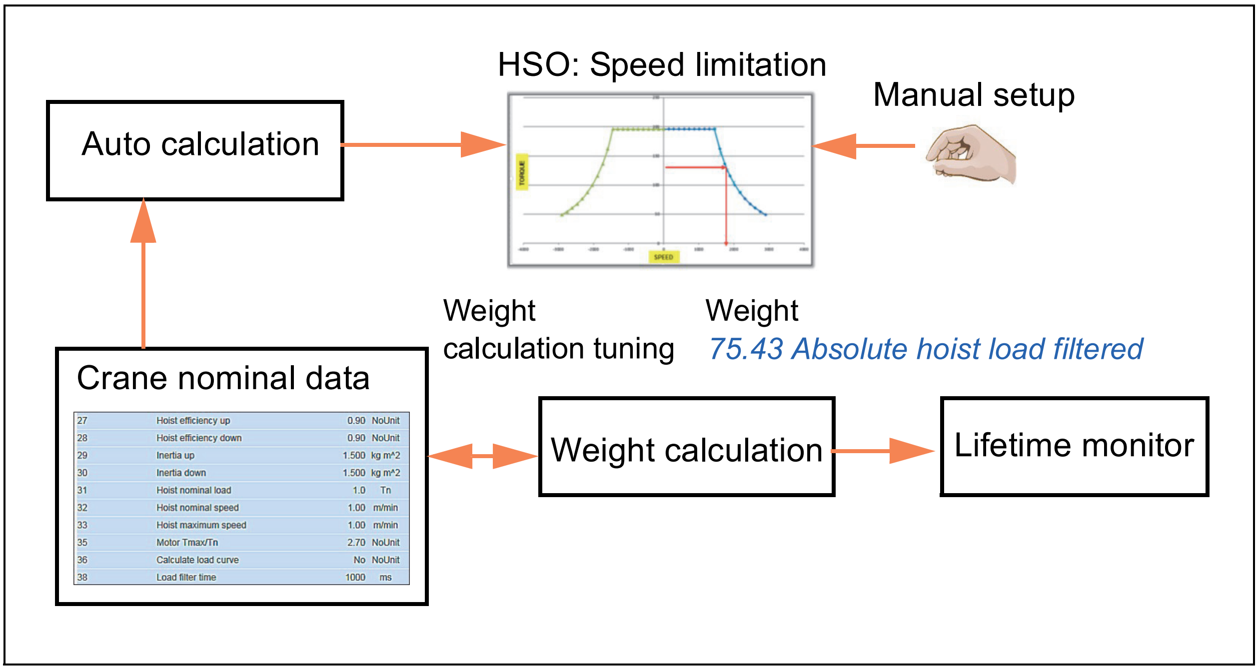
Warnings: -

Faults: *D10A Brake not selected*

Hoist speed optimization

General

If a hoist drive needs to run above its nominal speed (in the field weakening range), you need to enable its Hoist speed optimization (HSO) function. You also need to define the necessary variables for the function, such as the actual load values vs. the corresponding speed limit values. On the basis of the given data, the function automatically defines the allowed maximum speed depending on the actual load that the hoist is currently moving.



The diagram shows the relationship between different functions in the hoist speed optimization.

- **HSO: Speed limitation**, load vs speed points for both direction can be either manually defined or can be calculated and set automatically. When function is activated the speed reference is limited within safe limits.
- **Auto calculation** needs crane nominal data. If values are known, you can directly enter the values into parameters *75.03* and *75.27*...*75.35*. If it is needed to verify the crane nominal data, then the weight calculation function can be used by comparing the measured weight and test weight. The efficiency and inertia parameters can be tuned to find the correct reading from weight calculation. These parameters are finally used for auto calculation. See tuning instructions on page *108*.
- **Weight calculation** is used for Lifetime monitor function. Note that this calculation is not meant for overload protection.
- **Lifetime monitor** function monitors all working cycles of the hoist, considering the operating time, the lifting and lowering speed and the load. All these values are known signals for the operating inverter or from the sizing of the hoist.

HSO speed limitation defined manually

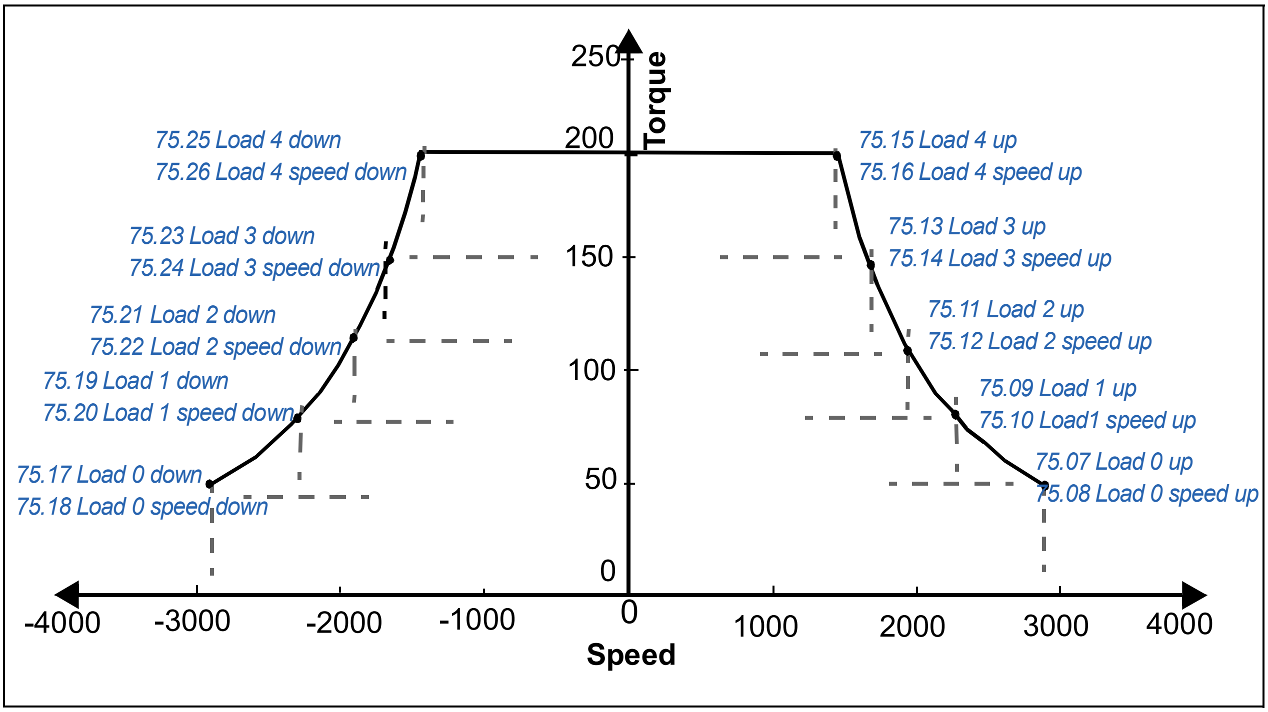
For manual parameterization of HSO speed limitation, you need to define these variables for the function:

- motor base speed (at which point the actual load is defined and above which the function is in use)
- actual load values vs. corresponding speed limit values for both forward and reverse directions.

Note: The function operates assuming that the load remains constant after the motor exceeds the motor base speed once until the drive stops and receives a new start command.

Operation chart

This chart shows the operation principle of the Hoist speed optimization function. The function controls the maximum speed limit according to the active load.



The right side shows the actual load values vs. the corresponding speed limit values for the forward direction. The left side shows the actual load values vs. the corresponding speed limit values for the reverse direction.

Note:

- Give the actual load values in increasing order and the speed limit values in decreasing order. Otherwise the function limits the speed to the base speed and generates a warning.
- Set all points in correct order. See example below.

Example

This example shows how to set the load and speed values shown in operation chart diagram on page 105.

Note: The values in this example only show the sequence and the setting method. You need to set the actual parameter values according to the actual motor details and the load.

In the example, motor nominal torque is equal to 100% that corresponds to motor base speed value 1500 rpm (*75.03*).

Enable the Hoist speed optimization function and define its attributes as follows:

- *75.03 Motor base speed* = 1500 rpm
- *75.07 Load 0 up* = 60%
- *75.08 Load 0 speed up* = 2000 rpm
- *75.09 Load 1 up* = 70%
- *75.10 Load1 speed up* = 1800 rpm
- *75.11 Load 2 up* = 80%
- *75.12 Load 2 speed up* = 1700 rpm
- *75.13 Load 3 up* = 90%
- *75.14 Load 3 speed up* = 1600 rpm
- *75.15 Load 4 up* = 100%
- *75.16 Load 4 speed up* = 1500 rpm

You have to set the parameters in the reverse direction in the same order. If you do not set the parameters in the correct order, the function limits the speed to the motor base speed (*75.03*).

Load margin calculation

The Hoist speed optimization function applies a load margin (*75.04*) to the detected base speed torque (*75.03*).

These formulas show how to calculate the load margin:

$$X\ (\%) = Y \cdot (\text{Load margin}\ (\%)\ /\ 100)$$

$$Z = Y - X$$

where:

- X = Torque or load offset
- Y = Torque at base speed
- Z = Base speed torque after the load margin has been deducted.

You can use the value of Z with a set of torque (%) and speed (rpm) parameters to calculate the load speed limit in the forward and reverse directions.

See *Operation chart* on page *105*.

Example

In this example:

- *75.04 Load margin* = 10%
- *01.10 Motor torque* monitored by the function during the base speed crossover = 60%.

The Hoist speed optimization function calculates the new maximum torque based on the load margin as follows:

$$X (\%) = Y \cdot (\text{Load margin} (\%)/100)$$

$$Z = Y - X$$

$$X (\%) = 60\% \cdot (10\%/100) = 6\%$$

$$Z = 60\% - 6\% = 54\%$$

Therefore, the new torque value that the function uses is 54% instead of the actual torque value (60%).

Note: If you do not want the function to use the load margin (*75.04*), you have to set it to zero.

Auto calculation

The control program can automatically calculate the speed Vs torque curve with the data defined in following parameters:

- *75.03 Motor base speed* = 1500 rpm (corresponds to parameter *75.32 Hoist nominal speed*)
- *75.27 Hoist efficiency up*
- *75.28 Hoist efficiency down*
- *75.29 Inertia up*
- *75.30 Inertia down*
- *75.31 Hoist nominal load*
- *75.32 Hoist nominal speed*
- *75.33 Hoist maximum speed*
- *75.35 Motor Tmax/Tn*

After settings these parameters, activate auto calculation with parameter *75.36 Calculate load curve* = *Calculate*. The control program sets the load curve parameters for one time. After this operation, you can manually change the load curve parameters.

The auto calculated hoist load values are shown in parameters *75.40 Relative hoist load* and *75.41 Absolute hoist load*.

Note:

- Auto calculation can be activated only when the drive is in standby state.
- If you changed acceleration/deceleration time after activating auto calculation, then you must again execute auto calculation.

Weight calculation

The Weight calculation function can be tuned with test runs of known load. Before starting the function tuning, configure the parameters *75.03*, *75.27*...*75.35*. The hoist efficiency and inertia of the hoist system can be set with parameters *75.03 Motor base speed*, *75.27 Hoist efficiency up*, *75.28 Hoist efficiency down*, *75.29 Inertia up* and *75.30 Inertia down*.

Tunning procedure

1. Lift a known load with constant speed and adjust the value in parameter *75.27 Hoist efficiency up* to the correct load value shown in signal *75.43 Absolute hoist load filtered*.
   - If value in signal *75.43* is less than the weight of the known load, increase the value in parameter *75.27 Hoist efficiency up*.
   - If value in signal *75.43* is more than the weight of the known load, decrease value in parameter *75.27 Hoist efficiency up*.
2. Lower the known load with constant speed and adjust the value in parameter *75.28 Hoist efficiency down* to the correct load value shown in signal *75.43 Absolute hoist load filtered*.
   - If value in signal *75.43* is more than the weight of the known load, increase the value in parameter *75.28 Hoist efficiency down*.
   - If value in signal *75.43* is less than the weight of the known load, decrease value in parameter *75.28 Hoist efficiency down*.
3. Lift the known load with variable speed (accelerating and decelerating) and adjust the value in parameter *75.29 Inertia up* to the correct load value shown in signal *75.43 Absolute hoist load filtered* during acceleration and deceleration.
   - If value in signal *75.43* is more than the weight of the known load during acceleration, increase the value in parameter *75.29 Inertia up*.
   - If value in signal *75.43* is less than the weight of the known load during acceleration, decrease value in parameter *75.29 Inertia up*.
4. Lower the known load with variable speed (accelerating and decelerating) and adjust the value in parameter *75.30 Inertia down* to the correct load value shown in signal *75.43 Absolute hoist load filtered* during acceleration and deceleration.
   - If value in signal *75.43* is more than the weight of the known load during acceleration, increase the value in parameter *75.30 Inertia down*.
   - If value in signal *75.43* is less than the weight of the known load during acceleration, decrease value in parameter *75.30 Inertia down*.

Load speed limit testing

You can check the load speed limit with a signal (*09.05*) by entering the test values into a parameter (*75.05*) without running the motor. Give a positive value for the forward direction and a negative value for the reverse direction.

Settings

Parameters: *75 Hoist speed optimization*

Signals: *09.01 Crane SW1*, *09.05 Hoist speed opt speed limit*, *09.07 Load speed error status*, *75.43 Absolute hoist load filtered*

Warnings: *D203 Hoist speed up limit*, *D204 Hoist speed down limit*

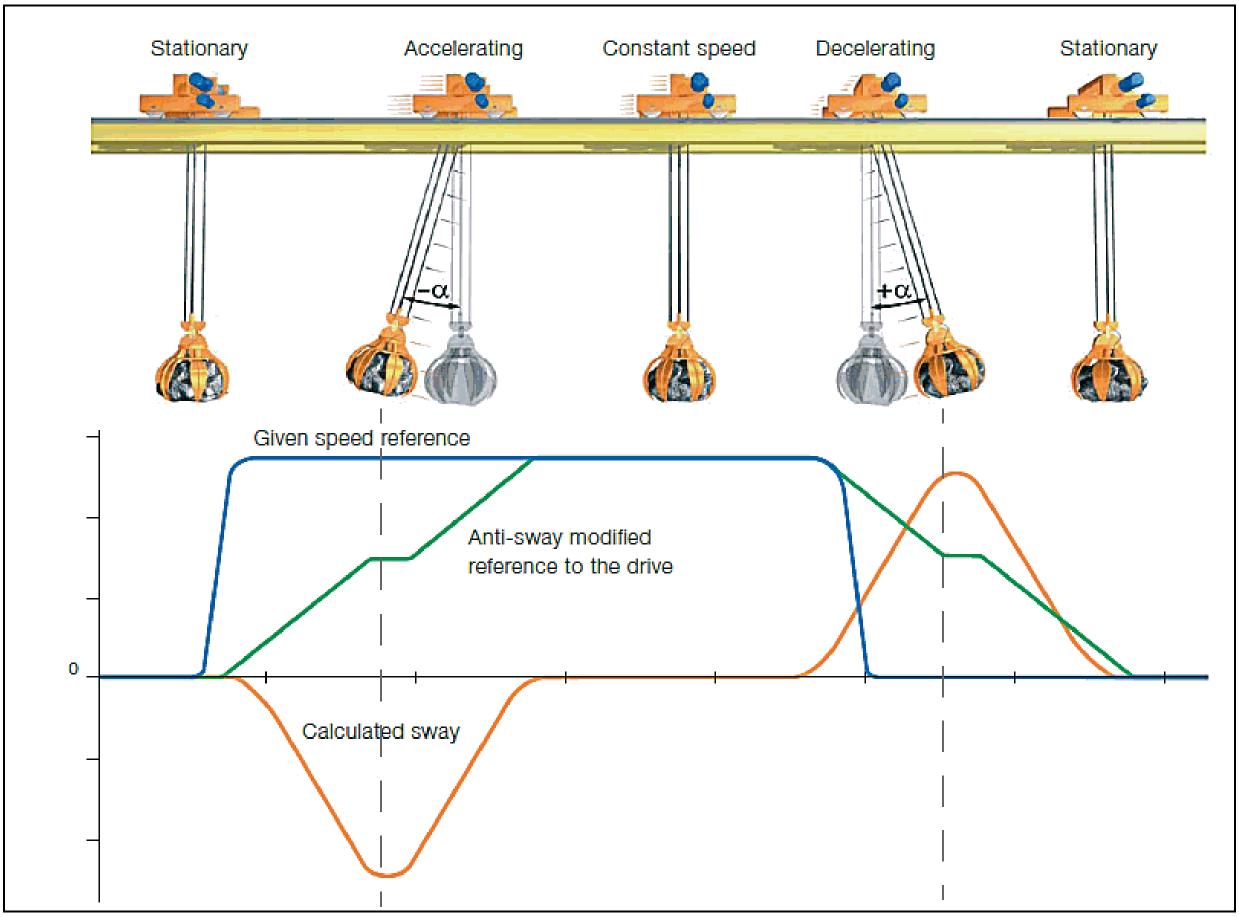
Faults: *D103 Hoist speed opt settings*

Antisway

Functional description

The Antisway function is designed for indoor cranes to prevent unnecessary swaying of the load. The function eliminates load sway by adjusting the operator given speed reference. It gives the crane operator a better control of the crane, cutting the time movements by higher speed and shorter acceleration and deceleration times.

The function works without any additional antisway sensors (open-loop). The function needs to know the total pendulum arm length to define the time constant of swaying (τ) that can control trolley and long travel accelerations and decelerations. See the acceleration and deceleration movements in the figure below.

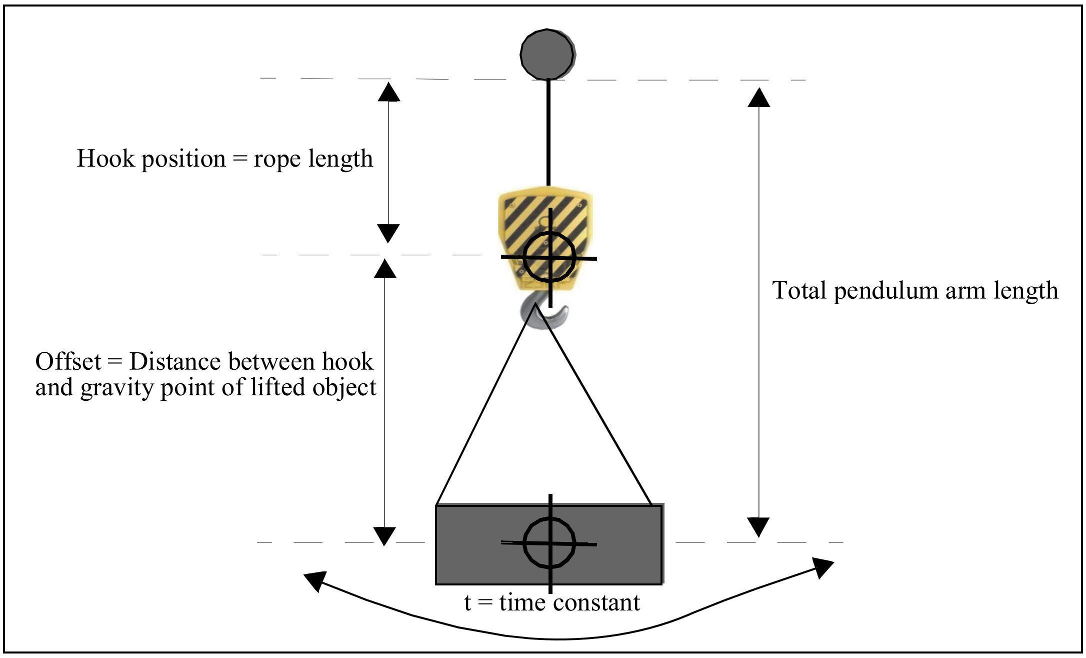


Total pendulum arm length is the sum of rope length and offset. See the below figure on page 111.

- **Rope length** is based on the hoist position. This value is transfered either from the hoist drive (with encoder) or from a PLC.
- **Offset** or pendulum arm offset is the distance between hook and gravity point of the lifted object. It can vary for different load types. See *Total pendulum arm length* on page 111.

Note: The accuracy of antisway control is as good as the known real pendulum arm length.

Total pendulum arm length



Offset determination

Pendulum arm offset determination is needed if the shape of lifted load varies. The determination is based on one of the following methods. The final offset is added to the pendulum arm length (from the hoist drive) and this result is used by the antisway core.

Step offset: Uses the step logic and consists of three offset values that are selected by either digital inputs DIx, PTR, or hoist load. For more information, see *Step offset* on page *120*.

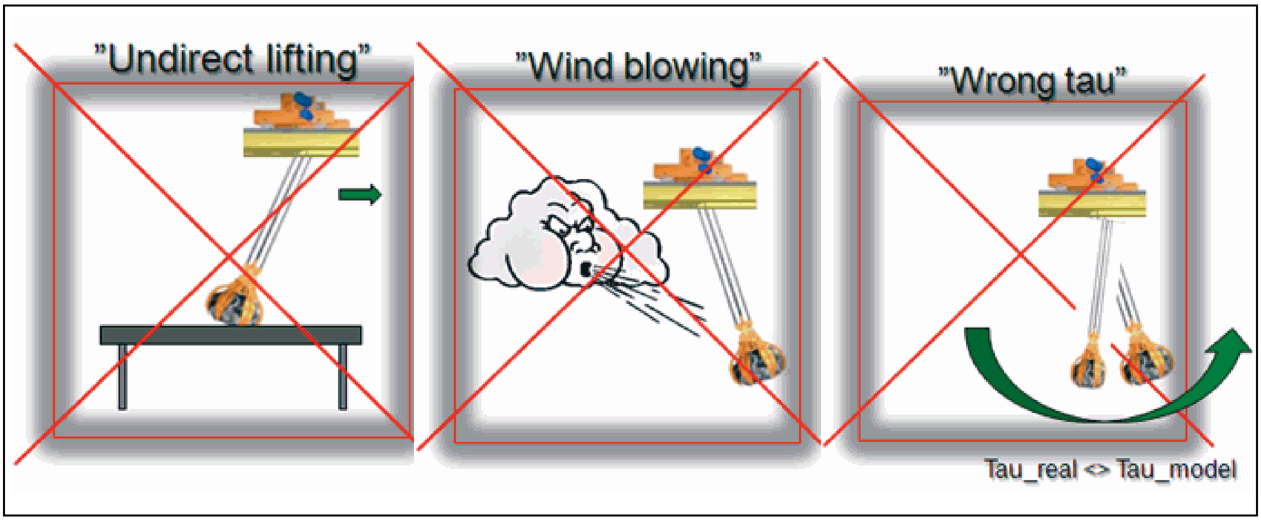
Linear offset: Used when the weight of the lifted load (hoist load) correlates with the shape of lifted load. The values are set in this parameter combination: Min load-Min offset and Max load-Max offset. See *Linear offset/weight sensitive offset* on page *121*.

Direct offset: The value comes directly from the fieldbus, analog inputs or PTR. See *Direct offset* on page *122*.

Auto offset: Used when the load is every time lifted from the same floor level. Offset = maximum length - actual hook position. See *Auto offset* on page *123*.

External disturbances

Because there is no feedback signal for the real load sway, Antisway function cannot compensate the effect of external disturbances (see figure below) such as wind or undirect lifting, or the difference between the behavior of real pendulum and behavior of pendulum model in the frequency converter (wrong settings during start-up).

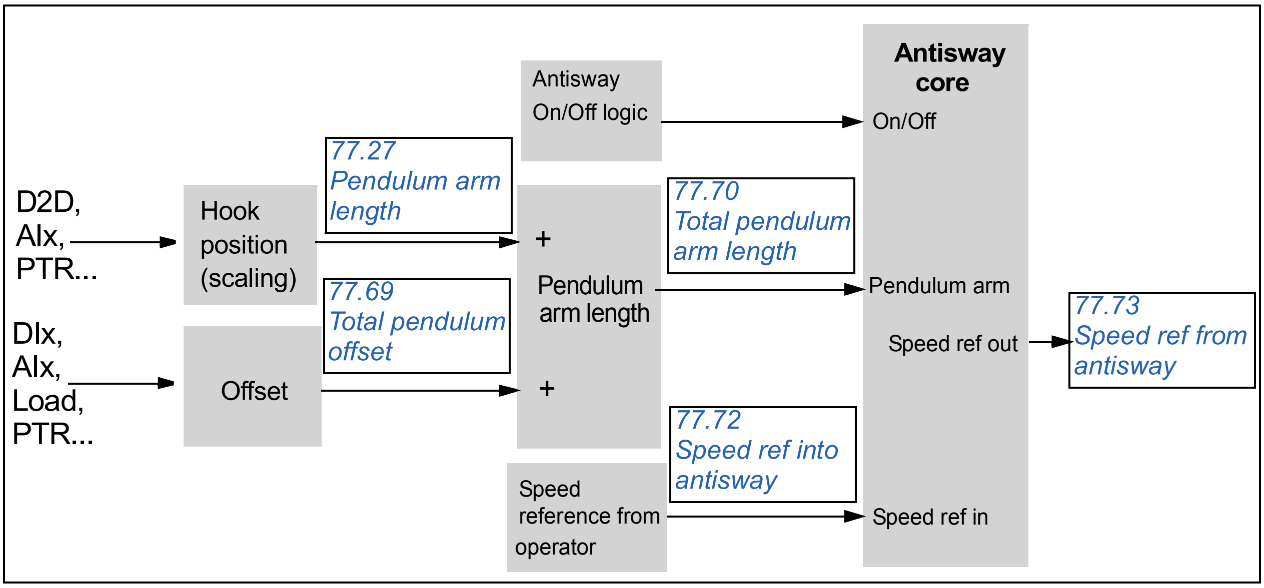


For successful operation, the function should have the following actual values from the hoist drive:

- **Load/torque**. If the hoist and antisway drives have D2D communication, then antisway drives calculate the actual load from the actual hoist torque.
- **Hook position/rope length**.

Main parts of Antisway function

The main parts of the Antisway function are shown in the block diagram below.



Antisway On/Off is activated with parameter *77.01 Antisway enable*. When antisway is enabled, for example, with digital inputs DIx, then it is possible to switch Off/On antisway automatically if parameter *77.02 Enable auto on function* is enabled with following parameters:

- minimum speed logic (parameter *77.05 Antisway enable minimum speed*)
- pendulum arm minimum/maximum length (parameters *77.03 Auto on at maximum pendulum* and *77.04 Auto on a minimum pendulum*).

See also *Automatic ON switching* on page *114*.

Pendulum arm length is the sum of hook position and offset. See *Total pendulum arm length* on page *111*.

- The value of hook position is transfered from the hoist drive. The signal source for hoist position can be selected with parameter *77.20 Pendulum length source*.
- Offset can be determined by step reference logic with actual hoist load (see parameters *77.33*...*77.54*).
- Offset can also be automatically determined using the Auto offset mode (parameter *77.56*). This method is used if the load is lifted up from the same floor level and when different load types and loading devices are used.

Antisway core modifies the speed reference ramp with the known pendulum arm length (parameters *77.72* and *77.73*) to eliminate load swaying. You can check the status of the Antisway function in parameter *77.71 Antisway status*.

Sway tracking

The Sway tracking function allows the drive to compensate the sway caused by movements before switching on the Antisway function.

The pendulum state calculation is activated whenever the speed reference changes. This allows the load swing compensation even if the Antisway function is enabled after the crane movement is already started.

- If sway tracking is enabled (parameter *77.07 Sway tracking enable*) and the antisway function is disabled (parameters *77.01 Antisway enable* and *77.02 Enable auto on function*), the control program tracks the sway movement caused by the given speed reference.

  Note: If Antisway function is enabled during acceleration, the control program compensates the existing (calculated) sway.
- If sway tracking is disabled (parameter *77.07*) and the Antisway function is disabled (parameters *77.01* and *77.02*), the control program does not track the sway movement. This gives the possibility for the crane operator during start (during hoisting) to compensate manually the initial sway before enabling the Antisway function.

You can check the status of the Sway tracking function in parameter *77.71 Antisway status*, bit 2.

Automatic ON switching

Switching the Antisway function ON and OFF can be automated based on the hoist position for the following occurrences:

- speed reference is above the set minimum speed (parameter *77.05 Antisway enable minimum speed*)
- pendulum arm length is between the set minimum and maximum length (parameters *77.03 Auto on at maximum pendulum* and *77.04 Auto on a minimum pendulum*
- time has not elapsed for Antisway function to end calculations (parameter *77.11 Antisway timeout*)

If it is frequently needed to correct the initial sway during hoisting of the load (example, trolley movement of waste-handling grab cranes), it is possible to define a certain lifting range where the Antisway function is always ON. Outside that range, it is always OFF. The AUTO ON function operates only when the Antisway function is switched ON and auto on function is enabled with parameter *77.02 Enable auto on function*. If the Antisway function is disabled, then the AUTO ON function has no effect.

You can check the status of the auto ON for antisway function in parameter *77.71 Antisway status*, bit 11, 13, 14 and 15.

Ramp times

The control program takes the ramp time based on the activation of Antisway function.

- If parameter *77.01 Antisway enable* = *Enable*, ramp time is taken from parameter *77.08 Antisway ramp time*.
- If parameter *77.01 Antisway enable* = *Disable*, ramp time is taken from parameters *23.201 Crane acc time 1* and *23.204 Crane dec time 2*.

In many cases, a higher acceleration rate can be utilized when driving the crane with the Antisway function.

Limit switches

The distance to stop the crane from full speed can be estimated using the following formula (units are SI units):

$$s = \frac{v}{4}(\tau + t_{acc}), t_{acc} = \text{deceleration time}$$

Here τ is the longest possible pendulum time constant. It can be estimated from the hoisting height

$$\tau = 2\sqrt{h}$$

(approximation from $\tau = \sqrt{\frac{4h\pi^2}{g}}$, where g = gravity and h = length of pendulum arm)

Example: The hoisting height is 16 m, crane full speed is 30 m/min (0.5 m/s), normal deceleration time for manual driving is 5 sec (parameter *23.202 Crane dec tme 1*). For a linear ramp (antisway OFF), the slowdown distance of the crane would be

$$s = \frac{1}{2}v \times t_{acc} \Rightarrow \frac{1}{2} \times 0,5\frac{m}{s} \times 5_s = 1,25m$$

With Antisway function enabled the basic ramp time can be set shorter, for example 4 seconds (parameter *77.08 Antisway ramp time*). In this case, the slowdown distance of the load is:

$$\tau = 2 \times \sqrt{16} = 8_s$$

$$s = \frac{0,5ms}{4} \times (8_s + 4_s) = 1,5m$$

Note: Stopping the load without antisway control (with linear ramp) in this example can cause overshoot of the load (swaying) which can make the real stopping distance of the load longer than the calculated distance (1.25 m).

With antisway (1.5 m), there is no overshoot problem and the load travels perpendicular to the trolley (because the load stops at equilibrium).

Antisway communication

Antisway communication can be used for delivering signals from the hoist drive to the Antisway function like hoist position and hoist torque. Antisway drives (trolley and long travel) form a chain. D2D communication must be used.

See *Example of parameter settings for antisway communication: From host to main trolley* on page *60*.

Fieldbus communication

In case of fieldbus controlled antisway drive (trolley/long travel), to get a faster response to the start and stop commands, use parameter *20.216 Crane control word 1*. Do the following parameter settings:

- *20.01 Ext1 commands* = *In1 Start fwd; In2 Start rev*
- *20.03 Ext1 in1 source* = Par. *20.216*, bit 0
- *20.04 Ext1 in2 source* = Par. *20.216*, bit 1,

instead of fieldbus control word (*20.01 Ext1 commands* = *Fieldbus A*).

Antisway commissioning instructions

Preparations

The general parameter settings for Antisway function are in group *77 Antisway* on page *464*. For best results it is essential to define the pendulum arm calculation parameters as accurately as possible. The mathematical length of pendulum arm can be different for bridge and trolley directions, so these settings should be done separately for both movements.

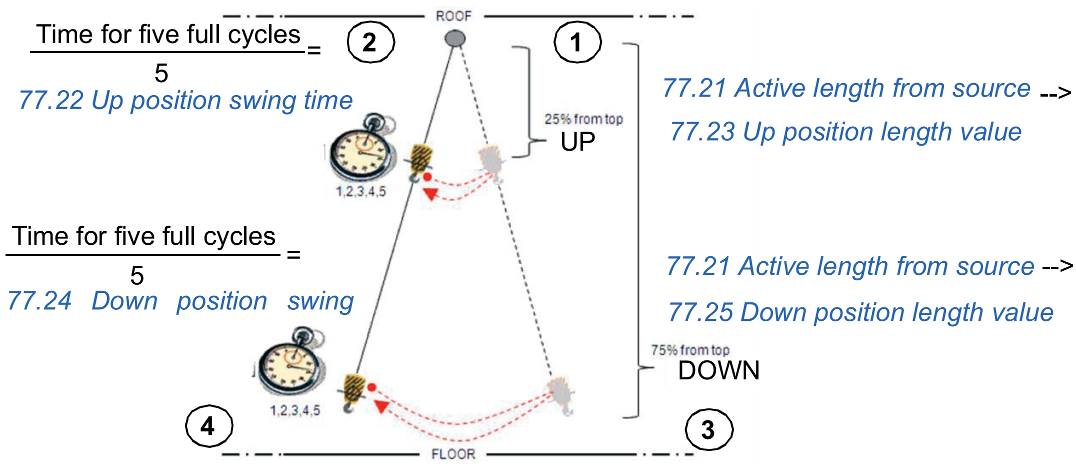
Before proceeding with parameter settings for Antisway function, the following checks are done:

Preliminary actions	
☐	Trial run the crane drives (hoist, trolley and long travel) to confirm the crane works as planned without the Antisway function.
☐	Check the position counter settings and function (rope length measurement) in the hoist drive or in an overriding system (PLC). The output of the position counter can be read in parameter *90.05 Load position scaled*.
☐	In the hoist drive, set parameter *90.05 Load position scaled* into D2D-link communication with parameter *77.20 Pendulum length source* = par. *90.05*.
☐	Build and configure Antisway communication between the drives according to the master/follower communication setup instructions. See *Example of parameter settings for antisway communication: From host to main trolley* on page *60*. See also figure in *The figure below shows the D2D-link configuration.* on page *56*.
☐	Check that actual length in parameter *77.21 Active length from source* follows the value sent by the hoist drive.
☐	Check that actual load is as shown in parameter *77.31 Active load* (when driving hoist up and down). The transmitted load value is set in the hoist drive with parameter *77.80 Load to antisway selection* (Internal = *77.81 Hoist load from torque act*, Other…(*75.40 Relative hoist load*, but in this case hoist speed optimization needs real crane data)

Measuring and calculating a real pendulum arm with an empty hook

When measuring and calculating the real pendulum arm length, note that the real pendulum arm length is not same as the rope length/hook position. The following procedure sets the two values (rope length/hook position and real pendulum arm length) to coincide with each other.

Note: This operation is done with an empty hook and Antisway function disabled.



Hook in UP position

Step	Action
1	Set parameter *77.01 Antisway enable* = Disable. The mathematical length of pendulum arm can be different for bridge and trolley directions, so these settings must be done for both movements. See the above picture.
2	Move the hook to UP position, for example, 25% from top position (UP).
3	In the trolley drive, read the signal in parameter *77.21 Active length from source* and enter it to parameter *77.23 Up position length value*. See (1) in above figure.
4	In the trolley drive, initiate load swing, for example, stop the trolley using emergency stop.
5	Measure the time for five full oscillations. Divide the measured time by the number of full oscillations (5). Set the calculated time in the parameter *77.22 Up position swing time*. See (2) in above figure.
6	While the hook is in the same UP position, repeated steps 3 to 5 with the long travel drive.

Hook in DOWN position

Step	Action
1	Make sure that parameter *77.01 Antisway enable* = Disable. The mathematical length of pendulum arm can be different for bridge and trolley directions, so these settings must be done for both movements. See the above picture.
2	Lower the hook to DOWN to the floor level, for example, 75% from top position (UP).
3	In the trolley drive, read the signal in parameter *77.21 Active length from source* and enter it to parameter *77.25 Down position length value*. See (3) in above figure.
4	In the trolley drive, initiate load swing, for example, stop the trolley by using emergency stop/fast stop.
5	Measure the time for five full oscillations. Divide the measured time by the number of full oscillations (5). Set the calculated time in the parameter *77.24 Down position swing time*. See (4) in above figure.
6	While the hook is in the same DOWN position, repeated steps 3 to 5 with the long travel drive.

Test with an empty hook

Step	Action
1	Set parameters *77.01 Antisway enable* = *Enable* and *77.02 Enable auto on function* = *Disable*
2	Execute the test with an empty hook. Test the trolley and long travel movements.
3	If swinging still exists, switch OFF antisway temporarily and swing the hook. Now measure/calculate the time for full cycle time and calculate the real pendulum length using the below formula. Compare the results with parameter *77.27 Pendulum arm length*. Pendulum arm length = 0.25 x One_full_cycle_time^2 = 1/4 τ^2
4	If the values are different, make sure the values are correct in parameters *77.22*...*77.25* and the actual position shown in parameter *77.21 Active length from source* is updated from the hoist drive or from the PLC.

Determining pendulum arm offset

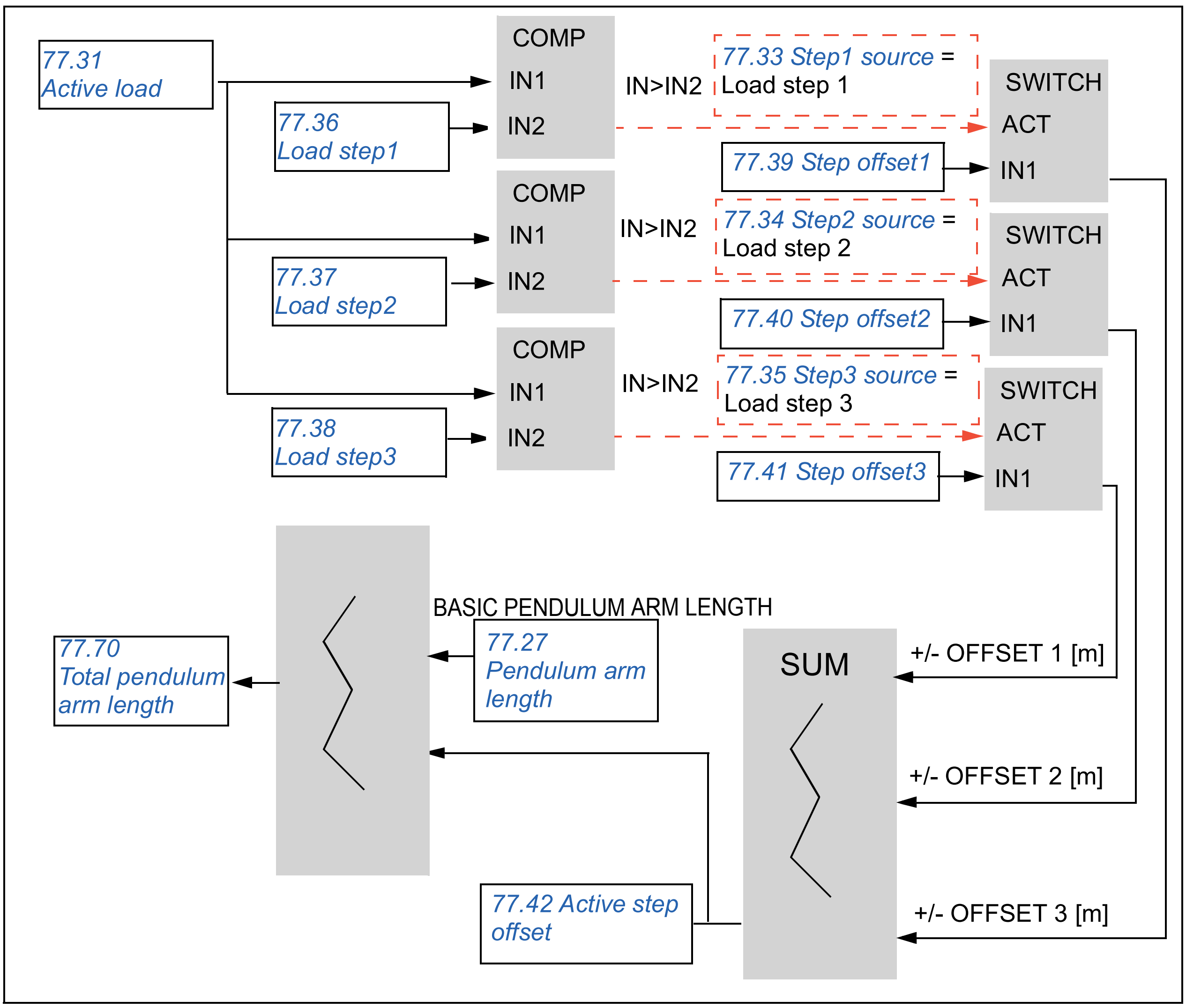
The pendulum arm offset is determined using one of the following methods. The final offset is added to the pendulum arm length (from the hoist drive) and this result is used by the antisway core. For more information, see *Total pendulum arm length* on page *111*.

- *Step offset* (page *120*)
- *Linear offset/weight sensitive offset* (page *121*)
- *Direct offset* (page *122*)
- *Auto offset* (page *123*)

Step offset

When the lifted load varies in shape, size and weight, the step offset method can be used. The control can be taken from Load or from digital I/O (example, crane operator or PLC). The load step is selected with parameter selection is made with parameters *77.36*...*77.38*. The figure below illustrates the load based offset control.

Offset steps controlled by the actual load of the hoist.



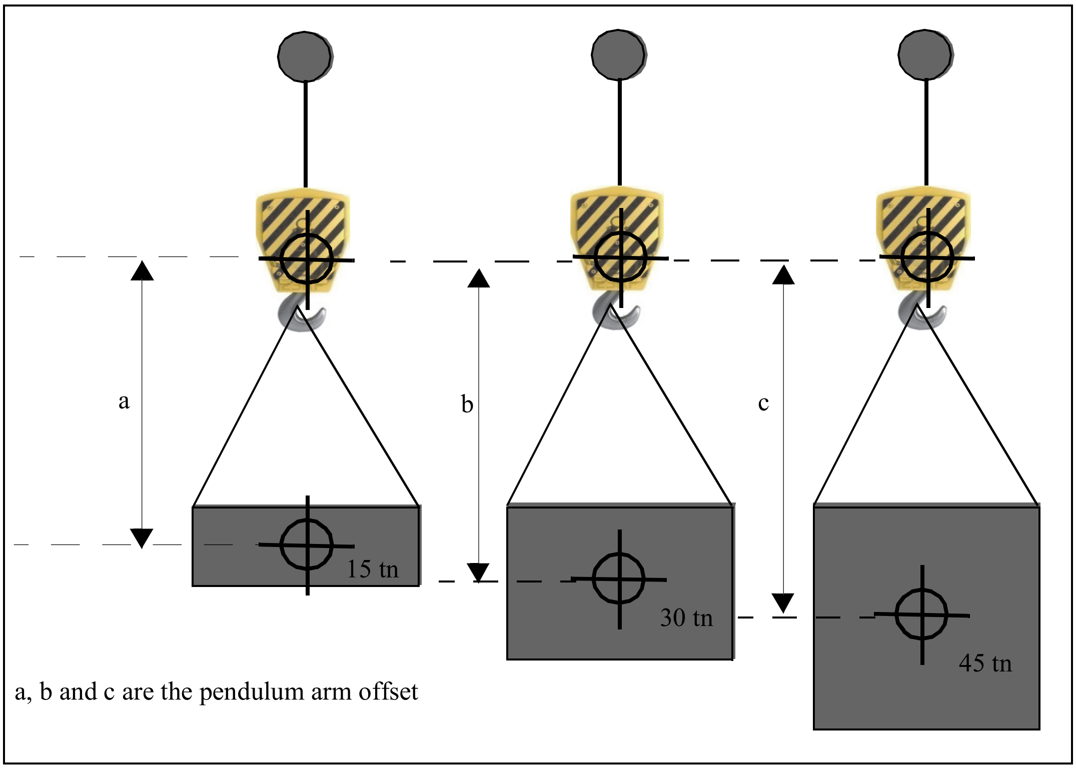
Linear offset/weight sensitive offset

The below procedure describes the configurations when offset is directly proportional (linear) to the weight of the lifted load. An example figure of the linear load configuration and the load curve is shown after this procedure on page *122*.

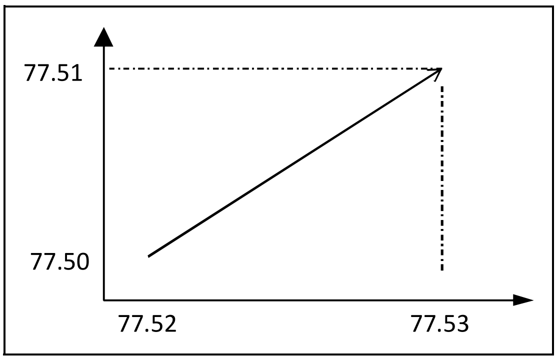
Step	Action
1	Read the empty hook or the lowest possible load from parameter *77.31 Active load* (when moving UP).
2	Enter the value into parameter *77.52 Load min*. Above this load, the linear effect to pendulum arm is calculated.
3	Measure the pendulum time and calculate the corresponding total pendulum arm length (five full cycles/5 = τ [s], length [m] = 0.25 x τ) m. Make sure that Antisway function is disabled.
4	Calculate the difference between the result of step 3 and value in parameter *77.27 Pendulum arm length*. Set this value into parameter *77.50 Load offset min*.
5	Connect the highest possible load to the hook and read the load value from parameter *77.31 Active load* (when moving UP).
6	Enter the value read in step 5 into parameter *77.53 Load max*.
7	Measure the pendulum time and calculate the corresponding total pendulum arm length (five full cycles/5 = τ [s], length [m] = 0.25 x τ) m. Make sure that Antisway function is disabled.
8	Calculate the difference between the result of step 7 and value in parameter *77.27 Pendulum arm length*. Set this value into parameter *77.51 Load offset max*.
9	Trial run with different load. If swaying still exist, then calculate the real pendulum arm length and compare with value in parameter *77.70 Total pendulum arm length* and tune points of linear offset.

Note: The accuracy remains same for any measurement unit other than millimeters, for example, centimeters.

Example: Linear load configuration



Linear load curve



Direct offset

When the pendulum arm offset is determined in a PLC program the value of the offset can be directly written into the antisway drive. The value can be first written into, for example, parameter *47.21 Data storage 1 int16* and picked up using pointer selection in parameter *77.65 Direct offset source* (=Parameter *47.21*).

The source for direct offset can also be from analog inputs AI.

Auto offset

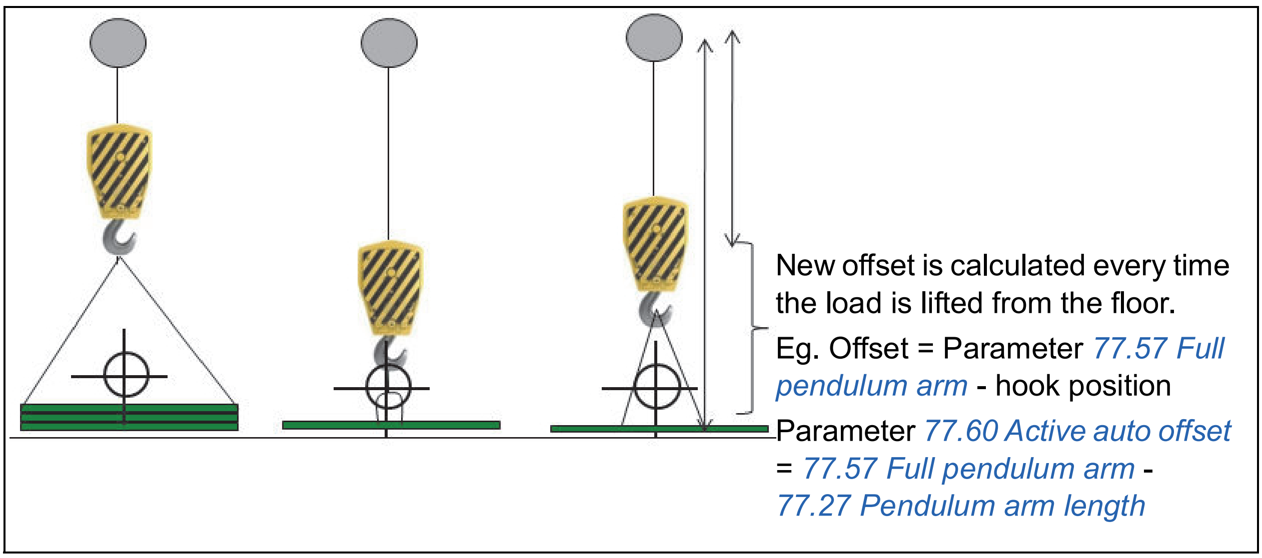
The Auto offset mode (parameter *77.56 Auto offset enable*) can be used only when the load is always lifted up from the same (approximately) floor level and it is especially useful when several different load types and loading devices (lifting straps) are in use.

In Auto offset mode, parameter *77.56 Auto offset enable* is considered as full pendulum arm length, meaning the load is just/almost touching the floor level.

The below procedure describes the configurations to use in the Auto offset mode.

Step	Action
1	Measure and calculate the real pendulum arm length with an empty hook. See page *118*.
2	Pick-up the lightest load to be lifted during normal operation.
3	Enter a suitable load value between the empty condition (point 1) and small load condition into parameter *77.58 Load minimum in auto mode* (this is the decision level between a load and no-load condition).
4	Put the empty hook swaying when close to the floor level and calculate the pendulum arm. Enter the result into parameter *77.57 Full pendulum arm*. Five cycles/5 = ___ s, length = 0.25 x tau = ___ m
5	Put the load on the floor and lift it up and measure/calculate again. Compare that value to the actual calculated pendulum arm in the signal *77.70 Total pendulum arm length*. If the values differ from each other considerably, change the setting of the parameter *77.57 Full pendulum arm* respectively and repeat the measurement. The actual signal *77.60 Active auto offset* shows the active offset.

Lifting different kind of objects from the same level

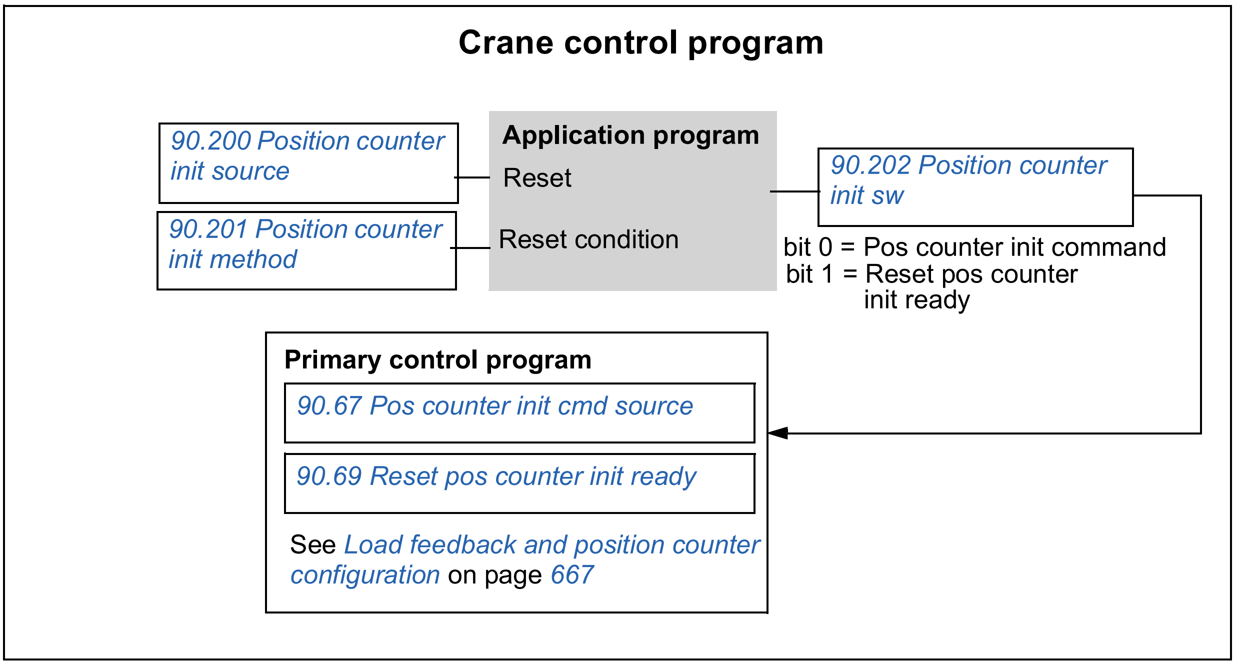


Position counter initialization and scaling for crane control program

Initialization

In addition to the standard position counter feature (on page *165*), the crane control program contains additional parameters to initialize (reset/preset) the counter value.

The initialization method (parameter *90.201 Position counter init method*) can be selected based on the reset condition that is rising or falling edge of the reset source input while the drive is in modulating or in standby mode. You can also manually trigger the position initialization command by setting the parameter *90.200 Position counter init source* = True.

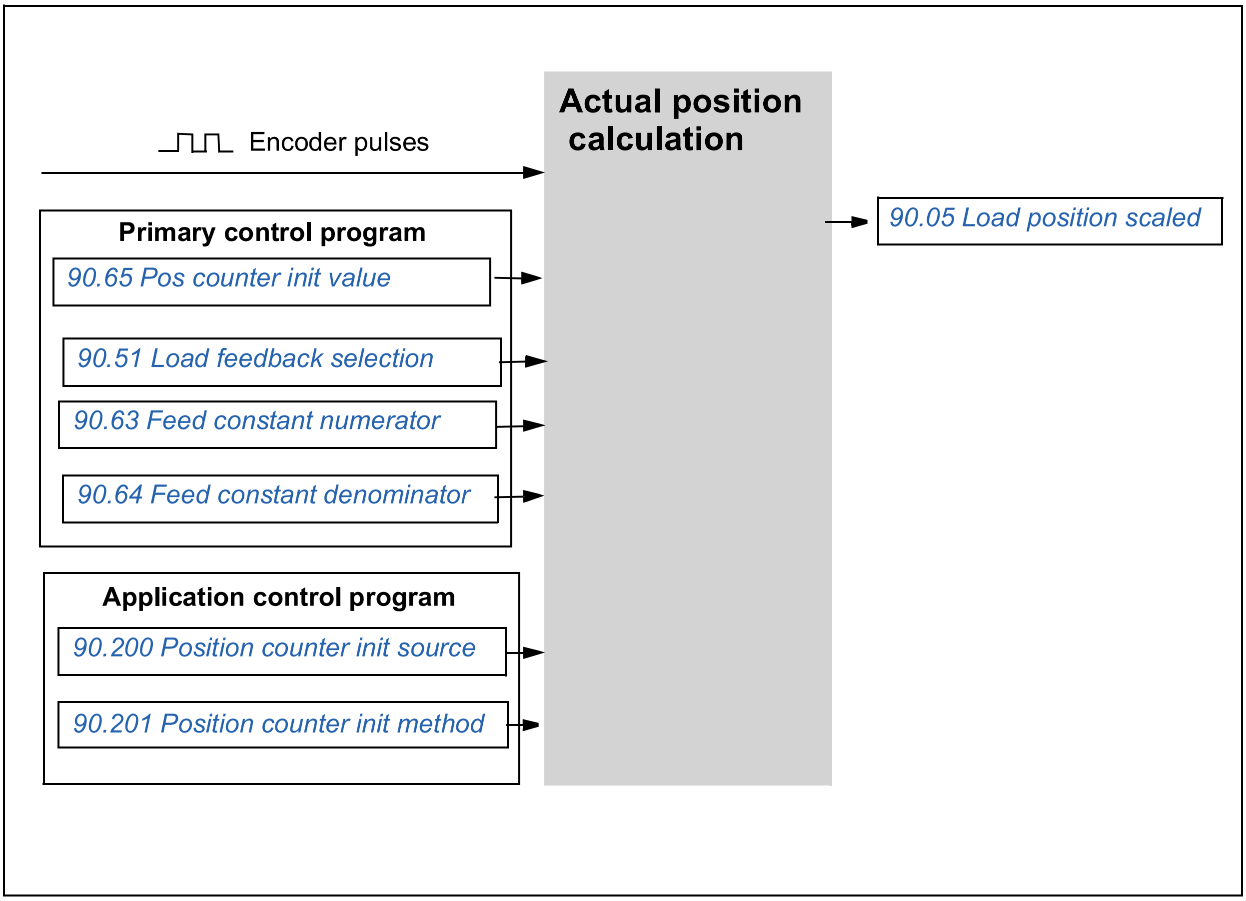


Parameter *90.202 Position counter init sw* shows the status of the position counter initialization function. Bit 0 is connected as default into parameter *90.67 Pos counter init cmd source* and Bit 1 is connected as default into parameter *90.69 Reset pos counter init ready*.

If only the position counter of primary control program is needed, then set their corresponding parameters. See *Position counter* on page *165*.

Scaling

The crane control program uses this function to calculate the actual position of the hook. The Shaft synchro function can use this hook position to synchronize the Master and Follower drives. The Antisway function also uses this hook position in trolley and long travel drives.

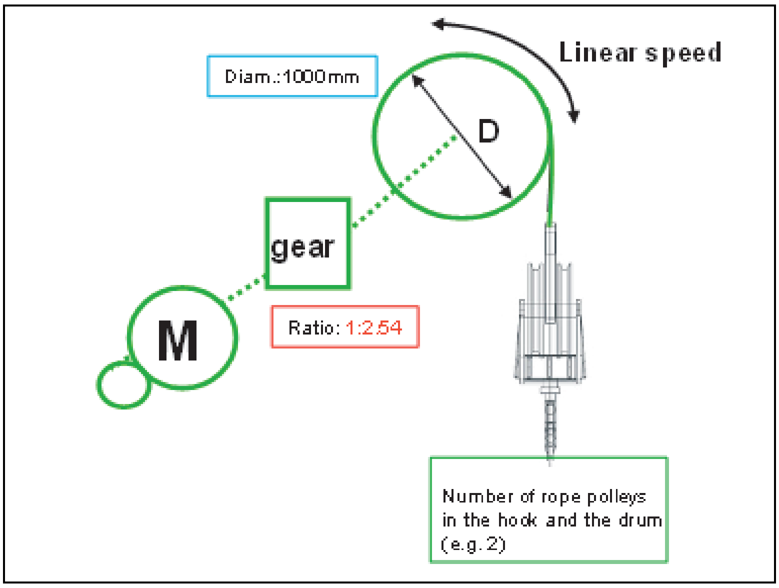


The position is determined based on the encoder located on the motor shaft. You can enable the position calculation, by defining the factor that scales the encoder pulse to the actual position units. See the example below.

Note:

- In M/F communication when synchro control is enabled, the scaling factor converts rotation speed reference to linear speed reference.
- The value of parameter *90.05 Load position scaled* remains over power failure.

Examples: Calculating linear speed of rope



$$Scaling = \frac{\pi \times D(mm)}{GearRatio \times NumberOfRopePulleys} = \frac{P90.63}{P90.64}$$

$$Example1 = \frac{\pi \times 1000(mm)}{2,54 \times 2} = \frac{3141,59}{5,08} \rightarrow \frac{P90.63 = 314159}{P90.64 = 508}$$

$$Example2 = \frac{\pi \times 1000(mm)}{2,54 \times 2} = 618,424 \rightarrow \frac{P90.63 = 618}{P90.64 = 1}$$

Settings:

Parameters: *90.200 Position counter init source*, *90.201 Position counter init method*

Signals: *90.202 Position counter init sw*

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 during the drive in standby.

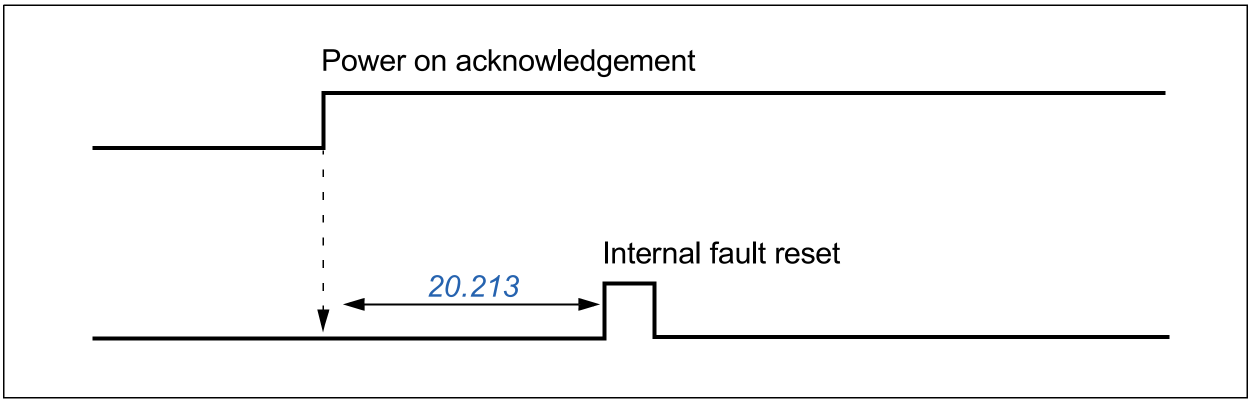
The control board (BCU-xx or ZCU-xx) consists of an external +24 V power supply that can be selected with parameter *95.04 Control board supply*.

The source for the Power on acknowledgement signal (*20.212*) is typically from the auxiliary contact of the main contactor. By default, the signal is connected to the DIIL input of the drive control unit.

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 (*20.213*).

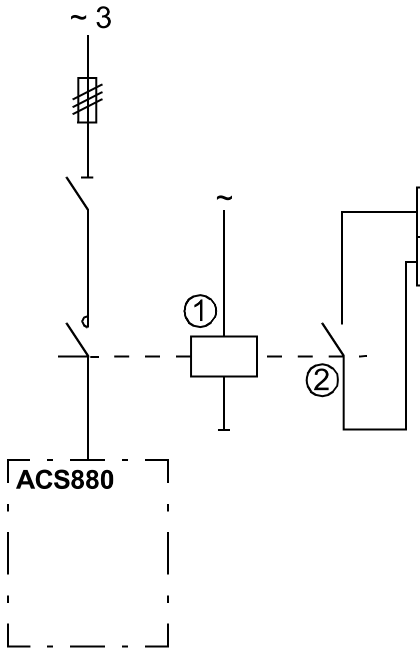
Meanwhile the Power on acknowledgement circuit is open (*20.212* = False), the drive shows a warning (*D20B*).

Timing diagram



Note: The same input as to the power acknowledge is used for RUN ENABLE (par. *20.12 Run enable 1 source*).

Wiring example



Drive control unit

XD24 Digital interlock

1	DIIL	Power acknowledge. See par. *20.212*.
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 par. *20.12 Run enable 1 source*

Settings

Parameters: *20.212 Power on acknowledge*, *20.213 Power on ackn reset delay*

Signals: *09.01 Crane SW1*

Warnings: *D20B Power on acknowledge*

Faults: -

Crane warning masking

The Crane warning masking function masks predefined crane control warnings. The masked warnings do not appear in the event logger or on the control panel.

Settings

Parameter: *31.205 Crane warning masking*

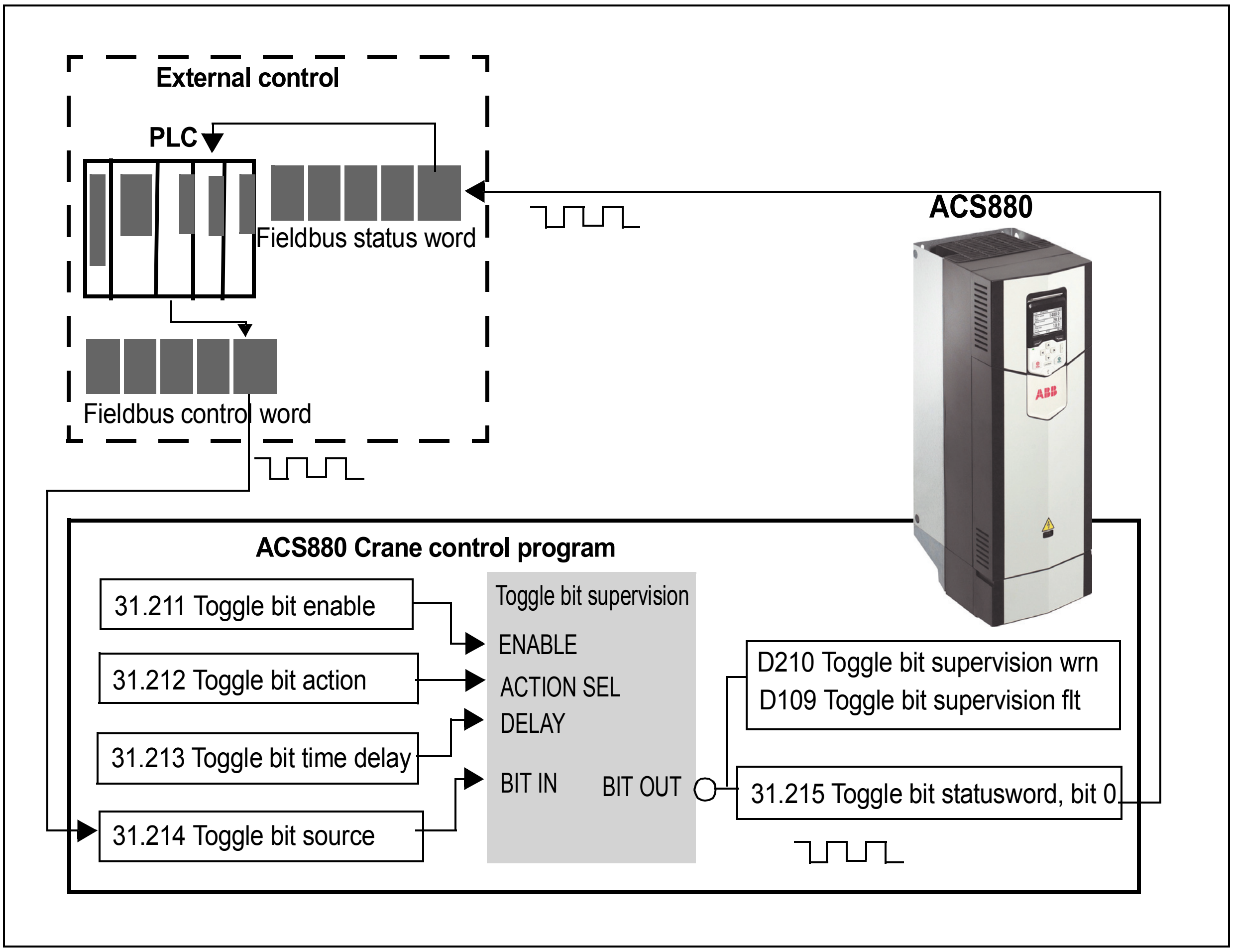
Signals: *09.01 Crane SW1*, *09.02 Crane SW2*

Warnings: -

Faults: -

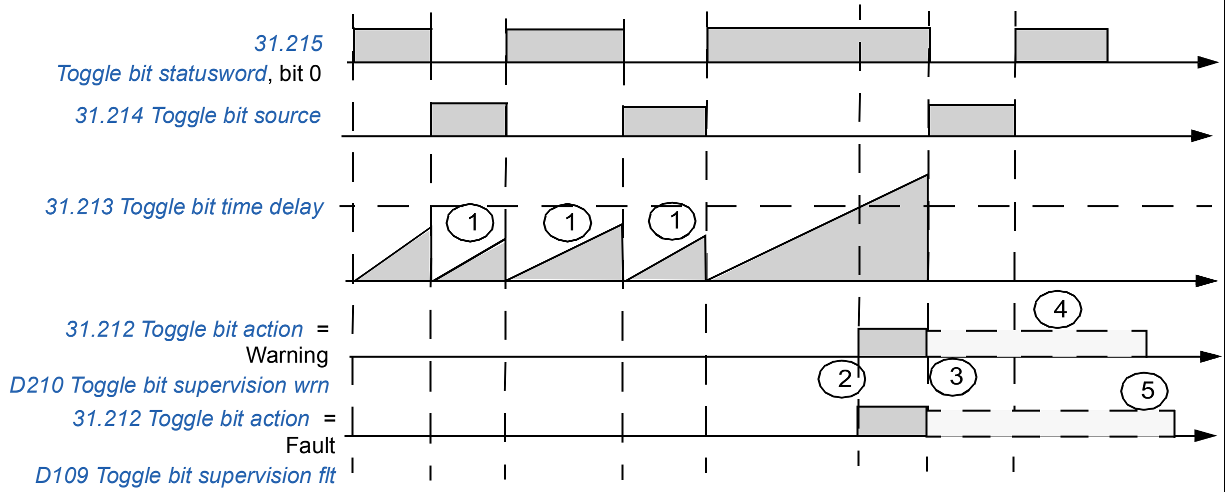
Toggle bit

The Toggle bit function provides additional protection in the event of communication loss between the overriding system (eg. PLC) and the drive. The function can be activated or the source signal can be selected with parameter *31.211 Toggle bit enable*. In the even of a communication loss, the function triggers a warning/fault based on the defined delay time. See the below timing diagram. The function transfers the toggle bit output pulse from parameter *31.215 Toggle bit statusword*, bit 0, into the overriding system through the fieldbus. The status word (*31.215*) inverts its own status. See the below diagram.



Note: External control works like a repeater for the toggle bit signal and prevents any modification to the signal.

Timing diagram



1. Toggle bit delay time (*31.213*) resets all the time because toggle bit status word (*31.215*) is equal to returned bit (*31.214*).
2. Warning or fault trips when the returned bit (*31.214*) is not equal to toggle bit (*31.215*) during the defined delay time (*31.213*).
3. The function resets the warning/fault as soon as returned bit is equal to toggle bit.
4. Warning *D210 Toggle bit supervision wrn* is active according to firmware instruction.
5. Fault *D109 Toggle bit supervision flt* remains active until the reset command from firmware.

Settings

Parameter: *31.211 Toggle bit enable*, *31.212 Toggle bit action*, *31.213 Toggle bit time delay*, *31.214 Toggle bit source*.

Signal: *31.215 Toggle bit statusword*

Warning: *D210 Toggle bit supervision wrn*

Fault: *D109 Toggle bit supervision flt*

Maintenance counters

In addition to the Supervision function (group *32 Supervision*), the crane control program contains three maintenance counters for supervising: crane operating hours, brake operation counts, and the number of times power is On.

The values of these maintenance counter can be set/reset after some maintenance actions or drive unit replacements. All these counters have warning limits. Parameter *09.02 Crane SW2* shows the actual status of these counter.

Operation hours counter

This counter supervises the crane operating hours, for example, number of hours the hoist was running with open brake.

Settings:

Parameters: *09.20 Crane operation hours*, *33.200 Set crane operation hours*, *33.201 Crane operation hrs init value*, and *33.202 Crane operation hrs warning limit*.

Signals: *09.02 Crane SW2*

Warnings: *D212 Crane operating hours*

Faults: -

Brake operated counts

This counter supervises the number of times mechanical brake was opened.

Settings:

Parameters: *09.21 Brake operation count*, *33.210 Set brake oper counts*, *33.211 Brake oper counts init value*, and *33.212 Brake oper counts warning limit*.

Signals: *09.02 Crane SW2*

Warnings: *D213 Brake oper counts*

Faults: -

Number of power on

This counter supervises the number of times the main power was connected to the drive. It counts the number of power acknowledgments (parameter *20.212 Power on acknowledge*). See also *Power on acknowledgement* on page *126*.

Settings:

Parameters: *09.22 Number of pwr on*, *33.220 Set number of power on*, *33.221 Number of pwr on init value*, and *33.222 Number of pwr on warning limit*.

Signals: *09.02 Crane SW2*

Warnings: *D214 Number of power on*

Faults: -

5

Standard program features

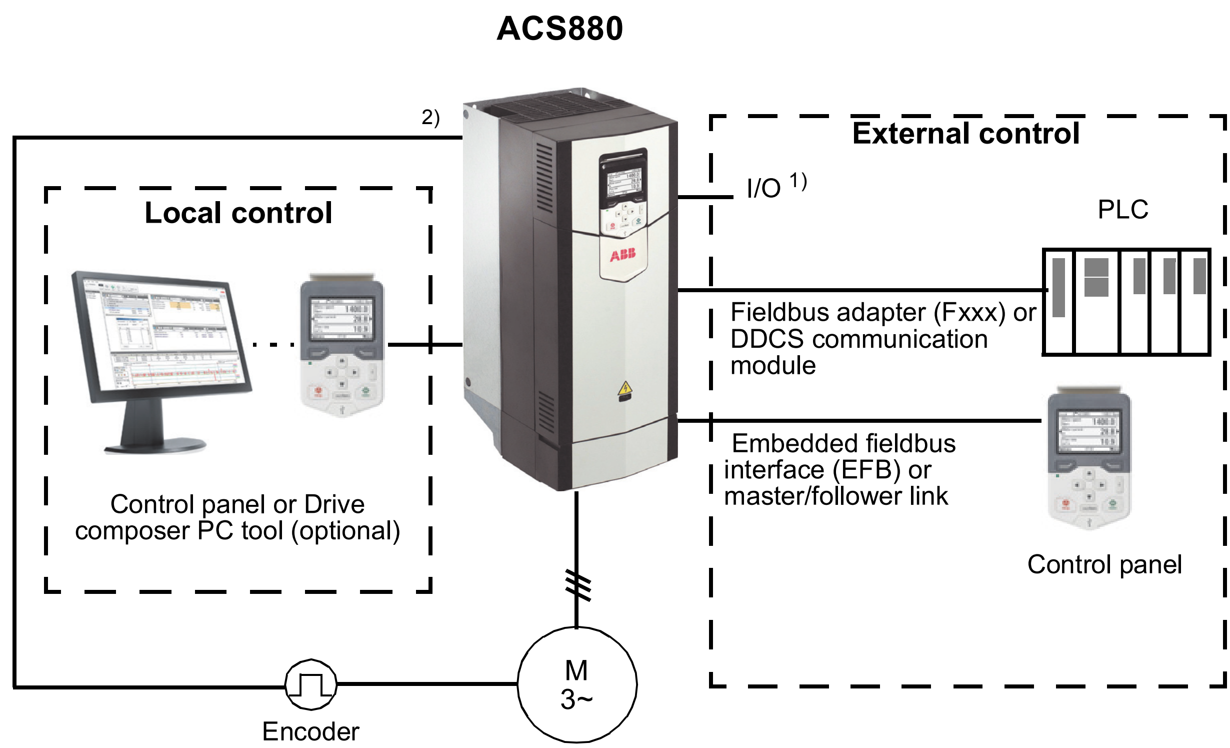
Contents of this chapter

The 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 crane applications, such as motor control.

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*).

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, and/or
- the master/follower link., and/or
- the control panel.

Two external control locations, EXT1 and EXT2, are available. The user can select the sources of the start and stop commands separately for each location by parameters *20.01*…*20.10*. The operating mode can be selected separately for each location (in parameter group *19 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 control location 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.

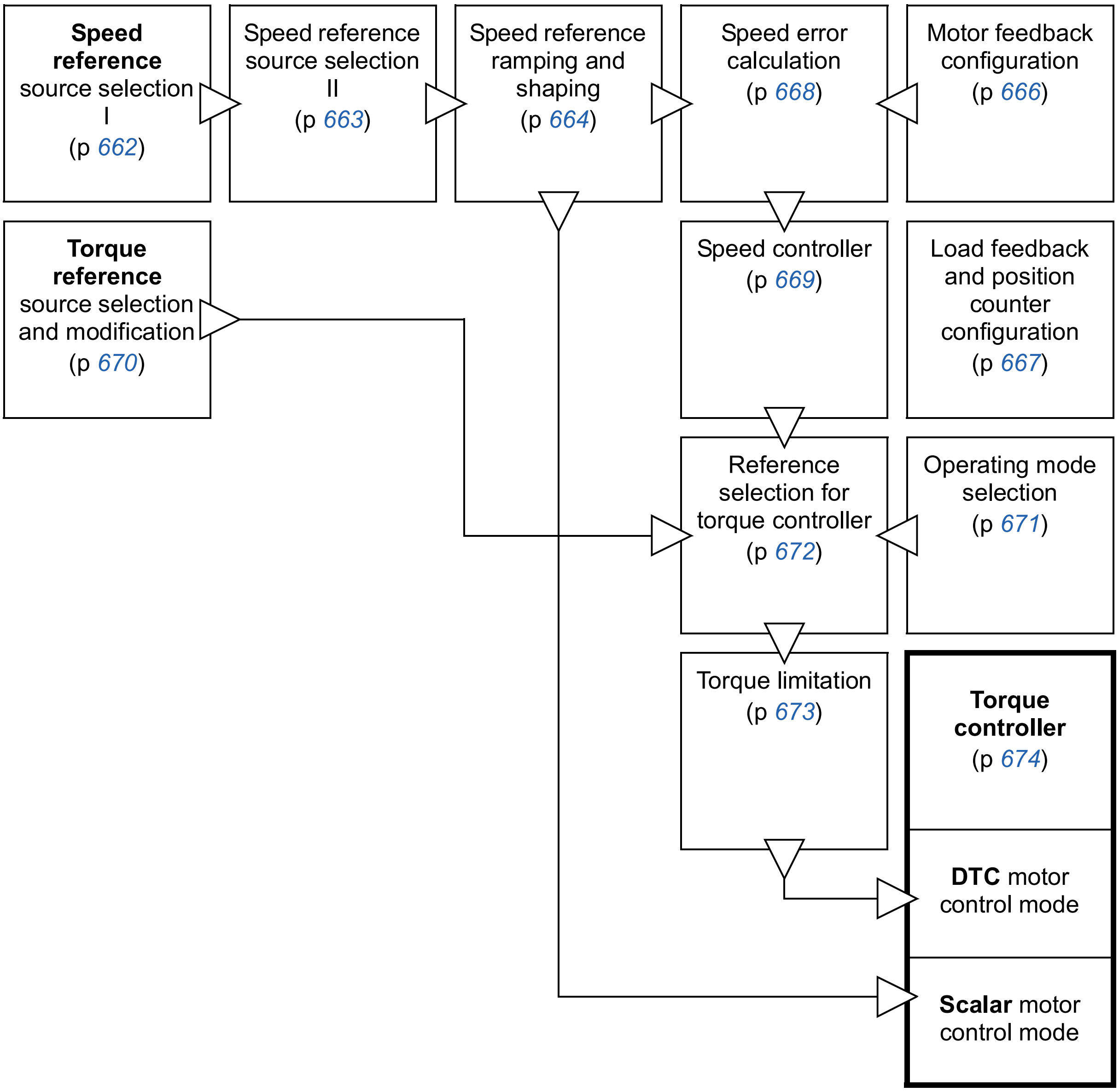
The panel reference is saved whenever another reference source is selected. If the reference source selection parameter is set to *Control panel (ref saved)*, the saved value is used as the initial reference when control switches back to the panel. Note that only one type of reference can be saved at 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*.



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.

Note: As a safety measure, hoist drives must be equipped with a speed feedback device, such as a pulse encoder.

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. Parameter *99.04 Motor control mode* can be used to select between DTC and scalar 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 use used in conjunction with a feedback device such as an encoder or a resolver. It is recommended that a feedback device is used in the crane control.

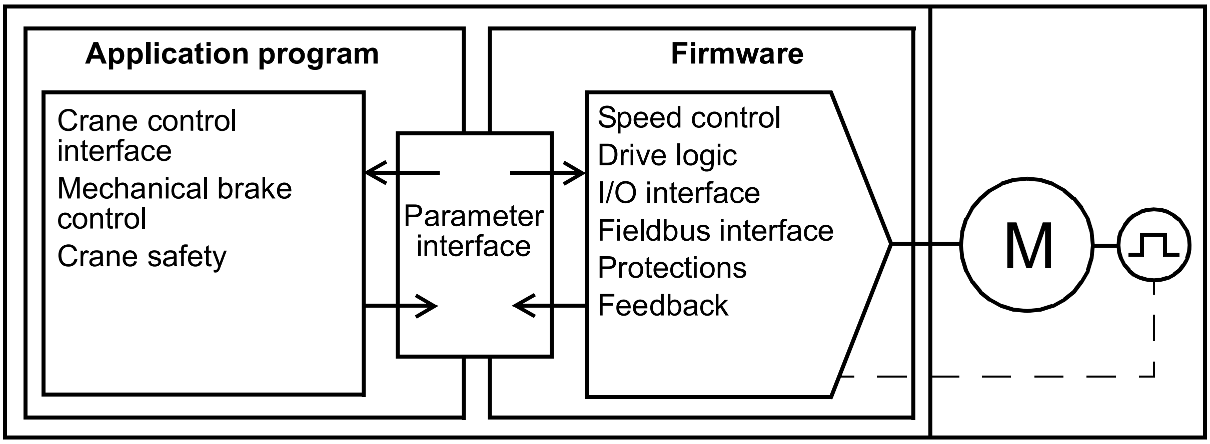
The torque control mode is available in DTC motor control mode for both local and external control locations.

Drive configuration and programming

The crane control program is divided into two parts:

- firmware program
- application program.

Crane control program



The firmware program performs the main control functions, including speed control, drive logic (start/stop), I/O, feedback, communication and protection functions. The application 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 pro PC tool (version 1.10 or later, available separately) has an Adaptive programming feature with a graphical user interface for building the custom program. The function blocks include the usual arithmetic and logical functions, as well as eg. selection, comparison and timer blocks. The program can contain a maximum of 20 blocks. The adaptive program is executed on a 10 ms time level.

The physical inputs, drive status information, actual values, constants and data storage parameters can be used as the input for the program. The output of the program can be used eg. as a start signal, external event or reference, or connected to the drive outputs. See below for a listing of the available inputs and outputs. Note that connecting the output of the adaptive program to a selection parameter will write-protect the parameter.

Parameter *07.30 Adaptive program status* shows the status of the adaptive program. The program can be disabled with parameter *96.70 Disable adaptive program*.

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

Inputs available to the adaptive program	
Input	*Source*
I/O	
DI1	*10.02 DI delayed status*, bit 0
DI2	*10.02 DI delayed status*, bit 1
DI3	*10.02 DI delayed status*, bit 2
DI4	*10.02 DI delayed status*, bit 3
DI5	*10.02 DI delayed status*, bit 4
DI6	*10.02 DI delayed status*, bit 5
DIIL	*10.02 DI delayed status*, bit 15
AI1	*12.11 AI1 actual value*
AI2	*12.21 AI2 actual value*
DIO1	*11.02 DIO delayed status*, bit 0
DIO2	*11.02 DIO delayed status*, bit 1
Actual signals	
Motor speed	*01.01 Motor speed used*
Output frequency	*01.06 Output frequency*
Motor current	*01.07 Motor current*
Motor torque	*01.10 Motor torque*
Motor shaft power	*01.17 Motor shaft power*
Status	
Enabled	*06.16 Drive status word 1*, bit 0
Inhibited	*06.16 Drive status word 1*, bit 1
Ready to start	*06.16 Drive status word 1*, bit 3
Tripped	*06.11 Main status word*, bit 3

Inputs available to the adaptive program	
Input	*Source*
At setpoint	*06.11 Main status word*, bit 8
Limiting	*06.16 Drive status word 1*, bit 7
Ext1 active	*06.16 Drive status word 1*, bit 10
Ext2 active	*06.16 Drive status word 1*, bit 11
Data storage	
Data storage 1 real32	*47.01 Data storage 1 real32*
Data storage 2 real32	*47.02 Data storage 2 real32*
Data storage 3 real32	*47.03 Data storage 3 real32*
Data storage 4 real32	*47.04 Data storage 4 real32*
Data storage 5 real32	*47.05 Data storage 5 real32*
Data storage 6 real32	*47.06 Data storage 6 real32*
Data storage 7 real32	*47.07 Data storage 7 real32*
Data storage 8 real32	*47.08 Data storage 8 real32*

Outputs available to the adaptive program	
Output	*Target*
I/O	
RO3	*10.30 RO3 source*
AO1	*13.12 AO1 source*
AO2	*13.22 AO2 source*
DIO1	*11.06 DIO1 output source*
DIO2	*11.10 DIO2 output source*
Start control	
Ext1/Ext2 selection	*19.11 Ext1/Ext2 selection*
Ext1 in1 cmd	*20.03 Ext1 in1 source*
Ext1 in2 cmd	*20.04 Ext1 in2 source*
Ext1 in3 cmd	*20.05 Ext1 in3 source*
Ext2 in1 cmd	*20.08 Ext2 in1 source*
Ext2 in2 cmd	*20.09 Ext2 in2 source*
Ext2 in3 cmd	*20.10 Ext2 in3 source*
Fault reset	*31.11 Limit word 1*
Speed control	
Speed ref1	*22.11 Speed ref1 source*
Speed ref2	*22.12 Speed ref2 source*
Speed additive 1	*22.15 Speed additive 1 source*
Speed (controller) proportional gain	*25.02 Speed proportional gain*
Speed (controller) integration time	*25.03 Speed integration time*
Limitations	
Minimum torque 2	*30.21 Minimum torque 2 source*
Maximum torque 2	*30.22 Maximum torque 2 source*
Events	
External event 1	*31.01 External event 1 source*
External event 2	*31.03 External event 2 source*
External event 3	*31.05 External event 3 source*
External event 4	*31.07 External event 4 source*
External event 5	*31.09 External event 5 source*
Data storage	

Outputs available to the adaptive program	
Output	*Target*
Data storage 1 real 32	*47.01 Data storage 1 real32*
...	...
Data storage 8 real 32	*47.08 Data storage 8 real32*

Application programming

The crane application program is based on the IEC 61131-3 standard. The program is an in-house application and is locked to the user to avoid any changes to the program.

Control interfaces

Programmable analog inputs

The control unit has two programmable analog inputs. Each of the inputs can be independently set as a voltage (0/2…10 V or -10…10 V) or current (0/4…20 mA) input by a jumper or switch on the control unit. Each input can be filtered, inverted and scaled. The number of analog inputs can be increased by installing FIO-11 or FAIO-01 I/O extensions (see *Programmable I/O extensions* below).

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

Parameter group *12 Standard AI* (page *246*).

Programmable analog outputs

The control unit has two current (0…20 mA) analog outputs. Each output can be filtered, inverted and scaled. The number of analog outputs can be increased by installing FIO-11 or FAIO-01 I/O extensions (see *Programmable I/O extensions* below).

Settings

Parameter group *13 Standard AO* (page *250*).

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).

One digital input (DI6) doubles as a PTC thermistor input. See section *Motor thermal protection* (page *182*).

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

The number of digital inputs/outputs can be increased by installing FIO-01, FIO-11 or FDIO-01 I/O extensions (see *Programmable I/O extensions* below).

Settings

Parameter groups *10 Standard DI, RO* (page *235*) and *11 Standard DIO, FI, FO* (page *241*).

Programmable relay outputs

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

Relay outputs can be added by installing FIO-01 or FDIO-01 I/O extensions.

Note:

- By default, relay output RO1 is used for the brake control command (*10.24 RO1 source* = *44.210*, b0). The default value must not be changed.
- By default relay output RO2 is used for the watchdog output (*10.27 RO2 source* = *32.227*, b1). The default value must not be changed.

Settings

Parameter group *10 Standard DI, RO* (page *235*).

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

- Parameter groups *14 I/O extension module 1* (page *254*), *15 I/O extension module 2* (page *274*), *16 I/O extension module 3* (page *278*).
- Parameter *60.41* (page *434*).

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 *621*) and *Fieldbus control through a fieldbus adapter* (page *645*).

Settings

Parameter groups *50 Fieldbus adapter (FBA)* (page *407*), *51 FBA A settings* (page *414*), *52 FBA A data in* (page *416*), and *53 FBA A data out* (page *417*), *54 FBA B settings* (page *417*), *55 FBA B data in* (page *418*), and *56 FBA B data out*(page *419*).

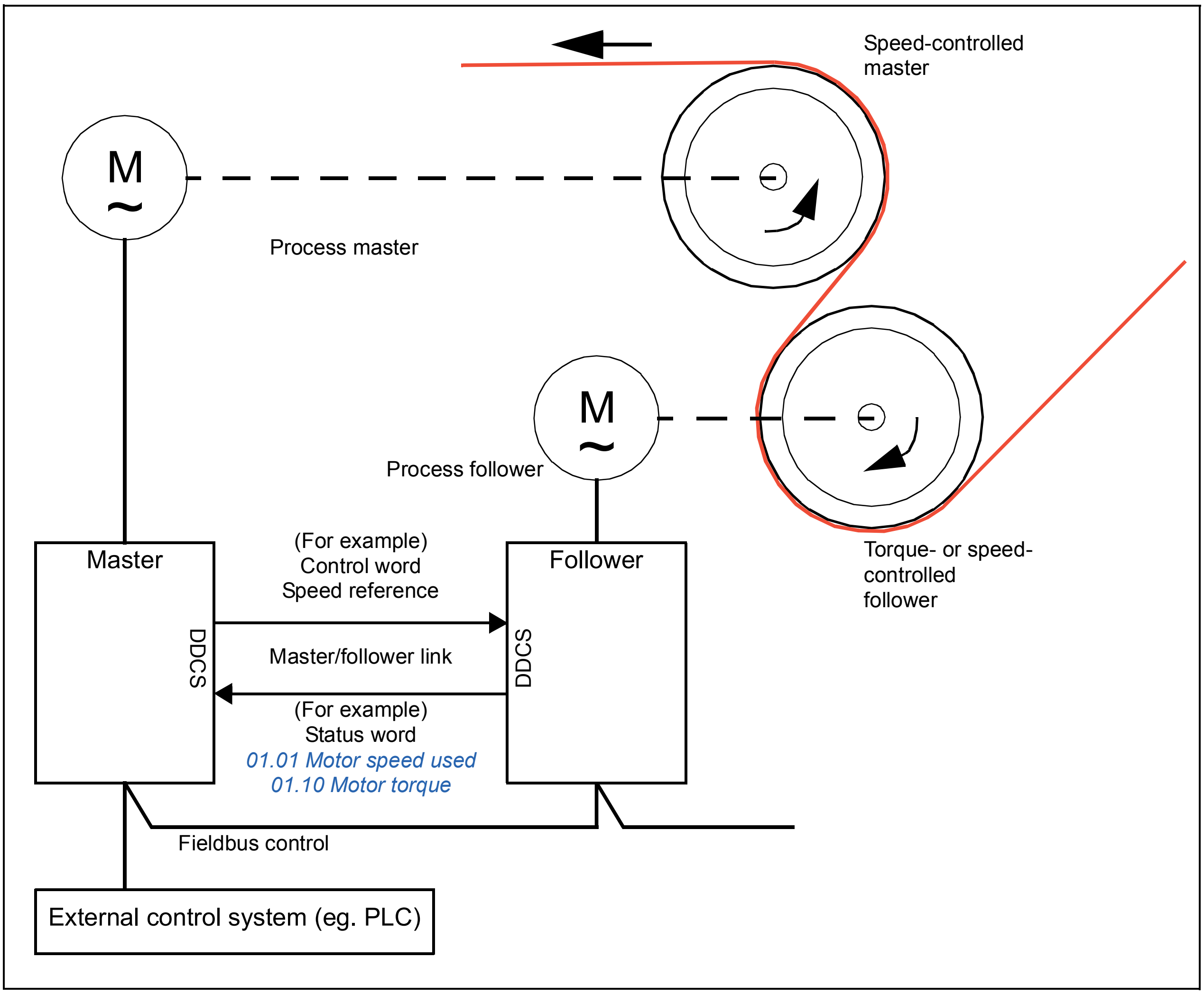
Master/follower functionality

General

Note: The crane control program uses its own master/follower communication with D2D-link and ready made crane application interlocks with Synchro and antisway controls. See section *Master/follower communication in crane application* on page 54. However, the Master/Follower functionality can be implemented as described in this section, but then you must separately build the crane application based interlocking.

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 in section *Load share function with a speed-controlled follower* on page *147*.

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. See sections *Local control vs. external control* (page *134*) and *Operating modes of the drive* (page *136*).
- 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 *192*) can be saved with the master settings, another with the follower settings. The suitable settings can then be activated using eg. digital inputs.
- In the crane application, the master/follower functionality is implemented in the application program instead of the primary control program, because it contains more number of nodes and more interlock signals. The function uses the D2D-link and also uses antisway communication from the hoist drive to long travel and trolley drives.

  In case of limited followers, you can use the primary control based Master/follower function having speed-torque or speed-speed combination with limited interlocking.

  For more information of the crane control master/follower function, see *Master/follower communication in crane application* on page *54*.

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 term 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 term added to the speed reference is shown by *23.39 Follower speed correction out*. See the block diagram on page *668*.

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 pushed 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 *675* and *676*.

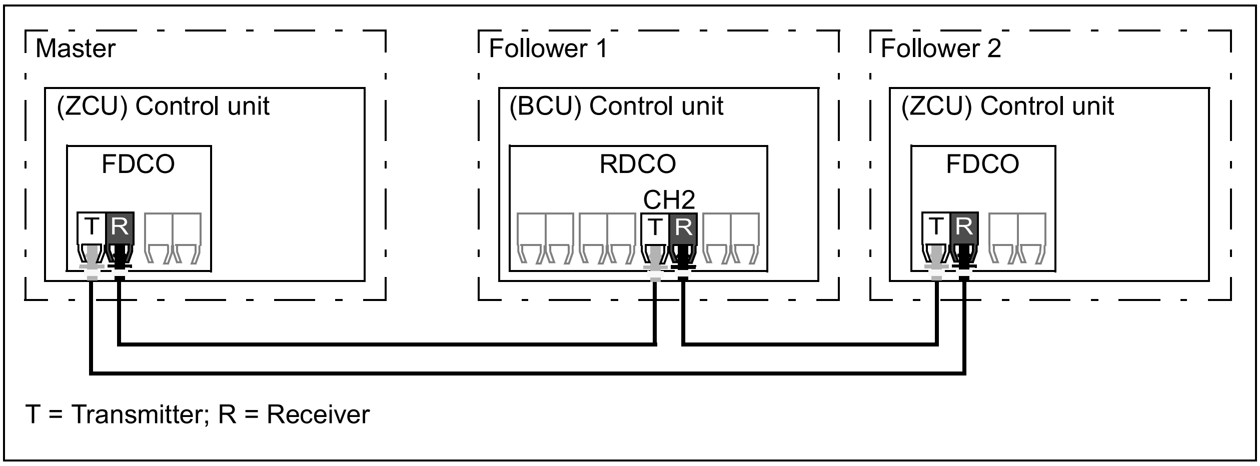
Construction of the master/follower link

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

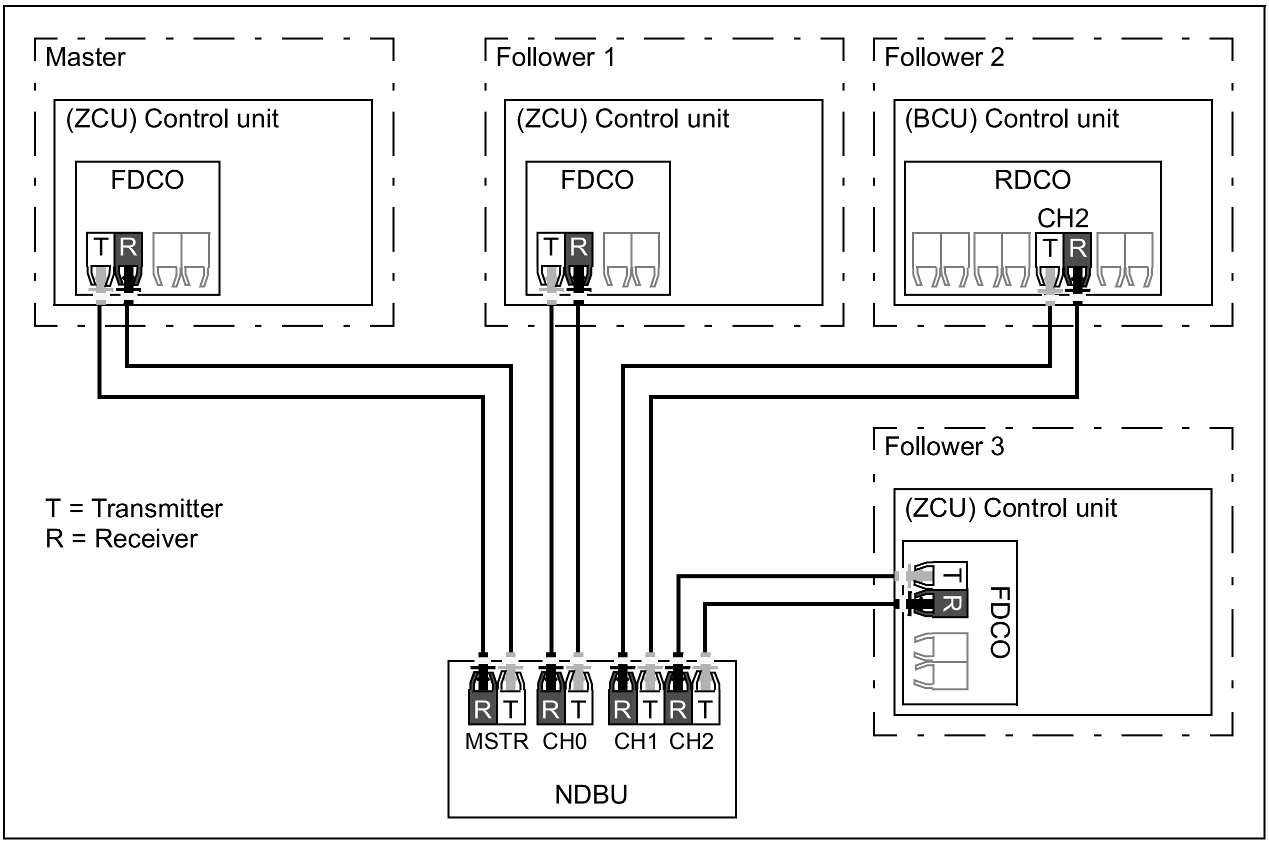
- shielded twisted-pair cable between the XD2D terminals of the drives, or
- fiber optic cables. Drives with a *ZCU* control unit require an additional FDCO DDCS communication module; drives with a *BCU* control unit require an RDCO module.

For connection diagrams of master/follower wiring with electrical cable (D2D), see the drive hardware manuals.

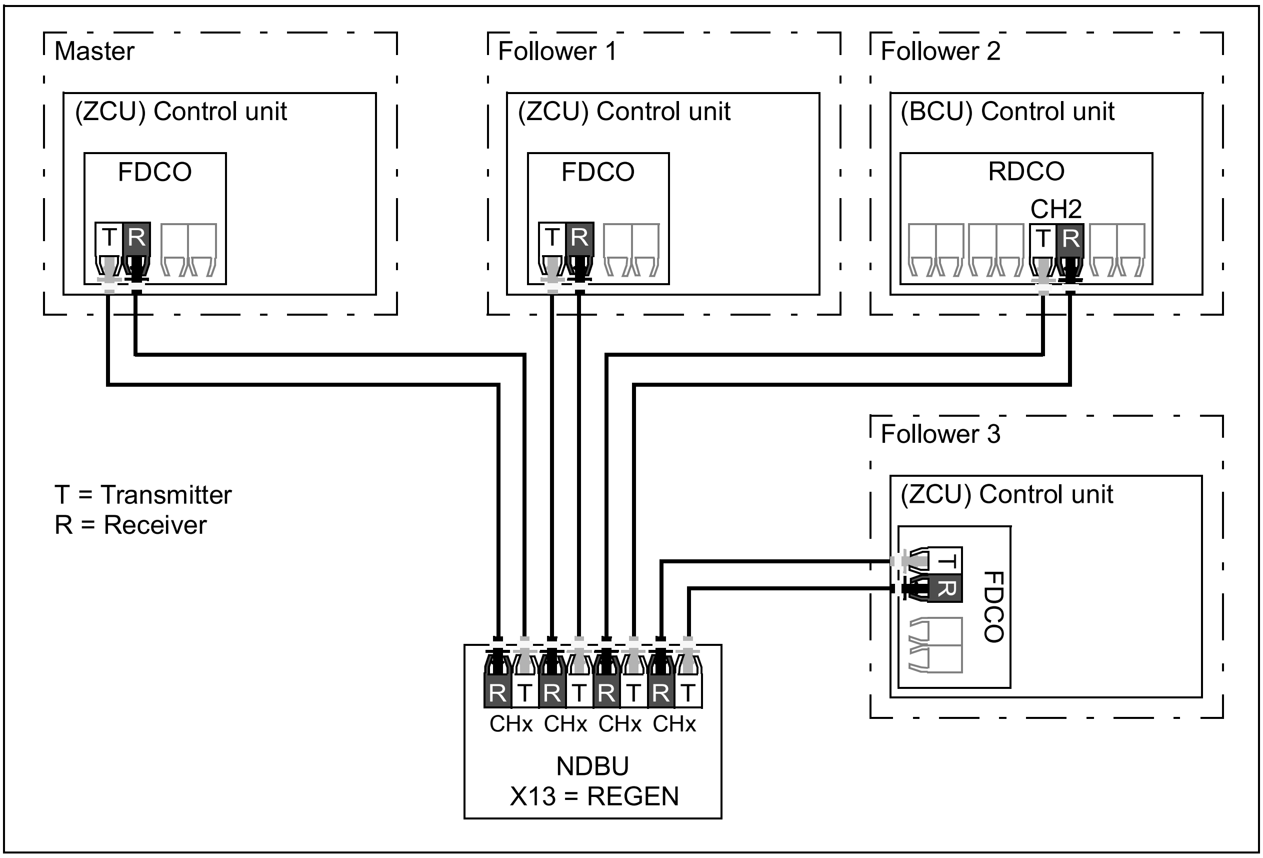
Ring configuration with fiber optic cables



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).

<u>Master settings</u>:

- 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*
  - *60.05 M/F HW connection* (*Ring* or *Star* for fiber optic, *Star* for wire)
- Data to be broadcast to the followers
  - *61.01 M/F data 1 selection* = *Follower CW* (Follower control word)
  - *61.02 M/F data 2 selection* = *Used speed reference*
  - *61.03 M/F data 3 selection* = *Torque reference act 5*
- Data to be read from the followers (optional)
  - *60.14 M/F follower selection* (selection of followers that data is read from)
  - *62.04 Follower node 2 data 1 sel* … *62.12 Follower node 4 data 3 sel* (mapping of data received from followers)

Follower settings:

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

Specifications of the fiber optic master/follower link

- Maximum fiber optic cable length:
  - FDCO-01/02 or RDCO-04 with POF (Plastic Optic Fiber): 30 m
  - FDCO-01/02 or RDCO-04 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 *427*), *61 D2D and DDCS transmit data* (page *444*) and *62 D2D and DDCS receive data* (page *449*).

External controller interface

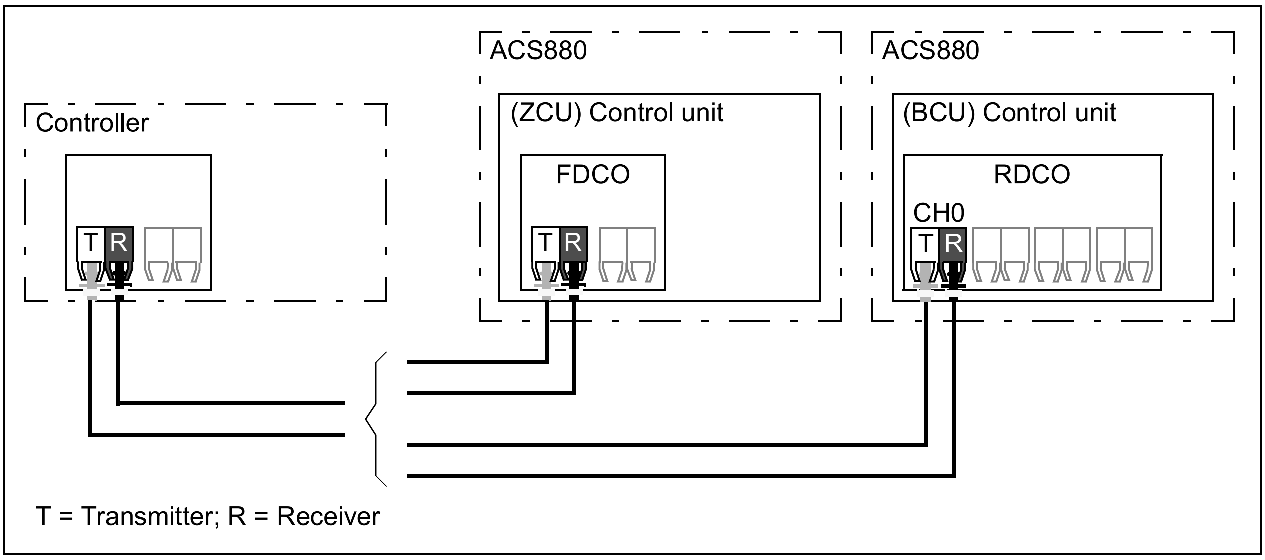
General

The drive can be connected to an external controller (such as the ABB AC 800M) using either fiber optic or twisted-pair cables. The ACS880 is compatible with both the ModuleBus and DriveBus connections.

Topology

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

Drives with *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 *145*); 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*.

Communication

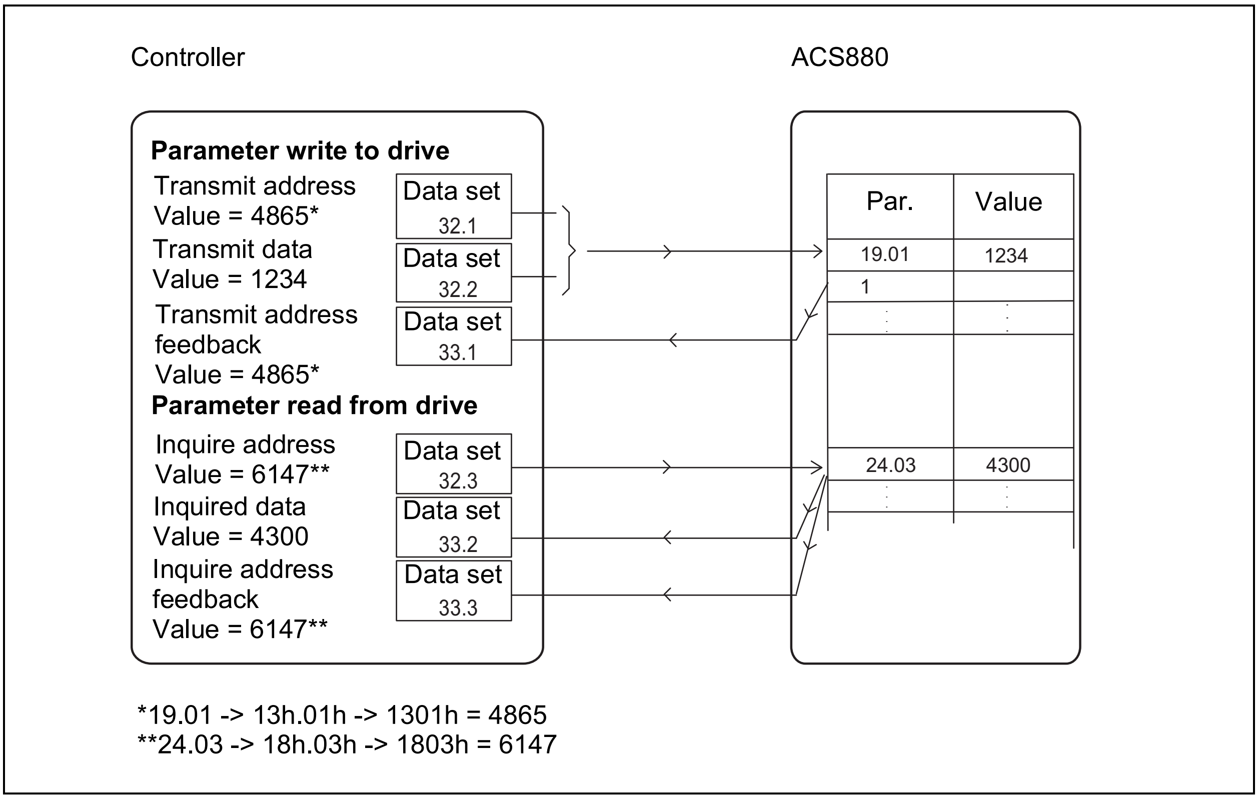
The communication between the controller and the drive consists of data sets of three 16-bit words each. The controller sends a data set to the drive, which returns the next data set to the controller.

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* (page *651*). Likewise, the coding of the status word is as shown in section *Contents of the fieldbus Status word* (page *653*).

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



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

Parameter groups *60 DDCS communication* (page *427*), *61 D2D and DDCS transmit data* (page *444*) and *62 D2D and DDCS receive data* (page *449*).

Control of a supply unit (LSU)

General

With drives that consist of a supply unit and one inverter unit, the supply unit can be controlled through the inverter unit. (In drive systems consisting of multiple inverter units, this feature is not typically used.) For example, the inverter unit can send a control word and references to the supply unit, enabling the control of both units from the interfaces of one control program.

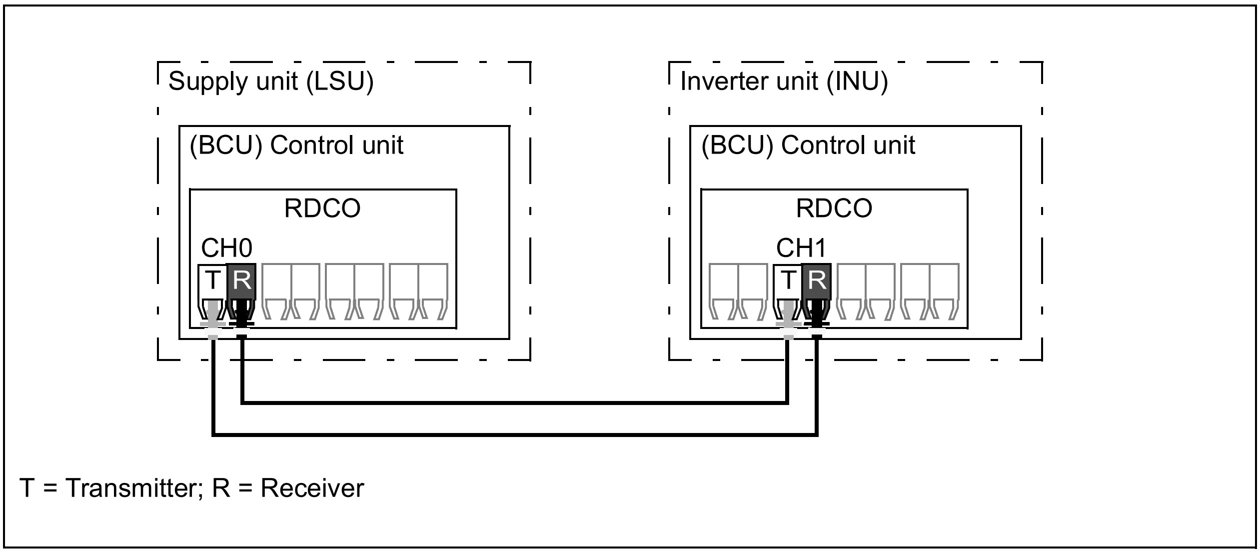
Note: This function is only supported by inverter units with a BCU control unit.

For more information, refer to the firmware manual of the other converter.

Topology

The control units of the supply unit and the inverter unit are connected by fiber optic cables. With BCU-x2 control units equipped with RDCO modules, CH1 of the inverter is connected to CH0 of the supply unit.

An example connection with a BCU-based drive system is shown below.



The fibre optic link specifications stated under *Specifications of the fiber optic master/follower link* (page *151*) apply.

Communication

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

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

With ACS880 single drives with a separate supply unit, the basic communication is initialized by parameter *95.20 HW options word 1*. If the supply unit is regenerative, it is possible to send a DC voltage and/or reactive power reference to it from inverter parameter group *94 LSU control*.

Settings

- Parameters *06.36*…*06.39* (page *224*) and *95.20 HW options word 1* (page *500*).
- Parameter groups *60 DDCS communication* (page *427*), *61 D2D and DDCS transmit data* (page *444*), *62 D2D and DDCS receive data* (page *449*) and *94 LSU control* (page *495*).

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 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 *169*).

Settings

Parameters *99.04 Motor control mode* (page *515*) and *99.13 ID run requested* (page *518*).

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*. 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 change rate of the motor potentiometer function (page *169*) is adjustable. The same rate applies in both directions.

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

Settings

- Speed reference ramping: Parameters *23.16*…*23.19* and *46.01* (pages *23.19* and *400*).
- Motor potentiometer: Parameters *22.220*...*22.227* (page *313*).

Constant speeds

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

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

Settings

Parameter groups *22 Speed reference selection* (page *303*).

Critical speeds

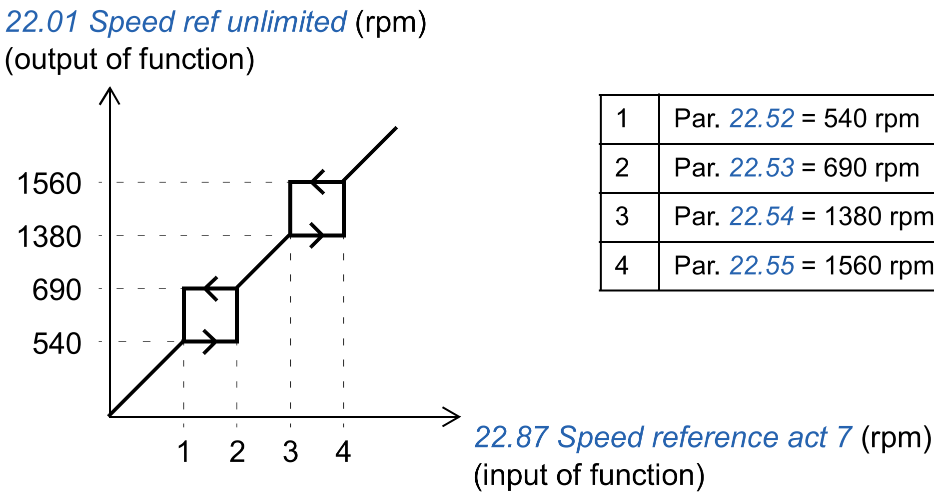
Critical speeds (sometimes called “skip speeds”) can be predefined for applications where it is necessary to avoid certain motor speeds or speed ranges because of, for example, mechanical resonance problems.

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

- Critical speeds: parameters *22.51*…*22.57* (page *307*)

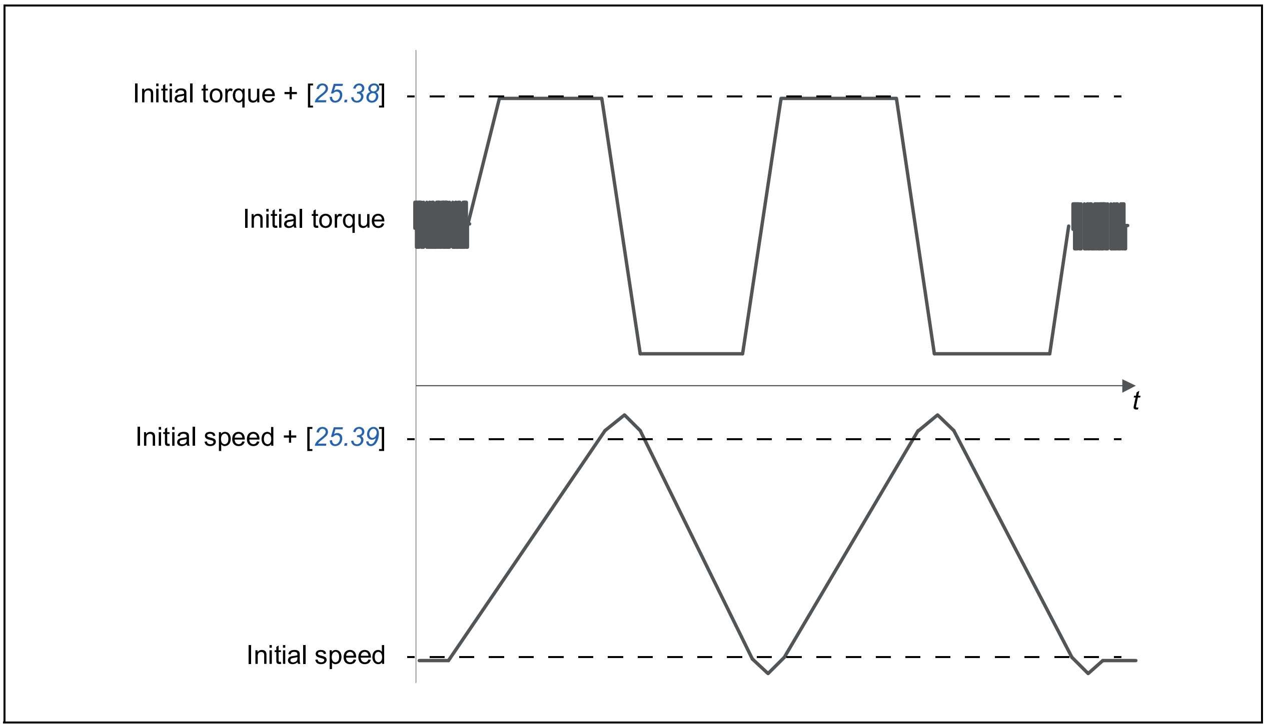
Speed controller autotune

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:

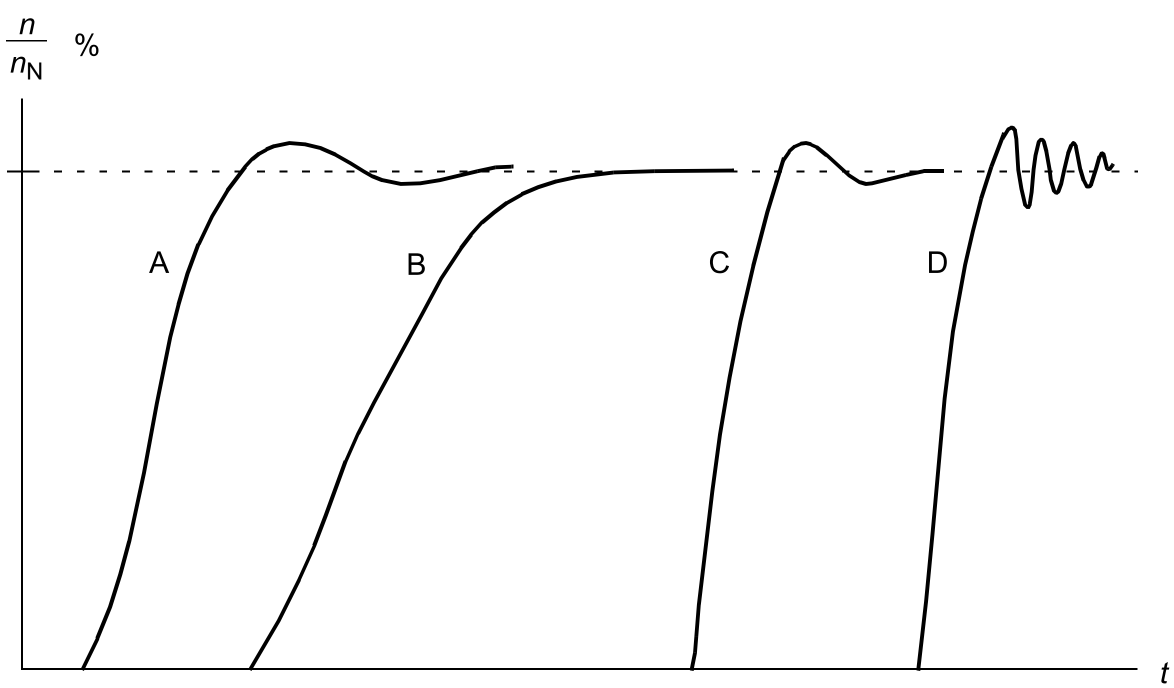
- The motor identification run (ID run) has been successfully completed
- Speed and torque limits (parameter group *30 Limits*) have been set
- The speed feedback has been monitored for noise, vibrations and other disturbances caused by the mechanics of the system, and following parameters are set to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

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

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

Autotune modes

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



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

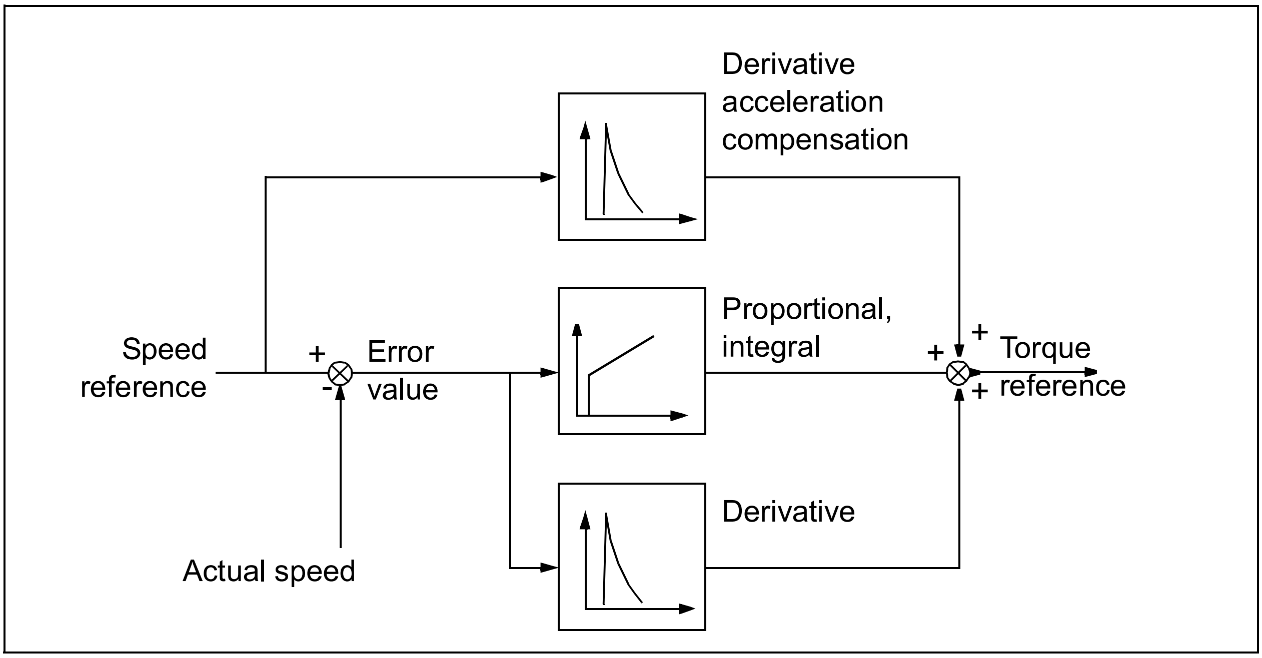
Autotune results

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

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

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

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



Warning indications

A warning message, *AF90 Speed controller autotuning*, will be generated if the autotune routine does not complete successfully. See chapter *Fault tracing* (page *579*) for further information.

Settings

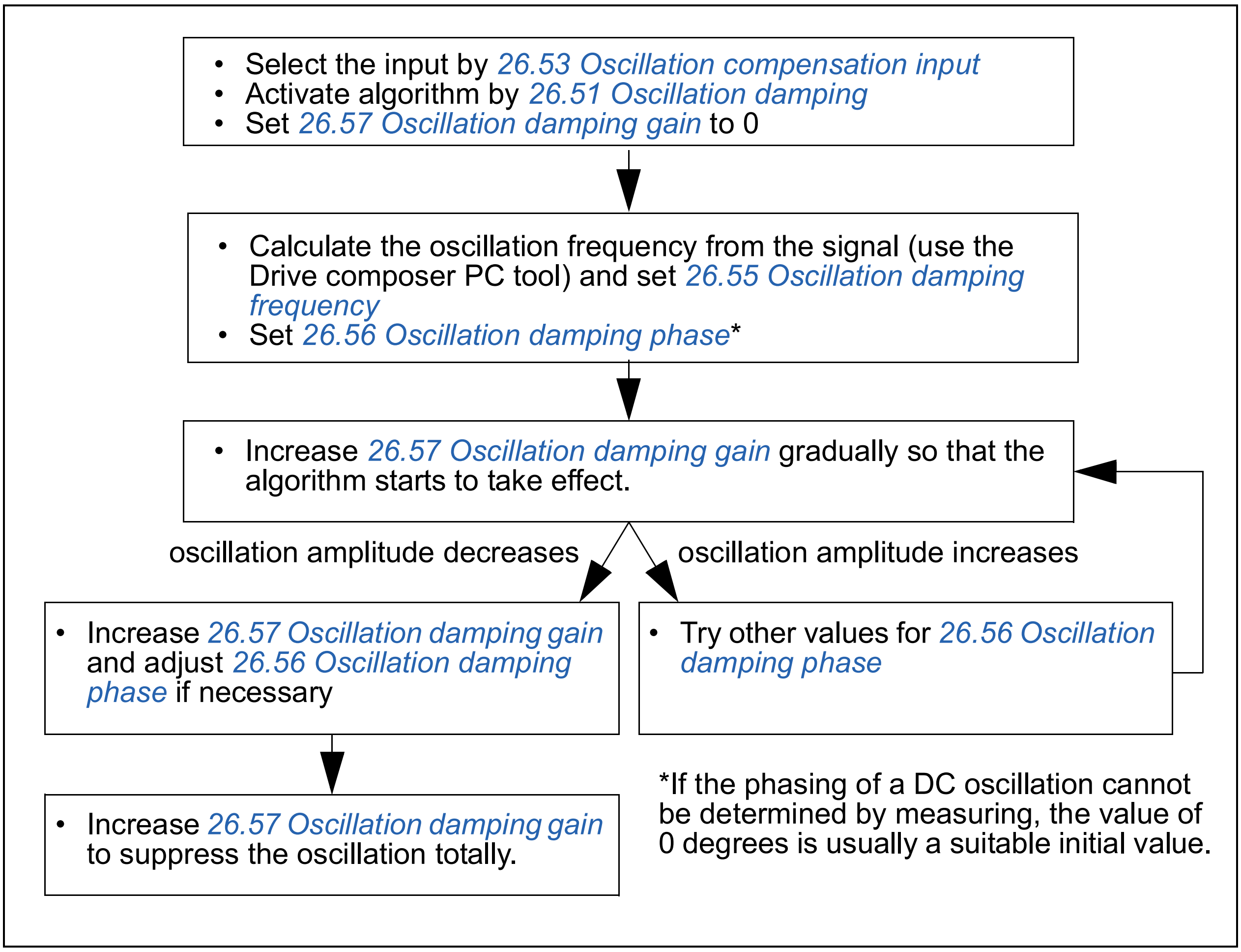
Parameters *25.33*…*25.40* (page *330*).

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



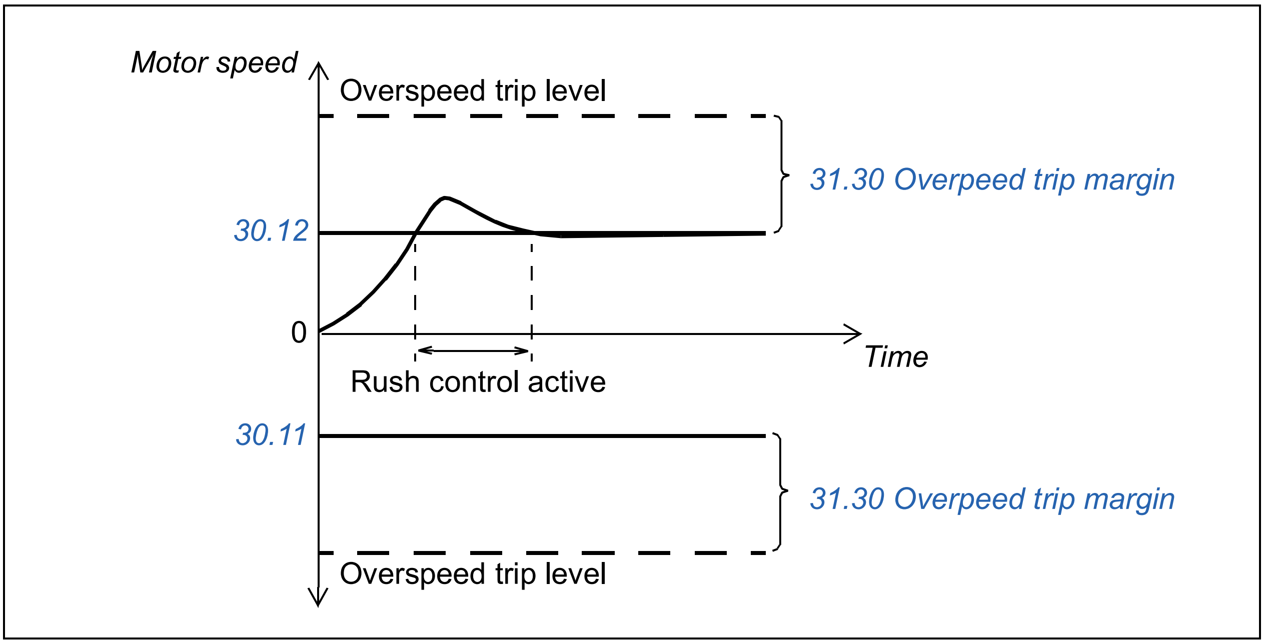
Note: Changing the speed error low-pass filter time constant or the integration time of the speed controller can affect the tuning of the oscillation damping algorithm. It is recommended to tune the speed controller before the oscillation damping algorithm. (The speed controller gain can be adjusted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

Settings

Parameters *26.51*…*26.58*

Rush control

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



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

Settings

Parameters *26.81 Rush control gain* and *26.82 Rush control integration time*

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.

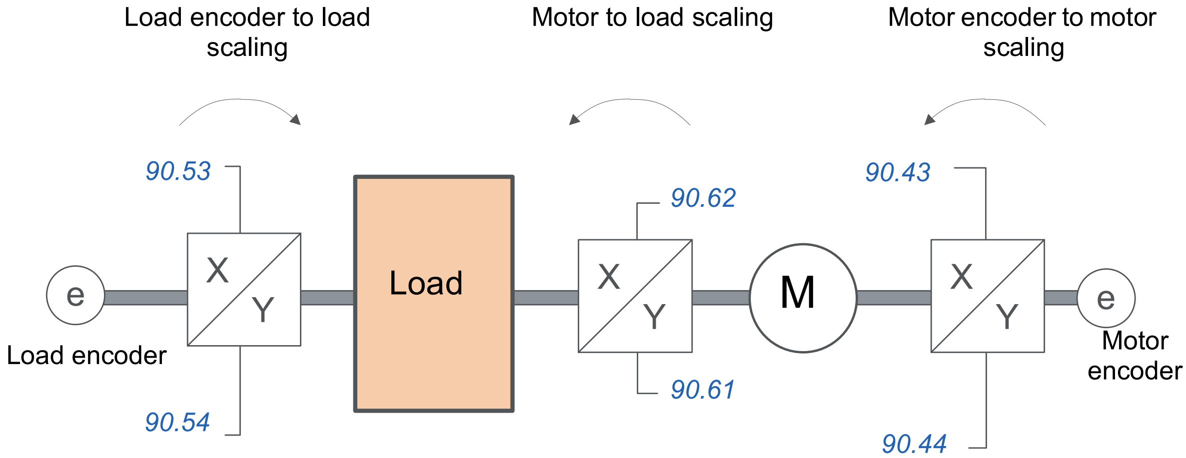
Encoder emulation also relays the encoder signal to the output, but the signal is either scaled, or position data converted to pulses. Emulation can be used when absolute encoder or resolver position needs to be converted to TTL pulses, or when the signal must be converted to a different pulse number 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 *666* and *667*. For more information on load position calculation, see section *Position counter* (page *165*).

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*.

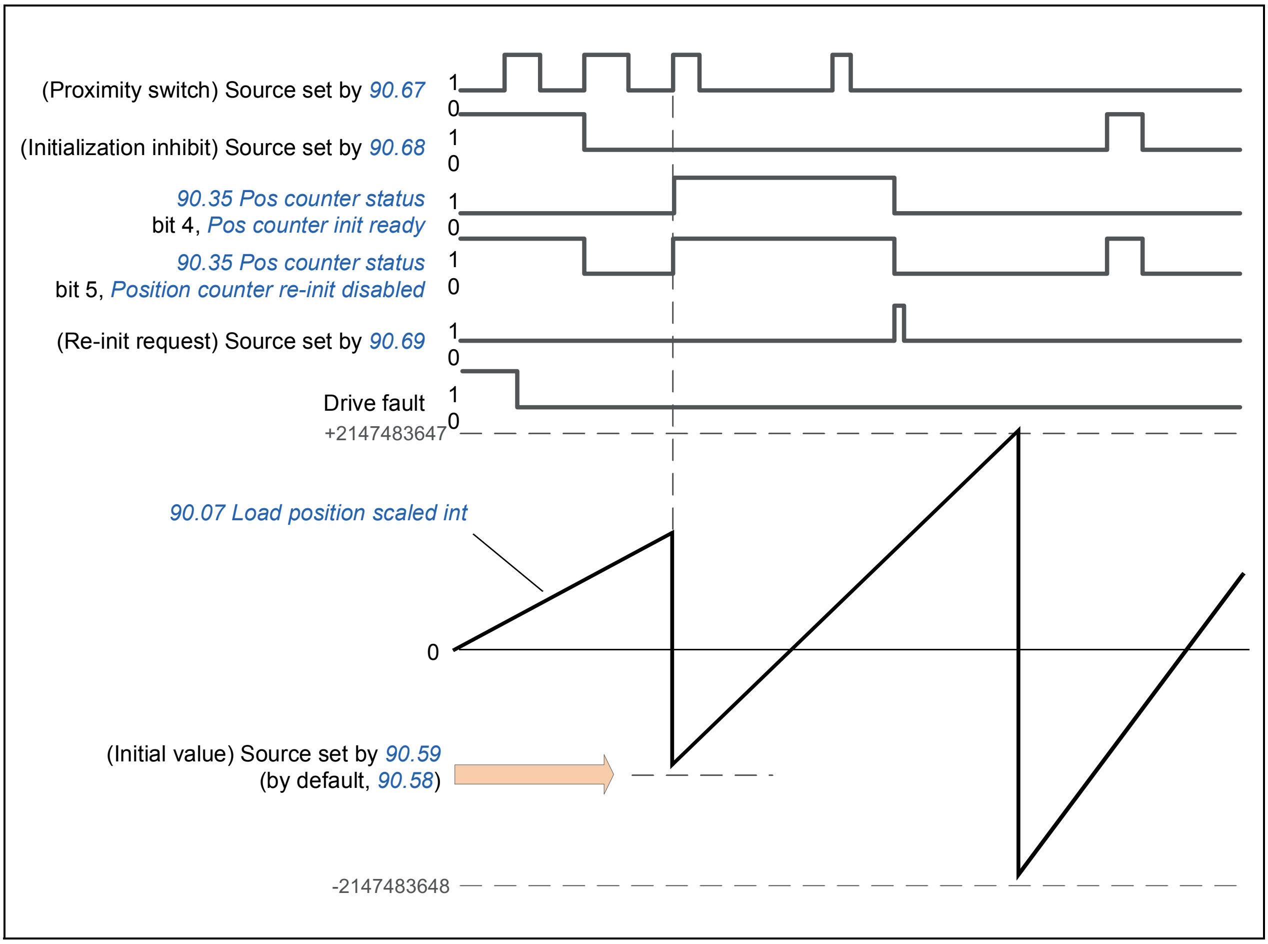
Position counter

Note: The crane control program uses its own interface to the position counter. The difference is a reset/preset logic. See *Position counter initialization and scaling for crane control program* on page *124*. The user can build a position counter for crane application without using any ready-made logic.

The control program contains a position counter feature that can be used to indicate the position of a 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 section *Load and motor feedback* on page *164*).

The relation between revolutions of the motor shaft and the translatory movement of the load (in any given unit of distance) is define 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 reintialization.

For detailed parameter connections of the load feedback function, see the block diagram on page *667*.



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 also prevents counter initialization.

Encoder error handling

When an encoder is used for load feedback, the action taken in case of an encoder error is specified by *90.55 Load feedback fault*. If the parameter is set to *Warning*, the calculation continues 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

In the Quick start-up guide, see section *Configuring speed feedback using a HTL encoder* on page *43*.

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 92.13*
- *90.51 Load feedback selection* = *Encoder 1*
- *90.63 Feed constant numerator* = 8192 (that is 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:

For example,

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

Parameter groups *90 Feedback selection* (page *474*), *91 Encoder module settings* (page *484*), *92 Encoder 1 configuration* (page *487*) and *93 Encoder 2 configuration* (page *493*).

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 reference. However, the outstanding performance of DTC is not achieved in scalar control.

It is recommended to activate scalar motor control mode

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

The scalar control mode can be used for long travel and trolley movements.

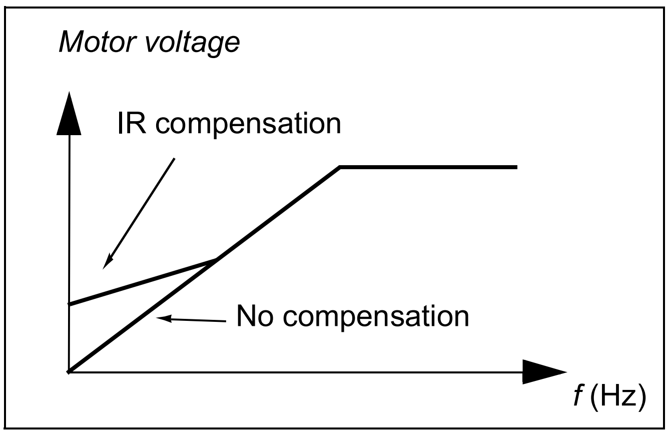
Note:

- Scalar control mode must not be used for hoisting the drive.
- In scalar control, some standard features are not available.
- For crane application, disable Torque proving and Brake open torque. Select the following:
  - *44.09 Brake open torque source* = *Zero*
  - *44.200 Brake open torque* = 0%
  - *44.202 Torque proving* = *Disable*

See also section *Operating modes of the drive* (page *136*).

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

Settings

Parameters *97.12 IR comp step-up frequency*, *97.13 IR compensation* and *99.04 Motor control mode*

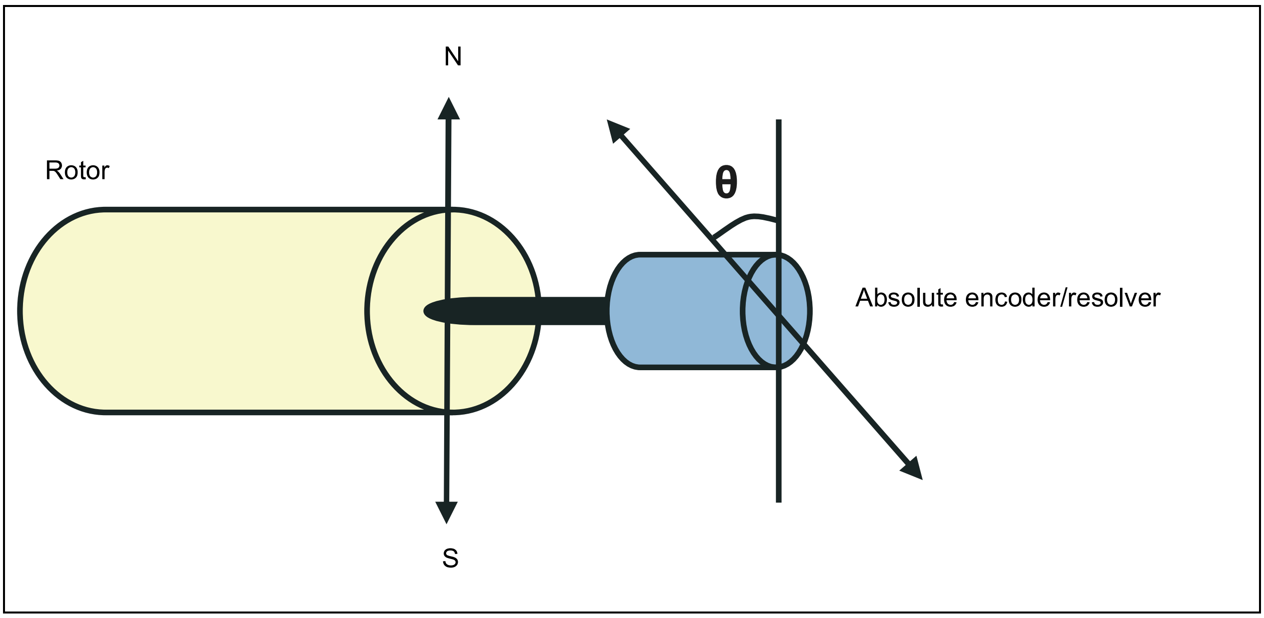
Autophasing

Autophasing is an automatic measurement routine to determine the angular position of the magnetic flux of a permanent magnet synchronous motor or the magnetic axis of a synchronous reluctance motor. The motor control requires the absolute position of the rotor flux 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 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 zero pulse improves the robustness of the rotor position measurement. The rotor position must be determined during starting because the initial value given 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.

The 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.

Autophasing modes

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

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

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

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

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

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

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

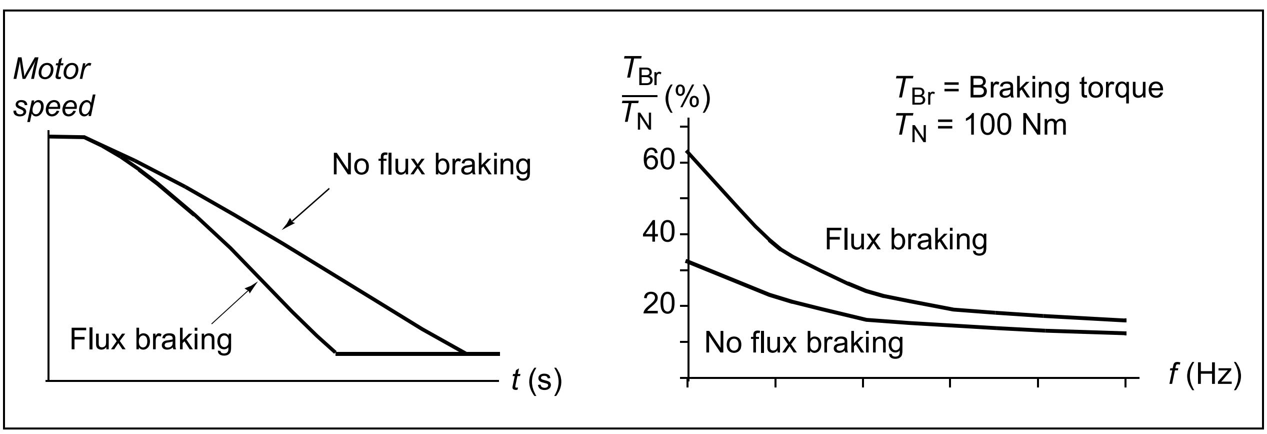
- The encoder is slipping on the motor shaft
- An incorrect value has been entered into *98.15 Position offset user*
- The motor is already turning before the autophasing routine is started
- Turning mode is selected in *21.13 Autophasing mode* but the motor shaft is locked
- *Turning with Z-pulse* mode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

Settings

Parameters *21.13 Autophasing mode*, *98.15 Position offset user* and *99.13 ID run requested*

Flux braking

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



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

Parameter *97.05 Flux braking*

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.

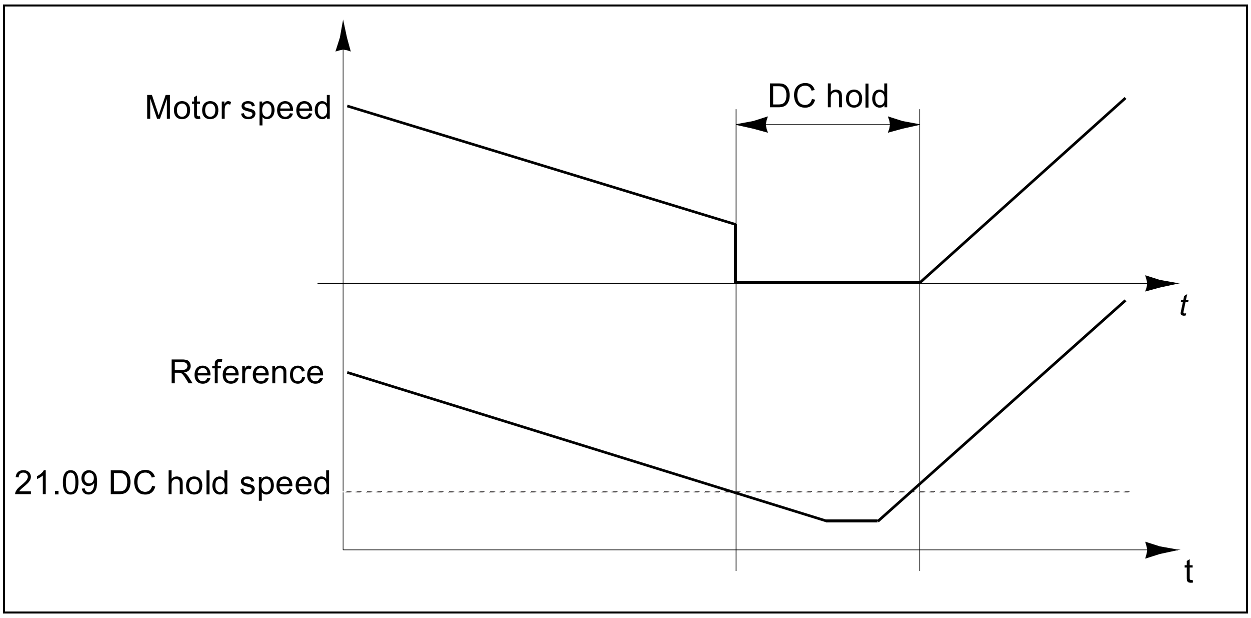
A digital source to control pre-heating is selected by parameter *21.14 Pre-heating input source*. The heating current is set by *21.16 Pre-heating current*.

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 control 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 stops generating sinusoidal current and starts 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.



Notes:

- DC hold is only available in speed control in DTC motor control mode (see page *136*).
- 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 in speed control in DTC motor control mode.

Continuous magnetization

This feature is used in processes requiring motors to be stopped (for example, to stand by until the new material is processed) and then quickly start without magnetizing them first.

In crane application, the Extended run time function uses this feature with parameter *21.12 Continuous magnetization command*. See *Extended run time* on page *80*.

Settings

Parameters *06.21 Drive status word 3*, *21.01 Start mode*, *21.02 Magnetization time*, *21.08*...*21.12*, *21.14 Pre-heating input source*, *21.16 Pre-heating current*.

Application control

Motor potentiometer

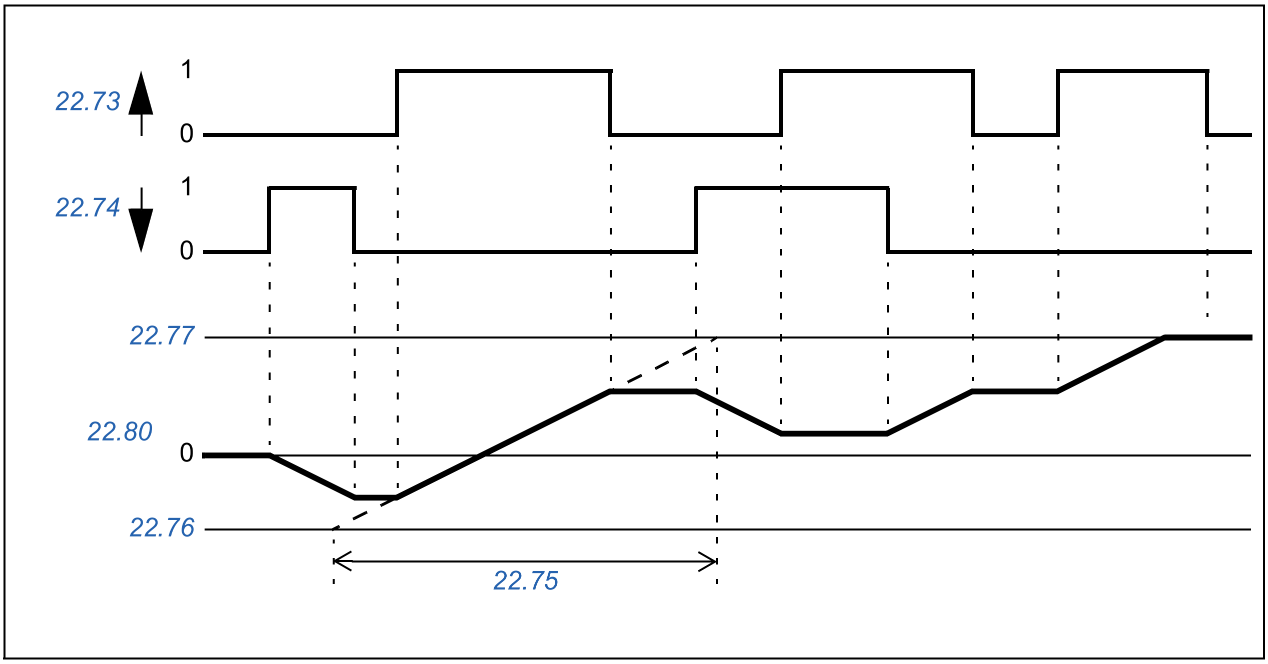
The motor potentiometer is, in effect, a counter whose value can be adjusted up and down using two digital signals selected by parameters *22.73 Motor potentiometer up source* and *22.74 Motor potentiometer down source*. Note that these signals have no effect when the drive is stopped.

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 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.



Note: In crane application, the motor potentiometer parameters *22.71*…*22.80* are hidden because these parameters are used for crane motor potentiometer function (see page *87*).

You can use the normal motor potentiometer by opening the user lock in parameter *96.02 Pass code* with the code *584*. Then the motor potentiometer parameters

22.71...*22.80* are visible. Again set parameter *96.02* to 1 to hide this and the rest of hidden parameters

Settings

Parameters *22.71*…*22.80*.

DC voltage control

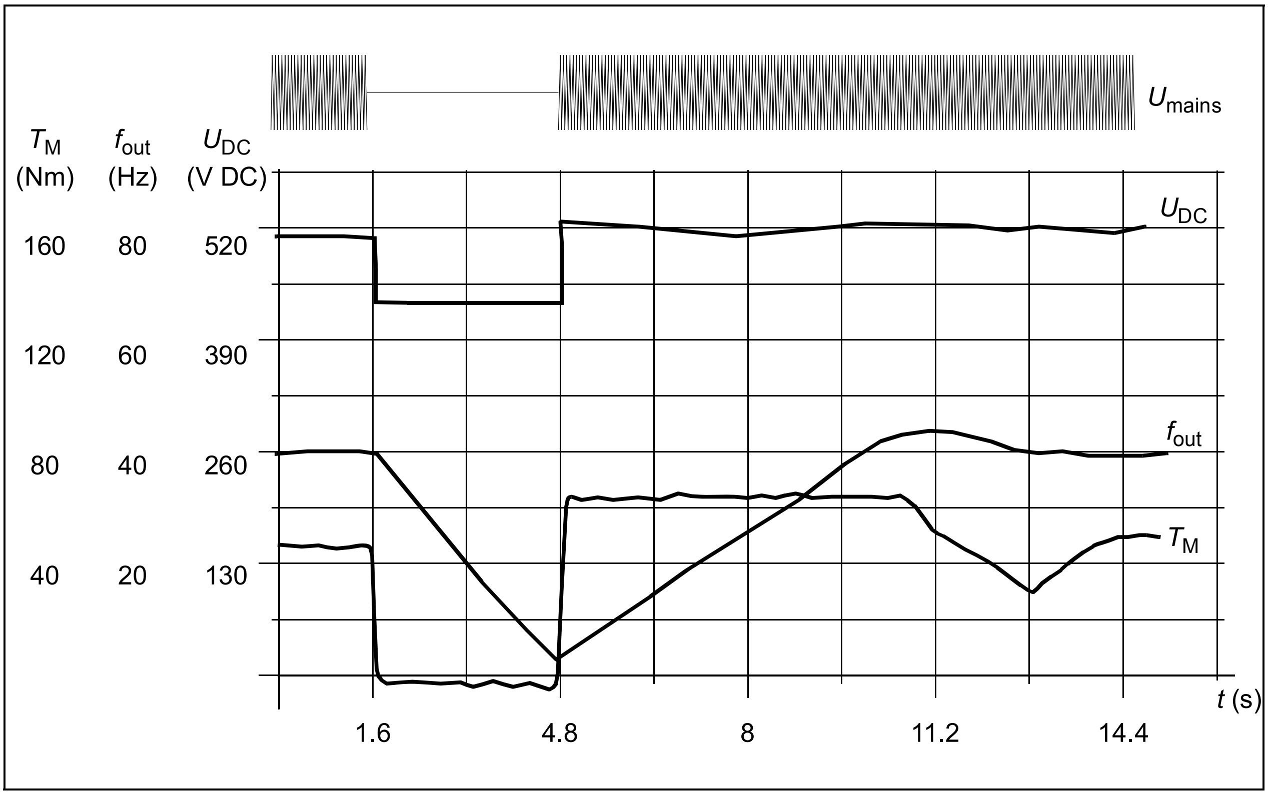
Overvoltage control

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

Undervoltage control (power loss ride-through)

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

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



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

Automatic restart

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.

Voltage control and trip limits

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

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

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

	Supply voltage range [V] (see *95.01 Supply voltage*)					
Level	**208…240**	**380…415**	**440…480**	**500**	**525…600**	**660…690**
Charging activation/standby limit	225	410	475	540	567	713
Undervoltage fault limit	168	308	356	405	425	535

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

Settings

Parameters *01.11 DC voltage*, *30.30 Overvoltage control*, *30.31 Undervoltage control*, *95.01 Supply voltage* and *95.02 Adaptive voltage limits*.

Brake chopper

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

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

In the crane control program, the overvoltage control (parameter *30.30 Overvoltage control*) is disabled by default and brake chopper (parameter *43.06 Brake chopper function*) is set as *Enabled without thermal model*.

Settings

Parameters *01.11 DC voltage* and *30.30 Overvoltage control*; parameter group *43 Brake chopper*.

Safety and protections

Emergency stop

The emergency stop function is used by the control program. An emergency stop can be generated through fieldbus (parameter *06.01 Main control word*, bits 0…2).

The mode of the emergency stop from the control program is always Off3: Stop by the emergency stop ramp, defined by parameter *23.23 Emergency stop time*.

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.

Note: In the crane control program, the crane movement can be stopped using the Fast stop function. See section *Fast stop* on page *93*.

Settings

Parameters *06.17 Drive status word 2*, *06.18 Start inhibit status word*, *23.23 Emergency stop time*, *31.32 Emergency ramp supervision* and *31.33 Emergency ramp supervision delay*.

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 results in a more accurate motor model.

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

Motor thermal protection model

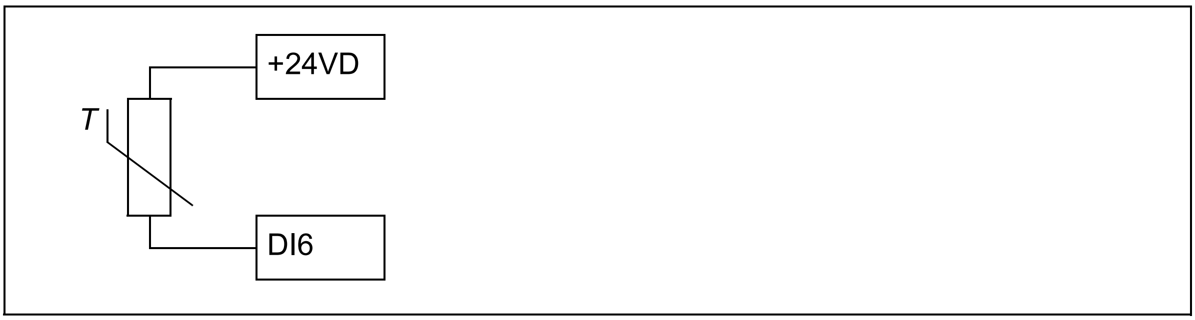
The drive calculates the temperature of the motor on the basis of the following assumptions:

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

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

Temperature monitoring using PTC sensors

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

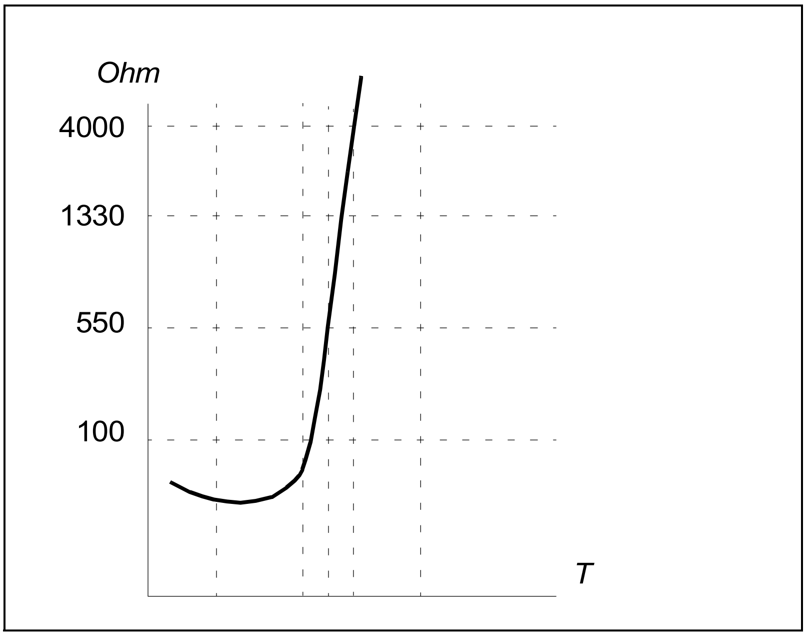


The resistance of the PTC sensor increases when its temperature rises. The increasing resistance of the sensor decreases the voltage at the input, and eventually its state switches from 1 to 0, indicating overtemperature.

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

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

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



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

Temperature monitoring using Pt100 or PT1000 sensors

1…3 Pt100 or 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

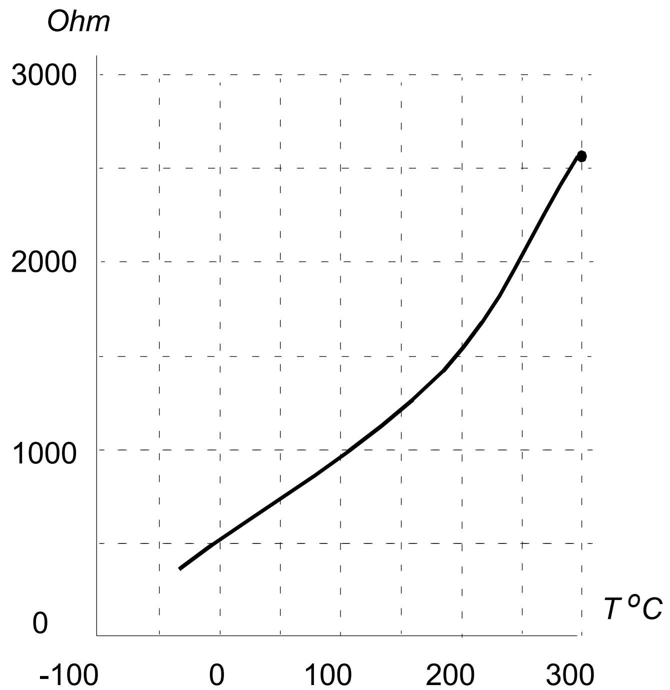
One KTY84 sensor can be connected to an analog input and an analog output on the control unit.

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 (parameters *95.15*, bit 0)

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

Settings

Parameter groups *35 Motor thermal protection* and *91 Encoder module settings*; parameter *95.15 Special HW settings*.

Thermal protection of motor cable

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

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

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

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

Settings

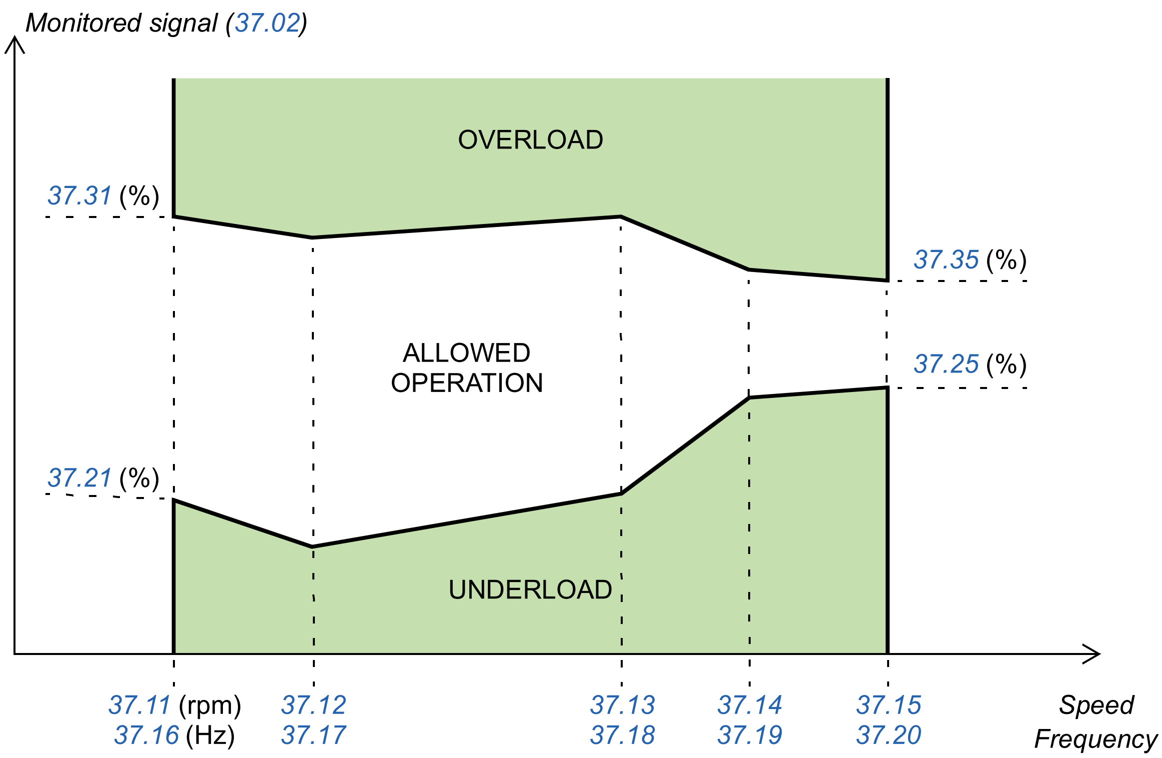
Parameters *35.60*…*35.62*.

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

Parameter group *37 User load curve* (page *389*).

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

Motor phase loss detection (parameter *31.19*)

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

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

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

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

Supply phase loss detection (parameter *31.21*)

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

Safe torque off detection (parameter *31.22*)

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

Swapped supply and motor cabling (parameter *31.23*)

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

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

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

Overspeed protection (parameter *31.30*)

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

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

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

Custom motor current fault limit (parameter *31.42*)

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

Local control loss detection (parameter *49.05*)

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

Automatic fault resets

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

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

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

Settings

Parameters *31.12*…*31.16*

Diagnostics

Fault and warning messages, data logging

See chapter *Fault tracing* (page *579*).

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

Parameter group *32 Supervision*

Maintenance timers and counters

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

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

There are three types of counters:

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

Settings

Parameter group *33 Generic timer & counter*

Load analyzer

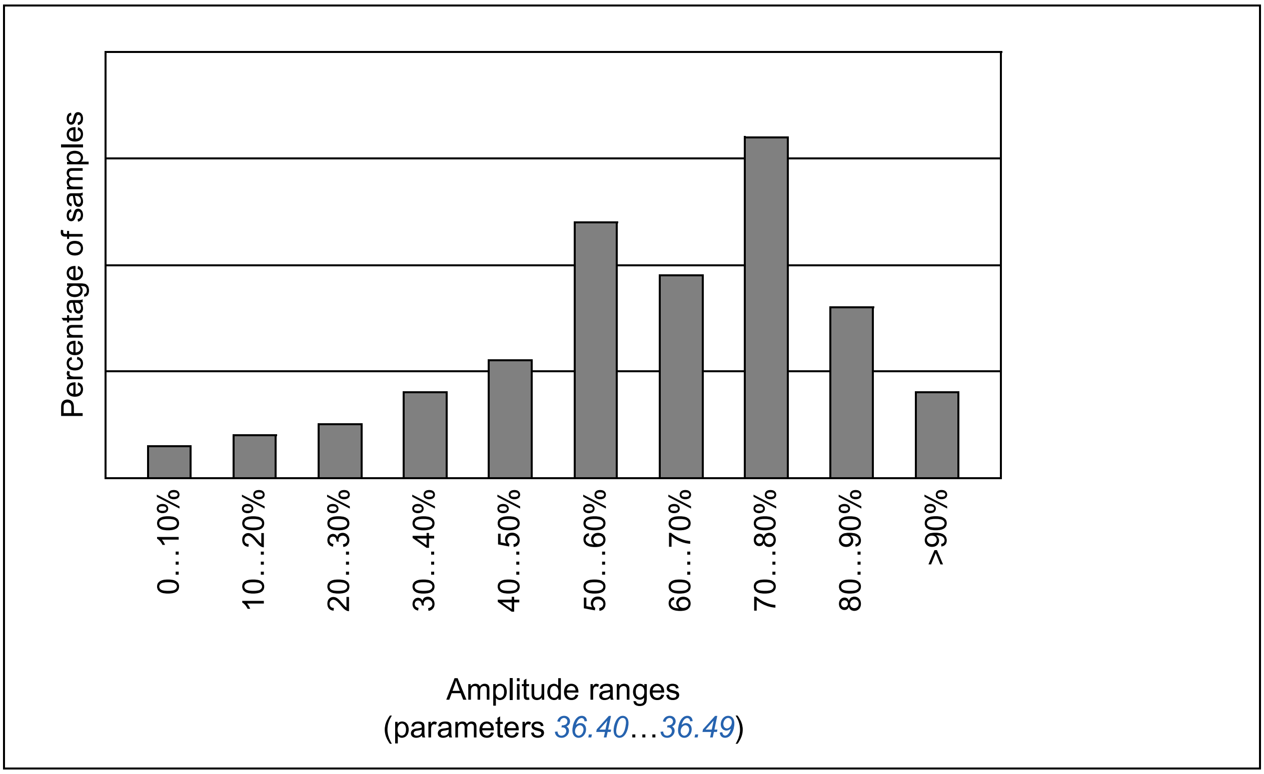
Peak value logger

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

Amplitude loggers

The control program has two amplitude loggers.

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



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 measured current is logged continuously. The distribution of samples is shown by parameters 36.20…36.29.

Settings

Parameter group *36 Load analyzer*

Miscellaneous

User parameter sets

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

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

- forced I/O values such as parameters *10.03 DI force selection* and *10.04 DI force data*
- I/O extension module settings (groups 14…16)
- data storage parameters (group 47)
- fieldbus communication settings (groups 51…56 and 58)
- encoder configuration settings (groups 92…93), and
- parameter *95.01 Supply voltage*.

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

Settings

Parameters *96.10*…*96.13*

Signal: *09.02 Crane SW1*, bits 2...5 indicates the loaded user set 1...4

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

Parameters *96.53*…*96.59* (page *507*).

User lock

For better cyber security, you can set a master password to prevent eg. the changing of parameter values and/or the loading of firmware and other files.

To activate the user lock for the first time, enter the default pass code, 10000000, into *96.02 Pass code*. This will make parameters *96.100*…*96.102* visible. Then enter a new pass code into *96.100 Change user pass code*, and confirm the code in *96.101 Confirm user pass code*. In *96.102 User lock functionality*, define the actions that you want to prevent.

To close the user lock, enter an invalid pass code into *96.02 Pass code*, activate *96.08 Control board boot*, or cycle the power. With the lock closed, parameters *96.100*…*96.102* are hidden.

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

Settings

Parameters *96.02* (page *502*) and *96.100*…*96.102* (page *509*).

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

Note that "*Analog src*" type parameters (see page *524*) expect a 32-bit real (floating point) source – in other words, parameters *47.01*…*47.08* can be used as a value source of other parameters while *47.11*…*47.28* cannot.

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

Parameter group *47 Data storage*

Reduced run function

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

Activation of the reduced run function

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

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

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

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

Settings

Parameters *06.17* and *95.13...95.14*

d*u*/d*t* filter support

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

Settings

Parameters *95.20 HW options word 1*.

Sine filter support

The control program has a setting that enables the use of ABB sine filters (available separately). With a sine filter connected to the output of the drive, bit 1 of *95.15 Special HW settings* must be switched on. The setting forces the drive to use the scalar motor control mode, and limits the switching and output frequencies to

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

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

Settings

Parameters *95.15 Special HW settings*.

6

Default control connections

The default I/O connections of the control program are shown in section *Control through the I/O interface using a joystick* on page *28*.

7

Parameters

Contents of this chapter

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

Terms and abbreviations

Term	Definition
Actual signal	Type of *parameter* that is the result of a measurement or calculation by the drive, or contains status information. Most actual signals are read-only, but some (especially counter-type actual signals) can be reset.
Bit pointer setting	A parameter setting that points to the value of a bit in another parameter (usually an actual signal), or that can be fixed to 0 (FALSE) or 1 (TRUE). When adjusting a bit pointer setting on the optional control panel, “Const” is selected in order to fix the value to 0 (displayed as “C.False”) or 1 (“C.True”). “Pointer” is selected to define a source from another parameter. A pointer value is given in the format **P.xx.yy.zz**, where **xx** = parameter group, **yy** = parameter index, **zz** = bit number. Pointing to a non existing bit will be interpreted as 0 (FALSE). In addition to the “Const” and “Pointer” selections, bit pointer settings may also have other pre-selected settings.
Def	(In the following table, shown on the same row as the parameter name) The default value of a *parameter*. **Note:** Certain configurations or optional equipment may require specific default values. These are labeled as follows: (*95.20* bx) = Default changed or write-protected by parameter *95.20*, bit x.

Term	Definition
FbEq16	(In the following table, shown on the same row as the parameter range, or for each selection) 16-bit fieldbus equivalent: The scaling between the value shown on the panel and the integer used in communication when a 16-bit value is selected for transmission to an external system. A dash (-) indicates that the parameter is not accessible in 16-bit format. The corresponding 32-bit scalings are listed in chapter *Additional Parameter data* (page *523*).
Other	The value is taken from another parameter. Choosing “Other” displays a parameter list in which the user can specify the source parameter. **Note:** The source parameter must be a 32-bit real (floating point) number. To use a 16-bit integer (for example, received from an external device in data sets) as the source, use data storage parameters *47.01*…*47.08*.
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

The groups that contain parameters specific to crane applications are **in bold**.

Group	Contents	Page
47 Data storage	Data storage parameters that can be written to and read from using other parameters' source and target settings.	*403*
49 Panel port communication	Communication settings for the control panel port on the drive.	*406*
50 Fieldbus adapter (FBA)	Fieldbus communication configuration.	*407*
51 FBA A settings	Fieldbus adapter A configuration.	*414*
52 FBA A data in	Selection of data to be transferred from drive to fieldbus controller through fieldbus adapter A.	*416*
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.	*417*
55 FBA B data in	Selection of data to be transferred from drive to fieldbus controller through fieldbus adapter B.	*418*
56 FBA B data out	Selection of data to be transferred from fieldbus controller to drive through fieldbus adapter B.	*419*
56 FBA B data out	Selection of data to be transferred from fieldbus controller to drive through fieldbus adapter B.	*419*
58 Embedded fieldbus	Configuration of the embedded fieldbus (EFB) interface.	*419*
60 DDCS communication	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). To build a master/follower configuration, shielded twisted-pair cable can alternatively be used to link the XD2D connectors of the drives together. For wiring instructions, see the hardware manual of the drive.	*427*
61 D2D and DDCS transmit data	Defines the data sent to the DDCS link.	*444*
62 D2D and DDCS receive data	Mapping of data received through the DDCS link.	*449*
74 Speed matching	Settings for Speed matching.	*456*
75 Hoist speed optimization	Settings for Hoist speed optimization.	*457*
77 Antisway	Settings for Antisway control.	*464*
76 Conical motor	Settings for Conical motor control.	*463*
82 Synchro control	Synchro control configuration. See description on page *61*.	*472*
90 Feedback selection	Motor and load feedback configuration.	*474*
91 Encoder module settings	Configuration of encoder interface modules.	*484*
92 Encoder 1 configuration	Settings for encoder 1.	*487*
93 Encoder 2 configuration	Settings for encoder 2.	*493*
94 LSU control	Control of the supply unit of the drive, such as DC voltage and reactive power reference.	*495*
95 HW configuration	Various hardware-related settings.	*496*
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.	*501*
97 Motor control	Motor model settings.	*510*
98 User motor parameters	Motor values supplied by the user that are used in the motor model.	*513*
99 Motor data	Motor configuration settings.	*515*

Parameter listing

No.	Name/Value	Description	Def/FbEq16
01 Actual values		Basic signals for monitoring the drive. All parameters in this group are read-only unless otherwise noted.	
01.01	*Motor speed used*	Measured or estimated motor speed depending on which type of feedback is used (see parameter *90.41 Motor feedback selection*). A filter time constant for this 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 %*	Shows the value of *01.01 Motor speed used* in percent of the synchronous speed of the motor.	10 = 1%
	-1000.00 ... 1000.00%	Measured or estimated motor speed.	See par. *46.01*
01.04	*Encoder 1 speed filtered*	Speed of encoder 1 in rpm. A filter time constant for this signal can be defined by parameter *46.11 Filter time motor speed*.	-
	-30000.00 … 30000.00 rpm	Encoder 1 speed.	See par. *46.01*
01.05	*Encoder 2 speed filtered*	Speed of encoder 2 in rpm. A filter time constant for this signal can be defined by parameter *46.11 Filter time motor speed*.	-
	-30000.00 … 30000.00 rpm	Encoder 2 speed.	See par. *46.01*
01.06	*Output frequency*	Estimated drive output frequency in Hz. A filter time constant for this signal can be defined by parameter *46.12 Filter time output frequency*.	-
	-500.00 … 500.00 Hz	Estimated output frequency.	See par. *46.02*
01.07	*Motor current*	Measured (absolute) motor current in A.	-
	0.00 … 30000.00 A	Motor current.	See par. *46.05*
01.10	*Motor torque*	Motor torque in percent of the nominal motor torque. See also parameter *01.30 Nominal torque scale*. A filter time constant for this signal can be defined by parameter *46.13 Filter time motor torque*.	-
	-1600.0 … 1600.0%	Motor torque.	See par. *46.03*
01.11	*DC voltage*	Measured DC link voltage.	-
	0.00 … 2000.00 V	DC link voltage.	10 = 1 V
01.13	*Output voltage*	Calculated motor voltage in V AC.	-
	0…2000 V	Motor voltage.	1 = 1 V

No.	Name/Value	Description	Def/FbEq16
01.14	*Output power*	Drive output power. The unit is selected by parameter *96.16 Unit selection*. A filter time constant for this signal can be defined by parameter *46.14 Filter time power out*.	-
	-32768.00 … 32767.00 kW or hp	Output power.	1 = 1 unit
01.15	*Output power % of motor nom*	Shows the value of *01.14 Output power* in percent of the nominal power of the motor.	-
	-300.00 … 300.00%	Output power.	1 = 1%
01.17	*Motor shaft power*	Estimated mechanical power at motor shaft. The unit is selected by parameter *96.16 Unit selection*. 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 (towards the motor) in full gigawatt-hours. The minimum value is zero.	-
	0…32767 GWh	Motoring energy in GWh.	1 = 1 GWh
01.19	*Inverter MWh motoring*	Amount of energy that has passed through the drive (towards the motor) in full megawatt-hours. Whenever the counter rolls over, *01.18 Inverter GWh motoring* is incremented.The minimum value is zero.	-
	0…999 MWh	Motoring energy in MWh.	1 = 1 MWh
01.20	*Inverter kWh motoring*	Amount of energy that has passed through the drive (towards the motor) in full kilowatt-hours. Whenever the counter rolls over, *01.19 Inverter MWh motoring* is incremented.The minimum value is zero.	-
	0…999 kWh	Motoring energy in kWh.	10 = 1 kWh
01.21	*U-phase current*	Measured U-phase current.	-
	-30000.00 … 30000.00 A	U-phase current.	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%
01.29	*Speed change rate*	Rate of actual speed change. Positive values indicate acceleration, negative values indicate deceleration. See also parameters *31.32 Emergency ramp supervision* and *31.33 Emergency ramp supervision delay*, *31.37 Ramp stop supervision* and *31.38 Ramp stop supervision delay*.	-
	-15000 … 15000 rpm/s	Rate of speed change.	1 = 1 rpm/s

No.	Name/Value	Description	Def/FbEq16
01.30	*Nominal torque scale*	Torque that corresponds to 100% of nominal motor torque. The unit is selected by parameter *96.16 Unit selection* **Note:** This value is copied from parameter *99.12 Motor nominal torque* if entered. Otherwise the value is calculated from other motor data.	-
	0.000… N·m or lb·ft	Nominal torque.	1 = 100 unit
01.31	*Ambient temperature*	Measured temperature of incoming cooling air. The unit is selected by parameter *96.16 Unit selection*.	-
	-40 … 120 °C or °F	Cooling air temperature.	1 = 1°
01.32	*Inverter GWh regenerating*	Amount of energy that has passed through the drive (towards the supply) in full gigawatt-hours. The minimum value is zero.	-
	0…32767 GWh	Motoring energy in GWh.	1 = 1 GWh
01.33	*Inverter MWh regenerating*	Amount of energy that has passed through the drive (towards the supply) in full megawatt-hours. Whenever the counter rolls over, *01.32 Inverter GWh regenerating* is incremented.The minimum value is zero.	-
	0…999 MWh	Motoring energy in MWh.	1 = 1 MWh
01.34	*Inverter kWh regenerating*	Amount of energy that has passed through the drive (towards the supply) in full kilowatt-hours. Whenever the counter rolls over, *01.33 Inverter MWh regenerating* is incremented.The minimum value is zero.	-
	0…999 kWh	Motoring energy in kWh.	10 = 1 kWh
01.35	*Mot - regen energy GWh*	Amount of net energy (motoring energy - regenerating energy) that has passed through the drive in full gigawatt-hours.	-
	-32768…32767 GWh	Motoring energy in GWh.	1 = 1 GWh
01.36	*Mot - regen energy MWh*	Amount of net energy (motoring energy - regenerating energy) that has passed through the drive in full megawatt-hours. Whenever the counter rolls over, *01.35 Mot - regen energy GWh* is incremented or decremented.	-
	-999…999 MWh	Motoring energy in MWh.	1 = 1 MWh
01.37	*Mot - regen energy kWh*	Amount of energy (motoring energy - regenerating energy) that has passed through the drive in full kilowatt-hours. Whenever the counter rolls over, *01.36 Mot - regen energy MWh* is incremented or decremented.	-
	-999…999 kWh	Motoring energy in kWh.	10 = 1 kWh
01.61	*Abs motor speed used*	Absolute value of *01.01 Motor speed used*.	-
	0.00 … 30000.00 rpm	Measured or estimated motor speed.	See par. *46.01*
01.62	*Abs motor speed %*	Absolute value of *01.03 Motor speed %*.	-
	0.00 … 1000.00%	Measured or estimated motor speed.	See par. *46.01*
01.63	*Abs output frequency*	Absolute value of *01.06 Output frequency*.	-
	0.00 … 500.00 Hz	Estimated output frequency.	See par. *46.02*

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

03 Input references		Values of references received from various sources. All parameters in this group are read-only unless otherwise noted.	
03.01	*Panel reference*	Local reference given from the control panel or PC tool.	-
	-100000.00 … 100000.00	Local control panel or PC tool reference.	1 = 10
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 *645*).	-
	-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

No.	Name/Value	Description	Def/FbEq16
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 *152*).	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 *145*).	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

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

No.	Name/Value	Description	Def/FbEq16
04.10	*Active warning 5*	Code of the 5th active warning.	-
	0000h…FFFFh	5th active warning.	1 = 1
04.11	*Latest fault*	Code of the 1st stored (non-active) fault.	-
	0000h…FFFFh	1st stored fault.	1 = 1
04.12	*2nd latest fault*	Code of the 2nd stored (non-active) fault.	-
	0000h…FFFFh	2nd stored fault.	1 = 1
04.13	*3rd latest fault*	Code of the 3rd stored (non-active) fault.	-
	0000h…FFFFh	3rd stored fault.	1 = 1
04.14	*4th latest fault*	Code of the 4th stored (non-active) fault.	-
	0000h…FFFFh	4th stored fault.	1 = 1
04.15	*5th latest fault*	Code of the 5th stored (non-active) fault.	-
	0000h…FFFFh	5th stored fault.	1 = 1
04.16	*Latest warning*	Code of the 1st stored (non-active) warning.	-
	0000h…FFFFh	1st stored warning.	1 = 1
04.17	*2nd latest warning*	Code of the 2nd stored (non-active) warning.	-
	0000h…FFFFh	2nd stored warning.	1 = 1
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

No.	Name/Value	Description	Def/FbEq16
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		**ACS880 events indicated by this bit** (see *Fault tracing*, page *579*)
	(*04.120* = *ACS800 Standard ctrl program*)	(*04.120* = *ACS800 System ctrl program*)	
0	SHORT CIRC	SHORT CIRC	*2340*
1	OVERCURRENT	OVERCURRENT	*2310*
2	DC OVERVOLT	DC OVERVOLT	*3210*
3	ACS800 TEMP	ACS800 TEMP	*2381*, *4210*, *4290*, *42F1*, *4310*, *4380*
4	EARTH FAULT	EARTH FAULT	*2330*, *2392*, *3181*
5	THERMISTOR	MOTOR TEMP M	*4981*
6	MOTOR TEMP	MOTOR TEMP	*4982*
7	SYSTEM_FAULT	SYSTEM_FAULT	*6481*, *6487*, *64A1*, *64A2*, *64A3*, *64B1*, *64E1*, *6881*, *6882*, *6883*, *6885*
8	UNDERLOAD	UNDERLOAD	-
9	OVERFREQ	OVERFREQ	*7310*
10	Reserved	MPROT SWITCH	*9081*
11	Reserved	CH2 COMM LOSS	*7582*
12	Reserved	SC (INU1)	*2340* (XXYY YY01)
13	Reserved	SC (INU2)	*2340* (XXYY YY02)
14	Reserved	SC (INU3)	*2340* (XXYY YY03)
15	Reserved	SC (INU4)	*2340* (XXYY YY04)

No.	Name/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 *579*)
	(*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*
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 579)
0	START INHIBIT	START INHIBI	B5A0
1	Reserved	EM STOP	AFE1, AFE2
2	THERMISTOR	MOTOR TEMP M	A491
3	MOTOR TEMP	MOTOR TEMP	A492
4	ACS800 TEMP	ACS800 TEMP	A2BA, A4A1, A4A9, A4B0, A4B1, A4F6
5	ENCODER ERR	ENCODER ERR	A797, A7B0, A7B1, A7E1
6	T MEAS ALM	T MEAS CIRC	A490, A5EA, A782, A8A0
7	Reserved	DIGITAL IO	-
8	Reserved	ANALOG IO	-
9	Reserved	EXT DIGITAL IO	-
10	Reserved	EXT ANALOG IO	A6E5, A7AA, A7AB
11	Reserved	CH2 COMM LOSS	A7CB, AF80
12	COMM MODULE	MPROT SWITCH	A981
13	Reserved	EM STOP DEC	-
14	EARTH FAULT	EARTH FAULT	A2B3
15	Reserved	SAFETY SWITC	A983

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

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

Bit	ACS800 alarm name		ACS880 events indicated by this bit (see *Fault tracing*, page *579*)
	(*04.120* = *ACS800 Standard ctrl program*)	(*04.120* = *ACS800 System ctrl program*)	
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

No.	Name/Value	Description	Def/FbEq16
04.41	*Event word 1 bit 0 code*	(*Visible when user lock is open with pass code 584. See parameter 96.02 Pass 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 *579*).	0000h
	0000h…FFFFh	Code of event.	1 = 1
04.42	*Event word 1 bit 0 aux code*	(*Visible when user lock is open with pass code 584. See parameter 96.02 Pass 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*	(*Visible when user lock is open with pass code 584. See parameter 96.02 Pass 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 *579*).	0000h
	0000h…FFFFh	Code of event.	1 = 1
04.44	*Event word 1 bit 1 aux code*	(*Visible when user lock is open with pass code 584. See parameter 96.02 Pass 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
…	…	…	…
04.55	*Event word 1 bit 7 code*	(*Visible when user lock is open with pass code 584. See parameter 96.02 Pass 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 *579*).	0000h
	0000h…FFFFh	Code of event.	1 = 1

No.	Name/Value	Description	Def/FbEq16
04.56	*Event word 1 bit 7 aux code*	(*Visible when user lock is open with pass code 584. See parameter 96.02 Pass 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
04.57	*Event word 1 bit 8 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 *579*).	0000h
	0000h…FFFFh	Code of event.	1 = 1
04.58	*Event word 1 bit 8 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
…	…	…	…
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 *579*).	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. All parameters in this group are read-only unless otherwise noted.	
05.01	*On-time counter*	On-time counter. The counter runs when the drive is powered.	-
	0…65535 d	On-time counter.	1 = 1 d
05.02	*Run-time counter*	Motor run-time counter. The counter runs when the inverter modulates.	-
	0…65535 d	Motor run-time counter.	1 = 1 d
05.04	*Fan on-time counter*	Running time of the drive cooling fan. Can be reset from the control panel by keeping Reset depressed for over 3 seconds.	-
	0…65535 d	Cooling fan run-time counter.	1 = 1 d
05.11	*Inverter temperature*	Estimated drive temperature in percent of fault limit. The 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%
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%

No.	Name/Value	Description	Def/FbEq16
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 *651*. The related status word and state diagram are presented on pages *653* and *654* respectively. **Note:** Bits 12…15 can be used to carry additional control data, and used as a signal source by any binary-source selector parameter. This parameter is read-only.	-
	0000h…FFFFh	Main control word.	1 = 1
06.02	*Application control word*	The drive control word received from the application program (if any). The bit assignments are described on page *651*. 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 *648*). 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 *648*). This parameter is read-only.	-
	00000000h … FFFFFFFFh	Control word received through fieldbus adapter B.	1 = 1
06.05	*EFB transparent control word*	Displays the unaltered control word received from the PLC through the embedded fieldbus interface when a transparent communication profile is selected in parameter *58.25 Control profile*. See section *The Transparent profile* (page *637*). 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 *653*. The related control word and state diagram are presented on pages *651* and *654* respectively. 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. **Note:** 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
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 *16*)
10	Ext1 active	1 = Control location EXT1 active
11	Ext2 active	1 = Control location EXT2 active
12	Reserved	
13	Start request	1 = Start requested
14…15	Reserved	

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

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

Bit	Name	Description
0	Identification run done	1 = Motor identification (ID) run has been performed
1	Magnetized	1 = The motor has been magnetized
2	Torque control	1 = Torque control mode active
3	Speed control	1 = Speed control mode active
4	Hoist speed optimization	1 = Hoist speed optimization mode active
5	Safe reference active	1 = A “safe” reference is applied by functions such as parameters *49.05* and *50.02*
6	Last speed active	1 = A “last speed” reference is applied by functions such as parameters *49.05* and *50.02*
7	Loss of reference	1 = Reference signal lost
8	Emergency stop failed	1 = Emergency stop failed (see parameters *31.32* and *31.33*)
9	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 *Reduced run function* on page *193*)
13	Reserved	
14	Stop failed	1 = Stopping failed (see parameters *31.37* and *31.38*)
15	Reserved	

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

No.	Name/Value	Description	Def/FbEq16
06.18	*Start inhibit status word*	Start inhibit status word. This word specifies the source of the inhibiting signal that is preventing the drive from starting. The conditions marked with an asterisk (*) only require that the start command is cycled. In all other instances, the inhibiting condition must be removed first. See also parameter *06.25 Drive inhibit status word 2*, and *06.16 Drive status word 1*, bit 1. This parameter is read-only.	-

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

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

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

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

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

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 *157*). This parameter is read-only.	-

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

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

Bit	Name	Description
0	DC hold active	1 = DC hold is active (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	PM smooth start active	Reserved.
4…15	Reserved	

No.	Name/Value	Description	Def/FbEq16
	0000h…FFFFh	Drive status word 3.	1 = 1
06.25	*Drive inhibit status word 2*	Drive inhibit status word 2. This word specifies the source of the inhibiting signal that is preventing the drive from starting. 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 *589*).
5…15	Reserved	

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

No.	Name/Value	Description	Def/FbEq16
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 1* (see page *219*).	2
	Other [bit]	Source selection (see *Terms and abbreviations* on page *199*).	-
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 *217*).	2
	Other [bit]	Source selection (see *Terms and abbreviations* on page *199*).	-
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 *220*).	2
	Other [bit]	Source selection (see *Terms and abbreviations* on page *199*).	-
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 *199*).	-
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 *199*).	-

No.	Name/Value	Description	Def/FbEq16
06.36	*LSU Status Word*	*(Only visible with a BCU control unit)* Shows the status of the supply unit. See also section *Control of a supply unit (LSU)* (page *154*), and parameter group *60 DDCS communication*. This parameter is read-only.	-

Bit	Name	Description
0	Ready on	1 = Ready to switch on
1	Ready run	1 = Ready to operate, DC link charged
2	Ready ref	1 = Operation enabled
3	Tripped	1 = A fault is active
4…6	Reserved	
7	Alarm	1 = A warning is active
8	Modulating	1 = The supply unit is modulating
9	Remote	1 = Remote control (EXT1 or EXT2) 0 = Local control
10	Net ok	1 = Supply network voltage OK
11…12	Reserved	
13	Charging or ready run	1 = Bit 1 or bit 14 active
14	Charging	1 = Charging contactor closed 0 = Charging contactor open
15	Reserved	

No.	Name/Value	Description	Def/FbEq16
	0000h…FFFFh	Supply unit status word.	1 = 1
06.39	*Internal state machine LSU CW*	*(Only visible with a BCU control unit)* Shows the control word sent to the supply unit from the INU-LSU (inverter unit/supply unit) state machine. This parameter is read-only.	-

Bit	Name	Description
0	ON/OFF	1 = Start charging 0 = Open main contactor (switch power off)
1	OFF 2	0 = Emergency stop (Off2)
2	OFF 3	0 = Emergency stop (Off3)
3	START	1 = Start modulating 0 = Stop modulating
4…6	Reserved	
7	RESET	0 -> 1 = Reset an active fault. A fresh start command is required after reset.
8…11	Reserved	
12	USER BIT 0	See parameter *06.40 LSU CW user bit 0 selection*.
13	USER BIT 1	See parameter *06.41 LSU CW user bit 1 selection*.
14	USER BIT 2	See parameter *06.42 LSU CW user bit 2 selection*.
15	USER BIT 3	See parameter *06.43 LSU CW user bit 3 selection*.

No.	Name/Value	Description	Def/FbEq16
	0000h…FFFFh	Supply unit control word.	1 = 1

No.	Name/Value	Description	Def/FbEq16
06.40	*LSU CW user bit 0 selection*	*(Only visible with a BCU control unit)* Selects a binary source whose status is transmitted as bit 12 of *06.39 Internal state machine LSU CW* to the supply unit.	*MCW user bit 0*
	False	0.	0
	True	1.	1
	MCW user bit 0	Bit 12 of *06.01 Main control word* (see page *217*).	2
	MCW user bit 1	Bit 13 of *06.01 Main control word* (see page *217*).	3
	MCW user bit 2	Bit 14 of *06.01 Main control word* (see page *217*).	4
	MCW user bit 3	Bit 15 of *06.01 Main control word* (see page *217*).	5
	Other [bit]	Source selection (see *Terms and abbreviations* on page *199*).	-
06.41	*LSU CW user bit 1 selection*	*(Only visible with a BCU control unit)* Selects a binary source whose status is transmitted as bit 13 of *06.39 Internal state machine LSU CW* to the supply unit.	*MCW user bit 1*
	False	0.	0
	True	1.	1
	MCW user bit 0	Bit 12 of *06.01 Main control word* (see page *217*).	2
	MCW user bit 1	Bit 13 of *06.01 Main control word* (see page *217*).	3
	MCW user bit 2	Bit 14 of *06.01 Main control word* (see page *217*).	4
	MCW user bit 3	Bit 15 of *06.01 Main control word* (see page *217*).	5
	Other [bit]	Source selection (see *Terms and abbreviations* on page *199*).	-
06.42	*LSU CW user bit 2 selection*	*(Only visible with a BCU control unit)* Selects a binary source whose status is transmitted as bit 14 of *06.39 Internal state machine LSU CW* to the supply unit.	*MCW user bit 2*
	False	0.	0
	True	1.	1
	MCW user bit 0	Bit 12 of *06.01 Main control word* (see page *217*).	2
	MCW user bit 1	Bit 13 of *06.01 Main control word* (see page *217*).	3
	MCW user bit 2	Bit 14 of *06.01 Main control word* (see page *217*).	4
	MCW user bit 3	Bit 15 of *06.01 Main control word* (see page *217*).	5
	Other [bit]	Source selection (see *Terms and abbreviations* on page *199*).	-
06.43	*LSU CW user bit 3 selection*	*(Only visible with a BCU control unit)* Selects a binary source whose status is transmitted as bit 15 of *06.39 Internal state machine LSU CW* to the supply unit.	*MCW user bit 3*
	False	0.	0
	True	1.	1
	MCW user bit 0	Bit 12 of *06.01 Main control word* (see page *217*).	2
	MCW user bit 1	Bit 13 of *06.01 Main control word* (see page *217*).	3
	MCW user bit 2	Bit 14 of *06.01 Main control word* (see page *217*).	4
	MCW user bit 3	Bit 15 of *06.01 Main control word* (see page *217*).	5
	Other [bit]	Source selection (see *Terms and abbreviations* on page *199*).	-

No.	Name/Value	Description	Def/FbEq16
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*.)	*MCW user bit 0*
	False	0.	0
	True	1.	1
	MCW user bit 0	Bit 12 of *06.01 Main control word* (see page *217*).	2
	MCW user bit 1	Bit 13 of *06.01 Main control word* (see page *217*).	3
	MCW user bit 2	Bit 14 of *06.01 Main control word* (see page *217*).	4
	MCW user bit 3	Bit 15 of *06.01 Main control word* (see page *217*).	5
	Other [bit]	Source selection (see *Terms and abbreviations* on page *199*).	-
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 *217*).	2
	MCW user bit 1	Bit 13 of *06.01 Main control word* (see page *217*).	3
	MCW user bit 2	Bit 14 of *06.01 Main control word* (see page *217*).	4
	MCW user bit 3	Bit 15 of *06.01 Main control word* (see page *217*).	5
	Other [bit]	Source selection (see *Terms and abbreviations* on page *199*).	-
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 *217*).	2
	MCW user bit 1	Bit 13 of *06.01 Main control word* (see page *217*).	3
	MCW user bit 2	Bit 14 of *06.01 Main control word* (see page *217*).	4
	MCW user bit 3	Bit 15 of *06.01 Main control word* (see page *217*).	5
	Other [bit]	Source selection (see *Terms and abbreviations* on page *199*).	-
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 *217*).	2
	MCW user bit 1	Bit 13 of *06.01 Main control word* (see page *217*).	3
	MCW user bit 2	Bit 14 of *06.01 Main control word* (see page *217*).	4

No.	Name/Value	Description	Def/FbEq16
	MCW user bit 3	Bit 15 of *06.01 Main control word* (see page *217*).	5
	Other [bit]	Source selection (see *Terms and abbreviations* on page *199*).	-
06.50	*User status word 1*	User-defined status word. This word shows the status of the binary sources selected by parameters *06.60*…*06.75*. This parameter is read-only.	-

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

No.	Name/Value	Description	Def/FbEq16
	0000h…FFFFh	User-defined status word.	1 = 1
06.60	*User status word 1 bit 0 sel*	Selects a binary source whose status is shown as bit 0 of *06.50 User status word 1*.	*False*
	False	0.	0
	True	1.	1
	Other [bit]	Source selection (see *Terms and abbreviations* on page *199*).	-
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 *221*).	2
	Other [bit]	Source selection (see *Terms and abbreviations* on page *199*).	-
06.62	*User status word 1 bit 2 sel*	Selects a binary source whose status is shown as bit 2 of *06.50 User status word 1*.	*Emergency stop failed*
	False	0.	0
	True	1.	1
	Emergency stop failed	Bit 8 of *06.17 Drive status word 2* (see page *219*).	2
	Other [bit]	Source selection (see *Terms and abbreviations* on page *199*).	-
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 *219*).	2
	Other [bit]	Source selection (see *Terms and abbreviations* on page *199*).	-
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

No.	Name/Value	Description	Def/FbEq16
	Run disable	Bit 5 of *06.18 Start inhibit status word* (see page *220*).	2
	Other [bit]	Source selection (see *Terms and abbreviations* on page *199*).	-
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 *199*).	-
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 *199*).	-
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 *219*).	2
	Other [bit]	Source selection (see *Terms and abbreviations* on page *199*).	-
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 *220*).	2
	Other [bit]	Source selection (see *Terms and abbreviations* on page *199*).	-
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 *218*).	2
	Other [bit]	Source selection (see *Terms and abbreviations* on page *199*).	-
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 *219*).	2
	Other [bit]	Source selection (see *Terms and abbreviations* on page *199*).	-

No.	Name/Value	Description	Def/FbEq16
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 *221*).	2
	Other [bit]	Source selection (see *Terms and abbreviations* on page *199*).	-
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 *221*).	2
	Other [bit]	Source selection (see *Terms and abbreviations* on page *199*).	-
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 *199*).	-
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 *199*).	-
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
	Other [bit]	Source selection (see *Terms and abbreviations* on page *199*).	-
06.100	*User control word 1*	User-defined control word 1. This parameter is read-only.	-

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

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

No.	Name/Value	Description	Def/FbEq16
06.101	*User control word 2*	User-defined control word 2. This parameter is read-only.	-

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

No.	Name/Value	Description	Def/FbEq16
	0000h…FFFFh	User-defined control word 2.	1 = 1
07 System info		Drive hardware and firmware information. All parameters in this group are read-only.	
07.03	*Drive rating id*	Type of the drive/inverter unit.	-
07.04	*Firmware name*	Firmware identification. Example: AINF6	-
07.05	*Firmware version*	Version number of the firmware. Example: 2.31.0.0	-
07.06	*Loading package name*	Name of the firmware loading package. Example: ACRL6	-
07.07	*Loading package version*	Version number of the firmware loading package. Example: 3.00.0.0	-
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.	-
07.21	*Application environment status 1*	Shows which tasks of the application program are running. See the *Drive (IEC 61131-3) application programming manual* (3AUA0000127808 [English]).	-

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

No.	Name/Value	Description	Def/FbEq16
	0000h…FFFFh	Application program task status.	1 = 1

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

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

No.	Name/Value	Description	Def/FbEq16
	0000h…FFFFh	Application program opening status.	1 = 1
07.23	*Application name*	First five ASCII letters of the name given to the application program in the programming tool. The full name is visible under System info on the control panel or the Drive composer PC tool. _N/A_ = None.	-
07.24	*Application version*	Application program version number given to the application program in the programming tool. Also visible under System info on the control panel or the Drive composer PC tool.	-
07.25	*Customization package name*	First five ASCII letters of the name given to the customization package. The full name is visible under System info on the control panel or the Drive composer PC tool. _N/A_ = None.	-
07.26	*Customization package version*	Customization package version number. Also visible under System info on the control panel or the Drive composer PC tool.	-
07.30	*Adaptive program status*	Shows the status of the adaptive program. See section *Adaptive programming* (page *139*).	-

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

No.	Name/Value	Description	Def/FbEq16
	0000h…FFFFh	Adaptive program status.	1 = 1

No.	Name/Value	Description	Def/FbEq16
09 Crane application signals		Signals related to crane applications. All parameters in this group are read-only.	
09.01	*Crane SW1*	Crane control program status word 1.	-

Bit	Name	Description
0	Brake slip at standstill	1 = Speed matching function detected a brake slip when the motor was not running.
1	Slowdown activated	1 = Slowdown command is active either in the forward or reverse direction.
2	Slowdown up	1 = Slowdown command is inactive in the forward direction.
3	Slowdown down	1 = Slowdown command is inactive in the reverse direction.
4	Load speed enabled	1 = Hoist speed optimization is active.
5	Hoist speed opt up limit	1 = Speed reference is limited in the forward direction by Hoist speed optimization.
6	Hoist speed opt down limit	1 = Speed reference is limited in the reverse direction by Hoist speed optimization.
7	Upper end limit	1 = Upper limit command is inactive.
8	Lower end limit	1 = Lower limit command is inactive.
9	Wrong start sequence	1 = Drive does not accept a start command because of a wrong start sequence.
10	Joystick reference check	1 = Reference is greater than +/- 10% of the minimum or maximum scaled value of the used joystick reference, and the joystick zero position input is active.
11	Joystick zero position	1 = Drive does not accept a start command because of a wrong state of the joystick zero position input.
12	Brake control selected	1 = Mechanical brake control is selected.
13	Torque prove ok	1 = Torque proving has been successfully performed or Torque proving has been disabled.
14	Fast stop	1 = Fast stop command is active.
15	Power on acknowledge warning	1 = Power on acknowledgement circuit is open, main contactor is open, warning *D20B Power on acknowledge* is generated. 0 = Power on acknowledgement circuit is closed, main contactor is closed. See parameter *20.212 Power on acknowledge* (page *295*) and section *Power on acknowledgement* (page *126*).

	0000h…FFFFh	Crane control program status word 1.	1 = 1

No.	Name/Value	Description	Def/FbEq16
09.02	*Crane SW2*	Crane control program status word 2. This parameter is read-only.	-

Bit	Name	Description
0	External speed limit1	1 = External speed limit1 is active.
1	Emergency control activated	1 = Emergency control mode is active.
2	User set 1 has been loaded	1 = User set 1 is loaded.
3	User set 2 has been loaded	1 = User set 2 is loaded.
4	User set 3 has been loaded	1 = User set 3 is loaded.
5	User set 4 has been loaded	1 = User set 4 is loaded.
6	Crane operating hours warning	1 = Warning *D212 Crane operating hours* activated.
7	Brake oper count warning	1 = Warning *D213 Brake oper counts* activated.
8	Number of power on warning	1 = Warning *D214 Number of power on* activated.
9	Slack rope detected	1 = Warning *D217 Slack rope* activated.
10…15	Reserved.	

No.	Name/Value	Description	Def/FbEq16
	00b…11b	Crane control program status word 2.	1 = 1
09.03	*Crane FW1*	Crane fault status word 1 with fault bits.	-

Bit	Name	Description
0	Inverter overload	1 = *D106 Inverter overload* (page *619*)
1	Speed match	1 = *D105 Speed match* (page *619*)
2	Over speed	1 = *D104 Over speed* (page *619*)
3	ID run and remote	1 = *D107 ID run and remote* (page *619*)
4	End limits IO error	1 = *D108 End limits I/O error* (page *619*)
5	Hoist speed optimization settings	1 = *D103 Hoist speed opt settings* (page *619*)
6	Torque prove	1 = *D100 Torque prove* (page *619*)
7	Brake slip	1 = *D101 Brake slip* (page *619*)
8	Brake safe closure	1 = *D102 Brake safe closure* (page *619*)
9…15	Reserved	

No.	Name/Value	Description	Def/FbEq16
	0000h…FFFFh	Crane fault status word 1 with fault bits.	1 = 1
09.05	*Hoist speed opt speed limit*	Shows the speed limit calculated by the Hoist speed optimization function.	0.00 rpm
	0.00 … 30000.00 rpm	Speed limit calculated by the Hoist speed optimization function.	1 = 1 rpm
09.06	*Crane speed reference*	Shows the final speed reference calculated by the control program.	0.00 rpm
	0.00 … 30000.00 rpm	Final speed reference calculated by the control program.	1 = 1 rpm

No.	Name/Value	Description	Def/FbEq16
09.07	*Load speed error status*	Load speed limit error status word (Hoist speed optimization)	-

Bit	Name	Description
0	Reserved	
1	Zero value error	1 = Any of the parameters for load values are incorrectly set to zero.
2	Order value error	1 = Parameters for load values are not set in increasing order, or parameters for speed limit values are not set in decreasing order.
3…15	Reserved	

No.	Name/Value	Description	Def/FbEq16
	000b…111b	Load speed limit error status word.	1 = 1
09.09	*Flux reference*	Shows the crane flux reference in percent of the nominal flux of the motor.	0%
	0…200%	Crane flux reference.	1 = 1%
09.10	*Lifetime left*	Shows the remaining lifetime hours from the defined lifetime hours in parameter *75.71 Crane lifetime*.	-
	0 ... 10000 h	Left lifetime hours.	1 = 1 h
09.11	*Lifetime left in percent*	Shows the percent of remaining lifetime from the defined lifetime hours in parameter *75.71 Crane lifetime*.	-
	0.00 ... 100.00%	Left lifetime in percent.	100 = 1%
09.12	*Load spectrum factor*	Shows the load spectrum factor.	-
	0.00 ... 10.00	Load spectrum factor.	10 = 1
09.13	*Lifetime sw*	Lifetime status word.	-

Bit	Name	Description
0	Lifetime monitor active	1 = Lifetime monitor function is activated.
1	Warning: less 10% lifetime left	1 = Warning *D216 Liftetime left less 10%*
2…15	Reserved	

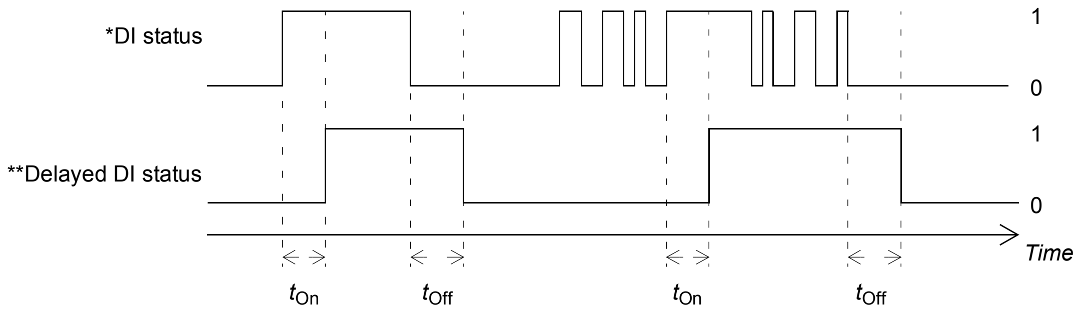
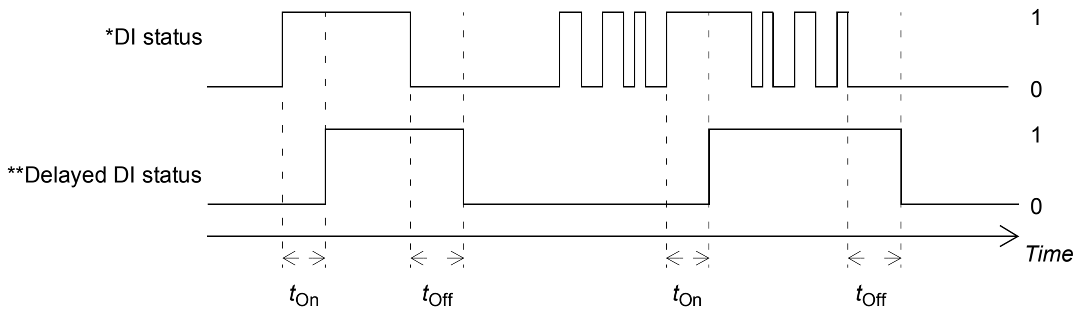
No.	Name/Value	Description	Def/FbEq16
	0000b…0111b	Load speed limit error status word.	1 = 1
09.20	*Crane operation hours*	Shows the number of hours the crane was operating with open brake. The counter can be initialized/preset with parameters *33.200*...*33.202*.	0 hr
	0…1100000	Hours	1 = 1 hr
09.21	*Brake operation count*	Shows the number of times the mechanical brake was opened. The counter can be initialized/preset with parameters *33.210*...*33.212*.	0
	0…4294967295	Mechanical brake open counts	1 = 1
09.22	*Number of pwr on*	Shows the number of times the crane system was powered on. The counter counts the number of power acknowledges. The source is set with parameter *20.212*. The counter can be initialized/preset with parameters *33.220*...*33.222*.	0
	0…65535	Power on counts	1 = 1

No.	Name/Value	Description	Def/FbEq16
09.31	*Motor load*	Shows the motor torque in percent of nominal motor torque. Negative sign indicates generating side of motor. Positive sign indicates motor side.	0.0%
	-1600.0 ... 1600.0%	Motor load in percent.	10 = 1%
09.50	*Crane speed reference cor*	Shows the crane speed reference correction value.	0.00 rpm
	-30000.00... 30000.00 rpm	Speed correction.	100 = 1 rpm

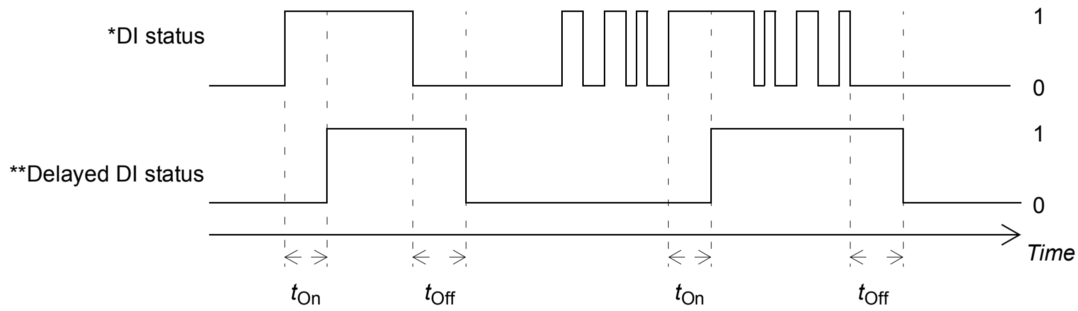
10 Standard DI, RO		Configuration of digital inputs and relay outputs.	
10.01	*DI status*	Displays the electrical status of digital inputs DIIL and DI6…DI1. The activation/deactivation delays of the inputs (if any are specified) are ignored. A filtering time can be defined by parameter *10.51 DI filter time*. Bits 0…5 reflect the status of DI1…DI6; bit 15 reflects the status of the DIIL input. **Example:** 1000000000010011b = DIIL, DI5, DI2 and DI1 are on, DI3, DI4 and DI6 are off. This parameter is read-only.	-
	0000h…FFFFh	Status of digital inputs.	1 = 1
10.02	*DI delayed status*	Displays the status of digital inputs DIIL and DI6…DI1. This word is updated only after activation/deactivation delays (if any are specified). Bits 0…5 reflect the delayed status of DI1…DI6; bit 15 reflects the delayed status of the DIIL input. This parameter is read-only.	-
	0000h…FFFFh	Delayed status of digital inputs.	1 = 1
10.03	*DI force selection*	The electrical statuses of the digital inputs can be overridden for eg. testing purposes. A bit in parameter *10.04 DI force data* is provided for each digital input, and its value is applied whenever the corresponding bit in this parameter is 1.	0000h

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

	0000h…FFFFh	Override selection for digital inputs.	1 = 1
10.04	*DI force data*	Contains the values that the digital inputs are forced to when selected by *10.03 DI force selection*. Bit 0 is the forced value for DI1; bit 15 is the forced value for the DIIL input.	0000h
	0000h…FFFFh	Forced values of digital inputs.	1 = 1

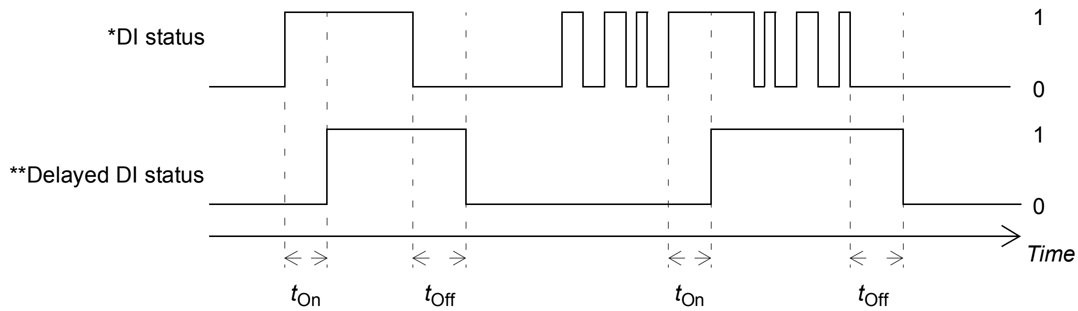
No.	Name/Value	Description	Def/FbEq16
10.05	*DI1 ON delay*	Defines the activation delay for digital input DI1.	0.0 s
	 t_{On} = *10.05 DI1 ON delay* t_{Off} = *10.06 DI1 OFF delay* *Electrical status of digital input. Indicated by *10.01 DI status*. **Indicated by *10.02 DI delayed status*.		
	0.0 …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

No.	Name/Value	Description	Def/FbEq16
10.09	*DI3 ON delay*	Defines the activation delay for digital input DI3.	0.0 s



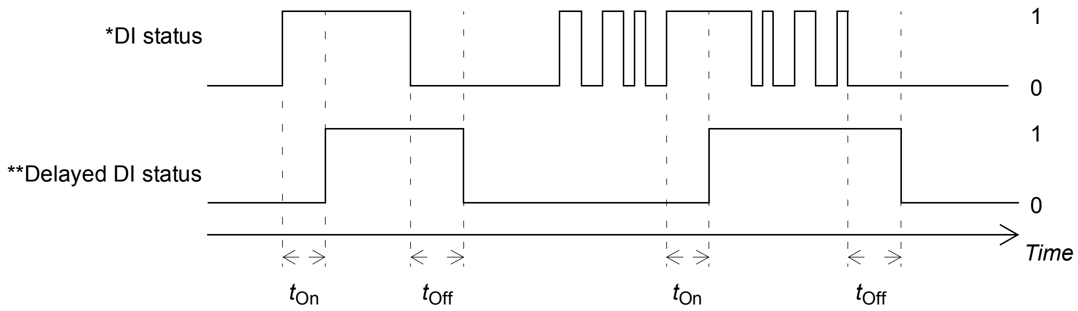
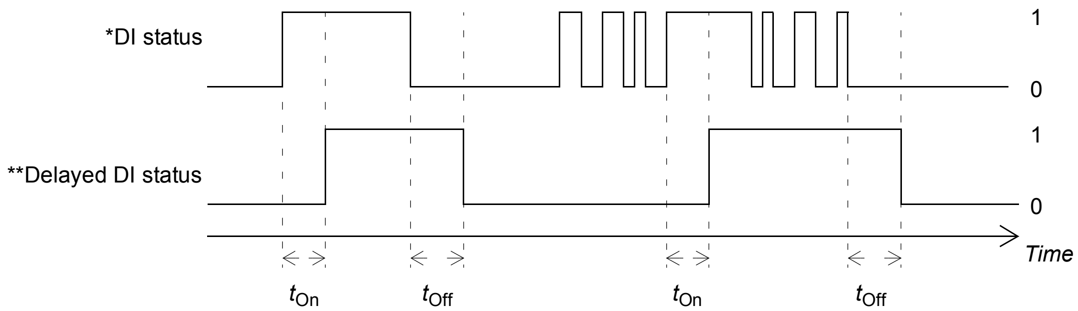
t_{On} = *10.09 DI3 ON delay*
t_{Off} = *10.10 DI3 OFF delay*
*Electrical status of digital input. Indicated by *10.01 DI status*.
**Indicated by *10.02 DI delayed status*.

	0.0 … 3000.0 s	Activation delay for DI3.	10 = 1 s
10.10	*DI3 OFF delay*	Defines the deactivation delay for digital input DI3. See parameter *10.09 DI3 ON delay*.	0.0 s
	0.0 … 3000.0 s	Deactivation delay for DI3.	10 = 1 s
10.11	*DI4 ON delay*	Defines the activation delay for digital input DI4.	0.0 s

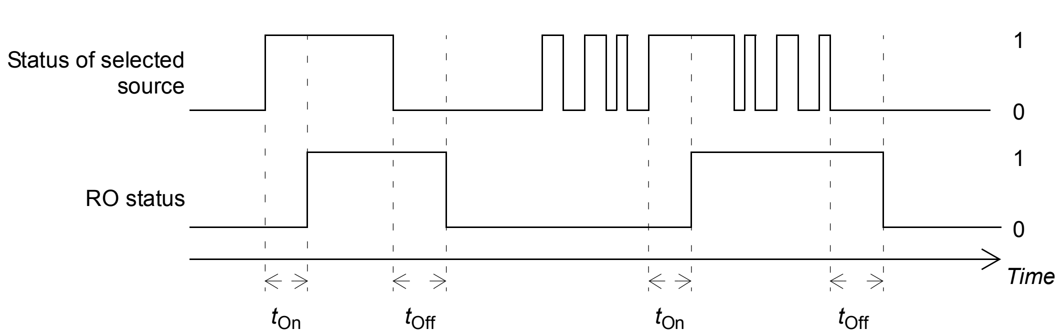


t_{On} = *10.11 DI4 ON delay*
t_{Off} = *10.12 DI4 OFF delay*
*Electrical status of digital input. Indicated by *10.01 DI status*.
**Indicated by *10.02 DI delayed status*.

	0.0 … 3000.0 s	Activation delay for DI4.	10 = 1 s
10.12	*DI4 OFF delay*	Defines the deactivation delay for digital input DI4. See parameter *10.11 DI4 ON delay*.	0.0 s
	0.0 … 3000.0 s	Deactivation delay for DI4.	10 = 1 s

No.	Name/Value	Description	Def/FbEq16
10.13	*DI5 ON delay*	Defines the activation delay for digital input DI5.	0.0 s
		 t_{On} = *10.13 DI5 ON delay* t_{Off} = *10.14 DI5 OFF delay* *Electrical status of digital input. Indicated by *10.01 DI status*. **Indicated by *10.02 DI delayed status*.	
	0.0 … 3000.0 s	Activation delay for DI5.	10 = 1 s
10.14	*DI5 OFF delay*	Defines the deactivation delay for digital input DI5. See parameter *10.13 DI5 ON delay*.	0.0 s
	0.0 … 3000.0 s	Deactivation delay for DI5.	10 = 1 s
10.15	*DI6 ON delay*	Defines the activation delay for digital input DI6.	0.0 s
		 t_{On} = *10.15 DI6 ON delay* t_{Off} = *10.16 DI6 OFF delay* *Electrical status of digital input. Indicated by *10.01 DI status*. **Indicated by *10.02 DI delayed status*.	
	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 *44.210 Crane brake status*, bit 0. The default value must not be changed. RO1 is to be used only for the control of the mechanical brake.	P. 44.210.0
	Not energized	Output is not energized.	0
	Energized	Output is energized.	1
	Ready run	Bit 1 of *06.11 Main status word* (see page *217*).	2
	Enabled	Bit 0 of *06.16 Drive status word 1* (see page *218*).	4

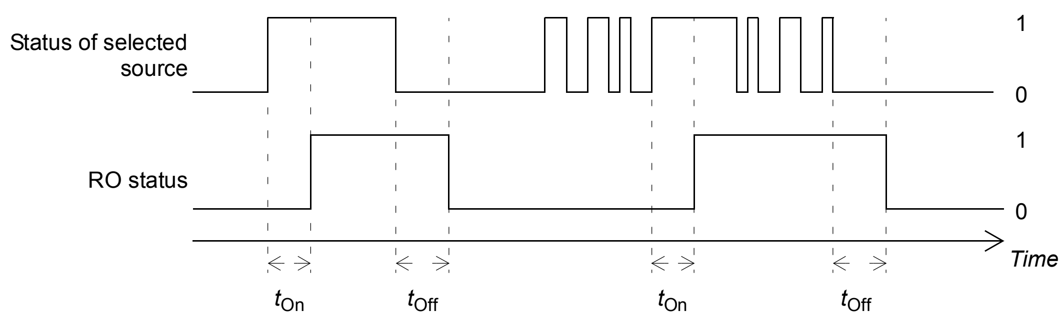
No.	Name/Value	Description	Def/FbEq16
	Started	Bit 5 of *06.16 Drive status word 1* (see page *218*).	5
	Magnetized	Bit 1 of *06.17 Drive status word 2* (see page *219*).	6
	Running	Bit 6 of *06.16 Drive status word 1* (see page *218*).	7
	Ready ref	Bit 2 of *06.11 Main status word* (see page *217*).	8
	At setpoint	Bit 8 of *06.11 Main status word* (see page *217*).	9
	Reverse	Bit 2 of *06.19 Speed control status word* (see page *221*).	10
	Zero speed	Bit 0 of *06.19 Speed control status word* (see page *221*).	11
	Above limit	Bit 10 of *06.17 Drive status word 2* (see page *219*).	12
	Warning	Bit 7 of *06.11 Main status word* (see page *217*).	13
	Fault	Bit 3 of *06.11 Main status word* (see page *217*).	14
	Fault (-1)	Inverted bit 3 of *06.11 Main status word* (see page *217*).	15
	Open brake command	Do not use this selection. **Note:** The default value of this parameter is *44.210 Crane brake status*, bit 0. The default value must not be changed.	22
	Ext2 active	Bit 11 of *06.16 Drive status word 1* (see page *218*).	23
	Remote control	Bit 9 of *06.11 Main status word* (see page *217*).	24
	Supervision 1	Bit 0 of *32.01 Supervision status* (see page *358*).	33
	Supervision 2	Bit 1 of *32.01 Supervision status* (see page *358*).	34
	Supervision 3	Bit 2 of *32.01 Supervision status* (see page *358*).	35
	RO/DIO control word bit0	Bit 0 of *10.99 RO/DIO control word* (see page *241*).	40
	RO/DIO control word bit1	Bit 1 of *10.99 RO/DIO control word* (see page *241*).	41
	RO/DIO control word bit2	Bit 2 of *10.99 RO/DIO control word* (see page *241*).	42
	RO/DIO control word bit8	Bit 8 of *10.99 RO/DIO control word* (see page *241*).	43
	RO/DIO control word bit9	Bit 9 of *10.99 RO/DIO control word* (see page *241*).	44
	Other [bit]	A specific bit in another parameter.	-
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*

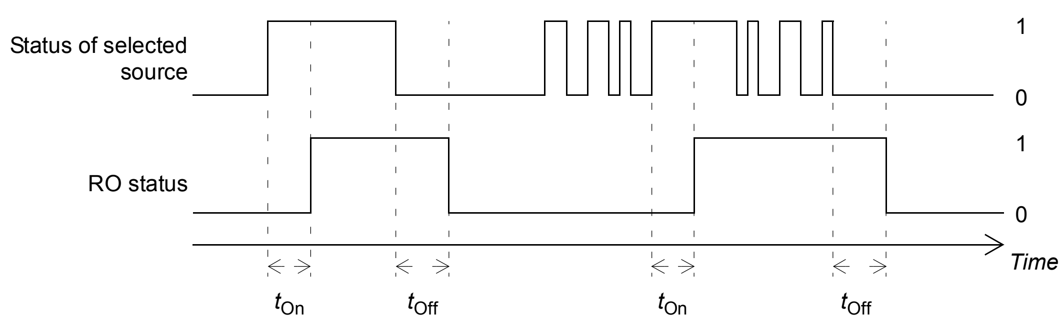
No.	Name/Value	Description	Def/FbEq16
	0.0 … 3000.0 s	Activation delay for RO1.	10 = 1 s

No.	Name/Value	Description	Def/FbEq16
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*. By default this source is parameter *32.227*, b1 Watchdog relay control.	*32.227*, b1
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*

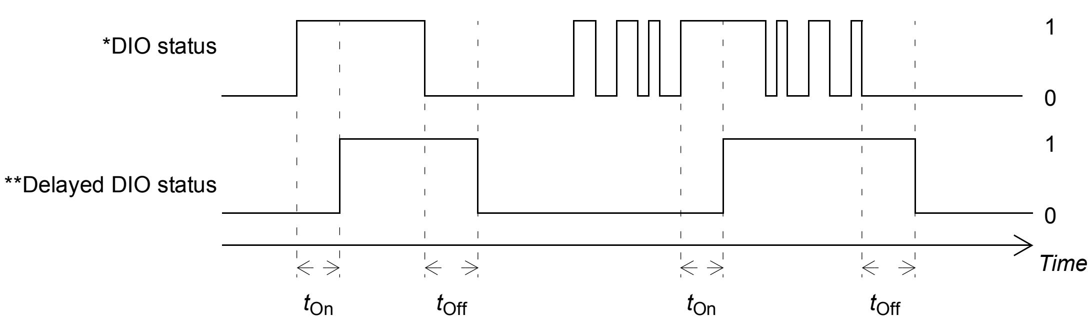
No.	Name/Value	Description	Def/FbEq16
	0.0 … 3000.0 s	Activation delay for RO3.	10 = 1 s
10.32	*RO3 OFF delay*	Defines the deactivation delay for relay output RO3. See parameter *10.31 RO3 ON delay*.	0.0 s
	0.0 … 3000.0 s	Deactivation delay for RO3.	10 = 1 s
10.51	*DI filter time*	Defines a filtering time for parameter *10.01 DI status*.	10.0 ms
	0.3 … 100.0 ms	Filtering time for *10.01*.	10 = 1 ms

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
	0000h…FFFFh	RO/DIO control word.	1 = 1
11 Standard DIO, FI, FO		Configuration of digital input/outputs and frequency inputs/outputs.	
11.01	*DIO status*	Displays the status of digital input/outputs DIO2 and DIO1. The activation/deactivation delays (if any are specified) are ignored. A filtering time (for input mode) can be defined by parameter *10.51 DI filter time*. **Example:** 0010 = DIO2 is on and DIO1 is off. This parameter is read-only.	-
	0000b…0011b	Status of digital input/outputs.	1 = 1
11.02	*DIO delayed status*	Displays the delayed status of digital input/outputs DIO2 and DIO1. This word is updated only after activation/deactivation delays (if any are specified). **Example:** 0010 = DIO2 is on and DIO1 is off. This parameter is read-only.	-
	0000b…0011b	Delayed status of digital input/outputs.	1 = 1
11.05	*DIO1 function*	Selects whether DIO1 is used as a digital output or input, or a frequency input.	*Output*
	Output	DIO1 is used as a digital output.	0
	Input	DIO1 is used as a digital input.	1
	Frequency	DIO1 is used as a frequency input.	2
11.06	*DIO1 output source*	Selects a drive signal to be connected to digital input/output DIO1 when parameter *11.05 DIO1 function* is set to *Output*.	*44.210*, b0
	Not energized	Output is off.	0
	Energized	Output is on.	1
	Ready run	Bit 1 of *06.11 Main status word* (see page *217*).	2
	Enabled	Bit 0 of *06.16 Drive status word 1* (see page *218*).	4
	Started	Bit 5 of *06.16 Drive status word 1* (see page *218*).	5

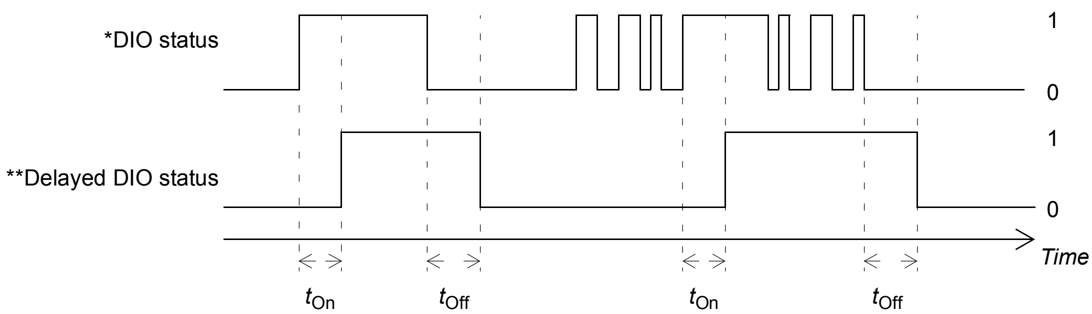
No.	Name/Value	Description	Def/FbEq16
	Magnetized	Bit 1 of *06.17 Drive status word 2* (see page *219*).	6
	Running	Bit 6 of *06.16 Drive status word 1* (see page *218*).	7
	Ready ref	Bit 2 of *06.11 Main status word* (see page *217*).	8
	At setpoint	Bit 8 of *06.11 Main status word* (see page *217*).	9
	Reverse	Bit 2 of *06.19 Speed control status word* (see page *221*).	10
	Zero speed	Bit 0 of *06.19 Speed control status word* (see page *221*).	11
	Above limit	Bit 10 of *06.17 Drive status word 2* (see page *219*).	12
	Warning	Bit 7 of *06.11 Main status word* (see page *217*).	13
	Fault	Bit 3 of *06.11 Main status word* (see page *217*).	14
	Fault (-1)	Inverted bit 3 of *06.11 Main status word* (see page *217*).	15
	Open brake command	Do not use this selection. **Note**: The default value for this parameter is *44.210 Crane brake status*, bit 0.	22
	Ext2 active	Bit 11 of *06.16 Drive status word 1* (see page *218*).	23
	Remote control	Bit 9 of *06.11 Main status word* (see page *217*).	24
	Supervision 1	Bit 0 of *32.01 Supervision status* (see page *358*).	33
	Supervision 2	Bit 1 of *32.01 Supervision status* (see page *358*).	34
	Supervision 3	Bit 2 of *32.01 Supervision status* (see page *358*).	35
	RO/DIO control word bit0	Bit 0 of *10.99 RO/DIO control word* (see page *241*).	40
	RO/DIO control word bit1	Bit 1 of *10.99 RO/DIO control word* (see page *241*).	41
	RO/DIO control word bit2	Bit 2 of *10.99 RO/DIO control word* (see page *241*).	42
	RO/DIO control word bit8	Bit 8 of *10.99 RO/DIO control word* (see page *241*).	43
	RO/DIO control bit9	Bit 9 of *10.99 RO/DIO control word* (see page *241*).	44
	Other [bit]	Source selection (see *Terms and abbreviations* on page *199*).	-
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*.

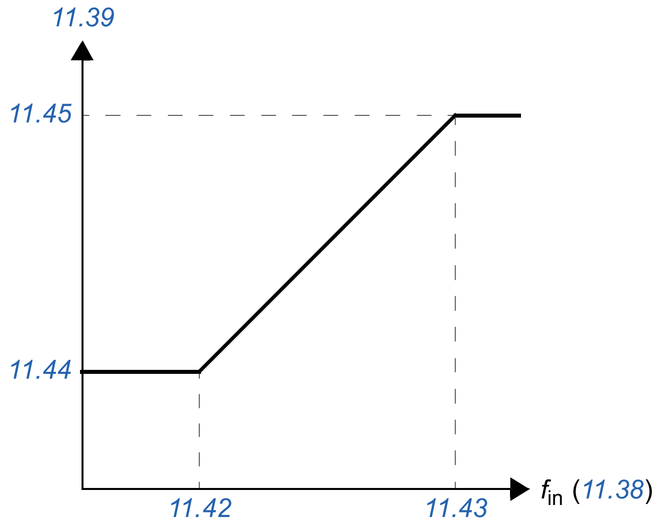
	0.0 … 3000.0 s	Activation delay for DIO1.	10 = 1 s

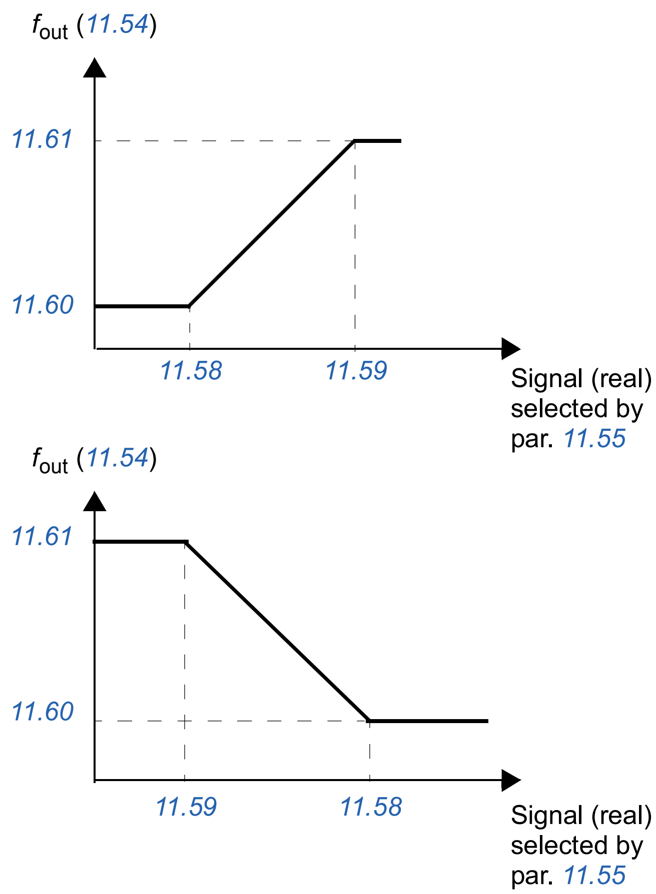
No.	Name/Value	Description	Def/FbEq16
11.08	*DIO1 OFF delay*	Defines the deactivation delay for digital input/output DIO1 (when used as a digital output or digital input). See parameter *11.07 DIO1 ON delay*.	0.0 s
	0.0 … 3000.0 s	Deactivation delay for DIO1.	10 = 1 s
11.09	*DIO2 function*	Selects whether DIO2 is used as a digital output or input, or a frequency output.	*Output*
	Output	DIO2 is used as a digital output.	0
	Input	DIO2 is used as a digital input.	1
	Frequency	DIO2 is used as a frequency output.	2
11.10	*DIO2 output source*	Selects a drive signal to be connected to digital input/output DIO2 when parameter *11.09 DIO2 function* is set to *Output*. For the available selections, see parameter *11.06 DIO1 output source*.	*Running*
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*.

No.	Name/Value	Description	Def/FbEq16
	0.0 … 3000.0 s	Activation delay for DIO2.	10 = 1 s
11.12	*DIO2 OFF delay*	Defines the deactivation delay for digital input/output DIO2 (when used as a digital output or digital input). See parameter *11.11 DIO2 ON delay*.	0.0 s
	0.0 … 3000.0 s	Deactivation delay for DIO2.	10 = 1 s
11.38	*Freq in 1 actual value*	Displays the value of frequency input 1 (via DIO1 when it is used as a frequency input) before scaling. See parameter *11.42 Freq in 1 min*. This parameter is read-only.	-
	0 … 16000 Hz	Unscaled value of frequency input 1.	1 = 1 Hz
11.39	*Freq in 1 scaled*	Displays the value of frequency input 1 (via DIO1 when it is used as a frequency input) after scaling. See parameter *11.42 Freq in 1 min*. This parameter is read-only.	-
	-32768.000 … 32767.000	Scaled value of frequency input 1.	1 = 1

No.	Name/Value	Description	Def/FbEq16
11.42	*Freq in 1 min*	Defines the minimum input frequency for 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 input frequency for 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 corresponds to the minimum input frequency defined by parameter *11.42 Freq in 1 min*. See diagram at parameter *11.42 Freq in 1 min*.	0.000
	-32768.000 … 32767.000	Value corresponding to minimum of frequency input 1.	1 = 1
11.45	*Freq in 1 at scaled max*	Defines the value that is required to correspond internally to the maximum input frequency defined by parameter *11.43 Freq in 1 max*. See diagram at parameter *11.42 Freq in 1 min*.	1500.000; 1800.000 (*95.20* b0)
	-32768.000 … 32767.000	Value corresponding to maximum of frequency input 1.	1 = 1
11.54	*Freq out 1 actual value*	Displays the value of frequency output 1 after scaling. See parameter *11.58 Freq out 1 src min*. This parameter is read-only.	-
	0 … 16000 Hz	Value of frequency output 1.	1 = 1
11.55	*Freq out 1 source*	Selects a signal to be connected to frequency output 1.	*Motor speed used*
	Zero	None.	0
	Motor speed used	*01.01 Motor speed used* (page *204*).	1
	Output frequency	*01.06 Output frequency* (page *204*).	3
	Motor current	*01.07 Motor current* (page *204*).	4
	Motor torque	*01.10 Motor torque* (page *204*).	6
	DC voltage	*01.11 DC voltage* (page *204*).	7
	Power inu out	*01.14 Output power* (page *205*).	8

No.	Name/Value	Description	Def/FbEq16
	Speed ref ramp in	*23.01 Speed ref ramp input* (page *314*).	10
	Speed ref ramped	*23.02 Speed ref ramp output* (page *314*).	11
	Speed ref used	*24.01 Used speed reference* (page *320*).	12
	Torq ref used	*26.02 Torque reference used* (page *332*).	13
	Freq ref used	Not in use.	14
	Process PID out	Not in use.	16
	Process PID fbk	Not in use.	17
	Process PID act	Not in use.	18
	Process PID dev	Not in use.	19
	Other	Source selection (see *Terms and abbreviations* on page *199*).	-
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

No.	Name/Value	Description	Def/FbEq16
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*. 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

12 Standard AI		Configuration of standard analog inputs.	
12.01	*AI tune*	Triggers the analog input tuning function. Connect the signal to the input and select the appropriate tuning function.	
	No action	AI tune is not activated.	0
	AI1 min tune	Current analog input AI1 signal value is set as minimum value of AI1 into parameter *12.17 AI1 min*. The value reverts back to *No action* automatically.	1
	AI1 max tune	Current analog input AI1 signal value is set as maximum value of AI1 into parameter *12.18 AI1 max*. The value reverts back to *No action* automatically.	2
	AI2 min tune	Current analog input AI2 signal value is set as minimum value of AI2 into parameter *12.27 AI2 min*. The value reverts back to *No action* automatically.	3
	AI2 max tune	Current analog input AI2 signal value is set as maximum value of AI2 into parameter *12.28 AI2 max*. The value reverts back to *No action* automatically.	4
12.03	*AI supervision function*	Selects how the drive reacts when an analog input signal moves out of the minimum and/or maximum limits specified for the input. The inputs and the limits to be observed are selected by parameter *12.04 AI supervision selection*. **Note:** Analog input signal supervision is only active when • the analog input is set as the source (using the *AI1 scaled* or *AI2 scaled* selection) in parameter *22.11*, *22.12*, *22.15*, *22.17*, *23.42*, *26.11*, *26.12*, *26.16*, *26.25*, *28.11*, *28.12, 30.21*, *30.22*, 40.16, 40.17, 40.50, 41.16, 41.17, 41.50 or *44.09*, and • being used as the active source.	*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

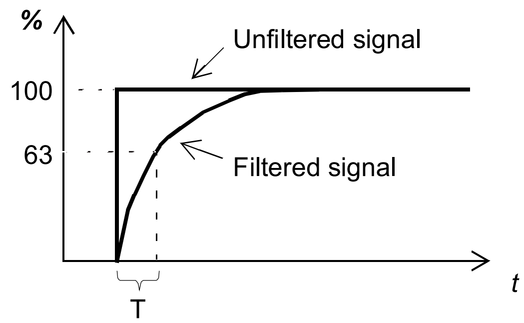
No.	Name/Value	Description	Def/FbEq16
	Last speed	Drive generates a warning (*A8A0 AI supervision*) and freezes the speed (or frequency) to the level the drive was operating at. The speed/frequency is determined on the basis of actual speed using 850 ms low-pass filtering. **WARNING!** Make sure that 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 *22.41 Speed ref safe*. **WARNING!** Make sure that it is safe to continue operation in case of a communication break.	4
12.04	*AI supervision selection*	Specifies the analog input limits to be supervised. See parameter *12.03 AI supervision function*.	0000b

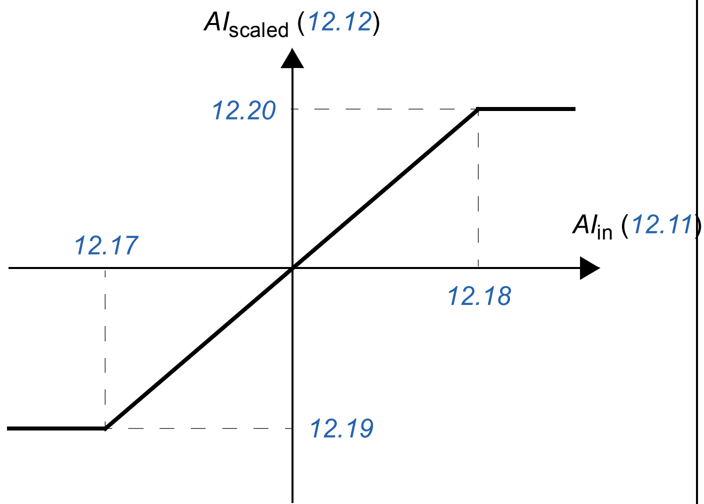
Bit	Name	Description
0	AI1 < MIN	1 = Minimum limit supervision of AI1 active.
1	AI1 > MAX	1 = Maximum limit supervision of AI1 active.
2	AI2 < MIN	1 = Minimum limit supervision of AI2 active.
3	AI2 > MAX	1 = Maximum limit supervision of AI2 active.
4…15	Reserved	

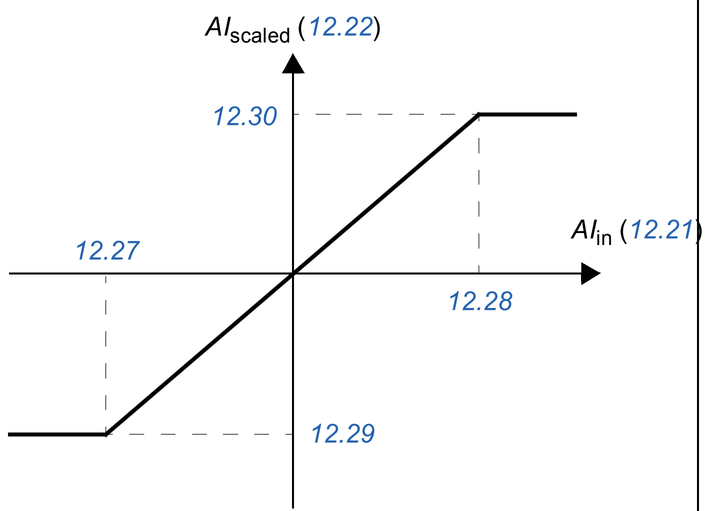
No.	Name/Value	Description	Def/FbEq16
	0000b…1111b	Activation of analog input supervision.	1 = 1
12.05	*AI supervision force*	Forces AI supervision to a control location.	0000b

Bit	Name	Description
0	AI1 Ext 1	1 = Force AI1 supervision to ext 1.
1	AI1 Ext 2	1 = Force AI1 supervision to ext 2.
2	AI1 Local	1 = Force AI1 supervision to local.
3	Reserved	
4	AI2 Ext 1	1 = Force AI2 supervision to ext 1.
5	AI2 Ext 2	1 = Force AI2 supervision to ext 2.
6	AI2 Local	1 = Force AI2 supervision to local.
7…15	Reserved	

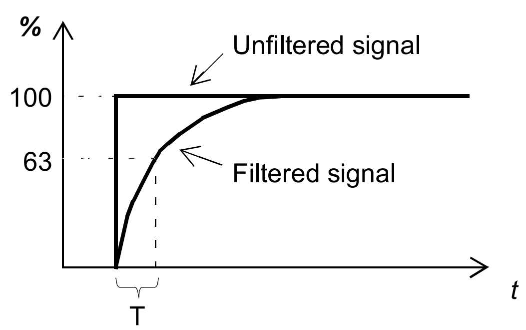
No.	Name/Value	Description	Def/FbEq16
	0000b…1111b	Activation of analog input supervision.	1 = 1
12.11	*AI1 actual value*	Displays the value of analog input AI1 in mA or V (depending on whether the input is set to current or voltage by a hardware setting). This parameter is read-only.	-
	-22.000 … 22.000 mA or V	Value of analog input AI1.	1000 = 1 mA or V
12.12	*AI1 scaled value*	Displays the value of analog input AI1 after scaling. See parameters *12.19 AI1 scaled at AI1 min* and *12.20 AI1 scaled at AI1 max*. This parameter is read-only.	-
	-32768.000 … 32767.000	Scaled value of analog input AI1.	1 = 1

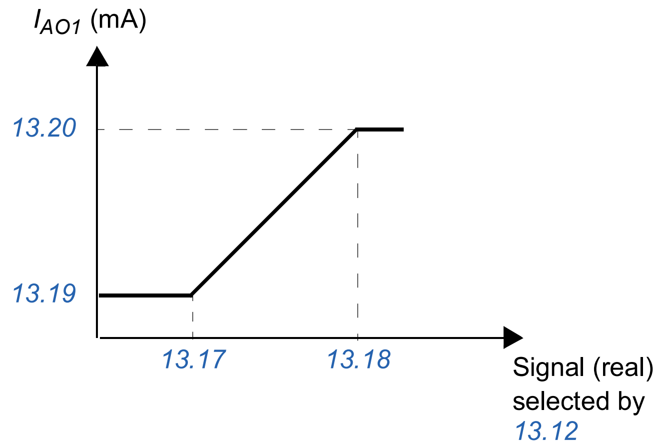
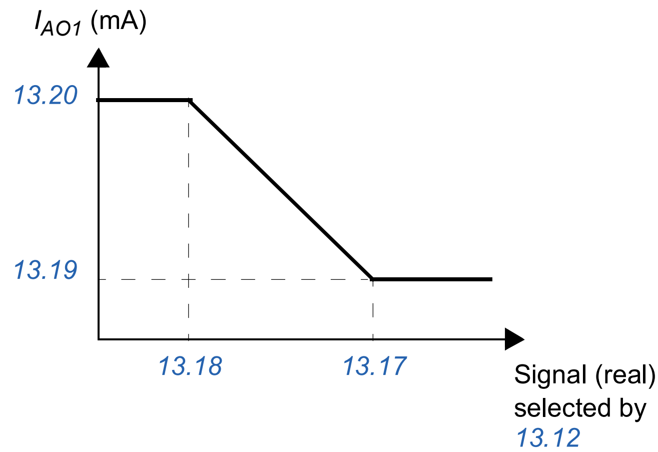
No.	Name/Value	Description	Def/FbEq16
12.15	*AI1 unit selection*	Selects the unit for readings and settings related to analog input AI1. **Note:** This setting must match the corresponding hardware setting on the drive control unit (see the hardware manual of the drive). Control board reboot (either 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 also parameter *12.01 AI tune*.	0.000 mA or V
	-22.000 … 22.000 mA or V	Minimum value of AI1.	1000 = 1 mA or V
12.18	*AI1 max*	Defines the maximum site value for analog input AI1. Set the value actually sent to the drive when the analog signal from plant is wound to its maximum setting. See also parameter *12.01 AI tune*.	20.000 mA or 10.000 V
	-22.000 … 22.000 mA or V	Maximum value of AI1.	1000 = 1 mA or V

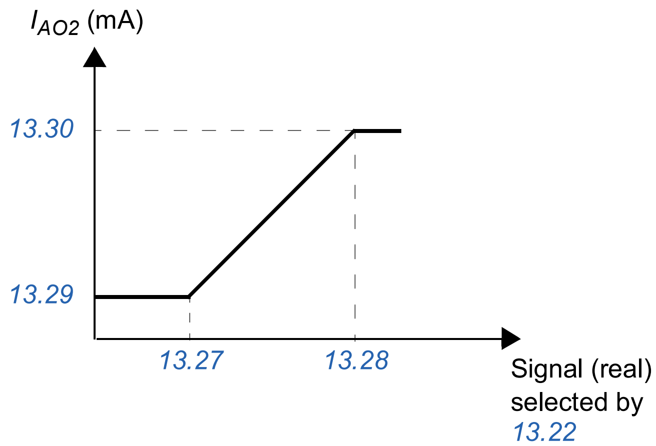
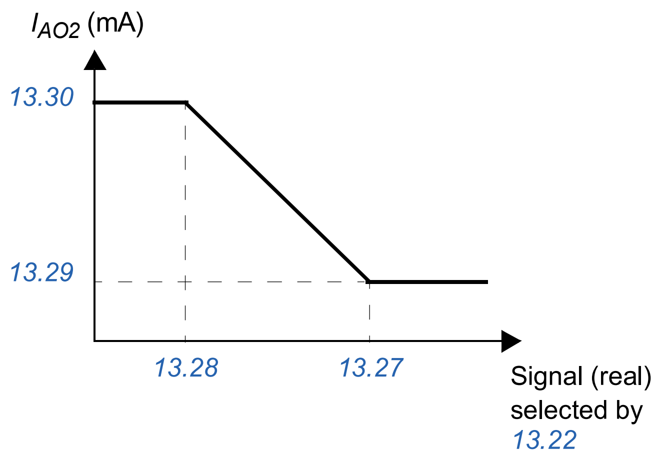
No.	Name/Value	Description	Def/FbEq16
12.19	*AI1 scaled at AI1 min*	Defines the real internal value that corresponds to the minimum analog input AI1 value defined by parameter *12.17 AI1 min*. (Changing the polarity settings of *12.19* and *12.20* can effectively invert the analog input.)  	-1500.000
	-32768.000 … 32767.000	Real value corresponding to minimum AI1 value.	1 = 1
12.20	*AI1 scaled at AI1 max*	Defines the real internal value that corresponds to the maximum analog input AI1 value defined by parameter *12.18 AI1 max*. See the drawing at parameter *12.19 AI1 scaled at AI1 min*.	1500.000; 1800.000 (*95.20* b0)
	-32768.000 … 32767.000	Real value corresponding to maximum AI1 value.	1 = 1
12.21	*AI2 actual value*	Displays the value of analog input AI2 in mA or V (depending on whether the input is set to current or voltage by a hardware setting). This parameter is read-only.	-
	-22.000 … 22.000 mA or V	Value of analog input AI2.	1000 = 1 mA or V
12.22	*AI2 scaled value*	Displays the value of analog input AI2 after scaling. See parameters *12.29 AI2 scaled at AI2 min* and *12.30 AI2 scaled at AI2 max*. This parameter is read-only.	-
	-32768.000 … 32767.000	Scaled value of analog input AI2.	1 = 1
12.25	*AI2 unit selection*	Selects the unit for readings and settings related to analog input AI2. **Note:** This setting must match the corresponding jumper 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 jumper 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 also parameter *12.01 AI tune*.	0.000 mA or V
	-22.000 … 22.000 mA or V	Minimum value of AI2.	1000 = 1 mA or V
12.28	*AI2 max*	Defines the maximum site value for analog input AI2. Set the value actually sent to the drive when the analog signal from plant is wound to its maximum setting. See also parameter *12.01 AI tune*.	20.000 mA or 10.000 V
	-22.000 … 22.000 mA or V	Maximum value of AI2.	1000 = 1 mA or V
12.29	*AI2 scaled at AI2 min*	Defines the real value that corresponds to the minimum analog input AI2 value defined by parameter *12.27 AI2 min*. (Changing the polarity settings of *12.29* and *12.30* can effectively invert the analog input.) 	0.000
	-32768.000 … 32767.000	Real value corresponding to minimum AI2 value.	1 = 1
12.30	*AI2 scaled at AI2 max*	Defines the real value that corresponds to the maximum analog input AI2 value defined by parameter *12.28 AI2 max*. See the drawing at parameter *12.29 AI2 scaled at AI2 min*.	100.000
	-32768.000 … 32767.000	Real value corresponding to maximum AI2 value.	1 = 1

13 Standard AO		Configuration of standard analog outputs.	
13.11	*AO1 actual value*	Displays the value of AO1 in mA. This parameter is read-only.	-
	0.000 … 22.000 mA	Value of AO1.	1000 = 1 mA
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 *204*).	1
	Output frequency	*01.06 Output frequency* (page *204*).	3

No.	Name/Value	Description	Def/FbEq16
	Motor current	*01.07 Motor current* (page *204*).	4
	Motor torque	*01.10 Motor torque* (page *204*).	6
	DC voltage	*01.11 DC voltage* (page *204*).	7
	Power inu out	*01.14 Output power* (page *205*).	8
	Speed ref ramp in	*23.01 Speed ref ramp input* (page *314*).	10
	Speed ref ramp out	*23.02 Speed ref ramp output* (page *314*).	11
	Speed ref used	*24.01 Used speed reference* (page *320*).	12
	Torq ref used	*26.02 Torque reference used* (page *332*).	13
	Freq ref used	Not used	14
	Process PID out	Not used.	16
	Process PID fbk	Not used	17
	Process PID act	Not used	18
	Process PID dev	Not used	19
	Force PT100 excitation	The output is used to feed an excitation current to 1…3 Pt100 sensors. See section *Motor thermal protection* (page *182*).	20
	Force KTY84 excitation	The output is used to feed an excitation current to a KTY84 sensor. See section *Motor thermal protection* (page *182*).	21
	Force PTC excitation	The output is used to feed an excitation current to 1…3 PTC sensors. See section *Motor thermal protection* (page *182*).	22
	Force Pt1000 excitation	The output is used to feed an excitation current to 1…3 Pt1000 sensors. See section *Motor thermal protection* (page *182*).	23
	AO1 data storage	*13.91 AO1 data storage* (page *254*).	37
	AO2 data storage	*13.92 AO2 data storage* (page *254*).	38
	Other	The value is taken from another parameter.	-
13.16	*AO1 filter time*	Defines the filtering time constant for analog output AO1.  $O = I \times (1 - e^{-t/T})$ I = filter input (step) O = filter output *t* = time T = filter time constant	0.100 s
	0.000 … 30.000 s	Filter time constant.	1000 = 1 s

No.	Name/Value	Description	Def/FbEq16
13.17	*AO1 source min*	Defines the real minimum value of the signal (selected by parameter *13.12 AO1 source*) that corresponds to the minimum required AO1 output value (defined by parameter *13.19 AO1 out at AO1 src min*).  Programming *13.17* as the maximum value and *13.18* as the minimum value inverts the output. 	0.0
	-32768.0 … 32767.0	Real signal value corresponding to minimum AO1 output value.	1 = 1
13.18	*AO1 source max*	Defines the real maximum value of the signal (selected by parameter *13.12 AO1 source*) that corresponds to the maximum required AO1 output value (defined by parameter *13.20 AO1 out at AO1 src max*). See parameter *13.17 AO1 source min*.	1500.0; 1800.0 (*95.20* b0)
	-32768.0 … 32767.0	Real signal value corresponding to maximum AO1 output value.	1 = 1
13.19	*AO1 out at AO1 src min*	Defines the minimum output value for analog output AO1. See also drawing at parameter *13.17 AO1 source min*.	0.000 mA
	0.000 … 22.000 mA	Minimum AO1 output value.	1000 = 1 mA
13.20	*AO1 out at AO1 src max*	Defines the maximum output value for analog output AO1. See also drawing at parameter *13.17 AO1 source min*.	20.000 mA
	0.000 … 22.000 mA	Maximum AO1 output value.	1000 = 1 mA

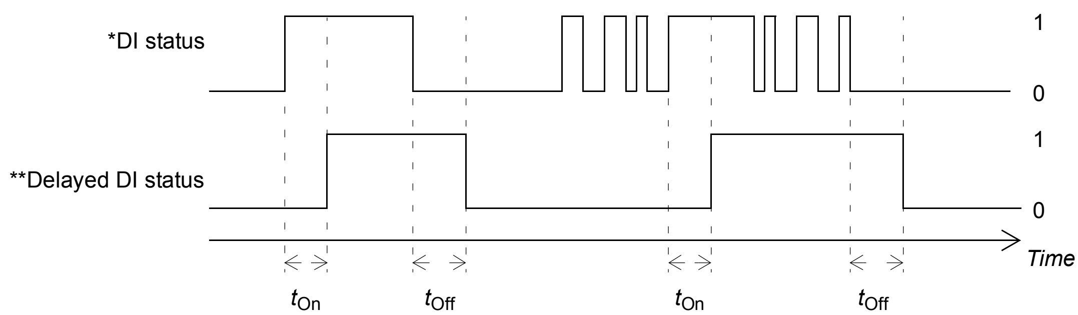
No.	Name/Value	Description	Def/FbEq16
13.21	*AO2 actual value*	Displays the value of AO2 in mA. This parameter is read-only.	-
	0.000 … 22.000 mA	Value of AO2.	1000 = 1 mA
13.22	*AO2 source*	Selects a signal to be connected to analog output AO2. Alternatively, sets the output to excitation mode to feed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

No.	Name/Value	Description	Def/FbEq16
13.28	*AO2 source max*	Defines the real maximum value of the signal (selected by parameter *13.22 AO2 source*) that corresponds to the maximum required AO2 output value (defined by parameter *13.30 AO2 out at AO2 src max*). See parameter *13.27 AO2 source min*.	100.0
	-32768.0 … 32767.0	Real signal value corresponding to maximum AO2 output value.	1 = 1
13.29	*AO2 out at AO2 src min*	Defines the minimum output value for analog output AO2. See also drawing at parameter *13.27 AO2 source min*.	0.000 mA
	0.000 … 22.000 mA	Minimum AO2 output value.	1000 = 1 mA
13.30	*AO2 out at AO2 src max*	Defines the maximum output value for analog output AO2. See also drawing at parameter *13.27 AO2 source min*.	20.000 mA
	0.000 … 22.000 mA	Maximum AO2 output value.	1000 = 1 mA
13.91	*AO1 data storage*	Storage parameter for controlling analog output AO1 eg. through fieldbus. In *13.12 AO1 source*, select *AO1 data storage*. Then set this parameter as the target of the incoming value data. With the embedded fieldbus interface, simply set the target selection parameter of that particular data (*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 *143*). **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 a FEA-0x extension adapter.	*Slot 1*
	Slot 1	Slot 1.	1
	Slot 2	Slot 2.	2
	Slot 3	Slot 3.	3
	4…254	Node ID of the slot on the FEA-0x extension adapter.	1 = 1

No.	Name/Value	Description	Def/FbEq16
14.03	*Module 1 status*	Displays the status of I/O extension module 1.	*No option*
	No option	No module detected in the specified slot.	0
	No communication	A module has been detected but cannot be communicated with.	1
	Unknown	The module type is unknown.	2
	FIO-01	An FIO-01 module has been detected and is active.	15
	FIO-11	An FIO-11 module has been detected and is active.	20
	FAIO-01	An FAIO-01 module has been detected and is active.	24
14.05	*DI status*	*(Visible when 14.01 Module 1 type = FDIO-01)* Displays the status of the digital inputs/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 DI filter time*. Bit 0 indicates the status of DI1. **Note:** The number of active bits in this parameter depends on the number of digital input/outputs on the extension module. **Example:** 0101b = DI1 and DI3 are on, remainder are off. This parameter is read-only.	-
	00000000h… FFFFFFFFh	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:** 1001b = DIO1 and DIO4 are on, remainder are off. This parameter is read-only.	-
	00000000h… FFFFFFFFh	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.	-
	00000000h… FFFFFFFFh	Delayed status of digital inputs.	1 = 1

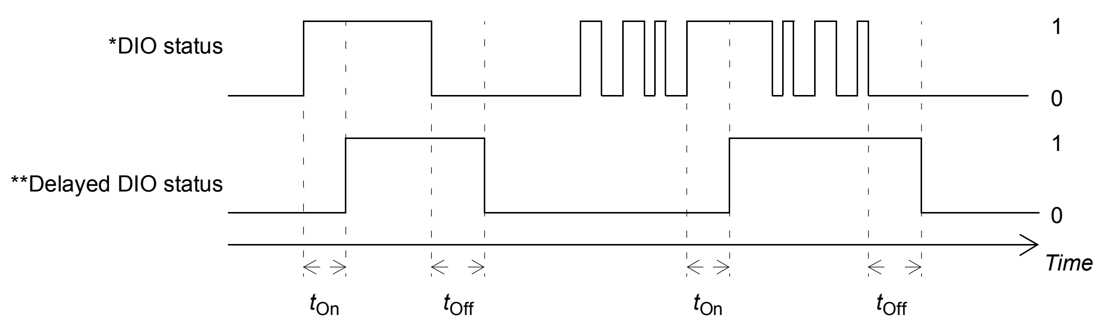
No.	Name/Value	Description	Def/FbEq16
14.06	*DIO delayed status*	*(Visible when 14.01 Module 1 type = FIO-01 or FIO-11)* Displays the delayed status of the digital input/outputs on the extension module. This word is updated only after activation/deactivation delays (if any are specified). Bit 0 indicates 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:** 1001b = DIO1 and DIO4 are on, remainder are off. This parameter is read-only.	-
	00000000h… FFFFFFFFh	Delayed status of digital input/outputs.	1 = 1
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 *217*).	2
	Enabled	Bit 0 of *06.16 Drive status word 1* (see page *218*).	4
	Started	Bit 5 of *06.16 Drive status word 1* (see page *218*).	5
	Magnetized	Bit 1 of *06.17 Drive status word 2* (see page *219*).	6
	Running	Bit 6 of *06.16 Drive status word 1* (see page *218*).	7
	Ready ref	Bit 2 of *06.11 Main status word* (see page *217*).	8
	At setpoint	Bit 8 of *06.11 Main status word* (see page *217*).	9
	Reverse	Bit 2 of *06.19 Speed control status word* (see page *221*).	10
	Zero speed	Bit 0 of *06.19 Speed control status word* (see page *221*).	11
	Above limit	Bit 10 of *06.17 Drive status word 2* (see page *219*).	12
	Warning	Bit 7 of *06.11 Main status word* (see page *217*).	13
	Fault	Bit 3 of *06.11 Main status word* (see page *217*).	14
	Fault (-1)	Inverted bit 3 of *06.11 Main status word* (see page *217*).	15
	Open brake command	Do not use this selection.	22
	Ext2 active	Bit 11 of *06.16 Drive status word 1* (see page *218*).	23

No.	Name/Value	Description	Def/FbEq16
	Remote control	Bit 9 of *06.11 Main status word* (see page *217*).	24
	Supervision 1	Bit 0 of *32.01 Supervision status* (see page *358*).	33
	Supervision 2	Bit 1 of *32.01 Supervision status* (see page *358*).	34
	Supervision 3	Bit 2 of *32.01 Supervision status* (see page *358*).	35
	RO/DIO control word bit0	Bit 0 of *10.99 RO/DIO control word* (see page *241*).	40
	RO/DIO control word bit1	Bit 1 of *10.99 RO/DIO control word* (see page *241*).	41
	RO/DIO control word bit2	Bit 2 of *10.99 RO/DIO control word* (see page *241*).	42
	RO/DIO control word bit8	Bit 8 of *10.99 RO/DIO control word* (see page *241*).	43
	RO/DIO control word bit9	Bit 9 of *10.99 RO/DIO control word* (see page *241*).	44
	Other [bit]	Source selection (see *Terms and abbreviations* on page *199*).	-
14.12	*DI1 ON delay*	*(Visible when 14.01 Module 1 type = FDIO-01)* Defines the activation delay for digital input/output DI1.	0.00 s



t_{On} = *14.12 DI1 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 DI status*.
**Indicated by *14.06 DI delayed status*.

No.	Name/Value	Description	Def/FbEq16
	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*.

No.	Name/Value	Description	Def/FbEq16
	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/output DI1. See parameter *14.12 DI1 ON delay*.	0.00 s
	0.00 … 3000.00 s	Deactivation delay for DI1.	10 = 1 s
14.13	*DIO1 OFF delay*	*(Visible when 14.01 Module 1 type = FIO-01 or FIO-11)* Defines the deactivation delay for digital input/output DIO1. See parameter *14.12 DIO1 ON delay*.	0.00 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 *Input*. 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 DIO1 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/output DIO2. 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

No.	Name/Value	Description	Def/FbEq16
	Warning	Drive generates an *A8A0 AI supervision* warning.	2
	Last speed	Drive generates a warning (*A8A0 AI supervision*) and freezes the speed (or frequency) to the level the drive was operating at. The speed/frequency is determined on the basis of actual speed using 850 ms low-pass filtering. **WARNING!** Make sure that it is safe to continue operation in case of a communication break.	3
	Speed ref safe	Drive generates a warning (*A8A0 AI supervision*) and sets the speed to the speed defined by parameter *22.41 Speed ref safe*. **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.	0000 0000b

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

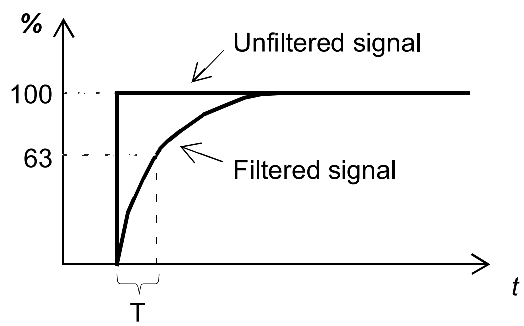
No.	Name/Value	Description	Def/FbEq16
	0000 0000b … 0011 1111b	Activation of analog input supervision.	1 = 1
14.21	*DIO3 output source*	*(Visible when 14.01 Module 1 type = FIO-01)* Selects a drive signal to be connected to digital input/output DIO3 when parameter *14.19 DIO3 function* is set to *Input*. 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

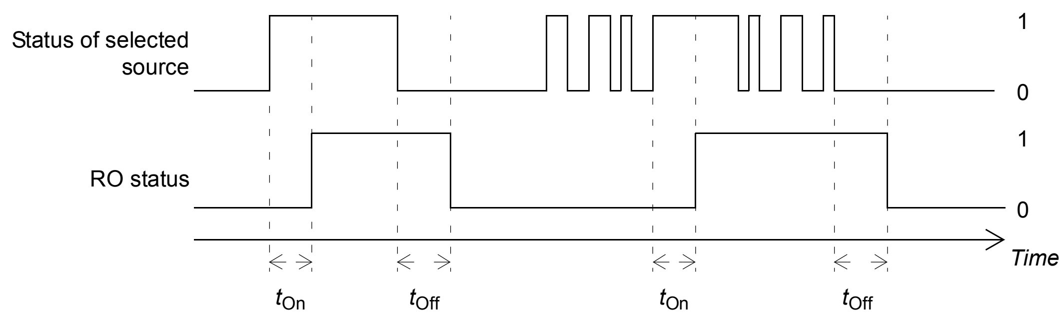
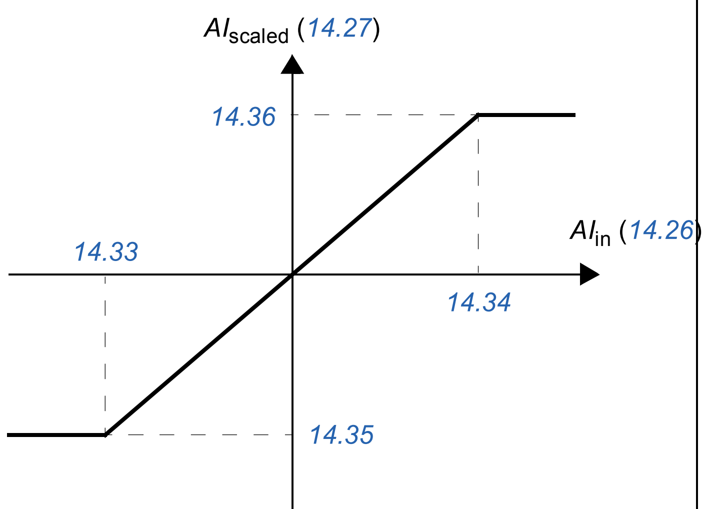
No.	Name/Value	Description	Def/FbEq16
	AI2 max tune	The measured value of AI2 is set as the maximum value of AI2 into parameter *14.49 AI2 max*.	4
	AI3 min tune	*(Visible when 14.01 Module 1 type = FIO-11)* The measured value of AI3 is set as the minimum value of AI3 into parameter *14.63 AI3 min*.	5
	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/output DIO3. 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 or FIO-11)* Defines the activation delay for digital input/output DIO3. See parameter *14.12 DIO1 ON delay*.	0.00 s
	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.	0000b

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

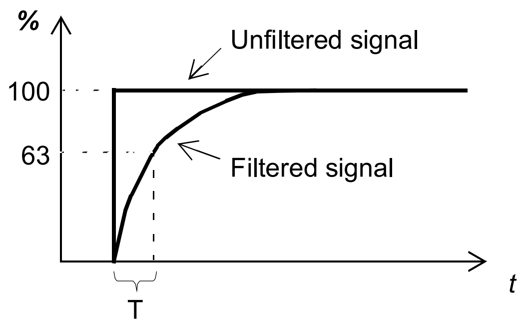
	0000b…0111b	Forced values selector for analog inputs.	1 = 1
14.23	*DI3 OFF delay*	*(Visible when 14.01 Module 1 type = FDIO-01)* Defines the deactivation delay for digital input/output DI3. See parameter *14.12 DI1 ON delay*.	0.00 s
	0.00 … 3000.00 s	Deactivation delay for DI3.	10 = 1 s
14.23	*DIO3 OFF delay*	*(Visible when 14.01 Module 1 type = FIO-01)* Defines the deactivation delay for digital input/output DIO3. See parameter *14.12 DIO1 ON delay*.	0.00 s
	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*

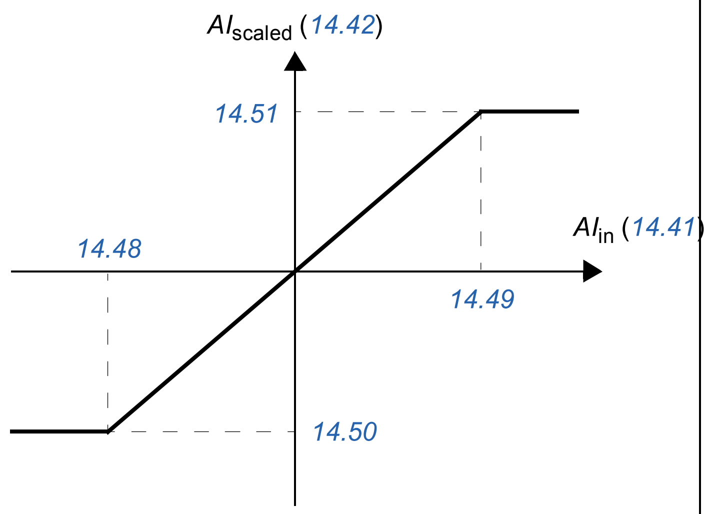
No.	Name/Value	Description	Def/FbEq16
14.26	*AI1 actual value*	*(Visible when 14.01 Module 1 type = FIO-11 or FAIO-01)* Displays the value of analog input AI1 in mA or V (depending on whether the input is set to current or voltage). This parameter is read-only.	-
	-22.000 … 22.000 mA or V	Value of analog input AI1.	1000 = 1 mA or V
14.27	*DIO4 ON delay*	*Visible when 14.01 Module 1 type = FIO-01 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 *14.27 DIO4 ON delay*.	0.0 s
	0.0 … 3000.0 s	Deactivation delay for DIO4.	10 = 1 s
14.28	*AI1 force data*	*(Visible when 14.01 Module 1 type = FIO-11 or FAIO-01)* Forced value that can be used instead of the true reading of the input. See parameter *14.22 AI force selection*.	
	-22.000 … 22.000 mA or V	Forced value of analog input AI1.	1000 = 1 mA or V
14.29	*AI1 HW switch position*	*(Visible when 14.01 Module 1 type = FIO-11 or FAIO-01)* Shows the position of the hardware current/voltage selector on the I/O extension module. **Note:** The setting of the current/voltage selector must match the unit selection made in parameter *14.30 AI1 unit selection*. I/O module reboot either by cycling the power or through parameter *96.08 Control board boot* is required to validate any changes in the hardware settings.	-
	V	Volts.	2
	mA	Milliamperes.	10
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.	*mA*
	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:** 0001b = RO1 is energized, RO2 is de-energized.	-
	0000b…1111b	Status of relay outputs.	1 = 1

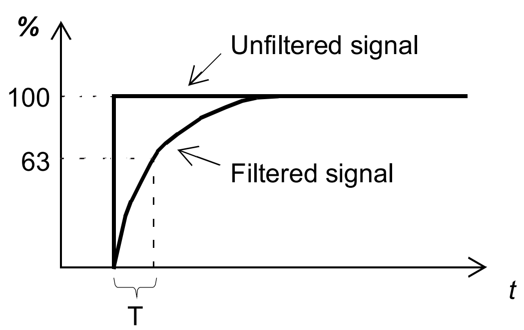
No.	Name/Value	Description	Def/FbEq16
14.31	*AI1 filter gain*	*(Visible when 14.01 Module 1 type = FIO-11 or FAIO-01)* Selects a hardware filtering time for AI1. See also parameter *14.32 AI1 filter time*.	*1 ms*
	No filtering	No filtering.	0
	125 us	125 microseconds.	1
	250 us	250 microseconds.	2
	500 us	500 microseconds.	3
	1 ms	1 millisecond.	4
	2 ms	2 milliseconds.	5
	4 ms	4 milliseconds.	6
	7.9375 ms	7.9375 milliseconds.	7
14.32	*AI1 filter time*	*(Visible when 14.01 Module 1 type = FIO-11 or FAIO-01)* Defines the filter time constant for analog input AI1.  $O = I \times (1 - e^{-t/T})$ I = filter input (step) O = filter output *t* = time T = filter time constant **Note:** The signal is also filtered due to the signal interface hardware. See parameter *14.31 AI1 filter gain*.	0.100 s
	0.000 … 30.000 s	Filter time constant.	1000 = 1 s
14.33	*AI1 min*	*(Visible when 14.01 Module 1 type = FIO-11 or FAIO-01)* Defines the minimum value for analog input AI1. See also parameter *14.21 AI tune*.	0.000 mA or V
	-22.000 … 22.000 mA or V	Minimum value of AI1.	1000 = 1 mA or V
14.34	*RO1 source*	*(Visible when 14.01 Module 1 type = FIO-01 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. See also parameter *14.21 AI tune*.	10.000 mA or V
	-22.000 … 22.000 mA or V	Maximum value of AI1.	1000 = 1 mA or V

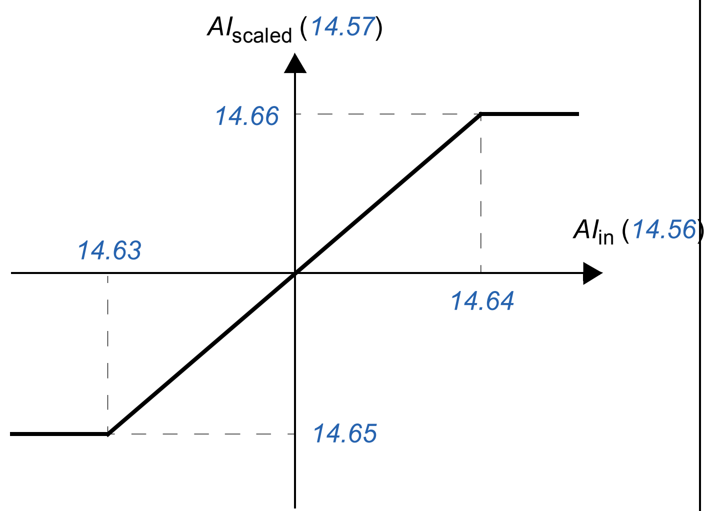
No.	Name/Value	Description	Def/FbEq16
14.35	RO1 ON delay	*(Visible when 14.01 Module 1 type = FIO-01 or FDIO-01)* Defines the activation delay for relay output RO1.	0.00 s
		 t_{On} = 14.35 RO1 ON delay t_{Off} = 14.36 RO1 OFF delay	
	0.00 … 3000.00 s	Activation delay for RO1.	10 = 1 s
14.35	AI1 scaled 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* or *FDIO-01)* Defines the activation delay for relay output RO2. See parameter *14.35 RO1 ON delay.*	0.00 s
	0.00 … 3000.00 s	Activation delay for RO2.	10 = 1 s
14.39	*RO2 OFF delay*	*(Visible when 14.01 Module 1 type = FIO-01* or *FDIO-01)* Defines the deactivation delay for relay output RO2. See parameter *14.35 RO1 ON delay.*	0.00 s
	0.00 … 3000.00 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)* Shows the position of the hardware current/voltage selector on the I/O extension module. **Note:** The setting of the current/voltage selector must match the unit selection made in parameter *14.45 AI2 unit selection*. I/O module reboot either by cycling the power or through parameter *96.08 Control board boot* is required to validate any changes in the hardware settings.	-
	V	Volts.	2
	mA	Milliamperes.	10
14.45	*AI2 unit selection*	*(Visible when 14.01 Module 1 type = FIO-11 or FAIO-01)* Selects the unit for readings and settings related to analog input AI2. **Note:** This setting must match the corresponding hardware setting on the I/O extension module (see the manual of the I/O extension module). The hardware setting is shown by parameter *14.44 AI2 HW switch 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

No.	Name/Value	Description	Def/FbEq16
	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
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

No.	Name/Value	Description	Def/FbEq16
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
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) Shows the position of the hardware current/voltage selector on the I/O extension module. **Note:** The setting of the current/voltage selector must match the unit selection made in parameter 14.60 AI3 unit selection. I/O module reboot either by cycling the power or through parameter 96.08 Control board boot is required to validate any changes in the hardware settings.	-
	V	Volts.	2

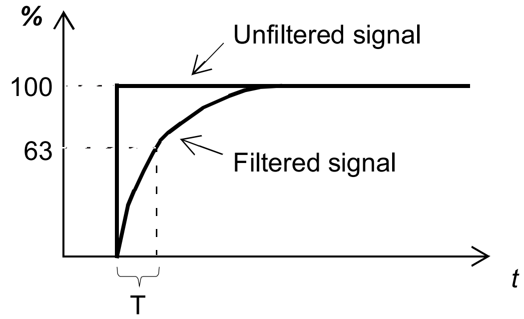
No.	Name/Value	Description	Def/FbEq16
	mA	Milliamperes.	10
14.60	*AI3 unit selection*	*(Visible when 14.01 Module 1 type = FIO-11)* Selects the unit for readings and settings related to analog input AI3. **Note:** This setting must match the corresponding hardware setting on the I/O extension module (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*.	*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
14.62	*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

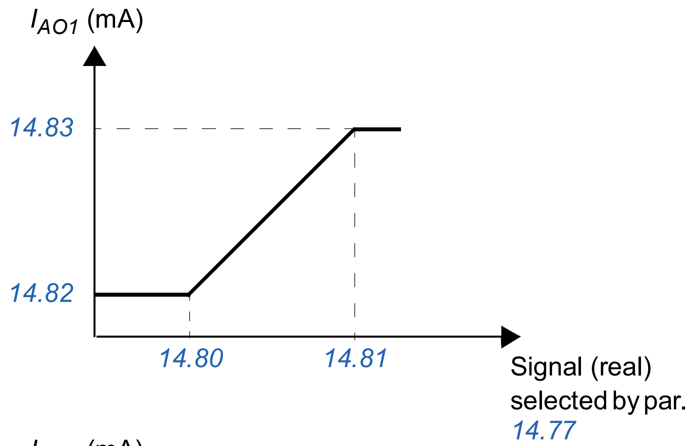
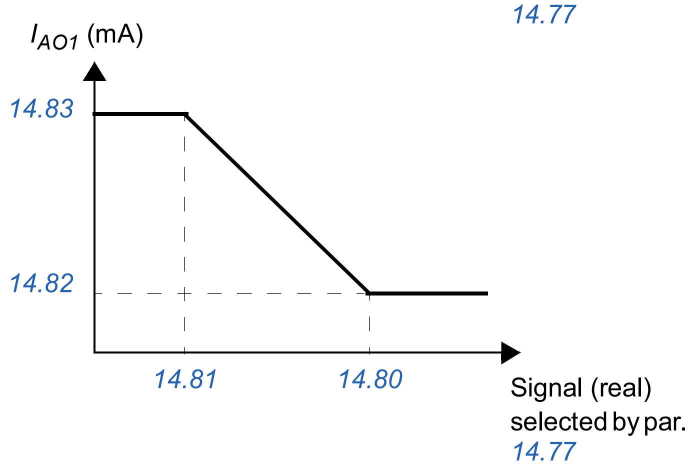
No.	Name/Value	Description	Def/FbEq16
14.63	*AI3 min*	*(Visible when 14.01 Module 1 type = FIO-11)* Defines the minimum value for analog input AI3. See also parameter *14.21 AI tune*.	0.000 mA or V
	-22.000 … 22.000 mA or V	Minimum value of AI3.	1000 = 1 mA or V
14.64	*AI3 max*	*(Visible when 14.01 Module 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
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	Description
0	AO1	1 = Force mode: Force AO1 to value of parameter *14.78 AO1 force data*.
1	AO2	1 = Force mode: Force AO2 to value of parameter *14.88 AO2 force data* (FAIO-01 only).
3…15	Reserved	

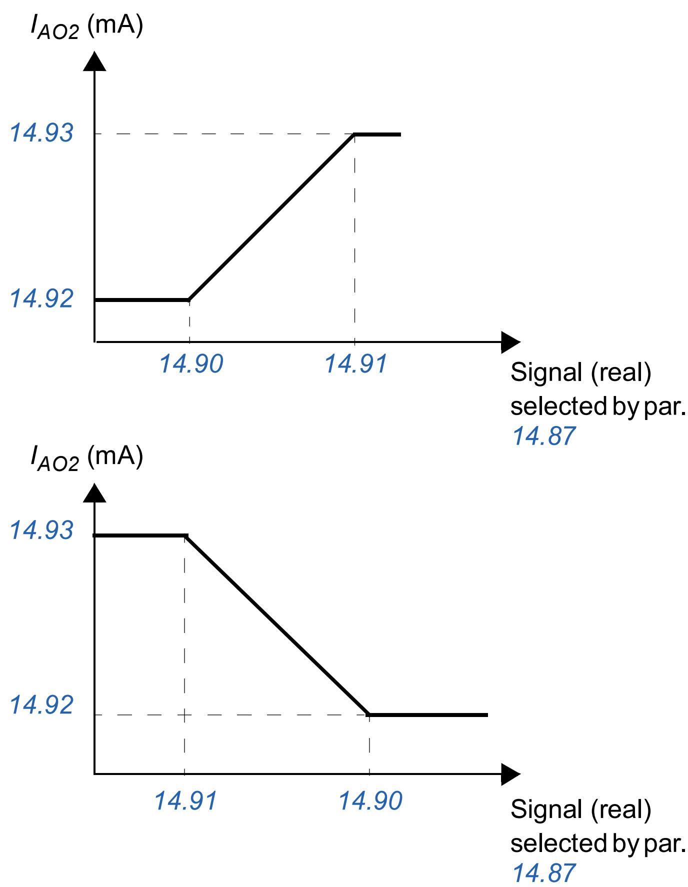
No.	Name/Value	Description	Def/FbEq16
	00b…11b	Forced values selector for analog outputs.	1 = 1

No.	Name/Value	Description	Def/FbEq16
14.76	*AO1 actual value*	*(Visible when 14.01 Module 1 type = FIO-11 or FAIO-01)* Displays the value of AO1 in mA. This parameter is read-only.	-
	0.000 … 22.000 mA	Value of AO1.	1000 = 1 mA
14.77	*AO1 source*	*(Visible when 14.01 Module 1 type = FIO-11 or FAIO-01)* Selects a signal to be connected to analog output AO1. Alternatively, sets the output to excitation mode to feed a constant current to a temperature sensor.	*Zero*
	Zero	None.	0
	Motor speed used	*01.01 Motor speed used* (page *204*).	1
	Output frequency	*01.06 Output frequency* (page *204*).	3
	Motor current	*01.07 Motor current* (page *204*).	4
	Motor torque	*01.10 Motor torque* (page *204*).	6
	DC voltage	*01.11 DC voltage* (page *204*).	7
	Power inu out	*01.14 Output power* (page *205*).	8
	Speed ref ramp in	*23.01 Speed ref ramp input* (page *314*).	10
	Speed ref ramp out	*23.02 Speed ref ramp output* (page *314*).	11
	Speed ref used	*24.01 Used speed reference* (page *320*).	12
	Torq ref used	*26.02 Torque reference used* (page *332*).	13
	Freq ref used	Not used	14
	Process PID out	Not used	16
	Process PID fbk	Not used	17
	Process PID act	Not used	18
	Process PID dev	Not used	19
	Force PT100 excitation	The output is used to feed an excitation current to 1…3 Pt100 sensors. See section *Motor thermal protection* (page *182*).	20
	Force KTY84 excitation	The output is used to feed an excitation current to a KTY84 sensor. See section *Motor thermal protection* (page *182*).	21
	Force PTC excitation	The output is used to feed an excitation current to 1…3 PTC sensors. See section *Motor thermal protection* (page *182*).	22
	Force Pt1000 excitation	The output is used to feed an excitation current to 1…3 Pt1000 sensors. See section *Motor thermal protection* (page *182*).	23
	AO1 data storage	*13.91 AO1 data storage* (page *254*).	37
	AO2 data storage	*13.92 AO2 data storage* (page *254*).	38
	Other	Source selection (see *Terms and abbreviations* on page *199*).	-
14.78	*AO1 force data*	*(Visible when 14.01 Module 1 type = FIO-11 or FAIO-01)* Forced value that can be used instead of the selected output signal. See parameter *14.71 AO force selection*.	0.000 mA
	0.000 … 22.000 mA	Forced value of analog output AO1.	1000 = 1 mA

No.	Name/Value	Description	Def/FbEq16
14.79	*AO1 filter time*	*(Visible when 14.01 Module 1 type* = *FIO-11 or FAIO-01)* Defines the filtering time constant for analog output AO1.  $O = I \times (1 - e^{-t/T})$ I = filter input (step) O = filter output *t* = time T = filter time constant	0.100 s
	0.000 … 30.000 s	Filter time constant.	1000 = 1 s

No.	Name/Value	Description	Def/FbEq16
14.80	*AO1 source min*	*(Visible when 14.01 Module 1 type = FIO-11 or FAIO-01)* Defines the real value of the signal (selected by parameter *14.77 AO1 source*) that corresponds to the minimum AO1 output value (defined by parameter *14.82 AO1 out at AO1 src min*).  	0.0
	-32768.0 … 32767.0	Real signal value corresponding to minimum AO1 output value.	1 = 1
14.81	*AO1 source max*	*(Visible when 14.01 Module 1 type = FIO-11 or FAIO-01)* Defines the real value of the signal (selected by parameter *14.77 AO1 source*) that corresponds to the maximum AO1 output value (defined by parameter *14.83 AO1 out at AO1 src max*). See parameter *14.80 AO1 source min*.	1500.0
	-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*.	20.000 mA
	0.000 … 22.000 mA	Maximum AO1 output value.	1000 = 1 mA

No.	Name/Value	Description	Def/FbEq16
14.86	*AO2 actual value*	*(Visible when 14.01 Module 1 type = FAIO-01)* Displays the value of AO2 in mA. This parameter is read-only.	-
	0.000 … 22.000 mA	Value of AO2.	1000 = 1 mA
14.87	*AO2 source*	*(Visible when 14.01 Module 1 type = FAIO-01)* Selects a signal to be connected to analog output AO2. Alternatively, sets the output to excitation mode to feed a constant current to a temperature sensor. For the selections, see parameter *14.77 AO1 source*.	*Zero*
14.88	*AO2 force data*	*(Visible when 14.01 Module 1 type = FAIO-01)* Forced value that can be used instead of the selected output signal. See parameter *14.71 AO force selection*.	0.000 mA
	0.000 … 22.000 mA	Forced value of analog output AO2.	1000 = 1 mA
14.89	*AO2 filter time*	*(Visible when 14.01 Module 1 type = FAIO-01)* Defines the filtering time constant for analog output AO2. 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
14.93	*AO2 out at AO2 src max*	*(Visible when 14.01 Module 1 type = FAIO-01)* Defines the maximum output value for analog output AO2. See also drawing at parameter *14.90 AO2 source min*.	10.000 mA
	0.000 … 22.000 mA	Maximum AO2 output value.	1000 = 1 mA

No.	Name/Value	Description	Def/FbEq16
15 I/O extension module 2		Configuration of I/O extension module 2. See also section *Programmable I/O extensions* (page *143*). **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	*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*.	0.00 s
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*.	0.00 s
15.13	*DIO1 OFF delay*	(Visible when *15.01 Module 2 type* = *FIO-01* or *FIO-11*) See parameter *14.13 DIO1 OFF delay*.	0.00 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
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*.	0.00 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*

No.	Name/Value	Description	Def/FbEq16
15.20	*AI supervision selection*	*(Visible when 15.01 Module 2 type = FIO-11 or FAIO-01)* See parameter *14.20 AI supervision selection*.	0000 0000b
15.21	*DIO3 output source*	*(Visible when 15.01 Module 2 type = FIO-01)* See parameter *14.21 DIO3 output source*.	*Not energized*
15.21	*AI tune*	*(Visible when 15.01 Module 2 type = FIO-11 or FAIO-01)* See parameter *14.21 AI tune*.	*No action*
15.22	*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*.	0000b
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*
15.32	*AI1 filter time*	*(Visible when 15.01 Module 2 type = FIO-11 or FAIO-01)* See parameter *14.32 AI1 filter time*.	0.100 s
15.33	*AI1 min*	*(Visible when 15.01 Module 2 type = FIO-11 or FAIO-01)* See parameter *14.33 AI1 min*.	0.000 mA or V
15.34	*RO1 source*	*(Visible when 15.01 Module 2 type = FIO-01 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

No.	Name/Value	Description	Def/FbEq16
15.35	RO1 ON delay	(Visible when 15.01 Module 2 type = FIO-01 or FAIO-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 FAIO-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 FAIO-01) See parameter 14.37 RO2 source.	Not energized
15.38	RO2 ON delay	(Visible when 15.01 Module 2 type = FIO-01 or FAIO-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 FAIO-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.	1 ms
15.47	AI2 filter time	(Visible when 15.01 Module 2 type = FIO-11 or FAIO-01) See parameter 14.47 AI2 filter time.	0.100 s
15.48	AI2 min	(Visible when 15.01 Module 2 type = FIO-11 or FAIO-01) See parameter 14.48 AI2 min.	0.000 mA or V
15.49	AI2 max	(Visible when 15.01 Module 2 type = FIO-11 or FAIO-01) See parameter 14.49 AI2 max.	10.000 mA or V
15.50	AI2 scaled at AI2 min	(Visible when 15.01 Module 2 type = FIO-11 or FAIO-01) See parameter 14.50 AI2 scaled at AI2 min.	0.000
15.51	AI2 scaled at AI2 max	(Visible when 15.01 Module 2 type = FIO-11 or FAIO-01) See parameter 14.51 AI2 scaled at AI2 max.	100.000
15.56	AI3 actual value	(Visible when 15.01 Module 2 type = FIO-11) See parameter 14.56 AI3 actual value.	-
15.57	AI3 scaled value	(Visible when 15.01 Module 2 type = FIO-11) See parameter 14.57 AI3 scaled value.	-
15.58	AI3 force data	(Visible when 15.01 Module 2 type = FIO-11) See parameter 14.58 AI3 force data.	0.000 mA
15.59	AI3 HW switch position	(Visible when 15.01 Module 2 type = FIO-11) See parameter 14.59 AI3 HW switch position.	-
15.60	AI3 unit selection	(Visible when 15.01 Module 2 type = FIO-11) See parameter 14.60 AI3 unit selection.	mA

No.	Name/Value	Description	Def/FbEq16
15.61	AI3 filter gain	(Visible when 15.01 Module 2 type = FIO-11) See parameter 14.61 AI3 filter gain.	1 ms
15.62	AI3 filter time	(Visible when 15.01 Module 2 type = FIO-11) See parameter 14.62 AI3 filter time.	0.100 s
15.63	AI3 min	(Visible when 15.01 Module 2 type = FIO-11) See parameter 14.63 AI3 min.	0.000 mA or V
15.64	AI3 max	(Visible when 15.01 Module 2 type = FIO-11) See parameter 14.64 AI3 max.	10.000 mA or V
15.65	AI3 scaled at AI3 min	(Visible when 15.01 Module 2 type = FIO-11) See parameter 14.65 AI3 scaled at AI3 min.	0.000
15.66	AI3 scaled at AI3 max	(Visible when 15.01 Module 2 type = FIO-11) See parameter 14.66 AI3 scaled at AI3 max.	100.000
15.71	AO force selection	(Visible when 15.01 Module 2 type = FIO-11 or FAIO-01) See parameter 14.71 AO force selection.	00b
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.	20.000 mA
15.86	AO2 actual value	(Visible when 15.01 Module 2 type = FAIO-01) See parameter 14.86 AO2 actual value.	-
15.87	AO2 source	(Visible when 15.01 Module 2 type = FAIO-01) See parameter 14.87 AO2 source.	Zero
15.88	AO2 force data	(Visible when 15.01 Module 2 type = FAIO-01) See parameter 14.88 AO2 force data.	0.000 mA
15.89	AO2 filter time	(Visible when 15.01 Module 2 type = FAIO-01) See parameter 14.89 AO2 filter time.	0.100 s
15.90	AO2 source min	(Visible when 15.01 Module 2 type = FAIO-01) See parameter 14.90 AO2 source min.	0.0
15.91	AO2 source max	(Visible when 15.01 Module 2 type = FAIO-01) See parameter 14.91 AO2 source max.	100.0
15.92	AO2 out at 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

No.	Name/Value	Description	Def/FbEq16
16 I/O extension module 3		Configuration of I/O extension module 3. See also section *Programmable I/O extensions* (page *143*). **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 DI 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*.	0.00 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
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*

No.	Name/Value	Description	Def/FbEq16
16.19	*AI supervision function*	*(Visible when 16.01 Module 3 type = FIO-11 or FAIO-01)* See parameter *14.19 AI supervision function*.	*No action*
16.20	*AI supervision selection*	*(Visible when 16.01 Module 3 type = FIO-11 or FAIO-01)* See parameter *14.20 AI supervision selection*.	0000 0000b
16.21	*DIO3 output source*	*(Visible when 16.01 Module 3 type = FIO-01)* See parameter *14.21 DIO3 output source*.	*Not energized*
16.21	*AI tune*	*(Visible when 16.01 Module 3 type = FIO-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*.	0000b
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*.	
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*
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*.	*1 ms*
16.32	*AI1 filter time*	*(Visible when 16.01 Module 3 type = FIO-11 or FAIO-01)* See parameter *14.32 AI1 filter time*.	0.100 s
16.33	*AI1 min*	*(Visible when 16.01 Module 3 type = FIO-11 or FAIO-01)* See parameter *14.33 AI1 min*.	0.000 mA or V
16.34	*RO1 source*	*(Visible when 16.01 Module 3 type = FIO-01 or FDIO-01)* See parameter *14.34 RO1 source*.	*Not energized*

No.	Name/Value	Description	Def/FbEq16
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*.	*1 ms*
16.47	*AI2 filter time*	*(Visible when 16.01 Module 3 type = FIO-11 or FAIO-01)* See parameter *14.47 AI2 filter time*.	0.100 s
16.48	*AI2 min*	*(Visible when 16.01 Module 3 type = FIO-11 or FAIO-01)* See parameter *14.48 AI2 min*.	0.000 mA or V
16.49	*AI2 max*	*(Visible when 16.01 Module 3 type = FIO-11 or FAIO-01)* See parameter *14.49 AI2 max*.	10.000 mA or V
16.50	*AI2 scaled at AI2 min*	*(Visible when 16.01 Module 3 type = FIO-11 or FAIO-01)* See parameter *14.50 AI2 scaled at AI2 min*.	0.000
16.51	*AI2 scaled at AI2 max*	*(Visible when 16.01 Module 3 type = FIO-11 or FAIO-01)* See parameter *14.51 AI2 scaled at AI2 max*.	100.000
16.56	*AI3 actual value*	*(Visible when 16.01 Module 3 type = FIO-11)* See parameter *14.56 AI3 actual value*.	-
16.57	*AI3 scaled value*	*(Visible when 16.01 Module 3 type = FIO-11)* See parameter *14.57 AI3 scaled value*.	-
16.58	*AI3 force data*	*(Visible when 16.01 Module 3 type = FIO-11)* See parameter *14.58 AI3 force data*.	0.000 mA
16.59	*AI3 HW switch position*	*(Visible when 16.01 Module 3 type = FIO-11)* See parameter *14.59 AI3 HW switch position*.	-

No.	Name/Value	Description	Def/FbEq16
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*
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

No.	Name/Value	Description	Def/FbEq16
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 *136*).	
19.01	*Actual operation mode*	Displays the operating mode currently used. **Note:** Speed control is the only applicable operating mode for the control program. See parameters *19.11*…*19.14*. This parameter is read-only.	-
	Zero	None.	1
	Speed	Speed control (in DTC motor control mode).	2
	Torque	Torque control (in DTC motor control mode).	3
	Min	The torque selector is comparing the output of the speed controller (*25.01 Torque reference speed control*) and torque reference (*26.74 Torque ref ramp out*) and the smaller of the two is used.	4
	Max	The torque selector is comparing the output of the speed controller (*25.01 Torque reference speed control*) and torque reference (*26.74 Torque ref ramp out*) and the greater of the two is used.	5
	Add	The speed controller output is added to the torque reference.	6
	Scalar (Hz)	Frequency control in scalar motor control mode.	10
	Scalar (rpm)	Speed control in scalar motor control mode.	11
	Forced magn.	Motor is in magnetizing mode.	20
19.11	*Ext1/Ext2 selection*	Selects the source for external control location EXT1/EXT2 selection. 0 = EXT1 1 = EXT2	*EXT1*
	EXT1	EXT1 (permanently selected).	0
	EXT2	EXT2 (permanently selected).	1
	FBA A MCW bit 11	Control word bit 11 received through fieldbus interface A.	2
	DI1	Digital input DI1 (*10.02 DI delayed status*, bit 0).	3
	DI2	Digital input DI2 (*10.02 DI delayed status*, bit 1).	4
	DI3	Digital input DI3 (*10.02 DI delayed status*, bit 2).	5
	DI4	Digital input DI4 (*10.02 DI delayed status*, bit 3).	6
	DI5	Digital input DI5 (*10.02 DI delayed status*, bit 4).	7
	DI6	Digital input DI6 (*10.02 DI delayed status*, bit 5).	8
	DIO1	Digital input/output DIO1 (*11.02 DIO delayed status*, bit 0).	11
	DIO2	Digital input/output DIO2 (*11.02 DIO delayed status*, bit 1).	12
	EFB MCW bit 11	Control word bit 11 received through the embedded fieldbus interface.	32
	Other [bit]	Source selection (see *Terms and abbreviations* on page *199*).	-

No.	Name/Value	Description	Def/FbEq16
19.12	*Ext1 control mode*	Selects the operating mode for external control location EXT1. **Note:** *Speed* is the only applicable selection for the crane control program.	*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
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. **Note:** *Speed* is the only applicable selection for the crane control program.	*Speed*
	Speed	Speed control. The torque reference used is *25.01 Torque reference speed control* (output of the speed reference chain).	0
	Torque	Torque control. The torque reference used is *26.74 Torque ref ramp out* (output of the torque reference chain).	1
19.17	*Local control disable*	Enables/disables local control (start and stop buttons on the control panel, and the local controls on the PC tool). **WARNING!** Before disabling local control, ensure that the control panel is not needed for stopping the drive.	*No*
	No	Local control enabled.	0
	Yes	Local control disabled.	1

<table>
<tr><th>No.</th><th>Name/Value</th><th>Description</th><th>Def/FbEq16</th></tr>
<tr><td colspan="2">20 Start/stop/direction</td><td>Start/stop/direction and run/start enable signal source selection; positive/negative reference enable signal source selection.
For information on control locations, see section Local control vs. external control (page 134).</td><td></td></tr>
<tr><td>20.01</td><td>Ext1 commands</td><td>Selects the source of start, stop and direction commands for external control location 1 (EXT1).
See also parameters 20.02…20.05.</td><td>In1 Start fwd; In2 Start rev</td></tr>
<tr><td></td><td>Not selected</td><td>No start or stop command sources selected.</td><td>0</td></tr>
<tr><td></td><td>In1 Start</td><td>The source of the start and stop commands is selected by parameter 20.03 Ext1 in1 source. The state transitions of the source bits are interpreted as follows:
<table>
<tr><th>State of source 1 (20.03)</th><th>Command</th></tr>
<tr><td>0 -> 1 (20.02 = Edge)
1 (20.02 = Level)</td><td>Start</td></tr>
<tr><td>0</td><td>Stop</td></tr>
</table></td><td>1</td></tr>
<tr><td></td><td>In1 Start; In2 Dir</td><td>The source selected by 20.03 Ext1 in1 source is the start signal; the source selected by 20.04 Ext1 in2 source determines the direction. The state transitions of the source bits are interpreted as follows:
<table>
<tr><th>State of source 1 (20.03)</th><th>State of source 2 (20.04)</th><th>Command</th></tr>
<tr><td>0</td><td>Any</td><td>Stop</td></tr>
<tr><td rowspan="2">0 -> 1 (20.02 = Edge)
1 (20.02 = Level)</td><td>0</td><td>Start forward</td></tr>
<tr><td>1</td><td>Start reverse</td></tr>
</table></td><td>2</td></tr>
<tr><td></td><td>In1 Start fwd; In2 Start rev</td><td>The source selected by 20.03 Ext1 in1 source is the forward start signal; the source selected by 20.04 Ext1 in2 source is the reverse start signal. The state transitions of the source bits are interpreted as follows:
<table>
<tr><th>State of source 1 (20.03)</th><th>State of source 2 (20.04)</th><th>Command</th></tr>
<tr><td>0</td><td>0</td><td>Stop</td></tr>
<tr><td>0 -> 1 (20.02 = Edge)
1 (20.02 = Level)</td><td>0</td><td>Start forward</td></tr>
<tr><td>0</td><td>0 -> 1 (20.02 = Edge)
1 (20.02 = Level)</td><td>Start reverse</td></tr>
<tr><td>1</td><td>1</td><td>Stop</td></tr>
</table></td><td>3</td></tr>
<tr><td></td><td>In1P Start; In2 Stop</td><td>The sources of the start and stop commands are selected by parameters 20.03 Ext1 in1 source and 20.04 Ext1 in2 source. The state transitions of the source bits are interpreted as follows:
<table>
<tr><th>State of source 1 (20.03)</th><th>State of source 2 (20.04)</th><th>Command</th></tr>
<tr><td>0 -> 1</td><td>1</td><td>Start</td></tr>
<tr><td>Any</td><td>0</td><td>Stop</td></tr>
</table>
Note: The start signal is always edge-triggered with this setting regardless of parameter 20.02 Ext1 start trigger type.</td><td>4</td></tr>
</table>

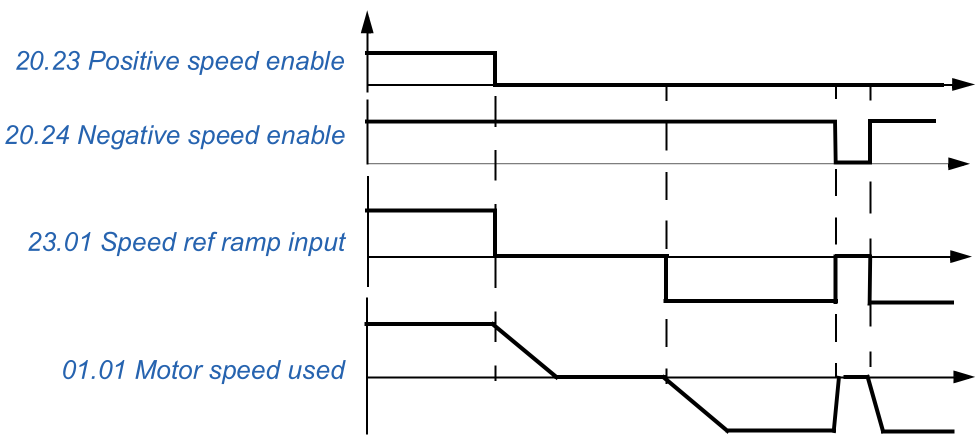
<table>
<tr><th>No.</th><th>Name/Value</th><th>Description</th><th>Def/FbEq16</th></tr>
<tr><td></td><td>In1P Start; In2 Stop; In3 Dir</td><td>The sources of the start and stop commands are selected by parameters *20.03 Ext1 in1 source* and *20.04 Ext1 in2 source*. The source selected by *20.05 Ext1 in3 source* determines the direction. The state transitions of the source bits are interpreted as follows:
<table>
<tr><th>State of source 1 (20.03)</th><th>State of source 2 (20.04)</th><th>State of source 3 (20.05)</th><th>Command</th></tr>
<tr><td>0 -> 1</td><td>1</td><td>0</td><td>Start forward</td></tr>
<tr><td>0 -> 1</td><td>1</td><td>1</td><td>Start reverse</td></tr>
<tr><td>Any</td><td>0</td><td>Any</td><td>Stop</td></tr>
</table>
Note: The start signal is always edge-triggered with this setting regardless of parameter 20.02 Ext1 start trigger type.</td><td>5</td></tr>
<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 drive-to-drive link or 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>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></td><td>Application Program</td><td>The start and stop commands are taken from the application program control word (parameter 06.02 Application control word).
Note: The start signal is always level-triggered with this setting regardless of parameter 20.02 Ext1 start trigger type.</td><td>21</td></tr>
<tr><td></td><td>ATF</td><td>Reserved.</td><td>22</td></tr>
</table>

<table>
<tr><th>No.</th><th>Name/Value</th><th>Description</th><th>Def/FbEq16</th></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, 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>
<tr><td>20.03</td><td>Ext1 in1 source</td><td>Selects source 1 for parameter 20.01 Ext1 commands.</td><td>DI1</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 199).</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>DI2</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>In1 Start fwd; In2 Start rev</td></tr>
<tr><td></td><td>Not selected</td><td>No start or stop command sources selected.</td><td>0</td></tr>
<tr><td></td><td>In1 Start</td><td>The source of the start and stop commands is selected by parameter 20.08 Ext2 in1 source. The state transitions of the source bits are interpreted as follows:
<table>
<tr><th>State of source 1 (20.08)</th><th>Command</th></tr>
<tr><td>0 -> 1 (20.07 = Edge)
1 (20.07 = Level)</td><td>Start</td></tr>
<tr><td>0</td><td>Stop</td></tr>
</table></td><td>1</td></tr>
<tr><td></td><td>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>
Note: The start signal is always edge-triggered with this setting regardless of parameter 20.07 Ext2 start trigger type.</td><td>4</td></tr>
<tr><td></td><td>In1P Start; In2 Stop; In3 Dir</td><td>The sources of the start and stop commands are selected by parameters 20.08 Ext2 in1 source and 20.09 Ext2 in2 source. The source selected by 20.10 Ext2 in3 source determines the direction. The state transitions of the source bits are interpreted as follows:
<table>
<tr><th>State of source 1 (20.08)</th><th>State of source 2 (20.09)</th><th>State of source 3 (20.10)</th><th>Command</th></tr>
<tr><td>0 -> 1</td><td>1</td><td>0</td><td>Start forward</td></tr>
<tr><td>0 -> 1</td><td>1</td><td>1</td><td>Start reverse</td></tr>
<tr><td>Any</td><td>0</td><td>Any</td><td>Stop</td></tr>
</table>
Note: The start signal is always edge-triggered with this setting regardless of parameter 20.07 Ext2 start trigger type.</td><td>5</td></tr>
<tr><td></td><td>In1P Start fwd; In2P Start rev; In3 Stop</td><td>The sources of the start and stop commands are selected by parameters 20.08 Ext2 in1 source, 20.09 Ext2 in2 source and 20.10 Ext2 in3 source. The state transitions of the source bits are interpreted as follows:
<table>
<tr><th>State of source 1 (20.08)</th><th>State of source 2 (20.09)</th><th>State of source 3 (20.10)</th><th>Command</th></tr>
<tr><td>0 -> 1</td><td>Any</td><td>1</td><td>Start forward</td></tr>
<tr><td>Any</td><td>0 -> 1</td><td>1</td><td>Start reverse</td></tr>
<tr><td>Any</td><td>Any</td><td>0</td><td>Stop</td></tr>
</table>
Note: The start signal is always edge-triggered with this setting regardless of parameter 20.07 Ext2 start trigger type.</td><td>6</td></tr>
<tr><td></td><td>Control panel</td><td>The start and stop commands are taken from the control panel.</td><td>11</td></tr>
</table>

No.	Name/Value	Description	Def/FbEq16
	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 drive-to-drive link or 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
	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
	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
20.07	*Ext2 start trigger type*	Defines whether the start signal for external control location EXT2 is edge-triggered or level-triggered. **Note:** This parameter is only effective when parameter *20.06 Ext2 commands* is set to *In1 Start*, *In1 Start; In2 Dir*, *In1 Start fwd; In2 Start rev* or *Control panel*.	*Level*
	Edge	The start signal is edge-triggered.	0
	Level	The start signal is level-triggered.	1
20.08	*Ext2 in1 source*	Selects source 1 for parameter *20.06 Ext2 commands*. For the available selections, see parameter *20.03 Ext1 in1 source*.	*Not selected*
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 *314*.	1
	Torque limit	Stop according to torque limits (parameters *30.19* and *30.20*).	2

No.	Name/Value	Description	Def/FbEq16
20.12	*Run enable 1 source*	Selects the source of the external run enable signal. If the run enable signal is switched off, the drive will not start. If already running, the drive will stop according to the setting of parameter *20.11 Run enable stop mode* 1 = Run enable signal on. **Note:** The warning that indicates a missing signal can be suppressed using parameter *20.30 Enable signals warning function*. See also parameter *20.19 Enable start command*.	*DIIL* (*95.20* b10); *Selected* (*95.20* b5); *DI5* (*95.20* b9)
	Not selected	0.	0
	Selected	1.	1
	DI1	Digital input DI1 (*10.02 DI delayed status*, bit 0).	2
	DI2	Digital input DI2 (*10.02 DI delayed status*, bit 1).	3
	DI3	Digital input DI3 (*10.02 DI delayed status*, bit 2).	4
	DI4	Digital input DI4 (*10.02 DI delayed status*, bit 3).	5
	DI5	Digital input DI5 (*10.02 DI delayed status*, bit 4).	6
	DI6	Digital input DI6 (*10.02 DI delayed status*, bit 5).	7
	DIO1	Digital input/output DIO1 (*11.02 DIO delayed status*, bit 0).	10
	DIO2	Digital input/output DIO2 (*11.02 DIO delayed status*, bit 1).	11
	FBA A MCW bit 3	Control word bit 3 received through fieldbus interface A.	30
	EFB MCW bit 3	Control word bit 3 received through the embedded fieldbus interface.	32
	DIIL	DIIL input (*10.02 DI delayed status*, bit 15).	33
	Active control source MCW bit 3	Control word bit 3 received from the active control source. In case the active source is the control panel, PC tool or drive I/O, the run enable signal is always on. **Note:** If the drive is running, switching bit 3 off effectively removes both the start and run enable signals. In this case, the stop mode is determined by *20.11 Run enable stop mode*. The order of stop modes from highest to lowest priority is *Coast* – *Torque limit* – *Ramp*.	34
	Other [bit]	Source selection (see *Terms and abbreviations* on page *199*).	-
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

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
	DIIL	DIIL input (*10.02 DI delayed status*, bit 15).	30
	Other [bit]	Source selection (see *Terms and abbreviations* on page *199*).	-
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.  **Example:** The motor is rotating in the forward direction. To stop the motor, the positive speed enable signal is deactivated by a hardware limit switch (e.g. via digital input). If the positive speed enable signal remains deactivated and the negative speed enable signal is active, only reverse rotation of the motor is allowed.	*Selected*
	Not selected	0.	0
	Selected	1.	1
	DI1	Digital input DI1 (*10.02 DI delayed status*, bit 0).	2
	DI2	Digital input DI2 (*10.02 DI delayed status*, bit 1).	3
	DI3	Digital input DI3 (*10.02 DI delayed status*, bit 2).	4
	DI4	Digital input DI4 (*10.02 DI delayed status*, bit 3).	5
	DI5	Digital input DI5 (*10.02 DI delayed status*, bit 4).	6
	DI6	Digital input DI6 (*10.02 DI delayed status*, bit 5).	7
	DIO1	Digital input/output DIO1 (*11.02 DIO delayed status*, bit 0).	10

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 *199*).	-
20.24	*Negative speed enable*	Selects the source of the negative speed reference enable command. See parameter *20.23 Positive speed enable*.	*Selected*
20.30	*Enable signals warning function*	Selects enable signal (eg. run enable, start enable) warnings to be suppressed. This parameter can be used to prevent these warnings from flooding the event log. Whenever a bit of this parameter is set to 1, the corresponding warning is suppressed, ie. no warning is generated even if the signal is switched off. The bits of this binary number correspond to the following warnings:	11b

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	*Slowdown select*	Selects the mode of the Slowdown function. For more information on the function, see section *Slowdown* on page *91*.	*Single bit with direction*
	Single bit with direction	Slowdown uses two switches through one input. Either of the switches triggers the Slowdown command, but it is not known which one. Parameter *20.201 Slowdown input 1* selects the input to which the switches are connected for activating the Slowdown command. The drive remembers the direction from which the slowdown switch was hit.	1
	Single bit without direction	Slowdown uses two switches through one input. Either of the switches triggers the Slowdown command, but it is not known which one. Parameter *20.201 Slowdown input 1* selects the input to which the switches are connected for activating the Slowdown command. The Slowdown command is active both in forward and reverse directions. A safe zone can be created using this selection.	2
	Double bit	Slowdown uses two switches through two inputs. Either of the switches triggers the Slowdown command. Parameter *20.201 Slowdown input 1* is only used in the forward direction and parameter *20.202 Slowdown input 2* in the reverse direction.	3

No.	Name/Value	Description	Def/FbEq16
20.201	*Slowdown input 1*	Selects the source for activating the Slowdown command • in the forward direction when the *Double bit* mode is active • both in forward and reverse directions when the *Single bit with direction* or *Single bit without direction* mode is active. 0 = Slowdown command is active. 1 = Slowdown command is inactive. When the command is active, the drive limits the speed reference to the value of parameter *22.200 Slowdown reference*.	*Inactive (true)*
	Active (false)	0.	0
	Inactive (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
	Other [bit]	Source selection (see *Terms and abbreviations* on page *199*).	-
20.202	*Slowdown input 2*	Selects the source for activating the Slowdown command in the reverse direction when the *Double bit* mode is active. 0 = Slowdown command is active. 1 = Slowdown command is inactive. When the command is active, the drive limits the speed reference to the value of parameter *22.200 Slowdown reference*.	*Inactive (true)*
	Active (false)	0.	0
	Inactive (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
	Other [bit]	Source selection (see *Terms and abbreviations* on page *199*).	-
20.203	*Slowdown up position*	Defines the Up position limit for Slowdown function in the forward direction. When the actual position of crane (signal *90.05 Load position scaled*) is greater than this value, the slowdown command in the forward direction is activated. When the command is active, the drive limits the speed reference to the value of parameter *22.200 Slowdown reference*.	0.000
	-32000.000... 32000.000	Up position limit.	1000 = 1

No.	Name/Value	Description	Def/FbEq16
20.204	*Slowdown dn position*	Defines the Down position limit for Slowdown function in the reverse direction. When the actual position of crane (signal *90.05 Load position scaled*) is less than this value, the slowdown command in the reverse direction is activated. When the command is active, the drive limits the speed reference to the negative value of parameter *22.200 Slowdown reference*.	0.000
	-32000.000... 32000.000	Down position limit.	1000 = 1
20.205	*Upper limit*	Selects the source for activating the Upper limit command. 0 = Upper limit command is active. 1 = Upper limit command is inactive. When the command is active, the function activates an emergency stop command in the forward direction, and the drive stops within the time defined in parameter *23.23 Emergency stop time*. For more information on the function, see section *Upper and lower limits* on page *90*.	*Inactive (true)*
	Active (false)	0.	0
	Inactive (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
	Other [bit]	Source selection (see *Terms and abbreviations* on page *199*).	-
20.206	*Lower limit*	Selects the source for activating the Lower limit command. 0 = Lower limit command is active. 1 = Lower limit command is inactive. When the command is active, the function activates an emergency stop command in the reverse direction, and the drive stops within the time defined in parameter *23.23 Emergency stop time*.	*Inactive (true)*
	Active (false)	0.	0
	Inactive (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
	Other [bit]	Source selection (see *Terms and abbreviations* on page *199*).	-

No.	Name/Value	Description	Def/FbEq16
20.207	*Emergency control enable*	Selects the source for activating the Emergency control mode. 0 = Emergency control mode is inactive (normal operation). 1 = Emergency control mode is active. Parameters *20.208* and *20.209* are applicable only when the Emergency control mode is active. For more information on the function, see section *Emergency control mode* on page *51*.	*Disable*
	Disable	0.	0
	Enable	1.	1
	DI1	Digital input DI1 (*10.02 DI delayed status*, bit 0).	2
	DI2	Digital input DI2 (*10.02 DI delayed status*, bit 1).	3
	DI3	Digital input DI3 (*10.02 DI delayed status*, bit 2).	4
	DI4	Digital input DI4 (*10.02 DI delayed status*, bit 3).	5
	DI5	Digital input DI5 (*10.02 DI delayed status*, bit 4).	6
	DI6	Digital input DI6 (*10.02 DI delayed status*, bit 5).	7
	Other [bit]	Source selection (see *Terms and abbreviations* on page *199*).	-
20.208	*Emergency control forward*	Selects the source for activating the Emergency control start command in the forward direction. This parameter is applicable only when the Emergency control mode is enabled using parameter *20.207*. 0 = Emergency control start command is inactive. 1 = Emergency control start command is active. When the command is active, the drive uses the speed reference defined in parameter *22.202 Emergency control reference* with positive polarity as the reference.	*False*
	False	0.	0
	True	1.	1
	DI1	Digital input DI1 (*10.02 DI delayed status*, bit 0).	2
	DI2	Digital input DI2 (*10.02 DI delayed status*, bit 1).	3
	DI3	Digital input DI3 (*10.02 DI delayed status*, bit 2).	4
	DI4	Digital input DI4 (*10.02 DI delayed status*, bit 3).	5
	DI5	Digital input DI5 (*10.02 DI delayed status*, bit 4).	6
	DI6	Digital input DI6 (*10.02 DI delayed status*, bit 5).	7
	Other [bit]	Source selection (see *Terms and abbreviations* on page *199*).	-
20.209	*Emergency control reverse*	Selects the source for activating the Emergency control start command in the reverse direction. This parameter is applicable only when the Emergency control mode is activated using parameter *20.207*. 0 = Emergency control start command is inactive. 1 = Emergency control start command is active. When the command is active, the drive uses the speed reference defined in parameter *22.202 Emergency control reference* with negative polarity as the reference.	*False*
	False	0.	0
	True	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
	Other [bit]	Source selection (see *Terms and abbreviations* on page *199*).	-
20.210	*Fast stop input*	Selects the source for activating the Fast stop command. 0 = Fast stop command is active. 1 = Fast stop command is inactive (normal operation). When the command is active, the drive decelerates according to the value of parameter *23.206 Fast stop deceleration time*.	*Inactive (true)*
	Active (false)	0.	0
	Inactive (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
	Other [bit]	Source selection (see *Terms and abbreviations* on page *199*).	-
20.211	*Fast stop mode*	Selects the mode of the Fast stop function.	*Ramp*
	Ramp	The drive decelerates to zero speed according to a defined ramp time. The mechanical brake closes when the drive reaches the brake close speed.	1
	Torque limit	The drive decelerates to zero speed against the drive torque limits. The mechanical brake closes when the drive reaches the brake close speed.	2
	Mechanical brake	The function forces the mechanical brake to close.	3
20.212	*Power on acknowledge*	Selects the source for activating the Power on acknowledgement signal. 1 = Power on acknowledgement circuit is closed, main contactor is closed. 0 = Power on acknowledgement circuit is open, main contactor is open, warning *D20B Power on acknowledge* generated. For more information on the function, see section *Power on acknowledgement* on page *126*.	*DIL*
	False	0.	0
	True	1.	1
	DIL	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

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
	Other [bit]	Source selection (see *Terms and abbreviations* on page *199*).	-
20.213	*Power on ackn reset delay*	Defines the time delay for a fault reset after the Power on acknowledgement signal is activated.	1000 ms
	0…30000 ms	Time delay.	1 = 1 ms
20.214	*Joystick zero position*	Selects the source for activating the joystick zero position input. 0 = Joystick is not at zero position. 1 = Joystick is at zero position. For more information, see section *Start/stop interlocking* on page *52*.	*Disable*
	Disable	0.	0
	Enable	1.	1
	DI1	Digital input DI1 (*10.02 DI delayed status*, bit 0).	2
	DI2	Digital input DI2 (*10.02 DI delayed status*, bit 1).	3
	DI3	Digital input DI3 (*10.02 DI delayed status*, bit 2).	4
	DI4	Digital input DI4 (*10.02 DI delayed status*, bit 3).	5
	DI5	Digital input DI5 (*10.02 DI delayed status*, bit 4).	6
	DI6	Digital input DI6 (*10.02 DI delayed status*, bit 5).	7
	Other [bit]	Source selection (see *Terms and abbreviations* on page *199*).	-
20.215	*Joystick warning delay*	Defines the time delay for generating warning *D208 Joystick reference check*. The warning is generated if *20.214 Joystick zero position* is active and the speed reference is greater than +/- 10% of the minimum or maximum scaled value of the joystick reference used.	1000 ms
	0…30000 ms	Time delay.	1 = 1 ms

No.	Name/Value	Description	Def/FbEq16
20.216	*Crane control word 1*	Crane control program control word 1. Can be updated from the fieldbus using parameter group *53 FBA A data out* or *56 FBA B data out*. **Note**: These bits are not connected to any functions by default. Bit names are existing, for which you need to make connections separately.	-

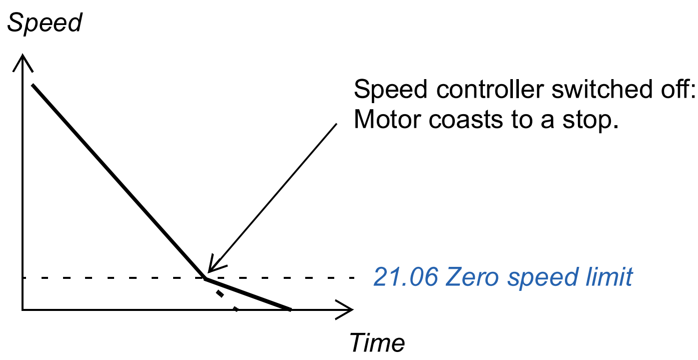
Bit	Name	Description
0	Start forward	1 = Start command in the forward direction.
1	Start reverse	1 = Start command in the reverse direction.
2	Fault reset	1 = Activate a fault reset.
3	Step reference mode	1 = Enable the Step reference mode.
4	Step reference select 2	1 = Enable step reference selection pointer 2.
5	Step reference select 3	1 = Enable step reference selection pointer 3.
6	Step reference select 4	1 = Enable step reference selection pointer 4.
7	Slowdown input 1	1 = Deactivate the Slowdown command in the forward direction.
8	Slowdown input 2	1 = Deactivate the Slowdown command in the reverse direction.
9	Upper limit	1 = Deactivate the Upper limit command.
10	Lower limit	1 = Deactivate the Lower limit command.
11	Fast stop	1 = Activate the Fast stop command.
12	Crane ramp set select	1 = Select acceleration/deceleration ramp set 2. 0 = Select acceleration/deceleration ramp set 1.
13	External speed limits	1 = Activate the External speed limits.
14	Torque proving sign	1 = Invert the torque proving and brake open torque directions.
15	Hoist speed optimization selection	1 = Enable the Hoist speed optimization function.

No.	Name/Value	Description	Def/FbEq16
	0000h…FFFFh	Crane control program control word 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 control 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 *174*).	*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

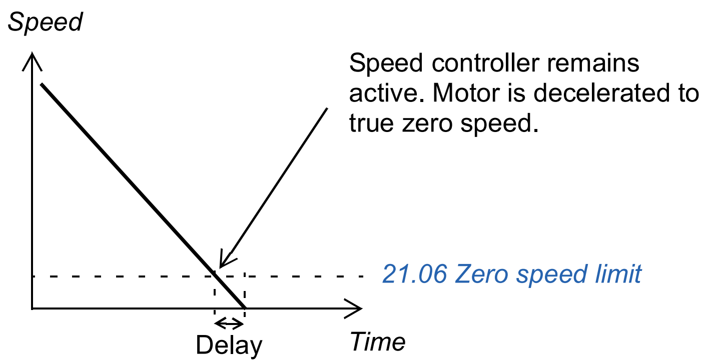
<table>
<tr><th>No.</th><th>Name/Value</th><th>Description</th><th>Def/FbEq16</th></tr>
<tr><td></td><td>Constant time</td><td>The drive pre-magnetizes the motor before start. The pre-magnetizing time is defined by parameter 21.02 Magnetization time. This mode should be selected if constant pre-magnetizing 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.</td><td>1</td></tr>
<tr><td></td><td>Automatic</td><td>Automatic start guarantees optimal motor start in most cases. It includes the flying start function (starting into a rotating motor) and the automatic restart function (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.</td><td>2</td></tr>
<tr><td></td><td>Flying start</td><td>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).</td><td>3</td></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 control 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>21.06</td><td>Zero speed limit</td><td>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.</td><td>30.00 rpm</td></tr>
<tr><td></td><td>0.00 … 30000.00 rpm</td><td>Zero speed limit.</td><td>See par. 46.01</td></tr>
</table>

<table>
<tr><th>No.</th><th>Name/Value</th><th>Description</th><th>Def/FbEq16</th></tr>
<tr><td>21.07</td><td>Zero speed delay</td><td>Defines the delay for the zero speed delay function. The function is useful in applications where a smooth and quick restarting is essential. During the delay, the drive knows the rotor position accurately.

Without zero speed delay:
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.



With zero speed delay:
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.



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

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 *174*). **Notes:** • These functions are only available in speed control in DTC motor control mode (see page *156*). • DC magnetization causes the motor to heat up. In applications where long DC magnetization times are required, externally ventilated motors should be used. If the DC magnetization period is long, DC magnetization cannot prevent the motor shaft from rotating if a constant load is applied to the motor.	0000b

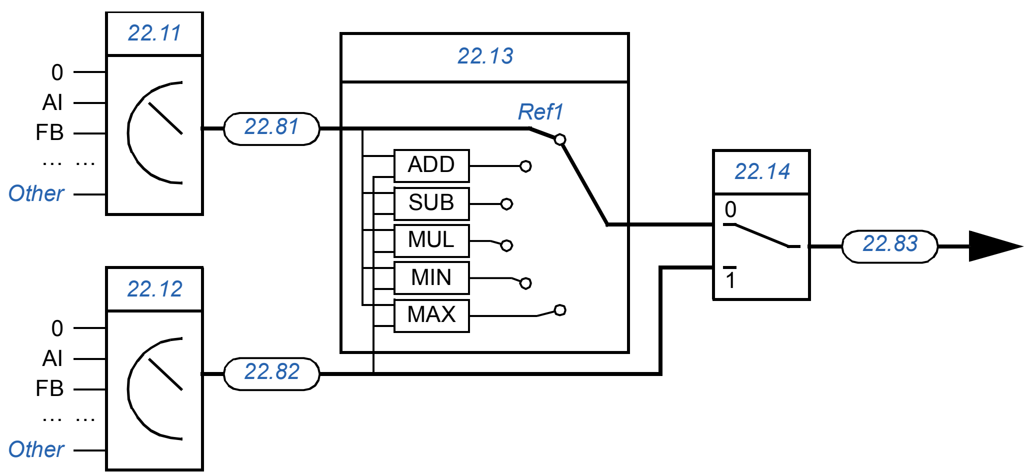
Bit	Value
0	1 = Enable DC hold. See section *DC hold* (page *175*). **Note:** The DC hold function has no effect if the start signal is switched off.
1	1 = Enable post-magnetization. See section *Post-magnetization* (page *175*).
2…15	Reserved

	0000b…0011b	DC magnetization selection.	1 = 1
21.09	*DC hold speed*	Defines the DC hold speed. See parameter *21.08 DC current control*, and section *DC hold* (page *175*).	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 *174*).	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
21.12	*Continuous magnetization command*	Activates/deactivates (or selects a source that activates/deactivates) continuous magnetization. See section *Motor potentiometer* (page *177*). The magnetization current is calculated on the basis of flux reference (see parameter group *97 Motor control*). **Notes:** • This function is only available when ramping is the selected stop mode (see parameter *21.03 Stop mode*), and only in speed control in DTC motor control mode (see page *136*). • Continuous magnetization causes the motor to heat up. In applications where long magnetization times are required, externally ventilated motors should be used. • Continuous magnetization may not be able to prevent the motor shaft from rotating during a long period if a constant load is applied to the motor. 0 = Normal operation 1 = Magnetization active	Par. *44.212*, bit 0
	Off	0.	0
	On	1.	1

No.	Name/Value	Description	Def/FbEq16
	Other [bit]	Source selection (see *Terms and abbreviations* on page *199*).	-
21.13	*Autophasing mode*	Selects the way autophasing is performed. See section *Autophasing* on page *171*.	*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 during the ID run and the start-up is not time-critical. **Note:** This mode will cause the motor to rotate. The load torque must be less than 5%	0
	Standstill 1	Faster than the *Turning* mode, but not as accurate. The motor will not rotate.	1
	Standstill 2	An alternative standstill autophasing mode that can be used if the *Turning* mode cannot be used, and the *Standstill 1* mode gives erratic results. However, this mode is considerably slower than *Standstill 1*.	2
	Turning with Z-pulse	This mode should be used if the zero pulse signal of the pulse encoder is to be observed, and other modes do not give a result. The motor will turn until a zero pulse is detected.	3
21.14	*Pre-heating input source*	Selects the source of the motor pre-heat on/off command. See section *Pre-heating* (page *174*). **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	*Off*
	Off	0. Pre-heating is always deactivated.	0
	On	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 *199*).	-

No.	Name/Value	Description	Def/FbEq16
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 *180*). When this parameter is set to 0.0 seconds, automatic restarting is disabled. Otherwise, the parameter defines the maximum duration of the power failure after which restarting is attempted. Note that this time also includes the DC pre-charging delay. ⚠ **WARNING!** Before you activate the function, make sure that no dangerous situations can occur. The function restarts the drive automatically and continues operation after a supply break.	0.1 s
	0.0 s	Automatic restarting disabled.	0
	0.1 … 5.0 s	Maximum power failure duration.	1 = 1 s
21.19	*Scalar control 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 *174*).	*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.	2
21.20	*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 command. 1 = Ramp stop forces speed control	*Not selected*
	Not selected	0.	0
	Selected	1.	1

No.	Name/Value	Description	Def/FbEq16
	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 *199*).	-
22 Speed reference selection		Speed reference selection; motor potentiometer settings. See the control chain diagrams on pages *662*…*664*.	
22.01	*Speed ref unlimited*	Displays the output of the speed reference selection block. See the control chain diagram on page *663*. This parameter is read-only.	-
	-30000.00 … 30000.00 rpm	Value of the selected speed reference.	See par. *46.01*
22.11	*Speed ref1 source*	Selects speed reference source 1. Two signal sources can be defined by this parameter and *22.12 Speed ref2 source*. A digital source selected by *22.14 Speed ref1/2 selection* can be used to switch between the two sources, or a mathematical function (*22.13 Speed ref1 function*) applied to the two signals to create the reference.	*AI1 scaled*



No.	Name/Value	Description	Def/FbEq16
	Zero	None.	0
	AI1 scaled	*12.12 AI1 scaled value* (see page *247*).	1
	AI2 scaled	*12.22 AI2 scaled value* (see page *249*).	2
	FB A ref1	*03.05 FB A reference 1* (see page *207*).	4
	FB A ref2	*03.06 FB A reference 2* (see page *207*).	5
	EFB ref1	*03.09 EFB reference 1* (see page *207*).	8
	EFB ref2	*03.10 EFB reference 2* (see page *207*).	9
	DDCS ctrl ref1	*03.11 DDCS controller ref 1* (see page *208*).	10

No.	Name/Value	Description	Def/FbEq16
	DDCS ctrl ref2	*03.12 DDCS controller ref 2* (see page *208*).	11
	M/F reference 1	*03.13 M/F or D2D ref1* (see page *208*).	12
	M/F reference 2	*03.14 M/F or D2D ref2* (see page *208*).	13
	Motor potentiometer	*22.80 Motor potentiometer ref act* (output of the motor potentiometer).	15
	PID	Not in use.	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 *135*).	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 *135*).	19
	Other	Source selection (see *Terms and abbreviations* on page *199*).	-
22.12	*Speed ref2 source*	Selects speed reference source 2. For the selections, and a diagram of reference source selection, see parameter *22.11 Speed ref1 source*.	*Zero*
22.13	*Speed ref1 function*	Selects a mathematical function between the reference sources selected by parameters *22.11 Speed ref1 source* and *22.12 Speed ref2 source*. See diagram at *22.11 Speed ref1 source*.	*Ref1*
	Ref1	Signal selected by *22.11 Speed ref1 source* is used as speed reference 1 as such (no function applied).	0
	Add (ref1 + ref2)	The sum of the reference sources is used as speed reference 1.	1
	Sub (ref1 - ref2)	The subtraction ([*22.11 Speed ref1 source*] - [*22.12 Speed ref2 source*]) of the reference sources is used as speed reference 1.	2
	Mul (ref1 × ref2)	The multiplication of the reference sources is used as speed reference 1.	3
	Min (ref1, ref2)	The smaller of the reference sources is used as speed reference 1.	4
	Max (ref1, ref2)	The greater of the reference sources is used as speed reference 1.	5
22.14	*Speed ref1/2 selection*	Configures the selection between speed references 1 and 2. See diagram at *22.11 Speed ref1 source*. 0 = Speed reference 1 1 = Speed reference 2	*Follow Ext1/Ext2 selection*
	Speed reference 1	0.	0
	Speed reference 2	1.	1
	Follow Ext1/Ext2 selection	Speed reference 1 is used when external control location EXT1 is active. Speed reference 2 is used when external control location EXT2 is active. See also parameter *19.11 Ext1/Ext2 selection*.	2
	DI1	Digital input DI1 (*10.02 DI delayed status*, bit 0).	3
	DI2	Digital input DI2 (*10.02 DI delayed status*, bit 1).	4
	DI3	Digital input DI3 (*10.02 DI delayed status*, bit 2).	5
	DI4	Digital input DI4 (*10.02 DI delayed status*, bit 3).	6
	DI5	Digital input DI5 (*10.02 DI delayed status*, bit 4).	7

<table>
<tr><th>No.</th><th>Name/Value</th><th>Description</th><th>Def/FbEq16</th></tr>
<tr><td></td><td>DI6</td><td>Digital input DI6 (10.02 DI delayed status, bit 5).</td><td>8</td></tr>
<tr><td></td><td>DIO1</td><td>Digital input/output DIO1 (11.02 DIO delayed status, bit 0).</td><td>11</td></tr>
<tr><td></td><td>DIO2</td><td>Digital input/output DIO2 (11.02 DIO delayed status, bit 1).</td><td>12</td></tr>
<tr><td></td><td>Other [bit]</td><td>Source selection (see Terms and abbreviations on page 199).</td><td>-</td></tr>
<tr><td>22.15</td><td>Speed additive 1 source</td><td>Defines a reference to be added to the speed reference after reference selection (see page 662).
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.</td><td>Zero</td></tr>
<tr><td>22.16</td><td>Speed share</td><td>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.</td><td>1.000</td></tr>
<tr><td></td><td>-8.000 …8.000</td><td>Speed reference scaling factor.</td><td>1000 = 1</td></tr>
<tr><td>22.17</td><td>Speed additive 2 source</td><td>Defines a reference to be added to the speed reference after the speed share function (see page 662).
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.</td><td>Zero</td></tr>
<tr><td>22.21</td><td>Constant speed function</td><td>Determines how constant speeds are selected, and whether the rotation direction signal is considered or not when applying a constant speed.</td><td>0000b</td></tr>
<tr><td></td><td colspan="3">
<table>
<tr><th>Bit</th><th>Name</th><th>Information</th></tr>
<tr><td rowspan="2">0</td><td rowspan="2">Constant speed mode</td><td>1 = Packed: 7 constant speeds are selectable using the three sources defined by parameters 22.22, 22.23 and 22.24.</td></tr>
<tr><td>0 = Separate: Constant speeds 1, 2 and 3 are separately activated by the sources defined by parameters 22.22, 22.23 and 22.24 respectively. In case of conflict, the constant speed with the smaller number takes priority.</td></tr>
<tr><td rowspan="2">1</td><td rowspan="2">Direction enable</td><td>1 = Start dir: To determine running direction for a constant speed, the sign of the constant speed setting (parameters 22.26…22.32) is multiplied by the direction signal (forward: +1, reverse: -1). This effectively allows the drive to have 14 (7 forward, 7 reverse) constant speeds if all values in 22.26…22.32 are positive.
WARNING: If the direction signal is reverse and the active constant speed is negative, the drive will run in the forward direction.</td></tr>
<tr><td>0 = Accord Par: The running direction for the constant speed is determined by the sign of the constant speed setting (parameters 22.26…22.32).</td></tr>
<tr><td>2…15</td><td colspan="2">Reserved</td></tr>
</table>
</td></tr>
<tr><td></td><td>0000b…0011b</td><td>Constant speed configuration word.</td><td>1 = 1</td></tr>
</table>

No.	Name/Value	Description	Def/FbEq16
22.22	*Constant speed sel1*	When bit 0 of parameter *22.21 Constant speed function* is 0 (Separate), selects a source that activates constant speed 1. When bit 0 of parameter *22.21 Constant speed function* is 1 (Packed), this parameter and parameters *22.23 Constant speed sel2* and *22.24 Constant speed sel3* select three sources whose states activate constant speeds as follows:	*Not selected*

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

No.	Name/Value	Description	Def/FbEq16
	Not selected	0 (always off).	0
	Selected	1 (always on).	1
	DI1	Digital input DI1 (*10.02 DI delayed status*, bit 0).	2
	DI2	Digital input DI2 (*10.02 DI delayed status*, bit 1).	3
	DI3	Digital input DI3 (*10.02 DI delayed status*, bit 2).	4
	DI4	Digital input DI4 (*10.02 DI delayed status*, bit 3).	5
	DI5	Digital input DI5 (*10.02 DI delayed status*, bit 4).	6
	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 *199*).	-
22.23	*Constant speed sel2*	When bit 0 of parameter *22.21 Constant speed function* is 0 (Separate), selects a source that activates constant speed 2. When bit 0 of parameter *22.21 Constant speed function* is 1 (Packed), this parameter and parameters *22.22 Constant speed sel1* and *22.24 Constant speed sel3* select three sources that are used to activate constant speeds. See table at parameter *22.22 Constant speed sel1*. For the selections, see parameter *22.22 Constant speed sel1*.	*Not selected*
22.24	*Constant speed sel3*	When bit 0 of parameter *22.21 Constant speed function* is 0 (Separate), selects a source that activates constant speed 3. When bit 0 of parameter *22.21 Constant speed function* is 1 (Packed), this parameter and parameters *22.22 Constant speed sel1* and *22.23 Constant speed sel2* select three sources that are used to activate constant speeds. See table at parameter *22.22 Constant speed sel1*. For the selections, see parameter *22.22 Constant speed sel1*.	*Not selected*

No.	Name/Value	Description	Def/FbEq16
22.26	*Constant speed 1*	Defines constant speed 1 (the speed the motor will turn when constant speed 1 is selected).	300.00 rpm
	-30000.00 … 30000.00 rpm	Constant speed 1.	See par. *46.01*
22.27	*Constant speed 2*	Defines constant speed 2.	0.00 rpm
	-30000.00 … 30000.00 rpm	Constant speed 2.	See par. *46.01*
22.28	*Constant speed 3*	Defines constant speed 3.	0.00 rpm
	-30000.00 … 30000.00 rpm	Constant speed 3.	See par. *46.01*
22.29	*Constant speed 4*	Defines constant speed 4.	0.00 rpm
	-30000.00 … 30000.00 rpm	Constant speed 4.	See par. *46.01*
22.30	*Constant speed 5*	Defines constant speed 5.	0.00 rpm
	-30000.00 … 30000.00 rpm	Constant speed 5.	See par. *46.01*
22.31	*Constant speed 6*	Defines constant speed 6.	0.00 rpm
	-30000.00 … 30000.00 rpm	Constant speed 6.	See par. *46.01*
22.32	*Constant speed 7*	Defines constant speed 7.	0.00 rpm
	-30000.00 … 30000.00 rpm	Constant speed 7.	See par. *46.01*
22.41	*Speed ref safe*	Defines a safe speed reference 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* • *50.32FBA B comm loss func* • *58.14 Communication loss action*.	0.00 rpm
	-30000.00 … 30000.00 rpm	Safe speed reference.	See par. *46.01*
22.51	*Critical speed function*	Enables/disables the critical speeds function. Also determines whether the specified ranges are effective in both rotating directions or not. See also section *Critical speeds* (page *157*).	0000b
	0000b…0011b	Critical speeds configuration word.	1 = 1

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
22.52	*Critical speed 1 low*	Defines the low limit for critical speed range 1. **Note:** This value must be less than or equal to the value of *22.53 Critical speed 1 high*.	0.00 rpm
	-30000.00 … 30000.00 rpm	Low limit for critical speed 1.	See par. *46.01*
22.53	*Critical speed 1 high*	Defines the high limit for critical speed range 1. **Note:** This value must be greater than or equal to the value of *22.52 Critical speed 1 low*.	0.00 rpm
	-30000.00 … 30000.00 rpm	High limit for critical speed 1.	See par. *46.01*
22.54	*Critical speed 2 low*	Defines the low limit for critical speed range 2. **Note:** This value must be less than or equal to the value of *22.55 Critical speed 2 high*.	0.00 rpm
	-30000.00 … 30000.00 rpm	Low limit for critical speed 2.	See par. *46.01*
22.55	*Critical speed 2 high*	Defines the high limit for critical speed range 2. **Note:** This value must be greater than or equal to the value of *22.54 Critical speed 2 low*.	0.00 rpm
	-30000.00 … 30000.00 rpm	High limit for critical speed 2.	See par. *46.01*
22.56	*Critical speed 3 low*	Defines the low limit for critical speed range 3. **Note:** This value must be less than or equal to the value of *22.57 Critical speed 3 high*.	0.00 rpm
	-30000.00 … 30000.00 rpm	Low limit for critical speed 3.	See par. *46.01*
22.57	*Critical speed 3 high*	Defines the high limit for critical speed range 3. **Note:** This value must be greater than or equal to the value of *22.56 Critical speed 3 low*.	0.00 rpm
	-30000.00 … 30000.00 rpm	High limit for critical speed 3.	See par. *46.01*
22.71	*Motor potentiometer function*	(*Visible 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 *Scalar motor control* (page *169*).	*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 restarts 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 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

No.	Name/Value	Description	Def/FbEq16
22.73	*Motor potentiometer up source*	(*Visible 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
	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 *199*).	-
22.74	*Motor potentiometer down source*	(*Visible 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 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 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 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

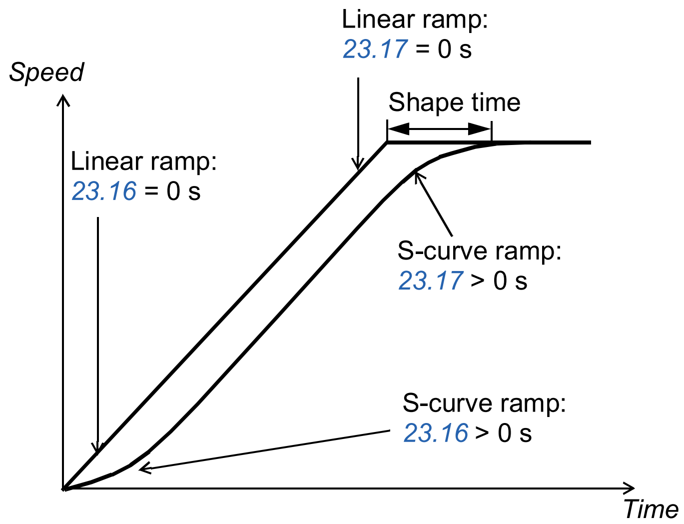
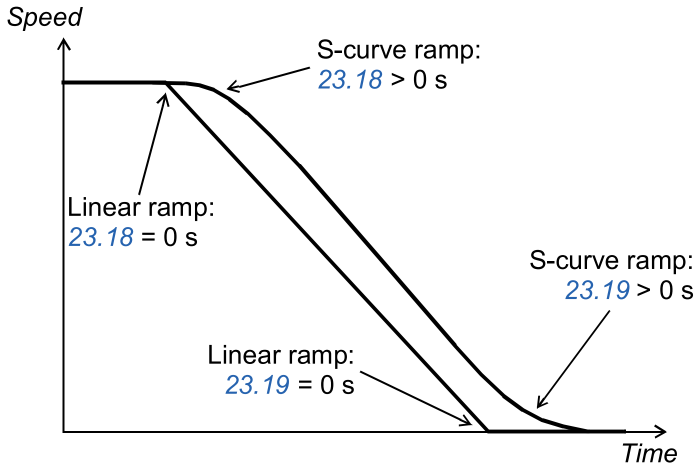
No.	Name/Value	Description	Def/FbEq16
22.80	*Motor potentiometer ref act*	Displays the output of the motor potentiometer function. (The motor potentiometer is configured using parameters *22.71*…*22.74*.) This parameter is read-only.	-
	-32768.00 … 32767.00	Value of motor potentiometer.	1 = 1
22.81	*Speed reference act 1*	Displays the value of speed reference source 1 (selected by parameter *22.11 Speed ref1 source*). See the control chain diagram on page *662*. This parameter is read-only.	-
	-30000.00 … 30000.00 rpm	Value of reference source 1.	See par. *46.01*
22.82	*Speed reference act 2*	Displays the value of speed reference source 2 (selected by parameter *22.12 Speed ref2 source*). See the control chain diagram on page *662*. 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 *662*. 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 *662*. 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 *662*. 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 *662*. 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 *663*. The value is received from *22.86 Speed reference act 6* unless overridden by • any constant speed • *network control* reference • control panel reference • safe speed reference. This parameter is read-only.	-

No.	Name/Value	Description	Def/FbEq16
	-30000.00 … 30000.00 rpm	Speed reference before application of critical speeds.	See par. *46.01*
22.200	*Slowdown reference*	Defines the speed reference limit used while the Slowdown function is active (*20.200 Slowdown select*). This reference is an absolute value, and its polarity is based on the motor direction.	150.00 rpm
	0.00 … 30000.00 rpm	Slowdown reference limit.	1 = 1 rpm
22.202	*Emergency control reference*	Defines the speed reference limit used while the Emergency control mode is active (*20.207 Emergency control enable*). This reference is an absolute value, and its polarity is defined by the start commands *20.208 Emergency control forward* and *20.209 Emergency control reverse*.	200.00 rpm
	0.00 … 30000.00 rpm	Emergency control reference limit.	1 = 1 rpm
22.203	*Step reference mode*	Selects the source for activating the Step reference mode. 0 = Step reference mode is inactive. 1 = Step reference mode is active. The combination of parameter values *22.204 Step reference select 2* … *22.206 Step reference select 4* determines which step reference speed is used. For the parameter value combinations, see section *Step reference selection* on page *81*.	*False*
	False	0.	0
	True	1.	1
	DI1	Digital input DI1 (*10.02 DI delayed status*, bit 0).	2
	DI2	Digital input DI2 (*10.02 DI delayed status*, bit 1).	3
	DI3	Digital input DI3 (*10.02 DI delayed status*, bit 2).	4
	DI4	Digital input DI4 (*10.02 DI delayed status*, bit 3).	5
	DI5	Digital input DI5 (*10.02 DI delayed status*, bit 4).	6
	DI6	Digital input DI6 (*10.02 DI delayed status*, bit 5).	7
	Other [bit]	Source selection (see *Terms and abbreviations* on page *199*).	-
22.204	*Step reference select 2*	Defines source bit 2 for selecting the step reference. 0 = Source bit 2 is disabled. 1 = Source bit 2 is enabled. See also parameter *22.203 Step reference mode*.	*False*
	False	0.	0
	True	1.	1
	DI1	Digital input DI1 (*10.02 DI delayed status*, bit 0).	2
	DI2	Digital input DI2 (*10.02 DI delayed status*, bit 1).	3
	DI3	Digital input DI3 (*10.02 DI delayed status*, bit 2).	4
	DI4	Digital input DI4 (*10.02 DI delayed status*, bit 3).	5
	DI5	Digital input DI5 (*10.02 DI delayed status*, bit 4).	6
	DI6	Digital input DI6 (*10.02 DI delayed status*, bit 5).	7
	Other [bit]	Source selection (see *Terms and abbreviations* on page *199*).	-

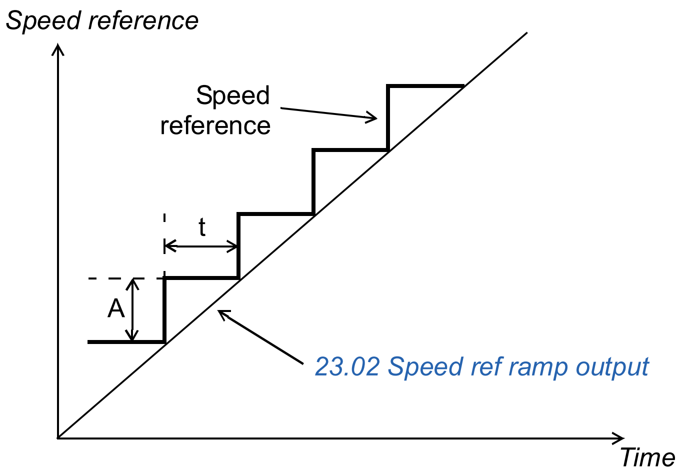
No.	Name/Value	Description	Def/FbEq16
22.205	*Step reference select 3*	Defines source bit 3 for selecting the step reference. 0 = Source bit 3 is disabled. 1 = Source bit 3 is enabled. See also parameter *22.203 Step reference mode*.	*False*
	False	0.	0
	True	1.	1
	DI1	Digital input DI1 (*10.02 DI delayed status*, bit 0).	2
	DI2	Digital input DI2 (*10.02 DI delayed status*, bit 1).	3
	DI3	Digital input DI3 (*10.02 DI delayed status*, bit 2).	4
	DI4	Digital input DI4 (*10.02 DI delayed status*, bit 3).	5
	DI5	Digital input DI5 (*10.02 DI delayed status*, bit 4).	6
	DI6	Digital input DI6 (*10.02 DI delayed status*, bit 5).	7
	Other [bit]	Source selection (see *Terms and abbreviations* on page *199*).	-
22.206	*Step reference select 4*	Defines source bit 4 for selecting the step reference. 0 = Source bit 4 is disabled. 1 = Source bit 4 is enabled. See also parameter *22.203 Step reference mode*.	*False*
	False	0.	0
	True	1.	1
	DI1	Digital input DI1 (*10.02 DI delayed status*, bit 0).	2
	DI2	Digital input DI2 (*10.02 DI delayed status*, bit 1).	3
	DI3	Digital input DI3 (*10.02 DI delayed status*, bit 2).	4
	DI4	Digital input DI4 (*10.02 DI delayed status*, bit 3).	5
	DI5	Digital input DI5 (*10.02 DI delayed status*, bit 4).	6
	DI6	Digital input DI6 (*10.02 DI delayed status*, bit 5).	7
	Other [bit]	Source selection (see *Terms and abbreviations* on page *199*).	-
22.207	*Step reference 1*	Defines step reference speed 1.	500.00 rpm
	0.00 … 30000.00 rpm	Step reference speed 1.	1 = 1 rpm
22.208	*Step reference 2*	Defines step reference speed 2.	600.00 rpm
	0.00 … 30000.00 rpm	Step reference speed 2.	1 = 1 rpm
22.209	*Step reference 3*	Defines step reference speed 3.	700.00 rpm
	0.00 … 30000.00 rpm	Step reference speed 3.	1 = 1 rpm
22.210	*Step reference 4*	Defines step reference speed 4.	1000.00
	0.00 … 30000.00 rpm	Step reference speed 4.	1 = 1 rpm
22.211	*Speed reference shape*	Defines the speed reference shape. See also section *Parabolic speed reference* on page *84*.	*Linear*
	Linear	Linear speed reference.	0
	Parabolic 1	X^2 speed reference.	1
	Parabolic 2	X^3 speed reference.	2

No.	Name/Value	Description	Def/FbEq16
22.220	*Crane motpot enable*	Enables or selects the source to activate the Crane motor potentiometer function. See section *Crane motor potentiometer* on page *87*.	*Disable*
	Disable	Crane motor potentiometer function is disabled.	0
	Enable	Crane motor potentiometer function is enabled.	1
	DI1	Digital input DI1 (*10.02 DI delayed status*, bit 0).	2
	DI2	Digital input DI2 (*10.02 DI delayed status*, bit 1).	3
	DI3	Digital input DI3 (*10.02 DI delayed status*, bit 2).	4
	DI4	Digital input DI4 (*10.02 DI delayed status*, bit 3).	5
	DI5	Digital input DI5 (*10.02 DI delayed status*, bit 4).	6
	DI6	Digital input DI6 (*10.02 DI delayed status*, bit 5).	7
	Other [bit]	Source selection (see *Terms and abbreviations* on page *199*).	-
22.223	*Crane motpot accel sel*	Selects the source of Crane motor potentiometer accelerate signal. See section *Crane motor potentiometer* on page *87*.	*False*
	False	No change.	0
	True	Increases the motor potentiometer value depending on the selected direction. The possible effect can be seen in parameter *22.225 Crane motpot sw*, bits 3 and 4.	1
	DI1	Digital input DI1 (*10.02 DI delayed status*, bit 0).	2
	DI2	Digital input DI2 (*10.02 DI delayed status*, bit 1).	3
	DI3	Digital input DI3 (*10.02 DI delayed status*, bit 2).	4
	DI4	Digital input DI4 (*10.02 DI delayed status*, bit 3).	5
	DI5	Digital input DI5 (*10.02 DI delayed status*, bit 4).	6
	DI6	Digital input DI6 (*10.02 DI delayed status*, bit 5).	7
	Other [bit]	Source selection (see *Terms and abbreviations* on page *199*).	-
22.224	*Crane motpot min speed*	Defines an initial value (starting point) for the motor potentiometer at start. See section *Crane motor potentiometer* on page *87*.	0 rpm
	0...32000 rpm	Minimum speed.	1 = 1 rpm

No.	Name/Value	Description	Def/FbEq16
22.225	Crane motpot sw	Crane motor potentiometer status word.	-
		<table><tr><th>Bit</th><th>Name</th><th>Description</th></tr><tr><td>0</td><td>Motpot enabled</td><td>Status of the Crane motor potentiometer function. 1 = Crane motor potentiometer enabled. 0 = Crane motor potentiometer disabled.</td></tr><tr><td>1...2</td><td>Reserved</td><td></td></tr><tr><td>3</td><td>Motpot up source</td><td>Used as source for four inputs of the motor potentiometer to increase the output value. 1 = Crane motor potentiometer with increased output reference. 0 = Crane motor potentiometer without increased output reference.</td></tr><tr><td>4</td><td>Motpot dn source</td><td>Used as source for four inputs of the motor potentiometer to decrease the output value. 1 = Crane motor potentiometer with decreased output reference. 0 = Crane motor potentiometer without decreased output reference.</td></tr><tr><td>5…15</td><td>Reserved</td><td></td></tr></table>	
	0000b…0011b	Status word.	1 = 1
22.226	Crane motpot min value	Defines the minimum value of the Crane motor potentiometer.	-1500.00
	-32768.00... 32767.00	Minimum value	100 = 1
22.227	Crane motpot max value	Defines the maximum value of Crane motor potentiometer.	1500.00
	-32768.00... 32767.00	Maximum value	100 = 1
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 664.	
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 665. 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 664. This parameter is read-only.	-
	-30000.00 … 30000.00 rpm	Speed reference after ramping and shaping.	See par. 46.01

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

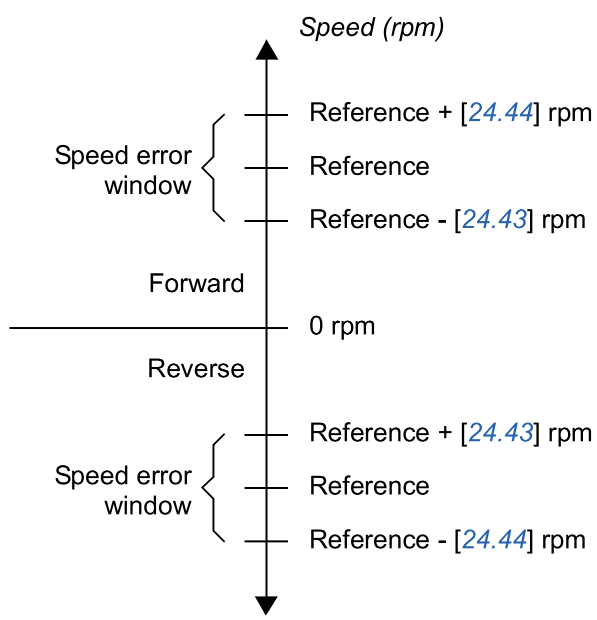
No.	Name/Value	Description	Def/FbEq16
23.19	*Shape time dec 2*	Defines the shape of the deceleration ramp at the end of the deceleration. See parameter *23.16 Shape time acc 1*.	0.000 s
	0.000 … 1800.000 s	Ramp shape at end of deceleration.	10 = 1 s
23.23	*Emergency stop time*	In the speed control mode, 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. Emergency stop can also be activated through fieldbus.	3.000 s
	0.000 … 1800.000 s	Emergency stop Off3 deceleration time.	10 = 1 s
23.24	*Speed ramp in zero source*	Selects a source that forces the speed reference to zero just before it enters the ramp function. 0 = Force speed reference to zero before the ramp function 1 = Speed reference continues towards the ramp function as normal	*Inactive*
	Active	0.	0
	Inactive	1.	1
	DI1	Digital input DI1 (*10.02 DI delayed status*, bit 0).	2
	DI2	Digital input DI2 (*10.02 DI delayed status*, bit 1).	3
	DI3	Digital input DI3 (*10.02 DI delayed status*, bit 2).	4
	DI4	Digital input DI4 (*10.02 DI delayed status*, bit 3).	5
	DI5	Digital input DI5 (*10.02 DI delayed status*, bit 4).	6
	DI6	Digital input DI6 (*10.02 DI delayed status*, bit 5).	7
	DIO1	Digital input/output DIO1 (*11.02 DIO delayed status*, bit 0).	10
	DIO2	Digital input/output DIO2 (*11.02 DIO delayed status*, bit 1).	11
	Other [bit]	Source selection (see *Terms and abbreviations* on page *199*).	-
23.26	*Ramp out balancing enable*	Selects the source for enabling/disabling speed reference ramp balancing. This function is used to generate a smooth transfer from a torque- or tension-controlled motor back to being speed-controlled. The balancing output would be tracking the present “line” speed of the application and when transfer is required, the speed reference can then be quickly “seeded” to the correct line speed. Balancing is also possible in the speed controller. See 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 *199*).	-
23.27	*Ramp out balancing ref*	Defines the reference for speed ramp balancing. The output of the ramp generator is forced to this value when balancing is enabled by parameter *23.26 Ramp out balancing enable*.	0.00 rpm
	-30000.00 … 30000.00 rpm	Speed ramp balancing reference.	See par. *46.01*
23.28	*Variable slope enable*	Activates the variable slope function, which controls the slope of the speed ramp during a speed reference change. This allows for a constantly variable ramp rate to be generated, instead of just the standard two ramps normally available. If the update interval of the signal from an external control system and the variable slope rate (*23.29 Variable slope rate*) are equal, the resulting speed reference (*23.02 Speed ref ramp output*) is a straight line.  t = update interval of signal from external control system A = speed reference change during t This function is only active in remote control.	*Off*
	Off	Variable slope disabled.	0
	On	Variable slope enabled (not available in local control).	1
	Other [bit]	Source selection (see *Terms and abbreviations* on page *199*).	-
23.29	*Variable slope rate*	Defines the rate of the speed reference change when variable slope is enabled by parameter *23.28 Variable slope enable*. For the best result, enter the reference update interval into this parameter.	50 ms
	2…30000 ms	Variable slope rate.	1 = 1 ms
23.39	*Follower speed correction out*	Displays the speed correction term for the load share function with a speed-controlled follower drive. This parameter is read-only.	-
	-30000.00 … 30000.00 rpm	Speed correction term.	See par. *46.01*

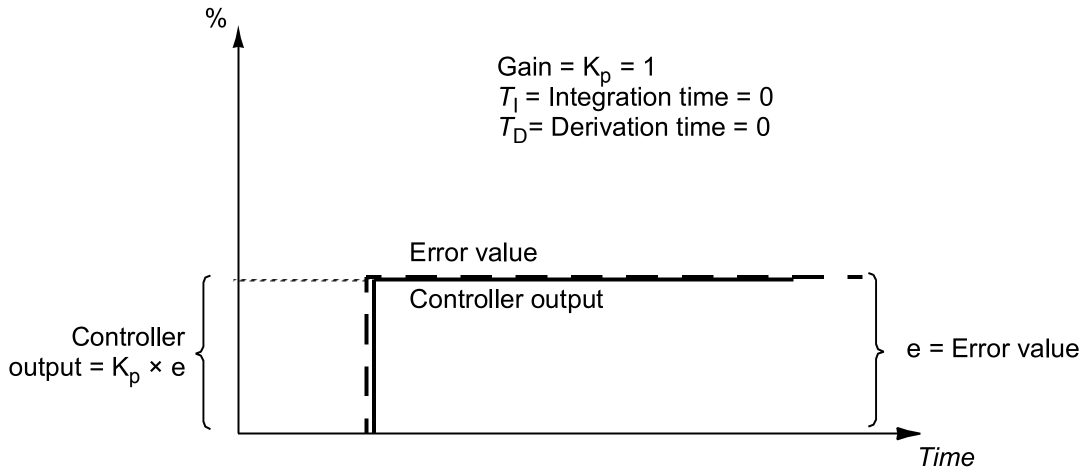
No.	Name/Value	Description	Def/FbEq16
23.40	*Follower speed correction enable*	With a speed-controlled follower, selects the source for enabling/disabling the load share function. 0 = Disabled 1 = Enabled	*Not selected*
	Not selected	0.	0
	Selected	1.	1
	DI1	Digital input DI1 (*10.02 DI delayed status*, 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 *199*).	-
23.41	*Follower speed correction gain*	Adjusts the gain of the speed correction term in a speed-controlled follower. In effect, defines how accurately the follower follows the master torque. A greater value results in a more accurate performance. See section *Load share function with a speed-controlled follower* (page *147*).	1.00%
	0.00 … 100.00%	Speed correction term adjustment.	1 = 1%
23.42	*Follower speed corr torq source*	Selects the source of the torque reference for the load share function. See section *Load share function with a speed-controlled follower* (page *147*).	*MF ref 2*
	NULL	None.	0
	MF ref 2	*03.14 M/F or D2D ref2* (page *208*).	1
	Other [bit]	Source selection (see *Terms and abbreviations* on page *199*).	-
23.200	*Crane ramp set selection*	Selects the source that switches between the two sets of acceleration/deceleration times defined by parameters *23.201*…*23.204*. 0 = Acceleration time 1 and deceleration time 1 are in force. 1 = Acceleration time 2 and deceleration time 2 are in force. 2 = Acceleration time 1 and deceleration time 1 are in force in the forward direction, and acceleration time 2 and deceleration time 2 are in force in the reverse direction.	*Acc/Dec 1*
	Acc/Dec 1	0.	0
	Acc/Dec 2	1.	1
	Acc/Dec Direction	2.	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
	Other [bit]	Source selection (see *Terms and abbreviations* on page *199*).	-
23.201	*Crane acc time 1*	Defines acceleration time 1 as the time required for the speed to change from zero to the speed defined by parameter *46.01 Speed scaling* (**not** to parameter *30.12 Maximum speed*). If the speed reference increases faster than the set acceleration rate, the motor speed will follow the acceleration rate. If the speed reference increases slower than the set acceleration rate, the motor speed will follow the reference. If the acceleration time is set too short, the drive will automatically prolong the acceleration in order not to exceed the drive torque limits.	3.00 s
	0.00 …1800.00 s	Acceleration time 1.	10 = 1.0 s
23.202	*Crane dec tme 1*	Defines deceleration time 1 as the time required for the speed to change from the speed defined by parameter *46.01 Speed scaling* (**not** from parameter *30.12 Maximum speed*) to zero. If the speed reference decreases slower than the set deceleration rate, the motor speed will follow the reference. If the reference changes faster than the set deceleration rate, the motor speed will follow the deceleration rate. If the deceleration rate is set too short, the drive will automatically prolong the deceleration in order not to exceed drive torque limits. 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 = 1.0 s
23.203	*Crane acc time 2*	Defines acceleration time 2. See parameter *23.201 Crane acc time 1*.	3.00 s
	0.00 …1800.00 s	Acceleration time 2.	10 = 1.0 s
23.204	*Crane dec time 2*	Defines deceleration time 2. See parameter *23.202 Crane dec tme 1*.	3.00 s
	0.00 …1800.00 s	Deceleration time 2.	10 = 1.0 s
23.206	*Fast stop deceleration time*	Defines the time within which the drive stops if the drive receives a Fast stop command (*20.210 Fast stop input*).	0.50 s
	0.00 …3000.00 s	Fast stop deceleration time.	10 = 1.0 s

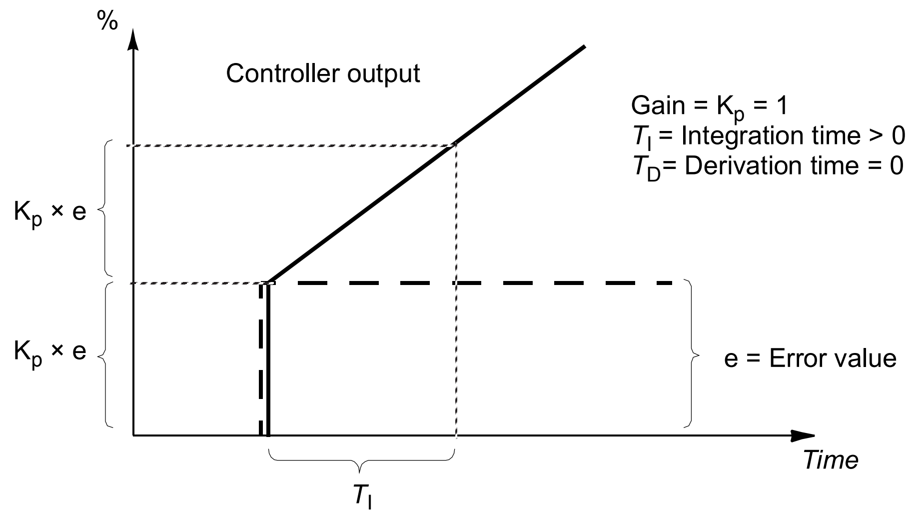
No.	Name/Value	Description	Def/FbEq16
24 Speed reference conditioning		Speed error calculation; speed error window control configuration; speed error step. See the control chain diagrams on pages *667* and *669*.	
24.01	*Used speed reference*	Displays the ramped and corrected speed reference (before speed error calculation).See the control chain diagram on page *667*. 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 *667*. 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 *667*.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 *667*.This parameter is read-only.	-
	-30000.0 … 30000.0 rpm	Inverted speed error.	See par. *46.01*
24.12	*Speed error filter time*	Defines the time constant of the speed error low-pass filter. If the used speed reference changes rapidly, the possible interferences in the speed measurement can be filtered with the speed error filter. Reducing the ripple with this filter may cause speed controller tuning problems. A long filter time constant and fast acceleration time contradict one another. A very long filter time results in unstable control.	0 ms
	0…10000 ms	Speed error filtering time constant. 0 = filtering disabled.	1 = 1 ms

No.	Name/Value	Description	Def/FbEq16
24.41	*Speed error window control enable*	Enables/disables speed error window control, sometimes also referred to as deadband control or strip break protection. It forms a speed supervision function for a torque-controlled drive, preventing the motor from running away if the material that is being held under tension breaks. **Note:** Speed error window control is only effective when the *Add* operating mode is active (see parameters *19.12* and *19.14*), or when the drive is a speed-controlled follower. 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). **Example:** In a load loss condition, the internal torque reference of the drive is decreased to prevent an excessive rise of the motor speed. If window control were inactive, the motor speed would rise until a speed limit of the drive were reached. 0 = Speed error window control disabled 1 = Speed error window control enabled	*Disable*
	Disable	0.	0
	Enable	1.	1

No.	Name/Value	Description	Def/FbEq16
	Other [bit]	Source selection (see *Terms and abbreviations* on page *199*).	-
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 a speed reference correction, ie. a value added to the existing reference between ramping and limitation. This is useful to trim the speed if necessary, for example to adjust draw between sections of a paper machine. **Note:** For safety reasons, the correction is not applied when an emergency stop is active. **WARNING!** If the speed reference correction exceeds *21.06 Zero speed limit*, a ramp stop may be impossible. Make sure the correction is reduced or removed when a ramp stop is required.	0.00 rpm
	-10000.00 ... 10000.00 rpm	Speed reference correction.	100 = 1 rpm
25 Speed control		Speed controller settings. See the control chain diagrams on pages *667* and *669*.	
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 *669*. This parameter is read-only.	-
	-1600.0 … 1600.0%	Limited speed controller output torque.	See par. *46.03*

No.	Name/Value	Description	Def/FbEq16
25.02	*Speed proportional gain*	Defines the proportional gain (K_p) of the speed controller. Too high a gain may cause speed oscillation. The figure below shows the speed controller output after an error step when the error remains constant.  If gain is set to 1.00, 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 *158*).	10.00; 5.00 (*95.21* b1)
	0.00 …250.00	Proportional gain for speed controller.	100 = 1

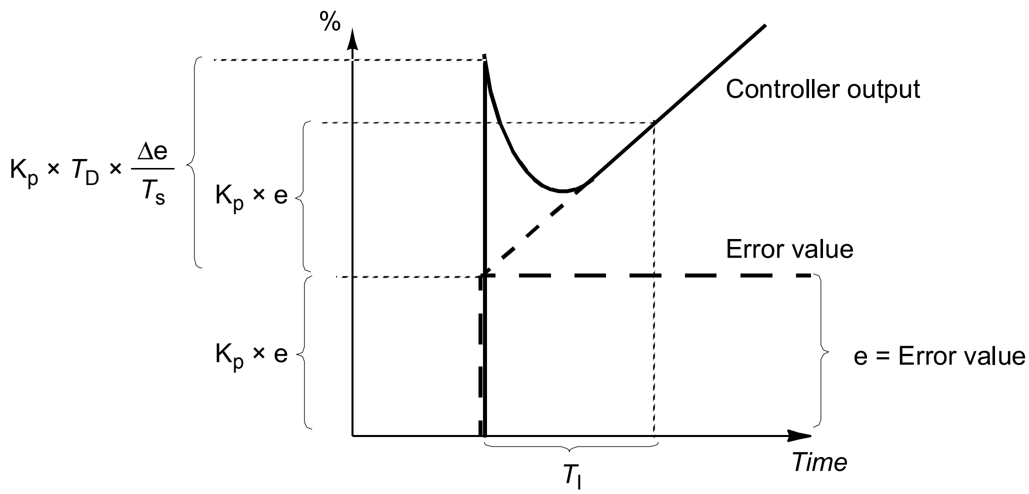
No.	Name/Value	Description	Def/FbEq16
25.03	*Speed integration time*	Defines the integration time of the speed controller. The integration time defines the rate at which the controller output changes when the error value is constant and the proportional gain of the speed controller is 1. The shorter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



Note: This parameter is automatically set by the speed controller autotune function. See section *Speed controller autotune* (page *158*).

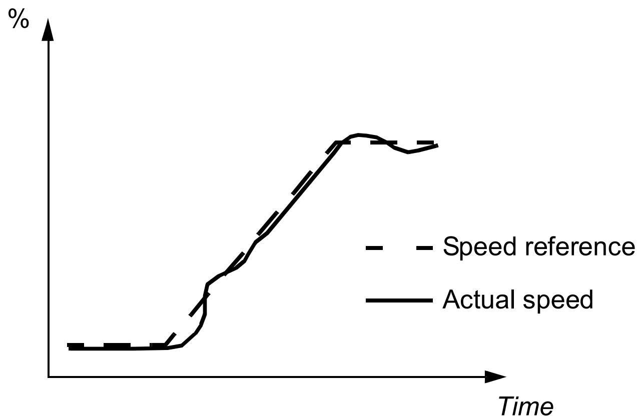
	0.00 … 1000.00 s	Integration time for speed controller.	10 = 1 s

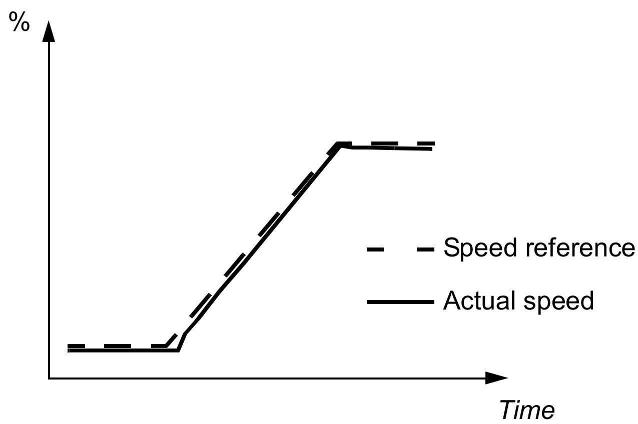
No.	Name/Value	Description	Def/FbEq16
25.04	*Speed derivation time*	Defines the derivation time of the speed controller. Derivative action boosts the controller output if the error value changes. The longer the derivation time, the more the speed controller output is boosted during the change. If the 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

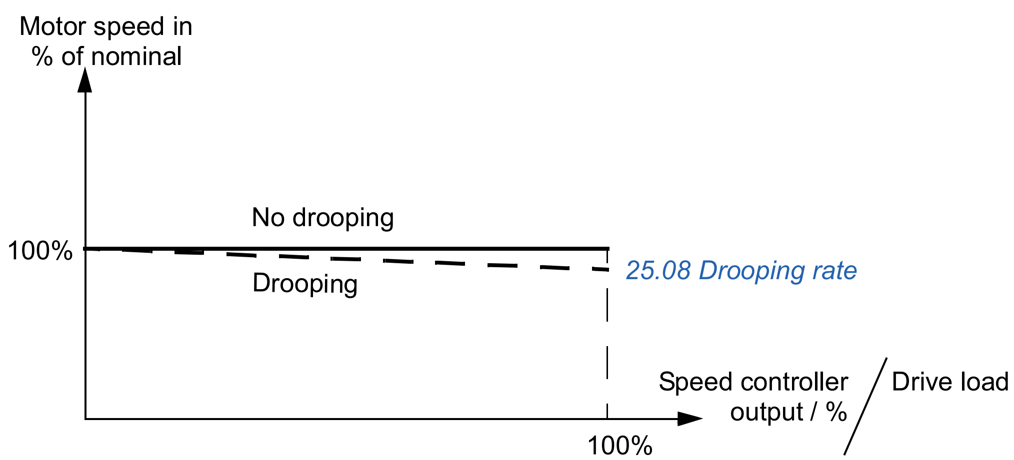


Gain = K_p = 1
T_I = Integration time > 0
T_D= Derivation time > 0
T_s= Sample time period = 500 µs
Δe = Error value change between two samples

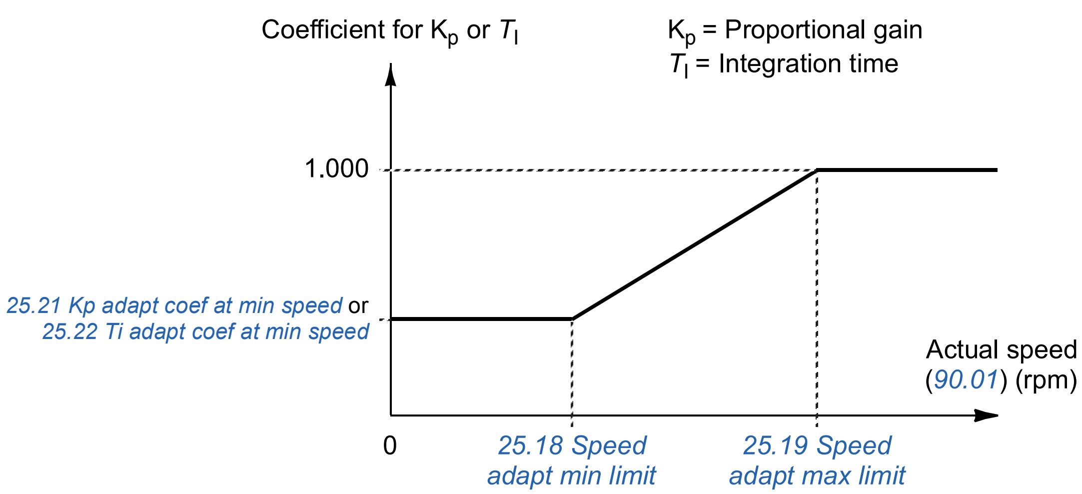
No.	Name/Value	Description	Def/FbEq16
	0.000 … 10.000 s	Derivation time for speed controller.	1000 = 1 s
25.05	*Derivation filter time*	Defines the derivation filter time constant. See parameter *25.04 Speed derivation time*.	8 ms
	0…10000 ms	Derivation filter time constant.	1 = 1 ms

<table>
<tr><th>No.</th><th>Name/Value</th><th>Description</th><th>Def/FbEq16</th></tr>
<tr><td>25.06</td><td>Acc comp derivation time</td><td>Defines the derivation time for acceleration(/deceleration) compensation. In order to compensate for 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:


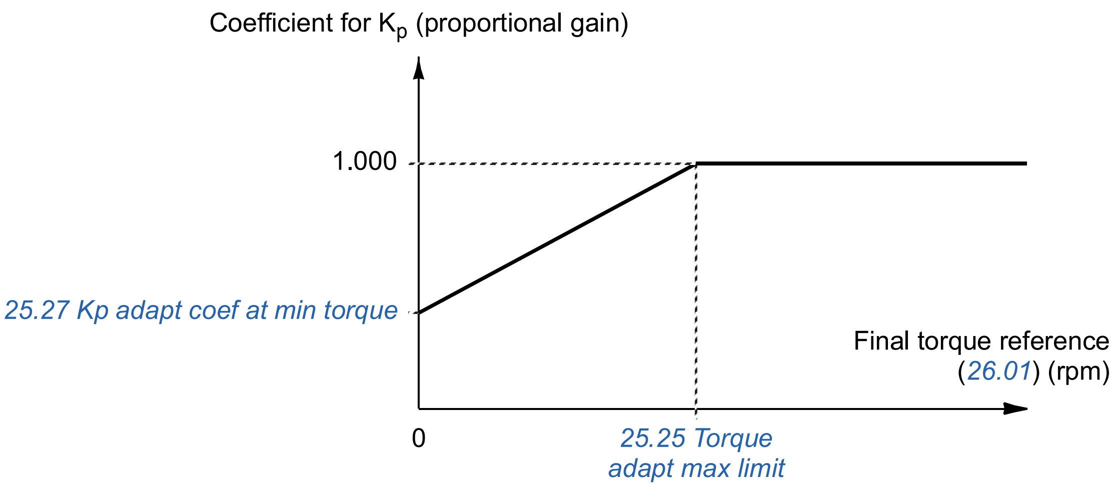
Acceleration compensation:

</td><td>0.00 s</td></tr>
<tr><td></td><td>0.00 … 1000.00 s</td><td>Acceleration compensation derivation time.</td><td>10 = 1 s</td></tr>
<tr><td>25.07</td><td>Acc comp filter time</td><td>Defines the acceleration (or deceleration) compensation filter time constant. See parameters 25.04 Speed derivation time and 25.06 Acc comp derivation time.</td><td>8.0 ms</td></tr>
<tr><td></td><td>0.0 … 1000.0 ms</td><td>Acceleration/deceleration compensation filter time.</td><td>1 = 1 ms</td></tr>
</table>

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.  		
	0.00 … 100.00%	Droop rate.	100 = 1%
25.11	*Speed control min torque*	Defines the minimum speed controller output torque.	-300.0%
	-1600.0 … 0.0%	Minimum speed controller output torque.	See par. *46.03*
25.12	*Speed control max torque*	Defines the maximum speed controller output torque.	300.0%
	0.0 … 1600.0%	Maximum speed controller output torque.	See par. *46.03*
25.13	*Min torq sp ctrl em stop*	Defines the minimum speed controller output torque during a ramped emergency stop (Off1 or Off3).	-400.0%
	-1600.0 … 0.0%	Minimum speed controller output torque for ramped emergency stop.	See par. *46.03*
25.14	*Max torq sp ctrl em stop*	Defines the maximum speed controller output torque during a ramped emergency stop (Off1 or Off3).	400.0%
	0.0 … 1600.0%	Maximum speed controller output torque for ramped emergency stop.	See par. *46.03*

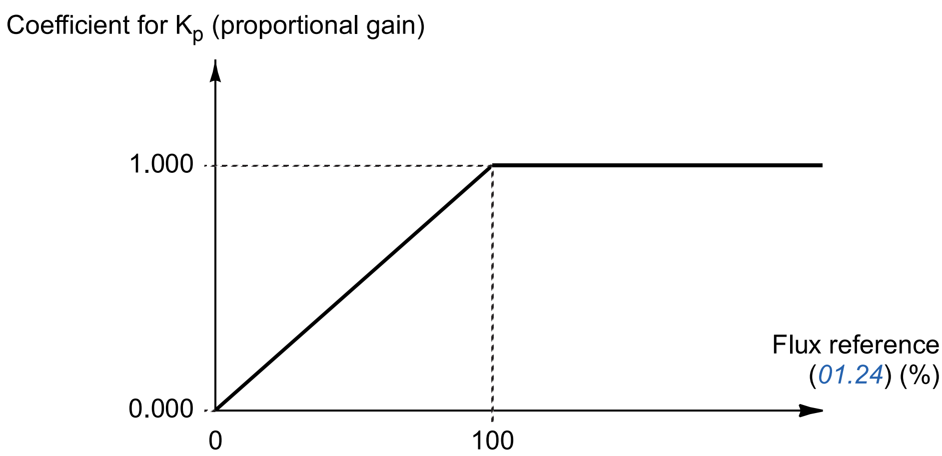
No.	Name/Value	Description	Def/FbEq16
25.15	*Proportional gain em stop*	Defines the proportional gain for the speed controller when an emergency stop is active. See parameter *25.02 Speed proportional gain*.	10.00: 5.00 (*95.21* b1)
	1.00 … 250.00	Proportional gain upon an emergency stop.	100 = 1
25.18	*Speed adapt min limit*	Minimum actual speed for speed controller adaptation. Speed controller gain and integration time can be adapted according to actual speed (*90.01 Motor speed for control*). This is done by multiplying the gain (*25.02 Speed proportional gain*) and integration time (*25.03 Speed integration time*) by coefficients at certain speeds. The coefficients are defined individually for both gain and integration time. When actual speed is below or equal to *25.18 Speed adapt min limit*, the gain and integration time are multiplied by *25.21 Kp adapt coef at min speed* and *25.22 Ti adapt coef at min speed* respectively. When actual speed is equal to or above *25.19 Speed adapt max limit*, no adaptation takes place (the coefficient is 1). When actual speed is between *25.18 Speed adapt min limit* and *25.19 Speed adapt max limit*, the coefficients for the gain and integration time are calculated linearly on the basis of the breakpoints. See also the control chain diagram on page *669*.	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 control chain diagram on page *669*. 	0.0%
	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 control chain diagram on page *669*.	*Enable*

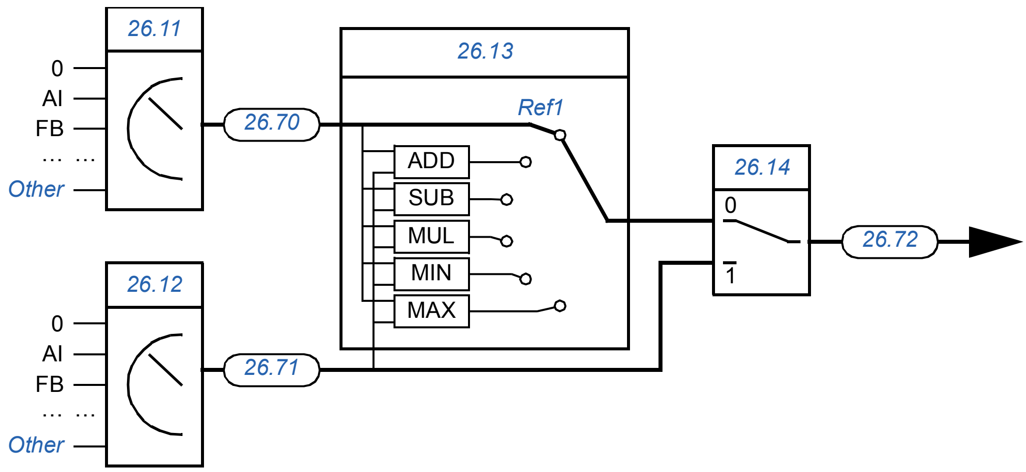


No.	Name/Value	Description	Def/FbEq16
	Disable	Speed controller adaptation based on flux reference disabled.	0
	Enable	Speed controller adaptation based on flux reference enabled.	1
25.33	*Speed controller autotune*	Activates (or selects a source that activates) the speed controller autotune function. See section *Speed controller autotune* (page *158*). 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
	Other [bit]	Source selection (see *Terms and abbreviations* on page *199*).	-

No.	Name/Value	Description	Def/FbEq16
25.34	*Speed controller autotune mode*	Defines a control preset for the speed controller autotune function. The setting affects the way the torque reference will respond to a speed reference step.	*Normal*
	Smooth	Slow but robust response.	0
	Normal	Medium setting.	1
	Tight	Fast response. May produce too high a gain value for some applications.	2
25.37	*Mechanical time constant*	Mechanical time constant of the drive and the machinery as determined by the speed controller autotune function. The value can be adjusted manually.	-
	0.00 … 1000.00 s	Mechanical time constant.	10 = 1 s
25.38	*Autotune torque step*	Defines an added torque value used by the autotune function. This value is scaled to motor nominal torque. Note that the torque used by the autotune function can also be limited by the torque limits (in parameter group *30 Limits*) and nominal motor torque.	10.00%
	0.00 … 100.00%	Autotune torque step.	100 = 1%
25.39	*Autotune speed step*	Defines a speed value added to the initial speed for the autotune routine. The initial speed (speed used when autotune is activated) plus the value of this parameter is the calculated maximum speed used by the autotune routine. The maximum speed can also be limited by the speed limits (in parameter group *30 Limits*) and nominal motor speed. The value is scaled to motor nominal speed. **Note:** The motor will exceed the calculated maximum speed slightly at the end of each acceleration stage.	10.00%
	0.00 … 100.00%	Autotune speed step.	100 = 1%
25.40	*Autotune repeat times*	Determines how many acceleration/deceleration cycles are performed during the autotune routine. Increasing the value will improve the accuracy of the autotune function, and allow the use of smaller torque or speed step values.	10
	1…10	Number of cycles during autotune routine.	1 = 1
25.53	*Torque prop reference*	Displays the output of the proportional (P) part of the speed controller. See the control chain diagram on page *669*. 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 *669*. 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 *669*. This parameter is read-only.	-
	-30000.0 … 30000.0%	D-part output of speed controller.	See par. *46.03*

No.	Name/Value	Description	Def/FbEq16
25.56	*Torque acc compensation*	Displays the output of the acceleration compensation function. See the control chain diagram on page *669*. 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 *669*. This parameter is read-only.	-
	-30000.0 … 30000.0%	Acceleration-compensated output of speed controller.	See par. *46.03*
26 Torque reference chain		Settings for the torque reference chain. See the control chain diagrams on pages *670* and *672*.	
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 *672* and *673*. 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 *673*. This parameter is read-only.	-
	-1600.0 … 1600.0%	Torque reference for torque control.	See par. *46.03*
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*

No.	Name/Value	Description	Def/FbEq16
26.11	*Torque ref1 source*	Selects torque reference source 1. Two signal sources can be defined by this parameter and *26.12 Torque ref2 source*. A digital source selected by *26.14 Torque ref1/2 selection* can be used to switch between the two sources, or a mathematical function (*26.13 Torque ref1 function*) applied to the two signals to create the reference.	*Zero*



	Zero	None.	0
	AI1 scaled	*12.12 AI1 scaled value* (see page *247*).	1
	AI2 scaled	*12.22 AI2 scaled value* (see page *249*).	2
	FB A ref1	*03.05 FB A reference 1* (see page *207*).	4
	FB A ref2	*03.06 FB A reference 2* (see page *207*).	5
	EFB ref1	*03.09 EFB reference 1* (see page *207*).	8
	EFB ref2	*03.10 EFB reference 2* (see page *207*).	9
	DDCS ctrl ref1	*03.11 DDCS controller ref 1* (see page *208*).	10
	DDCS ctrl ref2	*03.12 DDCS controller ref 2* (see page *208*).	11
	M/F reference 1	*03.13 M/F or D2D ref1* (see page *208*).	12
	M/F reference 2	*03.14 M/F or D2D ref2* (see page *208*).	13
	Motor potentiometer	*22.80 Motor potentiometer ref act* (output of the motor potentiometer).	15
	PID	Not in use.	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 *135*).	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 *135*).	19
	Other	Source selection (see *Terms and abbreviations* on page *199*).	-
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*

No.	Name/Value	Description	Def/FbEq16
26.13	*Torque ref1 function*	Selects a mathematical function between the reference sources selected by parameters *26.11 Torque ref1 source* and *26.12 Torque ref2 source*. See diagram at *26.11 Torque ref1 source*.	*Ref1*
	Ref1	Signal selected by *26.11 Torque ref1 source* is used as torque reference 1 as such (no function applied).	0
	Add (ref1 + ref2)	The sum of the reference sources is used as torque reference 1.	1
	Sub (ref1 - ref2)	The subtraction ([*26.11 Torque ref1 source*] - [*26.12 Torque ref2 source*]) of the reference sources is used as torque reference 1.	2
	Mul (ref1 × 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 *199*).	-
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 *670*. 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

No.	Name/Value	Description	Def/FbEq16
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!** If the additive 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 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 *672*. 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
	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 *199*).	-
26.41	*Torque step*	When enabled by parameter *26.42 Torque step enable*, adds an additional step to the torque reference. ⚠ **WARNING!** If the 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 removed when a ramp stop is required eg. by using parameter *26.42 Torque step enable*.	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

No.	Name/Value	Description	Def/FbEq16
	Enable	Torque step enabled.	1
26.51	*Oscillation damping*	Parameters *26.51*…*26.58* configure the oscillation damping function. See section *Oscillation damping* (page *161*), and the block diagram on page *672*. 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 *199*).	-
26.52	*Oscillation damping out enable*	Determines (or selects a source that determines) whether the output of the oscillation damping function is applied to the torque reference or not. **Note:** Before enabling the oscillation damping output, adjust parameters *26.53*…*26.57*. Then monitor the input signal (selected by *26.53*) and the output (*26.58*) to make sure that the correction is safe to apply. 1 = Apply oscillation damping output to torque reference	*Not selected*
	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 *199*).	-
26.53	*Oscillation compensation input*	Selects the input signal for the oscillation damping function. **Note:** Before changing this parameter run-time, disable the oscillation damping output using parameter *26.52*. Monitor the behavior of *26.58* before re-enabling the output.	*Speed error*
	Speed error	-(*24.04 Speed error inverted*), ie. *24.01 Used speed reference* - *24.02 Used speed feedback*. **Note:** This setting is not supported in scalar motor control mode.	0

No.	Name/Value	Description	Def/FbEq16
	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
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 *670*. 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 (selected by parameter *26.12 Torque ref2 source*). See the control chain diagram on page *670*. 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 *670*. This parameter is read-only.	-
	-1600.0 … 1600.0%	Torque reference after selection.	See par. *46.03*

No.	Name/Value	Description	Def/FbEq16
26.73	*Torque reference act 4*	Displays the torque reference after application of reference additive 1. See the control chain diagram on page 670. 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 670. 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 672. This parameter is read-only.	-
	-1600.0 … 1600.0%	Torque reference after control mode selection.	See par. 46.03
26.76	*Torque reference act 6*	Displays the torque reference after application of reference additive 2. See the control chain diagram on page 672. 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 672. 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 672. 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 163).	10.0
	0.0 …10000.0	Rush controller gain (0.0 = disabled).	1 = 1
26.82	*Rush control integration time*	Rush controller integration time term.	2.0 s
	0.0 …10.0 s	Rush controller integration time (0.0 = disabled).	1 = 1 s

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

Bit	Name	Description
0	Torq lim	1 = Drive torque is being limited by the motor control (undervoltage control, current control, load angle control or pull-out control), or by the torque limits defined by parameters.
1	Spd ctl tlim min	1 = Speed controller output is being limited by *25.11 Speed control min torque*
2	Spd ctl tlim max	1 = Speed controller output is being limited by *25.12 Speed control max torque*
3	Torq ref max	1 = Torque reference ramp input is being limited by *26.09 Maximum torque ref*, source of *30.25 Maximum torque sel*, *30.26 Power motoring limit* or *30.27 Power generating limit*. See diagram on page *673*.
4	Torq ref min	1 = Torque reference ramp input is being limited by *26.08 Minimum torque ref*, source of *30.18 Minimum torque sel*, *30.26 Power motoring limit* or *30.27 Power generating limit*. See diagram on page *673*.
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 eg. output filtering or ATEX-related protections)
13…15	Reserved	

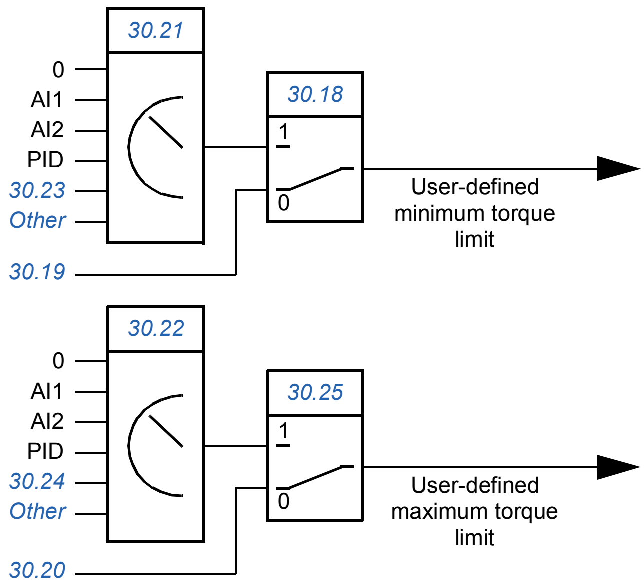
	0000h…FFFFh	Limit word 1.	1 = 1

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

Bit	Name	Description
0	Undervoltage	*1 = Intermediate DC circuit undervoltage
1	Overvoltage	*1 = Intermediate DC circuit overvoltage
2	Minimum torque	*1 = Torque is being limited by *30.26 Power motoring limit*, *30.27 Power generating limit* or the source of *30.18 Minimum torque sel*. See diagram on page *673*.
3	Maximum torque	*1 = Torque is being limited by *30.20 Maximum torque 1*, *30.26 Power motoring limit* or *30.27 Power generating limit*
4	Internal current	1 = An inverter current limit (identified by bits 8…11) is active
5	Load angle	(With permanent magnet motors and synchronous reluctance motors only) 1 = Load angle limit is active, ie. the motor cannot produce any more torque
6	Motor pullout	(With asynchronous motors only) Motor pull-out limit is active, ie. the motor cannot produce anymore 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…11 can be on simultaneously. The bit typically indicates the limit that is exceeded first.		

	0000h…FFFFh	Torque limitation status word.	1 = 1
30.11	*Minimum speed*	Defines the minimum allowed speed. **WARNING!** This value must not be higher than *30.12 Maximum speed*. **WARNING!** In frequency control mode, this limit is not effective. Make sure the frequency limits (*30.13* and *30.14*) are set appropriately if frequency control is used.	-1500.00 rpm; -1800.00 rpm (*95.20* b0)
	-30000.00 … 30000.00 rpm	Minimum allowed speed.	See par. *46.01*
30.12	*Maximum speed*	Defines the maximum allowed speed. **WARNING!** This value must not be lower than *30.11 Minimum speed*. **WARNING!** In frequency control mode, this limit is not effective. Make sure the frequency limits (*30.13* and *30.14*) are set appropriately if frequency control is used.	1500.00 rpm; 1800.00 rpm (*95.20* b0)
	-30000.00 … 30000.00 rpm	Maximum speed.	See par. *46.01*

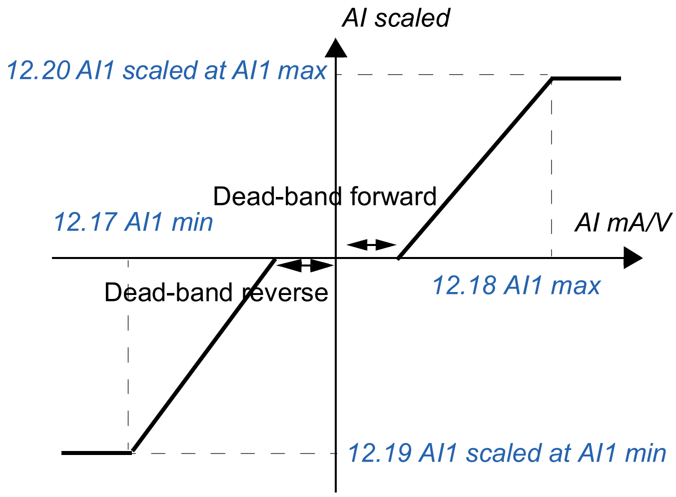
No.	Name/Value	Description	Def/FbEq16
30.13	*Minimum frequency*	Defines the minimum allowed frequency. **WARNING!** This value must not be higher than *30.14 Maximum frequency*. **WARNING!** This limit is effective in frequency control mode only.	-50.00 Hz; -60.00 Hz (*95.20* b0)
	-500.00 … 500.00 Hz	Minimum frequency.	See par. *46.02*
30.14	*Maximum frequency*	Defines the maximum allowed frequency. **WARNING!** This value must not be lower than *30.13 Minimum frequency*. **WARNING!** This limit is effective in frequency control mode only.	50.00 Hz; 60.00 Hz (*95.20* b0)
	-500.00 … 500.00 Hz	Maximum frequency.	See par. *46.02*
30.15	*Maximum start current enable*	A temporary motor current limit specifically for starting can be defined by this parameter and *30.16 Maximum start current*. When this parameter is set to *Enable*, the drive observes the start current limit defined by *30.16 Maximum start current*. The limit is in force for 2 seconds after initial magnetization (of an asynchronous induction motor) or autophasing (of a permanent magnet motor), but not more often than once in every 7 seconds. Otherwise, the limit defined by *30.17 Maximum current* is in force. **Note:** The availability of a start current higher than the general limit depends on drive hardware.	*Disable*
	Disable	Start current limit disabled.	0
	Enable	Start current limit enabled.	1
30.16	*Maximum start current*	Defines 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 *673*.	*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 *199*).	-

No.	Name/Value	Description	Def/FbEq16
30.19	*Minimum torque 1*	Defines a minimum torque limit for the drive (in percent of nominal motor torque). See diagram at parameter *30.18 Minimum torque sel*. The limit is effective when • the source selected by *30.18 Minimum torque sel* is 0, or • *30.18* is set to *Minimum torque 1*.	-300.0%
	-1600.0 … 1600.0%	Minimum torque limit 1.	See par. *46.03*
30.20	*Maximum torque 1*	Defines a maximum torque limit for the drive (in percent of nominal motor torque). See diagram at parameter *30.18 Minimum torque sel*. The limit is effective when • the source selected by *30.25 Maximum torque sel* is 0, or *30.25* is set to *Maximum torque 1*.	300.0%
	-1600.0 … 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 *247*).	1
	AI2 scaled	*12.22 AI2 scaled value* (see page *249*).	2
	PID	Not in use.	5
	Minimum torque 2	*30.23 Maximum torque 2*.	6
	Other	Source selection (see *Terms and abbreviations* on page *199*).	-
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 *247*).	1
	AI2 scaled	*12.22 AI2 scaled value* (see page *249*).	2
	PID	Not in use.	5
	Maximum torque 2	*30.24 Maximum torque 2*.	6
	Other	Source selection (see *Terms and abbreviations* on page *199*).	-

No.	Name/Value	Description	Def/FbEq16
30.23	*Minimum torque 2*	Defines the minimum torque limit for the drive (in percent of nominal motor torque) when • the source selected by parameter *30.18 Minimum torque sel* is 1, and • *30.21* is set to *Minimum torque 2*. See diagram at *30.18 Minimum torque sel*.	-300.0%
	-1600.0 … 0.0%	Minimum torque limit 2.	See par. *46.03*
30.24	*Maximum torque 2*	Defines the maximum torque limit for the drive (in percent of nominal motor torque) when • the source selected by parameter *30.25 Maximum torque sel* is 1, and • *30.22* is set to *Maximum torque 2*. See diagram at *30.18 Minimum torque sel*.	300.0%
	0.0 … 1600.0%	Maximum torque limit 2.	See par. *46.03*
30.25	*Maximum torque sel*	Selects a source that switches between two different maximum torque limits. 0 = Maximum torque limit 1 defined by *30.20* is active 1 = Maximum torque limit selected by *30.22* is active See also parameter *30.18 Minimum torque sel*.	*Maximum torque 1*
	Maximum torque 1	0.	0
	Maximum torque 2 source	1.	1
	DI1	Digital input DI1 (*10.02 DI delayed status*, bit 0).	2
	DI2	Digital input DI2 (*10.02 DI delayed status*, bit 1).	3
	DI3	Digital input DI3 (*10.02 DI delayed status*, bit 2).	4
	DI4	Digital input DI4 (*10.02 DI delayed status*, bit 3).	5
	DI5	Digital input DI5 (*10.02 DI delayed status*, bit 4).	6
	DI6	Digital input DI6 (*10.02 DI delayed status*, bit 5).	7
	DIO1	Digital input/output DIO1 (*11.02 DIO delayed status*, bit 0).	10
	DIO2	Digital input/output DIO2 (*11.02 DIO delayed status*, bit 1).	11
	Other [bit]	Source selection (see *Terms and abbreviations* on page *199*).	-
30.26	*Power motoring limit*	Defines the maximum allowed power fed by the inverter to the motor in percent of nominal motor power.	300.00%
	0.00 … 600.00%	Maximum motoring power.	1 = 1%
30.27	*Power generating limit*	Defines the maximum allowed power fed by the motor to the inverter in percent of nominal motor power.	-300.00%
	-600.00 … 0.00%	Maximum generating power.	1 = 1%
30.30	*Overvoltage control*	Enables the overvoltage control of the intermediate DC link. Fast braking of a high inertia load causes the voltage to rise to the overvoltage control limit. To prevent the DC voltage from exceeding the limit, the overvoltage controller automatically decreases the braking torque. **Note:** If the drive is equipped with a brake chopper and resistor, or a regenerative supply unit, the controller must be disabled.	*Disable*
	Disable	Overvoltage control disabled.	0

No.	Name/Value	Description	Def/FbEq16
	Enable	Overvoltage control enabled.	1
30.31	*Undervoltage control*	Enables the undervoltage control of the intermediate DC link. If the DC voltage drops due to input power cut off, the undervoltage controller will automatically decrease the motor torque in order to keep the voltage above the lower limit. By decreasing the motor torque, the inertia of the load will cause regeneration back to the drive, keeping the DC link charged and preventing an undervoltage trip until the motor coasts to a stop. This will act as a power-loss ride-through functionality in systems with high inertia, such as a centrifuge or a fan.	*Enable*
	Disable	Undervoltage control disabled.	0
	Enable	Undervoltage control enabled.	1
30.200	*External speed limits*	Selects the source for activating the External speed limitation command. 0 = External speed limitation command is inactive. 1 = External speed limitation command is active. When the command is active, the drive speed reference is limited to the value defined with parameter *30.201 External min speed limit* or *30.202 External max speed limit*, depending on the motor direction. For more information on the function, see section *External speed limitation* on page *86*.	*Disable*
	Disable	0.	0
	Enable	1.	1
	DI1	Digital input DI1 (*10.02 DI delayed status*, bit 0).	2
	DI2	Digital input DI2 (*10.02 DI delayed status*, bit 1).	3
	DI3	Digital input DI3 (*10.02 DI delayed status*, bit 2).	4
	DI4	Digital input DI4 (*10.02 DI delayed status*, bit 3).	5
	DI5	Digital input DI5 (*10.02 DI delayed status*, bit 4).	6
	DI6	Digital input DI6 (*10.02 DI delayed status*, bit 5).	7
	Other [bit]	Source selection (see *Terms and abbreviations* on page *199*).	-
30.201	*External min speed limit*	Defines the speed reference limit used in the reverse direction when the External speed limit command (*30.200 External speed limits*) is active.	-300.00 rpm
	-30000.00 … 0.00 rpm	External minimum speed limit.	1 = 1 rpm
30.202	*External max speed limit*	Defines the speed reference limit used in the forward direction when the External speed limit command (*30.200 External speed limits*) is active.	300.00 rpm
	0.00 … 30000.00 rpm	External maximum speed limit.	1 = 1 rpm

No.	Name/Value	Description	Def/FbEq16
30.203	*Deadband forward*	Defines the dead-band area for the positive speed reference when the speed reference is taken from an analog input. The analog speed reference is blocked for the dead-band area, and the speed reference is scaled from the dead-band forward value (*30.203*) to 100% instead of 0 to 100% of the analog input. This diagram shows the effect of the dead-band forward (*30.203*) and dead-band reverse (*30.204*) values when analog input 1 () is the source of the speed reference.  For more information, see section *Dead-band function* on page *83*.	2.00%
	0.00 … 100.00%	Dead-band forward setting in percent of the analog input signal (*12.11 AI1 actual value*).	10 = 1.0%
30.204	*Deadband reverse*	Defines the dead-band area for the negative speed reference when the speed reference is taken from an analog input. The analog speed reference is blocked for the dead-band area, and the speed reference is scaled from the dead-band reverse value (*30.204*) to 100% instead of 0 to 100% of the analog input. See the diagram in parameter *30.203 Deadband forward* for the effect of the dead-band reverse value in the reference scaling.	2.00%
	0.00 … 100.00%	Dead-band reverse setting in percent of the analog input signal (*12.11 AI1 actual value*).	10 = 1.0%

31 Fault functions		Settings that define the 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

No.	Name/Value	Description	Def/FbEq16
	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 *199*).	-
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)*

No.	Name/Value	Description	Def/FbEq16
31.10	*External event 5 type*	Selects the type of external event 5.	
	Fault	The external event generates a fault.	0
	Warning	The external event generates a warning.	1
	Warning/Fault	If the drive is modulating, the external event generates a fault. Otherwise, the event generates a warning.	3
31.11	*Fault reset selection*	Selects the source of an external fault reset signal. The signal resets the drive after a fault trip if the cause of the fault no longer exists. 0 -> 1 = Reset **Note:** A fault reset from the fieldbus interface is always observed regardless of this parameter.	*DI3*
	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 *199*).	-

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*. **Note:** The autoreset function is only available in external control; see section *Local control vs. external control* (page *134*). The bits of the 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 *579*).	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.	-
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

No.	Name/Value	Description	Def/FbEq16
31.16	*Delay time*	Defines the time that the drive will wait after a fault (or a previous reset attempt) before attempting an automatic reset. See parameter *31.12 Autoreset selection*.	0.0 s
	0.0 … 120.0 s	Autoreset delay.	10 = 1 s
31.19	*Motor phase loss*	Selects how the drive reacts when a motor phase loss is detected.	*Fault*
	No action	No action taken.	0
	Fault	The drive trips on fault *3381 Output phase loss*.	1
31.20	*Earth fault*	Selects how the drive reacts when an earth fault or current unbalance is detected in the motor or the motor cable.	*Fault*
	No action	No action taken.	0
	Warning	The drive generates an *A2B3 Earth leakage* warning.	1
	Fault	The drive trips on fault *2330 Earth leakage*.	2
31.21	*Supply phase loss*	Selects how the drive reacts when a supply phase loss is detected.	*Fault*
	No action	No action taken.	0
	Fault	The drive trips on fault *3130 Input phase loss*.	1
31.22	*STO indication run/stop*	Selects which indications are given when one or both Safe torque off (STO) signals are switched off or lost. The indications also depend on whether the drive is running or stopped when this occurs. The tables at each selection below show the indications generated with that particular setting. **Notes:** • This parameter does not affect the operation of the STO function itself. The STO function will operate regardless of the setting of this parameter: a running drive will stop upon removal of one or both STO signals, and will not start until both STO signals are restored and all faults reset. • The loss of only one STO signal always generates a fault as it is interpreted as a malfunction. For more information on the STO, see the *Hardware manual* of the drive.	*Fault/Fault*
	Fault/Fault	(see table below)	0

Inputs IN1	Inputs IN2	Indication (running or stopped)
0	0	Fault *5091 Safe torque off*
0	1	Faults *5091 Safe torque off* and *FA81 Safe torque off 1 loss*
1	0	Faults *5091 Safe torque off* and *FA82 Safe torque off 2 loss*
1	1	(Normal operation)

No.	Name/Value	Description	Def/FbEq16
	Fault/Warning		1

Inputs		Indication	
IN1	IN2	Running	Stopped
0	0	Fault *5091 Safe torque off*	Warning *A5A0 Safe torque off*
0	1	Faults *5091 Safe torque off* and *FA81 Safe torque off 1 loss*	Warning *A5A0 Safe torque off* and fault *FA81 Safe torque off 1 loss*
1	0	Faults *5091 Safe torque off* and *FA82 Safe torque off 2 loss*	Warning *A5A0 Safe torque off* and fault *FA82 Safe torque off 2 loss*
1	1	(Normal operation)	

No.	Name/Value	Description	Def/FbEq16
	Fault/Event		2

Inputs		Indication	
IN1	IN2	Running	Stopped
0	0	Fault *5091 Safe torque off*	Event *B5A0 Safe torque off*
0	1	Faults *5091 Safe torque off* and *FA81 Safe torque off 1 loss*	Event *B5A0 Safe torque off* and fault *FA81 Safe torque off 1 loss*
1	0	Faults *5091 Safe torque off* and *FA82 Safe torque off 2 loss*	Event *B5A0 Safe torque off* and fault *FA82 Safe torque off 2 loss*
1	1	(Normal operation)	

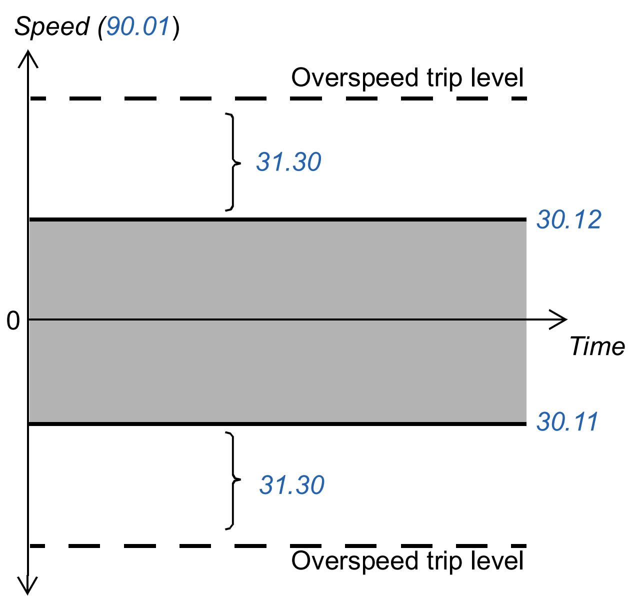
No.	Name/Value	Description	Def/FbEq16
	Warning/Warning		3

Inputs		Indication (running or stopped)
IN1	IN2	
0	0	Warning *A5A0 Safe torque off*
0	1	Warning *A5A0 Safe torque off* and fault *FA81 Safe torque off 1 loss*
1	0	Warning *A5A0 Safe torque off* and fault *FA82 Safe torque off 2 loss*
1	1	(Normal operation)

No.	Name/Value	Description	Def/FbEq16
	Event/Event		4

Inputs		Indication (running or stopped)
IN1	IN2	
0	0	Event *B5A0 Safe torque off*
0	1	Event *B5A0 Safe torque off* and fault *FA81 Safe torque off 1 loss*
1	0	Event *B5A0 Safe torque off* and fault *FA82 Safe torque off 2 loss*
1	1	(Normal operation)

<table>
<tr><th>No.</th><th>Name/Value</th><th>Description</th><th>Def/FbEq16</th></tr>
<tr><td></td><td>No indication/No indication</td><td><table><tr><th colspan="2">Inputs</th><th rowspan="2">Indication (running or stopped)</th></tr><tr><th>IN1</th><th>IN2</th></tr><tr><td>0</td><td>0</td><td>None</td></tr><tr><td>0</td><td>1</td><td>Fault FA81 Safe torque off 1 loss</td></tr><tr><td>1</td><td>0</td><td>Fault FA82 Safe torque off 2 loss</td></tr><tr><td>1</td><td>1</td><td>(Normal operation)</td></tr></table></td><td>5</td></tr>
<tr><td>31.23</td><td>Wiring or earth fault</td><td>Selects how the drive reacts to incorrect input power and motor cable connection (i.e. input power cable is connected to drive motor connection).
Note: The protection must be disabled with drive/inverter hardware supplied from a common DC bus.</td><td>Fault</td></tr>
<tr><td></td><td>No action</td><td>No action taken.</td><td>0</td></tr>
<tr><td></td><td>Fault</td><td>The drive trips on fault 3181 Wiring or earth fault.</td><td>1</td></tr>
<tr><td>31.24</td><td>Stall function</td><td>Selects how the drive reacts to a motor stall condition.
A stall condition is defined as follows:
• The drive exceeds the stall current limit (31.25 Stall current limit), and
• the output frequency is below the level set by parameter 31.27 Stall frequency limit or the motor speed is below the level set by parameter 31.26 Stall speed limit, and
• the conditions above have been true longer than the time set by parameter 31.28 Stall time.</td><td>Fault</td></tr>
<tr><td></td><td>No action</td><td>None (stall supervision disabled).</td><td>0</td></tr>
<tr><td></td><td>Warning</td><td>The drive generates an A780 Motor stall warning.</td><td>1</td></tr>
<tr><td></td><td>Fault</td><td>The drive trips on fault 7121 Motor stall.</td><td>2</td></tr>
<tr><td>31.25</td><td>Stall current limit</td><td>Stall current limit in percent of the nominal current of the motor. See parameter 31.24 Stall function.</td><td>200.0%</td></tr>
<tr><td></td><td>0.0 … 1600.0%</td><td>Stall current limit.</td><td>-</td></tr>
<tr><td>31.26</td><td>Stall speed limit</td><td>Stall speed limit in rpm. See parameter 31.24 Stall function.</td><td>150.00 rpm;
180.00 rpm
(95.20 b0)</td></tr>
<tr><td></td><td>0.00 … 10000.00 rpm</td><td>Stall speed limit.</td><td>See par. 46.01</td></tr>
<tr><td>31.27</td><td>Stall frequency limit</td><td>Stall frequency limit. See parameter 31.24 Stall function.
Note: Setting the limit below 10 Hz is not recommended.</td><td>15.00 rpm;
18.00 rpm
(95.20 b0)</td></tr>
<tr><td></td><td>0.00 … 500.00 Hz</td><td>Stall frequency limit.</td><td>See par. 46.02</td></tr>
<tr><td>31.28</td><td>Stall time</td><td>Stall time. See parameter 31.24 Stall function.</td><td>20 s</td></tr>
<tr><td></td><td>0 … 3600 s</td><td>Stall time.</td><td>-</td></tr>
</table>

No.	Name/Value	Description	Def/FbEq16
31.30	*Overpeed trip margin*	Defines, together with *30.11 Minimum speed* and *30.12 Maximum speed*, the maximum allowed speed of the motor (overspeed protection). If actual speed (*90.01 Motor speed for control*) exceeds the speed limit defined by parameter *30.11* or *30.12* by more than the value of this parameter, the drive trips on the *7310 Overspeed* fault. ⚠ **WARNING!** This function only supervises the speed in DTC motor control mode. The function is not effective in scalar motor control mode. **Example:** If the maximum speed is 1420 rpm and speed trip margin is 300 rpm, the drive trips at 1720 rpm.  	500.00 rpm
	0.00…10000.0 rpm	Overspeed trip margin.	See par. *46.01*
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 mode 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 parameter *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.	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 Off3) is allowed to take. If the motor has not stopped when the time elapses, the drive trips on *73B0 Emergency ramp failed*, sets bit 8 of *06.17 Drive status word 2*, and coasts to a stop. If *31.32* is set to a value other than 0%, this parameter defines a delay between the receipt of the emergency stop command and the activation of the supervision. It is recommended to specify a short delay to allow the speed change rate to stabilize.	0 s
	0…32767 s	Maximum ramp-down time, or supervision activation delay.	1 = 1 s
31.35	*Main fan fault function*	Selects how the drive reacts when a main cooling fan fault is detected.	*Fault*
	Fault	The drive trips on fault *5080 Fan*.	0
	Warning	The drive generates an *A581 Fan* warning.	1
	No action	No action taken.	2
31.36	*Aux fan fault bypass*	*(Only visible with a ZCU control unit)* Temporarily suppresses auxiliary fan faults. Certain drive types (especially those protected to IP55) have an auxiliary fan built into the front cover as standard. If the fan is sticking or disconnected, the control program first generates a warning (*A582 Auxiliary fan missing*), then a fault (*5081 Auxiliary fan broken*). If it is necessary to operate the drive without the front cover (for example, during commissioning), this parameter can be activated to temporarily suppress the fault. **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 only suppresses the fault, not the warning. • The parameter will be in effect until the auxiliary fan is reconnected and detected, or until the next control unit reboot.	*Off*
	Off	Normal operation.	0
	Temporarily bypassed	The auxiliary fan fault indication is temporarily suppressed. The setting will revert automatically to *Off*.	1

<table>
<tr><th>No.</th><th>Name/Value</th><th>Description</th><th>Def/FbEq16</th></tr>
<tr><td>31.37</td><td>Ramp stop supervision</td><td>Parameters 31.37 Ramp stop supervision and 31.38 Ramp stop supervision delay, together with 01.29 Speed change rate, provide a supervision function for normal (ie. non-emergency) ramp stopping.
The supervision is based on either
• observing the time within which the motor stops, or
• comparing the actual and expected deceleration rates.
If this parameter is set to 0%, the maximum stop time is directly set in parameter 31.38. Otherwise, 31.37 defines the maximum allowed deviation from the expected deceleration rate, which is calculated from parameters 23.11...23.19. If the actual deceleration rate (01.29) deviates too much from the expected rate, the drive trips on 73B1 Stop failed, sets bit 14 of 06.17 Drive status word 2, and coasts to a stop.
If 31.32 is set to 0% and 31.33 is set to 0 s, the ramp stop supervision is disabled.</td><td>0%</td></tr>
<tr><td></td><td>0…300%</td><td>Maximum deviation from expected deceleration rate.</td><td>1 = 1%</td></tr>
<tr><td>31.38</td><td>Ramp stop supervision delay</td><td>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.</td><td>0 s</td></tr>
<tr><td></td><td>0…32767 s</td><td>Maximum ramp-down time, or supervision activation delay.</td><td>1 = 1 s</td></tr>
<tr><td>31.40</td><td>Disable warnings</td><td>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:
<table><tr><th>Bit</th><th>Fault</th></tr><tr><td>0</td><td>Overvoltage</td></tr><tr><td>1</td><td>Reserved</td></tr><tr><td>2</td><td>Encoder 1</td></tr><tr><td>3</td><td>Encoder 2</td></tr><tr><td>4…15</td><td>Reserved</td></tr></table></td><td>0000b</td></tr>
<tr><td></td><td>0000b…0001b</td><td>Warning suppression word.</td><td>1 = 1</td></tr>
<tr><td>31.42</td><td>Overcurrent fault limit</td><td>Sets a custom motor current fault limit.
The drive automatically sets an internal motor current limit according to the drive hardware. The internal limit is appropriate in most cases, but this parameter can be used to set a lower current limit, for example, to protect a permanent magnet motor from demagnetization.
With this parameter at 0.0 A, only the internal limit is in force.</td><td>-</td></tr>
<tr><td></td><td>0.0 … 30000.0 A</td><td>Custom motor current fault limit.</td><td>See par. 46.05</td></tr>
</table>

No.	Name/Value	Description	Def/FbEq16
31.200	*Motor overspeed level*	Defines the motor overspeed level. The parameter value is applicable in both forward and reverse directions. For more information on the function, see section *Motor overspeed monitoring* on page *95*.	2000.00 rpm
	0.00 … 30000.00 rpm	Motor overspeed level.	1 = 1 rpm
31.201	*Motor overspeed level delay*	Defines the time delay for generating fault *D104 Over speed* after the motor speed has exceeded the level defined with parameter *31.200 Motor overspeed level*.	1000 ms
	0…30000 ms	Time delay.	1 = 1 ms
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. For more information on the function, see section *Inverter overload detection* on page *96*.	000000b

Bit	Name	Description
0	Minimum torque	See parameter *30.02 Torque limit status*.
1	Maximum torque	See parameter *30.02 Torque limit status*.
2	Maximum current	See parameter *30.02 Torque limit status*.
3	Load angle	See parameter *30.02 Torque limit status*.
4	Motor pullout	See parameter *30.02 Torque limit status*.
5	User bit	A bit of your own selection.
6…15	Reserved	

No.	Name/Value	Description	Def/FbEq16
	000000b…111111b	Inverter current and torque limit bits.	-
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.	0
	True	1.	1
	DI1	Digital input DI1 (*10.02 DI delayed status*, bit 0).	2
	DI2	Digital input DI2 (*10.02 DI delayed status*, bit 1).	3
	DI3	Digital input DI3 (*10.02 DI delayed status*, bit 2).	4
	DI4	Digital input DI4 (*10.02 DI delayed status*, bit 3).	5
	DI5	Digital input DI5 (*10.02 DI delayed status*, bit 4).	6
	DI6	Digital input DI6 (*10.02 DI delayed status*, bit 5).	7
	Other [bit]	Source selection (see *Terms and abbreviations* on page *199*).	-
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*.	3000 ms
	0…30000 s	Time delay.	1 = 1 ms

No.	Name/Value	Description	Def/FbEq16
31.205	*Crane warning masking*	Selects which crane control warnings trigger events to the drive. Whenever a bit of this parameter is set to 1, the corresponding warning can trigger an event. If a bit is set to 0, the warning does not appear in the event logger or control panel, and the warning can be read only from parameters *09.01 Crane SW1* and *09.02 Crane SW2*. The bits of this binary number correspond to the following warnings:	11111111b

Bit	Name	Warning
0	Brake slip at standstill	*D200 Brake slip at standstill2*
1	Slowdown up/down	*D201 Slowdown up*, *D202 Slowdown down*
2	Slowdown safe zone	*D20C Slowdown safe zone*
3	Hoist speed up/down limit	*D203 Hoist speed up limit*, *D204 Hoist speed down limit*
4	End limit upper/lower	*D205 Upper limit2*, *D206 Lower limit2*
5	External speed limit	*D20D External speed limit2*
6	Joystick reference check	*D208 Joystick reference check*
7	Joystick zero position	*D209 Joystick zero position2*
8	Power on acknowledge	*D20B Power on acknowledge*
9	Slack rope	*D217 Slack rope*
10	Fast stop	*D20A Fast stop*
11	Follower drive faulted	*E200 Follower 1 faulted*, *E201 Follower 2 faulted*, *E202 Follower 3 faulted*, *D20F Follower 4 Faulted*
12…15	Reserved	

No.	Name/Value	Description	Def/FbEq16
	00000000b… 11111111b	Crane control warnings that trigger events to the drive.	-
31.211	*Toggle bit enable*	Selects the source for enabling the Toggle bit function.	*Disable*
	Disable	Toggle bit function is disabled.	0
	Enable	Toggle bit function is enabled.	1
	DI1	Digital input DI1 (*10.02 DI delayed status*, bit 0).	2
	DI2	Digital input DI2 (*10.02 DI delayed status*, bit 1).	3
	DI3	Digital input DI3 (*10.02 DI delayed status*, bit 2).	4
	DI4	Digital input DI4 (*10.02 DI delayed status*, bit 3).	5
	DI5	Digital input DI5 (*10.02 DI delayed status*, bit 4).	6
	DI6	Digital input DI6 (*10.02 DI delayed status*, bit 5).	7
	Const	Bit point setting (see *Terms and abbreviations* on page *199*).	-
	Pointer		
31.212	*Toggle bit action*	Selects how the drive reacts when there is communication loss between the overriding system and the drive in both directions.	*Warning*
	Warning	The drive generates a warning (*D210 Toggle bit supervision wrn*).	0
	Fault	Drive trips on *D109 Toggle bit supervision flt*.	1

No.	Name/Value	Description	Def/FbEq16
31.213	*Toggle bit time delay*	Defines the delay time for activating warning/fault.	40 ms
	0...1000 ms	Delay time.	1 = 1
31.214	*Toggle bit source*	Selects the source signal from the fieldbus control word to the Toggle bit function. The signal comes, for example, from a overriding system (PLC) through a fieldbus. The function transfers the output from parameter *31.215 Toggle bit statusword*, bit 0, into the overriding system through the fieldbus.	*False*
	False	0.	0
	True	1.	1
	Other	Source selection (see *Terms and abbreviations* on page *199*).	-
31.215	*Toggle bit statusword*	Status word for Toggle bit function.	11111111b

Bit	Name	Description
0	Toggle bit out (pulse out)	This bit should be connected to the status word that is transferred to the overriding system. See *31.214 Toggle bit source*.
1	Warning active	1 = Warning *D210 Toggle bit supervision wrn* is active.
2	Fault active	1 = Fault *D109 Toggle bit supervision flt* is active.
3	Enabled	1 = Toggle bit function is enabled
4…15	Reserved	

No.	Name/Value	Description	Def/FbEq16
	00000000b… 11111111b	Status word.	-
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 *190*).	
32.01	*Supervision status*	Signal supervision status word. Indicates whether the values monitored by the signal supervision functions are within or outside their respective limits. **Note:** This word is independent of the drive actions defined by parameters *32.06*, *32.16* and *32.26*.	0000b

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

No.	Name/Value	Description	Def/FbEq16
	0000…0111b	Signal supervision status word.	1 = 1

No.	Name/Value	Description	Def/FbEq16
32.05	*Supervision 1 function*	Selects the mode of signal supervision function 1. Determines how the monitored signal (see parameter *32.07*) is compared to its lower and upper limits (*32.09* and *32.10* respectively). The action to be taken when the condition is fulfilled is selected by *32.06*.	*Disabled*
	Disabled	Signal supervision 1 not in use.	0
	Low	Action is taken whenever the signal falls below its lower limit.	1
	High	Action is taken whenever the signal rises above its upper limit.	2
	Abs low	Action is taken whenever the absolute value of the signal falls below its (absolute) lower limit.	3
	Abs high	Action is taken whenever the absolute value of the signal rises above its (absolute) upper limit.	4
	Both	Action is taken whenever the signal falls below its low limit or rises above its high limit.	5
	Abs both	Action is taken whenever the absolute value of the signal falls below its (absolute) low limit or rises above its (absolute) high limit.	6
32.06	*Supervision 1 action*	Selects the action the drive takes when the value monitored by signal supervision 1 exceeds its limits. **Note:** This parameter does not affect the status indicated by *32.01 Supervision status*.	*No action*
	No action	No action taken.	0
	Warning	A warning (*A8B0 Signal supervision*) is generated.	1
	Fault	The drive trips on *80B0 Signal supervision*.	2
32.07	*Supervision 1 signal*	Selects the signal to be monitored by signal supervision function 1.	*Zero*
	Zero	None.	0
	Speed	*01.01 Motor speed used* (page *204*).	1
	Frequency	*01.06 Output frequency* (page *204*).	3
	Current	*01.07 Motor current* (page *204*).	4
	Torque	*01.10 Motor torque* (page *204*).	6
	DC voltage	*01.11 DC voltage* (page *204*).	7
	Output power	*01.14 Output power* (page *205*).	8
	AI1	*12.11 AI1 actual value* (page *247*).	9
	AI2	*12.21 AI2 actual value* (page *249*).	10
	Speed ref ramp in	*23.01 Speed ref ramp input* (page *314*).	18
	Speed ref ramp out	*23.02 Speed ref ramp output* (page *314*).	19
	Speed ref used	*24.01 Used speed reference* (page *320*).	20
	Torque ref used	*26.02 Torque reference used* (page *332*).	21
	Freq ref used	Not in use.	22
	Process PID output	Not in use.	24
	Process PID feedback	Not in use.	25
	Other	Source selection (see *Terms and abbreviations* on page *199*).	-

No.	Name/Value	Description	Def/FbEq16
32.08	*Supervision 1 filter time*	Defines a filter time constant for the signal monitored by signal supervision 1.	0.000 s
	0.000 … 30.000 s	Signal filter time.	1000 = 1 s
32.09	*Supervision 1 low*	Defines the lower limit for signal supervision 1.	0.00
	-21474830.00 … 21474830.00	Low limit.	-
32.10	*Supervision 1 high*	Defines the upper limit for signal supervision 1.	0.00
	-21474830.00 … 21474830.00	Upper limit.	-
32.15	*Supervision 2 function*	Selects the mode of signal supervision function 2. Determines how the monitored signal (see parameter *32.17*) is compared to its lower and upper limits (*32.19* and *32.20* respectively). The action to be taken when the condition is fulfilled is selected by *32.16*.	*Disabled*
	Disabled	Signal supervision 2 not in use.	0
	Low	Action is taken whenever the signal falls below its lower limit.	1
	High	Action is taken whenever the signal rises above its upper limit.	2
	Abs low	Action is taken whenever the absolute value of the signal falls below its (absolute) lower limit.	3
	Abs high	Action is taken whenever the absolute value of the signal rises above its (absolute) upper limit.	4
	Both	Action is taken whenever the signal falls below its low limit or rises above its high limit.	5
	Abs both	Action is taken whenever the absolute value of the signal falls below its (absolute) low limit or rises above its (absolute) high limit.	6
32.16	*Supervision 2 action*	Selects the action the drive takes when the value monitored by signal supervision 2 exceeds its limits. **Note:** This parameter does not affect the status indicated by *32.01 Supervision status*.	*No action*
	No action	No action taken.	0
	Warning	A warning (*A8B1 Signal supervision 2*) is generated.	1
	Fault	The drive trips on *80B1 Signal supervision 2*.	2
32.17	*Supervision 2 signal*	Selects the signal to be monitored by signal supervision function 2. For the available selections, see parameter *32.07 Supervision 1 signal*.	*Zero*
32.18	*Supervision 2 filter time*	Defines the 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.	-

No.	Name/Value	Description	Def/FbEq16
32.25	*Supervision 3 function*	Selects the mode of signal supervision function 3. Determines how the monitored signal (see parameter *32.27*) is compared to its lower and upper limits (*32.29* and *32.30* respectively). The action to be taken when the condition is fulfilled is selected by *32.26*.	*Disabled*
	Disabled	Signal supervision 3 not in use.	0
	Low	Action is taken whenever the signal falls below its lower limit.	1
	High	Action is taken whenever the signal rises above its upper limit.	2
	Abs low	Action is taken whenever the absolute value of the signal falls below its (absolute) lower limit.	3
	Abs high	Action is taken whenever the absolute value of the signal rises above its (absolute) upper limit.	4
	Both	Action is taken whenever the signal falls below its low limit or rises above its high limit.	5
	Abs both	Action is taken whenever the absolute value of the signal falls below its (absolute) low limit or rises above its (absolute) high limit.	6
32.26	*Supervision 3 action*	Selects the action the drive takes when the value monitored by signal supervision 3 exceeds its limits. **Note:** This parameter does not affect the status indicated by *32.01 Supervision status*.	*No action*
	No action	No action taken.	0
	Warning	A warning (*A8B2 Signal supervision 3*) is generated.	1
	Fault	The drive trips on *80B2 Signal supervision 3*.	2
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 the 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.	-
32.221	*Watchdog test*	Enables the Watchdog test function. During power-up, the function performs a check-in of the watchdog circuit.	*Disable*
	Disable	Watchdog test function disabled.	0
	Enable	Watchdog test function enabled.	1
	Other	Source selection (see *Terms and abbreviations* on page *199*).	-

No.	Name/Value	Description	Def/FbEq16
32.222	*Watchdog test delay*	Defines the delay time for performing the watchdog test after the Power on acknowledgment signal (parameter *20.212*) is activated.	2.0 s
	0.0 ...10.0 s	Delay time	10 = 1 s
32.223	*Watchdog re test delay*	Defines the delay time to prevent repeating the watchdog tests upon a power-up, after the test has been performed once. With this delay time, you can, • prevent the next watchdog test • make sure that the test is not performed every time the drive is powered up. **Note**: The Watchdog function is applicable only when the drive is using an external power supply. Otherwise, the drive performs the watchdog test every time the drive is powered up without considering this parameter.	1800.0 s
	0.0 ... 1800.0 s	Re-test delay time	10 = 1 s
32.224	*Watchdog fault delay*	Defines the delay time for generating the *D10D Watchdog test fault*, when watchdog test fails.	2.0 s
	0.0 ...10.0 s	Fault delay time	10 = 1 s
32.225	*Watchdog user bit*	Selects the source for the watchdog signal bit used with pre-defined critical warning (alarm) bits for generating the *D10D Watchdog test fault*. When this bit is activated, the drive trips on the fault immediately.	*Disable*
	Disable	Watchdog user bit function disabled.	0
	Enable	Watchdog user bit function enabled.	1
	Other	Source selection (see *Terms and abbreviations* on page *199*).	-

No.	Name/Value	Description	Def/FbEq16
32.226	*Watchdog mask*	Allows to select the warnings that can be monitored by Watchdog function. **Note**: The Brake closing failure (bit 7) warning is active only when the delay time defined with parameter *44.213 Brake long fall delay* elapsed after the brake close command and brake acknowledge is not received. 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 generated. This eliminates the possibility of drive tripping to fault. The bits of this binary number correspond to the following warnings:	-

Bit	Function	Warning	Description
0	Fb A comm	*A7C1 FBA A communication*	1 = Parameter *50.02 FBA A comm loss func* is forced to *Warning*, if previous selection was *Fault* or *Fault always*.
1	Fb B comm	*A7C2 FBA B communication*	1 = Parameter *50.32 FBA B comm loss func* is forced to *Warning*, if previous selection was *Fault* or *Fault always*.
2	M/F comm	*A7CB MF comm loss*	1 = Parameter *60.09 M/F comm loss function* and *60.59 DDCS controller comm loss function* is forced to *Warning*, if previous selection was *Fault* or *Fault always*.
3	Braking resistor failure	*A791 Brake resistor*	Fault reaction cannot be prevented.
4	Braking resistor temp	*A793 BR excess temperature*	
5	Braking chopper failure	*A79B BC short circuit*	
6	Braking chopper temp	*A79C BC IGBT excess temperature*	
7	Brake closing failure	*A7A1 Mechanical brake closing failed*	1 = Parameter *44.17 Brake fault function* is forced to *Open fault*, if previous selection was *Fault*.
8…14	Reserved	-	
15	User bit 1	-	1 = Allows the Watchdog function to monitor the status of the bit selected by pointer parameter *32.225 Watchdog user bit*.

	0000b…0111b	Watchdog warnings.	1 = 1

No.	Name/Value	Description	Def/FbEq16
32.227	*Watchdog sw*	Displays the status of Watchdog function. The word can be used as the source of eg. control relay. This parameter is read-only.	-

Bit	Name	Description
0	Watchdog fault active	1 = Watchdog test failed. *D10D Watchdog test fault* has been detected.
1	Watchdog relay control	0 = Watchdog is Ok 1 = Watchdog tripped **Note**: By default, this bit is connected to relay output RO2 (*10.27 RO2 source*).
2	Watchdog test done	0 = Watchdog test is executing 1 = Watchdog test is done
3…10	Reserved	
11	Test step 1 (internal)	-
12	Test step 2 (internal)	-
13…15	Reserved	

No.	Name/Value	Description	Def/FbEq16
	0b0000…0b1111	Watchdog status word.	1 = 1
32.228	*Watchdog trip sw*	Displays the warnings that trip the Watchdog function. The parameter is a 16-bit word with each bit corresponding to a warning or fault. Whenever a bit is set to 1, the corresponding warning or fault is generated. The bits of this binary number correspond to the following warnings and faults:	

Bit	Name
0	A7C1 FBA A comm
1	A7C2 FBA B comm
2	A7CB M/F comm loss
3	D10C M/F comm loss
4	A791 Brake resistor
5	A793 Brake resistor temp
6	A79B Br chop short circuit
7	A79C Brake igbt temp
8	A7A1 Brake closing fail
9…14	Reserved
15	User bit 1

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

No.	Name/Value	Description	Def/FbEq16
33 Generic timer & counter		Configuration of maintenance timers/counters. See also section *Maintenance timers and counters* (page *190*).	
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	

No.	Name/Value	Description	Def/FbEq16
	0000 0000b … 0011 1111b	Maintenance time/counter status word.	1 = 1
33.10	*On-time 1 actual*	Displays the actual present value of on-time timer 1. The timer runs whenever the signal selected by parameter *33.13 On-time 1 source* is on. When the timer exceeds the limit set by *33.11 On-time 1 warn limit*, bit 0 of *33.01 Counter status* is set to 1. The warning specified by *33.14 On-time 1 warn message* is also given if enabled by *33.12 On-time 1 function*. The timer can be reset from the Drive composer PC tool, or from the control panel by keeping Reset depressed for over 3 seconds.	-
	0…4294967295 s	Actual present value of on-time timer 1.	-
33.11	*On-time 1 warn limit*	Sets the warning limit for on-time timer 1.	0 s
	0…4294967295 s	Warning limit for on-time timer 1.	-
33.12	*On-time 1 function*	Configures on-time timer 1.	0000b

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

No.	Name/Value	Description	Def/FbEq16
	0000b…0011b	On-time timer 1 configuration word.	1 = 1

No.	Name/Value	Description	Def/FbEq16
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 *238*).	2
	Other [bit]	Source selection (see *Terms and abbreviations* on page *199*).	-
33.14	*On-time 1 warn message*	Selects the optional warning message for on-time timer 1.	*On-time 1 exceeded*
	On-time 1 exceeded	*A886 On-time 1*. The message text can be edited on the control panel by choosing Menu – Settings – Edit texts.	0
	Clean device	*A88C Device clean*.	6
	Maintain additional cooling fan	*A890 Additional cooling*.	7
	Maintain cabinet fan	*A88E Cabinet fan*.	8
	Maintain DC capacitors	*A88D DC capacitor*.	9
	Maintain motor bearing	*A880 Motor bearing*.	10
33.20	*On-time 2 actual*	Displays the actual present value of on-time timer 2. The timer runs whenever the signal selected by parameter *33.23 On-time 2 source* is on. When the timer exceeds the limit set by *33.21 On-time 2 warn limit*, bit 1 of *33.01 Counter status* is set to 1. The warning specified by *33.24 On-time 2 warn message* is also given if enabled by *33.22 On-time 2 function*. The timer can be reset from the Drive composer PC tool, or from the control panel by keeping Reset depressed for over 3 seconds.	-
	0…4294967295 s	Actual present value of on-time timer 2.	-
33.21	*On-time 2 warn limit*	Sets the warning limit for on-time timer 2.	0 s
	0…4294967295 s	Warning limit for on-time timer 2.	-
33.22	*On-time 2 function*	Configures on-time timer 2.	00b

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

No.	Name/Value	Description	Def/FbEq16
	00b…11b	On-time timer 2 configuration word.	1 = 1

No.	Name/Value	Description	Def/FbEq16
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 *238*).	2
	Other [bit]	Source selection (see *Terms and abbreviations* on page *199*).	-
33.24	*On-time 2 warn message*	Selects the optional warning message for on-time timer 2.	*On-time 2 exceeded*
	On-time 2 exceeded	*A887 On-time 2*. The message text can be edited on the control panel by choosing Menu – Settings – Edit texts.	1
	Clean device	*A88C Device clean*.	6
	Maintain additional cool fan	*A890 Additional cooling*.	7
	Maintain cabinet fan	*A88E Cabinet fan*.	8
	Maintain DC capacitors	*A88D DC capacitor*.	9
	Maintain motor bearing	*A880 Motor bearing*.	10
33.30	*Edge counter 1 actual*	Actual present value of signal edge counter 1. The counter is incremented every time the signal selected by parameter *33.33 Edge counter 1 source* switches on or off (or either, depending on the setting of *33.32 Edge counter 1 function*). A divisor may be applied to the count (see *33.34 Edge counter 1 divider*). When the counter exceeds the limit set by *33.31 Edge counter 1 warn limit*, bit 2 of *33.01 Counter status* is set to 1. The warning specified by *33.35 Edge counter 1 warn message* is also given if enabled by *33.32 Edge counter 1 function*. The counter can be reset from the Drive composer PC tool, or from the control panel by keeping Reset depressed for over 3 seconds.	-
	0…4294967295	Actual present value of signal edge counter 1.	-
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.	-

No.	Name/Value	Description	Def/FbEq16
33.32	*Edge counter 1 function*	Configures signal edge counter 1.	0000b

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

No.	Name/Value	Description	Def/FbEq16
	0000b…1111b	Edge counter 1 configuration word.	1 = 1
33.33	*Edge counter 1 source*	Selects the signal to be monitored by signal edge counter 1.	*False*
	False	Constant 0.	0
	True	Constant 1.	1
	RO1	Bit 0 of *10.21 RO status* (page *238*).	2
	Other [bit]	Source selection (see *Terms and abbreviations* on page *199*).	-
33.34	*Edge counter 1 divider*	Defines a divisor for signal edge counter 1. Determines how many signal edges increment the counter by 1.	1
	1…4294967295	Divisor for signal edge counter 1.	-
33.35	*Edge counter 1 warn message*	Selects the optional warning message for signal edge counter 1.	*Edge counter 1 exceeded*
	Edge counter 1 exceeded	*A888 Edge counter 1*. The message text can be edited on the control panel by choosing Menu – Settings – Edit texts.	2
	Counted main contactor	*A884 Main contactor*.	11
	Counted output relay	*A881 Output relay*.	12
	Counted motor starts	*A882 Motor starts*.	13
	Counted power ups	*A883 Power ups*.	14
	Counted DC charges	*A885 DC charge*.	15

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

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

No.	Name/Value	Description	Def/FbEq16
	0000b…1111b	Edge counter 2 configuration word.	1 = 1
33.43	*Edge counter 2 source*	Selects the signal to be monitored by signal edge counter 2.	*False*
	False	0.	0
	True	1.	1
	RO1	Bit 0 of *10.21 RO status* (page *238*).	2
	Other [bit]	Source selection (see *Terms and abbreviations* on page *199*).	-
33.44	*Edge counter 2 divider*	Defines a divisor for signal edge counter 2. Determines how many signal edges increment the counter by 1.	1
	1…4294967295	Divisor for signal edge counter 2.	-

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

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

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

No.	Name/Value	Description	Def/FbEq16
	0000b…0011b	Value counter 1 configuration word.	1 = 1
33.53	*Value counter 1 source*	Selects the signal to be monitored by value counter 1.	*Not selected*
	Not selected	None (counter disabled).	0
	Motor speed	*01.01 Motor speed used* (see page *204*).	1
	Other	The value is taken from another parameter.	-
33.54	*Value counter 1 divider*	Defines a divisor for value counter 1. The value of the monitored signal is divided by this value before integration.	1.000
	0.001 … 2147483.000	Divisor for value counter 1.	-
33.55	*Value counter 1 warn message*	Selects the optional warning message for value counter 1.	*Value counter 1 exceeded*
	Value counter 1 exceeded	*A88A Value counter 1*. The message text can be edited on the control panel by choosing Menu – Settings – Edit texts.	4
	Maintain motor bearing	*A880 Motor bearing*.	10
33.60	*Value counter 2 actual*	Displays the actual present value of value counter 2. The value of the source selected by parameter *33.63 Value counter 2 source* is read at one-second intervals and added to the counter. A divisor can be applied to the count (see *33.64 Value counter 2 divider*). When the counter exceeds the limit set by *33.61 Value counter 2 warn limit*, bit 5 of *33.01 Counter status* is set to 1. The warning specified by *33.65 Value counter 2 warn message* is also given if enabled by *33.62 Value counter 2 function*. The counter can be reset from the Drive composer PC tool, or from the control panel by keeping Reset depressed for over 3 seconds.	-
	-2147483008 … 2147483008	Actual present value of value counter 2.	-

No.	Name/Value	Description	Def/FbEq16
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
	Motor speed	*01.01 Motor speed used* (see page *204*).	1
	Other	Source selection (see *Terms and abbreviations* on page *199*).	-
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	*Set crane operation hours*	(*Visible when user lock is open with pass code 584. See parameter 96.02 Pass code*.) Selects the command to initialize current crane operation time to the value specified with parameter *33.201 Crane operation hrs init value*. Actual value can be read from parameter *09.20 Crane operation hours*.	*Done*
	Done	Reset done.	0

No.	Name/Value	Description	Def/FbEq16
	Set	Resets the time counter.	1
	Other [bit]	Source selection (see *Terms and abbreviations* on page *199*).	
33.201	*Crane operation hrs init value*	(*Visible when user lock is open with pass code 584. See parameter 96.02 Pass code.*) Defines the value to which current crane operation time is reset upon activation of corresponding command. This parameter can be used to initialize the crane operation counter to the previous value after replacing the control board or after doing a firmware upgrade.	0 hour
	0...1100000 hours	Crane operation time	1 = 1 hour
33.202	*Crane operation hrs warning limit*	(*Visible when user lock is open with pass code 584. See parameter 96.02 Pass code.*) Defines the operation time limit at which a corresponding maintenance warning (*D212 Crane operating hours*) is activated.	0 hour
	0...1100000 hours	Crane operation time limit	1 = 1 hour
33.210	*Set brake oper counts*	(*Visible when user lock is open with pass code 584. See parameter 96.02 Pass code.*) Selects the command to initialize the current value of brake open counter to the value specified with parameter *33.211 Brake oper counts init value*. Actual value can be read from parameter *09.21 Brake operation count*.	
	Done	Reset done	0
	Set	Resets the brake operating counter.	1
	Other [bit]	Source selection (see *Terms and abbreviations* on page *199*).	
33.211	*Brake oper counts init value*	(*Visible when user lock is open with pass code 584. See parameter 96.02 Pass code.*) Defines the value to which the brake operation counter is reset upon activation of corresponding command. Using this parameter after replacing the control board or upgrading firmware will initialize the brake operation counter to the previous value.	0 hour
	0...1100000 hours	Crane operation time limit	1 = 1 hour
33.212	*Brake oper counts warning limit*	(*Visible when user lock is open with pass code 584. See parameter 96.02 Pass code.*) Defines the operation time limit at which a corresponding maintenance warning (*D213 Brake oper counts*) is activated.	0 hour
	0...1100000 hours	Crane operation time limit	1 = 1 hour
33.220	*Set number of power on*	(*Visible when user lock is open with pass code 584. See parameter 96.02 Pass code.*) Selects the command to initialize the current value of power on counter to the value specified with parameter *33.221 Number of pwr on init value*. Actual value can be read from parameter *09.22 Number of pwr on*.	
	Done	Reset done	0
	Set	Resets the power on counter.	1
	Other [bit]	Source selection (see *Terms and abbreviations* on page *199*).	

No.	Name/Value	Description	Def/FbEq16
33.221	*Number of pwr on init value*	(*Visible when user lock is open with pass code 584. See parameter 96.02 Pass code*.) Defines the value to which the power on counter is reset upon activation of corresponding command. Using this parameter after replacing the control board or after upgrading firmware will initialize the power on counter to the previous value.	0
	0...65535	Counts	1 = 1
33.222	*Number of pwr on warning limit*	(*Visible when user lock is open with pass code 584. See parameter 96.02 Pass code*.) Defines the counter limit at which a corresponding maintenance warning (*D214 Number of power on*) is activated.	0
	0...65535	Counts	1 = 1

35 Motor thermal protection		Motor thermal protection settings such as temperature measurement configuration, load curve definition and motor fan control configuration. See also section *Motor thermal protection* (page *182*).	
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 … 5000 °C, -76 … 9032 °F, 0 ohm or [*35.12*] ohm	Measured temperature 1.	1 = 1 unit
35.03	*Measured temperature 2*	Displays the temperature received through the source defined by parameter *35.21 Temperature 2 source*. The unit is selected by parameter *96.16 Unit selection*. **Note:** With a PTC sensor, the unit is ohms. This parameter is read-only.	-
	-60 … 5000 °C, -76 … 9032 °F, 0 ohm or [*35.22*] 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 activate. However, the “fault active” and “warning active” bits are not updated if the module is not activated. Modules are activated by parameter 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.
2	Warning active in slot 1	1 = Yes: The module in slot 1 has an active warning.
3	Module found in slot 2	1 = Yes: An 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.
5	Warning active in slot 2	1 = Yes: The module in slot 2 has an active warning.
6	Module found in slot 3	1 = Yes: An 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.
8	Warning active in slot 3	1 = Yes: The module in slot 3 has an active warning.
9…15	Reserved	

No.	Name/Value	Description	Def/FbEq16
	0000h…FFFFh	FPTC-xx status word.	1 = 1
35.11	*Temperature 1 source*	Selects the source from which measured temperature 1 is read. For wiring examples, see the hardware manual of the drive. Usually this source is from a sensor connected to the motor controlled by the drive, but it could be used to measure and monitor a temperature from other parts of the process as long as a suitable sensor is used as per the selection list.	*Disabled*
	Disabled	None. Temperature monitoring function 1 is disabled.	0
	Estimated temperature	Estimated motor temperature (see parameter *35.01 Motor estimated temperature*). The temperature is estimated from an internal drive calculation. It is important to set up the ambient temperature of the motor in *35.50 Motor ambient temperature*.	1

No.	Name/Value	Description	Def/FbEq16
	KTY84 analog I/O	KTY84 sensor connected to the analog input selected by parameter *35.14 Temperature 1 AI source* and an analog output. The input and output can be on the drive control unit or on an extension module. The following settings are required: • Set the hardware jumper or switch related to the analog input to ***U*** (voltage). Any change must be validated by a control unit reboot. • Set the unit selection parameter of the input to volt. • Set the source selection parameter of the analog output to "*Force KTY84 excitation*". • Select the analog input in parameter *35.14*. In case the input is located on an I/O extension module, use 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 x Pt100 analog I/O	Pt100 sensor connected to a standard analog input selected by parameter *35.14 Temperature 1 AI source* and an analog output. The input and output can be on the drive control unit or on an extension module. The required settings are the same as with selection *KTY84 analog I/O*, except that the source selection parameter of the analog output must be set to *Force PT100 excitation*.	5
	2 x Pt100 analog I/O	As selection *1 x Pt100 analog I/O*, but with two sensors connected in series. Using multiple sensors improves measurement accuracy significantly.	6
	3 x Pt100 analog I/O	As selection *1 x Pt100 analog I/O*, but with three sensors connected in series. Using multiple sensors improves measurement accuracy significantly.	7
	PTC DI6	PTC sensor connected to digital input DI6 (see the connection diagram on page *183*). **Note:** Either 0 ohm (normal temperature) or 4000 ohm (excessive temperature) will be shown by *35.02 Measured temperature 1*.	8
	PTC analog I/O	PTC sensor connected to a standard analog input selected by parameter *35.14 Temperature 1 AI source* and an analog output. The input and output can be on the drive control unit or on an extension module. The required settings are the same as with selection *KTY84 analog I/O*, except that the source selection parameter of the analog output must be set to *Force PTC excitation*. **Note:** Either 0 ohm (normal temperature) or 4000 ohm (excessive temperature) will be shown by *35.02 Measured temperature 1*.	20

No.	Name/Value	Description	Def/FbEq16
	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
	-60 … 5000 °C or ohm, or -76 … 1832 °F	Fault limit for temperature monitoring function 1.	1 = 1 unit
35.13	*Temperature 1 warning limit*	Defines the warning limit for temperature monitoring function 1. When measured temperature 1 exceeds this limit, the 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 or 230 °F
	-60 … 5000 °C or ohm, or -76 … 9032 °F	Warning limit for temperature monitoring function 1.	1 = 1 unit
35.14	*Temperature 1 AI source*	Specifies the analog input when the setting of *35.11 Temperature 1 source* requires measurement through an analog input. **Note:** If the input is located on an I/O extension module, use the selection *Other* to point to the AI actual value in group 14, 15 or 16, eg. *14.26 AI1 actual value*.	*Not selected*
	Not selected	None.	0
	AI1 actual value	Analog input AI1 on the control unit.	1
	AI2 actual value	Analog input AI2 on the control unit.	2
	Other	Source selection (see *Terms and abbreviations* on page *199*).	-

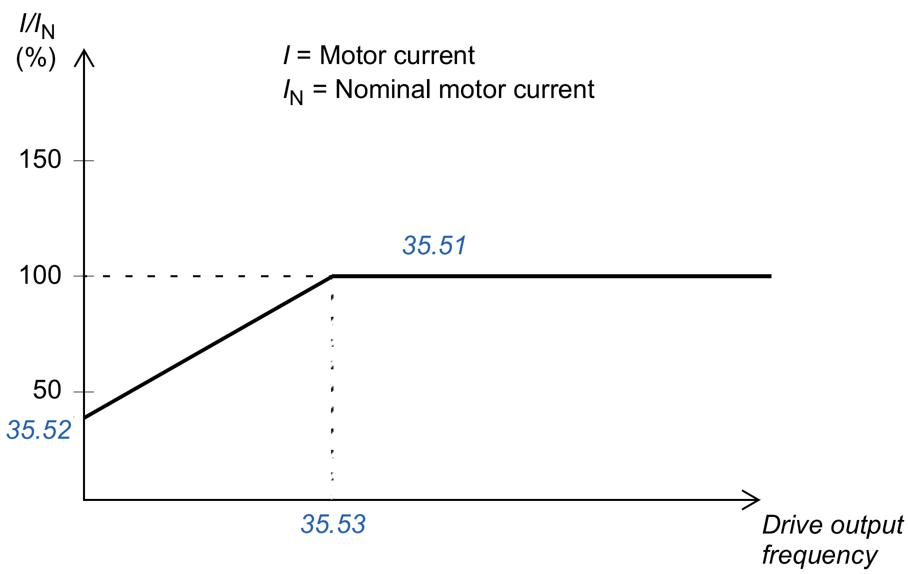
No.	Name/Value	Description	Def/FbEq16
35.21	*Temperature 2 source*	Selects the source from which measured temperature 2 is read. For wiring examples, see the hardware manual of the drive. Usually this source is from a sensor connected to the motor controlled by the drive, but it could be used to measure and monitor a temperature from other parts of the process as long as a suitable sensor is used as per the selection list.	*Disabled*
	Disabled	None. Temperature monitoring function 2 is disabled.	0
	Estimated temperature	Estimated motor temperature (see parameter *35.01 Motor estimated temperature*). The temperature is estimated from an internal drive calculation. It is important to set up the ambient temperature of the motor in *35.50 Motor ambient temperature*.	1
	KTY84 analog I/O	KTY84 sensor connected to the analog input selected by parameter *35.24 Temperature 2 AI source* and an analog output. The input and output can be on the drive control unit or on an extension module. The following settings are required: • Set the hardware jumper or switch related to the analog input to ***U*** (voltage). Any change must be validated by a control unit reboot. • Set the unit selection parameter of the input to volt. • Set the source selection parameter of the analog output to "*Force KTY84 excitation*". • Select the analog input in parameter *35.24*. In case the input is located on an I/O extension module, use the selection *Other* to point at the actual input value parameter (for example, *14.26 AI1 actual value*). The analog output feeds a constant current through the sensor. As the resistance of the sensor changes along with its temperature, the voltage over the sensor changes. The voltage is read by the analog input and converted into degrees.	2
	KTY84 encoder module 1	KTY84 sensor connected to encoder interface 1. See also parameters *91.21 Module 1 temp sensor type* and *91.22 Module 1 temp filter time*.	3
	KTY84 encoder module 2	KTY84 sensor connected to encoder interface 2. See also parameters *91.24 Module 2 temp sensor type* and *91.25 Module 2 temp filter time*.	4
	1 x Pt100 analog I/O	Pt100 sensor connected to a standard analog input selected by parameter *35.24 Temperature 2 AI source* and an analog output. The input and output can be on the drive control unit or on an extension module. The required settings are the same as with selection *KTY84 analog I/O*, except that the source selection parameter of the analog output must be set to *Force PT100 excitation*.	5
	2 x Pt100 analog I/O	As selection *1 x Pt100 analog I/O*, but with two sensors connected in series. Using multiple sensors improves measurement accuracy significantly.	6
	3 x Pt100 analog I/O	As selection *1 x Pt100 analog I/O*, but with three sensors connected in series. Using multiple sensors improves measurement accuracy significantly.	7

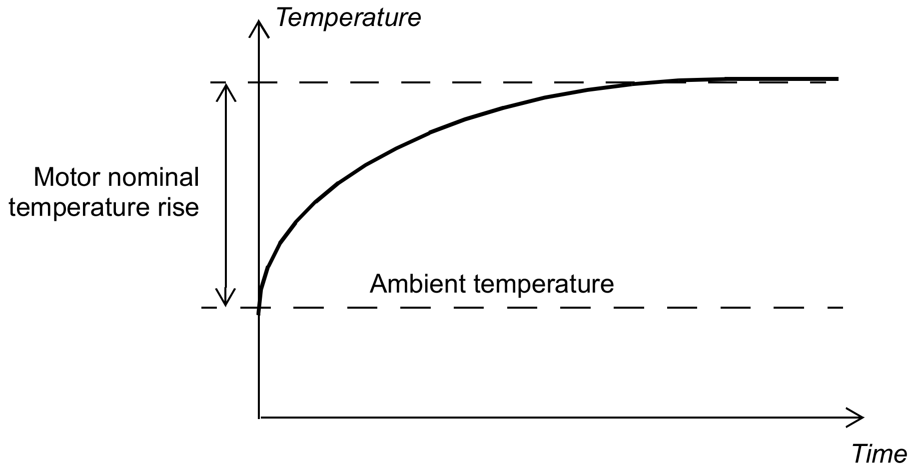
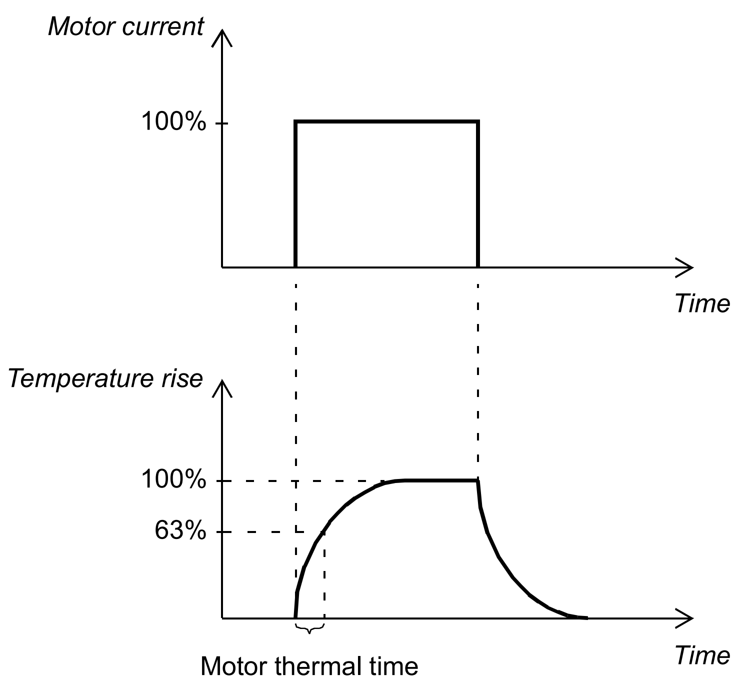
No.	Name/Value	Description	Def/FbEq16
	PTC DI6	PTC sensor connected to digital input DI6 (see the connection diagram on page *183*). **Note:** Either 0 ohm (normal temperature) or 4000 ohm (excessive temperature) will be shown by *35.03 Measured temperature 2*.	8
	PTC encoder module 1	PTC sensor connected 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 specifiec 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
	PTC analog I/O	PTC sensor connected to a standard analog input selected by parameter *35.24 Temperature 2 AI source* and an analog output. The input and output can be on the drive control unit or on an extension module. The required settings are the same as with selection *KTY84 analog I/O*, except that the source selection parameter of the analog output must be set to *Force PTC excitation*. **Note:** Either 0 ohm (normal temperature) or 4000 ohm (excessive temperature) will be shown by *35.03 Measured temperature 2*.	20
35.22	*Temperature 2 fault limit*	Defines the fault limit for temperature monitoring function 2. When measured temperature 2 exceeds the limit, the drive trips on fault *4982 External temperature 2*. The unit is selected by parameter *96.16 Unit selection*. **Note:** With a PTC sensor, the unit is ohms.	130 °C or 266 °F
	-60 … 5000 °C or -76 … 9032 °F	Fault limit for temperature monitoring function 2.	1 = 1 unit
35.23	*Temperature 2 warning limit*	Defines the warning limit for temperature monitoring function 2. When measured temperature 2 exceeds the limit, a warning (*A492 External temperature 2*) is generated. The unit is selected by parameter *96.16 Unit selection*. **Note:** With a PTC sensor, the unit is ohms.	110 °C or 230 °F
	-60 … 5000 °C or -76 … 9032 °F	Warning limit for temperature monitoring function 2.	1 = 1 unit

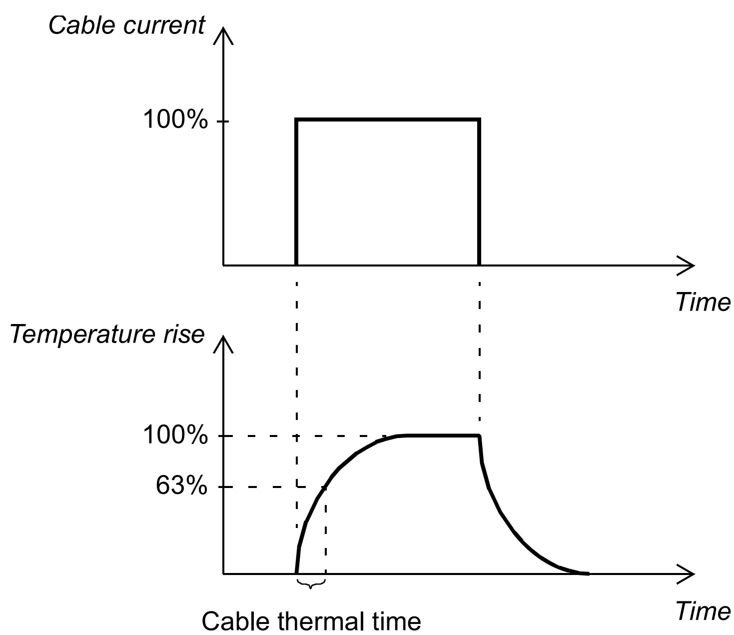
No.	Name/Value	Description	Def/FbEq16
35.24	*Temperature 2 AI source*	Selects the input for parameter *35.21 Temperature 2 source*, selections *KTY84 analog I/O*, *1 x Pt100 analog I/O*, *2 x Pt100 analog I/O*, *3 x Pt100 analog I/O* and *Direct temperature*.	*Not selected*
	Not selected	None.	0
	AI1 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 *199*).	-
35.30	*FPTC configuration word*	Activates FEX-01/FPTC-01 temperature monitoring modules installed on the control unit of the drive. Using this word, it is also possible to suppress the warnings (but not faults) from each module.	0000 0000b

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

No.	Name/Value	Description	Def/FbEq16
	0000 0000b … 0011 1111b	FEX-01/FPTC-01 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 it 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 °C

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%
			
	50 … 150%	Maximum load for the motor load curve.	1 = 1%
35.52	*Zero speed load*	Defines the motor load curve together with parameters *35.51 Motor load curve* and *35.53 Break point*. Defines the maximum motor load at zero speed of the load curve. A higher value can be used if the motor has an external motor fan to boost the cooling. See the motor manufacturer's recommendations. See parameter *35.51 Motor load curve*.	100%
	50 … 150%	Zero speed load for the motor load curve.	1 = 1%
35.53	*Break point*	Defines the motor load curve together with parameters *35.51 Motor load curve* and *35.52 Zero speed load*. Defines the break point frequency of the load curve 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	The unit is selected by parameter *96.16 Unit selection*.	1 = 1 °C
35.55	*Motor thermal time constant*	Defines the thermal time constant for use with the motor thermal protection model, defined as the time to reach 63% of the nominal motor temperature. See the motor manufacturer's recommendations.	256 s
			
	100 … 10000 s	Motor thermal time constant.	1 = 1 s

No.	Name/Value	Description	Def/FbEq16
35.60	*Cable temperature*	Shows the calculated temperature of the motor cable. See section *Thermal protection of motor cable* (page *186*). 102% = overtemperature warning (*A480 Motor cable overload*) 106% = overtemperature fault (*4000 Motor cable overload*) This parameter is read-only.	0.0%
	0.0 … 200.0%	Calculated temperature of motor cable.	1 = 1%
35.61	*Cable nominal current*	Specifies the continuous current of the motor cable for the thermal protection function in the control program. **WARNING!** The value entered in this parameter must be limited according to all factors affecting the loadability of the cable, such as ambient temperature, cabling arrangement, and shrouding. Refer to the technical data from the cable manufacturer.	10000.00 A
	0.00 … 10000.00 A	Continuous current-carrying capacity of motor cable.	1 = 1 A
35.62	*Cable thermal rise time*	Specifies the thermal time of the motor cable for the thermal protection function in the control program. This value is defined as the time to reach 63% of the nominal cable temperature when the cable is loaded with nominal current (parameter *35.61 Cable nominal current*). 0 s = Thermal protection of motor cable disabled Refer to the technical data from the cable manufacturer. 	1 s
	0 s	Thermal protection of motor cable disabled.	1 = 1 s
	1…50000 s	Motor cable thermal time constant.	1 = 1 s

No.	Name/Value	Description	Def/FbEq16
35.100	*DOL starter control source*	Parameters *35.100*…*35.106* configure a monitored start/stop control logic for external equipment such as a contactor-controlled motor cooling fan. This parameter selects the signal that starts and stops the fan. 0 = Stop 1 = Start The output controlling the fan contactor is to be connected to parameter *35.105*, bit 1. On and off delays can be set for the fan by *35.101* and *35.102* respectively. A feedback signal from the fan can be connected to an input selected by *35.103*; the loss of the feedback will optionally trigger a warning or fault (see *35.104* and *35.106*).	*Off*, *06.16* b6 (*95.20* b6)
	Off	0 (function disabled).	0
	On	1.	1
	Running	Bit 6 of *06.16 Drive status word 1* (see page *218*).	2
	Other [bit]	Source selection (see *Terms and abbreviations* on page *199*).	-
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 *199*).	-

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

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

No.	Name/Value	Description	Def/FbEq16
	0000b…1111b	Status of motor fan control logic.	1 = 1
35.106	*DOL starter event type*	Selects the action taken when missing fan feedback is detected by the motor fan control logic.	*Fault*
	No action	No action taken.	0
	Warning	The drive generates a warning (*A781 Motor fan*).	1
	Fault	Drive trips on *71B1 Motor fan*.	2
36 Load analyzer		Peak value and amplitude logger settings. See also section *Load analyzer* (page *190*).	
36.01	*PVL signal source*	Selects the signal to be monitored by the peak value logger. The signal is filtered using the filtering time specified by parameter *36.02 PVL filter time*. The peak value is stored, along with other pre-selected signals at the time, into parameters *36.10*…*36.15*. The peak value logger can be reset using parameter *36.09 Reset loggers*. The date and time of the last reset are stored into parameters *36.16* and *36.17* respectively.	*Power inu out*
	Zero	None (peak value logger disabled).	0
	Motor speed used	*01.01 Motor speed used* (page *204*).	1

No.	Name/Value	Description	Def/FbEq16
	Output frequency	*01.06 Output frequency* (page *204*).	3
	Motor current	*01.07 Motor current* (page *204*).	4
	Motor torque	*01.10 Motor torque* (page *204*).	6
	DC voltage	*01.11 DC voltage* (page *204*).	7
	Power inu out	*01.14 Output power* (page *205*).	8
	Speed ref ramp in	*23.01 Speed ref ramp input* (page *314*).	10
	Speed ref ramped	*23.02 Speed ref ramp output* (page *314*).	11
	Speed ref used	*24.01 Used speed reference* (page *320*).	12
	Torq ref used	*26.02 Torque reference used* (page *332*).	13
	Freq ref used	Not in use.	14
	Process PID out	Not in use.	16
	Process PID fbk	Not in use.	17
	Process PID act	Not in use.	18
	Process PID dev	Not in use.	19
	Other	Source selection (see *Terms and abbreviations* on page *199*).	-
36.02	*PVL filter time*	Defines a filtering time for the peak value logger. See parameter *36.01 PVL signal source*.	2.00 s
	0.00 … 120.00 s	Peak value logger filtering time.	100 = 1 s
36.06	*AL2 signal source*	Selects the signal to be monitored by amplitude logger 2. The signal is sampled at 200 ms intervals. The results are displayed by parameters *36.40*…*36.49*. Each parameter represents an amplitude range, and shows what portion of the samples fall within that range. The signal value corresponding to 100% is defined by parameter *36.07 AL2 signal scaling*. Amplitude logger 2 can be reset using parameter *36.09 Reset loggers*. The date and time of the last reset are stored into parameters *36.50* and *36.51* respectively. For the selections, see parameter *36.01 PVL signal source*.	*Motor torque*
36.07	*AL2 signal scaling*	Defines the signal value that corresponds to 100% amplitude.	100.00
	0.00 … 32767.00	Signal value corresponding to 100%.	1 = 1
36.09	*Reset loggers*	Resets the peak value logger and/or amplitude logger 2. (Amplitude logger 1 cannot be reset.)	*Done*
	Done	Reset completed or not requested (normal operation).	0
	All	Reset both the peak value logger and amplitude logger 2.	1
	PVL	Reset the peak value logger.	2
	AL2	Reset amplitude logger 2.	3
36.10	*PVL peak value*	Displays the peak value recorded by the peak value logger.	0.00
	-32768.00 … 32767.00	Peak value.	1 = 1
36.11	*PVL peak date*	Displays the date on which the peak value was recorded.	-
	-	Peak occurrence date.	-
36.12	*PVL peak time*	Displays the time at which the peak value was recorded.	-
	-	Peak occurrence time.	-

No.	Name/Value	Description	Def/FbEq16
36.13	*PVL current at peak*	Displays the motor current at the moment the peak value was recorded.	0.00 A
	-32768.00 … 32767.00 A	Motor current at peak.	1 = 1 A
36.14	*PVL DC voltage at peak*	Displays the voltage in the intermediate DC circuit of the drive at the moment the peak value was recorded.	0.00 V
	0.00 … 2000.00 V	DC voltage at peak.	10 = 1 V
36.15	*PVL speed at peak*	Displays the motor speed at the moment the peak value was recorded.	0.00 rpm
	-32768.00 … 32767.00 rpm	Motor speed at peak.	See par. *46.01*
36.16	*PVL reset date*	Displays the date on which the peak value logger was last reset.	-
	-	Last reset date of the peak value logger.	-
36.17	*PVL reset time*	Displays the time at which the peak value logger was last reset.	-
	-	Last reset time of the peak value logger.	-
36.20	*AL1 0 to 10%*	Displays the percentage of samples recorded by amplitude logger 1 that fall between 0 and 10%.	0.00%
	0.00 … 100.00%	Amplitude logger 1 samples between 0 and 10%.	1 = 1%
36.21	*AL1 10 to 20%*	Displays the percentage of samples recorded by amplitude logger 1 that fall between 10 and 20%.	0.00%
	0.00 … 100.00%	Amplitude logger 1 samples between 10 and 20%.	1 = 1%
36.22	*AL1 20 to 30%*	Displays the percentage of samples recorded by amplitude logger 1 that fall between 20 and 30%.	0.00%
	0.00 … 100.00%	Amplitude logger 1 samples between 20 and 30%.	1 = 1%
36.23	*AL1 30 to 40%*	Displays the percentage of samples recorded by amplitude logger 1 that fall between 30 and 40%.	0.00%
	0.00 … 100.00%	Amplitude logger 1 samples between 30 and 40%.	1 = 1%
36.24	*AL1 40 to 50%*	Displays the percentage of samples recorded by amplitude logger 1 that fall between 40 and 50%.	0.00%
	0.00 … 100.00%	Amplitude logger 1 samples between 40 and 50%.	1 = 1%
36.25	*AL1 50 to 60%*	Displays the percentage of samples recorded by amplitude logger 1 that fall between 50 and 60%.	0.00%
	0.00 … 100.00%	Amplitude logger 1 samples between 50 and 60%.	1 = 1%
36.26	*AL1 60 to 70%*	Displays the percentage of samples recorded by amplitude logger 1 that fall between 60 and 70%.	0.00%
	0.00 … 100.00%	Amplitude logger 1 samples between 60 and 70%.	1 = 1%
36.27	*AL1 70 to 80%*	Displays the percentage of samples recorded by amplitude logger 1 that fall between 70 and 80%.	0.00%
	0.00 … 100.00%	Amplitude logger 1 samples between 70 and 80%.	1 = 1%
36.28	*AL1 80 to 90%*	Displays the percentage of samples recorded by amplitude logger 1 that fall between 80 and 90%.	0.00%
	0.00 … 100.00%	Amplitude logger 1 samples between 80 and 90%.	1 = 1%
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%

No.	Name/Value	Description	Def/FbEq16
36.40	*AL2 0 to 10%*	Displays the percentage of samples recorded by amplitude logger 2 that fall between 0 and 10%.	0.00%
	0.00 … 100.00%	Amplitude logger 2 samples between 0 and 10%.	1 = 1%
36.41	*AL2 10 to 20%*	Displays the percentage of samples recorded by amplitude logger 2 that fall between 10 and 20%.	0.00%
	0.00 … 100.00%	Amplitude logger 2 samples between 10 and 20%.	1 = 1%
36.42	*AL2 20 to 30%*	Displays the percentage of samples recorded by amplitude logger 2 that fall between 20 and 30%.	0.00%
	0.00 … 100.00%	Amplitude logger 2 samples between 20 and 30%.	1 = 1%
36.43	*AL2 30 to 40%*	Displays the percentage of samples recorded by amplitude logger 2 that fall between 30 and 40%.	0.00%
	0.00 … 100.00%	Amplitude logger 2 samples between 30 and 40%.	1 = 1%
36.44	*AL2 40 to 50%*	Displays the percentage of samples recorded by amplitude logger 2 that fall between 40 and 50%.	0.00%
	0.00 … 100.00%	Amplitude logger 2 samples between 40 and 50%.	1 = 1%
36.45	*AL2 50 to 60%*	Displays the percentage of samples recorded by amplitude logger 2 that fall between 50 and 60%.	0.00%
	0.00 … 100.00%	Amplitude logger 2 samples between 50 and 60%.	1 = 1%
36.46	*AL2 60 to 70%*	Displays the percentage of samples recorded by amplitude logger 2 that fall between 60 and 70%.	0.00%
	0.00 … 100.00%	Amplitude logger 2 samples between 60 and 70%.	1 = 1%
36.47	*AL2 70 to 80%*	Displays the percentage of samples recorded by amplitude logger 2 that fall between 70 and 80%.	0.00%
	0.00 … 100.00%	Amplitude logger 2 samples between 70 and 80%.	1 = 1%
36.48	*AL2 80 to 90%*	Displays the percentage of samples recorded by amplitude logger 2 that fall between 80 and 90%.	0.00%
	0.00 … 100.00%	Amplitude logger 2 samples between 80 and 90%.	1 = 1%
36.49	*AL2 over 90%*	Displays the percentage of samples recorded by amplitude logger 2 that exceed 90%.	0.00%
	0.00 … 100.00%	Amplitude logger 2 samples over 90%.	1 = 1%
36.50	*AL2 reset date*	Displays the date on which amplitude logger 2 was last reset.	-
	-	Last reset date of amplitude logger 2.	-
36.51	*AL2 reset time*	Displays the time at which amplitude logger 2 was last reset.	-
	-	Last reset time of amplitude logger 2.	-
	MIN(In1,In2)	Smaller of the two sources.	5
	MAX(In1,In2)	Greater of the two sources.	6

No.	Name/Value	Description	Def/FbEq16
37 User load curve		Settings for user load curve. See also section *User load curve* (page *186*).	
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	

No.	Name/Value	Description	Def/FbEq16
	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 *204*).	2
	Motor torque %	*01.10 Motor torque* (see page *204*).	3
	Output power % of motor nominal	*01.15 Output power % of motor nom* (see page *205*).	4
	Other	Source selection (see *Terms and abbreviations* on page *199*).	-
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

No.	Name/Value	Description	Def/FbEq16
	Warning/Fault	The drive generates a warning (*A8BF ULC underload warning*) if the signal stays continuously below the underload curve for half of the time defined by *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
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

No.	Name/Value	Description	Def/FbEq16
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%
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

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

No.	Name/Value	Description	Def/FbEq16
	Other [bit]	Source selection (see *Terms and abbreviations* on page *199*).	-
43.08	*Brake resistor thermal tc*	Defines the thermal time constant of the brake resistor for overload protection.	0 s
	0 … 10000 s	Brake resistor thermal time constant.	1 = 1 s
43.09	*Brake resistor Pmax cont*	Defines the maximum continuous braking power of the resistor (in kW) which will raise the resistor temperature to the maximum allowed value. The value is used in the overload protection.	0.00 kW
	0.00 … 10000.00 kW	Maximum continuous braking power.	1 = 1 kW
43.10	*Brake resistance*	Defines the resistance value of the brake resistor. The value is used for brake chopper protection.	0.00 ohm
	0.00…1000.00 ohm	Brake resistor resistance value.	1 = 1 ohm
43.11	*Brake resistor fault limit*	Selects the fault limit for the brake resistor temperature protection function. When the limit is exceeded, the drive trips on fault *7183 BR excess temperature*. The value is given in percent of the temperature the resistor reaches when loaded with the power defined by parameter *43.09 Brake resistor Pmax cont*. .	105%
	0 … 150%	Brake resistor temperature fault limit.	1 = 1%
43.12	*Brake resistor warning limit*	Selects the warning limit for the brake resistor temperature protection function. When the limit is exceeded, the drive generates a *A793 BR excess temperature* warning. The value is given in percent of the temperature the resistor reaches when loaded with the power defined by parameter *43.09 Brake resistor Pmax cont*. .	95%
	0 … 150%	Brake resistor temperature warning limit.	1 = 1%

No.	Name/Value	Description	Def/FbEq16
44 Mechanical brake control		Configuration of mechanical brake control. See also section *Master/follower communication in crane application* (page *54*).	
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 CLOSED 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 *44.09 Brake open torque source* and *44.200 Brake open torque*.	-
	-1600.0 … 1600.0 %	Torque at brake closure.	See par. *46.03*
44.03	*Brake open torque reference*	Displays the currently active brake open torque. See parameters *44.09 Brake open torque source* and *44.200 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	*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 *199*).	-
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 *199*).	-
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.	1.00 s
	0.00 … 5.00 s	Brake open delay.	100 = 1 s
44.09	*Brake open torque source*	Defines a source that is used as a brake opening torque reference if • its absolute value is greater than the setting of parameter *44.200 Brake open torque*, and • its sign is the same as the setting of *44.200 Brake open torque*. See parameter *44.200 Brake open torque*. **Note**: For scalar motor control, disable Torque proving and Brake open torque. Select the following: *44.09 Brake open torque source* = *Zero* *44.200 Brake open torque* = 0% *44.202 Torque proving* = *Disable*	*Brake torque memory*
	Zero	Zero.	0
	AI1 scaled	*12.12 AI1 scaled value* (see page *247*).	1
	AI2 scaled	*12.22 AI2 scaled value* (see page *249*).	2
	FBA ref1	*03.05 FB A reference 1* (see page *207*).	3

No.	Name/Value	Description	Def/FbEq16
	FBA ref2	*03.06 FB A reference 2* (see page *207*).	4
	Brake torque memory	Parameter *44.02 Brake torque memory*.	7
	Brake open torque	Parameter *44.200 Brake open torque*.	8
	Other	Source selection (see *Terms and abbreviations* on page *199*).	-
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 *199*).	-
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.	3.00 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.	60.00 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
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

No.	Name/Value	Description	Def/FbEq16
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
44.200	*Brake open torque*	Defines the minimum absolute value of the brake open torque (motor torque requested at brake release in percent of motor nominal torque). The value of the source selected by parameter *44.09 Brake open torque source* is used as the brake open torque only if it has the same sign as this parameter and has a greater absolute value. **Note**: For scalar motor control, disable Torque proving and Brake open torque. Select the following: *44.09 Brake open torque source* = *Zero* *44.200 Brake open torque* = 0% *44.202 Torque proving* = *Disable*	30.0%
	0.0 … 1000.0%	Minimum torque at brake release.	10 = 1.0%

No.	Name/Value	Description	Def/FbEq16
44.201	*Torque proving sign*	Selects the source for the signal which inverts the torque proving and brake open torque values. 0 = Not inverted. Torque is applied in the hoisting direction. 1 = Inverted. Torque is applied in the reverse direction.	*False*
	False	0.	0
	True	1.	1
	DI1	Digital input DI1 (*10.02 DI delayed status*, bit 0).	2
	DI2	Digital input DI2 (*10.02 DI delayed status*, bit 1).	3
	DI3	Digital input DI3 (*10.02 DI delayed status*, bit 2).	4
	DI4	Digital input DI4 (*10.02 DI delayed status*, bit 3).	5
	DI5	Digital input DI5 (*10.02 DI delayed status*, bit 4).	6
	DI6	Digital input DI6 (*10.02 DI delayed status*, bit 5).	7
	Other [bit]	Source selection (see *Terms and abbreviations* on page *199*).	-
44.202	*Torque proving*	Selects whether Torque proving (electrical test) is active or not. For more information on the function, see section *Brake system checks – Torque proving* on page *76*. **Note**: For scalar motor control, disable Torque proving and Brake open torque. Select the following: *44.09 Brake open torque source* = *Zero* *44.200 Brake open torque* = 0% *44.202 Torque proving* = *Disable*	*Enable*
	Disable	Torque proving is inactive.	0
	Enable	Torque proving 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
	Other [bit]	Source selection (see *Terms and abbreviations* on page *199*).	-
44.203	*Torque proving reference*	Defines the Torque proving (electrical test) reference to be used when the Torque proving function is enabled.	25.00%
	0.00 … 300.00%	Torque proving (electrical test) reference in percentage of the motor nominal torque (*01.10 Motor torque*).	10 = 1.0%
44.204	*Brake system check time*	Defines the time delay during which Torque proving is active and the electrical and mechanical tests of the crane system are done against a closed brake. If the actual torque cannot be reached during this check time, the drive trips on fault *D100 Torque prove*.	300 ms
	100…30000 ms	Time delay.	10 = 1 ms
44.205	*Brake slip speed limit*	Defines the speed limit used for examining the system for brake slips during Torque proving (mechanical test). For more information on the function, see section *Brake system checks – Brake slip* on page *77*.	30.0 rpm
	0.0 … 30000.0 rpm	Brake slip speed limit.	1 = 1 rpm

No.	Name/Value	Description	Def/FbEq16
44.206	*Brake slip fault delay*	Defines the time delay before the drive trips on fault *D101 Brake slip* during Torque proving (mechanical test). If a brake slip is detected during the system check time (*44.204 Brake system check time*), the fault is generated immediately, even if the check time had not yet elapsed.	300 ms
	0…30000 ms	Time delay.	1 = 1 ms
44.207	*Safety close select*	Selects whether the Brake safe closure function is active or not. For more information on the function, see section *Brake safe closure* on page *78*.	*Disable*
	Disable	Brake safe closure function is inactive.	0
	Enable	Brake safe closure function 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
	Other [bit]	Source selection (see *Terms and abbreviations* on page *199*).	-
44.208	*Safety close speed*	Defines the speed limit for the Brake safe closure function.	50.00 rpm
	0.00 … 30000.00 rpm	Brake safe closure speed.	1 = 1 rpm
44.209	*Safety close delay*	Defines the time delay before the drive trips on fault *D102 Brake safe closure*.	2000 ms
	0…30000 ms	Time delay.	1 = 1 ms
44.210	*Crane brake status*	Shows the status of the brake.	-

Bit	Name	Information
0	Crane open brake command	0 = Brake is closed. 1= Brake is open.
1…15	Reserved	

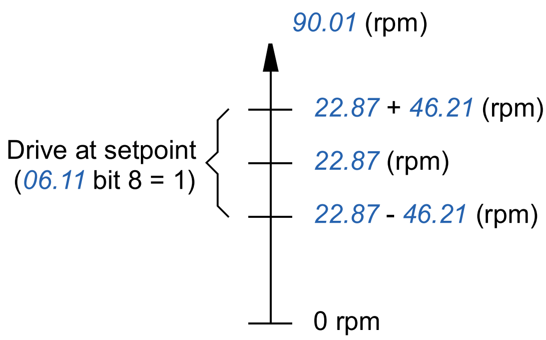
No.	Name/Value	Description	Def/FbEq16
	0b…1b	Brake status.	-
44.211	*Extended runtime*	Defines the time period during which drive keeps the motor magnetized after the brake is closed. The Extended run time function is enabled if this value is less than 3600 seconds or greater than 0 seconds. See also, section *Extended run time* on page *80*. **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 *136*) • the drive is in Remote control **WARNING!** Extended runtime causes the motor to heat up. In cases where long magnetization time is required, make sure to use motors with external ventilation.	0.0 s
	0.0…3600.0 s	Time period.	10 = 1 s

No.	Name/Value	Description	Def/FbEq16
44.212	*Extended runtime sw*	Shows the status of the Extended runtime function. Bit 0 is connected as default into parameter *21.12 Continuous magnetization command*. This parameter is read-only.	-

Bit	Name	Description
0	Extended run in operation	0 = Extended run time is active. 1= Extended run time is not active.
1	Extended run enabled	1 = Extended run time function is enabled. 0 = Extended run time function is disabled.
2…15	Reserved	

No.	Name/Value	Description	Def/FbEq16
	0b…1b	Extended runtime status.	-
44.213	*Brake long fall delay*	Defines the delay time for brake long fall delay.	
	0.0 ... 60.0 s	Delay time.	10 = 1 s
46 Monitoring/scaling settings		Speed supervision settings; actual signal filtering; general scaling settings.	
46.01	*Speed scaling*	Defines the maximum speed value used to define the acceleration ramp rate and the initial speed value used to define the deceleration ramp rate (see parameter group *23 Speed reference ramp*). The speed acceleration and deceleration ramp times are therefore related to this value (**not** to parameter *30.12 Maximum speed*). Also defines the 16-bit scaling of speed-related parameters. The value of this parameter corresponds to 20000 in fieldbus, master/follower etc. communication.	1500.00 rpm; 1800.00 rpm (*95.20* b0)
	0.10…30000.00 rpm	Acceleration/deceleration terminal/initial speed.	1 = 1 rpm
46.02	*Frequency scaling*	Defines the maximum frequency value used to define the acceleration ramp rate and the initial frequency value used to define deceleration ramp rate. 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 *46.42 Torque decimals*.	100.0%
	0.1 … 1000.0%	Torque corresponding to 10000 on fieldbus.	10 = 1%
46.04	*Power scaling*	Defines the output power value that corresponds to 10000 in fieldbus, master/follower etc. communication. The unit is selected by parameter *96.16 Unit selection*.	1000.00 kW or hp

No.	Name/Value	Description	Def/FbEq16
	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.	-
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
	0…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
	0…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*.	2 ms
	0…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
	0…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*) is smaller than *46.21 At speed hysteresis*, the drive is considered to be “at setpoint”. This is indicated by bit 8 of *06.11 Main status word*.  	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*
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*

No.	Name/Value	Description	Def/FbEq16
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

47 Data storage		Data storage parameters that can be written to and read from using other parameters' source and target settings. Note that there are different storage parameters for different data types. Integer-type storage parameters cannot be used as the source of other parameters. See also section *Data storage parameters* (page *193*).	
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 real (floating point) number.	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 real (floating point) number.	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 real (floating point) number.	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 real (floating point) number.	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 real (floating point) number.	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 real (floating point) number.	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 real (floating point) number.	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 real (floating point) number.	See par. *47.38*

No.	Name/Value	Description	Def/FbEq16
47.11	*Data storage 1 int32*	Data storage parameter 9.	0
	-2147483648 … 2147483647	32-bit integer.	-
47.12	*Data storage 2 int32*	Data storage parameter 10.	0
	-2147483648 … 2147483647	32-bit integer.	-
47.13	*Data storage 3 int32*	Data storage parameter 11.	0
	-2147483648 … 2147483647	32-bit integer.	-
47.14	*Data storage 4 int32*	Data storage parameter 12.	0
	-2147483648 … 2147483647	32-bit integer.	-
47.15	*Data storage 5 int32*	Data storage parameter 13.	0
	-2147483648 … 2147483647	32-bit integer.	-
47.16	*Data storage 6 int32*	Data storage parameter 14.	0
	-2147483648 … 2147483647	32-bit integer.	-
47.17	*Data storage 7 int32*	Data storage parameter 15.	0
	-2147483648 … 2147483647	32-bit integer.	-
47.18	*Data storage 8 int32*	Data storage parameter 16.	0
	-2147483648 … 2147483647	32-bit integer.	-
47.21	*Data storage 1 int16*	Data storage parameter 17.	0
	-32768 … 32767	16-bit integer.	1 = 1
47.22	*Data storage 2 int16*	Data storage parameter 18.	0
	-32768 … 32767	16-bit integer.	1 = 1
47.23	*Data storage 3 int16*	Data storage parameter 19.	0
	-32768 … 32767	16-bit integer.	1 = 1
47.24	*Data storage 4 int16*	Data storage parameter 20.	0
	-32768 … 32767	16-bit integer.	1 = 1
47.25	*Data storage 5 int16*	Data storage parameter 21.	0
	-32768 … 32767	16-bit integer.	1 = 1

No.	Name/Value	Description	Def/FbEq16
47.26	*Data storage 6 int16*	Data storage parameter 22.	0
	-32768 … 32767	16-bit integer.	1 = 1
47.27	*Data storage 7 int16*	Data storage parameter 23.	0
	-32768 … 32767	16-bit integer.	1 = 1
47.28	*Data storage 8 int16*	Data storage parameter 24.	0
	-32768 … 32767	16-bit integer.	1 = 1
47.31	*Data storage 1 real32 type*	Defines the scaling of parameter *47.01 Data storage 1 real32* to and from 16-bit integer format. This scaling is used when the data storage parameter is the target of received 16-bit data (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 Torque scaling*. Range: -1600.0 … 1600.0.	4
	Frequency	The scaling is defined by parameter *46.02 Frequency scaling*. Range: -500.00 … 500.00.	5
47.32	*Data storage 2 real32 type*	Defines the 16-bit scaling of parameter *47.02 Data storage 2 real32*. See parameter *47.31 Data storage 1 real32 type*.	*Unscaled*
47.33	*Data storage 3 real32 type*	Defines the 16-bit scaling of parameter *47.03 Data storage 3 real32*. See parameter *47.31 Data storage 1 real32 type*.	*Unscaled*
47.34	*Data storage 4 real32 type*	Defines the 16-bit scaling of parameter *47.04 Data storage 4 real32*. See parameter *47.31 Data storage 1 real32 type*.	*Unscaled*
47.35	*Data storage 5 real32 type*	Defines the 16-bit scaling of parameter *47.05 Data storage 5 real32*. See parameter *47.31 Data storage 1 real32 type*.	*Unscaled*
47.36	*Data storage 6 real32 type*	Defines the 16-bit scaling of parameter *47.06 Data storage 6 real32*. See parameter *47.31 Data storage 1 real32 type*.	*Unscaled*
47.37	*Data storage 7 real32 type*	Defines the 16-bit scaling of parameter *47.07 Data storage 7 real32*. See parameter *47.31 Data storage 1 real32 type*.	*Unscaled*
47.38	*Data storage 8 real32 type*	Defines the 16-bit scaling of parameter *47.08 Data storage 8 real32*. See parameter *47.31 Data storage 1 real32 type*.	*Unscaled*

No.	Name/Value	Description	Def/FbEq16
49 Panel port communication		Communication settings for the control panel port on the drive.	
49.01	*Node ID number*	Defines the node ID of the drive. All devices connected to the network must have a unique node ID. **Note:** For networked drives, it is advisable to reserve ID 1 for spare/replacement drives. •	1
	1…32	Node ID.	1 = 1
49.03	*Baud rate*	Defines the transfer rate of the link.	*230.4 kbps*
	38.4 kbps	38.4 kbit/s.	1
	57.6 kbps	57.6 kbit/s.	2
	86.4 kbps	86.4 kbit/s.	3
	115.2 kbps	115.2 kbit/s.	4
	230.4 kbps	230.4 kbit/s.	5
49.04	*Communication loss time*	Sets a timeout for control panel (or PC tool) communication. If a communication break lasts longer than the timeout, the action specified by parameter *49.05 Communication loss action* is taken.	10.0 s
	0.3 … 3000.0 s	Panel/PC tool communication timeout.	10 = 1 s
49.05	*Communication loss action*	Selects how the drive reacts to a control panel (or PC tool) communication break.	*Fault*
	No action	No action taken.	0
	Fault	Drive trips on *7081 Panel port communication*.	1
	Last speed	Drive generates an *A7EE Panel loss* warning and freezes the speed to the level the drive was operating at. The speed is determined on the basis of actual speed using 850 ms low-pass filtering. **WARNING!** Make sure that it is safe to continue operation in case of a communication break.	2
	Speed ref safe	Drive generates an *A7EE Panel loss* warning and sets the speed to the speed defined by parameter *22.41 Speed ref safe*. **WARNING!** Make sure that it is safe to continue operation in case of a communication break.	3
	Fault always	Drive trips on *7081 Panel port communication*. This occurs even though no control is expected from the panel (or PC tool).	4
	Warning	Drive generates an *A7EE Panel loss* warning. This occurs even though no control is expected from the panel (or PC tool). **WARNING!** Make sure that it is safe to continue operation in case of a communication break.	5
49.06	*Refresh settings*	Applies the settings of parameters *49.01*…*49.05*. **Note:** Refreshing may cause a communication break, so reconnecting the drive may be required.	*Done*
	Done	Refresh done or not requested.	0
	Refresh	Refresh parameters *49.01*…*49.05*. The value reverts automatically to *Done*.	1

No.	Name/Value	Description	Def/FbEq16
50 Fieldbus adapter (FBA)		Fieldbus communication configuration. See also chapter *Fieldbus control through a fieldbus adapter* (page *645*).	
50.01	*FBA A enable*	Enables/disables communication between the drive and fieldbus adapter A, and specifies the slot the adapter is installed into.	*Disable*
	Disable	Communication between drive and fieldbus adapter A disabled.	0
	Option slot 1	Communication between drive and fieldbus adapter A enabled. The adapter is in slot 1.	1
	Option slot 2	Communication between drive and fieldbus adapter A enabled. The adapter is in slot 2.	2
	Option slot 3	Communication between drive and fieldbus adapter A enabled. The adapter is in slot 3.	3
50.02	*FBA A comm loss func*	Selects how the drive reacts upon a fieldbus communication break. The time delay is defined by parameter *50.03 FBA A comm loss t out*.	*No action*
	No action	No action taken.	0
	Fault	Communication break detection active. Upon a communication break, the drive trips on a *7510 FBA A communication* fault and coasts to a stop.	1
	Last speed	Communication break detection active. Upon a communication break, the drive generates a warning (*A7C1 FBA A communication*) and freezes the speed to the level the drive was operating at. The speed is determined on the basis of actual speed using 850 ms low-pass filtering. **WARNING!** Make sure that it is safe to continue operation in case of a communication break.	2
	Speed ref safe	Communication break detection active. Upon a communication break, the drive generates a warning (*A7C1 FBA A communication*) and sets the speed to the value defined by parameter *22.41 Speed ref safe*. **WARNING!** Make sure that it is safe to continue operation in case of a communication break.	3
	Fault always	Drive trips on *7510 FBA A communication*. This occurs even though no control is expected from the fieldbus.	4
	Warning	Drive generates an *A7C1 FBA A communication* warning. This occurs even though no control is expected from the fieldbus. **WARNING!** Make sure that it is safe to continue operation in case of a communication break.	5
50.03	*FBA A comm loss t out*	Defines the time delay before the action defined by parameter *50.02 FBA A comm loss func* is taken. Time count starts when the communication link fails to update the message. As a rule of thumb, this parameter should be set to at least 3 times the transmit interval of the master.	0.3 s
	0.3 … 6553.5 s	Time delay.	1 = 1 s

No.	Name/Value	Description	Def/FbEq16
50.04	*FBA A ref1 type*	Selects the type and scaling of reference 1 received from fieldbus adapter A.	*Speed or frequency*
	Speed or frequency	Type and scaling is chosen automatically according to the currently active operation mode as follows:	0

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

No.	Name/Value	Description	Def/FbEq16
	Transparent	No scaling is applied.	1
	General	Generic reference with a scaling of 100 = 1 (ie. integer and two decimals).	2
	Torque	The scaling is defined by parameter *46.03 Torque scaling*.	3
	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. For the selections, see parameter *50.04 FBA A ref1 type*	*Speed or frequency*
50.07	*FBA A actual 1 type*	Selects the type/source and scaling of actual value 1 transmitted to the fieldbus network through fieldbus adapter A.	*Speed or frequency*
	Speed or frequency	Type and scaling is chosen automatically according to the currently active operation mode as follows:	0

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

No.	Name/Value	Description	Def/FbEq16
	Transparent	The value selected by parameter *50.10 FBA A act1 transparent source* is sent as actual value 1. No scaling is applied (the 16-bit scaling is 1 = 1 unit).	1
	General	The value selected by parameter *50.10 FBA A act1 transparent source* is sent as actual value 1 with a 16-bit scaling of 100 = 1 unit (ie. integer and two decimals).	2
	Torque	*01.10 Motor torque* is sent as actual value 1. The scaling is defined by parameter *46.03 Torque scaling*.	3
	Speed	*01.01 Motor speed used* is sent as actual value 1. The scaling is defined by parameter *46.01 Speed scaling*.	4
	Frequency	*01.06 Output frequency* is sent as actual value 1. The scaling is defined by parameter *46.02 Frequency scaling*.	5
	Position	Motor position is sent as actual value 1. See parameter *90.06 Motor position scaled*.	6

No.	Name/Value	Description	Def/FbEq16
50.08	*FBA A actual 2 type*	Selects the type/source and scaling of actual value 2 transmitted to the fieldbus network through fieldbus adapter A.	*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 2 type (source)	Scaling
Speed control	*Speed* (*01.01 Motor speed used*)	*46.01 Speed scaling*
Torque control		
Frequency control	*Frequency* (*01.06 Output frequency*)	*46.02 Frequency scaling*

No.	Name/Value	Description	Def/FbEq16
	Transparent	The value selected by parameter *50.11 FBA A 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 *50.11 FBA A 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
50.09	*FBA A SW transparent source*	Selects the source of the fieldbus status word when fieldbus adapter is set to a transparent communication profile, for example, 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 *199*).	-
50.10	*FBA A act1 transparent source*	When parameter *50.07 FBA A actual 1 type* is set to *Transparent* or *General*, this parameter selects the source of actual value 1 transmitted to the fieldbus network through fieldbus adapter A.	*Not selected*
	Not selected	No source selected.	-
	Other	Source selection (see *Terms and abbreviations* on page *199*).	-
50.11	*FBA A act2 transparent source*	When parameter *50.08 FBA A actual 2 type* is set to *Transparent* or *General*, this parameter selects the source of actual value 2 transmitted to the fieldbus network through fieldbus adapter A.	*Not selected*
	Not selected	No source selected.	-
	Other	Source selection (see *Terms and abbreviations* on page *199*).	-

No.	Name/Value	Description	Def/FbEq16
50.12	*FBA A debug mode*	Enables the display of raw (unmodified) data received from and sent to fieldbus adapter A in parameters *50.13*…*50.18*. This functionality should only be used for debugging.	*Disable*
	Disable	Display of raw data from fieldbus adapter A disabled.	0
	Fast	Display of raw data from fieldbus adapter A enabled.	1
50.13	*FBA A control word*	Displays the raw (unmodified) control word sent by the master (PLC) to fieldbus adapter A if debugging is enabled by parameter *50.12 FBA A debug mode*. This parameter is read-only.	-
	00000000h … FFFFFFFFh	Control word sent by master to fieldbus adapter A.	-
50.14	*FBA A reference 1*	Displays raw (unmodified) reference REF1 sent by the master (PLC) to fieldbus adapter A if debugging is enabled by parameter *50.12 FBA A debug mode*. This parameter is read-only.	-
	-2147483648 … 2147483647	Raw REF1 sent by master to fieldbus adapter A.	-
50.15	*FBA A reference 2*	Displays raw (unmodified) reference REF2 sent by the master (PLC) to fieldbus adapter A if debugging is enabled by parameter *50.12 FBA A debug mode*. This parameter is read-only.	-
	-2147483648 … 2147483647	Raw REF2 sent by master to fieldbus adapter A.	-
50.16	*FBA A status word*	Displays the raw (unmodified) status word sent by fieldbus adapter A to the master (PLC) if debugging is enabled by parameter *50.12 FBA A debug mode*. This parameter is read-only.	-
	00000000h … FFFFFFFFh	Status word sent by fieldbus adapter A to master.	-
50.17	*FBA A actual value 1*	Displays raw (unmodified) actual value ACT1 sent by fieldbus adapter A to the master (PLC) if debugging is enabled by parameter *50.12 FBA A debug mode*. This parameter is read-only.	-
	-2147483648 … 2147483647	Raw ACT1 sent by fieldbus adapter A to master.	-
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. **Selection** / **Cyclic high *** / **Cyclic low **** *Monitoring* / 10 ms / 10 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 *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.	*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 *134*). 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. **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	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.	*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
	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

No.	Name/Value	Description	Def/FbEq16
50.32	*FBA B comm loss func*	Selects how the drive reacts upon a fieldbus communication break. The time delay is defined by parameter *50.33 FBA B comm loss timeout*.	*No action*
	No action	No action taken.	0
	Fault	Communication break detection active. Upon a communication break, the drive trips on a *7520 FBA B communication* fault and coasts to a stop.	1
	Last speed	Communication break detection active. Upon a communication break, the drive generates a warning (*A7C2 FBA B communication*) and freezes the speed to the level the drive was operating at. The speed is determined on the basis of actual speed using 850 ms low-pass filtering. ⚠ **WARNING!** Make sure that it is safe to continue operation in case of a communication break.	2
	Speed ref safe	Communication break detection active. Upon a communication break, the drive generates a warning (*A7C2 FBA B communication*) and sets the speed to the value defined by parameter *22.41 Speed ref safe*. ⚠ **WARNING!** Make sure that it is safe to continue operation in case of a communication break.	3
	Fault always	Drive trips on *7520 FBA B communication*. This occurs even though no control is expected from the fieldbus.	4
	Warning	Drive generates an *A7C2 FBA B communication* warning. This occurs even though no control is expected from the fieldbus. ⚠ **WARNING!** Make sure that it is safe to continue operation in case of a communication break.	5
50.33	*FBA B comm loss timeout*	Defines the time delay before the action defined by parameter *50.32 FBA B comm loss func* is taken. Time count starts when the communication link fails to update the message. As a rule of thumb, this parameter should be set to at least 3 times the transmit interval of the master.	0.3 s
	0.3 … 6553.5 s	Time delay.	1 = 1 s
50.34	*FBA B ref1 type*	Selects the type and scaling of reference 1 received from fieldbus adapter B. For the selections, see parameter *50.04 FBA A ref1 type*.	*Speed or frequency*
50.35	*FBA B ref2 type*	Selects the type and scaling of reference 2 received from fieldbus adapter B. For the selections, see parameter *50.04 FBA A ref1 type*.	*Speed or frequency*
50.37	*FBA B actual 1 type*	Selects the type/source and scaling of actual value 1 transmitted to the fieldbus network through fieldbus adapter B. See parameter *50.07 FBA A actual 1 type*.	*Speed or frequency*
50.38	*FBA B actual 2 type*	Selects the type/source and scaling of actual value 2 transmitted to the fieldbus network through fieldbus adapter B. See parameter *50.08 FBA A actual 2 type*.	*Speed or frequency*
50.39	*FBA B SW transparent source*	Selects the source of the fieldbus status word when the fieldbus adapter is set to a transparent communication profile, for example, by its configuration parameters (group *54 FBA B settings*).	*Not selected*
	Not selected	No source selected.	-

No.	Name/Value	Description	Def/FbEq16
	Other	Source selection (see *Terms and abbreviations* on page *199*).	-
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 *199*).	-
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 *199*).	-
50.42	*FBA B debug mode*	Enables the display of raw (unmodified) data received from and sent to fieldbus adapter B in parameters *50.43*…*50.48*. This functionality should only be used for debugging.	*Disable*
	Disable	Display of raw data from fieldbus adapter B disabled.	0
	Fast	Display of raw data from fieldbus adapter B enabled.	1
50.43	*FBA B control word*	Displays the raw (unmodified) control word sent by the master (PLC) to fieldbus adapter B if debugging is enabled by parameter *50.42 FBA B debug mode*. This parameter is read-only.	-
	00000000h … FFFFFFFFh	Control word sent by master to fieldbus adapter B.	-
50.44	*FBA B reference 1*	Displays raw (unmodified) reference REF1 sent by the master (PLC) to fieldbus adapter B if debugging is enabled by parameter *50.42 FBA B debug mode*. This parameter is read-only.	-
	-2147483648 … 2147483647	Raw REF1 sent by master to fieldbus adapter B.	-
50.45	*FBA B reference 2*	Displays raw (unmodified) reference REF2 sent by the master (PLC) to fieldbus adapter B if debugging is enabled by parameter *50.42 FBA B debug mode*. This parameter is read-only.	-
	-2147483648 … 2147483647	Raw REF2 sent by master to fieldbus adapter B.	-
50.46	*FBA B status word*	Displays the raw (unmodified) status word sent by fieldbus adapter B to the master (PLC) if debugging is enabled by parameter *50.42 FBA B debug mode*. This parameter is read-only.	-
	00000000h … FFFFFFFFh	Status word sent by fieldbus adapter B to master.	-
50.47	*FBA B actual value 1*	Displays raw (unmodified) actual value ACT1 sent by fieldbus adapter B to the master (PLC) if debugging is enabled by parameter *50.42 FBA B debug mode*. This parameter is read-only.	-

No.	Name/Value	Description	Def/FbEq16
	-2147483648 … 2147483647	Raw ACT1 sent by fieldbus adapter B to master.	-
50.48	*FBA B actual value 2*	Displays raw (unmodified) actual value ACT2 sent by fieldbus adapter B to the master (PLC) if debugging is enabled by parameter *50.42 FBA B debug mode*. This parameter is read-only.	-
	-2147483648 … 2147483647	Raw ACT2 sent by fieldbus adapter B to master.	-
50.51	*FBA B timelevel sel*	Selects the communication time levels. In general, lower time levels of read/write services reduce CPU load. The table below shows the time levels of the read/write services for cyclic high and cyclic low data with each parameter setting. **Selection** / **Cyclic high *** / **Cyclic low **** *Monitoring* / 10 ms / 10 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.	*Normal*
	Normal	Normal speed.	0
	Fast	Fast speed.	1
	Very fast	Very fast speed.	2
	Monitoring	Low speed. Optimized for PC tool communication and monitoring usage.	3

51 FBA A settings		Fieldbus adapter A configuration.	
51.01	*FBA A type*	Displays the type of the connected fieldbus adapter module. **0** = Module is not found or is not properly connected, or is disabled by parameter *50.01 FBA A enable*; **1** = FPBA; **32** = FCAN; **37** = FDNA; **101** = FCNA, **128** = FENA-11/21; **135** = FECA; **136** = FEPL; **485** = FSCA. This parameter is read-only.	-
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

No.	Name/Value	Description	Def/FbEq16
51.27	*FBA A par refresh*	Validates any changed fieldbus adapter module configuration settings. After refreshing, the value reverts automatically to *Done*. **Note:** This parameter cannot be changed while the drive is running.	*Done*
	Done	Refreshing done.	0
	Refresh	Refreshing.	1
51.28	*FBA A par table ver*	Displays the parameter table revision of the fieldbus adapter module mapping file (stored in the memory of the drive). In format axyz, where ax = major table revision number; yz = minor table revision number. This parameter is read-only.	-
		Parameter table revision of adapter module.	-
51.29	*FBA A drive type code*	Displays the drive type code in the fieldbus adapter module mapping file (stored in the memory of the drive). This parameter is read-only.	-
	0…65535	Drive type code stored in the mapping file.	1 = 1
51.30	*FBA A mapping file ver*	Displays the fieldbus adapter module mapping file revision stored in the memory of the drive in decimal format. This parameter is read-only.	-
	0…65535	Mapping file revision.	1 = 1
51.31	*D2FBA comm status*	Displays the status of the fieldbus adapter module communication.	-
	Idle	Adapter is not configured.	0
	Exec.init	Adapter is initializing.	1
	Time out	A timeout has occurred in the communication between the adapter and the drive.	2
	Conf.err	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 xyz, 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 *199*).	-
…	…	…	…
52.12	*FBA A data in12*	See parameter *52.01 FBA A data in1*.	*None*

No.	Name/Value	Description	Def/FbEq16
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
	Other	Source selection (see *Terms and abbreviations* on page *199*).	-
…	…	…	…
53.12	*FBA A data out12*	See parameter *53.01 FBA A data out1*.	*None*
54 FBA B settings		Fieldbus adapter B configuration.	
54.01	*FBA B type*	Displays the type of the connected fieldbus adapter module. **0** = Module is not found or is not properly connected, or is disabled by parameter *50.31 FBA B enable*; **1** = FPBA; **32** = FCAN; **37** = FDNA; **101** = FCNA, **128** = FENA-11/21; **135** = FECA; **136** = FEPL; **485** = FSCA. This parameter is read-only.	-
54.02	*FBA B Par2*	Parameters *54.02*…*54.26* are adapter module-specific. For more information, see the documentation of the fieldbus adapter module. Note that not all of these parameters are necessarily in use.	-
	0…65535	Fieldbus adapter configuration parameter.	1 = 1
	…	…	…
54.26	*FBA B Par26*	See parameter *54.02 FBA A 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.	-

No.	Name/Value	Description	Def/FbEq16
	0…65535	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.	-
		Mapping file revision.	1 = 1
54.31	*D2FBA B comm status*	Displays the status of the fieldbus adapter module communication.	-
	Not configured	Adapter is not configured.	0
	Initializing	Adapter is initializing.	1
	Time out	A timeout has occurred in the communication between the adapter and the drive.	2
	Configuration error	Adapter configuration error: mapping file not found in the file system of the drive, or mapping file upload has failed more than three times.	3
	Off-line	Fieldbus communication is off-line.	4
	On-line	Fieldbus communication is on-line, or fieldbus adapter has been configured not to detect a communication break. For more information, see the documentation of the fieldbus adapter.	5
	Reset	Adapter is performing a hardware reset.	6
54.32	*FBA B comm SW ver*	Displays the patch and build versions of the adapter module firmware in format xxyy, where xx = patch version number, yy = build version number. Example: C802 = 200.02 (patch version 200, build version 2).	
		Patch and build versions of adapter module firmware.	-
54.33	*FBA B appl SW ver*	Displays the major and minor versions of the adapter module firmware in format xyz, 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

No.	Name/Value	Description	Def/FbEq16
	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 *199*).	-
	…	…	…
55.12	*FBA B data in12*	See parameter *55.01 FBA B data in1*.	*None*
56 FBA B data out		Selection of data to be transferred from fieldbus controller to drive through fieldbus adapter B.	
56.01	*FBA B data out1*	Parameters *56.01*…*56.12* select data to be transferred from the fieldbus controller to the drive through fieldbus adapter B.	*None*
	None	None.	0
	CW 16bit	Control Word (16 bits)	1
	Ref1 16bit	Reference REF1 (16 bits)	2
	Ref2 16bit	Reference REF2 (16 bits)	3
	CW 32bit	Control Word (32 bits)	11
	Ref1 32bit	Reference REF1 (32 bits)	12
	Ref2 32bit	Reference REF2 (32 bits)	13
	CW2 16bit	Control Word 2 (16 bits)	21
	Other	Source selection (see *Terms and abbreviations* on page *199*).	-
	…	…	…
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 *621*).	
58.01	*Protocol enable*	Enables/disables the embedded fieldbus interface and selects the protocol to use. **Note:** When the embedded fieldbus interface is enabled, the drive-to-drive link functionality is automatically disabled.	*None*
	None	None (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

No.	Name/Value	Description	Def/FbEq16
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*
	Autodetect	Enables automatic detection of the transfer rate. When activated, the bus is monitored for a period of time, after which the parameter is set to the detected transfer rate. Note that parameter *58.05 Parity* must be set before autodetection is activated.	0
	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 number of data bits, type of parity bit, and number of stop bits. Changes to this parameter take effect after the control unit is rebooted or the new settings validated by parameter *58.06 Communication control*.	*8 EVEN 1*
	8 NONE 1	Eight data bits, no parity bit, one stop bit.	0
	8 NONE 2	Eight data bits, no parity bit, two stop bits.	1
	8 EVEN 1	Eight data bits, even parity bit, one stop bit.	2
	8 ODD 1	Eight data bits, odd parity bit, one stop bit.	3
58.06	*Communication control*	Validates any changes in the EFB settings, or activates silent mode.	*Enabled*
	Enabled	Normal operation.	0
	Refresh settings	Validates any changed EFB configuration settings. Reverts automatically to *Enabled*.	1
	Silent mode	Activates silent mode (no messages are transmitted). Silent mode can be terminated by activating the *Refresh settings* selection of this parameter.	2

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

Bit	Name	Description
0	Init failed	1 = EFB initialization failed
1	Addr config err	1 = Node address not allowed by protocol
2	Silent mode	1 = Drive not allowed to transmit
		0 = Drive allowed to transmit
3	Autobauding	1 = Drive attempting to determine transfer rate
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	1 = Protocol-dependent status information
14	Protocol 2	1 = Protocol-dependent status information
15	Internal error	1 = Problem with calls to drive control program

No.	Name/Value	Description	Def/FbEq16
	0000h…FFFFh	EFB communication status.	1 = 1
58.08	*Received packets*	Displays a count of valid packets addressed to the drive. During normal operation, this number increases constantly. Can be reset from the control panel by keeping Reset depressed for over 3 seconds.	-
	0…4294967295	Number of received packets addressed to the drive.	1 = 1
58.09	*Transmitted packets*	Displays a count of valid packets transmitted by the drive. During normal operation, this number increases constantly. Can be reset from the control panel by keeping Reset depressed for over 3 seconds.	-
	0…4294967295	Number of transmitted packets.	1 = 1
58.10	*All packets*	Displays a count of valid packets addressed to any device on the bus. During normal operation, this number increases constantly. Can be reset from the control panel by keeping Reset depressed for over 3 seconds.	-
	0…4294967295	Number of all received packets.	1 = 1
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

No.	Name/Value	Description	Def/FbEq16
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*.	*No*
	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.	1
	Last speed	Drive generates an *A7CE EFB comm loss* warning and freezes the speed to the level the drive was operating at. This only occurs if control is expected from the EFB. The speed is determined on the basis of actual speed using 850 ms low-pass filtering. **WARNING!** Make sure that it is safe to continue operation in case of a communication break.	2
	Speed ref safe	Drive generates an *A7CE EFB comm loss* warning and sets the speed to the speed defined by parameter *22.41 Speed ref safe*. This only occurs if control is expected from the EFB. **WARNING!** Make sure that it is safe to continue operation in case of a communication break.	3
	Fault always	Drive trips on *6681 EFB comm loss*. This occurs even though no control is expected from the EFB.	4
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*.	*None*
	None	None (monitoring disabled).	0
	Any message	Any message addressed to the drive resets the timeout.	1
	Cw / Ref1 / Ref2	A write of the control word or a reference resets the timeout.	2
58.16	*Communication loss time*	Sets a timeout for EFB communication. If a communication break lasts longer than the timeout, the action specified by parameter *58.14 Communication loss action* is taken. Changes to this parameter take effect after the control unit is rebooted or the new settings validated by parameter *58.06 Communication control*. See also parameter *58.15 Communication loss mode*.	30.0 s
	0.0 … 6000.0 s	EFB communication timeout.	1 = 1

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

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

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

No.	Name/Value	Description	Def/FbEq16
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*

	Transparent	The value selected by parameter *58.31 EFB act1 transparent source* is sent as actual value 1. No scaling is applied (the 16-bit scaling is 1 = 1 unit).	1
	General	The value selected by parameter *58.31 EFB act1 transparent source* is sent as actual value 1 with a 16-bit scaling of 100 = 1 unit (ie. integer and two decimals).	2
	Torque	*01.10 Motor torque* is sent as actual value 1. The scaling is defined by parameter *46.03 Torque scaling*.	3
	Speed	*01.01 Motor speed used* is sent as actual value 1. The scaling is defined by parameter *46.01 Speed scaling*.	4
	Frequency	*01.06 Output frequency* is sent as actual value 1. The scaling is defined by parameter *46.02 Frequency scaling*.	5
	Position	Motor position is sent as actual value 1. See parameter *90.06 Motor position scaled*.	6
58.29	*EFB act2 type*	Selects the type/source and scaling of actual value 2 transmitted to the fieldbus network through the embedded fieldbus interface.	*Torque*
	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 2 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*

	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

No.	Name/Value	Description	Def/FbEq16
	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 *199*).	-
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 *199*).	-
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 *199*).	-
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
	Mode 1	<u>16-bit values (groups 1…255, indexes 1…255)</u>: Register address = 400000 + 256 × parameter group + parameter index. For example, parameter 22.80 would be mapped to register 400000 + 5632 + 80 = 405712.	1
	Mode 2	<u>32-bit values (groups 1…127, indexes 1…255)</u>: Register address = 400000 + 512 × parameter group + 2 × parameter index. For example, parameter 22.80 would be mapped to register 400000 + 11264 + 160 = 411424.	2
58.34	*Word order*	Selects in which order 16-bit registers of 32-bit parameters are transfered. 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

No.	Name/Value	Description	Def/FbEq16
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*.	*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
	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 *199*).	-
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*

No.	Name/Value	Description	Def/FbEq16
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*

60 DDCS communication		DDCS communication configuration. The DDCS protocol is used in the communication between • drives in a master/follower configuration (see page *145*), • the drive and an external controller such as the AC 800M (see page *152*), or • the drive (or more precisely, an inverter unit) and the supply unit of the drive system (see page *154*). 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). To build a master/follower configuration, shielded twisted-pair cable can alternatively be used to link the XD2D connectors of the drives together. For wiring instructions, see the hardware manual of the drive.	
60.01	*M/F communication port*	Selects the connection used by the master/follower functionality.	*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	Drive-to-drive link.	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.	

No.	Name/Value	Description	Def/FbEq16
60.03	*M/F mode*	Defines the role of the drive on the master/follower 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
	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:** Use the setting *DDCS master* if using the master/follower functionality (see page *145*) through the XD2D connector.	3
	D2D follower	The drive is a follower on the drive-to-drive (D2D) link. **Note:** Use the setting *DDCS follower* if using the master/follower functionality (see page *145*) through the XD2D connector.	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:** Use the setting *DDCS forcing* if using the master/follower functionality (see page *145*) through the XD2D connector.	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 *145*) 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.	10
	1…15	Light intensity.	
60.08	*M/F comm loss timeout*	Sets a timeout for master/follower 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. See also parameter *60.19 M/F comm supervision sel 1*.	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
	Warning	The drive generates a warning (*A7CB MF comm loss*).	1

No.	Name/Value	Description	Def/FbEq16
	Fault	Drive trips on *7582 MF comm loss*.	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*).	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
60.11	*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/source and scaling of actual value ACT1 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.	0
	Transparent	Reserved.	1
	General	Reserved.	2
	Torque	*01.10 Motor torque* is sent as actual value 1. The scaling is defined by parameter *46.03 Torque scaling*.	3
	Speed	*01.01 Motor speed used* is sent as actual value 1. The scaling is defined by parameter *46.01 Speed scaling*.	4
	Frequency	*01.06 Output frequency* is sent as actual value 1. The scaling is defined by parameter *46.02 Frequency scaling*.	5
60.13	*M/F act2 type*	Selects the type and scaling of actual value 2 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.	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
60.14	*M/F follower selection*	(Effective in the master only.) Defines the followers from which data is read. See also parameters *62.28*…*62.33*. For the selections, see parameter *60.10 M/F ref1 type*.	*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 *199*).	-
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 *199*).	-
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

No.	Name/Value	Description	Def/FbEq16
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 is 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 is on.	6
60.19	*M/F comm supervision sel 1*	(This parameter is only effective when the drive is the master on a drive-to-drive master/follower link. See parameters *60.01 M/F communication port* and *60.03 M/F mode*.) 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.	-
	0000h…FFFFh	Selection of followers for communication supervision (1).	1 = 1

<table>
<tr><th>No.</th><th>Name/Value</th><th>Description</th><th>Def/FbEq16</th></tr>
<tr><td>60.20</td><td>M/F comm supervision sel 2</td><td>Selects which followers (out of followers 17…32) are monitored for loss of communication. See parameter 60.19 M/F comm supervision sel 1.

<table>
<tr><th>Bit</th><th>Name</th><th>Description</th></tr>
<tr><td>0</td><td>Follower 17</td><td>1 = Follower 17 is polled by the master.</td></tr>
<tr><td>1</td><td>Follower 18</td><td>1 = Follower 18 is polled by the master.</td></tr>
<tr><td>…</td><td>…</td><td>…</td></tr>
<tr><td>15</td><td>Follower 32</td><td>1 = Follower 32 is polled by the master.</td></tr>
</table></td><td>-</td></tr>
<tr><td></td><td>0000h…FFFFh</td><td>Selection of followers for communication supervision (2).</td><td>1 = 1</td></tr>
<tr><td>60.23</td><td>M/F status supervision sel 1</td><td>(This parameter is only effective when the drive is the master on a drive-to-drive master/follower 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.
The status of communication is shown by 62.37 M/F communication status 1 and 62.38 M/F communication status 2.

<table>
<tr><th>Bit</th><th>Name</th><th>Description</th></tr>
<tr><td>0</td><td>Follower 1</td><td>1 = Status of follower 1 is monitored.</td></tr>
<tr><td>1</td><td>Follower 2</td><td>1 = Status of follower 2 is monitored.</td></tr>
<tr><td>…</td><td>…</td><td>…</td></tr>
<tr><td>15</td><td>Follower 16</td><td>1 = Status of follower 16 is monitored.</td></tr>
</table></td><td>-</td></tr>
<tr><td></td><td>0000h…FFFFh</td><td>M/F follower status supervision selection (followers 1…16).</td><td>1 = 1</td></tr>
<tr><td>60.24</td><td>M/F status supervision sel 2</td><td>Selects the followers (out of followers 17…32) whose status words are monitored by the master.
See parameter 60.23 M/F status supervision sel 1.

<table>
<tr><th>Bit</th><th>Name</th><th>Description</th></tr>
<tr><td>0</td><td>Follower 17</td><td>1 = Status of follower 17 is monitored.</td></tr>
<tr><td>1</td><td>Follower 18</td><td>1 = Status of follower 18 is monitored.</td></tr>
<tr><td>…</td><td>…</td><td>…</td></tr>
<tr><td>15</td><td>Follower 32</td><td>1 = Status of follower 32 is monitored.</td></tr>
</table></td><td>-</td></tr>
<tr><td></td><td>0000h…FFFFh</td><td>M/F follower status supervision selection (followers 17…32).</td><td>1 = 1</td></tr>
</table>

No.	Name/Value	Description	Def/FbEq16
60.27	*M/F status supv mode sel 1*	In the master, parameters *60.27 M/F status supv mode sel 1* and *60.28 M/F status supv mode sel 2* specify the mode of follower status word monitoring. Each follower can individually be set to be monitored continuously, or only when it is in stopped state. This parameter selects the mode of status word monitoring of followers 1…16.	-

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	M/F 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	M/F status supervision mode selection 2.	1 = 1

No.	Name/Value	Description	Def/FbEq16
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
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 *134*). 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
	0.0 … 180.0 s	Master/follower wake-up delay.	10 = 1 s
60.41	*Extension adapter com port*	Selects the channel used for connecting an optional FEA-xx extension adapter.	*No connect*
	No connect	None (communication disabled).	0
	Slot 1A	Channel A on FDCO module in slot 1.	1
	Slot 2A	Channel A on FDCO module in slot 2.	2
	Slot 3A	Channel A on FDCO module in slot 3.	3
	Slot 1B	Channel B on FDCO module in slot 1.	4
	Slot 2B	Channel B on FDCO module in slot 2.	5
	Slot 3B	Channel B on FDCO module in slot 3.	6
	RDCO CH 3	Channel CH 3 on RDCO module (with BCU control unit only).	13
60.50	*DDCS controller drive type*	In ModuleBus communication, defines whether the drive is of the “engineered” or “standard” type.	*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.	1
	Slot 2A	Channel A on FDCO module in slot 2.	2
	Slot 3A	Channel A on FDCO module in slot 3.	3
	Slot 1B	Channel B on FDCO module in slot 1.	4
	Slot 2B	Channel B on FDCO module in slot 2.	5

No.	Name/Value	Description	Def/FbEq16
	Slot 3B	Channel B on FDCO module in slot 3.	6
	XD2D	Connector XD2D.	7
	RDCO CH 0	Channel 0 on RDCO module (with BCU control unit only).	10
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. 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
60.57	*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.	10
	1…15	Light intensity.	
60.58	*DDCS controller comm loss time*	Sets a timeout for communication with the external controller. If a communication break lasts longer than the timeout, the action specified by parameter *60.59 DDCS controller comm loss function* is taken. As a rule of thumb, this parameter should be set to at least 3 times the transmit interval of the controller. **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.	

No.	Name/Value	Description	Def/FbEq16
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.	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. 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 *22.41 Speed ref safe*. This only occurs if control is expected from the external controller. **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 occurs even though no control is expected from the external controller. **WARNING!** Make sure that it is safe to continue operation in case of a communication break.	5
60.60	*DDCS controller ref1 type*	Selects the type and scaling of reference 1 received from the external controller. The scaling of the reference is defined by parameters *46.01*…*46.04*, depending on which reference type is selected by this parameter. 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 scaling of the reference is defined by parameters *46.01*…*46.04*, depending on which reference type is selected by this parameter. The resulting value is shown by *03.12 DDCS controller ref 2*. For the selections, see parameter *60.60 DDCS controller ref1 type*.	*Auto*

No.	Name/Value	Description	Def/FbEq16
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 1. The scaling is defined by parameter *46.03 Torque scaling*.	3
	Speed	*01.01 Motor speed used* is sent as actual value 1. The scaling is defined by parameter *46.01 Speed scaling*.	4
	Frequency	*01.06 Output frequency* is sent as actual value 1. The scaling is defined by parameter *46.02 Frequency scaling*.	5
60.63	*DDCS controller act2 type*	Selects the type/source and scaling of actual value ACT2 transmitted to the external controller.	*Auto*
	Auto	Type/source and scaling follow the type of reference 2 selected by parameter *60.61 DDCS controller ref2 type*. See the individual settings below for the sources and scalings.	0
	Transparent	Reserved.	1
	General	Reserved.	2
	Torque	*01.10 Motor torque* is sent as actual value 2. The scaling is defined by parameter *46.03 Torque scaling*.	3
	Speed	*01.01 Motor speed used* is sent as actual value 2. The scaling is defined by parameter *46.01 Speed scaling*.	4
	Frequency	*01.06 Output frequency* is sent as actual value 2. The scaling is defined by parameter *46.02 Frequency scaling*.	5
60.64	*Mailbox dataset selection*	Selects the pair of data sets used by the mailbox service in the drive/controller communication. See section *External controller interface* (page *152*).	*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 *134*). 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	

	0000b…0111b	DDCS controller communication monitoring selection.	1 = 1

No.	Name/Value	Description	Def/FbEq16
60.71	*INU-LSU communication port*	*(Only visible with a BCU control unit)* Selects the DDCS channel used for connecting to another converter (such as a supply unit). See also section *Control of a supply unit (LSU)* (page *154*).	*Not in use*; *RDCO CH 1* (*95.20* b11, *95.20* b15)
	Not in use	None (communication disabled).	0
	RDCO CH 1	Channel 1 on RDCO module (with BCU control unit only).	11
60.77	*INU-LSU link control*	*(Only visible with a BCU control unit)* Defines the light intensity of the transmission LED of RDCO module channel CH1. (This parameter is effective only when parameter *60.71 INU-LSU communication port* is set to *RDCO CH 1*. 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 *151*).	10
	1…15	Light intensity.	
60.78	*INU-LSU comm loss timeout*	*(Only visible with a BCU control unit)* Sets a timeout for communication with another converter (such as the supply unit). If a communication break lasts longer than the timeout, the action specified by parameter *60.71 INU-LSU comm loss function* is taken.	100 ms
	0…65535 ms	Timeout for communication between converters.	
60.79	*INU-LSU comm loss function*	*(Only visible with a BCU control unit)* Selects how the inverter unit reacts to a communication break between the inverter unit and the other converter.	*Fault*
	No action	No action taken.	0
	Warning	The drive generates a warning (*AF80 INU-LSU comm loss*).	1
	Fault	Drive trips on *7580 INU-LSU comm loss*.	2
60.200	*Crane drive type*	Selects the crane drive type for M/F communication in the D2D-link. All drives in the link must have individual value of this parameter. After setting this parameter, the application will automatically set D2D-link communication parameters. For example, parameters *60.01*...*60.03*. These parameters are not allowed to change manually. **Note**: Reboot the drive after setting parameters *60.200* and *60.201*.	*Not selected*
	Not selected	Crane drive type is not selected.	0
	Main hoist (D2D master)	Main hoist (D2D master)	1
	Main trolley	Main trolley	2
	Main long travel	Main long travel	3
	Follower hoist 1	Follower hoist 1	4
	Follower hoist 2	Follower hoist 2	5
	Follower hoist 3	Follower hoist 3	6
	Follower hoist 4	Follower hoist 4	7
	Follower trolley 1	Follower trolley 1	8
	Follower trolley 2	Follower trolley 2	9

No.	Name/Value	Description	Def/FbEq16
	Follower long travel 1	Follower long travel 1	10
	Follower long travel 2	Follower long travel 2	11
60.201	*Crane drives structure*	Sets the crane M/F communication supervision in the D2D-link. Setting the bit from 0 to 1 activates supervision. For example, in the main hoist drive setting bits 3,4,5,6 activates supervision between main hoist and its followers. Similarly, in the main trolley drive setting bits 7 and 8 activates supervision. **Note**: • It is not recommended to activate all the bits in the main hoist drive, because a communication problem between the main trolley and its follower trips the main hoist. • Reboot the drive after setting parameters *60.200* and *60.201*.	-

Bit	Name	Description
0	0	
1	Main trolley	Main trolley
2	Main long travel	Main long travel
3	Follower hoist 1	Follower hoist 1
4	Follower hoist 2	Follower hoist 2
5	Follower hoist 3	Follower hoist 3
6	Follower hoist 4	Follower hoist 4
7	Follower trolley 1	Follower trolley 1
8	Follower trolley 2	Follower trolley 2
9	Follower long travel 1	Follower long travel 1
10	Follower long travel 2	Follower long travel 2

No.	Name/Value	Description	Def/FbEq16
	0000h…FFFFh	M/F communication status (followers 1…16).	1 = 1
60.202	*CW1*	Control word 1 generated by current drive.	-

Bit	Name	Description
0	Start	Start command with Running bit combined in follower side
1	Modulating	Modulating status of this drive
2	Brake closed	Brake closed status of this drive
3...11	Reserved	
12	Master toggle	Internal information - used for M/F communication
13	Master Reply for followers 1 Toggle bit	Internal information - used for M/F communication
14	Master Reply for followers 2 Toggle bit	Internal information - used for M/F communication
15	Reset	Reset command

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

No.	Name/Value	Description	Def/FbEq16
60.203	CW2	Control word 2 generated by current drive.	-

Bit	Name	Description
0	System ready	Par 06.11 bit device Ready run
1	System fault	Par 06.11 bit device Tripped
2	Ext speed limit	External speed limit is active. Application related status
3	System running	Par 06.16 bit Modulating
4	Off3	Emergency stop
5	Torq prv ok	Application related status
6	Slowdown up	Application related status
7	Slowdown dn	Application related status
8	High-end cmd	Application related status
9	Low-end cmd	Application related status
10	Ext 2 act	Par 06.16 bit Ext2 active
11	Synchron sel on	Application related status
12	Start inhibit	Application related status
13	Reserved	
14	Fast stop	Application related status
15	Master not in ext 2	Application related status

No.	Name/Value	Description	Def/FbEq16
	0000h…FFFFh		1 = 1
60.204	Ref1	Reference 1. Value depends on Synchro On or Off (par. 82.01) different data transfered.	-
	Synchro On	Linear speed reference	-
	Synchro Off (Normal M/F)	Device_speed_ref_used_24.01 Used speed reference	-
60.205	Ref2	Reference 2. Value depends on Synchro On or Off (par. 82.01) different data transfered.	
	Synchro On	Device_Load_position_scaled_90.05 Load position (Master position)	
	Synchro Off (Normal M/F)	Device_Torque_ref5_act_26.75 Torque reference act 5	

No.	Name/Value	Description	Def/FbEq16
60.206	*Master SW1*	Master drive application status word 1.	-

Bit	Name	Description
0	System ready	Par *06.11* bit device Ready run
1	System fault	Par *06.11* bit device Tripped
2	Ext speed limit	External speed limit is active. Application related status
3	System running	Par *06.16* bit Modulating
4	Modulating	Modulating status of drive
5	Torq prv ok	Application related status
6	Slowdown up	Application related status
7	Slowdown dn	Application related status
8	High-end cmd	Application related status
9	Low-end cmd	Application related status
10	Ext 2 act	Par *06.16* bit Ext2 active
11	Synchron sel on	Application related status
12	Start inhibit	Application related status
13	Reserved	Brake closed status of drive
14	Fast stop	Application related status
15	Master not in ext 2	Application related status

No.	Name/Value	Description	Def/FbEq16
	0000h…FFFFh	Status word 1	1 = 1
60.207	*Master SW2*	Master drive application status word 2. Used by application internally for D2D supervision.	-
	0000h…FFFFh	Status word 2	1 = 1
60.210	*Follower 1 SW1*	Follower x drive application status word 1.	-

Bit	Name	Description
0	System ready	Par *06.11* bit device Ready run
1	System fault	Par *06.11* bit device Tripped
2	Ext speed limit	Application related status
3	System running	Par *06.16* bit Modulating
4	Off3	Emergency stop
5	Torq prv ok	Application related status
6	Slowdown up	Application related status
7	Slowdown dn	Application related status
8	High-end cmd	Application related status
9	Low-end cmd	Application related status
10	Ext 2 act	Par *06.16* bit Ext2 active
11	Synchron sel on	Application related status
12	Start inhibit	Application related status
13	Reserved	
14	Fast stop	Application related status
15	Master not in ext 2	Application related status

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

No.	Name/Value	Description	Def/FbEq16
60.211	*Follower 1 SW2*	Follower x drive application status word 2. Used by application internally for D2D supervision.	-
	0000h…FFFFh	Status word 2	1 = 1
60.212	*Follower 1 position error*	Shows the follower x drive position difference compared with the master drive. This parameter is visible only in master drive.	-
60.213	*Follower 1 position actual*	Shows the actual position of the follower x drive. This parameter is visible only in master drive.	-
60.214	*Follower 2 SW1*	Follower x drive application status word 1.	-

Bit	Name	Description
0	System ready	Par *06.11* bit device Ready run
1	System fault	Par *06.11* bit device Tripped
2	Ext speed limit	Application related status
3	System running	Par *06.16* bit Modulating
4	Off3	Emergency stop
5	Torq prv ok	Application related status
6	Slowdown up	Application related status
7	Slowdown dn	Application related status
8	High-end cmd	Application related status
9	Low-end cmd	Application related status
10	Ext 2 act	Par *06.16* bit Ext2 active
11	Synchron sel on	Application related status
12	Start inhibit	Application related status
13	Reserved	
14	Fast stop	Application related status
15	Master not in ext 2	Application related status

No.	Name/Value	Description	Def/FbEq16
	0000h…FFFFh	Status word 1	1 = 1
60.215	*Follower 2 SW2*	Follower x drive application status word 2. Used by application internally for D2D supervision.	-
	0000h…FFFFh	Status word 2	1 = 1
60.216	*Follower 2 position error*	Shows the follower x drive position difference compared with the master drive. This parameter is visible only in master drive.	-
60.217	*Follower 2 position actual*	Shows the actual position of the follower x drive. This parameter is visible only in master drive.	-

No.	Name/Value	Description	Def/FbEq16
60.218	*Follower 3 SW1*	Follower x drive application status word 1.	-

Bit	Name	Description
0	System ready	Par *06.11* bit device Ready run
1	System fault	Par *06.11* bit device Tripped
2	Ext speed limit	Application related status
3	System running	Par *06.16* bit Modulating
4	Off3	Emergency stop
5	Torq prv ok	Application related status
6	Slowdown up	Application related status
7	Slowdown dn	Application related status
8	High-end cmd	Application related status
9	Low-end cmd	Application related status
10	Ext 2 act	Par *06.16* bit Ext2 active
11	Synchron sel on	Application related status
12	Start inhibit	Application related status
13	Reserved	
14	Fast stop	Application related status
15	Master not in ext 2	Application related status

No.	Name/Value	Description	Def/FbEq16
	0000h…FFFFh	Status word 1	1 = 1
60.219	*Follower 3 SW1*	Follower x drive status word 1. Used by application internally for D2D supervision.	-
	0000h…FFFFh	Status word 1	1 = 1
60.220	*Follower 3 position error*	Shows the follower x drive position difference compared with the master drive. This parameter is visible only in master drive.	-
60.221	*Follower 3 position actual*	Shows the actual position of the follower x drive. This parameter is visible only in master drive.	-

No.	Name/Value	Description	Def/FbEq16
60.222	*Follower 4 SW1*	Follower x drive application status word 1.	-

Bit	Name	Description
0	System ready	Par *06.11* bit device Ready run
1	System fault	Par *06.11* bit device Tripped
2	Ext speed limit	Application related status
3	System running	Par *06.16* bit Modulating
4	Off3	Emergency stop
5	Torq prv ok	Application related status
6	Slowdown up	Application related status
7	Slowdown dn	Application related status
8	High-end cmd	Application related status
9	Low-end cmd	Application related status
10	Ext 2 act	Par *06.16* bit Ext2 active
11	Synchron sel on	Application related status
12	Start inhibit	Application related status
13	Reserved	
14	Fast stop	Application related status
15	Master not in ext 2	Application related status

No.	Name/Value	Description	Def/FbEq16
	0000h…FFFFh	Status word 1	1 = 1
60.223	*Follower 4 SW2*	Follower x drive application status word 2. Used by application internally for D2D supervision.	-
	0000h…FFFFh	Status word 2	1 = 1
60.224	*Follower 4 position error*	Shows the follower x drive position difference compared with the master drive. This parameter is visible only in master drive.	-
60.225	*Follower 4 position actual*	Shows the actual position of the follower x drive. This parameter is visible only in master drive.	
60.226	*Hoist position*	Shows the value of hoist position transferred from the main hoist drive through D2D link to all drives. See parameter *77.20 Pendulum length source*.	-
60.227	*Hoist weight*	Shows the hoist load value transferred from the main hoist drive through D2D link to all drives. See parameter *77.80 Load to antisway selection*.	-
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*.	*Follower CW*
	None	None.	0
	CW 16bit	Control Word (16 bits)	1
	SW 16bit	Status Word (16 bits)	4
	Act1 16bit	Actual value ACT1 (16 bits) **Note:** Using this setting to send a reference to the follower is not recommended as the source signal is filtered. Use the “reference” selections instead.	5

No.	Name/Value	Description	Def/FbEq16
	Act2 16bit	Actual value ACT2 (16 bits) **Note:** Using this setting to send a reference to the follower is not recommended as the source signal is filtered. Use the “reference” selections instead.	6
	Follower CW	A word consisting of bits 0…11 of *06.01 Main control word* and the bits selected by parameters *06.45*…*06.48*.	27
	Used speed reference	*24.01 Used speed reference* (page *320*).	6145
	Torque reference act 5	*26.75 Torque reference act 5* (page *338*).	6731
	Torque reference used	*26.02 Torque reference used* (page *332*).	6658
	Other	Source selection (see *Terms and abbreviations* on page *199*).	-
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.	
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.	

No.	Name/Value	Description	Def/FbEq16
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 *199*).	-
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
	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 *199*).	-

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

No.	Name/Value	Description	Def/FbEq16
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.	
61.151	*INU-LSU Data set 10 data 1 sel*	*(Parameters 61.151…61.203 only visible with a BCU control unit)* Parameters *61.151*…*61.153* preselect data to be sent in data sets 10, 12, 14, 16, 18, 20, 22, 24 and 32 to another converter. (Data set 32 is typically used by the mailbox function.) Parameters *61.201*…*61.203* display the data to be sent to the other converter. 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 10. Parameter *61.201 INU-LSU Data set 10 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 *61.201*.	*None*; *LSU CW* (*95.20* b11, *95.20* b15)
	None	None.	0
	LSU CW	Control word for the supply unit.	22
	DC voltage reference	*94.20 DC voltage reference* (page *496*).	24084
	Reactive power reference	*94.30 Reactive power reference* (page *496*).	24094
	Other	Source selection (see *Terms and abbreviations* on page *199*).	-
61.152	*INU-LSU Data set 10 data out 2*	Preselects the data to be sent as word 2 of data set 10 to the other converter. See also parameter *61.202 INU-LSU Data set 10 data 2 value*. For the selections, see parameter *61.151 INU-LSU Data set 10 data 1 sel*.	*None*; *DC voltage reference* (*95.20* b15)

No.	Name/Value	Description	Def/FbEq16
61.153	*INU-LSU Data set 10 data 2 sel*	Preselects the data to be sent as word 3 of data set 10 to the other converter. See also parameter *61.203 INU-LSU Data set 10 data 3 value*. For the selections, see parameter *61.151 INU-LSU Data set 10 data 1 sel*.	*None*
61.201	*INU-LSU Data set 10 data 1 value*	Displays (in integer format) the data to be sent to the other converter as word 1 of data set 10. If no data has been preselected by *61.151 INU-LSU Data set 10 data 1 sel*, 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 10.	
61.202	*INU-LSU Data set 10 data 2 value*	Displays (in integer format) the data to be sent to the other converter as word 2 of data set 10. If no data has been preselected by *61.152 INU-LSU Data set 10 data out 2*, 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 10.	
61.203	*INU-LSU Data set 10 data 3 value*	Displays (in integer format) the data to be sent to the other converter as word 3 of data set 10. If no data has been selected by *61.153 INU-LSU Data set 10 data 2 sel*, 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 10.	

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 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 *199*).	-
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 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 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*.	*Follower SW*
	None	None.	0

No.	Name/Value	Description	Def/FbEq16
	Follower SW	Status word of the follower. See also parameter *60.18 Follower enable*.	26
	Other	Source selection (see *Terms and abbreviations* on page *199*).	-
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 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 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 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.	
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.	

No.	Name/Value	Description	Def/FbEq16
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.	
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

<table>
<tr><th>No.</th><th>Name/Value</th><th>Description</th><th>Def/FbEq16</th></tr>
<tr><td>62.41</td><td>M/F follower ready status 1</td><td>In the master, displays the ready status of the communication with followers specified by parameter 60.23 M/F status supervision sel 1.</td><td>-</td></tr>
<tr><td colspan="4">
<table>
<tr><th>Bit</th><th>Name</th><th>Description</th></tr>
<tr><td>0</td><td>Follower 1</td><td>1 = Follower 1 ready.</td></tr>
<tr><td>1</td><td>Follower 2</td><td>1 = Follower 2 ready.</td></tr>
<tr><td>…</td><td>…</td><td>…</td></tr>
<tr><td>15</td><td>Follower 16</td><td>1 = Follower 16 ready.</td></tr>
</table>
</td></tr>
<tr><td></td><td>0000h…FFFFh</td><td>Follower 1…16 ready status.</td><td>1 = 1</td></tr>
<tr><td>62.42</td><td>M/F follower ready status 2</td><td>In the master, displays the ready status of the communication with followers specified by parameter 60.24 M/F status supervision sel 2.</td><td>-</td></tr>
<tr><td colspan="4">
<table>
<tr><th>Bit</th><th>Name</th><th>Description</th></tr>
<tr><td>0</td><td>Follower 17</td><td>1 = Follower 17 ready.</td></tr>
<tr><td>1</td><td>Follower 18</td><td>1 = Follower 18 ready.</td></tr>
<tr><td>…</td><td>…</td><td>…</td></tr>
<tr><td>15</td><td>Follower 32</td><td>1 = Follower 32 ready.</td></tr>
</table>
</td></tr>
<tr><td></td><td>0000h…FFFFh</td><td>Follower 17…32 ready status.</td><td>1 = 1</td></tr>
<tr><td>62.45</td><td>Data set 1 data 1 selection</td><td>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.</td><td>None</td></tr>
<tr><td></td><td>None</td><td>None.</td><td>0</td></tr>
<tr><td></td><td>CW 16bit</td><td>Control Word (16 bits)</td><td>1</td></tr>
<tr><td></td><td>Ref1 16bit</td><td>Reference REF1 (16 bits)</td><td>2</td></tr>
<tr><td></td><td>Ref2 16bit</td><td>Reference REF2 (16 bits)</td><td>3</td></tr>
<tr><td></td><td>Other</td><td>Source selection (see Terms and abbreviations on page 199).</td><td>-</td></tr>
<tr><td>62.46</td><td>Data set 1 data 2 selection</td><td>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.</td><td>None</td></tr>
</table>

No.	Name/Value	Description	Def/FbEq16
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 *199*).	-
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*
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.	

No.	Name/Value	Description	Def/FbEq16
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.	
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.	

No.	Name/Value	Description	Def/FbEq16
62.151	*INU-LSU Data set 11 data 1 sel*	*(Parameters 62.151…62.203 only visible with a BCU control unit)* Parameters *62.151*…*62.153* define a target for the data received in data sets 11from another converter (typically the supply unit of the drive). Parameters *62.201*…*62.203* display the data received from the other converter in integer format, and can be used as sources by other parameters. For example, this parameter selects a target for word 1 of data set 11. Parameter *62.201 INU-LSU Data set 11 data 1 value* displays the received data in integer format, and can also be used as a source by other parameters.	*None*; *LSU SW* (*95.20* b11, *95.20* b15)
	None	None.	0
	LSU SW	Status word of the supply unit.	4
	Other	Source selection (see *Terms and abbreviations* on page *199*).	-
62.152	*INU-LSU Data set 11 data 2 sel*	Defines a target for the data received as word 2 of data set 11. See also parameter *62.202 INU-LSU Data set 11 data 2 value*. For the selections, see parameter *62.151 INU-LSU Data set 11 data 1 sel*.	*None*
62.153	*INU-LSU Data set 11 data 3 sel*	Defines a target for the data received as word 3 of data set 11. See also parameter *62.203 INU-LSU Data set 11 data 3 value*. For the selections, see parameter *62.151 INU-LSU Data set 11 data 1 sel*.	*None*
62.201	*INU-LSU Data set 11 data 1 value*	Displays (in integer format) the data received from the other converter as word 1 of data set 11. A target for this data can be selected by parameter *62.151 INU-LSU Data set 11 data 1 sel*. The value can also be used as a source by another parameter.	0
	0…65535	Data received as word 1 of data set 11.	
62.202	*INU-LSU Data set 11 data 2 value*	Displays (in integer format) the data received from the other converter as word 2 of data set 11. A target for this data can be selected by parameter *62.152 INU-LSU Data set 11 data 2 sel*. The value can also be used as a source by another parameter.	0
	0…65535	Data received as word 2 of data set 11.	
62.203	*INU-LSU Data set 11 data 3 value*	Displays (in integer format) the data received from the other converter as word 3 of data set 11. A target for this data can be selected by parameter *62.153 INU-LSU Data set 11 data 3 sel*. The value can also be used as a source by another parameter.	0
	0…65535	Data received as word 3 of data set 11.	

74 Speed matching		Settings for Speed matching. See also section *Speed matching* on page *93*.	
74.01	*Motor speed match*	Enables the Speed matching function.	*Enable*
	Disable	Speed matching disabled.	0
	Enable	Speed matching enabled.	1

No.	Name/Value	Description	Def/FbEq16
	DI1	Digital input DI1 (*10.02 DI delayed status*, bit 0).	2
	DI2	Digital input DI2 (*10.02 DI delayed status*, bit 1).	3
	DI3	Digital input DI3 (*10.02 DI delayed status*, bit 2).	4
	DI4	Digital input DI4 (*10.02 DI delayed status*, bit 3).	5
	DI5	Digital input DI5 (*10.02 DI delayed status*, bit 4).	6
	DI6	Digital input DI6 (*10.02 DI delayed status*, bit 5).	7
	Other [bit]	Source selection (see *Terms and abbreviations* on page *199*).	-
74.02	*Motor speed steady deviation level*	Defines the absolute motor speed deviation level for the steady state. **Note**: We recommend to define this value as minimum settings that is double the nominal slip speed of the motor.	30.00 rpm
	0.00 … 30000.00 rpm	Speed deviation level for the steady state.	1 = 1 rpm
74.03	*Motor speed ramp deviation level*	Defines the absolute motor speed deviation level for the ramping state (acceleration/deceleration).	70.00 rpm
	0.00 … 30000.00 rpm	Speed deviation level for the ramping state.	1 = 1 rpm
74.04	*Speed match fault delay*	Defines the time delay for generating fault *D105 Speed match* and warning *D200 Brake slip at standstill2*.	1000 ms
	0…30000 ms	Time delay.	1 = 1 ms

75 Hoist speed optimization		Settings for Hoist speed optimization. See also section *Hoist speed optimization* on page *104*.	
75.01	*Hoist speed optimization sel*	Enables the Hoist speed optimization function.	*Disable*
	Disable	Hoist speed optimization is disabled.	0
	Enable	Hoist speed optimization is enabled.	1
	DI1	Digital input DI1 (*10.02 DI delayed status*, bit 0).	2
	DI2	Digital input DI2 (*10.02 DI delayed status*, bit 1).	3
	DI3	Digital input DI3 (*10.02 DI delayed status*, bit 2).	4
	DI4	Digital input DI4 (*10.02 DI delayed status*, bit 3).	5
	DI5	Digital input DI5 (*10.02 DI delayed status*, bit 4).	6
	DI6	Digital input DI6 (*10.02 DI delayed status*, bit 5).	7
	Other [bit]	Source selection (see *Terms and abbreviations* on page *199*).	-

No.	Name/Value	Description	Def/FbEq16
75.03	*Motor base speed*	Defines the motor base speed. When the actual motor speed exceeds this value either in the forward or reverse direction, the Hoist speed optimization function uses this value to check for the actual motor torque after the period of time defined in parameter *75.06 Hold ramp*. This motor torque is further used with parameters *75.07…75.25* to calculate the speed limit in the forward and reverse directions. If you do not set parameters *75.07…75.25* in the correct order, the speed is always limited to this base speed.	1500.00 rpm
	0.00… 30000.00 rpm	Motor base speed.	100 = 1 rpm
75.04	*Load margin*	Defines a torque margin for the set load values. The Hoist speed optimization function applies this margin to the detected base speed torque. The margin can be used for reserving tolerance for motor actual current because of voltage drops.	0.00%
	0.00 … 100.00%	Torque margin as percentage of the monitored current.	100 = 1%
75.05	*Load speed limit test*	Defines a test value (torque) for calculating the load speed limit when the drive is not running.	0.00%
	-30000.00 … 30000.00%	Test value (torque).	10 = 1.0%
75.06	*Hold ramp*	Defines the time period for holding the speed reference at the motor base speed before the function checks for the actual motor torque. This motor torque is considered by the Hoist speed optimization function as the base speed torque for the particular load used.	200.00 ms
	0.00…10000.00 ms	Hold ramp time.	1 = 1 ms
75.07	*Load 0 up*	Defines the torque value (X1) in the forward direction for the load speed graph. If the Hoist speed optimization function detects this value as the base speed torque in the forward direction, the load speed limit calculated is the speed defined in parameter *75.07 Load 0 up*. **Notes:** • You must define two load and speed parameters at the minimum. • If you set a load parameter to zero, all the parameters above this parameter must be set to zero. • The load parameters must be in increasing order and the speed parameters in decreasing order. If any of the above conditions is not met, the speed is limited to the motor base speed.	0.00%
	0.00 … 300.00%	Torque value (X1) in the forward direction.	100 = 1%
75.08	*Load 0 speed up*	Defines the speed limit value (Y1) in the forward direction based on *75.07 Load 0 up* (X1). This value can be the maximum allowed speed with an empty hook in the forward direction. See the notes in *75.07 Load 0 up*.	0.00 rpm
	0.00…3000.00 rpm	Speed limit value (Y1) in the forward direction.	100 = 1 rpm

No.	Name/Value	Description	Def/FbEq16
75.09	*Load 1 up*	Defines the torque value at load1 (X2) in the forward direction for the load speed graph. See the notes in *75.07 Load 0 up*.	0.00%
	0.00…300.00%	Torque value (X2) in the forward direction.	100 = 1%
75.10	*Load1 speed up*	Defines the speed limit value (Y2) in the forward direction based on *75.09 Load 1 up*.	0.00 rpm
	0.00…3000.00 rpm	Speed limit value (Y2) in the forward direction.	100 = 1 rpm
75.11	*Load 2 up*	Defines the torque value at load2 (X3) in the forward direction for the load speed graph. See the notes in *75.07 Load 0 up*.	0.00%
	0.00…300.00%	Torque value (X3) in the forward direction.	100 = 1%
75.12	*Load 2 speed up*	Defines the speed limit value (Y3) in the forward direction based on *75.11 Load 2 up*.	0.00 rpm
	0.00…3000.00 rpm	Speed limit value (Y3) in the forward direction.	100 = 1 rpm
75.13	*Load 3 up*	Defines the torque value at load3 (X4) in the forward direction for the load speed graph. See the notes in *75.07 Load 0 up*.	0.00%
	0.00 … 300.00%	Torque value (X4) in the forward direction.	100 = 1%
75.14	*Load 3 speed up*	Defines the speed limit value (Y4) in the forward direction based on *75.13 Load 3 up*.	0.00 rpm
	0.00 … 3000.00 rpm	Speed limit value (Y4) in the forward direction.	100 = 1 rpm
75.15	*Load 4 up*	Defines the torque value at load4 (X5) in the forward direction for the load speed graph. This torque can be the torque at the base speed with maximum load when the motor is running in the forward direction.	0.00%
	0.00 … 300.00%	Torque value (X5) in the forward direction.	100 = 1%
75.16	*Load 4 speed up*	Defines the speed limit value (Y5) in the forward direction based on *75.15 Load 4 up*. See the notes in *75.07 Load 0 up*.	0.00 rpm
	0.00…3000.00 rpm	Speed limit value (Y5) in the forward direction.	100 = 1 rpm
75.17	*Load 0 down*	Defines the torque value X1 in the reverse direction for the hoist speed optimization graph. If the Hoist speed optimization function detects this value as the base speed torque in the reverse direction, the load speed limit calculated is the speed defined in parameter *75.17 Load 0 down*. See the notes in *75.07 Load 0 up*.	0.00%
	0.00 … 300.00%	Torque value (X1) in the reverse direction.	100 = 1%
75.18	*Load 0 speed down*	Defines the speed limit value (Y1) in the reverse direction based on *75.17 Load 0 down*. This value can be the maximum allowed speed with an empty hook in the reverse direction.	0.00 rpm
	0.00…3000.00 rpm	Speed limit value (Y1) in the reverse direction.	100 = 1 rpm
75.19	*Load 1 down*	Defines the torque value at load1 (X2) in the reverse direction for the load speed graph. See the notes in *75.07 Load 0 up*.	0.00%
	0.00…300.00%	Torque value (X2) in the reverse direction.	100 = 1%

No.	Name/Value	Description	Def/FbEq16
75.20	*Load 1 speed down*	Defines the speed limit value (Y2) in the reverse direction based on *75.19 Load 1 down*.	0.00 rpm
	0.00…3000.00 rpm	Speed limit value (Y2) in the reverse direction.	100 = 1 rpm
75.21	*Load 2 down*	Defines the torque value at load2 (X3) in the reverse direction for the load speed graph. See the notes in *75.07 Load 0 up*.	0.00%
	0.00…300.00%	Torque value (X3) in the reverse direction.	100 = 1%
75.22	*Load 2 speed down*	Defines the speed limit value (Y3) in the reverse direction based on *75.21 Load 2 down*.	0.00 rpm
	0.00…3000.00 rpm	Speed limit value (Y3) in the reverse direction.	100 = 1 rpm
75.23	*Load 3 down*	Defines the torque value at load3 (X4) in the reverse direction for the load speed graph. See the notes in *75.07 Load 0 up*.	0.00%
	0.00 … 300.00%	Torque value (X4) in the reverse direction.	100 = 1%
75.24	*Load 3 speed down*	Defines the speed limit value (Y4) in the reverse direction based on *75.23 Load 3 down*.	0.00 rpm
	0.00…3000.00 rpm	Speed limit value (Y4) in the reverse direction.	100 = 1 rpm
75.25	*Load 4 down*	Defines the torque value at load4 (X5) in the reverse direction for the load speed graph. This torque can be the torque at the base speed with the maximum load when the motor is running in the reverse direction. See the notes in *75.07 Load 0 up*.	0.00%
	0.00…300.00%	Torque value (X5) in the reverse direction.	100 = 1%
75.26	*Load 4 speed down*	Defines the speed limit value (Y5) in the reverse direction based on *75.25 Load 4 down*.	0.00 rpm
	0.00…3000.00 rpm	Speed limit value (Y5) in the reverse direction.	100 = 1 rpm
75.27	*Hoist efficiency up*	Allows the user to define the mechanical efficiency of the system.	0.9
	0.00…1.00	Efficiency	100 = 1
75.28	*Hoist efficiency down*	Allows the user to define the mechanical efficiency of the system.	0.9
	0.00…1.00	Efficiency	100 = 1
75.29	*Inertia up*	Allows the user to define the motor maximum overload ability (estimated pull out torque at base speed).	1.5 kgm^2
	0.00...100.00 kgm^2	Overload ability.	100 = 1 kgm^2
75.30	*Inertia down*	Allows the user to define the motor maximum overload ability (estimated pull out torque at base speed).	1.5 kgm^2
	0.00...100.00 kgm^2	Overload ability.	100 = 1 kgm^2
75.31	*Hoist nominal load*	Defines the hoist load for hoist speed optimization.	1.0 Tn
	0.0…32000.0 Tn	Load in Tons.	10 = 1 Tn
75.32	*Hoist nominal speed*	Defines the nominal speed of the hoist drive.	1 m/min
	0.00 ... 1000.00 m/min	Speed	100 = 1 m/min
75.33	*Hoist maximum speed*	Defines the maximum speed limit of the hoist drive. This value is used to plot equal divisions on the load curve.	1 m/min

No.	Name/Value	Description	Def/FbEq16
	0.00 ... 1000.00 m/min	Speed limit.	100 = 1 m/min
75.35	*Motor Tmax/Tn*	Allows the user to define the motor pull-out torque (from motor catalogue or rating plate).	2.7
	0.00...10.00	Torque value	100 = 1
75.36	*Calculate load curve*	Enables load curve calculation.	*No*
	No	Load curve calculation is disabled.	0
	Calculate	Load curve calculation is enabled.	1
75.38	*Load filter time*	Defines the time constant of the absolute hoist load and relative hoist load low pass filter.	1000 ms
	0 ... 30000 ms	Load filter time.	1 = 1 ms
75.40	*Relative hoist load*	Shows the calculated relative hoist load value from load curve calculation. This signal from the hoist drive can be used in antisway drives to define pendulum arm offset. (In the hoist drive, parameter *77.80 Load to antisway selection* is equal to this value). At 100%, value is equal to hoist nominal load (par. *75.31*). To get correct value, set parameters *75.31*...*75.36*. This parameter is read only.	-
75.41	*Absolute hoist load*	Shows the calculated absolute hoist load value from load curve calculation. This signal can be used for fine tuning hoist speed optimization (by comparing actual value with reading on the external system, if exists). To get correct value of this signal, see settings in par. *75.40*. This parameter is read only.	-
75.42	*Relative hoist load filtered*	Shows the filtered value of the parameter *75.40 Relative hoist load* for the filter time constant defined with parameter *75.38 Load filter time*. This parameter is read only.	-
75.43	*Absolute hoist load filtered*	Shows the filtered value of the parameter *75.41 Absolute hoist load* for the filter time constant defined with parameter *75.38 Load filter time*. This parameter is read only.	-
75.50	*Inertia acceleration torque up*	(*Visible when user lock is open with pass code 584. See parameter 96.02 Pass code.*) Shows the intermediate calculated inertia acceleration torque up value from load curve calculation. This parameter is hidden. To make it visible, set pass code 584 in parameter *96.02 Pass code*. After reading the signal, set pass code 1 in par. *96.02* to hide par. *96.06*. This parameter is read only.	-
75.51	*Load acceleration torque up*	(*Visible when user lock is open with pass code 584. See parameter 96.02 Pass code.*) Shows the intermediate calculated load acceleration torque up value from load curve calculation. This parameter is hidden. To make it visible, set pass code 584 in parameter *96.02 Pass code*. After reading the signal, set pass code 1 in par. *96.02* to hide par. *96.06*. This parameter is read only.	-

No.	Name/Value	Description	Def/FbEq16
75.52	*Acceleration torque up*	(*Visible when user lock is open with pass code 584. See parameter 96.02 Pass code*.) Shows the intermediate calculated acceleration torque up value from load curve calculation. This parameter is hidden. To make it visible, set pass code 584 in parameter *96.02 Pass code*. After reading the signal, set pass code 1 in par. *96.02* to hide par. *96.06*. This parameter is read only.	-
75.53	*Inertia acceleration torque down*	(*Visible when user lock is open with pass code 584. See parameter 96.02 Pass code*.) Shows the intermediate calculated inertia acceleration torque down value from load curve calculation. This parameter is hidden. To make it visible, set pass code 584 in parameter *96.02 Pass code*. After reading the signal, set pass code 1 in par. *96.02* to hide par. *96.06*. This parameter is read only.	-
75.54	*Load acceleration torque down*	(*Visible when user lock is open with pass code 584. See parameter 96.02 Pass code*.) Shows the intermediate calculated load acceleration torque down value from load curve calculation. This parameter is hidden. To make it visible, set pass code 584 in parameter *96.02 Pass code*. After reading the signal, set pass code 1 in par. *96.02* to hide par. *96.06*. This parameter is read only.	-
75.55	*Acceleration torque down*	(*Visible when user lock is open with pass code 584. See parameter 96.02 Pass code*.) Shows the intermediate calculated acceleration torque down value from load curve calculation. This parameter is hidden. To make it visible, set pass code 584 in parameter *96.02 Pass code*. After reading the signal, set pass code 1 in par. *96.02* to hide par. *96.06*. This parameter is read only.	-
75.60	*Slack rope enable*	Enables the Slack rope function.	*Enable*
	Disable	Slack rope disabled.	0
	Enable	Slack rope enabled.	1
75.61	*Slack rope load level*	Defines the slack rope load level	-400.00%
	-400.00...400.00%	Load level	100 = 1%
75.70	*Start lifetime monitor*	(*Visible when user lock is open with pass code 584. See parameter 96.02 Pass code*.) Activates the lifetime function.	*Off*
	Off	Lifetime monitor function is Off.	0
	On	Lifetime monitor function is On.	1
75.71	*Crane lifetime*	(*Visible when user lock is open with pass code 584. See parameter 96.02 Pass code*.) Defines the user defined lifetime for the mechanics of the crane.	10000 h
	0...10000 h	Lifetime hours	1 = 1 h

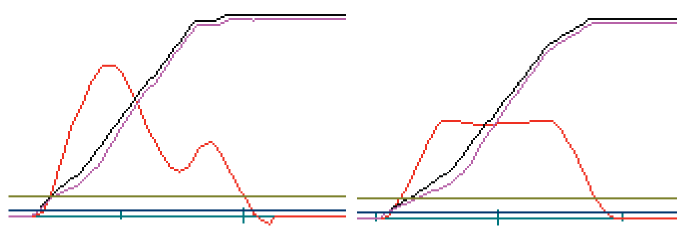
No.	Name/Value	Description	Def/FbEq16
75.72	*Reset load spectrum*	(*Visible when user lock is open with pass code 584. See parameter 96.02 Pass code*.) Allows to reset the load spectrum to the value defined in parameter *75.73 Preset value of load spectrum*. See also *Lifetime monitor maintenance* on page *45*.	*Done*
	Reset	Reset activated.	0
	Done	Reset done.	1
75.73	*Preset value of load spectrum*	(*Visible when user lock is open with pass code 584. See parameter 96.02 Pass code*.) Defines the preset value that is accounted when parameter *75.72 Reset load spectrum* is set to *Reset*. See also *Lifetime monitor maintenance* on page *45*.	1
	0 ... 10	Preset value	1 = 1
75.74	*Lifetime speed scaling*	(*Visible when user lock is open with pass code 584. See parameter 96.02 Pass code*.) Defines the relation between required hoist speed to the motor nominal speed. For example: At 2 m/min, nominal hoist speed = 2000 rpm Base speed of the motor = 1380 rpm Speed scaling = 2000/1380 = 145%	100%
	0 ... 200%	Percent of nominal motor speed to reach the hoist nominal speed.	1 = 1%
75.75	*Lifetime factor*	(*Visible when user lock is open with pass code 584. See parameter 96.02 Pass code*.) Defines the scaling factor for the lifetime monitor function.	1.000
	0.000 ... 2.000	Scaling factor	1000 = 1
75.80	*Lifetime used*	(*Visible when user lock is open with pass code 584. See parameter 96.02 Pass code*.) Shows the used lifetime hours. This parameter is used as memory cell (at power failure).	PAR: POWER SAVE
	0 ...10000 h	Lifetime hours	
75.81	*Load at stop*	Shows the load value when drive stops.	*Off*
	Off	When drive stops load value resets to 0.	0
	On	When drive stops the last known value of the load remains visible.	1

76 Conical motor		Settings for Conical motor control. See also section *Conical motor control* on page *101*.	
76.01	*Conical control*	Enables the Conical motor control function. **Note:** Mechanical brake control must be enabled when the Conical motor control function is used. See parameter *44.06 Brake control enable*.	*Disable*
	Disable	Conical motor control function is disabled.	0
	Enable	Conical motor control function is enabled.	1
76.02	*Start flux level*	Defines the start flux level, that is, the flux level for opening the brake. The drive uses this value as the flux reference when the Conical motor function is activated and the drive is started. See also parameter *76.04 Start flux hold time*.	125%
	0…150%	Start flux level in percentage of the motor nominal flux.	1 = 1%

No.	Name/Value	Description	Def/FbEq16
76.03	*Stop flux level*	Defines the stop flux level, that is, the flux level for closing the brake. The drive uses this value as the flux reference when the stop command is given and the motor actual speed is below *21.06 Zero speed limit*.	75%
	0…100%	Stop flux level in percentage of the motor nominal flux.	1 = 1%
76.04	*Start flux hold time*	Defines the hold time for the start flux level as the flux reference. This hold time makes sure that the start flux level is active for the time required for the brake to open.	2000 ms
	0…10000 ms	Start flux hold time.	1 = 1 ms
76.05	*Flux ramp up time*	Defines the time for the flux reference to ramp up from the normal flux level (100%) to the start flux level, and from the stop flux level to the normal level (100%).	2000 ms
	0…10000 ms	Flux ramp-up time.	1 = 1 ms
76.06	*Flux ramp down time*	Defines the time for the flux reference to ramp down from the normal flux level (100%) to the stop flux level, and from the start flux level to the normal level (100%).	2000 ms
	0…10000 ms	Flux ramp-down time.	1 = 1 ms

77 Antisway		Settings for Antisway control. See also section *Antisway* on page *110*.	
77.01	*Antisway enable*	Enables the Antisway function.	*Disable*
	Disable	Antisway function is disabled.	0
	Enable	Antisway function is enabled.	1
	DI1	Digital input DI1 (*10.02 DI delayed status*, bit 0).	2
	DI2	Digital input DI2 (*10.02 DI delayed status*, bit 1).	3
	DI3	Digital input DI3 (*10.02 DI delayed status*, bit 2).	4
	DI4	Digital input DI4 (*10.02 DI delayed status*, bit 3).	5
	DI5	Digital input DI5 (*10.02 DI delayed status*, bit 4).	6
	DI6	Digital input DI6 (*10.02 DI delayed status*, bit 5).	7
	Const	Bit point setting (see *Terms and abbreviations* on page *199*).	-
	Pointer		
77.02	*Enable auto on function*	Enables some Antisway auto On/Off functions. See parameters *77.03*, *77.04* and *77.05*. **Note**: This parameter is effective only if the Antisway function is enabled (parameter *77.01*).	*Disable*
	Disable	Antisway control function is disabled.	0
	Enable	Antisway control function is enabled.	1
	DI1	Digital input DI1 (*10.02 DI delayed status*, bit 0).	2
	DI2	Digital input DI2 (*10.02 DI delayed status*, bit 1).	3
	DI3	Digital input DI3 (*10.02 DI delayed status*, bit 2).	4
	DI4	Digital input DI4 (*10.02 DI delayed status*, bit 3).	5
	DI5	Digital input DI5 (*10.02 DI delayed status*, bit 4).	6
	DI6	Digital input DI6 (*10.02 DI delayed status*, bit 5).	7
	Const	Bit point setting (see *Terms and abbreviations* on page *199*).	-
	Pointer		

No.	Name/Value	Description	Def/FbEq16
77.03	*Auto on at maximum pendulum*	Defines the maximum limit for pendulum arm length. If the pendulum arm length (parameter *77.27*) is less than this value, Antisway function is automatically On. **Note**: This parameter is effective only if both Antisway function (parameter *77.01 Antisway enable*) and Auto On function (parameter *77.02*) is enabled.	100
	0...100 m	Maximum pendulum arm length.	1 = 1
77.04	*Auto on a minimum pendulum*	Defines the minimum limit for pendulum arm length. If the pendulum arm length (parameter *77.27*) is more than this value, Antisway function is automatically On. **Note**: This parameter is effective only if both Antisway functions are enabled with parameters *77.01 Antisway enable* and *77.02 Enable auto on function*.	0
	0...100 m	Minimum pendulum arm length.	1 = 1
77.05	*Antisway enable minimum speed*	Defines the minimum speed limit to enable Antisway function in trolley/long travel drives. • If actual speed (parameter *90.01 Motor speed for control*) is less than this value, Antisway function is deactivated. • If actual speed (parameter *90.01 Motor speed for control*) is more than this value, Antisway function is activated. **Note**: This parameter is not effective at zero speed.	0
	0...32000 rpm	Minimum speed.	1 = 1
77.06	*Antisway enable in slowdown*	Enables Antisway function during drive slowdown.	*Normal ramp*
	Normal ramp	Normal ramp time without Antisway	0
	Antisway ramp	Antisway is active during slowdown	1
77.07	*Sway tracking enable*	Enables the Sway tracking function that allows the drive to compensate the sway caused by movements before switching on Antisway function.	*Disable*
	Disable	Sway function is disabled.	0
	Enable	Sway function is enabled.	1
	DI1	Digital input DI1 (*10.02 DI delayed status*, bit 0).	2
	DI2	Digital input DI2 (*10.02 DI delayed status*, bit 1).	3
	DI3	Digital input DI3 (*10.02 DI delayed status*, bit 2).	4
	DI4	Digital input DI4 (*10.02 DI delayed status*, bit 3).	5
	DI5	Digital input DI5 (*10.02 DI delayed status*, bit 4).	6
	DI6	Digital input DI6 (*10.02 DI delayed status*, bit 5).	7
	Const	Bit point setting (see *Terms and abbreviations* on page *199*).	-
	Pointer		
77.08	*Antisway ramp time*	Defines ramp time for Antisway function. **Note**: • When Antisway function is disabled, ramp time is taken from parameters *23.201*...*23.204*. • It is recommend to set this value less than the normal ramp time.	3.00
	0.00...1800.00 s	Antisway ramp time.	100 = 1 s

No.	Name/Value	Description	Def/FbEq16
77.09	*Antisway gain*	Defines Antisway gain factor. The acceleration rate increases with gain when speed reference is changed in smaller steps. Example: If gain is 5, then acceleration rate (parameter 22.01 Asway ramp time) is applied with 20% difference between the speed reference and actual speed. In this case the program produces maximum acceleration at 20% speed reference change and the crane is more dynamic. If gain is 1, then acceleration is applied with 100% difference between the speed reference and actual speed. With smaller speed steps acceleration rate is limited proportionally to the difference between speed reference and actual speed. **Note**: When changing the gain value it is recommended to start from 1 and check the behaviour of the crane when increasing it.	1
	1.00...5.00	Gain factor.	100 = 1
77.10	*Short rope mode enable*	Enables the short rope mode (SR mode). • The SR mode keeps the sway angle constant during acceleration rather than allowing several oscillations in the acceleration pattern. • With this mode the time to execute the acceleration pattern is longer (up to 1.33 times) than in the normal mode. The difference may be 5.3 s against 4.9 s (+8%). • In a open loop system, this mode improves the antisway performance by reducing the cumulative error in sway calculation. The difference between normal mode and SR mode is illustrated below. 	*Disable*
	Disable	SR mode is disabled.	0
	Enable	SR mode is enabled.	1
	Other	Source selection (see *Terms and abbreviations* on page *199*).	-
77.11	*Antisway timeout*	Allows to define the time at which Antisway function can end all calculations. The timeout counter starts as soon as speed reference is 0. With this parameter the antisway drive can control oscillations and force the antisway output to zero after this timeout value. **Note**: You must define a timeout longer than the time constant, so that antisway output is not forced to 0 before the sway is compensated. If this value is set to 0, the timeout feature is deactivated.	0
	0...32000 s	Timeout value	1 = 1 s

No.	Name/Value	Description	Def/FbEq16
77.15	*Lock antisway in hoist*	(*Visible when user lock is open with pass code 584. See parameter 96.02 Pass code*.) Locks/unlocks Antisway function in hoist drives. **Note**: This functionality is used when the hoist drive (master of the complete D2D-link) is placed as master trolley or master long travel. The trolley or long travel may have more than two followers.	*Lock*
	Unlock	Antisway function is unlocked and can be used in hoist drives. For example, when the system does not have hoist drive, but this motion is used as trolley or long travel motion.	0
	Lock	Antisway function is disabled in hoist drives.	1
77.20	*Pendulum length source*	Selects the hoist position signal source for pendulum calculation. In the hoist drive, this parameter defines the source signal transmitted to the antisway drive when the D2D-link is used. In the antisway drive, this parameter selects the hoist position signal source for pendulum calculation (par. *77.20* = par. *90.05*).	*D2D*
	D2D	Value comes through the D2D link from the main hoist.	0
	AI1	*12.12 AI1 scaled value* (see page *247*).	1
	AI2	*12.22 AI2 scaled value* (see page *249*).	2
	Load position (90.05)	Value comes from parameter *90.05 Load position scaled*. Encoder settings and scaling are done in group *90 Feedback selection*.	3
	Hoist length from 77.91	Value comes from parameter *77.91 Hoist pos fba int*. Hoist position signal is in INT16 format from fieldbus.	4
	Other	Source selection (see *Terms and abbreviations* on page *199*).	-
77.21	*Active length from source*	Shows the active length from the selected source (parameter *77.20*). Scaling of pendulum arm length is done with parameters *77.22*...*77.25*. This parameter is read-only.	-
77.22	*Up position swing time*	Defines the time constant of one full swaying cycle when hook is at UP position. For accurate results, we recommend to take five full swaying cycle time and divide the total by 5. The calculated result is stored in this parameter. For more details, see section .	4 s
	1.00...20.00 s	Sway cycle time in UP position.	100 = 1 s
77.23	*Up position length value*	Defines the measurement point when hook is at UP position during the swaying test. The scaled value is shown in parameter *77.21 Active length from source*.	20000
	-32768...32768	Scaled pendulum arm length.	1 = 1
77.24	*Down position swing time*	Defines the time constant of one full swaying cycle when hook is at DOWN position. For accurate results, we recommend to take five full swaying cycle time and divide the total by 5. The calculated result is stored in this parameter. For more details, see section .	4 s
	1...20 s	Sway cycle time in DOWN position.	1 = 1 s
77.25	*Down position length value*	Defines the measurement point when the hook is at DOWN position during the swaying test. The scaled value is shown in parameter *77.21 Active length from source*.	20000

No.	Name/Value	Description	Def/FbEq16
	-32768...32768	Scaled pendulum arm length.	1 = 1
77.26	*Maximum pendulum length*	Defines the maximum pendulum arm length. It limits the maximum pendulum arm length in the selected source.	100.000 m
	1.000...100.000 m	Pendulum arm length.	1000 = 1 m
77.27	*Pendulum arm length*	Shows the actual pendulum arm length. This parameter is read-only.	
	0.00...100.00 m	Actual pendulum arm length.	100 = 1 m
77.30	*Load signal source*	Selects the load signal source for pendulum arm offset calculation.	
	D2D	Value comes through the D2D link from the main hoist.	0
	AI1	*12.12 AI1 scaled value* (see page *247*).	1
	AI2	*12.22 AI2 scaled value* (see page *249*).	2
	Hoist load from 77.92	Value comes from parameter *77.92 Hoist load fba int*. Hoist load signal is in INT16 format from fieldbus.	4
	Other	Source selection (see *Terms and abbreviations* on page *199*).	-
77.31	*Active load*	Shows the active load signal. This parameter is read-only.	
	0.00...300.00%	Load signal	100 = 1%
77.33	*Step1 source*	Selects the source to activate offset step 1. The offset value is defined with parameter *77.39 Step offset1*.	*False*
	False	Step 1 source is not activated.	0
	True	Step 1 source is activated.	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
	Load step 1	When hoist load is greater than *77.36 Load step1*, then *77.39 Step offset1* is added to the final pendulum arm length.	8
	Other	Source selection (see *Terms and abbreviations* on page *199*).	-
77.34	*Step2 source*	Selects the source to activate offset step 2. The offset value is defined with parameter *77.40 Step offset2*.	*False*
	False	Step 2 source is not activated.	0
	True	Step 2 source is activated.	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
	Load step 2	When hoist load is greater than *77.37 Load step2*, then *77.40 Step offset2* is added to the final pendulum arm length.	8
	Other	Source selection (see *Terms and abbreviations* on page *199*).	-
77.35	*Step3 source*	Selects the source to activate offset step 3. The offset value is defined with parameter *77.41 Step offset3*.	*False*
	False	Step 3 source is not activated.	0
	True	Step 3 source is activated.	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
	Load step 3	When hoist load is greater than *77.38 Load step3*, then *77.41 Step offset3* is added to the final pendulum arm length.	8
	Step1and2	When step1 and step2 are active at the same time, then *77.41 Step offset3* is added to the final pendulum arm length.	9
	Other	Source selection (see *Terms and abbreviations* on page *199*).	-
77.36	*Load step1*	Defines the step1 load weight above which the offset 1 (par. *77.39*) is added to the pendulum arm length. See parameter *77.33 Step1 source*.	0.00%
	0.00...300.00%	Percent of step1 load weight.	100 = 1%
77.37	*Load step2*	Defines the step2 load weight above which the offset 2 (par. *77.40*) is added to the pendulum arm length. See parameter *77.34 Step2 source*.	0.00%
	0.00...300.00%	Percent of step 2 load weight.	100 = 1%
77.38	*Load step3*	Defines the step3 load weight above which the offset 3 (par. *77.41*) is added to the pendulum arm length. See parameter *77.35 Step3 source*.	0.00%
	0.00...300.00%	Percent of step3 load weight.	100 = 1%
77.39	*Step offset1*	Defines the step1 offset that adds to the final pendulum arm length.	0.00 m
	0.00...100.00 m	Offset 1.	1 = 1 m
77.40	*Step offset2*	Defines the step 2 offset that adds to the final pendulum arm length.	0.00 m
	0.00...100.00 m	Offset 2.	1 = 1 m
77.41	*Step offset3*	Defines the step 3 offset that adds to the final pendulum arm length.	0.00 m
	0.00...100.00 m	Offset 3.	1 = 1 m
77.42	*Active step offset*	Shows the active step offset. This parameter is read-only.	-
	0.00...100.00 m	Active step offset.	100 = 1 m

No.	Name/Value	Description	Def/FbEq16
77.50	*Load offset min*	Defines offset for minimum load (parameter 77.52 Load min) on the linear curve.	0.00 m
	0.00...100.00 m	Load offset minimum value.	100 = 1 m
77.51	*Load offset max*	Defines offset for maximum load (parameter 77.53 Load max) on the linear curve.	0
	0.00...100.00 m	Load offset minimum.	1 = 1
77.52	*Load min*	Defines minimum load on the linear curve. The offset in parameter *77.50 Load offset min* is added to this value.	0.00%
	0.00...300.00%	Minimum load.	100 = 1 m
77.53	*Load max*	Defines maximum load on the linear curve. The offset in parameter *77.51 Load offset max* is added to this value.	100.00%
	0.00...300.00%	Maximum load.	1 = 1
77.54	*Active linear offset*	Shows the active linear offset. This parameter is read-only.	-
	0.00...100.00 m	Active linear offset	100 = 1 m
77.56	*Auto offset enable*	Enables auto offset mode. When the lifted load is greater than the minimum load (parameter *77.58 Load minimum in auto mode*), the difference between total arm length (parameter *77.57 Full pendulum arm*) and actual hook position (parameter *77.27 Pendulum arm length*) is calculated and result is shown in *77.60 Active auto offset*. **Note**: This setting is used only when the load is lifted up from the same floor level, and when different load types and loading devices (lifting straps) are used.	*Disable*
	Disable	Auto offset mode is disabled.	0
	Enable	Auto offset mode is enabled.	1
	Other	Source selection (see *Terms and abbreviations* on page *199*).	-
77.57	*Full pendulum arm*	Defines the total length from hoist drum to the floor level (lifting basement). See parameter *77.56 Auto offset enable*.	0.00 m
	0.00...100.00 m	Total pendulum arm length.	1 = 1
77.58	*Load minimum in auto mode*	Defines the minimum load at which auto offset value is calculated. If lifted load is greater than this value, auto offset is calculated as *77.57 Full pendulum arm* - *77.27 Pendulum arm length*.	0.00%
	0.00...300.00%	Minimum load.	1 = 1 %
77.60	*Active auto offset*	Shows the active auto offset value if *77.56 Auto offset enable* is set. This parameter is read-only.	-
	0.00...100.00 m	Active auto offset value.	100 = 1 m
77.65	*Direct offset source*	Selects the source for direct offset. Parameter *77.67 Active direct offset* shows the actual value.	*No*
	No	Direct offset is not active.	0
	AI1	*12.12 AI1 scaled value* (see page *247*).	1
	AI2	*12.22 AI2 scaled value* (see page *249*).	2
	Other	Source selection (see *Terms and abbreviations* on page *199*).	-

No.	Name/Value	Description	Def/FbEq16
77.67	*Active direct offset*	Shows the active direct offset. This parameter is read-only.	-
77.69	*Total pendulum offset*	Shows the total pendulum offset. This parameter is read-only.	-
77.70	*Total pendulum arm length*	Shows the total pendulum arm length (sum of *77.27 Pendulum arm length* + *77.69 Total pendulum offset* limited with *77.26 Maximum pendulum length*). This parameter is read-only.	-
77.71	*Antisway status*	Shows the active status of antisway control. This parameter is read-only.	-

Bit	Name	Description
0	Antisway control on	1 = Antisway logic activated and allows changing the speed reference.
1	Antisway pattern on	1 = Antisway logic is calculating new reference.
2	Sway tracking on	1 = Antisway logic provides sway tracking.
3	Brake command	0 = Brake closed 1 = Brake open
4	Offset 1 selected	1 = Offset 1 selected. See parameter *77.39 Step offset1*.
5	Offset 2 selected	1 = Offset 2 selected. See parameter *77.40 Step offset2*.
6	Offset 3 selected	1 = Offset 3 selected. See parameter *77.41 Step offset3*.
7	Offset 1 & 2 selected	1 = Offset 1 and 2 (parameters *77.39* and *77.40*) values are added to pendulum.
8	Load 1	1 = Load level 1 reached. See parameter *77.36 Load step1*.
9	Load 2	1 = Load level 2 reached. See parameter *77.37 Load step2*.
10	Load 3	1 = Load level 3 reached. See parameter *77.38 Load step3*.
11	Auto mode load level reached	1 = Load level defined for auto offset activation is reached.
12	Reserved	
13	Above min speed	1 = Condition to enable Antisway function: actual speed is greater than defined minimum speed. See parameter *75.05 Antisway enable minimum speed*.
14	Min pendulum	1 = Condition to enable Antisway function: Pendulum arm length is higher than the defined limit. See parameter *75.04 Auto on a minimum pendulum*
15	Max pendulum	1 = Condition to enable Antisway function: Pendulum arm length is higher than the defined limit. See parameter *75.03 Auto on at maximum pendulum*

No.	Name/Value	Description	Def/FbEq16
77.72	*Speed ref into antisway*	Shows the speed reference into the antisway core. This parameter is read-only.	-
	-30000.00... 30000.00 rpm	Speed reference	100 = 1 rpm
77.73	*Speed ref from antisway*	Shows the speed reference from antisway control. This is connected to the speed reference chain. This parameter is read-only.	-
	-30000.00... 30000.00 rpm	Speed reference	-

No.	Name/Value	Description	Def/FbEq16
77.75	*Pendulum angle*	Shows the sway angle of pendulum arm. This parameter is read-only.	-
77.76	*Pendulum time constant*	Shows the calculated internal time constant. This parameter is read-only.	-
	-	Time constant	-
77.80	*Load to antisway selection*	Selects the signal type to transmit the load signal from hoist drive to antisway drives (trolley and long travel)	*NULL*
	NULL	None	0
	Internal	Internally calculated load value from actual torque. Active value can be seen in parameter *77.81*.	1
	Other	Source selection (see *Terms and abbreviations* on page *199*). For example, parameter *75.40 Relative hoist load*, if hoist speed optimization was set.	-
77.81	*Hoist load from torque act*	Shows the calculated load value from actual torque. This parameter is read-only.	-
	-	Load value.	-
77.82	*Hoist load to antisway*	Shows the load value transmitted from hoist drive to antisway drive based on the signal selected with parameter *77.80 Load to antisway selection*.	-
	-	Load value from hoist drive.	-
77.91	*Hoist pos fba int*	Shows the hoist position signal in INT16 format from fieldbus.	0
	-32768...-32767	Hoist position.	1 = 1
77.92	*Hoist load fba int*	Shows the hoist load signal in INT16 format from fieldbus.	0
	-32768...-32767	Hoist load.	1 = 1

82 Synchro control		Synchro control configuration. See description on page *61*.	
82.01	*Synchro control*	Enables the Synchro control function.	*Off*
	Off	Synchro control function is disabled.	0
	On	Synchro control function is enabled.	1
	Other	Source selection (see *Terms and abbreviations* on page *199*).	-
82.02	*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 synchronisation is enabled. This parameter is active only when the Synchro control function is enabled with parameter *82.01 Synchro control*.	*No*
	No	Synchro command is not active.	0
	Selected	Synchro command is always active.	1
	Other	Source selection (see *Terms and abbreviations* on page *199*).	-

No.	Name/Value	Description	Def/FbEq16
82.03	*Sync corr mode*	Defines the synchronisation correction mode used in Synchro command activation with parameter *82.02 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
82.04	*Sync gain*	Defines the gain for Synchro control (P-controller) in Follower drives.	1.00
	0.00...100.00	Gain	100 = 1
82.05	*Position corr limit*	Defines the maximum/minimum limit for position correction value. The difference between the Master and Follower position in unit (mm) is limited to this value before it is given as speed correction factor to the Follower speed loop.	1.00
	0.00...100.00	Gain	100 = 1
82.06	*Sync corr scale*	Defines the scaling factor for final speed correction reference in slave speed loop. The scaling value corresponds to a correction of speed in rpm for a position error of 1 mm.	1.00
	0.00...100.00 rpm/mm	Gain	100 = 1 rpm/mm
82.07	*Sync err limit*	Defines the synchronization error limit in the Follower drive for the fault supervision of synchronization error. The fault delay timer is activated immediately when the actual position is greater or equal to this limit and is reset.	1.00 mm
	0.00...100.00 mm	Synchronization error limit.	100 = 1 mm
82.08	*Sync err fault delay*	Defines the time delay in generating the fault due to synchronization error. The fault is generated when the synchronization error limit (par. *82.07 Sync err limit*) is active and the corresponding delay time has elapsed.	2 s
	0...100 s	Synchronization error limit.	1 = 1 s
82.09	*Position hysteresis*	Defines the position hysteresis for stop sequence in synchronization mode. The drive stops only when the absolute synchronization position error is in this range. **Note**: This parameter is applicable only for Follower drives in the synchronization mode.	5.00 mm
	0.00...50.00 mm	Synchronization error limit.	100 = 1 mm

No.	Name/Value	Description	Def/FbEq16
82.11	*Synchro sw*	Displays the status of Synchro control function. This parameter is read-only.	-

Bit	Name	Description
0	Synchro on	Synchro control function is On.
1	Synchro selected	Synchro control function is selected and Position correction logic modifies the speed reference.
2	Synchro fault	Fault condition tripped and still presented due to position difference going beyond limits defined in parameter *82.07 Sync err limit*.
3...15	Reserved	

	0b0000h…0b1111h	Follower 17…32 ready status.	1 = 1
82.20	*Act position error*	Shows the actual position error. This parameter is read-only.	-
	-	Position error	-
82.21	*Master position*	Shows the Synchro control position in Master drive. If the Synchro control function is Off, this signal is set to 0, because when Synchro control is Off, different signals can be transferred. This parameter is read-only.	-
	-	Synchro control position.	-
82.22	*Offset value*	Shows the offset value. This parameter is read-only.	-
	-	Offset value.	-
82.23	*Correction speed ref*	Shows the speed reference correction. This parameter is read-only.	-
	-	Offset value.	-
82.24	*Master linear speed ref*	Shows the linear speed reference correction in Master drive. This parameter is read-only.	-
	-	Offset value.	-
82.25	*Actual linear speed ref*	Shows the actual speed reference of the drive. This parameter is read-only.	-
	-	Offset value.	-

90 Feedback selection	Motor and load feedback configuration. See also section *Encoder support* (page *163*) and *Position counter* (page *165*), and the diagram on page *665*.	
90.01 *Motor speed for control*	Displays the estimated or measured motor speed that is used for motor control, ie. final motor speed feedback selected by parameter *90.41 Motor feedback selection* and filtered by parameter *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 used for motor control, that is final load speed feedback selected by parameter *90.51 Load feedback selection* and filtered by parameter *90.52 Load speed filter time*. If measured feedback is selected, it is scaled by the load gear function (*90.53 Load gear numerator* and *90.54 Load gear denominator*). If motor feedback or estimated feedback is used, it is inversely scaled by *90.61 Gear numerator* and *90.62 Gear denominator* (that is *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*. If measured feedback is selected, it is scaled by the load gear function (*90.53 Load gear numerator* and *90.54 Load gear denominator*). If motor feedback or estimated feedback is used, it is inversely scaled by *90.61 Gear numerator* and *90.62 Gear denominator* (that is *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 scaled load position in decimal format. The position is relative to the initial position set by parameters *90.65…90.69*. The number of decimal places is defined by parameter *90.38 Pos counter decimals*. This parameter is read-only. **Note:** This is a floating point parameter, and the accuracy is compromised near the ends of the range. This signal is used for synchro and antisway controls.	-
	-2147483.648 … 2147483.647	Scaled load position in decimal format.	-

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. This parameter is read-only. **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*.	-
	-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 *165*), and the block diagram on page *667*. This parameter is read-only. **Note**: This signal is not used in synchro and antisway controls, but instead uses signal in par. *90.05*.	-
	-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 of encoder 2 position (within one revolution) as a 24-bit unsigned integer received from the encoder interface. This parameter is read-only.	-
	0…16777215	Raw encoder 2 position within one revolution.	-
90.25	*Encoder 2 revolutions raw*	Displays the revolutions of (multiturn) encoder 2 within its value range (see parameter *93.14 Revolution data width*) as a raw measurement. This parameter is read-only.	-
	0…16777215	Raw encoder 2 revolution count.	-
90.26	*Motor revolution extension*	Displays the motor revolution count extension. The counter is incremented when the position selected by *90.41 Motor feedback selection* wraps around in the positive direction, and decremented in the negative direction. This parameter is read-only.	-
	-2147483648 … 2147483647	Motor revolution count extension.	-
90.27	*Load revolution extension*	Displays the load revolution count extension. The counter is incremented when the position selected by *90.51 Load feedback selection* wraps around in the positive direction, and decremented in the negative direction. This parameter is read-only.	-

No.	Name/Value	Description	Def/FbEq16
	-2147483648 … 2147483647	Load revolution count extension.	-
90.35	Pos counter status	Status information related to the position counter function. See section Position counter (page 165). 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	0 = Position counter not initialized, or encoder feedback was lost. Fresh counter initialization recommended. 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
	0000 0000b … 0111 1111b	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 written from or read to from an external source (eg. fieldbus). The setting corresponds to the number of decimal places. For example, with the setting of 3, an integer value of 66770 written into 90.65 Pos counter init value is divided by 1000, so the final value applied will be 66.770. Likewise, the value of 90.05 Load position scaled is multiplied by 1000 when read.	3
	0…9	Number of position counter decimal places.	1 = 1
90.41	Motor feedback selection	Selects the motor speed feedback value used during motor control.	Estimate
	Estimate	A calculated speed estimate generated from the DTC core is used.	0
	Encoder 1	Actual speed measured by encoder 1. The encoder is set up by the parameters in group 92 Encoder 1 configuration.	1
	Encoder 2	Actual speed measured by encoder 2. The encoder is set up by the parameters in group 93 Encoder 2 configuration.	2
90.42	Motor speed filter time	Defines a filter time for motor speed feedback used for control (90.01 Motor speed for control).	3 ms
	0 … 10000 ms	Motor speed filter time.	1 = 1 ms

No.	Name/Value	Description	Def/FbEq16
90.43	*Motor gear numerator*	Parameters *90.43* and *90.44* define a gear function between the motor speed feedback and motor control. The gear is used to correct a difference between the motor and encoder speeds for example if the encoder is not mounted directly on the motor shaft. $\frac{\text{90.43 Motor gear numerator}}{\text{90.44 Motor gear denominator}} = \frac{\text{Motor speed}}{\text{Encoder speed}}$	1
	-2147483648 … 2147483647	Motor gear numerator.	-
90.44	*Motor gear denominator*	See parameter *90.43 Motor gear numerator*.	1
	-2147483648 … 2147483647	Motor gear denominator.	-
90.45	*Motor feedback fault*	Selects how the drive reacts to loss of measured motor feedback.	*Fault*
	Fault	Drive trips on a *7301 Motor speed feedback* or *7381Encoder* fault.	0
	Warning	Drive generates a *A7B0 Motor speed feedback* or *A7E1 Encoder* warning and continues operation using estimated feedbacks. **Note:** Before using this setting, test the stability of the speed control loop with estimated feedback by running the drive on estimated feedback (see *90.41 Motor feedback selection*)warning.	1
90.46	*Force open loop*	Defines the speed feedback used by the DTC motor model.	*No*
	No	The motor model uses the feedback selected by *90.41 Motor feedback selection*.	0
	Yes	The motor model uses the calculated speed estimate (regardless of the setting of *90.41 Motor feedback selection*, which in this case only selects the source of feedback for the speed controller).	1
90.48	*Motor position axis mode*	Selects the axis type for motor position measurement.	*Rollover*
	Linear	Linear.	0
	Rollover	The value is between 0 and 1 revolutions, and rolls over at 360 degrees.	1
90.49	*Motor position resolution*	Defines how many bits are used for motor position count within one revolution. For example, with the setting of 24, the position value is multiplied by 16777216 for display in parameter *90.06 Motor position scaled* (or for fieldbus).	24
	0…31	Motor position resolution.	-
90.51	*Load feedback selection*	Selects the source of load speed and position feedbacks used in control.	*None*
	None	No load feedback selected.	0
	Encoder 1	Load feedbacks are updated based on the speed and position values read from encoder 1. The values are scaled by the load gear function (*90.53 Load gear numerator* and *90.54 Load gear denominator*). The encoder is set up by the parameters in group *92 Encoder 1 configuration*.	1

No.	Name/Value	Description	Def/FbEq16
	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* (that is *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* (that is *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.	-
90.53	*Load gear numerator*	Parameters *90.53* and *90.54* define a gear function between the load (that is 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. $\frac{\textit{90.53 Load gear numerator}}{\textit{90.54 Load gear denominator}} = \frac{\text{Load speed}}{\text{Encoder speed}}$	1
	-2147483648 … 2147483647	Load gear numerator.	-
90.54	*Load gear denominator*	See parameter *90.53 Load gear numerator*.	1
	-2147483648 … 2147483647	Load gear denominator.	-
90.55	*Load feedback fault*	Selects how the drive reacts to loss of load feedback.	*Fault*
	Fault	Drive trips on a *73A1 Load feedback* fault.	0
	Warning	Drive generates a *A7B1 Load speed feedback* warning and continues operation using estimated feedbacks.	1
90.56	*Load position offset*	Defines a load-side position offset. The resolution is determined by parameter *90.57 Load position resolution*.	0 rev
	-2147483648 … 2147483647 rev	Load-side position offset.	-
90.57	*Load position resolution*	Defines how many bits are used for load position count within one revolution. For example, with the setting of 16, the position value is multiplied by 65536 for display in parameter *90.04 Load position*.	16
	0…31	Load position resolution.	-

No.	Name/Value	Description	Def/FbEq16
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 *165*).	0
	-2147483648 … 2147483647	Initial integer value for position counter.	-
90.59	*Pos counter init value int source*	Selects the source of the initial position integer value. When the source selected by *90.67 Pos counter init cmd source* activates, the value selected in this parameter is assumed to be the position of the load.	*Pos counter init value int*
	Zero	0.	0
	Pos counter init value int	Parameter *90.58 Pos counter init value int*.	1
	Other	Source selection (see *Terms and abbreviations* on page *199*).	-
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. $\frac{\text{90.61 Gear numerator}}{\text{90.62 Gear denominator}} = \frac{\text{Motor speed}}{\text{Load speed}}$	1
	-2147483648 … 2147483647	Gear numerator (motor-side).	-
90.62	*Gear denominator*	See parameter *90.61 Gear numerator*.	1
	-2147483648 … 2147483647	Gear denominator (load-side).	-
90.63	*Feed constant numerator*	Parameters *90.63* and *90.64* define the feed constant for the position calculation: $\frac{\text{90.63 Feed constant numerator}}{\text{90.64 Feed constant denominator}}$ The feed constant converts rotational motion into translatory motion. The feed constant is the distance the load moves during one turn of the motor shaft. The translatory load position is shown by parameter *90.05 Load position scaled*.	1
	-2147483648 … 2147483647	Feed constant numerator.	-

No.	Name/Value	Description	Def/FbEq16
90.64	*Feed constant denominator*	See parameter *90.63 Feed constant numerator*.	1
	-2147483648 … 2147483647	Feed constant denominator.	-
90.65	*Pos counter init value*	Defines an initial position (or distance) for the position counter (as a decimal number) when parameter *90.66 Pos counter init value source* is set to *Pos counter init value*. See also section *Position counter* (page *165*). The number of decimal places is defined by parameter *90.38 Pos counter decimals*.	0.000
	-2147483.648 … 2147483.647	Initial value for position counter.	-
90.66	*Pos counter init value source*	Selects the source of the initial position value. When the source selected by *90.67 Pos counter init cmd source* activates, the value selected in this parameter is assumed to be the position of the load (in decimal format). In ACS880 crane application initial position is as per par. *90.65*.	*Pos counter init value*
	Zero	0.	0
	Pos counter init value	Parameter *90.65 Pos counter init value*.	1
	Other	Source selection (see *Terms and abbreviations* on page *199*).	-
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. In ACS880 crane application, by default the source for this parameter is in par. *90.202*, bit 0. See also *Position counter initialization and scaling for crane control program* on page *124*. **Note:** Position counter initialization can be prevented by parameter *90.68 Disable pos counter initialization*.	Par.*90.202*, bit 0
	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 *199*).	-
90.68	*Disable pos counter initialization*	Selects a source that prevents the initialization of the position counter.	*Not selected*
	Not selected	0.	0

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 *199*).	-
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*. In ACS880 crane application, by default the source for this parameter is in par. *90.202*, bit 1. See also *Position counter initialization and scaling for crane control program* on page *124*.	Par.*90.202*, bit 1
	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 *199*).	-
90.200	*Position counter init source*	Selects the source for position counter initialization reset command or allows to manually reset the position counter initialization. **Note**: This parameter is applicable only for Crane application program.	*False*
	False	Position counter initialization reset command.	0
	True	Allows manual resetting of position counter initialization.	1
	Other	Source selection (see *Terms and abbreviations* on page *199*).	-
90.201	*Position counter init method*	Selects the method of reseting the position counter initialization. **Note**: This parameter is applicable only for Crane application program.	*Rising edge standby*
	Rising edge running	Rising edge of signal when drive is running.	0
	Rising edge standby	Rising edge of signal when drive is in standby.	1

No.	Name/Value	Description	Def/FbEq16
	Rising edge	Rising edge of signal when drive is running or is in standby.	2
	Falling edge running	Falling edge of signal when drive is running.	3
	Falling edge standby	Falling edge of signal when drive is in standby.	4
	Falling edge	Falling edge of signal when drive is running or is in standby.	5
90.202	*Position counter init sw*	Status information related to the position counter initialization function. This is used together with standard position counter. Status word bits with default connection. See section *Position counter initialization and scaling for crane control program* (page *124*). This parameter is read-only. **Note**: This parameter is applicable only for Crane application program.	-

Bit	Name	Value
0	Pos counter init command	This bit is connected as default into parameter *90.67 Pos counter init cmd source*.
1	Reset pos counter init ready	This bit is connected as default into a parameter *90.69 Reset pos counter init ready*.
2…15	Reserved	

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

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

No.	Name/Value	Description	Def/FbEq16
	FEN-11	FEN-11.	2
	FEN-21	FEN-21.	3
	FEN-31	FEN-31.	4
	FSE-31	FSE-31.	5
91.14	*Module 2 location*	Specifies the slot (1…3) on the control unit of the drive into which the interface module is installed. Alternatively, specifies the node ID of the slot on an FEA-0x extension adapter.	*Slot 3*
	Slot 1	Slot 1.	1
	Slot 2	Slot 2.	2
	Slot 3	Slot 3.	3
	4…254	Node ID of the slot on the FEA-0x extension adapter.	1 = 1
91.21	*Module 1 temp sensor type*	Specifies the type of temperature sensor connected to interface module 1.	*None*
	None	None.	0
	PTC	PTC. (The unit is ohms.)	1
	KTY-84	KTY84. (The unit is selected by parameter *96.16 Unit selection*.)	2
91.22	*Module 1 temp filter time*	Defines a filtering time for the temperature measurement through interface module 1.	1500 ms
	0…10000 ms	Filtering time for temperature measurement.	-
91.24	*Module 2 temp sensor type*	Specifies the type of temperature sensor connected to interface module 2.	*None*
	None	None.	0
	PTC	PTC. (The unit is ohms.)	1
	KTY-84	KTY84. (The unit is selected by parameter *96.16 Unit selection*.)	2
91.25	*Module 2 temp filter time*	Defines a filtering time for the temperature measurement through interface 2.	1500 ms
	0…10000 ms	Filtering time for temperature measurement.	-
91.31	*Module 1 TTL output source*	Selects the encoder input on interface module 1 whose signal is echoed by or emulated to the TTL output. See also section *Encoder support* (page *163*).	*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 *163*).	*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*	Selects the type of encoder/resolver 1.	*None configured*
	None configured	Inactive.	0
	TTL	TTL. Module type (input): FEN-01 (X31), FEN-11 (X41) or FEN-21 (X51).	1
	TTL+	TTL+ (with commutation signals). Module type (input): FEN-01 (X32).	2
	Absolute encoder	Absolute encoder. Module type (input): FEN-11 (X42).	3
	Resolver	Resolver. Module type (input): FEN-21 (X52).	4
	HTL	HTL. Module type (input): FEN-31 (X82).	5
	HTL 1	HTL. Module type (input): FSE-31 (X31).	6
	HTL 2	HTL. Module type (input): FSE-31 (X32).	7

No.	Name/Value	Description	Def/FbEq16
	TTL 1	TTL. Module type (input): FSE-31 (X31).	8
	TTL 2	TTL. Module type (input): FSE-31 (X32).	9
92.02	*Encoder 1 source*	Selects the interface module that the encoder is connected to. (The physical locations and types of encoder interface modules are defined in parameter group *91 Encoder module settings*.)	*Module 1*
	Module 1	Interface module 1.	0
	Module 2	Interface module 2.	1
92.10	*Pulses/revolution*	*(Visible when a TTL, TTL+ or HTL encoder is selected)* Defines the pulse number per revolution.	2048
	0…65535	Number of pulses.	-
92.10	*Sine/cosine number*	*(Visible when an absolute encoder is selected)* Defines the number of sine/cosine wave cycles within one revolution. **Note:** This parameter need not be set when an EnDat or SSI encoder is used in continuous mode. See parameter *92.30 Serial link mode*.	0
	0…65535	Number of sine/cosine wave cycles within one revolution.	-
92.10	*Excitation signal frequency*	*(Visible when a resolver is selected)* Defines the frequency of the excitation signal.	1 kHz
	1…20 kHz	Excitation signal frequency.	1 = 1 kHz
92.11	*Pulse encoder type*	*(Visible when a TTL, TTL+ or HTL encoder is selected)* Selects the type of encoder.	*Quadrature*
	Quadrature	Quadrature encoder (with two channels, A and B)	0
	Single track	Single-track encoder (with one channel, A) **Note:** With this setting, the measured speed value is always positive regardless of direction of rotation.	1
92.11	*Absolute position source*	*(Visible when 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 amplitude of the excitation signal.	4.0 V
	4.0 … 12.0 V	Excitation signal amplitude.	10 = 1 V
92.12	*Speed calculation mode*	*(Visible when a TTL, TTL+ or HTL 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.	*Auto rising*
	A&B all	Channels A and B: Rising and falling edges are used for speed calculation. *Channel B: Defines the direction of rotation. **Note:** With a single-track encoder (parameter *92.11 Pulse encoder type*), this setting acts like setting *A all*.	0

No.	Name/Value	Description	Def/FbEq16
	A all	Channel A: Rising and falling edges are used for speed calculation. *Channel B: Defines the direction of rotation.	1
	A rising	Channel A: Rising edges are used for speed calculation. *Channel B: Defines the direction of rotation.	2
	A falling	Channel A: Falling edges are used for speed calculation. *Channel B: Defines the direction of rotation.	3
	Auto rising	One of the above modes is selected automatically depending on the pulse frequency as follows: <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>	4
	Auto falling	One of the above modes is selected automatically depending on the pulse frequency as follows: <table><tr><th>Pulse frequency of the channel(s)</th><th>Used mode</th></tr><tr><td>< 2442 Hz</td><td>*A&B all*</td></tr><tr><td>2442…4884 Hz</td><td>*A all*</td></tr><tr><td>> 4884 Hz</td><td>*A falling*</td></tr></table>	5
92.12	*Zero pulse enable*	*(Visible when an absolute encoder is selected)* Enables the encoder zero pulse for the absolute encoder input (X42) of the FEN-11 interface module. **Note:** No zero pulse exists with serial interfaces, ie. when parameter *92.11 Absolute position source* is set to *EnDat*, *Hiperface*, *SSI* or *Tamagawa*.	*Disable*
	Disable	Zero pulse disabled.	0
	Enable	Zero pulse enabled.	1
92.12	*Resolver polepairs*	*(Visible when a resolver is selected)* Defines the number of pole pairs of the resolver.	1
	1…32	Number of resolver pole pairs.	1 = 1
92.13	*Position estimation enable*	*(Visible when a TTL, TTL+ or HTL encoder is selected)* Selects whether position estimation is used with encoder 1 to increase position data resolution or not.	*Enable*
	Disable	Measured position used. (The resolution is 4 × pulses per revolution for quadrature encoders, 2 × pulses per revolution for single-track encoders.)	0
	Enable	Estimated position used. (Uses position interpolation; extrapolated at the time of data request.)	1

No.	Name/Value	Description	Def/FbEq16
92.13	*Position data width*	*(Visible when an absolute encoder is selected)* Defines the number of bits used to indicate position within one revolution. For example, a setting of 15 bits corresponds to 32768 positions per revolution. The value is used when parameter *92.11 Absolute position source* is set to *EnDat*, *Hiperface* or *SSI*. When parameter *92.11 Absolute position source* is set to *Tamagawa*, this parameter is internally set to 17.	0
	0…32	Number of bits used in position indication within one revolution.	1 = 1
92.14	*Speed estimation enable*	*(Visible when 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.	*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.	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
92.16	*Encoder 1 supply voltage*	*(Visible when parameter 92.01 Encoder 1 type = HTL 1, HTL 2, TTL 1 or TTL 2)* Selects the power supply voltage for encoder 1.	*0V*
	0V	Disabled.	0
	5V	5 V.	1
	24V	24 V.	2
92.17	*Accepted pulse freq of encoder 1*	*(Visible when parameter 92.01 Encoder 1 type = HTL 1, HTL 2, TTL 1 or TTL 2)* Defines the maximum pulse frequency of encoder 1.	0 kHz
	0…300 kHz	Pulse frequency.	1 = 1 kHz
92.21	*Encoder cable fault mode*	*(Visible when a TTL, TTL+ or HTL encoder is selected)* Selects which encoder cable channels and wires are monitored for wiring faults.	*A, B*
	A, B	A and B.	0

No.	Name/Value	Description	Def/FbEq16
	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 ms
	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 an absolute encoder is selected)* Selects the serial link mode with an EnDat or SSI encoder.	*Initial position*
	Initial position	Single position transfer mode (initial position).	0
	Continuous	Continuous position data transfer mode.	1
	Continuous speed and position	Continuous speed and position data transfer mode. This setting is intended for EnDat 2.2 encoders without sin/cos signals. **Note:** This setting requires an FEN-11 interface revision H or later.	2

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

No.	Name/Value	Description	Def/FbEq16
	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.	
	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*	Selects the type of encoder/resolver 2.	*None configured*
	None configured	None.	0
	TTL	TTL. Module type (input): FEN-01 (X31), FEN-11 (X41) or FEN-21 (X51).	1

No.	Name/Value	Description	Def/FbEq16
	TTL+	TTL+ (with commutation signals). Module type (input): FEN-01 (X32).	2
	Absolute encoder	Absolute encoder. Module type (input): FEN-11 (X42).	3
	Resolver	Resolver. Module type (input): FEN-21 (X52).	4
	HTL	HTL. Module type (input): FEN-31 (X82).	5
	HTL 1	HTL. Module type (input): FSE-31 (X31).	6
	HTL 2	HTL. Module type (input): FSE-31 (X32).	7
	TTL 1	TTL. Module type (input): FSE-31 (X31).	8
	TTL 2	TTL. Module type (input): FSE-31 (X32).	9
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/rev*	*(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 a resolver is selected)* 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*
93.16	*Encoder 2 supply voltage*	*(Visible when parameter 93.01 Encoder 2 type = HTL 1, HTL 2, TTL 1 or TTL 2)* See parameter *92.16 Encoder 1 supply voltage*.	*0V*

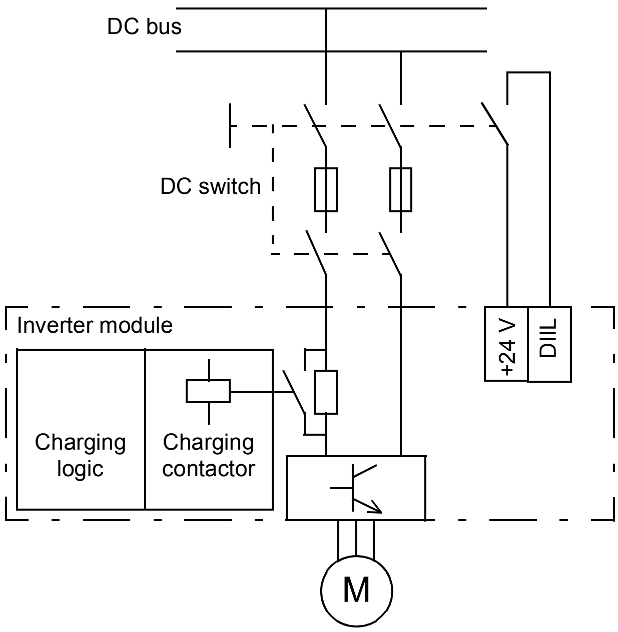
No.	Name/Value	Description	Def/FbEq16
93.17	*Accepted pulse freq of encoder 2*	*(Visible when parameter 93.01 Encoder 2 type = HTL 1, HTL 2, TTL 1 or TTL 2)* See parameter *92.17 Accepted pulse freq of encoder 1*.	0 kHz
93.21	*Encoder cable fault mode*	*(Visible when a TTL, TTL+ or HTL encoder is selected)* See parameter *92.21 Encoder cable fault mode*.	*A, B*
93.30	*Serial link mode*	*(Visible when an absolute encoder is selected)* See parameter *92.30 Serial link mode*.	*Initial position*
93.31	*EnDat calc time*	*(Visible when an absolute encoder is selected)* See parameter *92.31 EnDat max calculation time*.	*50 ms*
93.32	*SSI cycle time*	*(Visible when an absolute encoder is selected)* See parameter *92.32 SSI cycle time*.	*100 us*
93.33	*SSI clock cycles*	*(Visible when an absolute encoder is selected)* See parameter *92.33 SSI clock cycles*.	2
93.34	*SSI position msb*	*(Visible when an absolute encoder is selected)* See parameter *92.34 SSI position msb*.	1
93.35	*SSI revolution msb*	*(Visible when an absolute encoder is selected)* See parameter *92.35 SSI revolution msb*.	1
93.36	*SSI data format*	*(Visible when an absolute encoder is selected)* See parameter *92.36 SSI data format*.	*Binary*
93.37	*SSI baud rate*	*(Visible when an absolute encoder is selected)* See parameter *92.37 SSI baud rate*.	*100 kBit/s*
93.40	*SSI zero phase*	*(Visible when an absolute encoder is selected)* See parameter *92.40 SSI zero phase*.	*315-45 deg*
93.45	*Hiperface parity*	*(Visible when an absolute encoder is selected)* See parameter *92.45 Hiperface parity*.	*Odd*
93.46	*Hiperface baud rate*	*(Visible when an absolute encoder is selected)* See parameter *92.46 Hiperface baud rate*.	*4800 bits/s*
93.47	*Hiperface node address*	*(Visible when an absolute encoder is selected)* See parameter *92.47 Hiperface node address*.	64

94 LSU control		Control of the supply unit of the drive, such as DC voltage and reactive power reference. Note that the references defined here must also be selected as the reference source in the supply control program to be effective. This group is only visible with a BCU control unit.	
94.01	*LSU control*	Enables/disables the internal INU-LSU state machine. When the state machine is enabled, the inverter unit (INU) controls the supply unit (LSU) and prevents the inverter unit from starting until the supply unit is ready. When the state machine is disabled, the status of the supply unit (LSU) is ignored by the inverter unit.	*Off*; *On* (*95.20* b11, *95.20* b15)
	Off	INU-LSU state machine disabled.	0
	On	INU-LSU state machine enabled.	1
94.10	*LSU max charging time*	Defines the maximum time the supply unit (LSU) is allowed for charging before a fault (*7584 LSU charge failed*) is generated.	15 s
	0…65535 s	Maximum charging time.	1 = 1 s

No.	Name/Value	Description	Def/FbEq16
94.20	*DC voltage reference*	Displays the DC voltage reference sent to the supply unit. This parameter is read-only.	-
	0.0 … 2000.0 V	DC voltage reference sent to supply unit.	10 = 1 V
94.21	*DC voltage ref source*	Selects the source of the DC voltage reference to be sent to the supply unit.	*User ref*
	Zero	None.	0
	User ref	*94.22 User DC voltage reference*.	1
	Other	Source selection (see *Terms and abbreviations* on page *199*).	-
94.22	*User DC voltage reference*	Defines the DC voltage reference for the supply unit when *94.21 DC voltage ref source* is set to *User ref*.	0.0 V
	0.0 … 2000.0 V	User DC reference.	10 = 1 V
94.30	*Reactive power reference*	Displays the reactive power reference sent to the supply unit. This parameter is read-only.	-
	-3276.8 … 3276.7 kvar	Reactive power reference sent to the supply unit.	10 = 1 kvar
94.31	*Reactive power ref source*	Selects the source of the reactive power reference to be sent to the supply unit.	*User ref*
	Zero	None.	0
	User ref	*94.32 User reactive power reference*.	1
	Other	Source selection (see *Terms and abbreviations* on page *199*).	-
94.32	*User reactive power reference*	Defines the reactive power reference for the supply unit when *94.31 Reactive power ref source* is set to *User ref*.	0.0 kvar
	-3276.8 … 3276.7 kvar	User reactive power reference.	10 = 1 kvar

95 HW configuration		Various hardware-related settings.	
95.01	*Supply voltage*	Selects the supply voltage range. This parameter is used by the drive to determine the nominal voltage of the supply network. The parameter also affects the current ratings and the DC voltage control functions (trip and brake chopper activation limits) of the drive. ⚠ **WARNING!** An incorrect setting may cause the motor to rush uncontrollably, or the brake chopper or resistor to overload. **Note:** The selections shown depend on the hardware of the drive. If only one voltage range is valid for the drive in question, it is selected by default.	-
	Not given	No voltage range selected. The drive will not start modulating before a range is selected.	0
	208…240 V	208…240 V	1
	380…415 V	380…415 V	2
	440…480 V	440…480 V	3
	500 V	500 V	4
	525…600 V	525…600 V	5
	660…690 V	660…690 V	6

No.	Name/Value	Description	Def/FbEq16
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. The limits are calculated based on the measured DC voltage at the end of the pre-charging sequence. This function is also useful if the AC supply voltage to the drive is high, as the warning levels are raised accordingly.	*Disable*
	Disable	Adaptive voltage limits disabled.	0
	Enable	Adaptive voltage limits enabled.	1
95.04	*Control board supply*	Specifies how the control unit of the drive is powered.	*Internal 24V*; *External 24V* (*95.20* b4)
	Internal 24V	The drive control unit is powered from the drive power unit it is connected to.	0
	External 24V	The drive control unit is powered from an external power supply.	1
	Redundant external 24V	(Type BCU control units only) The drive control unit is powered from two redundant external power supplies. The loss of one of the supplies generates a warning *AFEC External power signal missing*.	2

No.	Name/Value	Description	Def/FbEq16
95.08	*DC switch monitoring*	Enables/disables DC switch monitoring via the DIIL input. This setting is intended for use with inverter modules with an internal charging circuit that are connected to the DC bus through a DC switch. An auxiliary contact of the DC switch must be wired to the DIIL input so that the input switches off when the DC switch is opened.  If the DC switch is opened with the inverter running, the inverter is given a coast-to-stop command, and its charging circuit activated. Starting the inverter is prevented until the DC switch is closed and the DC circuit in the inverter unit recharged. **Notes:** • By default, DIIL is the input for the Run enable signal. Adjust *20.12 Run enable 1 source* if necessary. • An internal charging circuit is standard on some inverter module types but optional on others; check with your local ABB representative.	*Disable*; *Enable* (*95.20* b7)
	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.	-

Bit	Name	Information
0	EX motor	1 = The drive is part of a drive/motor package 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…15	Reserved	

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

No.	Name/Value	Description	Def/FbEq16
95.20	*HW options word 1*	Specifies hardware-related options that require differentiated parameter defaults. Activating a bit in this parameter makes the necessary changes in other parameters – for example, activating an emergency stop option reserves a digital input. In 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.	-

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* and *21.05*.
2	Emergency stop Cat 1	1 = Emergency stop, Category 1, without FSO module. Affects *10.24*, *21.04* and *21.05*.
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 parameter *95.04*.
5	DC supply switch	1 = DC switch monitoring active. Affects *20.12*, *31.03*, *95.08*.
6	DOL motor switch	1 = Motor fan control active. Affects *10.24*, *35.100*, *35.103*, *35.104*.
7	xSFC-01 fuse switch controller	1 = xSFC charging controller used. Affects *95.09*.
8	Service switch	1 = Service switch 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	INU-DSU communication	1 = Diode supply unit control by inverter unit active. Affects *60.71*, *61.151*, *62.151*, *94.01*.
12	Reserved	
13	Du/dt filter activation	1 = A du/dt filter is connected to the drive/inverter output. **Note:** This bit should be set to 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-online 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 *60.71*, *61.151*, *61.152*, *61.153*, *62.151*, *94.01*.

	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.	-

Bit	Name	Information
0	Dual use	1 = Dual use active. For drives with option +N8200. (Allows higher output frequencies and frequency reference limits.)
1	SynRM	1 = Synchronous reluctance motor used. Affects *25.02*, *25.03*, *25.15*, *99.03*
2…15	Reserved	

No.	Name/Value	Description	Def/FbEq16
	0000b…0011b	Hardware options configuration word 2.	1 = 1
96 System		Language selection; access levels; macro selection; parameter save and restore; control unit reboot; user parameter sets; unit selection; 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
	Portugues	Portuguese.	2070
	Nederlands	Dutch.	1043
	Français	French.	1036
	Dansk	Danish.	1030
	Suomi	Finnish.	1035
	Svenska	Swedish.	1053
	Russki	Russian.	1049
	Polski	Polish.	1045
	Czech	Czech.	1029
	Türkçe	Turkish.	1055

No.	Name/Value	Description	Def/FbEq16
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 pass code 358 toggles the parameter lock, which prevents changing all other parameters through the control panel or the Drive composer PC tool. • In crane application, entering pass code 584 makes certain access levels active, for example, parameter *96.06 Parameter restore* will be visible. After reading/using the hidden parameters, activate end user access level by entering pass code 1. This will hide par. *96.06*. • 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. See also section *User lock* (page *193*).	0
	0…99999999	Pass code.	-
96.03	*Access levels active*	Shows which access levels have been activated by pass codes entered into parameter *96.02 Pass code*. This parameter is read-only.	0001h

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

No.	Name/Value	Description	Def/FbEq16
	0000h…FFFFh	Active access levels.	-
96.06	*Parameter restore*	(*Visible when user lock is open with pass code 584. See parameter 96.02 Pass code.*) Restores the original settings of the control program, ie. parameter default values. **Note:** • This parameter cannot be changed while the drive is running. **Note:** In crane application, this parameter is hidden to the user. To access this parameter: • Enter pass code 584 into parameter *96.02 Pass code*. • Select *Restore defaults*. Before you use the crane application again, do the following: • Enter pass code 1 into parameter *96.02 Pass code*. • Switch Off and switch On power once.	*Done*
	Done	Restoring is completed.	0

No.	Name/Value	Description	Def/FbEq16
	Restore defaults	All editable parameter values are restored to default values, except • motor data and ID run results • parameter *31.42 Overcurrent fault limit* • control panel/PC communication settings • I/O extension module settings • fieldbus adapter settings • encoder configuration data • application macro selection and the parameter defaults implemented by it • parameter *95.01 Supply voltage* • 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
	Clear all	All editable parameter values are restored to default values, except • control panel/PC communication settings • fieldbus adapter settings • application macro selection and the parameter defaults implemented by it • parameter *95.01 Supply voltage* • 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.	62
96.07	*Parameter save manually*	Saves the valid parameter values to permanent memory. This parameter should be used to store values sent from a fieldbus, or when using an external power supply to the control board as the supply might have a very short hold-up time when powered off. **Note:** A new parameter value is saved automatically when changed from the PC tool or control panel but not when altered through a fieldbus adapter connection.	*Done*
	Done	Save completed.	0
	Save	Save in progress.	1
96.08	*Control board boot*	Changing the value of this parameter to 1 reboots the control unit (without requiring a power off/on cycle of the complete drive module). The value reverts to 0 automatically.	0
	0…1	1 = Reboot the control unit.	1 = 1
96.09	*FSO reboot*	Changing the value of (or the source selected by) this parameter from 0 to 1 reboots the optional FSO-xx safety functions module. **Note:** The value does not revert to 0 automatically.	*False*
	False	0.	0
	True	1.	1
	Other [bit]	Source selection (see *Terms and abbreviations* on page *199*).	-
96.10	*User set status*	Shows the status of the user parameter sets. This parameter is read-only. See also section *User parameter sets* (page *192*). Parameters *09.02 Crane SW1*, bits 2...5 indicate active user sets 1...4.	-
	n/a	No user parameter sets have been saved.	0

<table>
<tr><th>No.</th><th>Name/Value</th><th>Description</th><th>Def/FbEq16</th></tr>
<tr><td></td><td>Loading</td><td>A user set is being loaded.</td><td>1</td></tr>
<tr><td></td><td>Saving</td><td>A user set is being saved.</td><td>2</td></tr>
<tr><td></td><td>Faulted</td><td>Invalid or empty parameter set.</td><td>3</td></tr>
<tr><td></td><td>User set 1</td><td>User set 1 has been loaded.</td><td>4</td></tr>
<tr><td></td><td>User set 2</td><td>User set 2 has been loaded.</td><td>5</td></tr>
<tr><td></td><td>User set 3</td><td>User set 3 has been loaded.</td><td>6</td></tr>
<tr><td></td><td>User set 4</td><td>User set 4 has been loaded.</td><td>7</td></tr>
<tr><td>96.11</td><td>User set save/load</td><td>Enables the saving and restoring of up to four custom sets of parameter settings. See section User parameter sets (page 192).
The set that was in use before powering down the drive is in use after the next power-up.
Notes:
Hardware configuration settings such as I/O extension module, fieldbus and encoder configuration parameters (groups 14…16, 47, 51…56, 58 and 92…93), 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.</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>
<tr><td></td><td>Selected</td><td>1.</td><td>1</td></tr>
<tr><td></td><td>DI1</td><td>Digital input DI1 (10.02 DI delayed status, bit 0).</td><td>2</td></tr>
</table>

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 *199*).	-
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	

No.	Name/Value	Description	Def/FbEq16
	0000 0000b … 0001 0101b	Unit selection word.	1 = 1
96.20	*Time synch primary source*	Defines the 1st priority external source for synchronizing date and time of the drive.	*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	Embedded fieldbus interface.	6
	Embedded Ethernet	Ethernet port on type BCU control unit.	7
	Panel link	Control panel, or Drive composer PC tool connected to the control panel.	8
	Ethernet tool link	Drive composer PC tool through an FENA module.	9
96.23	*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

No.	Name/Value	Description	Def/FbEq16
96.24	*Full days since 1st Jan 1980*	Number of full days passed since beginning of the year 1980. This parameter, together with *96.25 Time in minutes within 24 h* and *96.26 Time in ms within one minute* makes it possible to set the date and time in the drive via the parameter interface from a fieldbus or application program. This may be necessary if the fieldbus protocol does not support time synchronization.	-
	1…59999	Days since beginning of 1980.	1 = 1
96.25	*Time in minutes within 24 h*	Number of full minutes passed since midnight. For example, the value 860 corresponds to 2:20 pm. See parameter *96.24 Full days since 1st Jan 1980*.	0 min
	1…1439	Minutes since midnight.	1 = 1
96.26	*Time in ms within one minute*	Number of milliseconds passed since last minute. See parameter *96.24 Full days since 1st Jan 1980*.	0 ms
	0…59999	Number of milliseconds since last minute.	1 = 1
96.29	*Time sync source status*	Time source status word. This parameter is read-only.	-

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

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

No.	Name/Value	Description	Def/FbEq16
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
96.53	*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 *192*).	0h
	00000000h… FFFFFFFFh	Actual checksum.	-
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 1	1 = Enabled: Checksum 2 (*96.57*) is observed.
2	Approved checksum 1	1 = Enabled: Checksum 3 (*96.58*) is observed.
3	Approved checksum 1	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 1	1 = Set: Copy value of *96.53* into *96.57*.
6	Set approved checksum 1	1 = Set: Copy value of *96.53* into *96.58*.
7	Set approved checksum 1	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.	-

No.	Name/Value	Description	Def/FbEq16
96.57	*Approved checksum 2*	Approved (reference) checksum 2.	0h
	00000000h… FFFFFFFFh	Approved checksum 2.	-
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 *471*).	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 *199*).	-
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 *199*).	-
96.65	*Factory data logger time level*	Selects the sampling interval for the factory data logger (see page *470*).	*500us*
	500us	500 microseconds.	500
	2ms	2 milliseconds.	2000
	10ms	10 milliseconds.	10000

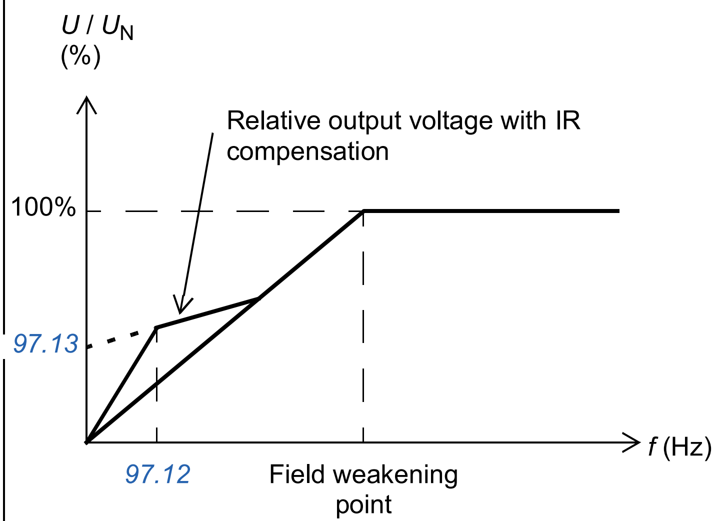
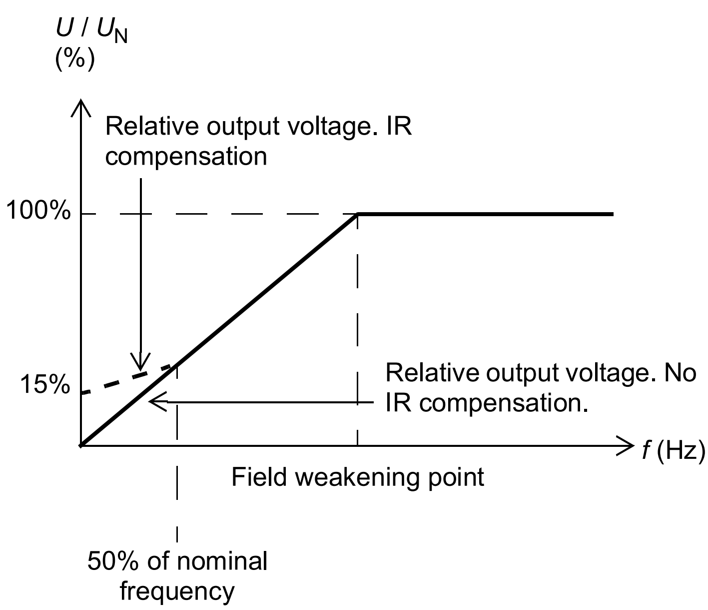
No.	Name/Value	Description	Def/FbEq16
96.70	*Disable adaptive program*	Enables/disables the adaptive program (if present). See also section *Adaptive programming* (page *27*).	*No*
	No	Adaptive program enabled.	0
	Yes	Adaptive program disabled.	1
96.100	*Change user pass code*	*(Visible when user lock is open)* To change the current user pass code, enter a new code into this parameter as well as *96.101 Confirm user pass code*. A warning will be active until the new pass code is confirmed. To cancel changing the pass code, close the user lock without confirming. To close the lock, enter an invalid pass code in parameter *96.02 Pass code*, activate parameter *96.08 Control board boot*, or cycle the power. See also section *User lock* (page *193*).	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.	-
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*.	000b

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 of adaptive or application programs • 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…15	Reserved	

No.	Name/Value	Description	Def/FbEq16
	000b…111b	Selection of actions to be prevented by user lock.	-

No.	Name/Value	Description	Def/FbEq16
97 Motor control		Motor model settings.	
97.03	Slip gain	Defines the slip gain which is used to improve the estimated motor slip. 100% means full slip gain; 0% means no slip gain. The default value is 100%. Other values can be used if a static speed error is detected despite having the setting at full slip gain. **Example** (with nominal load and nominal slip of 40 rpm): A 1000 rpm constant speed reference is given to the drive. Despite having full slip gain (= 100%), a manual tachometer measurement from the motor axis gives a speed value of 998 rpm. The static speed error is 1000 rpm - 998 rpm = 2 rpm. To compensate the error, the slip gain should be increased to 105% (2 rpm / 40 rpm = 5%).	100%
	0 … 200%	Slip gain.	1 = 1%
97.04	Voltage reserve	Defines the minimum allowed voltage reserve. When the voltage reserve has decreased to the set value, the drive enters the field weakening area. **Note:** This is an expert level parameter and should not be adjusted without appropriate skill. If the intermediate circuit DC voltage U_{dc} = 550 V and the voltage reserve is 5%, the RMS value of the maximum output voltage in steady-state operation is 0.95 × 550 V / sqrt(2) = 369 V The dynamic performance of the motor control in the field weakening area can be improved by increasing the voltage reserve value, but the drive enters the field weakening area earlier.	-2%
	-4 … 50%	Voltage reserve.	1 = 1%
97.05	Flux braking	Defines the level of flux braking power. (Other stopping and braking modes can be configured in parameter group *21 Start/stop mode*). See section *Flux braking* (page *173*). **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	(*Visible when user lock is open with pass code 584. See parameter 96.02 Pass code*.) Defines the source of flux reference. This parameter is used in the crane application for Conical motor control. See section *Conical motor control* on page *101*. **Note:** This is an expert level parameter and should not be adjusted without appropriate skill.	User flux reference
	Zero	None.	0
	User flux reference	Parameter *97.07 User flux reference*.	1
	Other	Source selection (see *Terms and abbreviations* on page *199*).	-

No.	Name/Value	Description	Def/FbEq16
97.07	*User flux reference*	(*Visible when user lock is open with pass code 584. See parameter 96.02 Pass code*.) Defines the flux reference when parameter *97.06 Flux reference select* is set to *User flux reference*. This parameter is used in the crane application for Conical motor control. See section *Conical motor control* on page *101*.	100.00%
	0.00 … 200.00%	User-defined flux reference.	100 = 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.	*Normal*
	Normal	Control performance optimized for long motor cables.	0
	Low noise	Minimizes motor noise. **Note:** This setting requires derating. Refer to the rating data in the *Hardware manual*.	1
	Cyclic	Control performance optimized for cyclic load applications. **Note:** This setting is not suitable for long motor cables.	2
	Custom	This setting is to be used by ABB-authorized service personnel only. **Note:** This setting may require derating. Refer to the rating data in the *Hardware manual*.	3
97.10	*Signal injection*	Enables the anti-cogging function: a high-frequency alternating signal is injected to the motor in the low speed region to improve the stability of torque control. This removes the “cogging” that can sometimes be seen as the rotor passes the motor magnetic poles. Anti-cogging can be enabled with different amplitude levels. **Notes:** • This is an expert level parameter and should not be adjusted without appropriate skill. • Use as low a level as possible that gives satisfactory performance. • Signal injection cannot be applied to asynchronous motors.	*Disabled*
	Disabled	Anti-cogging disabled.	0
	Enabled (5 %)	Anti-cogging enabled with amplitude level of 5%.	1
	Enabled (10 %)	Anti-cogging enabled with amplitude level of 10%.	2
	Enabled (15 %)	Anti-cogging enabled with amplitude level of 15%.	3
	Enabled (20 %)	Anti-cogging enabled with amplitude level of 20%.	4
97.11	*TR tuning*	Rotor time constant tuning. This parameter can be used to improve torque accuracy in closed-loop control of an induction motor. Normally, the motor identification run provides sufficient torque accuracy, but manual fine-tuning can be applied in exceptionally demanding applications to achieve optimal performance. **Note:** This is an expert level parameter and should not be adjusted without appropriate skill.	100%
	25…400%	Rotor time constant tuning.	1 = 1%

No.	Name/Value	Description	Def/FbEq16
97.12	*IR comp step-up frequency*	IR compensation (ie. output voltage boost) can be used in step-up applications to compensate for resistive losses in the step-up transformer, cabling and motor. As voltage cannot be fed through a step-up transformer at 0 Hz, a specific type of IR compensation should be used. This parameter adds a frequency breakpoint for parameter *97.13 IR compensation* as shown below.  0.0 Hz = Breakpoint disabled.	0.0 Hz
	0.0 … 50.0 Hz	IR compensation breakpoint for step-up applications.	1 = 1 Hz
97.13	*IR compensation*	Defines the relative output voltage boost at zero speed (IR compensation). The function is useful in applications with a high break-away torque where direct torque control (DTC mode) cannot be applied.  See also section *IR compensation for scalar motor control* on page *170*.	0.00%
	0.00 … 50.00%	Voltage boost at zero speed in percent of nominal motor voltage.	1 = 1%

No.	Name/Value	Description	Def/FbEq16
97.15	*Motor model temperature adaptation*	Selects whether the temperature-dependent parameters (such as stator or rotor resistance) of the motor model adapt to actual (measured or estimated) temperature or not. See parameter group *35 Motor thermal protection* for selection of temperature measurement sources.	*Disabled*
	Disabled	Temperature adaptation of motor model disabled.	0
	Estimated temperature	Estimated temperature (*35.01 Motor estimated temperature*) used for adaptation of motor model.	1
	Measured temperature 1	Measured temperature 1 (*35.02 Measured temperature 1*) used for adaptation of motor model.	2
	Measured temperature 2	Measured temperature 2 (*35.03 Measured temperature 2*) used for adaptation of motor model.	3
97.32	*Motor torque unfiltered*	Unfiltered motor torque in percent of the nominal motor torque.	-
	-1600.0 … 1600.0%	Unfiltered motor torque.	See par. *46.03*
97.33	*Speed estimate filter time*	Defines a filtering time for estimated speed. See the diagram on page *666*.	5.00 ms
	0.00 … 100.00 ms	Filtering time for estimated speed.	1 = 1 ms

98 User motor parameters		Motor values supplied by the user that are used in the motor model. These parameters are useful for non-standard motors, or to just get more accurate motor control of the motor on site. A better motor model always improves the shaft performance.	
98.01	*User motor model mode*	Activates the motor model parameters *98.02*…*98.14* and the rotor angle offset parameter *98.15*. **Notes**: • Parameter value is automatically set to zero when ID run is selected by parameter *99.13 ID run requested*. The values of parameters *98.02*…*98.15* are then updated according to the motor characteristics identified during the ID run. • Measurements made directly from the motor terminals during the ID run are likely to produce slightly different values than those on a datasheet from a motor manufacturer. • This parameter cannot be changed while the drive is running.	*Not selected*
	Not selected	Parameters *98.02*…*98.15* inactive.	0
	Motor parameters	The values of parameters *98.02*…*98.14* are used as the motor model.	1
	Position offset	The value of parameter *98.15* is used as the rotor angle offset. Parameters *98.02*…*98.14* are inactive.	2
	Motor parameters & position offset	The values of parameters *98.02*…*98.14* are used as the motor model, and the value of parameter *98.15* is used as the rotor angle offset.	3
98.02	*Rs user*	Defines the stator resistance R_S of the motor model. With a star-connected motor, R_S is the resistance of one winding. With a delta-connected motor, R_S is one-third of the resistance of one winding.	0.00000 p.u.
	0.00000 … 0.50000 p.u.	Stator resistance in per unit.	-

No.	Name/Value	Description	Def/FbEq16
98.03	*Rr user*	Defines the rotor resistance R_R of the motor model. **Note:** This parameter is valid only for asynchronous motors.	0.00000 p.u.
	0.00000 … 0.50000 p.u.	Rotor resistance in per unit.	-
98.04	*Lm user*	Defines the main inductance L_M of the motor model. **Note:** This parameter is valid only for asynchronous motors.	0.00000 p.u.
	0.00000 … 10.00000 p.u.	Main inductance in per unit.	-
98.05	*SigmaL user*	Defines the leakage inductance σL_S. **Note:** This parameter is valid only for asynchronous motors.	0.00000 p.u.
	0.00000 … 1.00000 p.u.	Leakage inductance in per unit.	-
98.06	*Ld user*	Defines the direct axis (synchronous) inductance. **Note:** This parameter is valid only for permanent magnet motors.	0.00000 p.u.
	0.00000 … 10.00000 p.u	Direct axis inductance in per unit.	-
98.07	*Lq user*	Defines the quadrature axis (synchronous) inductance. **Note:** This parameter is valid only for permanent magnet motors.	0.00000 p.u.
	0.00000 … 10.00000 p.u	Quadrature axis inductance in per unit.	-
98.08	*PM flux user*	Defines the permanent magnet flux. **Note:** This parameter is valid only for permanent magnet motors.	0.00000 p.u.
	0.00000 … 2.00000 p.u	Permanent magnet flux in per unit.	-
98.09	*Rs user SI*	Defines the stator resistance R_S of the motor model.	0.00000 ohm
	0.00000 … 100.00000 ohm	Stator resistance.	-
98.10	*Rr user SI*	Defines the rotor resistance R_R of the motor model. **Note:** This parameter is valid only for asynchronous motors.	0.00000 ohm
	0.00000 … 100.00000 ohm	Rotor resistance.	-
98.11	*Lm user SI*	Defines the main inductance L_M of the motor model. **Note:** This parameter is valid only for asynchronous motors.	0.00 mH
	0.00 …100000.00 mH	Main inductance.	1 = 10000 mH
98.12	*SigmaL user SI*	Defines the leakage inductance σL_S. **Note:** This parameter is valid only for asynchronous motors.	0.00 mH
	0.00 …100000.00 mH	Leakage inductance.	1 = 10000 mH
98.13	*Ld user SI*	Defines the direct axis (synchronous) inductance. **Note:** This parameter is valid only for permanent magnet motors.	0.00 mH
	0.00 …100000.00 mH	Direct axis inductance.	1 = 10000 mH

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 = 10000 mH
98.15	*Position offset user*	Defines an angle offset between the zero position of the synchronous motor and the zero position of the position sensor. This value is initially set by the autophasing routine when parameter *21.13 Autophasing mode* is set to *Turning with Z-pulse*, and can be fine-tuned later on. **Notes:** • The value is in electrical degrees. The electrical angle equals the mechanical angle multiplied by the number of motor pole pairs. • This parameter is valid only for permanent magnet motors.	0 deg
	0…360 deg	Angle offset.	1 = 1 deg

99 Motor data		Motor configuration settings.	
99.03	*Motor type*	Selects the motor type. **Note:** This parameter cannot be changed while the drive is running.	*Asynchro-nous motor*
	Asynchronous motor	Standard squirrel cage AC induction motor (asynchronous induction motor).	0
	Permanent magnet motor	Permanent magnet motor. Three-phase AC synchronous motor with permanent magnet rotor and sinusoidal BackEMF voltage.	1
	SynRM	*(Only visible with option +N7502)* Synchronous reluctance motor. Three-phase AC synchronous motor with salient pole rotor without permanent magnets.	2
99.04	*Motor control mode*	Selects the motor control mode.	*DTC*
	DTC	Direct torque control. This mode is suitable for most applications. **Note:** Instead of direct torque control, scalar control is also available, and should be used in the following situations: • with multimotor applications 1) if the load is not equally shared between the motors, 2) if the motors are of different sizes, or 3) if the motors are going to be changed after the motor identification (ID run) • if the nominal current of the motor is less than 1/6 of the nominal output current of the drive • if the drive is used with no motor connected (for example, for test purposes). See also section *Operating modes of the drive* on page *136*.	0

No.	Name/Value	Description	Def/FbEq16
	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. • In crane application, disable Torque proving and Brake open torque. Select the following: *44.09 Brake open torque source* = *Zero* *44.200 Brake open torque* = 0% *44.202 Torque proving* = *Disable* See also section *Scalar motor control* (page *169*), and section *Operating modes of the drive* (page *136*).	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 … 32767.0 A	Nominal current of the motor. The allowable range is 1/6…2 × I_N (nominal current) of the drive (0…2 × I_N with scalar control mode).	1 = 1 A
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 the nominal voltage is not equal to the equivalent DC motor voltage (EDCM) specified by some motor manufacturers. The nominal voltage can be calculated by dividing the EDCM voltage by 1.7 (or square root of 3). • The stress on the motor insulation is always dependent on the drive supply voltage. This also applies to the case where the motor voltage rating is lower than that of the drive and the supply. • This parameter cannot be changed while the drive is running.	0.0 V
	0.0 … 32767.0 V	Nominal voltage of the motor. The allowable range is 1/6…2 × U_N (nominal voltage) of the drive. U_N equals the upper bound of the supply voltage range selected by parameter *95.01 Supply voltage*.	10 = 1 V

No.	Name/Value	Description	Def/FbEq16
99.08	*Motor nominal frequency*	Defines the nominal motor frequency. This setting must match the value on the rating plate of the motor. **Note:** This parameter cannot be changed while the drive is running.	50.00 Hz
	0.00 … 500.00 Hz	Nominal frequency of the motor.	10 = 1 Hz
99.09	*Motor nominal speed*	Defines the nominal motor speed. The setting must match the value on the rating plate of the motor. **Note:** This parameter cannot be changed while the drive is running.	0 rpm
	0 … 30000 rpm	Nominal speed of the motor.	1 = 1 rpm
99.10	*Motor nominal power*	Defines the nominal motor power. The setting must match the value on the rating plate of the motor. If nominal power is not shown on the rating plate, nominal torque can be entered instead in parameter *99.12*. If multiple motors are connected to the drive, enter the total power of the motors. The unit is selected by parameter *96.16 Unit selection*. **Note:** This parameter cannot be changed while the drive is running.	0.00 kW or hp
	0.00…10000.00 kW or 0.00…13404.83 hp	Nominal power of the motor.	1 = 1 unit
99.11	*Motor nominal cos Φ*	Defines the cosphi of the motor for a more accurate motor model. The value is not obligatory, but is useful with an asynchronous motor, especially when performing a standstill identification run. The setting should match the value on the rating plate of the motor. With a permanent magnet or synchronous reluctance motor, this value is not needed. **Note:** This parameter cannot be changed while the drive is running.	0.00
	0.00 … 1.00	Cosphi of the motor.	100 = 1
99.12	*Motor nominal torque*	Defines the nominal motor shaft torque for a more accurate motor model. This value can be given instead of nominal power (*99.10*) if shown on the rating plate of the motor. The unit is selected by parameter *96.16 Unit selection*. **Note:** • This setting is an alternative to the nominal power value (*99.10*). If both are entered, *99.12* takes priority. • This parameter cannot be changed while the drive is running.	0.000 N·m or lb·ft
	0.000… N·m or lb·ft	Nominal motor torque.	1 = 1 unit

No.	Name/Value	Description	Def/FbEq16
99.13	*ID run requested*	Selects the type of the motor identification routine (ID run) performed at the next start of the drive. During the ID run, the drive will identify the characteristics of the motor for optimum motor control. 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%. • With scalar control mode (*99.04 Motor control mode* = *Scalar*), only the *Current measurement calibration* ID run mode is possible. • Once the ID run is activated, it can be canceled by stopping the drive. • The ID run must be performed every time any of the motor parameters (*99.04*, *99.06*…*99.12*) have been changed. • Ensure that the Safe torque off and emergency stop circuits (if any) are closed during the ID run. • Mechanical brake (if present) is not opened by the logic for the ID run. • This parameter cannot be changed while the drive is running.	*None*
	None	No motor ID run is requested. This mode can be selected only if the ID run (*Normal*, *Reduced*, *Standstill*, *Advanced*, *Advanced Standstill*) has already been performed once.	0
	Normal	Normal ID run. Guarantees good control accuracy for all cases. The ID run takes about 90 seconds. This mode should be selected whenever it is possible. **Notes:** • If the load torque will be higher than 20% of motor nominal torque, or if the machinery is not able to withstand the nominal torque transient during the ID run, then the driven machinery must be de-coupled from the motor during a Normal ID run. • Check the direction of rotation of the motor before starting the ID run. During the run, the motor will rotate in the forward direction. ⚠ **WARNING!** The motor will run at up to approximately 50…100% of the nominal speed during the ID run. ENSURE THAT IT IS SAFE TO RUN THE MOTOR BEFORE PERFORMING THE ID RUN!	1

No.	Name/Value	Description	Def/FbEq16
	Reduced	Reduced ID run. This mode should be selected instead of the *Normal* or *Advanced* ID Run if • mechanical losses are higher than 20% (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 (eg. with lift or crane applications). See also selection *Advanced Standstill*.	3
	Autophasing	The autophasing routine determines the start angle of a permanent magnet or synchronous reluctance motor (see page *171*). Autophasing does not update the other motor model values. Autophasing is automatically performed as part of the *Normal*, *Reduced*, *Standstill*, *Advanced* or *Advanced Standstill* ID runs. Using this setting, it is possible to perform autophasing alone. This is useful after changes in the feedback configuration, such as the replacement or addition of an absolute encoder, resolver, or pulse encoder with commutation signals. **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, that is identification of current measurement offset and gain errors. The calibration will be performed at next start.	5

No.	Name/Value	Description	Def/FbEq16
	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 runs at up to approximately 50...100% of the nominal speed during the ID run. Several accelerations and decelerations are done. ENSURE THAT IT IS SAFE TO RUN THE MOTOR BEFORE PERFORMING THE ID RUN!	6
	Advanced Standstill	Advanced Standstill ID run. This selection is recommended with AC induction motors up to 75 kW instead of the Standstill ID run if • the exact nominal ratings of the motor are not known, or • the control performance of the motor is not satisfactory after a Standstill ID run. **Note:** The time it takes for the Advanced Standstill ID run to complete varies according to motor size. With a small motor, the ID run typically completes within 5 minutes; with a large motor, the ID run may take up to an hour.	7
99.14	*Last ID run performed*	Shows the type of ID run that was performed last. For more information about the different modes, see the selections of parameter *99.13 ID run requested*.	*None*
	None	No ID run has been performed.	0
	Normal	*Normal* ID run.	1
	Reduced	*Reduced* ID run.	2
	Standstill	*Standstill* ID run.	3
	Autophasing	*Autophasing*.	4
	Current measurement calibration	*Current measurement calibration*.	5
	Advanced	*Advanced* ID run.	6
	Advanced Standstill	*Advanced Standstill* ID run.	7
99.15	*Motor polepairs calculated*	Calculated number of pole pairs in the motor.	0
	0…1000	Number of pole pairs.	1 = 1

No.	Name/Value	Description	Def/FbEq16
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.	*U V W*
	U V W	Normal.	0
	U W V	Reversed rotation direction.	1

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

8

Additional Parameter data

Contents of this chapter

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 *199*).

Terms and abbreviations

Term	Definition
Actual signal	Signal measured or calculated by the drive. Usually can only be monitored but not adjusted; some counter-type signals can however be reset.
Analog src	Analog source: the parameter can be set to the value of another parameter by choosing "Other", and selecting the source parameter from a list. **Note:** The source parameter must be a 32-bit real (floating point) number. To use a 16-bit integer (for example, received in DDCS data sets) as the source, data storage parameters *47.01*…*47.08* (see page *403*) can be used. In addition to the "Other" selection, the parameter may offer other pre-selected settings.
Binary src	Binary source: the value of the parameter can be taken from a specific bit in another parameter value ("Other"). Sometimes the value can be fixed to 0 (false) or 1 (true). In addition, the parameter may offer other pre-selected settings.
Bit pointer	Bit pointer. A bit pointer can point to a single bit in the value of another parameter, or be fixed to 0 (C.FALSE) or 1 (C.TRUE).
Data	Data parameter.
FbEq32	32-bit fieldbus equivalent: The scaling between the value shown on the panel and the integer used in communication when a 32-bit value is selected for transmission to an external system. The corresponding 16-bit scalings are listed in chapter *Parameters* (page *199*).
INT16	16-bit integer value (15 bits + sign).
INT32	32-bit integer value (31 bits + sign).
List	Selection list.
No.	Parameter number.
PB	Packed Boolean (bit list).
Real	Real number.
Type	Parameter type. See *Analog src*, *Binary src*, *List*, *PB*, *Real*.
UDINT	32-bit unsigned integer value.
UINT	32-bit unsigned integer value.

Fieldbus addresses

Refer to the *User's manual* of the fieldbus adapter.

Parameter groups 1...9

No.	Name	Type	Range	Unit	FbEq32
01 Actual values					
01.01	Motor speed used	*Real*	-30000.00 … 30000.00	rpm	100 = 1 rpm
01.02	Motor speed estimated	*Real*	-30000.00 … 30000.00	rpm	100 = 1 rpm
01.03	Motor speed %	*Real*	-1000.00 ... 1000.00	%	100 = 1%
01.04	Encoder 1 speed filtered	*Real*	-30000.00 … 30000.00	rpm	100 = 1 rpm
01.05	Encoder 2 speed filtered	*Real*	-30000.00 … 30000.00	rpm	100 = 1 rpm
01.06	Output frequency	*Real*	-500.00 … 500.00	Hz	100 = 1 Hz
01.07	Motor current	*Real*	0.00 … 30000.00	A	100 = 1 A
01.10	Motor torque	*Real*	-1600.0 … 1600.0	%	10 = 1%
01.11	DC voltage	*Real*	0.00 … 2000.00	V	100 = 1 V
01.13	Output voltage	*Real*	0…2000	V	1 = 1 V
01.14	Output power	*Real*	-32768.00 … 32767.00	kWor hp	100 = 1 unit
01.15	Output power % of motor nom	*Real*	-300.00 … 300.00	%	10 = 1%
01.17	Motor shaft power	*Real*	-32768.00 … 32767.00	kW or hp	100 = 1 unit
01.18	Inverter GWh motoring	*Real*	0…32767	GWh	1 = 1 GWh
01.19	Inverter MWh motoring	*Real*	0…999	MWh	1 = 1 MWh
01.20	Inverter kWh motoring	*Real*	0…999	kWh	1 = 1 kWh
01.21	U-phase current	*Real*	-30000.00 … 30000.00	A	100 = 1 A
01.22	V-phase current	*Real*	-30000.00 … 30000.00	A	100 = 1 A
01.23	W-phase current	*Real*	-30000.00 … 30000.00	A	100 = 1 A
01.24	Flux actual %	*Real*	0…200	%	1 = 1%
01.29	Speed change rate	*Real*	-15000 … 15000	rpm/s	1 = 1 rpm/s
01.30	Nominal torque scale	*Real*	0.000…	N•m or lb·ft	1000 = 1 unit
01.31	Ambient temperature	*Real*	-40 … 120	°C or °F	10 = 1°
01.32	Inverter GWh regenerating	*Real*	0…32767	GWh	1 = 1 GWh
01.33	Inverter MWh regenerating	*Real*	0…999	MWh	1 = 1 MWh
01.34	Inverter kWh regenerating	*Real*	0…999	kWh	1 = 1 kWh
01.35	Mot - regen energy GWh	*Real*	-32768 … 32767	GWh	1 = 1 GWh
01.36	Mot - regen energy MWh	*Real*	-999…999	MWh	1 = 1 MWh
01.37	Mot - regen energy kWh	*Real*	-999…999	kWh	1 = 1 kWh
01.61	Abs motor speed used	*Real*	0.00 … 30000.00	rpm	100 = 1 rpm
01.62	Abs motor speed %	*Real*	0.00 … 1000.00	%	100 = 1 rpm
01.63	Abs output frequency	*Real*	0.00 … 500.00	Hz	100 = 1 Hz
01.64	Abs motor torque	*Real*	0.0 … 1600.0	%	10 = 1%
01.65	Abs output power	*Real*	0.00 … 32767.00	kW or hp	100 = 1 unit
01.66	Abs output power % motor nom	*Real*	0.00 … 300.00	%	10 = 1%
01.68	Abs motor shaft power	*Real*	0.00 … 32767.00	kW or hp	100 = 1 unit

No.	Name	Type	Range	Unit	FbEq32
03 Input references					
03.01	Panel reference	*Real*	-100000.00 … 100000.00	-	100 = 1
03.02	Panel reference 2	*Real*	-30000.00 … 30000.00	-	100 = 1
03.05	FB A reference 1	*Real*	-100000.00 … 100000.00	-	100 = 1
03.06	FB A reference 2	*Real*	-100000.00 … 100000.00	-	100 = 1
03.07	FB B reference 1	*Real*	-100000.00 … 100000.00	-	100 = 1
03.08	FB B reference 2	*Real*	-100000.00 … 100000.00	-	100 = 1
03.09	EFB reference 1	*Real*	-30000.00 … 30000.00	-	100 = 1
03.10	EFB reference 2	*Real*	-30000.00 … 30000.00	-	100 = 1
03.11	DDCS controller ref 1	*Real*	-30000.00 … 30000.00	-	100 = 1
03.12	DDCS controller ref 2	*Real*	-30000.00 … 30000.00	-	100 = 1
03.13	M/F or D2D ref1	*Real*	-30000.00 … 30000.00	-	100 = 1
03.14	M/F or D2D ref2	*Real*	-30000.00 … 30000.00	-	100 = 1
04 Warnings and faults					
04.01	Tripping fault	*Data*	0000h…FFFFh	-	1 = 1
04.02	Active fault 2	*Data*	0000h…FFFFh	-	1 = 1
04.03	Active fault 3	*Data*	0000h…FFFFh	-	1 = 1
04.04	Active fault 4	*Data*	0000h…FFFFh	-	1 = 1
04.05	Active fault 5	*Data*	0000h…FFFFh	-	1 = 1
04.06	Active warning 1	*Data*	0000h…FFFFh	-	1 = 1
04.07	Active warning 2	*Data*	0000h…FFFFh	-	1 = 1
04.08	Active warning 3	*Data*	0000h…FFFFh	-	1 = 1
04.09	Active warning 4	*Data*	0000h…FFFFh	-	1 = 1
04.10	Active warning 5	*Data*	0000h…FFFFh	-	1 = 1
04.11	Latest fault	*Data*	0000h…FFFFh	-	1 = 1
04.12	2nd latest fault	*Data*	0000h…FFFFh	-	1 = 1
04.13	3rd latest fault	*Data*	0000h…FFFFh	-	1 = 1
04.14	4th latest fault	*Data*	0000h…FFFFh	-	1 = 1
04.15	5th latest fault	*Data*	0000h…FFFFh	-	1 = 1
04.16	Latest warning	*Data*	0000h…FFFFh	-	1 = 1
04.17	2nd latest warning	*Data*	0000h…FFFFh	-	1 = 1
04.18	3rd latest warning	*Data*	0000h…FFFFh	-	1 = 1
04.19	4th latest warning	*Data*	0000h…FFFFh	-	1 = 1
04.20	5th latest warning	*Data*	0000h…FFFFh	-	1 = 1
04.21	Fault word 1	*PB*	0000h…FFFFh	-	1 = 1
04.22	Fault word 2	*PB*	0000h…FFFFh	-	1 = 1
04.31	Warning word 1	*PB*	0000h…FFFFh	-	1 = 1
04.32	Warning word 2	*PB*	0000h…FFFFh	-	1 = 1
04.40	Event word 1	*PB*	0000h…FFFFh	-	1 = 1

No.	Name	Type	Range	Unit	FbEq32
Parameters 04.41...04.56 are visible only when user lock is open with pass code 584. See parameter 96.02 Pass code.					
04.41	Event word 1 bit 0 code	*Data*	0000h…FFFFh	-	1 = 1
04.42	Event word 1 bit 0 aux code	*Data*	0000 0000h … FFFF FFFFh	-	1 = 1
04.43	Event word 1 bit 1 code	*Data*	0000h…FFFFh	-	1 = 1
04.44	Event word 1 bit 1 aux code	*Data*	0000 0000h … FFFF FFFFh	-	1 = 1
…	…	…	…	…	
04.55	Event word 1 bit 7 code	*Data*	0000h…FFFFh	-	1 = 1
04.56	Event word 1 bit 7 aux code	*Data*	0000 0000h … FFFF FFFFh	-	1 = 1
04.57	Event word 1 bit 8 code	*Data*	0000h…FFFFh	-	1 = 1
04.58	Event word 1 bit 8 aux code	*Data*	0000 0000h … FFFF FFFFh	-	1 = 1
…	…	…	…	…	
04.71	Event word 1 bit 15 code	*Data*	0000h…FFFFh	-	1 = 1
04.72	Event word 1 bit 15 aux code	*Data*	0000 0000h … FFFF FFFFh	-	1 = 1
04.120	Fault/Warning word compatibility	*List*	0…1	-	1 = 1
05 Diagnostics					
05.01	On-time counter	*Real*	0…65535	d	1 = 1 d
05.02	Run-time counter	*Real*	0…65535	d	1 = 1 d
05.04	Fan on-time counter	*Real*	0…65535	d	1 = 1 d
05.11	Inverter temperature	*Real*	-40.0 … 160.0	%	10 = 1%
05.22	Diagnostic word 3	*PB*	0x0000…0xFFFF	-	-
05.41	Main fan service counter	*Real*	0…150	%	1 = 1%
05.42	Aux. fan service counter	*Real*	0…150	%	1 = 1%
06 Control and status words					
06.01	Main control word	*PB*	0000h…FFFFh	-	1 = 1
06.02	Application control word	*PB*	0000h…FFFFh	-	1 = 1
06.03	FBA A transparent control word	*PB*	00000000h…FFFFFFFFh	-	1 = 1
06.04	FBA B transparent control word	*PB*	00000000h…FFFFFFFFh	-	1 = 1
06.05	EFB transparent control word	*PB*	00000000h…FFFFFFFFh	-	
06.11	Main status word	*PB*	0000h…FFFFh	-	1 = 1
06.16	Drive status word 1	*PB*	0000h…FFFFh	-	1 = 1
06.17	Drive status word 2	*PB*	0000h…FFFFh	-	1 = 1
06.18	Start inhibit status word	*PB*	0000h…FFFFh	-	1 = 1
06.19	Speed control status word	*PB*	0000h…FFFFh	-	1 = 1
06.20	Constant speed status word	*PB*	0000h…FFFFh	-	1 = 1
06.21	Drive status word 3	*PB*	0000h…FFFFh	-	1 = 1

No.	Name	Type	Range	Unit	FbEq32
06.25	Drive inhibit status word 2	PB	0000h…FFFFh	-	1 = 1
06.29	MSW bit 10 sel	Binary src	-	-	1 = 1
06.30	MSW bit 11 sel	Binary src	-	-	1 = 1
06.31	MSW bit 12 sel	Binary src	-	-	1 = 1
06.32	MSW bit 13 sel	Binary src	-	-	1 = 1
06.33	MSW bit 14 sel	Binary src	-	-	1 = 1
(Parameters 06.36…06.43 only visible with a BCU control unit)					
06.36	LSU Status Word	PB	0000h…FFFFh	-	1 = 1
06.39	Internal state machine LSU CW	PB	0000h…FFFFh	-	1 = 1
06.40	LSU CW user bit 0 selection	Binary src	-	-	1 = 1
06.41	LSU CW user bit 1 selection	Binary src	-	-	1 = 1
06.42	LSU CW user bit 2 selection	Binary src	-	-	1 = 1
06.43	LSU CW user bit 3 selection	Binary src	-	-	1 = 1
06.45	Follower CW user bit 0 selection	Binary src	-	-	1 = 1
06.46	Follower CW user bit 1 selection	Binary src	-	-	1 = 1
06.47	Follower CW user bit 2 selection	Binary src	-	-	1 = 1
06.48	Follower CW user bit 3 selection	Binary src	-	-	1 = 1
06.50	User status word 1	PB	0000h…FFFFh	-	1 = 1
06.60	User status word 1 bit 0 sel	Binary src	-	-	1 = 1
06.61	User status word 1 bit 1 sel	Binary src	-	-	1 = 1
06.62	User status word 1 bit 2 sel	Binary src	-	-	1 = 1
06.63	User status word 1 bit 3 sel	Binary src	-	-	1 = 1
06.64	User status word 1 bit 4 sel	Binary src	-	-	1 = 1
06.65	User status word 1 bit 5 sel	Binary src	-	-	1 = 1
06.66	User status word 1 bit 6 sel	Binary src	-	-	1 = 1
06.67	User status word 1 bit 7 sel	Binary src	-	-	1 = 1

No.	Name	Type	Range	Unit	FbEq32
06.68	User status word 1 bit 8 sel	*Binary src*	-	-	1 = 1
06.69	User status word 1 bit 9 sel	*Binary src*	-	-	1 = 1
06.70	User status word 1 bit 10 sel	*Binary src*	-	-	1 = 1
06.71	User status word 1 bit 11 sel	*Binary src*	-	-	1 = 1
06.72	User status word 1 bit 12 sel	*Binary src*	-	-	1 = 1
06.73	User status word 1 bit 13 sel	*Binary src*	-	-	1 = 1
06.74	User status word 1 bit 14 sel	*Binary src*	-	-	1 = 1
06.75	User status word 1 bit 15 sel	*Binary src*	-	-	1 = 1
06.100	User control word 1	*PB*	0000h…FFFFh	-	1 = 1
06.101	User control word 2	*PB*	0000h…FFFFh	-	1 = 1
07 System info					
07.03	Drive rating id	*List*	-	-	1 = 1
07.04	Firmware name	*List*	-	-	1 = 1
07.05	Firmware version	*Data*	-	-	1 = 1
07.06	Loading package name	*List*	-	-	1 = 1
07.07	Loading package version	*Data*	-	-	1 = 1
07.08	Bootloader version	*Data*	-	-	1 = 1
07.11	Cpu usage	*Real*	0…100	%	1 = 1%
07.13	PU logic version number	*Data*	-	-	1 = 1
07.21	Application environment status 1	*PB*	0000h…FFFFh	-	1 = 1
07.22	Application environment status 2	*PB*	0000h…FFFFh	-	1 = 1
07.23	Application name	*Data*	-	-	1 = 1
07.24	Application version	*Data*	-	-	1 = 1
07.25	Customization package name	*Data*	-	-	1 = 1
07.26	Customization package version	*Data*	-	-	1 = 1
07.30	Adaptive program status	*PB*	0000h…FFFFh	-	1 = 1
09 Crane application signals					
09.01	Crane SW1	*PB*	0000h…FFFFh	-	1 = 1
09.02	Crane SW2	*PB*	00b…11b	-	1 = 1
09.03	Crane FW1	*PB*	0000h…FFFFh	-	1 = 1
09.05	Hoist speed opt speed limit	*Real*	0.00…30000.00	rpm	1 = 1 rpm
09.06	Crane speed reference	*Real*	0.00…30000.00	rpm	1 = 1 rpm
09.07	Load speed error status	*PB*	000b…111b	-	1 = 1
09.09	Flux reference	*Real*	0…200	%	1 = 1%

No.	Name	Type	Range	Unit	FbEq32
09.10	Lifetime left	*Real*	0 ...10000	h	1 =1 h
09.11	Lifetime left in percent	*Real*	0.00 ... 100.00	%	100 = 1%
09.12	Load spectrum factor	*Real*	0.00 ... 10.00	-	1 = 1
09.13	Lifetime sw	*UINT*	0000 ... 0111b	-	1 = 1
09.20	Crane operation hours	*Real*	0...1100000	h	1 = 1 h
09.21	Brake operation count	*UINT*	0...4294967295	-	1 = 1
09.22	Number of pwr on	*UINT*	0...65535	-	1 = 1
09.31	Motor load	*Real*	-1600.0...1600.0	%	10 = 1%
09.50	Crane speed reference cor	*Real*	-30000.00...30000	rpm	100 = 1 rpm

Parameter groups 10...99

No.	Name	Type	Range	Unit	FbEq32
10 Standard DI, RO					
10.01	DI status	*PB*	0000h…FFFFh	-	1 = 1
10.02	DI delayed status	*PB*	0000h…FFFFh	-	1 = 1
10.03	DI force selection	*PB*	0000h…FFFFh	-	1 = 1
10.04	DI force data	*PB*	0000h…FFFFh	-	1 = 1
10.05	DI1 ON delay	*Real*	0.0 … 3000.0	s	10 = 1 s
10.06	DI1 OFF delay	*Real*	0.0 … 3000.0	s	10 = 1 s
10.07	DI2 ON delay	*Real*	0.0 … 3000.0	s	10 = 1 s
10.08	DI2 OFF delay	*Real*	0.0 … 3000.0	s	10 = 1 s
10.09	DI3 ON delay	*Real*	0.0 … 3000.0	s	10 = 1 s
10.10	DI3 OFF delay	*Real*	0.0 … 3000.0	s	10 = 1 s
10.11	DI4 ON delay	*Real*	0.0 … 3000.0	s	10 = 1 s
10.12	DI4 OFF delay	*Real*	0.0 … 3000.0	s	10 = 1 s
10.13	DI5 ON delay	*Real*	0.0 … 3000.0	s	10 = 1 s
10.14	DI5 OFF delay	*Real*	0.0 … 3000.0	s	10 = 1 s
10.15	DI6 ON delay	*Real*	0.0 … 3000.0	s	10 = 1 s
10.16	DI6 OFF delay	*Real*	0.0 … 3000.0	s	10 = 1 s
10.21	RO status	*PB*	0000h…FFFFh	-	1 = 1
10.24	RO1 source	*Binary src*	-	-	1 = 1
10.25	RO1 ON delay	*Real*	0.0 … 3000.0	s	10 = 1 s
10.26	RO1 OFF delay	*Real*	0.0 … 3000.0	s	10 = 1 s
10.27	RO2 source	*Binary src*	-	-	1 = 1
10.28	RO2 ON delay	*Real*	0.0 … 3000.0	s	10 = 1 s
10.29	RO2 OFF delay	*Real*	0.0 … 3000.0	s	10 = 1 s
10.30	RO3 source	*Binary src*	-	-	1 = 1
10.31	RO3 ON delay	*Real*	0.0 … 3000.0	s	10 = 1 s
10.32	RO3 OFF delay	*Real*	0.0 … 3000.0	s	10 = 1 s
10.51	DI filter time	*Real*	0.3 … 100.0	ms	10 = 1 ms
10.99	RO/DIO control word	*PB*	0000h…FFFFh	-	1 = 1
11 Standard DIO, FI, FO					
11.01	DIO status	*PB*	0000h…FFFFh	-	1 = 1
11.02	DIO delayed status	*PB*	0000h…FFFFh	-	1 = 1
11.05	DIO1 function	*List*	0…2	-	1 = 1
11.06	DIO1 output source	*Binary src*	-		1 = 1
11.07	DIO1 ON delay	*Real*	0.0 … 3000.0	s	10 = 1 s
11.08	DIO1 OFF delay	*Real*	0.0 … 3000.0	s	10 = 1 s
11.09	DIO2 function	*List*	0…2	-	1 = 1

No.	Name	Type	Range	Unit	FbEq32
11.10	DIO2 output source	*Binary src*	-		1 = 1
11.11	DIO2 ON delay	*Real*	0.0 … 3000.0	s	10 = 1 s
11.12	DIO2 OFF delay	*Real*	0.0 … 3000.0	s	10 = 1 s
11.38	Freq in 1 actual value	*Real*	0…16000	Hz	1 = 1 Hz
11.39	Freq in 1 scaled	*Real*	-32768.000 … 32767.000	-	1000 = 1
11.42	Freq in 1 min	*Real*	0…16000	Hz	1 = 1 Hz
11.43	Freq in 1 max	*Real*	0…16000	Hz	1 = 1 Hz
11.44	Freq in 1 at scaled min	*Real*	-32768.000 … 32767.000	-	1000 = 1
11.45	Freq in 1 at scaled max	*Real*	-32768.000 … 32767.000	-	1000 = 1
11.54	Freq out 1 actual value	*Real*	0…16000	Hz	1 = 1 Hz
11.55	Freq out 1 source	*Analog src*	-	-	1 = 1
11.58	Freq out 1 src min	*Real*	-32768.000 … 32767.000	-	1000 = 1
11.59	Freq out 1 src max	*Real*	-32768.000 … 32767.000	-	1000 = 1
11.60	Freq out 1 at src min	*Real*	0…16000	Hz	1 = 1 Hz
11.61	Freq out 1 at src max	*Real*	0…16000	Hz	1 = 1 Hz
11.81	DIO filter time	*Real*	0.3 … 100.0	ms	10 = 1 ms
12 Standard AI					
12.01	AI tune	enum	0…4	-	
12.03	AI supervision function	*List*	0…4	-	1 = 1
12.04	AI supervision selection	*PB*	0000h…FFFFh	-	1 = 1
12.05	AI supervision force	*PB*	0000h…FFFFh	-	1 = 1
12.11	AI1 actual value	*Real*	-22.000 … 22.000	mA or V	1000 = 1 unit
12.12	AI1 scaled value	*Real*	-32768.000 … 32767.000	-	1000 = 1
12.15	AI1 unit selection	*List*	-	-	1 = 1
12.16	AI1 filter time	*Real*	0.000 … 30.000	s	1000 = 1 s
12.17	AI1 min	*Real*	-22.000 … 22.000	mA or V	1000 = 1 mA or V
12.18	AI1 max	*Real*	-22.000 … 22.000	mA or V	1000 = 1 mA or V
12.19	AI1 scaled at AI1 min	*Real*	-32768.000 … 32767.000	-	1000 = 1
12.20	AI1 scaled at AI1 max	*Real*	-32768.000 … 32767.000	-	1000 = 1
12.21	AI2 actual value	*Real*	-22.000 … 22.000	mA or V	1000 = 1 mA or V
12.22	AI2 scaled value	*Real*	-32768.000 … 32767.000	-	1000 = 1
12.25	AI2 unit selection	*List*	-	-	1 = 1
12.26	AI2 filter time	*Real*	0.000 … 30.000	s	1000 = 1 s
12.27	AI2 min	*Real*	-22.000 … 22.000	mA or V	1000 = 1 mA or V
12.28	AI2 max	*Real*	-22.000 … 22.000	mA or V	1000 = 1 mA or V
12.29	AI2 scaled at AI2 min	*Real*	-32768.000 … 32767.000	-	1000 = 1

No.	Name	Type	Range	Unit	FbEq32
12.30	AI2 scaled at AI2 max	*Real*	-32768.000 … 32767.000	-	1000 = 1
13 Standard AO					
13.11	AO1 actual value	*Real*	0.000 … 22.000	mA	1000 = 1 mA
13.12	AO1 source	*Analog src*	-	-	1 = 1
13.16	AO1 filter time	*Real*	0.000 … 30.000	s	1000 = 1 s
13.17	AO1 source min	*Real*	-32768.0 … 32767.0	-	10 = 1
13.18	AO1 source max	*Real*	-32768.0 … 32767.0	-	10 = 1
13.19	AO1 out at AO1 src min	*Real*	0.000 … 22.000	mA	1000 = 1 mA
13.20	AO1 out at AO1 src max	*Real*	0.000 … 22.000	mA	1000 = 1 mA
13.21	AO2 actual value	*Real*	0.000 … 22.000	mA	1000 = 1 mA
13.22	AO2 source	*Analog src*	-	-	1 = 1
13.26	AO2 filter time	*Real*	0.000 … 30.000	s	1000 = 1 s
13.27	AO2 source min	*Real*	-32768.0 … 32767.0	-	10 = 1
13.28	AO2 source max	*Real*	-32768.0 … 32767.0	-	10 = 1
13.29	AO2 out at AO2 src min	*Real*	0.000 … 22.000	mA	1000 = 1 mA
13.30	AO2 out at AO2 src max	*Real*	0.000 … 22.000	mA	1000 = 1 mA
13.91	AO1 data storage	*Real*	-327.68 … 327.67	-	100 = 1
13.92	AO2 data storage	*Real*	-327.68 … 327.67	-	100 = 1
14 I/O extension module 1					
14.01	Module 1 type	*List*	-	-	1 = 1
14.02	Module 1 location	*Real*	1…254	-	1 = 1
14.03	Module 1 status	*List*	0…4	-	1 = 1
DIx (14.01 Module 1 type = FDIO-01)					
14.05	DI status	*PB*	00000000h…FFFFFFFFh	-	1 = 1
14.06	DI delayed status	*PB*	00000000h…FFFFFFFFh	-	1 = 1
14.08	DI filter time	*Real*	0.8 … 100.0	ms	10 = 1 ms
14.12	DI1 ON delay	*Real*	0.00 … 3000.00	s	100 = 1 s
14.13	DI1 OFF delay	*Real*	0.00 … 3000.00	s	100 = 1 s
14.17	DI2 ON delay	*Real*	0.00 … 3000.00	s	100 = 1 s
14.18	DI2 OFF delay	*Real*	0.00 … 3000.00	s	100 = 1 s
14.22	DI3 ON delay	*Real*	0.00 … 3000.00	s	100 = 1 s
14.23	DI3 OFF delay	*Real*	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	*PB*	00000000h…FFFFFFFFh	-	1 = 1
14.06	DIO delayed status	*PB*	00000000h…FFFFFFFFh	-	1 = 1
DIO1/DIO2 (14.01 Module 1 type = FIO-01 or *FIO-11)*					
14.08	DIO filter time	*Real*	0.8 … 100.0	ms	10 = 1 ms
14.09	DIO1 function	*List*	0…1	-	1 = 1
14.11	DIO1 output source	*Binary src*	-	-	1 = 1

No.	Name	Type	Range	Unit	FbEq32
14.12	DIO1 ON delay	*Real*	0.00 … 3000.00	s	100 = 1 s
14.13	DIO1 OFF delay	*Real*	0.00 … 3000.00	s	100 = 1 s
14.14	DIO2 function	*List*	0…1	-	1 = 1
14.16	DIO2 output source	*Binary src*	-	-	1 = 1
14.17	DIO2 ON delay	*Real*	0.00 … 3000.00	s	100 = 1 s
14.18	DIO2 OFF delay	*Real*	0.00 … 3000.00	s	100 = 1 s
DIO3/DIO4 (*14.01 Module 1 type* = *FIO-01*)					
14.19	DIO3 function	*List*	0…1	-	1 = 1
14.21	DIO3 output source	*Binary src*	-	-	1 = 1
14.22	DIO3 ON delay	*Real*	0.00 … 3000.00	s	100 = 1 s
14.23	DIO3 OFF delay	*Real*	0.00 … 3000.00	s	100 = 1 s
14.24	DIO4 function	*List*	0…1	-	1 = 1
14.26	DIO4 output source	*Binary src*	-	-	1 = 1
14.27	DIO4 ON delay	*Real*	0.00 … 3000.00	s	100 = 1 s
14.28	DIO4 OFF delay	*Real*	0.00 … 3000.00	s	100 = 1 s
RO1/RO2 (*14.01 Module 1 type* = *FIO-01* or *FDIO-01*)					
14.31	RO status	*PB*	0000h…FFFFh	-	1 = 1
14.34	RO1 source	*Binary src*	-	-	1 = 1
14.35	RO1 ON delay	*Real*	0.00 … 3000.00	s	100 = 1 s
14.36	RO1 OFF delay	*Real*	0.00 … 3000.00	s	100 = 1 s
14.37	RO2 source	*Binary src*	-	-	1 = 1
14.38	RO2 ON delay	*Real*	0.00 … 3000.00	s	100 = 1 s
14.39	RO2 OFF delay	*Real*	0.00 … 3000.00	s	100 = 1 s
Common parameters for AIx (*14.01 Module 1 type* = *FIO-11* or *FAIO-01*)					
14.19	AI supervision function	*List*	0…4	-	1 = 1
14.20	AI supervision selection	*PB*	0000h…FFFFh	-	1 = 1
14.21	AI tune	*List*	0…6 (*FIO-11*) 0…4 (*FAIO-01*)	-	1 = 1
14.22	AI force selection	*PB*	0000h…FFFFh	-	1 = 1
AI1/AI2 (*14.01 Module 1 type* = *FIO-11* or *FAIO-01*)					
14.26	AI1 actual value	*Real*	-22.000 … 22.000	mA or V	1000 = 1 unit
14.27	AI1 scaled value	*Real*	-32768.000 … 32767.000	-	1000 = 1
14.28	AI1 force data	*Real*	-22.000 … 22.000	mA or V	1000 = 1 unit
14.29	AI1 HW switch position	*List*	-	-	1 = 1
14.30	AI1 unit selection	*List*	-	-	1 = 1
14.31	AI1 filter gain	*List*	0…7	-	1 = 1
14.32	AI1 filter time	*Real*	0.000 … 30.000	s	1000 = 1 s

No.	Name	Type	Range	Unit	FbEq32
14.33	AI1 min	*Real*	-22.000 … 22.000	mA or V	1000 = 1 mA or V
14.34	AI1 max	*Real*	-22.000 … 22.000	mA or V	1000 = 1 mA or V
14.35	AI1 scaled at AI1 min	*Real*	-32768.000 … 32767.000	-	1000 = 1
14.36	AI1 scaled at AI1 max	*Real*	-32768.000 … 32767.000	-	1000 = 1
14.41	AI2 actual value	*Real*	-22.000 … 22.000	mA or V	1000 = 1 unit
14.42	AI2 scaled value	*Real*	-32768.000 … 32767.000	-	1000 = 1
14.43	AI2 force data	*Real*	-22.000 … 22.000	mA or V	1000 = 1 unit
14.44	AI2 HW switch position	*List*	-	-	1 = 1
14.45	AI2 unit selection	*List*	-	-	1 = 1
14.46	AI2 filter gain	*List*	0…7	-	1 = 1
14.47	AI2 filter time	*Real*	0.000 … 30.000	s	1000 = 1 s
14.48	AI2 min	*Real*	-22.000 … 22.000	mA or V	1000 = 1 mA or V
14.49	AI2 max	*Real*	-22.000 … 22.000	mA or V	1000 = 1 mA or V
14.50	AI2 scaled at AI2 min	*Real*	-32768.000 … 32767.000	-	1000 = 1
14.51	AI2 scaled at AI2 max	*Real*	-32768.000 … 32767.000	-	1000 = 1
AI3 (14.01 Module 1 type = FIO-11)					
14.56	AI3 actual value	*Real*	-22.000 … 22.000	mA or V	1000 = 1 unit
14.57	AI3 scaled value	*Real*	-32768.000 … 32767.000	-	1000 = 1
14.58	AI3 force data	*Real*	-22.000 … 22.000	mA or V	1000 = 1 unit
14.59	AI3 HW switch position	*List*	-	-	1 = 1
14.60	AI3 unit selection	*List*	-	-	1 = 1
14.61	AI3 filter gain	*List*	0…7	-	1 = 1
14.62	AI3 filter time	*Real*	0.000 … 30.000	s	1000 = 1 s
14.63	AI3 min	*Real*	-22.000 … 22.000	mA or V	1000 = 1 mA or V
14.64	AI3 max	*Real*	-22.000 … 22.000	mA or V	1000 = 1 mA or V
14.65	AI3 scaled at AI3 min	*Real*	-32768.000 … 32767.000	-	1000 = 1
14.66	AI3 scaled at AI3 max	*Real*	-32768.000 … 32767.000	-	1000 = 1
Common parameters for AOx (14.01 Module 1 type = FIO-11 or *FAIO-01)*					
14.71	AO force selection	*PB*	00000000h…FFFFFFFFh	-	1 = 1
AO1 (14.01 Module 1 type = FIO-11 or *FAIO-01)*					
14.76	AO1 actual value	*Real*	0.000 … 22.000	mA	1000 = 1 mA
14.77	AO1 source	*Analog src*	-	-	1 = 1
14.78	AO1 force data	*Real*	0.000 … 22.000	mA	1000 = 1 mA
14.79	AO1 filter time	*Real*	0.000 … 30.000	s	1000 = 1 s
14.80	AO1 source min	*Real*	-32768.0 … 32767.0	-	10 = 1
14.81	AO1 source max	*Real*	-32768.0 … 32767.0	-	10 = 1

No.	Name	Type	Range	Unit	FbEq32
14.82	AO1 out at AO1 src min	*Real*	0.000 … 22.000	mA	1000 = 1 mA
14.83	AO1 out at AO1 src max	*Real*	0.000 … 22.000	mA	1000 = 1 mA
AO2 (14.01 Module 1 type = FAIO-01)					
14.86	AO2 actual value	*Real*	0.000 … 22.000	mA	1000 = 1 mA
14.87	AO2 source	*Analog src*	-	-	1 = 1
14.88	AO2 force data	*Real*	0.000 … 22.000	mA	1000 = 1 mA
14.89	AO2 filter time	*Real*	0.000 … 30.000	s	1000 = 1 s
14.90	AO2 source min	*Real*	-32768.0 … 32767.0	-	10 = 1
14.91	AO2 source max	*Real*	-32768.0 … 32767.0	-	10 = 1
14.92	AO2 out at AO2 src min	*Real*	0.000 … 22.000	mA	1000 = 1 mA
14.93	AO2 out at AO2 src max	*Real*	0.000 … 22.000	mA	1000 = 1 mA
15 I/O extension module 2					
15.01	Module 2 type	*List*	0...4	-	1 = 1
15.02	Module 2 location	*Real*	1…254	-	1 = 1
15.03	Module 2 status	*List*	0…2	-	1 = 1
DIx (15.01 Module 2 type = FDIO-01)					
15.05	DI status	*PB*	00000000h…FFFFFFFFh	-	1 = 1
15.06	DI delayed status	*PB*	00000000h…FFFFFFFFh	-	1 = 1
15.08	DI filter time	*Real*	0.8 … 100.0	ms	10 = 1 ms
15.12	DI1 ON delay	*Real*	0.00 … 3000.00	s	100 = 1 s
15.13	DI1 OFF delay	*Real*	0.00 … 3000.00	s	100 = 1 s
15.17	DI2 ON delay	*Real*	0.00 … 3000.00	s	100 = 1 s
15.18	DI2 OFF delay	*Real*	0.00 … 3000.00	s	100 = 1 s
15.22	DI3 ON delay	*Real*	0.00 … 3000.00	s	100 = 1 s
15.23	DI3 OFF delay	*Real*	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	*PB*	00000000h…FFFFFFFFh	-	1 = 1
15.06	DIO delayed status	*PB*	00000000h…FFFFFFFFh	-	1 = 1
DIO1/DIO2 (15.01 Module 2 type = FIO-01 or *FIO-11)*					
15.08	DIO filter time	*Real*	0.8 … 100.0	ms	10 = 1 ms
15.09	DIO1 function	*List*	0…1	-	1 = 1
15.11	DIO1 output source	*Binary src*	-	-	1 = 1
15.12	DIO1 ON delay	*Real*	0.00 … 3000.00	s	100 = 1 s
15.13	DIO1 OFF delay	*Real*	0.00 … 3000.00	s	100 = 1 s
15.14	DIO2 function	*List*	0…1	-	1 = 1
15.16	DIO2 output source	*Binary src*	-	-	1 = 1
15.17	DIO2 ON delay	*Real*	0.00 … 3000.00	s	100 = 1 s
15.18	DIO2 OFF delay	*Real*	0.00 … 3000.00	s	100 = 1 s

No.	Name	Type	Range	Unit	FbEq32
DIO3/DIO4 (15.01 Module 2 type = FIO-01)					
15.19	DIO3 function	*List*	0…1	-	1 = 1
15.21	DIO3 output source	*Binary src*	-	-	1 = 1
15.22	DIO3 ON delay	*Real*	0.00 … 3000.00	s	100 = 1 s
15.23	DIO3 OFF delay	*Real*	0.00 … 3000.00	s	100 = 1 s
15.24	DIO4 function	*List*	0…1	-	1 = 1
15.26	DIO4 output source	*Binary src*	-	-	1 = 1
15.27	DIO4 ON delay	*Real*	0.00 … 3000.00	s	100 = 1 s
15.28	DIO4 OFF delay	*Real*	0.00 … 3000.00	s	100 = 1 s
RO1/RO2 (15.01 Module 2 type = FIO-01 or *FDIO-01)*					
15.31	RO status	*PB*	0000h…FFFFh	-	1 = 1
15.34	RO1 source	*Binary src*	-	-	1 = 1
15.35	RO1 ON delay	*Real*	0.00 … 3000.00	s	100 = 1 s
15.36	RO1 OFF delay	*Real*	0.00 … 3000.00	s	100 = 1 s
15.37	RO2 source	*Binary src*	-	-	1 = 1
15.38	RO2 ON delay	*Real*	0.00 … 3000.00	s	100 = 1 s
15.39	RO2 OFF delay	*Real*	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	*List*	0…4	-	1 = 1
15.20	AI supervision selection	*PB*	0000h…FFFFh	-	1 = 1
15.21	AI tune	*List*	0…6 (*FIO-11*) 0…4 (*FAIO-01*)	-	1 = 1
15.22	AI force selection	*PB*	00000000h…FFFFFFFFh	-	1 = 1
AI1/AI2 (15.01 Module 2 type = FIO-11 or *FAIO-01)*					
15.26	AI1 actual value	*Real*	-22.000 … 22.000	mA or V	1000 = 1 unit
15.27	AI1 scaled value	*Real*	-32768.000 … 32767.000	-	1000 = 1
15.28	AI1 force data	*Real*	-22.000 … 22.000	mA or V	1000 = 1 unit
15.29	AI1 HW switch position	*List*	-	-	1 = 1
15.30	AI1 unit selection	*List*	-	-	1 = 1
15.31	AI1 filter gain	*List*	0…7	-	1 = 1
15.32	AI1 filter time	*Real*	0.000 … 30.000	s	1000 = 1 s
15.33	AI1 min	*Real*	-22.000 … 22.000	mA or V	1000 = 1 mA or V
15.34	AI1 max	*Real*	-22.000 … 22.000	mA or V	1000 = 1 mA or V
15.35	AI1 scaled at AI1 min	*Real*	-32768.000 … 32767.000	-	1000 = 1
15.36	AI1 scaled at AI1 max	*Real*	-32768.000 … 32767.000	-	1000 = 1
15.41	AI2 actual value	*Real*	-22.000 … 22.000	mA or V	1000 = 1 unit
15.42	AI2 scaled value	*Real*	-32768.000 … 32767.000	-	1000 = 1

No.	Name	Type	Range	Unit	FbEq32
15.43	AI2 force data	*Real*	-22.000 … 22.000	mA or V	1000 = 1 unit
15.44	AI2 HW switch position	*List*	-	-	1 = 1
15.45	AI2 unit selection	*List*	-	-	1 = 1
15.46	AI2 filter gain	*List*	0…7	-	1 = 1
15.47	AI2 filter time	*Real*	0.000 … 30.000	s	1000 = 1 s
15.48	AI2 min	*Real*	-22.000 … 22.000	mA or V	1000 = 1 mA or V
15.49	AI2 max	*Real*	-22.000 … 22.000	mA or V	1000 = 1 mA or V
15.50	AI2 scaled at AI2 min	*Real*	-32768.000 … 32767.000	-	1000 = 1
15.51	AI2 scaled at AI2 max	*Real*	-32768.000 … 32767.000	-	1000 = 1
AI3 (15.01 Module 2 type = FIO-11)					
15.56	AI3 actual value	*Real*	-22.000 … 22.000	mA or V	1000 = 1 unit
15.57	AI3 scaled value	*Real*	-32768.000 … 32767.000	-	1000 = 1
15.58	AI3 force data	*Real*	-22.000 … 22.000	mA or V	1000 = 1 unit
15.59	AI3 HW switch position	*List*	-	-	1 = 1
15.60	AI3 unit selection	*List*	-	-	1 = 1
15.61	AI3 filter gain	*List*	0…7	-	1 = 1
15.62	AI3 filter time	*Real*	0.000 … 30.000	s	1000 = 1 s
15.63	AI3 min	*Real*	-22.000 … 22.000	mA or V	1000 = 1 mA or V
15.64	AI3 max	*Real*	-22.000 … 22.000	mA or V	1000 = 1 mA or V
15.65	AI3 scaled at AI3 min	*Real*	-32768.000 … 32767.000	-	1000 = 1
15.66	AI3 scaled at AI3 max	*Real*	-32768.000 … 32767.000	-	1000 = 1
Common parameters for AOx (15.01 Module 2 type = FIO-11 or *FAIO-01)*					
15.71	AO force selection	*PB*	00000000h…FFFFFFFFh	-	1 = 1
AO1 (15.01 Module 2 type = FIO-11 or *FAIO-01)*					
15.76	AO1 actual value	*Real*	0.000 … 22.000	mA	1000 = 1 mA
15.77	AO1 source	*Analog src*	-	-	1 = 1
15.78	AO1 force data	*Real*	0.000 … 22.000	mA	1000 = 1 mA
15.79	AO1 filter time	*Real*	0.000 … 30.000	s	1000 = 1 s
15.80	AO1 source min	*Real*	-32768.0 … 32767.0	-	10 = 1
15.81	AO1 source max	*Real*	-32768.0 … 32767.0	-	10 = 1
15.82	AO1 out at AO1 src min	*Real*	0.000 … 22.000	mA	1000 = 1 mA
15.83	AO1 out at AO1 src max	*Real*	0.000 … 22.000	mA	1000 = 1 mA
AO2 (15.01 Module 2 type = FAIO-01)					
15.86	AO2 actual value	*Real*	0.000 … 22.000	mA	1000 = 1 mA
15.87	AO2 source	*Analog src*	-	-	1 = 1
15.88	AO2 force data	*Real*	0.000 … 22.000	mA	1000 = 1 mA
15.89	AO2 filter time	*Real*	0.000 … 30.000	s	1000 = 1 s

No.	Name	Type	Range	Unit	FbEq32
15.90	AO2 source min	*Real*	-32768.0 … 32767.0	-	10 = 1
15.91	AO2 source max	*Real*	-32768.0 … 32767.0	-	10 = 1
15.92	AO2 out at AO2 src min	*Real*	0.000 … 22.000	mA	1000 = 1 mA
15.93	AO2 out at AO2 src max	*Real*	0.000 … 22.000	mA	1000 = 1 mA
16 I/O extension module 3					
16.01	Module 3 type	*List*	0...4	-	1 = 1
16.02	Module 3 location	*Real*	1…254	-	1 = 1
16.03	Module 3 status	*List*	0…2	-	1 = 1
DIx (16.01 Module 3 type = FDIO-01)					
16.05	DI status	*PB*	00000000h…FFFFFFFFh	-	1 = 1
16.06	DI delayed status	*PB*	00000000h…FFFFFFFFh	-	1 = 1
16.08	DI filter time	*Real*	0.8 … 100.0	ms	10 = 1 ms
16.12	DI1 ON delay	*Real*	0.00 … 3000.00	s	100 = 1 s
16.13	DI1 OFF delay	*Real*	0.00 … 3000.00	s	100 = 1 s
16.17	DI2 ON delay	*Real*	0.00 … 3000.00	s	100 = 1 s
16.18	DI2 OFF delay	*Real*	0.00 … 3000.00	s	100 = 1 s
16.22	DI3 ON delay	*Real*	0.00 … 3000.00	s	100 = 1 s
16.23	DI3 OFF delay	*Real*	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	*PB*	00000000h…FFFFFFFFh	-	1 = 1
16.06	DIO delayed status	*PB*	00000000h…FFFFFFFFh	-	1 = 1
DIO1/DIO2 (16.01 Module 3 type = FIO-01 or *FIO-11)*					
16.08	DIO filter time	*Real*	0.8 … 100.0	ms	10 = 1 ms
16.09	DIO1 function	*List*	0…1	-	1 = 1
16.11	DIO1 output source	*Binary src*	-	-	1 = 1
16.12	DIO1 ON delay	*Real*	0.00 … 3000.00	s	100 = 1 s
16.13	DIO1 OFF delay	*Real*	0.0 0… 3000.00	s	100 = 1 s
16.14	DIO2 function	*List*	0…1	-	1 = 1
16.16	DIO2 output source	*Binary src*	-	-	1 = 1
16.17	DIO2 ON delay	*Real*	0.00 … 3000.00	s	100 = 1 s
16.18	DIO2 OFF delay	*Real*	0.00 … 3000.00	s	100 = 1 s
DIO3/DIO4 (16.01 Module 3 type = FIO-01)					
16.19	DIO3 function	*List*	0…1	-	1 = 1
16.21	DIO3 output source	*Binary src*	-	-	1 = 1
16.22	DIO3 ON delay	*Real*	0.00 … 3000.00	s	100 = 1 s
16.23	DIO3 OFF delay	*Real*	0.00 … 3000.00	s	100 = 1 s
16.24	DIO4 function	*List*	0…1	-	1 = 1
16.26	DIO4 output source	*Binary src*	-	-	1 = 1

No.	Name	Type	Range	Unit	FbEq32
16.27	DIO4 ON delay	*Real*	0.00 … 3000.00	s	100 = 1 s
16.28	DIO4 OFF delay	*Real*	0.00 … 3000.00	s	100 = 1 s
RO1/RO2 (16.01 Module 3 type = FIO-01 or *FDIO-01)*					
16.31	RO status	*PB*	0000h…FFFFh	-	1 = 1
16.34	RO1 source	*Binary src*	-	-	1 = 1
16.35	RO1 ON delay	*Real*	0.00 … 3000.00	s	100 = 1 s
16.36	RO1 OFF delay	*Real*	0.00 … 3000.00	s	100 = 1 s
16.37	RO2 source	*Binary src*	-	-	1 = 1
16.38	RO2 ON delay	*Real*	0.00 … 3000.00	s	100 = 1 s
16.39	RO2 OFF delay	*Real*	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	*List*	0…4	-	1 = 1
16.20	AI supervision selection	*PB*	0000h…FFFFh	-	1 = 1
16.21	AI tune	*List*	0…6 (*FIO-11*) 0…4 (*FAIO-01*)	-	1 = 1
16.22	AI force selection	*PB*	00000000h…FFFFFFFFh	-	1 = 1
AI1/AI2 (16.01 Module 3 type = FIO-11 or *FAIO-01)*					
16.26	AI1 actual value	*Real*	-22.000 … 22.000	mA or V	1000 = 1 unit
16.27	AI1 scaled value	*Real*	-32768.000 … 32767.000	-	1000 = 1
16.28	AI1 force data	*Real*	-22.000 … 22.000	mA or V	1000 = 1 unit
16.29	AI1 HW switch position	*List*	-	-	1 = 1
16.30	AI1 unit selection	*List*	-	-	1 = 1
16.31	AI1 filter gain	*List*	0…7	-	1 = 1
16.32	AI1 filter time	*Real*	0.000 … 30.000	s	1000 = 1 s
16.33	AI1 min	*Real*	-22.000 … 22.000	mA or V	1000 = 1 mA or V
16.34	AI1 max	*Real*	-22.000 … 22.000	mA or V	1000 = 1 mA or V
16.35	AI1 scaled at AI1 min	*Real*	-32768.000 … 32767.000	-	1000 = 1
16.36	AI1 scaled at AI1 max	*Real*	-32768.000 … 32767.000	-	1000 = 1
16.41	AI2 actual value	*Real*	-22.000 … 22.000	mA or V	1000 = 1 unit
16.42	AI2 scaled value	*Real*	-32768.000 … 32767.000	-	1000 = 1
16.43	AI2 force data	*Real*	-22.000 … 22.000	mA or V	1000 = 1 unit
16.44	AI2 HW switch position	*List*	-	-	1 = 1
16.45	AI2 unit selection	*List*	-	-	1 = 1
16.46	AI2 filter gain	*List*	0…7	-	1 = 1
16.47	AI2 filter time	*Real*	0.000 … 30.000	s	1000 = 1 s
16.48	AI2 min	*Real*	-22.000 … 22.000	mA or V	1000 = 1 mA or V
16.49	AI2 max	*Real*	-22.000 … 22.000	mA or V	1000 = 1 mA or V

No.	Name	Type	Range	Unit	FbEq32
16.50	AI2 scaled at AI2 min	*Real*	-32768.000 … 32767.000	-	1000 = 1
16.51	AI2 scaled at AI2 max	*Real*	-32768.000 … 32767.000	-	1000 = 1
AI3 (16.01 Module 3 type = FIO-11)					
16.56	AI3 actual value	*Real*	-22.000 … 22.000	mA or V	1000 = 1 unit
16.57	AI3 scaled value	*Real*	-32768.000 … 32767.000	-	1000 = 1
16.58	AI3 force data	*Real*	-22.000 … 22.000	mA or V	1000 = 1 unit
16.59	AI3 HW switch position	*List*	-	-	1 = 1
16.60	AI3 unit selection	*List*	-	-	1 = 1
16.61	AI3 filter gain	*List*	0…7	-	1 = 1
16.62	AI3 filter time	*Real*	0.000 … 30.000	s	1000 = 1 s
16.63	AI3 min	*Real*	-22.000 … 22.000	mA or V	1000 = 1 mA or V
16.64	AI3 max	*Real*	-22.000 … 22.000	mA or V	1000 = 1 mA or V
16.65	AI3 scaled at AI3 min	*Real*	-32768.000 … 32767.000	-	1000 = 1
16.66	AI3 scaled at AI3 max	*Real*	-32768.000 … 32767.000	-	1000 = 1
Common parameters for AOx (16.01 Module 3 type = FIO-11 or *FAIO-01)*					
16.71	AO force selection	*PB*	00000000h…FFFFFFFFh	-	1 = 1
AO1 (16.01 Module 3 type = FIO-11 or *FAIO-01)*					
16.76	AO1 actual value	*Real*	0.000 … 22.000	mA	1000 = 1 mA
16.77	AO1 source	*Analog src*	-	-	1 = 1
16.78	AO1 force data	*Real*	0.000 … 22.000	mA	1000 = 1 mA
16.79	AO1 filter time	*Real*	0.000 … 30.000	s	1000 = 1 s
16.80	AO1 source min	*Real*	-32768.0 … 32767.0	-	10 = 1
16.81	AO1 source max	*Real*	-32768.0 … 32767.0	-	10 = 1
16.82	AO1 out at AO1 src min	*Real*	0.000 … 22.000	mA	1000 = 1 mA
16.83	AO1 out at AO1 src max	*Real*	0.000 … 22.000	mA	1000 = 1 mA
AO2 (16.01 Module 3 type = FAIO-01)					
16.86	AO2 actual value	*Real*	0.000 … 22.000	mA	1000 = 1 mA
16.87	AO2 source	*Analog src*	-	-	1 = 1
16.88	AO2 force data	*Real*	0.000 … 22.000	mA	1000 = 1 mA
16.89	AO2 filter time	*Real*	0.000 … 30.000	s	1000 = 1 s
16.90	AO2 source min	*Real*	-32768.0 … 32767.0	-	10 = 1
16.91	AO2 source max	*Real*	-32768.0 … 32767.0	-	10 = 1
16.92	AO2 out at AO2 src min	*Real*	0.000 … 22.000	mA	1000 = 1 mA
16.93	AO2 out at AO2 src max	*Real*	0.000 … 22.000	mA	1000 = 1 mA
19 Operation mode					
19.01	Actual operation mode	*List*	-	-	1 = 1
19.11	Ext1/Ext2 selection	*Binary src*	-	-	1 = 1
19.12	Ext1 control mode	*List*	1…6	-	1 = 1

No.	Name	Type	Range	Unit	FbEq32
19.14	Ext2 control mode	*List*	1…6	-	1 = 1
19.16	Local control mode	*List*	0…1	-	1 = 1
19.17	Local control disable	*List*	0…1	-	1 = 1
20 Start/stop/direction					
20.01	Ext1 commands	*List*	-	-	1 = 1
20.02	Ext1 start trigger type	*List*	0…1	-	1 = 1
20.03	Ext1 in1 source	*Binary src*	-	-	1 = 1
20.04	Ext1 in2 source	*Binary src*	-	-	1 = 1
20.05	Ext1 in3 source	*Binary src*	-	-	1 = 1
20.06	Ext2 commands	*List*	-	-	1 = 1
20.07	Ext2 start trigger type	*List*	0…1	-	1 = 1
20.08	Ext2 in1 source	*Binary src*	-	-	1 = 1
20.09	Ext2 in2 source	*Binary src*	-	-	1 = 1
20.10	Ext2 in3 source	*Binary src*	-	-	1 = 1
20.11	Run enable stop mode	*List*	0…2	-	1 = 1
20.12	Run enable 1 source	*Binary src*	-	-	1 = 1
20.19	Enable start command	*Binary src*	-	-	1 = 1
20.23	Positive speed enable	*Binary src*	-	-	1 = 1
20.24	Negative speed enable	*Binary src*	-	-	1 = 1
20.30	Enable signals warning function	*PB*	00b…11b	-	1 = 1
20.200	Slowdown select	*List*	1…3	-	1 = 1
20.201	Slowdown input 1	*Binary src*	-	-	1 = 1
20.202	Slowdown input 2	*Binary src*	-	-	1 = 1
20.203	Slowdown up position	*Real*	-32000.000...32000.000	-	100 = 1
20.204	Slowdown dn position	*Real*	-32000.000...32000.000	-	100 = 1
20.205	Upper limit	*Binary src*	-	-	1 = 1
20.206	Lower limit	*Binary src*	-	-	1 = 1
20.207	Emergency control enable	*Binary src*	-	-	1 = 1
20.208	Emergency control forward	*Binary src*	-	-	1 = 1

No.	Name	Type	Range	Unit	FbEq32
20.209	Emergency control reverse	*Binary src*	-	-	1 = 1
20.210	Fast stop input	*Binary src*	-	-	1 = 1
20.211	Fast stop mode	*List*	1…3	-	1 = 1
20.212	Power on acknowledge	*Binary src*	-	-	1 = 1
20.213	Power on ackn reset delay	*Real*	0…30000	ms	1 = 1 ms
20.214	Joystick zero position	*Binary src*	-	-	1 = 1
20.215	Joystick warning delay	*Real*	0…30000	ms	1 = 1 ms
20.216	Crane control word 1	*PB*	0000h…FFFFh	-	1 = 1
21 Start/stop mode					
21.01	Start mode	*List*	0…3	-	1 = 1
21.02	Magnetization time	*Real*	0…10000	ms	1 = 1 ms
21.06	Zero speed limit	*Real*	0.00 … 30000.00	rpm	100 = 1 rpm
21.07	Zero speed delay	*Real*	0…30000	ms	1 = 1 ms
21.08	DC current control	*PB*	0000b…0011b	-	1 = 1
21.09	DC hold speed	*Real*	0.00 … 1000.00	rpm	100 = 1 rpm
21.10	DC current reference	*Real*	0.0 … 100.0	%	10 = 1%
21.11	Post magnetization time	*Real*	0…30000	s	1 = 1 s
21.12	Continuous magnetization command	*Binary src*	-	-	1 = 1
21.13	Autophasing mode	*List*	0…2	-	1 = 1
21.14	Pre-heating input source	*Binary src*	-	-	1 = 1
21.16	Pre-heating current	*Real*	0.0 … 30.0	%	10 = 1%
21.18	Auto restart time	*Real*	0.0, 0.1 … 5.0	s	10 = 1 s
21.19	Scalar control mode	*List*	0…2	-	1 = 1
21.20	Follower force ramp stop	*Binary src*	-	-	1 = 1
22 Speed reference selection					
22.01	Speed ref unlimited	*Real*	-30000.00 … 30000.00	rpm	100 = 1 rpm
22.11	Speed ref1 source	*Analog src*	-	-	1 = 1
22.12	Speed ref2 source	*Analog src*	-	-	1 = 1
22.13	Speed ref1 function	*List*	0…5	-	1 = 1
22.14	Speed ref1/2 selection	*Binary src*	-	-	1 = 1
22.15	Speed additive 1 source	*Analog src*	-	-	1 = 1
22.16	Speed share	*Real*	-8.000 … 8.000	-	1000 = 1
22.17	Speed additive 2 source	*Analog src*	-	-	1 = 1

No.	Name	Type	Range	Unit	FbEq32
22.21	Constant speed function	*PB*	00b…11b	-	1 = 1
22.22	Constant speed sel1	*Binary src*	-	-	1 = 1
22.23	Constant speed sel2	*Binary src*	-	-	1 = 1
22.24	Constant speed sel3	*Binary src*	-	-	1 = 1
22.26	Constant speed 1	*Real*	-30000.00 … 30000.00	rpm	100 = 1 rpm
22.27	Constant speed 2	*Real*	-30000.00 … 30000.00	rpm	100 = 1 rpm
22.28	Constant speed 3	*Real*	-30000.00 … 30000.00	rpm	100 = 1 rpm
22.29	Constant speed 4	*Real*	-30000.00 … 30000.00	rpm	100 = 1 rpm
22.30	Constant speed 5	*Real*	-30000.00 … 30000.00	rpm	100 = 1 rpm
22.31	Constant speed 6	*Real*	-30000.00 … 30000.00	rpm	100 = 1 rpm
22.32	Constant speed 7	*Real*	-30000.00 … 30000.00	rpm	100 = 1 rpm
22.41	Speed ref safe	*Real*	-30000.00 … 30000.00	rpm	100 = 1 rpm
22.51	Critical speed function	*PB*	00b…11b	-	1 = 1
22.52	Critical speed 1 low	*Real*	-30000.00 … 30000.00	rpm	100 = 1 rpm
22.53	Critical speed 1 high	*Real*	-30000.00 … 30000.00	rpm	100 = 1 rpm
22.54	Critical speed 2 low	*Real*	-30000.00 … 30000.00	rpm	100 = 1 rpm
22.55	Critical speed 2 high	*Real*	-30000.00 … 30000.00	rpm	100 = 1 rpm
22.56	Critical speed 3 low	*Real*	-30000.00 … 30000.00	rpm	100 = 1 rpm
22.57	Critical speed 3 high	*Real*	-30000.00 … 30000.00	rpm	100 = 1 rpm
Parameters 22.71...22.77 are visible only when user lock is open with pass code 584. See parameter 96.02 Pass code.					
22.71	Motor potentiometer function	*List*	0…2	-	1 = 1
22.72	Motor potentiometer initial value	*Real*	-32768.00 … 32767.00	-	100 = 1
22.73	Motor potentiometer up source	*Binary src*	-	-	1 = 1
22.74	Motor potentiometer down source	*Binary src*	-	-	1 = 1
22.75	Motor potentiometer ramp time	*Real*	0.0 … 3600.0	s	10 = 1 s
22.76	Motor potentiometer min value	*Real*	-32768.00 … 32767.00	-	100 = 1
22.77	Motor potentiometer max value	*Real*	-32768.00 … 32767.00	-	100 = 1
22.80	Motor potentiometer ref act	*Real*	-32768.00 … 32767.00	-	100 = 1
22.81	Speed reference act 1	*Real*	-30000.00 … 30000.00	rpm	100 = 1 rpm
22.82	Speed reference act 2	*Real*	-30000.00 … 30000.00	rpm	100 = 1 rpm
22.83	Speed reference act 3	*Real*	-30000.00 … 30000.00	rpm	100 = 1 rpm
22.84	Speed reference act 4	*Real*	-30000.00 … 30000.00	rpm	100 = 1 rpm
22.85	Speed reference act 5	*Real*	-30000.00 … 30000.00	rpm	100 = 1 rpm
22.86	Speed reference act 6	*Real*	-30000.00 … 30000.00	rpm	100 = 1 rpm
22.87	Speed reference act 7	*Real*	-30000.00 … 30000.00	rpm	100 = 1 rpm
22.200	Slowdown reference	*Real*	0.00 … 30000.00	rpm	1 = 1 rpm

No.	Name	Type	Range	Unit	FbEq32
22.202	Emergency control reference	*Real*	0.00 … 30000.00	rpm	1 = 1 rpm
22.203	Step reference mode	*Binary src*	-	-	1 = 1
22.204	Step reference select 2	*Binary src*	-	-	1 = 1
22.205	Step reference select 3	*Binary src*	-	-	1 = 1
22.206	Step reference select 4	*Binary src*	-	-	1 = 1
22.207	Step reference 1	*Real*	0.00 … 30000.00	rpm	1 = 1 rpm
22.208	Step reference 2	*Real*	0.00 … 30000.00	rpm	1 = 1 rpm
22.209	Step reference 3	*Real*	0.00 … 30000.00	rpm	1 = 1 rpm
22.210	Step reference 4	*Real*	0.00 … 30000.00	rpm	1 = 1 rpm
22.211	Speed reference shape	*List*	0…2	-	1 = 1
22.220	Crane motpot enable	*List*	0...8	-	1 = 1
22.223	Crane motpot accel sel	*List*	0...8	-	1 = 1
22.224	Crane motpot min speed	*Real*	0...32000	rpm	1 = 1 rpm
22.225	Crane motpot sw	*PB*	-	-	1 = 1
22.226	Crane motpot min value	*Real*	-32768.00...32767.00	-	100 = 1
22.227	Crane motpot max value	*Real*	-32768.00...32767.00	-	100 = 1
23 Speed reference ramp					
23.01	Speed ref ramp input	*Real*	-30000.00 … 30000.00	rpm	100 = 1 rpm
23.02	Speed ref ramp output	*Real*	-30000.00 … 30000.00	rpm	100 = 1 rpm
23.16	Shape time acc 1	*Real*	0.000 …1800.000	s	1000 = 1 s
23.17	Shape time acc 2	*Real*	0.000 …1800.000	s	1000 = 1 s
23.18	Shape time dec 1	*Real*	0.000 …1800.000	s	1000 = 1 s
23.19	Shape time dec 2	*Real*	0.000 …1800.000	s	1000 = 1 s
23.23	Emergency stop time	*Real*	0.000 …1800.000	s	1000 = 1 s
23.24	Speed ramp in zero source	*Binary src*	-	-	1 = 1
23.25	Ramp hold				
23.26	Ramp out balancing enable	*Binary src*	-	-	1 = 1
23.27	Ramp out balancing ref	*Real*	-30000.00 … 30000.00	rpm	100 = 1 rpm
23.28	Variable slope enable	*List*	0…1	-	1 = 1
23.29	Variable slope rate	*Real*	2…30000	ms	1 = 1 ms
23.39	Follower speed correction out	*Real*	-30000.00 30000.00	rpm	100 = 1 rpm
23.40	Follower speed correction enable	*Binary src*	-	-	1 = 1
23.41	Follower speed correction gain	*Real*	0.00 … 100.00	%	100 = 1%
23.42	Follower speed corr torq source	*Analog src*	-	-	1 = 1
23.200	Crane ramp set selection	*Binary src*	-	-	1 = 1

No.	Name	Type	Range	Unit	FbEq32
23.201	Crane acc time 1	*Real*	0.00 …1800.00	s	10 = 1.0 s
23.202	Crane dec tme 1	*Real*	0.00 …1800.00	s	10 = 1.0 s
23.203	Crane acc time 2	*Real*	0.00 …1800.00	s	10 = 1.0 s
23.204	Crane dec time 2	*Real*	0.00 …1800.00	s	10 = 1.0 s
23.206	Fast stop deceleration time	*Real*	0.00 …3000.00	s	10 = 1.0 s
24 Speed reference conditioning					
24.01	Used speed reference	*Real*	-30000.00 … 30000.00	rpm	100 = 1 rpm
24.02	Used speed feedback	*Real*	-30000.00 … 30000.00	rpm	100 = 1 rpm
24.03	Speed error filtered	*Real*	-30000.0 … 30000.0	rpm	100 = 1 rpm
24.04	Speed error inverted	*Real*	-30000.0 … 30000.0	rpm	100 = 1 rpm
24.11	Speed correction	*Real*	-10000.00…10000.00	-	100 = 1
24.12	Speed error filter time	*Real*	0…10000	ms	1 = 1 ms
24.41	Speed error window control enable	*Binary src*	-	-	1 = 1
24.42	Speed window control mode	*List*	0…1	-	1 = 1
24.43	Speed error window high	*Real*	0.00 … 3000.00	rpm	100 = 1 rpm
24.44	Speed error window low	*Real*	0.00 … 3000.00	rpm	100 = 1 rpm
24.46	Speed error step	*Real*	-3000.00 … 3000.00	rpm	100 = 1 rpm
24.200	Speed correction	*Real*	-10000.00…10000.00	rpm	100 = 1 rpm
25 Speed control					
25.01	Torque reference speed control	*Real*	-1600.0 … 1600.0	%	10 = 1%
25.02	Speed proportional gain	*Real*	0.00 … 250.00	-	100 = 1
25.03	Speed integration time	*Real*	0.00 … 1000.00	s	100 = 1 s
25.04	Speed derivation time	*Real*	0.000 … 10.000	s	1000 = 1 s
25.05	Derivation filter time	*Real*	0…10000	ms	1 = 1 ms
25.06	Acc comp derivation time	*Real*	0.00 … 1000.00	s	100 = 1 s
25.07	Acc comp filter time	*Real*	0.0 … 1000.0	ms	10 = 1 ms
25.08	Drooping rate	*Real*	0.00 … 100.00	%	100 = 1%
25.11	Speed control min torque	*Real*	-1600.0 … 0.0	%	10 = 1%
25.12	Speed control max torque	*Real*	0.0 … 1600.0	%	10 = 1%
25.13	Min torq sp ctrl em stop	*Real*	-1600.0 … 0.0	%	10 = 1%
25.14	Max torq sp ctrl em stop	*Real*	0.0 … 1600.0	%	10 = 1%
25.15	Proportional gain em stop	*Real*	1.00 … 250.00	-	100 = 1
25.18	Speed adapt min limit	*Real*	0…30000	rpm	1 = 1 rpm
25.19	Speed adapt max limit	*Real*	0…30000	rpm	1 = 1 rpm
25.21	Kp adapt coef at min speed	*Real*	0.000 … 10.000	-	1000 = 1
25.22	Ti adapt coef at min speed	*Real*	0.000 … 10.000	-	1000 = 1
25.25	Torque adapt max limit	*Real*	0.0 … 1600.0	%	10 = 1%
25.26	Torque adapt filt time	*Real*	0.000 … 100.000	s	1000 = 1 s
25.27	Kp adapt coef at min torque	*Real*	0.000 … 10.000	-	1000 = 1

No.	Name	Type	Range	Unit	FbEq32
25.30	Flux adaption enable	*List*	0…1	-	1 = 1
25.33	Speed controller autotune	*Binary src*	-	-	1 = 1
25.34	Speed controller autotune mode	*List*	0…2	-	1 = 1
25.37	Mechanical time constant	*Real*	0.00 … 1000.00	s	100 = 1 s
25.38	Autotune torque step	*Real*	0.00 … 100.00	%	100 = 1%
25.39	Autotune speed step	*Real*	0.00 … 100.00	%	100 = 1%
25.40	Autotune repeat times	*Real*	1…10	-	1 = 1
25.53	Torque prop reference	*Real*	-30000.0 … 30000.0	%	10 = 1%
25.54	Torque integral reference	*Real*	-30000.0 … 30000.0	%	10 = 1%
25.55	Torque deriv reference	*Real*	-30000.0 … 30000.0	%	10 = 1%
25.56	Torque acc compensation	*Real*	-30000.0 … 30000.0	%	10 = 1%
25.57	Torque reference unbalanced	*Real*	-30000.0 … 30000.0	%	10 = 1%
26 Torque reference chain					
26.01	Torque reference to TC	*Real*	-1600.0 … 1600.0	%	10 = 1%
26.02	Torque reference used	*Real*	-1600.0 … 1600.0	%	10 = 1%
26.08	Minimum torque ref	*Real*	-1000.0 … 0.0	%	10 = 1%
26.09	Maximum torque ref	*Real*	0.0 … 1000.0	%	10 = 1%
26.11	Torque ref1 source	*Analog src*	-	-	1 = 1
26.12	Torque ref2 source	*Analog src*	-	-	1 = 1
26.13	Torque ref1 function	*List*	0…5	-	1 = 1
26.14	Torque ref1/2 selection	*Binary src*	-	-	1 = 1
26.15	Load share	*Real*	-8.000 … 8.000	-	1000 = 1
26.16	Torque additive 1 source	*Analog src*	-	-	1 = 1
26.17	Torque ref filter time	*Real*	0.000 … 30.000	s	1000 = 1 s
26.18	Torque ramp up time	*Real*	0.000 … 60.000	s	1000 = 1 s
26.19	Torque ramp down time	*Real*	0.000 … 60.000	s	1000 = 1 s
26.25	Torque additive 2 source	*Analog src*	-	-	1 = 1
26.26	Force torque ref add 2 zero	*Binary src*	-	-	1 = 1
26.41	Torque step	*Real*	-300.0 … 300.0	%	10 = 1%
26.42	Torque step enable	*List*	0…1	-	1 = 1
26.51	Oscillation damping	*Binary src*	-	-	1 = 1
26.52	Oscillation damping out enable	*Binary src*	-	-	1 = 1
26.53	Oscillation compensation input	*List*	0…1	-	1 = 1
26.55	Oscillation damping frequency	*Real*	0.1 … 60.0	Hz	10 = 1 Hz

No.	Name	Type	Range	Unit	FbEq32
26.56	Oscillation damping phase	*Real*	0…360	deg	1 = 1 deg
26.57	Oscillation damping gain	*Real*	0.0 … 100.0	%	10 = 1%
26.58	Oscillation damping output	*Real*	-1600.000 … 1600.000	%	1000 = 1%
26.70	Torque reference act 1	*Real*	-1600.0 … 1600.0	%	10 = 1%
26.71	Torque reference act 2	*Real*	-1600.0 … 1600.0	%	10 = 1%
26.72	Torque reference act 3	*Real*	-1600.0 … 1600.0	%	10 = 1%
26.73	Torque reference act 4	*Real*	-1600.0 … 1600.0	%	10 = 1%
26.74	Torque ref ramp out	*Real*	-1600.0 … 1600.0	%	10 = 1%
26.75	Torque reference act 5	*Real*	-1600.0 … 1600.0	%	10 = 1%
26.76	Torque reference act 6	*Real*	-1600.0 … 1600.0	%	10 = 1%
26.77	Torque ref add A actual	*Real*	-1600.0 … 1600.0	%	10 = 1%
26.78	Torque ref add B actual	*Real*	-1600.0 … 1600.0	%	10 = 1%
26.81	Rush control gain	*Real*	0.0 … 10000.0	-	10 = 1
26.82	Rush control integration time	*Real*	0.0 … 10.0	s	10 = 1 s
30 Limits					
30.01	Limit word 1	*PB*	0000h…FFFFh	-	1 = 1
30.02	Torque limit status	*PB*	0000h…FFFFh	-	1 = 1
30.11	Minimum speed	*Real*	-30000.00 … 30000.00	rpm	100 = 1 rpm
30.12	Maximum speed	*Real*	-30000.00 … 30000.00	rpm	100 = 1 rpm
30.13	Minimum frequency	*Real*	-500.00 … 500.00	Hz	100 = 1 Hz
30.14	Maximum frequency	*Real*	-500.00 … 500.00	Hz	100 = 1 Hz
30.15	Maximum start current enable	*List*	0…1	-	1 = 1
30.16	Maximum start current	*Real*	0.00 … 30000.00	A	100 = 1 A
30.17	Maximum current	*Real*	0.00 … 30000.00	A	100 = 1 A
30.18	Minimum torque sel	*Binary src*	-	-	1 = 1
30.19	Minimum torque 1	*Real*	-1600.0 … 1600.0	%	10 = 1%
30.20	Maximum torque 1	*Real*	-1600.0 … 1600.0	%	10 = 1%
30.21	Minimum torque 2 source	*Analog src*	-	-	1 = 1
30.22	Maximum torque 2 source	*Analog src*	-	-	1 = 1
30.23	Minimum torque 2	*Real*	-1600.0 … 0.0	%	10 = 1%
30.24	Maximum torque 2	*Real*	0.0 … 1600.0	%	10 = 1%
30.25	Maximum torque sel	*Binary src*	-	-	1 = 1
30.26	Power motoring limit	*Real*	0.00 … 600.00	%	100 = 1%
30.27	Power generating limit	*Real*	-600.00 … 0.00	%	100 = 1%
30.30	Overvoltage control	*List*	0…1	-	1 = 1
30.31	Undervoltage control	*List*	0…1	-	1 = 1
30.200	External speed limits	*Binary src*	-	-	1 = 1
30.201	External min speed limit	*Real*	-30000.00 … 0.00	rpm	1 = 1 rpm

No.	Name	Type	Range	Unit	FbEq32
30.202	External max speed limit	*Real*	0.00 … 30000.00	rpm	1 = 1 rpm
30.203	Deadband forward	*Real*	0.00 … 100.00	%	10 = 1.0%
30.204	Deadband reverse	*Real*	0.00 … 100.00	%	10 = 1.0%
31 Fault functions					
31.01	External event 1 source	*Binary src*	-	-	1 = 1
31.02	External event 1 type	*List*	0…3	-	1 = 1
31.03	External event 2 source	*Binary src*	-	-	1 = 1
31.04	External event 2 type	*List*	0…3	-	1 = 1
31.05	External event 3 source	*Binary src*	-	-	1 = 1
31.06	External event 3 type	*List*	0…3	-	1 = 1
31.07	External event 4 source	*Binary src*	-	-	1 = 1
31.08	External event 4 type	*List*	0…3	-	1 = 1
31.09	External event 5 source	*Binary src*	-	-	1 = 1
31.10	External event 5 type	*List*	0…3	-	1 = 1
31.11	Fault reset selection	*Binary src*	-	-	1 = 1
31.12	Autoreset selection	*PB*	0000h…FFFFh	-	1 = 1
31.13	User selectable fault	*Real*	0000h…FFFFh	-	1 = 1
31.14	Number of trials	*Real*	0…5	-	1 = 1
31.15	Total trials time	*Real*	1.0 … 600.0	s	10 = 1 s
31.16	Delay time	*Real*	0.0 … 120.0	s	10 = 1 s
31.19	Motor phase loss	*List*	0…1	-	1 = 1
31.20	Earth fault	*List*	0…2	-	1 = 1
31.21	Supply phase loss	*List*	0…1	-	1 = 1
31.22	STO indication run/stop	*List*	0…5	-	1 = 1
31.23	Wiring or earth fault	*List*	0…1	-	1 = 1
31.24	Stall function	*List*	0…2	-	1 = 1
31.25	Stall current limit	*Real*	0.0 … 1600.0	%	10 = 1%
31.26	Stall speed limit	*Real*	0.0 … 10000.0	rpm	100 = 1 rpm
31.27	Stall frequency limit	*Real*	0.00 … 500.00	Hz	100 = 1 Hz
31.28	Stall time	*Real*	0…3600	s	1 = 1 s
31.30	Overpeed trip margin	*Real*	0…10000	rpm	100 = 1 rpm
31.32	Emergency ramp supervision	*Real*	0…300	%	1 = 1%
31.33	Emergency ramp supervision delay	*Real*	0…32767	s	1 = 1 s
31.35	Main fan fault function	*List*	0…2	-	1 = 1
31.36	Aux fan fault bypass	*List*	0…1	-	1 = 1
31.37	Ramp stop supervision	*Real*	0…300	%	1 = 1%

No.	Name	Type	Range	Unit	FbEq32
31.38	Ramp stop supervision delay	*Real*	0…32767	s	1 = 1 s
31.40	Disable warnings	*PB*	0000h…FFFFh	-	1 = 1
31.42	Overcurrent fault limit	*Real*	0.0 … 30000.0	A	100 = 1 A
31.200	Motor overspeed level	*Real*	0.00 …30000.00	rpm	1 = 1 rpm
31.201	Motor overspeed level delay	*Real*	0…30000	ms	1 = 1 ms
31.202	Inverter overload selection	*PB*	000000b…111111b	-	1 = 1
31.203	User limit bit selection	*Binary src*	-	-	1 = 1
31.204	Inverter overload delay	*Real*	0…30000	ms	1 = 1 ms
31.205	Crane warning masking	*PB*	00000000b… 11111111b	-	-
31.211	Toggle bit enable	*Bit pointer*	-	-	1 = 1
31.212	Toggle bit action	*List*	0…1	-	1 = 1
31.213	Toggle bit time delay	*UDINT*	0…1000	ms	1 = 1
31.214	Toggle bit source	*Bit pointer*	-	-	1 = 1
31.215	Toggle bit statusword	*UINT*	-	-	1 = 1
32 Supervision					
32.01	Supervision status	*PB*	000b…111b	-	1 = 1
32.05	Supervision 1 function	*List*	0…6	-	1 = 1
32.06	Supervision 1 action	*List*	0…2	-	1 = 1
32.07	Supervision 1 signal	*Analog src*	-	-	1 = 1
32.08	Supervision 1 filter time	*Real*	0.000 … 30.000	s	1000 = 1 s
32.09	Supervision 1 low	*Real*	-21474830.00 … 21474830.00	-	100 = 1
32.10	Supervision 1 high	*Real*	-21474830.00 … 21474830.00	-	100 = 1
32.15	Supervision 2 function	*List*	0…6	-	1 = 1
32.16	Supervision 2 action	*List*	0…2	-	1 = 1
32.17	Supervision 2 signal	*Analog src*	-	-	1 = 1
32.18	Supervision 2 filter time	*Real*	0.000 … 30.000	s	1000 = 1 s
32.19	Supervision 2 low	*Real*	-21474830.00 … 21474830.00	-	100 = 1
32.20	Supervision 2 high	*Real*	-21474830.00 … 21474830.00	-	100 = 1
32.25	Supervision 3 function	*List*	0…6	-	1 = 1
32.26	Supervision 3 action	*List*	0…2	-	1 = 1
32.27	Supervision 3 signal	*Analog src*	-	-	1 = 1
32.28	Supervision 3 filter time	*Real*	0.000 … 30.000	s	1000 = 1 s
32.29	Supervision 3 low	*Real*	-21474830.00 … 21474830.00	-	100 = 1

No.	Name	Type	Range	Unit	FbEq32
32.30	Supervision 3 high	*Real*	21474830.00 … 21474830.00	-	100 = 1
32.221	Watchdog test	*Bit pointer*	-	-	1 = 1
32.222	Watchdog test delay	*UDINT*	0.0 ... 10.0	s	10 = 1 s
32.223	Watchdog re test delay	*UDINT*	0.0 ... 1800.0	s	10 = 1 s
32.224	Watchdog fault delay	*UDINT*	0.0 ... 10.0	s	10 = 1 s
32.225	Watchdog user bit	*Bit pointer*	-	-	1 = 1
32.226	Watchdog mask	*UINT*	-	-	1 = 1
32.227	Watchdog sw	*PB*	000000b…111111b	-	1 = 1
32.228	Watchdog trip sw	*PB*	000000b…111111b	-	1 = 1
33 Generic timer & counter					
33.01	Counter status	*PB*	000000b…111111b	-	1 = 1
33.10	On-time 1 actual	*Real*	0…4294967295	s	1 = 1 s
33.11	On-time 1 warn limit	*Real*	0…4294967295	s	1 = 1 s
33.12	On-time 1 function	*PB*	00b…11b	-	1 = 1
33.13	On-time 1 source	*Binary src*	-	-	1 = 1
33.14	On-time 1 warn message	*List*	-	-	1 = 1
33.20	On-time 2 actual	*Real*	0…4294967295	s	1 = 1 s
33.21	On-time 2 warn limit	*Real*	0…4294967295	s	1 = 1 s
33.22	On-time 2 function	*PB*	00b…11b	-	1 = 1
33.23	On-time 2 source	*Binary src*	-	-	1 = 1
33.24	On-time 2 warn message	*List*	-	-	1 = 1
33.30	Edge counter 1 actual	*Real*	0…4294967295	-	1 = 1
33.31	Edge counter 1 warn limit	*Real*	0…4294967295	-	1 = 1
33.32	Edge counter 1 function	*PB*	0000b…1111b	-	1 = 1
33.33	Edge counter 1 source	*Binary src*	-	-	1 = 1
33.34	Edge counter 1 divider	*Real*	1…4294967295	-	1 = 1
33.35	Edge counter 1 warn message	*List*	-	-	1 = 1
33.40	Edge counter 2 actual	*Real*	0…4294967295	-	1 = 1
33.41	Edge counter 2 warn limit	*Real*	0…4294967295	-	1 = 1
33.42	Edge counter 2 function	*PB*	0000b…1111b	-	1 = 1
33.43	Edge counter 2 source	*Binary src*	-	-	1 = 1
33.44	Edge counter 2 divider	*Real*	1…4294967295	-	1 = 1
33.45	Edge counter 2 warn message	*List*	-	-	1 = 1
33.50	Value counter 1 actual	*Real*	-2147483008 … 2147483008	-	1 = 1
33.51	Value counter 1 warn limit	*Real*	-2147483008 … 2147483008	-	1 = 1

No.	Name	Type	Range	Unit	FbEq32
33.52	Value counter 1 function	*PB*	00b…11b	-	1 = 1
33.53	Value counter 1 source	*Analog src*	-	-	1 = 1
33.54	Value counter 1 divider	*Real*	0.001 … 2147483.000	-	1000 = 1
33.55	Value counter 1 warn message	*List*	-	-	1 = 1
33.60	Value counter 2 actual	*Real*	-2147483008 … 2147483008	-	1 = 1
33.61	Value counter 2 warn limit	*Real*	-2147483008 … 2147483008	-	1 = 1
33.62	Value counter 2 function	*PB*	00b…11b	-	1 = 1
33.63	Value counter 2 source	*Analog src*	-	-	1 = 1
33.64	Value counter 2 divider	*Real*	0.001 … 2147483.000	-	1000 = 1
33.65	Value counter 2 warn message	*List*	-	-	1 = 1
Parameters 33.200...33.222 are visible only when user lock is open with pass code 584. See parameter 96.02 Pass code.					
33.200	Set crane operation hours	*Bit pointer*	-	-	1 = 1
33.201	Crane operation hrs init value	*Real*	0...1100000	h	1 = 1
33.202	Crane operation hrs warning limit	*Real*	0...1100000	h	1 = 1
33.210	Set brake oper counts	*Bit pointer*	-	-	1 = 1
33.211	Brake oper counts init value	*UINT*	0...4294967295	-	1 = 1
33.212	Brake oper counts warning limit	*UINT*	0...4294967295	-	1 = 1
33.220	Set number of power on	*Bit pointer*	-	-	1 = 1
33.221	Number of pwr on init value	*UINT*	0...65535	-	1 = 1
33.222	Number of pwr on warning limit	*UINT*	0...65535	-	1 = 1
35 Motor thermal protection					
35.01	Motor estimated temperature	*Real*	-60 … 1000	°C or °F	1 = 1 °
35.02	Measured temperature 1	*Real*	-60 … 5000 °C, -76 … 9032 °F, 0 ohm or [35.12] ohm	°C, °F or ohm	1 = 1 unit
35.03	Measured temperature 2	*Real*	-60 … 5000 °C, -76 … 9032 °F, 0 ohm or [35.22] ohm	°C, °F or ohm	1 = 1 unit
35.04	FPTC status word	*PB*	0000h…FFFFh	-	1 = 1
35.11	Temperature 1 source	*List*	0…11	-	1 = 1
35.12	Temperature 1 fault limit	*Real*	-60 … 5000 °C or ohm, or -76 … 9032 °F	°C, °F or ohm	1 = 1 unit
35.13	Temperature 1 warning limit	*Real*	-60 … 5000 °C or ohm, or -76 … 9032 °F	°C, °F or ohm	1 = 1 unit
35.14	Temperature 1 AI source	*Analog src*	-	-	1 = 1

No.	Name	Type	Range	Unit	FbEq32
35.21	Temperature 2 source	*List*	0…11	-	1 = 1
35.22	Temperature 2 fault limit	*Real*	-60 … 5000 °C or ohm, or -76 … 9032 °F	°C, °F or ohm	1 = 1 unit
35.23	Temperature 2 warning limit	*Real*	-60 … 5000 °C or ohm, or -76 … 9032 °F	°C, °F or ohm	1 = 1 unit
35.24	Temperature 2 AI source	*Analog src*	-	-	1 = 1
35.30	FPTC configuration word	*PB*	0000h…FFFFh	-	1 = 1
35.50	Motor ambient temperature	*Real*	-60 … 100 °C or -76 … 212 °F	°C or °F	1 = 1 °C
35.51	Motor load curve	*Real*	50…150	%	1 = 1%
35.52	Zero speed load	*Real*	50…150	%	1 = 1%
35.53	Break point	*Real*	1.00 … 500.00	Hz	100 = 1 Hz
35.54	Motor nominal temperature rise	*Real*	0…300	°C	1 = 1 °C
35.55	Motor thermal time constant	*Real*	100…10000	s	1 = 1 s
35.60	Cable temperature	*Real*	0.0 … 200.0	%	10 = 1%
35.61	Cable nominal current	*Real*	0.00 … 10000.0	A	100 = 1 A
35.62	Cable thermal rise time	*Real*	0…50000	s	1 = 1 s
35.100	DOL starter control source	*Binary src*	-	-	1 = 1
35.101	DOL starter on delay	*Real*	0…42949673	s	1 = 1 s
35.102	DOL starter off delay	*Real*	0…715828	min	1 = 1 min
35.103	DOL starter feedback source	*Binary src*	-	-	1 = 1
35.104	DOL starter feedback delay	*Real*	0…42949673	s	1 = 1 s
35.105	DOL starter status word	*PB*	0000b…1111b	-	1 = 1
35.106	DOL starter event type	*List*	0…2	-	1 = 1
36 Load analyzer					
36.01	PVL signal source	*Analog src*	-	-	1 = 1
36.02	PVL filter time	*Real*	0.00 … 120.00	s	100 = 1 s
36.06	AL2 signal source	*Analog src*	-	-	1 = 1
36.07	AL2 signal scaling	*Real*	0.00 … 32767.00	-	100 = 1
36.09	Reset loggers	*List*	0…3	-	1 = 1
36.10	PVL peak value	*Real*	-32768.00 … 32767.00	-	100 = 1
36.11	PVL peak date	*Data*	-	-	1 = 1
36.12	PVL peak time	*Data*	-	-	1 = 1
36.13	PVL current at peak	*Real*	-32768.00 … 32767.00	A	100 = 1 A
36.14	PVL DC voltage at peak	*Real*	0.00 … 2000.00	V	100 = 1 V
36.15	PVL speed at peak	*Real*	-32768.00 … 32767.00	rpm	100 = 1 rpm
36.16	PVL reset date	*Data*	-	-	1 = 1

No.	Name	Type	Range	Unit	FbEq32
36.17	PVL reset time	*Data*	-	-	1 = 1
36.20	AL1 0 to 10%	*Real*	0.00 … 100.00	%	100 = 1%
36.21	AL1 10 to 20%	*Real*	0.00 … 100.00	%	100 = 1%
36.22	AL1 20 to 30%	*Real*	0.00 … 100.00	%	100 = 1%
36.23	AL1 30 to 40%	*Real*	0.00 … 100.00	%	100 = 1%
36.24	AL1 40 to 50%	*Real*	0.00 … 100.00	%	100 = 1%
36.25	AL1 50 to 60%	*Real*	0.00 … 100.00	%	100 = 1%
36.26	AL1 60 to 70%	*Real*	0.00 … 100.00	%	100 = 1%
36.27	AL1 70 to 80%	*Real*	0.00 … 100.00	%	100 = 1%
36.28	AL1 80 to 90%	*Real*	0.00 … 100.00	%	100 = 1%
36.29	AL1 over 90%	*Real*	0.00 … 100.00	%	100 = 1%
36.40	AL2 0 to 10%	*Real*	0.00 … 100.00	%	100 = 1%
36.41	AL2 10 to 20%	*Real*	0.00 … 100.00	%	100 = 1%
36.42	AL2 20 to 30%	*Real*	0.00 … 100.00	%	100 = 1%
36.43	AL2 30 to 40%	*Real*	0.00 … 100.00	%	100 = 1%
36.44	AL2 40 to 50%	*Real*	0.00 … 100.00	%	100 = 1%
36.45	AL2 50 to 60%	*Real*	0.00 … 100.00	%	100 = 1%
36.46	AL2 60 to 70%	*Real*	0.00 … 100.00	%	100 = 1%
36.47	AL2 70 to 80%	*Real*	0.00 … 100.00	%	100 = 1%
36.48	AL2 80 to 90%	*Real*	0.00 … 100.00	%	100 = 1%
36.49	AL2 over 90%	*Real*	0.00 … 100.00	%	100 = 1%
36.50	AL2 reset date	*Data*	-	-	1 = 1
36.51	AL2 reset time	*Data*	-	-	1 = 1
37 User load curve					
37.01	ULC output status word	*PB*	0000h…FFFFh	-	1 = 1
37.02	ULC supervision signal	*List*	-	-	1 = 1
37.03	ULC overload actions	*List*	0…3	-	1 = 1
37.04	ULC underload actions	*List*	0…3	-	1 = 1
37.11	ULC speed table point 1	*Real*	0.0 … 30000.0	rpm	10 = 1 rpm
37.12	ULC speed table point 2	*Real*	0.0 … 30000.0	rpm	10 = 1 rpm
37.13	ULC speed table point 3	*Real*	0.0 … 30000.0	rpm	10 = 1 rpm
37.14	ULC speed table point 4	*Real*	0.0 … 30000.0	rpm	10 = 1 rpm
37.15	ULC speed table point 5	*Real*	0.0 … 30000.0	rpm	10 = 1 rpm
37.16	ULC frequency table point 1	*Real*	0.0 … 500.0	Hz	10 = 1 Hz
37.17	ULC frequency table point 2	*Real*	0.0 … 500.0	Hz	10 = 1 Hz
37.18	ULC frequency table point 3	*Real*	0.0 … 500.0	Hz	10 = 1 Hz
37.19	ULC frequency table point 4	*Real*	0.0 … 500.0	Hz	10 = 1 Hz
37.20	ULC frequency table point 5	*Real*	0.0 … 500.0	Hz	10 = 1 Hz
37.21	ULC underload point 1	*Real*	0.0 … 1600.0	%	10 = 1%
37.22	ULC underload point 2	*Real*	0.0 … 1600.0	%	10 = 1%
37.23	ULC underload point 3	*Real*	0.0 … 1600.0	%	10 = 1%

No.	Name	Type	Range	Unit	FbEq32
37.24	ULC underload point 4	*Real*	0.0 … 1600.0	%	10 = 1%
37.25	ULC underload point 5	*Real*	0.0 … 1600.0	%	10 = 1%
37.31	ULC overload point 1	*Real*	0.0 … 1600.0	%	10 = 1%
37.32	ULC overload point 2	*Real*	0.0 … 1600.0	%	10 = 1%
37.33	ULC overload point 3	*Real*	0.0 … 1600.0	%	10 = 1%
37.34	ULC overload point 4	*Real*	0.0 … 1600.0	%	10 = 1%
37.35	ULC overload point 5	*Real*	0.0 … 1600.0	%	10 = 1%
37.41	ULC overload timer	*Real*	0.0 … 10000.0	s	10 = 1 s
37.42	ULC underload timer	*Real*	0.0 … 10000.0	s	10 = 1 s
43 Brake chopper					
43.01	Braking resistor temperature	*Real*	0.0 … 120.0	%	10 = 1%
43.06	Brake chopper function	*List*	0…3	-	1 = 1
43.07	Brake chopper run enable	*Binary src*	-	-	1 = 1
43.08	Brake resistor thermal tc	*Real*	0…10000	s	1 = 1 s
43.09	Brake resistor Pmax cont	*Real*	0.10 … 10000.00	kW	100 = 1 kW
43.10	Brake resistance	*Real*	0.0…1000.0	ohm	10 = 1 ohm
43.11	Brake resistor fault limit	*Real*	0…150	%	1 = 1%
43.12	Brake resistor warning limit	*Real*	0…150	%	1 = 1%
44 Mechanical brake control					
44.01	Brake control status	*PB*	00000000b…11111111b	-	1 = 1
44.02	Brake torque memory	*Real*	-1600.0 … 1600.0	%	10 = 1%
44.03	Brake open torque reference	*Real*	-1600.0 … 1600.0	%	10 = 1%
44.06	Brake control enable	*Binary src*	-	-	1 = 1
44.07	Brake acknowledge selection	*Binary src*	-	-	1 = 1
44.08	Brake open delay	*Real*	0.00 … 5.00	s	100 = 1 s
44.09	Brake open torque source	*Analog src*	-	-	1 = 1
44.11	Keep brake closed	*Binary src*	-	-	1 = 1
44.13	Brake close delay	*Real*	0.00 … 60.00	s	100 = 1 s
44.14	Brake close level	*Real*	0.0 … 1000.0	rpm	100 = 1 rpm
44.15	Brake close level delay	*Real*	0.00 … 10.00	s	100 = 1 s
44.16	Brake reopen delay	*Real*	0.00 … 10.00	s	100 = 1 s
44.17	Brake fault function	*List*	0…2	-	1 = 1
44.18	Brake fault delay	*Real*	0.00 … 60.00	s	100 = 1 s
44.200	Brake open torque	*Real*	0.0…1000.0	%	10 = 1.0%
44.201	Torque proving sign	*Binary src*	-	-	1 = 1
44.202	Torque proving	*Binary src*	-	-	1 = 1

No.	Name	Type	Range	Unit	FbEq32
44.203	Torque proving reference	*Real*	0.00 … 300.00	%	10 = 1.0%
44.204	Brake system check time	*Real*	100…30000	ms	10 = 1 ms
44.205	Brake slip speed limit	*Real*	0.0 … 30000.0	rpm	1 = 1 rpm
44.206	Brake slip fault delay	*Real*	0…30000	ms	1 = 1 ms
44.207	Safety close select	*Binary src*	-	-	1 = 1
44.208	Safety close speed	*Real*	0.00 … 30000.00	rpm	1 = 1 rpm
44.209	Safety close delay	*Real*	0…30000	ms	1 = 1 ms
44.210	Crane brake status	*PB*	0b…1b	-	-
44.211	Extended runtime	*Real*	0.0…3600.0	s	10 = 1 s
44.212	Extended runtime sw	DINT	-	-	-
44.213	Brake long fall delay	*Real*	0.0 ... 60.0	s	10 = 1 s
46 Monitoring/scaling settings					
46.01	Speed scaling	*Real*	0.10 … 30000.00	rpm	100 = 1 rpm
46.02	Frequency scaling	*Real*	0.10 … 1000.00	Hz	100 = 1 Hz
46.03	Torque scaling	*Real*	0.1 … 1000.0	%	10 = 1%
46.04	Power scaling	*Real*	0.10 … 30000.00 kW or 0.10 … 40214.48 hp	kW or hp	100 = 1 unit
46.05	Current scaling	*Real*	0…30000	A	1 = 1 A
46.06	Speed ref zero scaling	*Real*	0.00 … 30000.00	rpm	100 = 1 rpm
46.07	Frequency ref zero scaling	*Real*	0.00 … 1000.00	Hz	100 = 1 Hz
46.11	Filter time motor speed	*Real*	0…20000	ms	1 = 1 ms
46.12	Filter time output frequency	*Real*	0…20000	ms	1 = 1 ms
46.13	Filter time motor torque	*Real*	0…20000	ms	1 = 1 ms
46.14	Filter time power out	*Real*	0…20000	ms	1 = 1 ms
46.21	At speed hysteresis	*Real*	0.00 … 30000.00	rpm	100 = 1 rpm
46.22	At frequency hysteresis	*Real*	0.00 … 1000.00	Hz	100 = 1 Hz
46.23	At torque hysteresis	*Real*	0.0 … 300.0	%	1 = 1%
46.31	Above speed limit	*Real*	0.00 … 30000.00	rpm	100 = 1 rpm
46.32	Above frequency limit	*Real*	0.00 … 1000.00	Hz	100 = 1 Hz
46.33	Above torque limit	*Real*	0.00 … 3000.00	%	1 = 1%
46.42	Torque decimals	*List*	0…2	-	1 = 1
47 Data storage					
47.01	Data storage 1 real32	*Real*	Defined by *47.31*	-	1000 = 1
47.02	Data storage 2 real32	*Real*	Defined by *47.32*	-	1000 = 1
47.03	Data storage 3 real32	*Real*	Defined by *47.33*	-	1000 = 1
47.04	Data storage 4 real32	*Real*	Defined by *47.34*	-	1000 = 1
47.05	Data storage 5 real32	*Real*	Defined by *47.35*	-	1000 = 1
47.06	Data storage 6 real32	*Real*	Defined by *47.36*	-	1000 = 1
47.07	Data storage 7 real32	*Real*	Defined by *47.37*	-	1000 = 1
47.08	Data storage 8 real32	*Real*	Defined by *47.38*	-	1000 = 1

No.	Name	Type	Range	Unit	FbEq32
47.11	Data storage 1 int32	*Real*	-2147483648 … 2147483647	-	1 = 1
47.12	Data storage 2 int32	*Real*	-2147483648 … 2147483647	-	1 = 1
47.13	Data storage 3 int32	*Real*	-2147483648 … 2147483647	-	1 = 1
47.14	Data storage 4 int32	*Real*	-2147483648 … 2147483647	-	1 = 1
47.15	Data storage 5 int32	*Real*	-2147483648 … 2147483647	-	1 = 1
47.16	Data storage 6 int32	*Real*	-2147483648 … 2147483647	-	1 = 1
47.17	Data storage 7 int32	*Real*	-2147483648 … 2147483647	-	1 = 1
47.18	Data storage 8 int32	*Real*	-2147483648 … 2147483647	-	1 = 1
47.21	Data storage 1 int16	*Real*	-32768 … 32767	-	1 = 1
47.22	Data storage 2 int16	*Real*	-32768 … 32767	-	1 = 1
47.23	Data storage 3 int16	*Real*	-32768 … 32767	-	1 = 1
47.24	Data storage 4 int16	*Real*	-32768 … 32767	-	1 = 1
47.25	Data storage 5 int16	*Real*	-32768 … 32767	-	1 = 1
47.26	Data storage 6 int16	*Real*	-32768 … 32767	-	1 = 1
47.27	Data storage 7 int16	*Real*	-32768 … 32767	-	1 = 1
47.28	Data storage 8 int16	*Real*	-32768 … 32767	-	1 = 1
47.31	Data storage 1 real32 type	*List*	0…5	-	1 = 1
47.32	Data storage 2 real32 type	*List*	0…5	-	1 = 1
47.33	Data storage 3 real32 type	*List*	0…5	-	1 = 1
47.34	Data storage 4 real32 type	*List*	0…5	-	1 = 1
47.35	Data storage 5 real32 type	*List*	0…5	-	1 = 1
47.36	Data storage 6 real32 type	*List*	0…5	-	1 = 1
47.37	Data storage 7 real32 type	*List*	0…5	-	1 = 1
47.38	Data storage 8 real32 type	*List*	0…5	-	1 = 1
49 Panel port communication					
49.01	Node ID number	*Real*	1…32	-	1 = 1
49.03	Baud rate	*List*	1…5	-	1 = 1
49.04	Communication loss time	*Real*	0.3 … 3000.0	s	10 = 1 s
49.05	Communication loss action	*List*	0…5	-	1 = 1
49.06	Refresh settings	*List*	0…1	-	1 = 1
49.07	Panel comm supervision force	*PB*	0000h…FFFFh	-	1 = 1
49.08	Secondary comm. loss action	*List*	0…5	-	1 = 1
49.14	Panel speed reference unit	*List*	0…1	-	1 = 1
49.15	Minimum ext speed ref panel	*Real*	-30000.00 … 30000.00	rpm	100 = 1 rpm
49.16	Maximum ext speed ref panel	*Real*	-30000.00 … 30000.00	rpm	100 = 1 rpm

No.	Name	Type	Range	Unit	FbEq32
49.17	Minimum ext frequency ref panel	*Real*	-500.00 … 500.00	Hz	100 = 1 Hz
49.18	Maximum ext frequency ref panel	*Real*	-500.00 … 500.00	Hz	100 = 1 Hz
50 Fieldbus adapter (FBA)					
50.01	FBA A enable	*List*	0…3	-	1 = 1
50.02	FBA A comm loss func	*List*	0…5	-	1 = 1
50.03	FBA A comm loss t out	*Real*	0.3 … 6553.5	s	10 = 1 s
50.04	FBA A ref1 type	*List*	0…5	-	1 = 1
50.05	FBA A ref2 type	*List*	0…5	-	1 = 1
50.07	FBA A actual 1 type	*List*	0…6	-	1 = 1
50.08	FBA A actual 2 type	*List*	0…6	-	1 = 1
50.09	FBA A SW transparent source	*Analog src*	-	-	1 = 1
50.10	FBA A act1 transparent source	*Analog src*	-	-	1 = 1
50.11	FBA A act2 transparent source	*Analog src*	-	-	1 = 1
50.12	FBA A debug mode	*List*	0…1	-	1 = 1
50.13	FBA A control word	*Data*	00000000h … FFFFFFFFh	-	1 = 1
50.14	FBA A reference 1	*Real*	-2147483648 … 2147483647	-	1 = 1
50.15	FBA A reference 2	*Real*	-2147483648 … 2147483647	-	1 = 1
50.16	FBA A status word	*Data*	00000000h … FFFFFFFFh	-	1 = 1
50.17	FBA A actual value 1	*Real*	-2147483648 … 2147483647	-	1 = 1
50.18	FBA A actual value 2	*Real*	-2147483648 … 2147483647	-	1 = 1
50.21	FBA A timelevel sel	*List*	0…3	-	1 = 1
50.26	FBA A comm supervision force	*PB*	0000h…FFFFh	-	1 = 1
50.31	FBA B enable	*List*	0…1	-	1 = 1
50.32	FBA B comm loss func	*Real*	0…5	-	1 = 1
50.33	FBA B comm loss timeout	*List*	0.3 … 6553.5	s	10 = 1 s
50.34	FBA B ref1 type	*List*	0…5	-	1 = 1
50.35	FBA B ref2 type	*List*	0…5	-	1 = 1
50.37	FBA B actual 1 type	*List*	0…6	-	1 = 1
50.38	FBA B actual 2 type	*Analog src*	0…6	-	1 = 1
50.39	FBA B SW transparent source	*Analog src*	-	-	1 = 1
50.40	FBA B act1 transparent source	*Analog src*	-	-	1 = 1
50.41	FBA B act2 transparent source	*List*	-	-	1 = 1
50.42	FBA B debug mode	*Data*	0…1	-	1 = 1

No.	Name	Type	Range	Unit	FbEq32
50.43	FBA B control word	*Real*	00000000h … FFFFFFFFh	-	1 = 1
50.44	FBA B reference 1	*Real*	-2147483648 … 2147483647	-	1 = 1
50.45	FBA B reference 2	*Data*	-2147483648 … 2147483647	-	1 = 1
50.46	FBA B status word	*Real*	00000000h … FFFFFFFFh	-	1 = 1
50.47	FBA B actual value 1	*Real*	-2147483648 … 2147483647	-	1 = 1
50.48	FBA B actual value 2		-2147483648 … 2147483647	-	1 = 1
50.51	FBA B timelevel sel	*List*	0…3	-	1 = 1
50.56	FBA B comm supervision force	*PB*	0000h…FFFFh	-	1 = 1
51 FBA A settings					
51.01	FBA A type	*List*	-	-	1 = 1
51.02	FBA A Par2	*Real*	0…65535	-	1 = 1
…	…	…	…	…	
51.26	FBA A Par26	*Real*	0…65535	-	1 = 1
51.27	FBA A par refresh	*List*	0…1	-	1 = 1
51.28	FBA A par table ver	*Data*	-	-	1 = 1
51.29	FBA A drive type code	*Real*	0…65535	-	1 = 1
51.30	FBA A mapping file ver	*Real*	0…65535	-	1 = 1
51.31	D2FBA comm status	*List*	0…6	-	1 = 1
51.32	FBA A comm SW ver	*Data*	-	-	1 = 1
51.33	FBA A appl SW ver	*Data*	-	-	1 = 1
52 FBA A data in					
52.01	FBA A data in1	*List*	-	-	1 = 1
…	…	…	…	…	
52.12	FBA A data in12	*List*	-	-	1 = 1
53 FBA A data out					
53.01	FBA A data out1	*List*	-	-	1 = 1
…	…	…	…	…	
53.12	FBA A data out12	*List*	-	-	1 = 1
54 FBA B settings					
54.01	FBA B type				
54.02	FBA B Par2	UINT16	0…65535	-	
…	…	…	…	…	
54.26	FBA B Par26	UINT16	0…65535	-	
54.27	FBA B par refresh	*List*	0…1	-	
54.28	FBA B par table ver	UINT16	0…65535	-	
54.29	FBA B drive type code	UINT16	0…65535	-	
54.30	FBA B mapping file ver	UINT16	0…65535	-	

No.	Name	Type	Range	Unit	FbEq32
54.31	D2FBA B comm status	*List*	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	*List*	-	-	1 = 1
…	…	…	…	…	
55.12	FBA B data in12	*List*	-	-	1 = 1
56 FBA B data out					
56.01	FBA B data out1	*List*	-	-	1 = 1
…	…	…	…	…	
56.12	FBA B data out12	*List*	-	-	1 = 1
58 Embedded fieldbus					
58.01	Protocol enable	*List*	0…1	-	1 = 1
58.02	Protocol ID	*Real*	0000h…FFFFh	-	1 = 1
58.03	Node address	*Real*	0…255	-	1 = 1
58.04	Baud rate	*List*	2…7	-	1 = 1
58.05	Parity	*List*	0…3	-	1 = 1
58.06	Communication control	*List*	0…2	-	1 = 1
58.07	Communication diagnostics	*PB*	0000h…FFFFh	-	1 = 1
58.08	Received packets	*Real*	0…4294967295	-	1 = 1
58.09	Transmitted packets	*Real*	0…4294967295	-	1 = 1
58.10	All packets	*Real*	0…4294967295	-	1 = 1
58.11	UART errors	*Real*	0…4294967295	-	1 = 1
58.12	CRC errors	*Real*	0…4294967295	-	1 = 1
58.14	Communication loss action	*List*	0…3	-	1 = 1
58.15	Communication loss mode	*List*	0…2	-	1 = 1
58.16	Communication loss time	*Real*	0.0 … 6000.0	s	10 = 1 s
58.17	Transmit delay	*Real*	0…65535	ms	1 = 1 ms
58.18	EFB control word	*PB*	0000h…FFFFh	-	1 = 1
58.19	EFB status word	*PB*	0000h…FFFFh	-	1 = 1
58.25	Control profile	*List*	0, 2	-	1 = 1
58.26	EFB ref1 type	*List*	0…5	-	1 = 1
58.27	EFB ref2 type	*List*	0…5	-	1 = 1
58.28	EFB act1 type	*List*	0…6	-	1 = 1
58.29	EFB act2 type	*List*	0…6	-	1 = 1
58.30	EFB status word transparent source	*Analog src*	-	-	1 = 1
58.31	EFB act1 transparent source	*Analog src*	-	-	1 = 1
58.32	EFB act2 transparent source	*Analog src*	-	-	1 = 1
58.33	Addressing mode	*List*	0…3	-	1 = 1

No.	Name	Type	Range	Unit	FbEq32
58.34	Word order	*List*	0…1	-	1 = 1
58.101	Data I/O 1	*Analog src*	-	-	1 = 1
58.102	Data I/O 2	*Analog src*	-	-	1 = 1
58.103	Data I/O 3	*Analog src*	-	-	1 = 1
58.104	Data I/O 4	*Analog src*	-	-	1 = 1
58.105	Data I/O 5	*Analog src*	-	-	1 = 1
58.106	Data I/O 6	*Analog src*	-	-	1 = 1
58.107	Data I/O 7	*Analog src*	-	-	1 = 1
…	…	…	…	…	
58.124	Data I/O 24	*Analog src*	-	-	1 = 1
60 DDCS communication					
60.01	M/F communication port	*List*	-	-	-
60.02	M/F node address	*Real*	1…254	-	-
60.03	M/F mode	*List*	0…6	-	-
60.05	M/F HW connection	*List*	0…1	-	-
60.07	M/F link control	*Real*	1…15	-	-
60.08	M/F comm loss timeout	*Real*	0…65535	ms	-
60.09	M/F comm loss function	*List*	0…3	-	-
60.10	M/F ref1 type	*List*	0…5	-	-
60.11	M/F ref2 type	*List*	0…5	-	-
60.12	M/F act1 type	*List*	0…5	-	-
60.13	M/F act2 type	*List*	0…5	-	-
60.14	M/F follower selection	*Real*	0…16	-	-
60.15	Force master	*Binary src*	-	-	1 = 1
60.16	Force follower	*Binary src*	-	-	1 = 1
60.17	Follower fault action	*List*	0…2	-	1 = 1
60.18	Follower enable	*List*	0…3	-	1 = 1
60.19	M/F comm supervision sel 1	*PB*	0000h…FFFFh	-	1 = 1
60.20	M/F comm supervision sel 2	*PB*	0000h…FFFFh	-	1 = 1
60.23	M/F status supervision sel 1	*PB*	0000h…FFFFh	-	1 = 1
60.24	M/F status supervision sel 2	*PB*	0000h…FFFFh	-	1 = 1
60.27	M/F status supv mode sel 1	*PB*	0000h…FFFFh	-	1 = 1
60.28	M/F status supv mode sel 2	*PB*	0000h…FFFFh	-	1 = 1
60.31	M/F wake up delay	*Real*	0.0 … 180.0	s	10 = 1 s

No.	Name	Type	Range	Unit	FbEq32
60.32	M/F comm supervision force	*PB*	0000h…FFFFh	-	1 = 1
60.41	Extension adapter com port	*List*	-	-	-
60.50	DDCS controller drive type	*List*	0…1	-	-
60.51	DDCS controller comm port	*List*	-	-	-
60.52	DDCS controller node address	*Real*	1…254	-	-
60.55	DDCS controller HW connection	*List*	0…1	-	-
60.57	DDCS controller link control	*Real*	1…15	-	-
60.58	DDCS controller comm loss time	*Real*	0…60000	ms	-
60.59	DDCS controller comm loss function	*List*	0…5	-	-
60.60	DDCS controller ref1 type	*List*	0…5	-	-
60.61	DDCS controller ref2 type	*List*	0…5	-	-
60.62	DDCS controller act1 type	*List*	0…5	-	-
60.63	DDCS controller act2 type	*List*	0…5	-	-
60.64	Mailbox dataset selection	*List*	0…1	-	-
60.65	DDCS controller comm supervision force	*PB*	0000h…FFFFh	-	1 = 1
(Parameters 60.71…94.10 only visible with a BCU control unit)					
60.71	INU-LSU communication port	*List*	-	-	1 = 1
60.77	INU-LSU link control	*Real*	1…15	-	-
60.78	INU-LSU comm loss timeout	*Real*	0…65535	ms	-
60.79	INU-LSU comm loss function	*Binary src*	-	-	1 = 1
60.200	Crane drive type	*List*	0...11	-	1 = 1
60.201	Crane drives structure	*PB*	0000h…FFFFh	-	1 = 1
60.202	CW1	*PB*	-	-	-
60.203	CW2	*PB*	-	-	-
60.204	Ref1	*PB*	-	-	-
60.205	Ref2	*PB*	-	-	-
60.206	Master SW1	*PB*	-	-	-
60.207	Master SW2	*PB*	-	-	-
60.210	Follower 1 SW1	*PB*	-	-	-
60.211	Follower 1 SW2	*PB*	-	-	-
60.212	Follower 1 position error	*Real*	-	-	-
60.213	Follower 1 position actual	*Real*	-	-	-
60.214	Follower 2 SW1	*PB*	-	-	-
60.215	Follower 2 SW2	*PB*	-	-	-
60.216	Follower 2 position error	*Real*	-	-	-
60.217	Follower 2 position actual	*Real*	-	-	-
60.218	Follower 3 SW1	*PB*	-	-	-
60.219	Follower 3 SW2	*PB*	-	-	-

No.	Name	Type	Range	Unit	FbEq32
60.220	Follower 3 position error	*Real*	-	-	-
60.221	Follower 3 position actual	*Real*	-	-	-
60.222	Follower 4 SW1	*PB*	-	-	-
60.223	Follower 4 SW2	*PB*	-	-	-
60.224	Follower 4 position error	*Real*	-	-	-
60.225	Follower 4 position actual	*Real*	-	-	-
60.226	Hoist position	*Real*	-	-	-
60.227	Hoist weight	*Real*	-	%	-
61 D2D and DDCS transmit data					
61.01	M/F data 1 selection	*List*	-	-	-
61.02	M/F data 2 selection	*List*	-	-	-
61.03	M/F data 3 selection	*List*	-	-	-
61.25	M/F data 1 value	*Real*	0…65535	-	-
61.26	M/F data 2 value	*Real*	0…65535	-	-
61.27	M/F data 3 value	*Real*	0…65535	-	-
61.45	Data set 2 data 1 selection	*List*	-	-	-
61.46	Data set 2 data 2 selection	*List*	-	-	-
61.47	Data set 2 data 3 selection	*List*	-	-	-
61.48	Data set 4 data 1 selection	*List*	-	-	-
61.49	Data set 4 data 2 selection	*List*	-	-	-
61.50	Data set 4 data 3 selection	*List*	-	-	-
61.51	Data set 11 data 1 selection	*List*	-	-	-
61.52	Data set 11 data 2 selection	*List*	-	-	-
61.53	Data set 11 data 3 selection	*List*	-	-	-
61.54	Data set 13 data 1 selection	*List*	-	-	-
61.55	Data set 13 data 2 selection	*List*	-	-	-
61.56	Data set 13 data 3 selection	*List*	-	-	-
61.57	Data set 15 data 1 selection	*List*	-	-	-
61.58	Data set 15 data 2 selection	*List*	-	-	-
61.59	Data set 15 data 3 selection	*List*	-	-	-
61.60	Data set 17 data 1 selection	*List*	-	-	-
61.61	Data set 17 data 2 selection	*List*	-	-	-
61.62	Data set 17 data 3 selection	*List*	-	-	-
61.63	Data set 19 data 1 selection	*List*	-	-	-
61.64	Data set 19 data 2 selection	*List*	-	-	-
61.65	Data set 19 data 3 selection	*List*	-	-	-
61.66	Data set 21 data 1 selection	*List*	-	-	-
61.67	Data set 21 data 2 selection	*List*	-	-	-
61.68	Data set 21 data 3 selection	*List*	-	-	-
61.69	Data set 23 data 1 selection	*List*	-	-	-
61.70	Data set 23 data 2 selection	*List*	-	-	-

No.	Name	Type	Range	Unit	FbEq32
61.71	Data set 23 data 3 selection	List	-	-	-
61.72	Data set 25 data 1 selection	List	-	-	-
61.73	Data set 25 data 2 selection	List	-	-	-
61.74	Data set 25 data 3 selection	List	-	-	-
61.95	Data set 2 data 1 value	Real	0…65535	-	-
61.96	Data set 2 data 2 value	Real	0…65535	-	-
61.97	Data set 2 data 3 value	Real	0…65535	-	-
61.98	Data set 4 data 1 value	Real	0…65535	-	-
61.99	Data set 4 data 2 value	Real	0…65535	-	-
61.100	Data set 4 data 3 value	Real	0…65535	-	-
61.101	Data set 11 data 1 value	Real	0…65535	-	-
61.102	Data set 11 data 2 value	Real	0…65535	-	-
61.103	Data set 11 data 3 value	Real	0…65535	-	-
61.104	Data set 13 data 1 value	Real	0…65535	-	-
61.105	Data set 13 data 2 value	Real	0…65535	-	-
61.106	Data set 13 data 3 value	Real	0…65535	-	-
61.107	Data set 15 data 1 value	Real	0…65535	-	-
61.108	Data set 15 data 2 value	Real	0…65535	-	-
61.109	Data set 15 data 3 value	Real	0…65535	-	-
61.110	Data set 17 data 1 value	Real	0…65535	-	-
61.111	Data set 17 data 2 value	Real	0…65535	-	-
61.112	Data set 17 data 3 value	Real	0…65535	-	-
61.113	Data set 19 data 1 value	Real	0…65535	-	-
61.114	Data set 19 data 2 value	Real	0…65535	-	-
61.115	Data set 19 data 3 value	Real	0…65535	-	-
61.116	Data set 21 data 1 value	Real	0…65535	-	-
61.117	Data set 21 data 2 value	Real	0…65535	-	-
61.118	Data set 21 data 3 value	Real	0…65535	-	-
61.119	Data set 23 data 1 value	Real	0…65535	-	-
61.120	Data set 23 data 2 value	Real	0…65535	-	-
61.121	Data set 23 data 3 value	Real	0…65535	-	-
61.122	Data set 25 data 1 value	Real	0…65535	-	-
61.123	Data set 25 data 2 value	Real	0…65535	-	-
61.124	Data set 25 data 3 value	Real	0…65535	-	-
(Parameters 61.151…61.203 only visible with a BCU control unit)					
61.151	INU-LSU Data set 10 data 1 sel	List	-	-	-
61.152	INU-LSU Data set 10 data out 2	List	-	-	-
61.153	INU-LSU Data set 10 data 2 sel	List	-	-	-

No.	Name	Type	Range	Unit	FbEq32
61.201	INU-LSU Data set 10 data 1 value	*Real*	0…65535	-	-
61.202	INU-LSU Data set 10 data 2 value	*Real*	0…65535	-	-
61.203	INU-LSU Data set 10 data 3 value	*Real*	0…65535	-	-
62 D2D and DDCS receive data					
62.01	M/F data 1 selection	*List*	-	-	-
62.02	M/F data 2 selection	*List*	-	-	-
62.03	M/F data 3 selection	*List*	-	-	-
62.04	Follower node 2 data 1 sel	*List*	-	-	-
62.05	Follower node 2 data 2 sel	*List*	-	-	-
62.06	Follower node 2 data 3 sel	*List*	-	-	-
62.07	Follower node 3 data 1 sel	*List*	-	-	-
62.08	Follower node 3 data 2 sel	*List*	-	-	-
62.09	Follower node 3 data 3 sel	*List*	-	-	-
62.10	Follower node 4 data 1 sel	*List*	-	-	-
62.11	Follower node 4 data 2 sel	*List*	-	-	-
62.12	Follower node 4 data 3 sel	*List*	-	-	-
62.25	MF data 1 value	*Real*	0…65535	-	-
62.26	MF data 2 value	*Real*	0…65535	-	-
62.27	MF data 3 value	*Real*	0…65535	-	-
62.28	Follower node 2 data 1 value	*Real*	0…65535	-	-
62.29	Follower node 2 data 2 value	*Real*	0…65535	-	-
62.30	Follower node 2 data 3 value	*Real*	0…65535	-	-
62.31	Follower node 3 data 1 value	*Real*	0…65535	-	-
62.32	Follower node 3 data 2 value	*Real*	0…65535	-	-
62.33	Follower node 3 data 3 value	*Real*	0…65535	-	-
62.34	Follower node 4 data 1 value	*Real*	0…65535	-	-
62.35	Follower node 4 data 2 value	*Real*	0…65535	-	-
62.36	Follower node 4 data 3 value	*Real*	0…65535	-	-
62.37	M/F communication status 1	*PB*	0000h…FFFFh	-	1 = 1
62.38	M/F communication status 2	*PB*	0000h…FFFFh	-	1 = 1
62.41	M/F follower ready status 1	*PB*	0000h…FFFFh	-	1 = 1
62.42	M/F follower ready status 2	*PB*	0000h…FFFFh	-	1 = 1
62.45	Data set 1 data 1 selection	*List*	-	-	-
62.46	Data set 1 data 2 selection	*List*	-	-	-
62.47	Data set 1 data 3 selection	*List*	-	-	-
62.48	Data set 3 data 1 selection	*List*	-	-	-
62.49	Data set 3 data 2 selection	*List*	-	-	-
62.50	Data set 3 data 3 selection	*List*	-	-	-
62.51	Data set 10 data 1 selection	*List*	-	-	-

No.	Name	Type	Range	Unit	FbEq32
62.52	Data set 10 data 2 selection	*List*	-	-	-
62.53	Data set 10 data 3 selection	*List*	-	-	-
62.54	Data set 12 data 1 selection	*List*	-	-	-
62.55	Data set 12 data 2 selection	*List*	-	-	-
62.56	Data set 12 data 3 selection	*List*	-	-	-
62.57	Data set 14 data 1 selection	*List*	-	-	-
62.58	Data set 14 data 2 selection	*List*	-	-	-
62.59	Data set 14 data 3 selection	*List*	-	-	-
62.60	Data set 16 data 1 selection	*List*	-	-	-
62.61	Data set 16 data 2 selection	*List*	-	-	-
62.62	Data set 16 data 3 selection	*List*	-	-	-
62.63	Data set 18 data 1 selection	*List*	-	-	-
62.64	Data set 18 data 2 selection	*List*	-	-	-
62.65	Data set 18 data 3 selection	*List*	-	-	-
62.66	Data set 20 data 1 selection	*List*	-	-	-
62.67	Data set 20 data 2 selection	*List*	-	-	-
62.68	Data set 20 data 3 selection	*List*	-	-	-
62.69	Data set 22 data 1 selection	*List*	-	-	-
62.70	Data set 22 data 2 selection	*List*	-	-	-
62.71	Data set 22 data 3 selection	*List*	-	-	-
62.72	Data set 24 data 1 selection	*List*	-	-	-
62.73	Data set 24 data 2 selection	*List*	-	-	-
62.74	Data set 24 data 3 selection	*List*	-	-	-
62.95	Data set 1 data 1 value	*Real*	0…65535	-	-
62.96	Data set 1 data 2 value	*Real*	0…65535	-	-
62.97	Data set 1 data 3 value	*Real*	0…65535	-	-
62.98	Data set 3 data 1 value	*Real*	0…65535	-	-
62.99	Data set 3 data 2 value	*Real*	0…65535	-	-
62.100	Data set 3 data 3 value	*Real*	0…65535	-	-
62.101	Data set 10 data 1 value	*Real*	0…65535	-	-
62.102	Data set 10 data 2 value	*Real*	0…65535	-	-
62.103	Data set 10 data 3 value	*Real*	0…65535	-	-
62.104	Data set 12 data 1 value	*Real*	0…65535	-	-
62.105	Data set 12 data 2 value	*Real*	0…65535	-	-
62.106	Data set 12 data 3 value	*Real*	0…65535	-	-
62.107	Data set 14 data 1 value	*Real*	0…65535	-	-
62.108	Data set 14 data 2 value	*Real*	0…65535	-	-
62.109	Data set 14 data 3 value	*Real*	0…65535	-	-
62.110	Data set 16 data 1 value	*Real*	0…65535	-	-
62.111	Data set 16 data 2 value	*Real*	0…65535	-	-
62.112	Data set 16 data 3 value	*Real*	0…65535	-	-

No.	Name	Type	Range	Unit	FbEq32
62.113	Data set 18 data 1 value	*Real*	0…65535	-	-
62.114	Data set 18 data 2 value	*Real*	0…65535	-	-
62.115	Data set 18 data 3 value	*Real*	0…65535	-	-
62.116	Data set 20 data 1 value	*Real*	0…65535	-	-
62.117	Data set 20 data 2 value	*Real*	0…65535	-	-
62.118	Data set 20 data 3 value	*Real*	0…65535	-	-
62.119	Data set 22 data 1 value	*Real*	0…65535	-	-
62.120	Data set 22 data 2 value	*Real*	0…65535	-	-
62.121	Data set 22 data 3 value	*Real*	0…65535	-	-
62.122	Data set 24 data 1 value	*Real*	0…65535	-	-
62.123	Data set 24 data 2 value	*Real*	0…65535	-	-
62.124	Data set 24 data 3 value	*Real*	0…65535	-	-
(Parameters 62.151…62.203 only visible with a BCU control unit)					
62.151	INU-LSU Data set 11 data 1 sel	*Real*	*List*	-	-
62.152	INU-LSU Data set 11 data 2 sel	*Real*	*List*	-	-
62.153	INU-LSU Data set 11 data 3 sel	*Real*	*List*	-	-
62.201	INU-LSU Data set 11 data 1 value	*Real*	0…65535	-	-
62.202	INU-LSU Data set 11 data 2 value	*Real*	0…65535	-	-
62.203	INU-LSU Data set 11 data 3 value	*Real*	0…65535	-	-
74 Speed matching					
74.01	Motor speed match	*Binary src*	-	-	1 = 1
74.02	Motor speed steady deviation level	*Real*	0.00 … 30000.00	rpm	1 = 1 rpm
74.03	Motor speed ramp deviation level	*Real*	0.00 … 30000.00	rpm	1 = 1 rpm
74.04	Speed match fault delay	*Real*	0… 30000	ms	1 = 1 ms
75 Hoist speed optimization					
75.01	Hoist speed optimization sel	*Binary src*	-	-	1 = 1
75.03	Motor base speed	*Real*	0.0 … 30000.0	rpm	1 = 1 rpm
75.04	Load margin	*Real*	0.0 … 100.0	%	10 = 1.0%
75.05	Load speed limit test	*Real*	-30000.00 … 30000.00	%	10 = 1.0%
75.06	Hold ramp	*Real*	0…10000	ms	1 = 1 ms
75.07	Load 0 up	*Real*	0.0 … 300.0	%	10 = 1.0%
75.08	Load 0 speed up	*Real*	0.0 … 3000.0	rpm	1 = 1 rpm
75.09	Load 1 up	*Real*	0.0 … 300.0	%	10 = 1.0%
75.10	Load1 speed up	*Real*	0.0 … 3000.0	rpm	1 = 1 rpm

No.	Name	Type	Range	Unit	FbEq32
75.11	Load 2 up	*Real*	0.0 … 300.0	%	10 = 1.0%
75.12	Load 2 speed up	*Real*	0.0 … 3000.0	rpm	1 = 1 rpm
75.13	Load 3 up	*Real*	0.0 … 300.0	%	10 = 1.0%
75.14	Load 3 speed up	*Real*	0.0 … 3000.0	rpm	1 = 1 rpm
75.15	Load 4 up	*Real*	0.0 … 300.0	%	10 = 1.0%
75.16	Load 4 speed up	*Real*	0.0 … 3000.0	rpm	1 = 1 rpm
75.17	Load 0 down	*Real*	0.0 … 300.0	%	10 = 1.0%
75.18	Load 0 speed down	*Real*	0.0 … 3000.0	rpm	1 = 1 rpm
75.19	Load 1 down	*Real*	0.0 … 300.0	%	10 = 1.0%
75.20	Load 1 speed down	*Real*	0.0 … 3000.0	rpm	1 = 1 rpm
75.21	Load 2 down	*Real*	0.0 … 300.0	%	10 = 1.0%
75.22	Load 2 speed down	*Real*	0.0 … 3000.0	rpm	1 = 1 rpm
75.23	Load 3 down	*Real*	0.0 … 300.0	%	10 = 1.0%
75.24	Load 3 speed down	*Real*	0.0 … 3000.0	rpm	1 = 1 rpm
75.25	Load 4 down	*Real*	0.0 … 300.0	%	10 = 1.0%
75.26	Load 4 speed down	*Real*	0.0 … 3000.0	rpm	1 = 1 rpm
75.27	Hoist efficiency up	*Real*	0.00...1.00	-	100 = 1
75.28	Hoist efficiency down	*Real*	0.00...1.00	-	100 = 1
75.29	Inertia up	*Real*	0.00...100.00	kgm^2	100 = 1 kgm^2
75.30	Inertia down	*Real*	0.00...100.00	kgm^2	100 = 1 kgm^2
75.31	Hoist nominal load	*Real*	0.0...32000.0	Tn	10 = 1 Tn
75.32	Hoist nominal speed	*Real*	0.00...1000.00	m/min	100 = 1 m/min
75.33	Hoist maximum speed	*Real*	0.00...1000.00	m/min	100 = 1 m/min
75.35	Motor Tmax/Tn	*Real*	0.00...10.00	-	100 = 1
75.36	Calculate load curve	*List*	0...1	-	-
75.38	Load filter time	*Real*	0...30000	ms	1 = 1 ms
75.40	Relative hoist load	*Real*	-	%	100 = 1%
75.41	Absolute hoist load	*Real*	-	Tn	100 = 1 Tn
75.42	Relative hoist load filtered	*Real*	-	%	100 = 1%
75.43	Absolute hoist load filtered	*Real*	-	Tn	100 = 1 Tn
Parameters 75.50...75.55 are visible only when user lock is open with pass code 584. See parameter 96.02 Pass code.					
75.50	Inertia acceleration torque up	*Real*	-	-	-
75.51	Load acceleration torque up	*Real*	-	-	-
75.52	Acceleration torque up	*Real*	-	-	-
75.53	Inertia acceleration torque down	*Real*	-	-	-
75.54	Load acceleration torque down	*Real*	-	-	-
75.55	Acceleration torque down	*Real*	-	-	-
75.60	Slack rope enable	*Real*	0...2	-	1 = 1
75.61	Slack rope load level	*Real*	-400.00...400.00	%	100 = 1%

No.	Name	Type	Range	Unit	FbEq32
Parameters 75.70...75.80 are visible only when user lock is open with pass code 584. See parameter 96.02 Pass code.					
75.70	Start lifetime monitor	*Bit pointer*	0 ... 1	-	1 = 1
75.71	Crane lifetime	*Real*	0 ... 10000	h	1 = 1 h
75.72	Reset load spectrum	*List*	0 ... 1	-	1 = 1
75.73	Preset value of load spectrum	*Real*	0 ... 10	-	1 = 1
75.74	Lifetime speed scaling	*Real*	0 ... 200	%	1 = 1%
75.75	Lifetime factor	*Real*	0.000 ... 2.000	-	1000 = 1
75.80	Lifetime used	*Real*	0 ... 10000	-	1 = 1
75.81	Load at stop	*Bit pointer*	0 ... 1	-	1 = 1
76 Conical motor					
76.01	Conical control	*Binary src*	-	-	1 = 1
76.02	Start flux level	*Real*	0…150	%	1 = 1%
76.03	Stop flux level	*Real*	0…100	%	1 = 1%
76.04	Start flux hold time	*Real*	0…10000	ms	1 = 1 ms
76.05	Flux ramp up time	*Real*	0…10000	ms	1 = 1 ms
76.06	Flux ramp down time	*Real*	0…10000	ms	1 = 1 ms
77 Antisway					
77.01	Antisway enable	*Bit pointer*	-	-	1 = 1
77.02	Enable auto on function	*Bit pointer*	-	-	1 = 1
77.03	Auto on at maximum pendulum	*Real*	0...100	m	1 = 1 m
77.04	Auto on a minimum pendulum	*Real*	0...100	m	1 = 1 m
77.05	Antisway enable minimum speed	*Real*	0...32000	rpm	
77.06	Antisway enable in slowdown	*List*	0...1	-	1 = 1
77.07	Sway tracking enable	*Bit pointer*	-	-	1 = 1
77.08	Antisway ramp time	*Real*	0...1800	s	100 = 1 s
77.09	Antisway gain	DINT	1.00...5.00	-	100 - 1
77.10	Short rope mode enable	*Bit pointer*	-	-	-
77.11	Antisway timeout	*Real*	0...32000	s	1 = 1
Parameter 77.15 is visible only when user lock is open with pass code 584. See parameter 96.02 Pass code.					
77.15	Lock antisway in hoist	*Bit pointer*	-	-	-
77.20	Pendulum length source	Val pointer	-	-	-
77.21	Active length from source	*Real*	-	-	-
77.22	Up position swing time	*Real*	1...20	s	100 = 1 s

No.	Name	Type	Range	Unit	FbEq32
77.23	Up position length value	*Real*	-32768...32768	-	1 = 1
77.24	Down position swing time	*Real*	1...20	s	1 = 1 s
77.25	Down position length value	*Real*	-32768...32768	-	1 = 1
77.26	Maximum pendulum length	*Real*	1.000...100.000	m	1000 = 1 m
77.27	Pendulum arm length	*Real*	0.00...100.00	m	100 = 1 m
77.30	Load signal source	Val pointer	-	%	-
77.31	Active load	*Real*	0.00...300.00	%	100 = 1%
77.33	Step1 source	*Bit pointer*	-	-	-
77.34	Step2 source	*Bit pointer*	-	%	-
77.35	Step3 source	*Bit pointer*	-	%	-
77.36	Load step1	*Real*	0...300	%	100 = 1%
77.37	Load step2	*Real*	0...300	%	100 = 1%
77.38	Load step3	*Real*	0...300	%	100 = 1%
77.39	Step offset1	*Real*	0...100	m	1 = 1 m
77.40	Step offset2	*Real*	0...100	m	1 = 1 m
77.41	Step offset3	*Real*	0.00...100.00	m	1 = 1 m
77.42	Active step offset	*Real*	0.00...100.00	m	100 = 1 m
77.50	Load offset min	*Real*	0.00...100.00	m	100 = 1 m
77.51	Load offset max	*Real*	0...100	m	1 = 1
77.52	Load min	*Real*	0...300	%	
77.53	Load max	*Real*	0...300	%	1 = 1
77.54	Active linear offset	*Real*	-	m	100 = 1 m
77.56	Auto offset enable	*Bit pointer*	-	-	-
77.57	Full pendulum arm	*Real*	0.00...100.00	m	1 = 1 m
77.58	Load minimum in auto mode	*Real*	0.00...300.00	%	1 = 1 %
77.60	Active auto offset	*Real*	0.00...100.00	m	100 = 1 m
77.65	Direct offset source	Val pointer	-	-	-
77.67	Active direct offset	*Real*	-	-	-
77.69	Total pendulum offset	*Real*	-	-	-
77.70	Total pendulum arm length	*Real*	-	-	-
77.71	Antisway status	Word	-	-	-
77.72	Speed ref into antisway	*Real*	-30000.00...30000.00	rpm	100 = 1 rpm
77.73	Speed ref from antisway	*Real*	-30000.00...30000.00	rpm	100 = 1 rpm
77.75	Pendulum angle	*Real*	-	-	-
77.76	Pendulum time constant	*Real*	-	-	-
77.80	Load to antisway selection	Val pointer	-	-	-

No.	Name	Type	Range	Unit	FbEq32
77.81	Hoist load from torque act	*Real*	0.00...300.00	%	100 = 1%
77.82	Hoist load to antisway	*Real*	-	-	-
77.91	Hoist pos fba int	*INT16*	-32768...-32767	-	1 = 1
77.92	Hoist load fba int	*INT16*	-32768...-32767	-	1 = 1
82 Synchro control					
82.01	Synchro control	*Bit pointer*	-	-	1 = 1
82.02	Synchro sel	*Bit pointer*	0…150	%	1 = 1%
82.03	Sync corr mode	*List*	0...1	-	1 = 1
82.04	Sync gain	*Real*	0.00...100.00	-	100 = 1
82.05	Position corr limit	*Real*	0.00...100.00	mm	100 = 1 mm
82.06	Sync corr scale	*Real*	0.00...100.00	rpm/mm	100 = 1 rpm/ mm
82.07	Sync err limit	*Real*	0.00...100.00	mm	100 = 1 mm
82.08	Sync err fault delay	*Real*	0...100	s	1 = 1 s
82.09	Position hysteresis	*Real*	0.00...50.00	mm	100 = 1 mm
82.11	Synchro sw	*PB*	-	-	-
82.20	Act position error	*Real*	-	mm	-
82.21	Master position	*Real*	-	mm	-
82.22	Offset value	*Real*	-	mm	-
82.23	Correction speed ref	*Real*	-	rpm	-
82.24	Master linear speed ref	*Real*	-	mm/min	-
82.25	Actual linear speed ref	*Real*	-	mm/min	-
90 Feedback selection					
90.01	Motor speed for control	*Real*	-32768.00 … 32767.00	rpm	100 = 1 rpm
90.02	Motor position	*Real*	0.00000000 … 1.00000000	rev	100000000 = 1 rev
90.03	Load speed	*Real*	-32768.00 … 32767.00	rpm	100 = 1 rpm
90.04	Load position	*Real*	-2147483648 … 2147483647	-	1 = 1
90.05	Load position scaled	*Real*	-2147483.648 … 2147483.647	-	100000 = 1
90.06	Motor position scaled	*Real*	-2147483.648 … 2147483.647	-	1000 = 1
90.07	Load position scaled int	*Real*	-2147483648 … 2147483647	-	1 = 1
90.10	Encoder 1 speed	*Real*	-32768.00 … 32767.00	rpm	100 = 1 rpm
90.11	Encoder 1 position	*Real*	0.00000000 … 1.00000000	rev	100000000 = 1 rev
90.12	Encoder 1 multiturn revolutions	*Real*	0…16777215	-	1 = 1
90.13	Encoder 1 revolution extension	*Real*	-2147483648 … 2147483647	-	1 = 1
90.14	Encoder 1 position raw	*Real*	0…16777215	-	1 = 1

No.	Name	Type	Range	Unit	FbEq32
90.15	Encoder 1 revolutions raw	*Real*	0…16777215	-	1 = 1
90.20	Encoder 2 speed	*Real*	-32768.00 … 32767.00	rpm	100 = 1 rpm
90.21	Encoder 2 position	*Real*	0.00000000 … 1.00000000	rev	100000000 = 1 rev
90.22	Encoder 2 multiturn revolutions	*Real*	0…16777215	-	1 = 1
90.23	Encoder 2 revolution extension	*Real*	-2147483648 … 2147483647	-	1 = 1
90.24	Encoder 2 position raw	*Real*	0…16777215	-	1 = 1
90.25	Encoder 2 revolutions raw	*Real*	0…16777215	-	1 = 1
90.26	Motor revolution extension	*Real*	-2147483648 … 2147483647	-	1 = 1
90.27	Load revolution extension	*Real*	-2147483648 … 2147483647	-	1 = 1
90.35	Pos counter status	*PB*	000000b…111111b	-	1 = 1
90.38	Pos counter decimals	*List*	0…9	-	1 = 1
90.41	Motor feedback selection	*List*	0…2	-	1 = 1
90.42	Motor speed filter time	*Real*	0…10000	ms	1 = 1 ms
90.43	Motor gear numerator	*Real*	-32768…32767	-	1 = 1
90.44	Motor gear denominator	*Real*	-32768…32767	-	1 = 1
90.45	Motor feedback fault	*List*	0…1	-	1 = 1
90.46	Force open loop	*List*	0…1	-	1 = 1
90.48	Motor position axis mode	*List*	0…1	-	1 = 1
90.49	Motor position resolution	*Real*	0…31	-	1 = 1
90.51	Load feedback selection	*List*	0…4	-	1 = 1
90.52	Load speed filter time	*Real*	0…10000	ms	1 = 1 ms
90.53	Load gear numerator	*Real*	-2147483648 … 2147483647	-	1 = 1
90.54	Load gear denominator	*Real*	-2147483648 … 2147483647	-	1 = 1
90.55	Load feedback fault	*List*	0…1	-	1 = 1
90.56	Load position offset	*Real*	-2147483648 … 2147483647	rev	1 = 1 rev
90.57	Load position resolution	*Real*	0…31	-	1 = 1
90.58	Pos counter init value int	*Real*	-2147483648 … 2147483647	-	1 = 1
90.59	Pos counter init value int source	*Binary src*	-	-	1 = 1
90.60	Pos counter error and boot action	*List*	0…1	-	1 = 1
90.61	Gear numerator	*Real*	-2147483648 … 2147483647	-	1 = 1
90.62	Gear denominator	*Real*	-2147483648 … 2147483647	-	1 = 1
90.63	Feed constant numerator	*Real*	-2147483648 … 2147483647	-	1 = 1

No.	Name	Type	Range	Unit	FbEq32
90.64	Feed constant denominator	*Real*	-2147483648 … 2147483647	-	1 = 1
90.65	Pos counter init value	*Real*	-2147483.648 … 2147483.647	-	1 = 1
90.66	Pos counter init value source	*Binary src*	-	-	1 = 1
90.67	Pos counter init cmd source	*Binary src*	-	-	1 = 1
90.68	Disable pos counter initialization	*Binary src*	-	-	1 = 1
90.69	Reset pos counter init ready	*Binary src*	-	-	1 = 1
90.200	Position counter init source	*Bit pointer*	0...1	-	1 = 1
90.201	Position counter init method	*List*	0...1	-	1 = 1
90.202	Position counter init sw	*PB*	-	-	-
91 Encoder module settings					
91.01	FEN DI status	*PB*	000000b…111111b	-	1 = 1
91.02	Module 1 status	*List*	-	-	1 = 1
91.03	Module 2 status	*List*	-	-	1 = 1
91.04	Module 1 temperature	*Real*	0…1000	°C, °F or ohm	1 = 1 unit
91.06	Module 2 temperature	*Real*	0…1000	°C, °F or ohm	1 = 1 unit
91.10	Encoder parameter refresh	*List*	0…1	-	1 = 1
91.11	Module 1 type	*List*	0…4	-	1 = 1
91.12	Module 1 location	*Real*	1…254	-	1 = 1
91.13	Module 2 type	*List*	0…4	-	1 = 1
91.14	Module 2 location	*Real*	1…254	-	1 = 1
91.21	Module 1 temp sensor type	*List*	0…2	-	1 = 1
91.22	Module 1 temp filter time	*Real*	0…10000	ms	1 = 1 ms
91.24	Module 2 temp sensor type	*List*	0…2	-	1 = 1
91.25	Module 2 temp filter time	*Real*	0…10000	ms	1 = 1 ms
91.31	Module 1 TTL output source	*List*	0…2	-	1 = 1
91.32	Module 1 emulation pulses/rev	*Real*	0…65535	-	1 = 1
91.33	Module 1 emulated Z-pulse offset	*Real*	0.00000 … 1.00000	rev	100000 = 1 rev
91.41	Module 2 TTL output source	*List*	0…2	-	1 = 1
91.42	Module 2 emulation pulses/rev	*Real*	0…65535	-	1 = 1
91.43	Module 2 emulated Z-pulse offset	*Real*	0.00000 … 1.00000	rev	100000 = 1 rev
92 Encoder 1 configuration					
92.01	Encoder 1 type	*List*	0…7	-	1 = 1
92.02	Encoder 1 source	*List*	1…2	-	1 = 1

No.	Name	Type	Range	Unit	FbEq32
Other parameters in this group when a TTL, TTL+ and HTL encoder is selected (92.16, 92.17, 92.23…92.25 visible depending on encoder type selection)					
92.10	Pulses/revolution	*Real*	0…65535	-	1 = 1
92.11	Pulse encoder type	*List*	0…1	-	1 = 1
92.12	Speed calculation mode	*List*	0…5	-	1 = 1
92.13	Position estimation enable	*List*	0…1	-	1 = 1
92.14	Speed estimation enable	*List*	0…1	-	1 = 1
92.15	Transient filter	*List*	0…3	-	1 = 1
92.16	Encoder 1 supply voltage	*List*	0…2	-	1 = 1
92.17	Accepted pulse freq of encoder 1	*Real*	0…300	kHz	1 = 1 kHz
92.21	Encoder cable fault mode	*List*	0…3	-	1 = 1
92.23	Maximum pulse waiting time	*Real*	1…200	ms	1 = 1 ms
92.24	Pulse edge filtering	*List*	0…2	-	1 = 1
92.25	Pulse overfrequency function	*List*	0…1	-	1 = 1
Other parameters in this group when an absolute encoder is selected					
92.10	Sine/cosine number	*Real*	0…65535	-	1 = 1
92.11	Absolute position source	*List*	0…5	-	1 = 1
92.12	Zero pulse enable	*List*	0…1	-	1 = 1
92.13	Position data width	*Real*	0…32	-	1 = 1
92.14	Revolution data width	*Real*	0…32	-	1 = 1
92.30	Serial link mode	*List*	0…2	-	1 = 1
92.31	EnDat max calculation time	*List*	0…3	-	1 = 1
92.32	SSI cycle time	*List*	0…5	-	1 = 1
92.33	SSI clock cycles	*Real*	2…127	-	1 = 1
92.34	SSI position msb	*Real*	1…126	-	1 = 1
92.35	SSI revolution msb	*Real*	1…126	-	1 = 1
92.36	SSI data format	*List*	0…1	-	1 = 1
92.37	SSI baud rate	*List*	0…5	-	1 = 1
92.40	SSI zero phase	*List*	0…3	-	1 = 1
92.45	Hiperface parity	*List*	0…1	-	1 = 1
92.46	Hiperface baud rate	*List*	0…3	-	1 = 1
92.47	Hiperface node address	*Real*	0…255	-	1 = 1
Other parameters in this group when a resolver is selected					
92.10	Excitation signal frequency	*Real*	1…20	kHz	1 = 1 kHz
92.11	Excitation signal amplitude	*Real*	4.0 … 12.0	V	10 = 1 V
92.12	Resolver polepairs	*List*	1…32	-	1 = 1
93 Encoder 2 configuration					
93.01	Encoder 2 type	*List*	0...7	-	1 = 1
93.02	Encoder 2 source	*List*	1…2	-	1 = 1

No.	Name	Type	Range	Unit	FbEq32
Other parameters in this group when a TTL, TTL+ and HTL encoder is selected (93.16, 93.17, 93.23…93.25 visible depending on encoder type selection)					
93.10	Pulses/rev	*Real*	0…65535	-	1 = 1
93.11	Pulse encoder type	*List*	0…1	-	1 = 1
93.12	Speed calculation mode	*List*	0…5	-	1 = 1
93.13	Position estimation enable	*List*	0…1	-	1 = 1
93.14	Speed estimation enable	*List*	0…1	-	1 = 1
93.15	Transient filter	*List*	0…3	-	1 = 1
93.16	Encoder 2 supply voltage	*List*	0…2	-	1 = 1
93.17	Accepted pulse freq of encoder 2	*Real*	0…300	kHz	1 = 1 kHz
93.21	Encoder cable fault mode	*List*	0…3	-	1 = 1
93.23	Maximum pulse waiting time	*Real*	1…200	ms	1 = 1 ms
93.24	Pulse edge filtering	*List*	0…2	-	1 = 1
93.25	Pulse overfrequency function	*List*	0…1	-	1 = 1
Other parameters in this group when an absolute encoder is selected					
93.10	Sine/cosine number	*Real*	0…65535	-	1 = 1
93.11	Absolute position source	*List*	0…5	-	1 = 1
93.12	Zero pulse enable	*List*	0…1	-	1 = 1
93.13	Position data width	*Real*	0…32	-	1 = 1
93.14	Revolution data width	*Real*	0…32	-	1 = 1
93.30	Serial link mode	*List*	0…2	-	1 = 1
93.31	EnDat calc time	*List*	0…3	-	1 = 1
93.32	SSI cycle time	*List*	0…5	-	1 = 1
93.33	SSI clock cycles	*Real*	2…127	-	1 = 1
93.34	SSI position msb	*Real*	1…126	-	1 = 1
93.35	SSI revolution msb	*Real*	1…126	-	1 = 1
93.36	SSI data format	*List*	0…1	-	1 = 1
93.37	SSI baud rate	*List*	0…5	-	1 = 1
93.40	SSI zero phase	*List*	0…3	-	1 = 1
93.45	Hiperface parity	*List*	0…1	-	1 = 1
93.46	Hiperface baud rate	*List*	0…3	-	1 = 1
93.47	Hiperface node address	*Real*	0…255	-	1 = 1
Other parameters in this group when a resolver is selected					
93.10	Excitation signal frequency	*Real*	1…20	kHz	1 = 1 kHz
93.11	Excitation signal amplitude	*Real*	4.0 … 12.0	V	10 = 1 V
93.12	Resolver polepairs	*List*	1…32	-	1 = 1
94 LSU control					
(This group is visible only with a BCU control unit)					
94.01	LSU control	*List*	0…1	-	1 = 1
94.10	LSU max charging time	*Real*	0…65535	s	1 = 1 s
94.11	LSU stop delay	*Real*	0.0 … 3600.0	s	10 = 1 s

No.	Name	Type	Range	Unit	FbEq32
94.20	DC voltage reference	*Real*	0.0 … 2000.0	V	10 = 1 V
94.21	DC voltage ref source	*List*	-	-	1 = 1
94.22	User DC voltage reference	*Real*	0.0 … 2000.0	V	10 = 1 V
94.30	Reactive power reference	*Real*	-3276.8 … 3276.7	kvar	10 = 1 kvar
94.31	Reactive power ref source	*List*	-	-	1 = 1
94.32	User reactive power reference	*Real*	-3276.8 … 3276.7	kvar	10 = 1 kvar
95 HW configuration					
95.01	Supply voltage	*List*	0…6	-	1 = 1
95.02	Adaptive voltage limits	*List*	0…1	-	1 = 1
95.04	Control board supply	*List*	0…2	-	1 = 1
95.08	DC switch monitoring	*List*	0…1	-	1 = 1
95.15	Special HW settings	*PB*	0000h…FFFFh	-	1 = 1
95.20	HW options word 1	*PB*	0000h…FFFFh	-	1 = 1
95.21	HW options word 2	*PB*	0000h…FFFFh	-	1 = 1
96 System					
96.01	Language	*List*	-	-	1 = 1
96.02	Pass code	*Data*	0…99999999	-	1 = 1
96.03	Access levels active	*PB*	0000h…FFFFh	-	1 = 1
Parameter 96.06 is visible when only user lock is open with pass code 584. See parameter 96.02 Pass code.					
96.06	Parameter restore	*List*	-	-	1 = 1
96.07	Parameter save manually	*List*	0…1	-	1 = 1
96.08	Control board boot	*Real*	0…1	-	1 = 1
96.09	FSO reboot	*Binary src*	-	-	-
96.10	User set status	*List*	-	-	-
96.11	User set save/load	*List*	-	-	-
96.12	User set I/O mode in1	*Binary src*	-	-	-
96.13	User set I/O mode in2	*Binary src*	-	-	-
96.16	Unit selection	*PB*	0000h…FFFFh	-	1 = 1
96.20	Time synch primary source	*List*	0…9	-	1 = 1
96.23	M/F and D2D clock synchronization	*List*	0…1	-	1 = 1
96.24	Full days since 1st Jan 1980	*Real*	1…59999	-	1 = 1
96.25	Time in minutes within 24 h	*Real*	0…1439	-	1 = 1
96.26	Time in ms within one minute	*Real*	0…59999	-	1 = 1
96.29	Time sync source status	*PB*	0000h…FFFFh	-	1 = 1
96.31	Drive ID number	*Real*	0…32767	-	1 = 1
96.53	Actual checksum	*Real*	00000000h…FFFFFFFFh	-	1 = 1
96.54	Checksum action	*List*	0…4	-	1 = 1
96.55	Checksum control word	*PB*	0000h…FFFFh	-	1 = 1

No.	Name	Type	Range	Unit	FbEq32
96.56	Approved checksum 1	*Real*	00000000h…FFFFFFFFh	-	1 = 1
96.57	Approved checksum 2	*Real*	00000000h…FFFFFFFFh	-	1 = 1
96.58	Approved checksum 3	*Real*	00000000h…FFFFFFFFh	-	1 = 1
96.59	Approved checksum 4	*Real*	00000000h…FFFFFFFFh	-	1 = 1
96.61	User data logger status word	*PB*	0000h…FFFFh	-	1 = 1
96.63	User data logger trigger	*Binary src*	-	-	-
96.64	User data logger start	*Binary src*	-	-	-
96.65	Factory data logger time level	*List*	-	-	1 = 1
96.70	Disable adaptive program	*List*	0…1	-	1 = 1
(Parameters 96.100…96.102 visible only when enabled by parameter 96.02)					
96.100	Change user pass code	*Data*	10000000…99999999	-	1 = 1
96.101	Confirm user pass code	*Data*	10000000…99999999	-	1 = 1
96.102	User lock functionality	*PB*	0000h…FFFFh	-	1 = 1
97 Motor control					
97.03	Slip gain	*Real*	0…200	%	1 = 1%
97.04	Voltage reserve	*Real*	-4…50	%	1 = 1%
97.05	Flux braking	*List*	0…2	-	1 = 1
Parameters 97.06...97.07 are visible only when user lock is open with pass code 584. See parameter 96.02 Pass code.					
97.06	Flux reference select	*Binary src*	-	-	1 = 1
97.07	User flux reference	*Real*	0.00 … 200.00	%	100 = 1%
97.09	Switching freq mode	*List*	0…3	-	1 = 1
97.10	Signal injection	*List*	0…4	-	1 = 1
97.11	TR tuning	*Real*	25…400	%	1 = 1%
97.12	IR comp step-up frequency	*Real*	0.0 … 50.0	Hz	10 = 1 Hz
97.13	IR compensation	*Real*	0.00 … 50.00	%	100 = 1%
97.15	Motor model temperature adaptation	*List*	0…3	-	1 = 1
97.32	Motor torque unfiltered	*Real*	-1600.0 … 1600.0	%	10 = 1%
97.33	Speed estimate filter time	*Real*	0.00 … 100.00	ms	100 = 1 ms
98 User motor parameters					
98.01	User motor model mode	*List*	0…3	-	1 = 1
98.02	Rs user	*Real*	0.0000 … 0.50000	p.u.	100000 = 1 p.u.
98.03	Rr user	*Real*	0.0000 … 0.50000	p.u.	100000 = 1 p.u.
98.04	Lm user	*Real*	0.00000 … 10.00000	p.u.	100000 = 1 p.u.
98.05	SigmaL user	*Real*	0.00000 … 1.00000	p.u.	100000 = 1 p.u.

No.	Name	Type	Range	Unit	FbEq32
98.06	Ld user	*Real*	0.00000 … 10.00000	p.u.	100000 = 1 p.u.
98.07	Lq user	*Real*	0.00000 … 10.00000	p.u.	100000 = 1 p.u.
98.08	PM flux user	*Real*	0.00000 … 2.00000	p.u.	100000 = 1 p.u.
98.09	Rs user SI	*Real*	0.00000 … 100.00000	ohm	100000 = 1 p.u.
98.10	Rr user SI	*Real*	0.00000 … 100.00000	ohm	100000 = 1 p.u.
98.11	Lm user SI	*Real*	0.00 … 100000.00	mH	100 = 1 mH
98.12	SigmaL user SI	*Real*	0.00 … 100000.00	mH	100 = 1 mH
98.13	Ld user SI	*Real*	0.00 … 100000.00	mH	100 = 1 mH
98.14	Lq user SI	*Real*	0.00 … 100000.00	mH	100 = 1 mH
98.15	Position offset user	*Real*	0…360	degrees electrical	1 = 1 deg
99 Motor data					
99.03	Motor type	*List*	0…1 or 0...2	-	1 = 1
99.04	Motor control mode	*List*	0…1	-	1 = 1
99.06	Motor nominal current	*Real*	0.0 … 32767.0	A	10 = 1 A
99.07	Motor nominal voltage	*Real*	0.0 … 32767.0	V	10 = 1 V
99.08	Motor nominal frequency	*Real*	0.00 … 500.00	Hz	10 = 1 Hz
99.09	Motor nominal speed	*Real*	0 … 30000	rpm	1 = 1 rpm
99.10	Motor nominal power	*Real*	0.00 … 10000.00 kW or 0.00 … 13404.83 hp	kW or hp	100 = 1 unit
99.11	Motor nominal cos Φ	*Real*	0.00 … 1.00	-	100 = 1
99.12	Motor nominal torque	*Real*	0.000 …	N·m or lb·ft	1000 = 1 unit
99.13	ID run requested	*List*	0…7	-	1 = 1
99.14	Last ID run performed	*List*	0…7	-	1 = 1
99.15	Motor polepairs calculated	*Real*	0…1000	-	1 = 1
99.16	Motor phase order	*List*	0…1	-	1 = 1
200 Safety					
This group contains parameters related to the optional FSO-xx safety functions module. For details on the parameters in this group, refer to the documentation of the FSO-xx module.					

9

Fault tracing

Contents of this chapter

This 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 is 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 *142*)
- *Programmable relay outputs* (page *143*), and
- *Programmable I/O extensions* (page *143*).

Pure events

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

Warning/fault history and analysis

Event logs

The drive has two event logs that can be accessed from the main Menu on the control panel. The logs can also be accessed (and reset) using the Drive composer PC tool.

One log contains faults and fault resets. The other log lists warnings and pure events, as well as clearing entries. Both logs contain 32 most recent events. All indications are stored in the event logs with a time stamp and other information.

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. Approximately 7000 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 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 memory 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 *208*). 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*.)
A2B1	Overcurrent	Output current has exceeded internal fault limit.	Check motor load. . Also check parameters *46.01 Speed scaling*, *46.02 Frequency scaling* and *46.03 Torque scaling*. Check motor and motor cable (including phasing and delta/star connection). Check there are no contactors opening and closing in motor cable. Check that the start-up data in parameter group 99 corresponds to the motor rating plate. Check that there are no power factor correction capacitors or surge absorbers in motor cable. Check encoder cable (including phasing).
A2B3	Earth leakage	Drive has detected load unbalance typically due to earth fault in motor or motor cable.	Check there are no power factor correction capacitors or surge absorbers in motor cable. Check for an earth fault in motor or motor cables by measuring the insulation resistances of motor and motor cable. Try running the motor in scalar control mode if allowed. (See parameter *99.04 Motor control mode*.) If no earth fault can be detected, contact your local ABB representative.
A2B4	Short circuit	Short-circuit in motor cable(s) or motor.	Check motor and motor cable for cabling errors. Check there are no power factor correction capacitors or surge absorbers in motor cable.
A2BA	IGBT overload	Excessive IGBT junction to case temperature. This warning protects the IGBT(s) and can be activated by a short circuit in the motor cable.	Check motor cable. Check ambient conditions. Check air flow and fan operation. Check heatsink fins for dust pick-up. Check motor power against drive power.

Code (hex)	Warning	Cause	What to do
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. With A3A1 or A3A2 on parallel-connected inverter modules, the auxiliary code indicates the affected module. The format of the code is 000X XX00, where “XXX” specifies the channel on the BCU control unit. 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	Sensor type mismatch	Check the settings of temperature source parameters *35.11* and *35.21* against *91.21* and *91.24*.
		Faulty wiring between an encoder interface module and the temperature sensor.	Check the wiring of the sensor. The auxiliary code identifies the interface module. (0 = Module 1, 1 = Module 2).
A491	External temperature 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.
	(none)	Temperature above warning limit	Check ambient conditions. Check air flow and fan operation. Check heatsink fins for dust pick-up.

Code (hex)	Warning	Cause	What to do
	1	Thermistor broken	Contact an ABB service representative for control unit replacement.
A4A1	IGBT overtemperature	Estimated drive IGBT temperature is excessive.	Check ambient conditions. Check air flow and fan operation. Check heatsink fins for dust pick-up. Check motor power against drive power.
A4A9	Cooling	Drive module temperature is excessive.	Check ambient temperature. If it exceeds 40 °C (104 °F), ensure that load current does not exceed derated load capacity of drive. See appropriate *Hardware manual.* Check drive module cooling air flow and fan operation. Check inside of cabinet and heatsink of drive module for dust pick-up. Clean whenever necessary.
A4B0	Excess temperature	Power unit module temperature is excessive.	Check ambient conditions. Check air flow and fan operation. Check heatsink fins for dust pick-up. Check motor power against drive power. Check the auxiliary code (format XXXY YYZZ). “Y YY” specifies through which BCU control unit channel the fault was received. “ZZ” specifies the location (**1:** U-phase, **2:** V-phase, **3:** W-phase, **4:** INT board, **5:** Brake chopper, **6:** Air inlet, **7:** Power supply board, **8:** du/dt filter (R8i) or temperature switch (XT), **0FA:** Ambient temperature).
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). With parallel-connected modules, “Y YY” specifies through which BCU control unit channel the fault was received. “ZZ” specifies the phase (**0:** single module, **1:** U-phase [parallel connection], **2:** W-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).
A581	Fan	Cooling fan feedback is missing.	Check the setting of parameter *95.20 HW options word 1*, bit 14. Check the auxiliary code to identify the fan. Code **0** denotes main fan 1. Other codes (format XYZ): “X” specifies state code (**1:** ID run, **2:** normal). “Y” specifies the index of the inverter unit 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). Check fan operation and connection. Replace fan if faulty.
A582	Auxiliary fan missing	An auxiliary cooling fan (connected to the fan connectors on the control unit) is stuck or disconnected.	The auxiliary code identifies the fan (**1**: Auxiliary fan 1, **2**: Auxiliary fan 2). Check auxiliary fan(s) and connection(s). Replace faulty fan. Make sure the front cover of the drive module is in place and tightened. If the commissioning of the drive requires that the cover is off, this warning will be generated even if the corresponding fault is defeated. See fault *5081 Auxiliary fan broken* (page *606*).
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 *350*).
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 unit INT board, **5:** Brake chopper, **6:** Air inlet, **7:** Power supply board, **8:** du/dt filter, **FAh**: Air in temp).
A5EB	PU board powerfail	Power unit power supply failure.	Contact your local ABB representative.

Code (hex)	Warning	Cause	What to do
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 progress	Information 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.
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.	
A684	SD card	Error related to SD card used to store data (BCU control unit only).	Check the auxiliary code. See actions for each code below.
	1	No SD card	Insert a compatible, writable SD card into the SD CARD slot of the BCU control unit.
	2	SD card write-protected	
	3	SD card unreadable	
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.

Code (hex)	Warning	Cause	What to do
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	
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 *91*).
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 *91*).
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*.

Code (hex)	Warning	Cause	What to do
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*], **03** = torque reference chain [*26.11*, *26.12*, *26.16*], **04** = other torque-related parameters [*26.25*, *30.21*, *30.22*, *44.09*], “ZZ” indicates the conflicting reference source (**01…0E** = index in parameter group 3, **33** = process PID control, **3D** = motor potentiometer, **65** = AI1, **66** = AI2, **6F** = frequency input).
A6E5	AI parametrization	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).
	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*.

Code (hex)	Warning	Cause	What to do
A782	FEN temperature	Error in temperature measurement when temperature sensor (KTY or PTC) connected to encoder interface FEN-xx is used.	Check that parameter *35.11 Temperature 1 source* / *35.21 Temperature 2 source* setting corresponds to actual encoder interface installation.
		Error in temperature measurement when KTY sensor connected to encoder interface FEN-01 is used.	FEN-01 does not support temperature measurement with KTY sensor. Use PTC sensor or other encoder interface module.
A791	Brake resistor	Brake resistor broken or not connected.	Check that a brake resistor has been connected. Check the condition of the brake resistor.
A793	BR excess temperature	Brake resistor temperature has exceeded warning limit defined by parameter *43.12 Brake resistor warning limit*.	Stop drive. Let resistor cool down. Check resistor overload protection function settings (parameter group *43 Brake chopper*). Check warning limit setting, parameter *43.12 Brake resistor warning limit*. Check that the resistor has been dimensioned correctly. Check that braking cycle meets allowed limits.
A794	BR data	Brake resistor data has not been given.	One or more of the resistor data settings (parameters *43.08*…*43.10*) is incorrect. The parameter is specified by the auxiliary code.
	0000 0001	Resistance value too low.	Check value of *43.10*.
	0000 0002	Thermal time constant not given.	Check value of *43.08*.
	0000 0003	Maximum continuous power not given.	Check value of *43.09*.
A797	Speed feedback configuration	Speed feedback configuration has changed.	Check the auxiliary code (format XXYY ZZZZ). “XX” specifies the number of the encoder interface module (**01**: *91.11*/*91.12*, **02**: *91.13*/*91.14*), “YY” specifies the encoder (**01:** *92 Encoder 1 configuration*, **02:** *93 Encoder 2 configuration*). “ZZZZ” indicates the problem (see actions for each code below).
	0001	Adapter not found in specified slot.	Check module location (*91.12* or *91.14*).
	0002	Detected type of interface module does not match parameter setting.	Check the module type (*91.11* or *91.13*) against status (*91.02* or *91.03*).
	0003	Logic version too old.	Contact your local ABB representative.
	0004	Software version too old.	Contact your local ABB representative.
	0006	Encoder type incompatible with interface module type.	Check module type (*91.11* or *91.13*) against encoder type (*92.01* or *93.01*).
	0007	Adapter not configured.	Check module location (*91.12* or *91.14*).

Code (hex)	Warning	Cause	What to do
	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.
	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.
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.

Code (hex)	Warning	Cause	What to do
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.
A7A1	Mechanical brake closing failed Programmable warning: *44.17 Brake fault function*	Status of mechanical brake acknowledgement is not as expected during brake close.	Check mechanical brake connection. Check mechanical brake settings in parameter group *44 Mechanical brake control*. Check that acknowledgement signal matches actual status of brake.
A7A2	Mechanical brake opening failed Programmable warning: *44.17 Brake fault function*	Status of mechanical brake acknowledgement is not as expected during brake open.	Check mechanical brake connection. Check mechanical brake settings in parameter group *44 Mechanical brake control*. Check that acknowledgement signal matches actual status of brake.
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 parametrization	The hardware current/voltage setting of an analog input (on an I/O extension module) does not correspond to parameter settings.	Check the auxiliary code (format XX00 00YY). “XX” specifies the number of the I/O extension module (**01:** parameter group *14 I/O extension module 1*, **02:** *15 I/O extension module 2*, **03:** *16 I/O extension module 3*). “YY” specifies the analog input on the module. For example, in case of I/O extension module 1, analog input AI1 (auxiliary code 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.

Code (hex)	Warning	Cause	What to do
A7AB	Extension I/O configuration failure	The I/O extension module types and locations specified by parameters do not match the detected configuration.	Check the auxiliary code. The code indicates which I/O extension module is affected. Check the type and location settings of the modules (parameters *14.01*, *14.02*, *15.01*, *15.02*, *16.01* and *16.02*). Check that the modules are properly installed.
A7B0	Motor speed feedback Programmable warning: *90.45 Motor feedback fault*	No motor speed feedback is received.	Check the auxiliary code (format XXYY ZZZZ). “XX” specifies the number of the encoder interface module (**01**: *91.11*/*91.12*, **02**: *91.13*/*91.14*), “YY” specifies the encoder (**01:** *92 Encoder 1 configuration*, **02:** *93 Encoder 2 configuration*). “ZZZZ” indicates the problem (see actions for each code below).
	0001	Motor gear definition invalid or outside limits.	Check motor gear settings (*90.43* and *90.44*).
	0002	Encoder not configured.	Check encoder settings (*92 Encoder 1 configuration* or *93 Encoder 2 configuration*). Use parameter *91.10 Encoder parameter refresh*) to validate any changes in the settings.
	0003	Encoder stopped working.	Check encoder status.
	0004	Encoder drift detected.	Check for slippage between encoder and motor.
A7B1	Load speed feedback Programmable warning: *90.55 Load feedback fault*	No load speed feedback is received.	Check the auxiliary code (format XXYY ZZZZ). “XX” specifies the number of the encoder interface module (**01**: *91.11*/*91.12*, **02**: *91.13*/*91.14*), “YY” specifies the encoder (**01:** *92 Encoder 1 configuration*, **02:** *93 Encoder 2 configuration*). “ZZZZ” indicates the problem (see actions for each code below).
	0001	Load gear definition invalid or outside limits.	Check load gear settings (*90.53* and *90.54*).
	0002	Feed constant definition invalid or outside limits.	Check feed constant settings (*90.63* and *90.64*).
	0003	Encoder stopped working.	Check encoder status.
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.

Code (hex)	Warning	Cause	What to do
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.
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*. 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.

Code (hex)	Warning	Cause	What to do
	0009	Absolute encoder initialization error	Contact your local ABB representative.
	000A	Absolute SSI encoder configuration error	Contact your local ABB representative.
	000B	Encoder reported an internal error	See the documentation of the encoder.
	000C	Encoder reported a battery error	See the documentation of the encoder.
	000D	Encoder reported overspeed or decreased resolution due to overspeed	See the documentation of the encoder.
	000E	Encoder reported a position counter error	See the documentation of the encoder.
	000F	Encoder reported an internal error	See the documentation of the encoder.
A7EE	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*).

Code (hex)	Warning	Cause	What to do
A889	Edge counter 2 (Editable message text) Programmable warning: *33.45 Edge counter 2 warn message*	Warning generated by edge counter 2.	Check the source of the warning (parameter *33.43 Edge counter 2 source*).
A88A	Value counter 1 (Editable message text) Programmable warning: *33.55 Value counter 1 warn message*	Warning generated by value counter 1.	Check the source of the warning (parameter *33.53 Value counter 1 source*).
A88B	Value counter 2 (Editable message text) Programmable warning: *33.65 Value counter 2 warn message*	Warning generated by value counter 2.	Check the source of the warning (parameter *33.63 Value counter 2 source*).
A88C	Device clean	Warning generated by an on-time timer. Programmable warnings: *33.14 On-time 1 warn message* *33.24 On-time 2 warn message*	Check the auxiliary code. Check the source of the warning corresponding to the code: 0: *33.13 On-time 1 source* 1: *33.23 On-time 2 source* 10: *05.04 Fan on-time counter*.
A88D	DC capacitor		
A88E	Cabinet fan		
A88F	Cooling fan		
A890	Additional cooling		
A8A0	AI supervision Programmable warning: *12.03 AI supervision function*	An analog signal is outside the limits specified for the analog input.	Check 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*.
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*).

Code (hex)	Warning	Cause	What to do
A8BF	ULC underload warning Programmable fault: *37.04 ULC underload actions*	Selected signal has fallen below the user underload curve.	Check for any operating conditions decreasing the monitored signal (for example, loss of load if the torque or current is being monitored). Check the definition of the load curve (parameter group *37 User load curve*).
A8C0	Fan service counter	A cooling fan has reached the end of its estimated lifetime. See parameters *05.41* and *05.42*.	Check the auxiliary code. The code indicates which fan is to be replaced. 0: Main cooling fan 1:Auxiliary cooling fan 2:Auxiliary cooling fan 2 3:Cabinet cooling fan 4:PCB compartment fan Refer to the hardware manual of the drive for fan replacement instructions.
A981	External warning 1 (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.

Code (hex)	Warning	Cause	What to do
AF85	Line side unit warning	The supply unit has generated a warning.	If using a control panel or the Drive composer tool, connect to the supply unit to read the warning code. Refer to the firmware manual of the supply unit for instructions related to the code.
AF8C	Process PID sleep mode	The drive is entering sleep mode.	Informative warning.
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 *159*).
	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.
		(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.
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*.

Code (hex)	Warning	Cause	What to do
AFEB	Run enable missing	No run enable signal is received.	Check setting of parameter *20.12 Run enable 1 source*. Switch signal on (e.g. in the fieldbus Control Word) or check wiring of selected source.
AFEC	External power signal missing	*95.04 Control board supply* is set to *External 24V* but no voltage is connected to the XPOW connector of the control unit.	Check the external 24 V DC power supply to the control unit, or change the setting of parameter *95.04*.
AFF6	Identification run	Motor ID run will occur at next start, 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 *350*).
B5A4	SW internal diagnostics	Control unit rebooted unexpectedly.	Informative event.
B686	Checksum mismatch Programmable event: *96.54 Checksum action*	The calculated parameter checksum does not match any enabled reference checksum.	See *A686 Checksum mismatch* (page *587*).
D200	Brake slip at standstill2	Brake is slipping when the motor is not running.	Check the mechanical brake. Check the parameter settings in group *74 Speed matching*.
D201	Slowdown up	Slowdown command is active in the forward (up) direction based on the selection in parameter *20.200 Slowdown select*.	Run the motor in the opposite direction and deactivate the Slowdown command, or let the drive run with the limited speed reference.
D202	Slowdown down	Slowdown command is active in the reverse (down) direction based on the selection in parameter *20.200 Slowdown select*.	Run the motor in the opposite direction and deactivate the Slowdown command, or let the drive run with the limited speed reference.
D203	Hoist speed up limit	Hoist speed optimization function is limiting the speed reference in the forward direction.	Check the parameter settings in group *75 Hoist speed optimization*. Check the physical load condition and the motor current settings.
D204	Hoist speed down limit	Hoist speed optimization function is limiting the speed reference in the reverse direction.	Check the parameter settings in group *75 Hoist speed optimization*. Check the physical load condition and the motor current settings.
D205	Upper limit2	Upper limit command is active based on the selection in parameter *20.205 Upper limit*.	Check the wiring of the upper limit connection. Run the motor in the opposite direction and deactivate the Upper limit command.
D206	Lower limit2	Lower limit command is active based on the selection in parameter *20.206 Lower limit*.	Check the wiring of the lower limit connection. Run the motor in the opposite direction and deactivate the Lower limit command.

Code (hex)	Warning	Cause	What to do
D207	Wrong start sequence	Drive does not accept a start command because the drive is not ready for the following reasons: • The main power is switched off. • Fieldbus control bits are used in the wrong order. • The upper or lower limit is active.	Check and correct the possible causes for the warning, and then give the start command again.
D208	Joystick reference check	Speed reference is greater than +/- 10% of the minimum or maximum scaled value of the used joystick reference, the joystick zero position input (*20.214 Joystick zero position*) is active, and the delay defined with parameter *20.215 Joystick warning delay* has elapsed.	Check the wiring of the joystick zero position input. Check the wiring of the analog input reference signal of the joystick.
D209	Joystick zero position2	Drive does not accept a start command because of a wrong state of the joystick zero position input (*20.214 Joystick zero position*).	Check the wiring of the joystick zero position input.
D210	Toggle bit supervision wrn	Communication loss occurred between the overriding system and the drive. Time between two consecutive toggle bit rising edges from overriding system is longer than the time set in parameter *31.213 Toggle bit time delay*.	Check communication between overriding system and drive.
D211	Synchro sel mismatch	Parameter (*82.01 Synchro control*) settings are different in Master and Follower drives.	Check settings in parameter *82.01 Synchro control*. The settings should be same.
D212	Crane operating hours	Crane actual operating time (when brake was open) limit is more than the limit defined in parameter *33.202 Crane operation hrs warning limit*.	Do the required maintenance task. Reset the time counter with parameter *33.200 Set crane operation hours*.
D213	Brake oper counts	Number of times mechanical brake was open is more than the limit defined in parameter *33.212 Brake oper counts warning limit*.	Do the required maintenance task. Reset the brake operating counter with parameter *33.210 Set brake oper counts*.
D214	Number of power on	Number of times the drive was powered on is more than the limit defined in parameter *33.222 Number of pwr on warning limit*.	Do the required maintenance task. Reset the power on counter with parameter *33.220 Set number of power on*.
D215	Watchdog warning	Monitored condition detected and watchdog relay is activated	Check parameter *32.228 Watchdog trip sw*.
D216	Liftetime left less 10%	System lifetime is less than 10%.	Do the required maintenance task. Reset the maintenance counters.

Code (hex)	Warning	Cause	What to do
D217	Slack rope	Slack rope condition detected.	Check parameter settings. *75.70 Start lifetime monitor*
D20A	Fast stop	Fast stop command (*20.210 Fast stop input*) is activated.	Deactivate the Fast stop command.
D20B	Power on acknowledge	Power on acknowledge circuit is open.	Check the wiring and the setting of parameter *20.212 Power on acknowledge*.
D20C	Slowdown safe zone	Crane is operating within the safe zone limit. Slowdown function mode in parameter *20.200 Slowdown select* is set as *Single bit without direction*.	Check the source for activating the Slowdown command in parameter *20.201 Slowdown input 1*. Check the external circuit. See also section *Slowdown* on page *91*. Check parameter *31.205 Crane warning masking*, b2 for masking warning.
D20D	External speed limit2	External speed limits are active instead of the internal speed limits.	Check the source from parameter *30.200 External speed limits*. Check the external circuit. See also section *External speed limitation* on page *86*. Check parameter *31.205 Crane warning masking*, b5 for masking warnings.
D20E	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.
D20F	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.
E200	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.
E201	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.
E202	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.

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) and *26 Torque reference chain* (torque control). Also check parameters *31.42 Overcurrent fault limit*, *46.01 Speed scaling*, *46.02 Frequency scaling* and *46.03 Torque scaling*. Check motor and motor cable (including phasing and delta/star connection). Check there are no contactors opening and closing in motor cable. Check that the start-up data in parameter group 99 corresponds to the motor rating plate. Check that there are no power factor correction capacitors or surge absorbers in motor cable. Check encoder cable (including phasing). Check the auxiliary code (format XXXY YYZZ). With parallel-connected inverter modules, “Y YY” specifies through which BCU control unit channel the fault was received. “ZZ” indicates the phase that triggered the fault (**0:** No detailed information available, **1:** U-phase, **2:** V-phase, **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.	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. Check there are no power factor correction capacitors or surge absorbers in motor cable. Check the auxiliary code (format XXXY YYZZ). With parallel-connected inverter modules, “Y YY” specifies through which BCU control unit channel the fault was received. “ZZ” indicates the location of the short circuit (**0:** No detailed information available, **1:** Upper branch of U-phase, **2:** Lower branch of U-phase, **4:** Upper branch of V-phase, **8:** Lower branch of V-phase, **10:** Upper branch of W-phase, **20:** Lower branch of W-phase, **other:** combinations of the above). After correcting the cause of the fault, reboot the control unit (using parameter *96.08 Control board boot*) or by cycling power.
2381	IGBT overload	Excessive IGBT junction to case temperature. This fault protects the IGBT(s) and can be activated by a short circuit in the motor cable.	Check motor cable. Check ambient conditions. Check air flow and fan operation. Check heatsink fins for dust pick-up. Check motor power against drive power.
2391	BU current difference	AC phase current difference between parallel-connected inverter modules is excessive.	Check motor cabling. Check there are no power factor correction capacitors or surge absorbers in motor cable. Check the auxiliary code (format XXXY YYZZ). “XXX” specifies the source of the first error (see “YYY”). “YYY” specifies the module through which BCU control unit channel the fault was received (**0:** Channel 1, **1:** Channel 2, **2:** Channel 3, **4:** Channel 4, **8:** Channel 5, …, **400:** Channel 12, **other:** combinations of the above). “ZZ” indicates the phase (**1:** U, **2:** V, **3:** W).
2392	BU earth leakage	Total earth leakage of inverter modules is excessive.	Check there are no power factor correction capacitors or surge absorbers in motor cable. Measure insulation resistances of motor cables and motor. Contact your local ABB representative.
3130	Input phase loss Programmable fault: *31.21 Supply phase loss*	Intermediate circuit DC voltage is oscillating due to missing input power line phase or blown fuse.	Check input power line fuses. Check for loose power cable connections. Check for input power supply imbalance.
3180	Charge relay lost	No acknowledgement received from charge relay.	Contact your local ABB representative.

Code (hex)	Fault	Cause	What to do
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 drive motor connection).	Check the power connections.
		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 *180*).	Check the condition of the supply (voltage, cabling, fuses, switchgear).
3291	BUDC 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” specifies the module through which BCU control unit channel the fault was received (**0:** Channel 1, **1:** Channel 2, **2:** Channel 3, **4:** Channel 4, **8:** Channel 5, …, **400:** Channel 12).
3381	Output phase loss Programmable fault: *31.19 Motor phase loss*	Motor circuit fault due to missing motor connection (all three phases are not connected).	Connect motor cable.

Code (hex)	Fault	Cause	What to do
3385	Autophasing	Autophasing routine (see section *Autophasing* on page *171*) has failed.	Try other autophasing modes (see parameter *21.13 Autophasing mode*) if possible. If the *Turning with Z-pulse* mode is selected, check the zero pulse given by the encoder. Check that the motor ID run has been successfully completed. Clear parameter *98.15 Position offset user*. Check that the encoder is not slipping on the motor shaft. Check that the motor is not already turning when the autophasing routine starts. Check the setting of parameter *99.03 Motor type*.
4000	Motor cable overload	Calculated motor cable temperature has exceeded warning limit.	Check the settings of parameters *35.61* and *35.62*. Check the dimensioning of the motor cable in regard to required load.
4210	IGBT overtemperature	Estimated drive IGBT temperature is excessive.	Check ambient conditions. Check air flow and fan operation. Check heatsink fins for dust pick-up. Check motor power against drive power.
4290	Cooling	Drive module temperature is excessive.	Check ambient temperature. If it exceeds 40 °C (104 °F), ensure that load current does not exceed derated load capacity of drive. See appropriate *Hardware manual.* Check drive module cooling air flow and fan operation. Check inside of cabinet and heatsink of drive module for dust pick-up. Clean whenever necessary.
42F1	IGBT temperature	Drive IGBT temperature is excessive.	Check ambient conditions. Check air flow and fan operation. Check heatsink fins for dust pick-up. Check motor power against drive power.
4310	Excess temperature	Power unit module temperature is excessive.	See *A4B0 Excess temperature* (page *585*).
4380	Excess temperature difference	High temperature difference between the IGBTs of different phases.	See *A4B1 Excess temperature difference* (page *585*).
4381	PCB space cooling	Temperature difference between ambient and drive module PCB space is excessive.	See *A4B2 PCB space cooling* (page *585*).
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*.

Code (hex)	Fault	Cause	What to do
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	Cooling fan feedback is missing.	See *A581 Fan* (page *586*).
5081	Auxiliary fan broken	An auxiliary cooling fan (connected to the fan connectors on the control unit) is stuck or disconnected.	Check auxiliary fan(s) and connection(s). Replace faulty fan. The auxiliary code identifies the fan (**1:** Auxiliary fan 1, **2:** Auxiliary fan 2). Check the auxiliary fan(s) and connection(s). Make sure the front cover of the drive module is in place and tightened. If the commissioning of the drive requires that the cover is off, activate parameter *31.36 Aux fan fault bypass* within 2 minutes from control unit reboot to temporarily suppress the fault.
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).

Code (hex)	Fault	Cause	What to do
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 *350*).
5092	PU logic error	Power unit memory has cleared.	Cycle the power to the drive. If the control unit is externally powered, also reboot the control unit (using parameter *96.08 Control board boot*) or by cycling its power. If the problem persists, contact your local ABB representative.
5093	Rating ID mismatch	The hardware of the drive does not match the information stored in the memory unit. This may occur eg. after a firmware update or memory unit replacement.	Cycle the power to the drive. Check the auxiliary code. 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). With parallel connection faults, the format of the auxiliary code is 0X0Y. “Y” indicates the auxiliary code category, “X” indicates the first faulty PU channel in hexadecimal (1…C).
5094	Measurement circuit temperature	Problem with internal temperature measurement of the drive.	See *A5EA Measurement circuit temperature* (page *586*).

Code (hex)	Fault	Cause	What to do
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.
5690	PU communication internal	Internal communication error.	Contact your local ABB representative.
5691	Measurement circuit ADC	Measurement circuit fault.	Contact your local ABB representative, quoting the auxiliary code.
5692	PU board powerfail	Power unit power supply failure.	Check the auxiliary code (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).
5693	Measurement circuit DFF	Measurement circuit fault.	Contact your local ABB representative, quoting the auxiliary code.
5694	PU communication configuration	Version check cannot find a matching power unit FPGA logic.	Contact your local ABB representative.
5696	PU state feedback	State feedback from output phases does not match control signals.	Contact your local ABB representative, quoting the auxiliary code.
5697	Charging feedback	Charging feedback signal missing.	Check the feedback signal coming from the charging system.
5698	Unknown power unit fault	Unidentified power unit logic fault.	Check power unit logic and firmware compatibility. Contact your local ABB representative.
6000	Internal SW error	Internal error.	Contact your local ABB representative. Quote the auxiliary code (check the event details in the event log).
6181	FPGA version incompatible	Firmware and FPGA 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.

Code (hex)	Fault	Cause	What to do
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 *587*).
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.
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.	
	8007	The application contains the wrong library version.	
	800A	The application contains an unknown target (system) library function.	
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 non-existing parameter or block is used in the program.	Edit the program to correct the parameter reference, or to use an existing block.

Code (hex)	Fault	Cause	What to do
	001D	Parameter type invalid for selected pin.	Edit the program to correct the parameter reference.
	001E	Output to parameter failed because the parameter was write-protected.	Check the parameter reference in the program. Check for other sources affecting the target parameter.
	0023	Program file incompatible with current firmware version.	Adapt the program to current block library and firmware version.
	0024		
	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 • requested set does not exist • set is not compatible with control program • drive was switched off during loading.	Ensure that a valid user parameter set exists. Reload if uncertain.
64E1	Kernel overload	Operating system error.	Reboot the control unit (using parameter *96.08 Control board boot*) or by cycling power. If the problem persists, contact your local ABB representative.
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 589).

Code (hex)	Fault	Cause	What to do
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.
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 *591*).
7081	Panel port communication Programmable fault: *49.05 Communication loss action*	Control panel or PC tool selected as active control location for drive has ceased communicating.	Check PC tool or control panel connection. Check control panel connector. Disconnect and reconnect the control panel. Check the auxiliary code. 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.
7181	Brake resistor	Brake resistor broken or not connected.	Check that a brake resistor has been connected. Check the condition of the brake resistor. Check the dimensioning of the brake resistor.
7183	BR excess temperature	Brake resistor temperature has exceeded fault limit defined by parameter *43.11 Brake resistor fault limit*.	Stop drive. Let resistor cool down. Check resistor overload protection function settings (parameter group *43 Brake chopper*). Check fault limit setting, parameter *43.11 Brake resistor fault limit*. Check that braking cycle meets allowed limits.
7184	Brake resistor wiring	Brake resistor short circuit or brake chopper control fault.	Check brake chopper and brake resistor connection. Ensure brake resistor is not damaged. Ensure brake resistor is not damaged. After correcting the cause of the fault, reboot the control unit (using parameter *96.08 Control board boot*) or by cycling power.

Code (hex)	Fault	Cause	What to do
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 acknowledgement 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*.
7301	Motor speed feedback Programmable fault: *90.45 Motor feedback fault*	No motor speed feedback received.	See *A7B0 Motor speed feedback* (page *593*).

Code (hex)	Fault	Cause	What to do
7310	Overspeed	Motor is turning faster than highest allowed speed due to incorrectly set minimum/maximum speed, insufficient braking torque or changes in load when using torque reference.	Check minimum/maximum speed settings, parameters *30.11 Minimum speed* and *30.12 Maximum speed*. Check adequacy of motor braking torque. Check applicability of torque control. 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 *518*).
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 *594*).
73A0	Speed feedback configuration	Speed feedback configuration incorrect.	See *A797 Speed feedback configuration* (page *590*).
73A1	Load feedback Programmable fault: *90.55 Load feedback fault*	No load feedback received.	Check the auxiliary code (format XXYY ZZZZ). "XX" specifies the number of the encoder interface module (**01**: *91.11*/*91.12*, **02**: *91.13*/*91.14*), "YY" specifies the encoder (**01:** *92 Encoder 1 configuration*, **02:** *93 Encoder 2 configuration*). "ZZZZ" indicates the problem (see actions for each code below).
	0001	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 time (*23.23* for mode Off3).
73B1	Stop failed	Ramp stop did not finish within expected time.	Check the settings of parameters *31.37 Ramp stop supervision* and *31.38 Ramp stop supervision delay*. Check the predefined ramp times in parameter group *23 Speed reference ramp*.

Code (hex)	Fault	Cause	What to do
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 (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.
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 *594*).
7583	Line side unit faulted	The supply unit (or other converter) connected to the inverter unit has generated a fault.	Check fault status of supply unit (or other converter). Refer to the firmware manual of the supply unit.
7584	LSU charge failed	The supply unit was not ready (ie. the main contactor/breaker could not be closed) within expected time.	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 *597*).
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 *596*).

Code (hex)	Fault	Cause	What to do
80A0	AI supervision Programmable fault: *12.03 AI supervision function*	An analog signal is outside the limits specified for the analog input.	Check 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*.
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*.

Code (hex)	Fault	Cause	What to do
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 *350*). 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.	
FB11	Memory unit missing	No memory unit is attached to the drive 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 drive 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.
FF61	ID run	Motor ID run was not completed successfully.	Check the nominal motor values in parameter group *99 Motor data*. Check that no external control system is connected to the drive. Cycle the power to the drive (and its control unit, if powered separately). Check that the motor shaft is not locked. Check the auxiliary code. The second number of the code indicates the problem (see actions for each code below).
	0001	Maximum current limit too low.	Check settings of parameters *99.06 Motor nominal current* and *30.17 Maximum current*. Make sure that *30.17* > *99.06*. Check that the drive is dimensioned correctly according to the motor.

Code (hex)	Fault	Cause	What to do
	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.
	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.

Code (hex)	Fault	Cause	What to do
D100	Torque prove	Drive was not able to provide sufficient torque during Torque proving. The pre-magnetizing time mode is wrong or too short.	Check the motor and motor cables. Check that the parameter settings are as follows: • *21.01 Start mode* = Const time • *21.02 Magnetization time* = Setting is not fixed. Enter an appropriate value.
D101	Brake slip	Brake slipped during Torque proving.	Check the brake. Check whether the brake is slipping when it is in the closed state.
D102	Brake safe closure	Start command is active, the actual speed is below the limit defined with parameter *44.208 Safety close speed*, and the delay defined with parameter *44.209 Safety close delay* has elapsed.	Check whether it is necessary to drive the application at a low speed. If it is not, change the values of parameters *44.208 Safety close speed* and *44.209 Safety close delay* to correspond to the application. In trolley or long-travel applications, disable the Brake safe closure function with parameter *44.207 Safety close select*.
D103	Hoist speed opt settings	Parameters settings for Hoist speed optimization are incorrect.	Check the parameter settings in group *75 Hoist speed optimization*.
D104	Over speed	Motor speed has exceeded the motor overspeed level (*31.200 Motor overspeed level*), and the delay defined with parameter *31.201 Motor overspeed level delay* has elapsed.	Check the torque and current limit settings. Check the motor and motor cables. Check pulse encoder connections, if used.
D105	Speed match	Motor speed has exceeded the steady state deviation level (par. *74.02*) or the ramping state deviation level (par. *74.03*), and the delay defined with parameter *74.04 Speed match fault delay* has elapsed.	Check the torque and current limit settings. If an encoder is used, check the encoder settings.
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	ID run and remote	Motor ID run was requested when the drive was in external control.	Switch the drive to local control to perform the motor ID run.
D108	End limits I/O error	Both the upper limit and lower limit inputs are active simultaneously.	Check the upper limit and lower limit wiring.

Code (hex)	Fault	Cause	What to do
D109	Toggle bit supervision flt	Communication loss occurred between the overriding system and the drive. Time between two consecutive toggle bit rising edges from overriding system is longer than the time set in parameter *31.213 Toggle bit time delay*.	Check communication between overriding system and drive.
D10A	Brake not selected	Mechanical brake control was inactive when the Conical motor control function was enabled.	Activate mechanical brake control with parameter *44.06 Brake control enable*.
D10B	Synchron fault	Difference in actual position of Master drive and Follower drive. For example, value in parameter *82.20 Act position error* is more than the limit defined in parameter *82.07 Sync err limit* and the condition prevails for more than the delay time set in parameter *82.08Sync err fault delay*.	Check the limit set for position difference in parameter *82.07 Sync err limit*. Check the delay time set in parameter *82.08Sync err fault delay*. Check the position correction parameters: *82.04 Sync gain*, *82.05 Position corr limit*, and *82.06 Sync corr scale*.
D10C	M/F comm loss	Master/follower communication is lost in trolley or long travel drives.	Check the D2D link connections in trolley or long travel drives. Check the master drive settings in parameter *60.201 Crane drives structure* of trolley or long travel drives.
D10D	Watchdog test fault	Watchdog test routine fails: welded contacts in main contactor.	Check the wiring and drive parameterization (eg. wrong relay used). Check the mechanical condition of the watchdog relay and main contactor.

10

Fieldbus control through the embedded fieldbus interface (EFB)

What this chapter contains

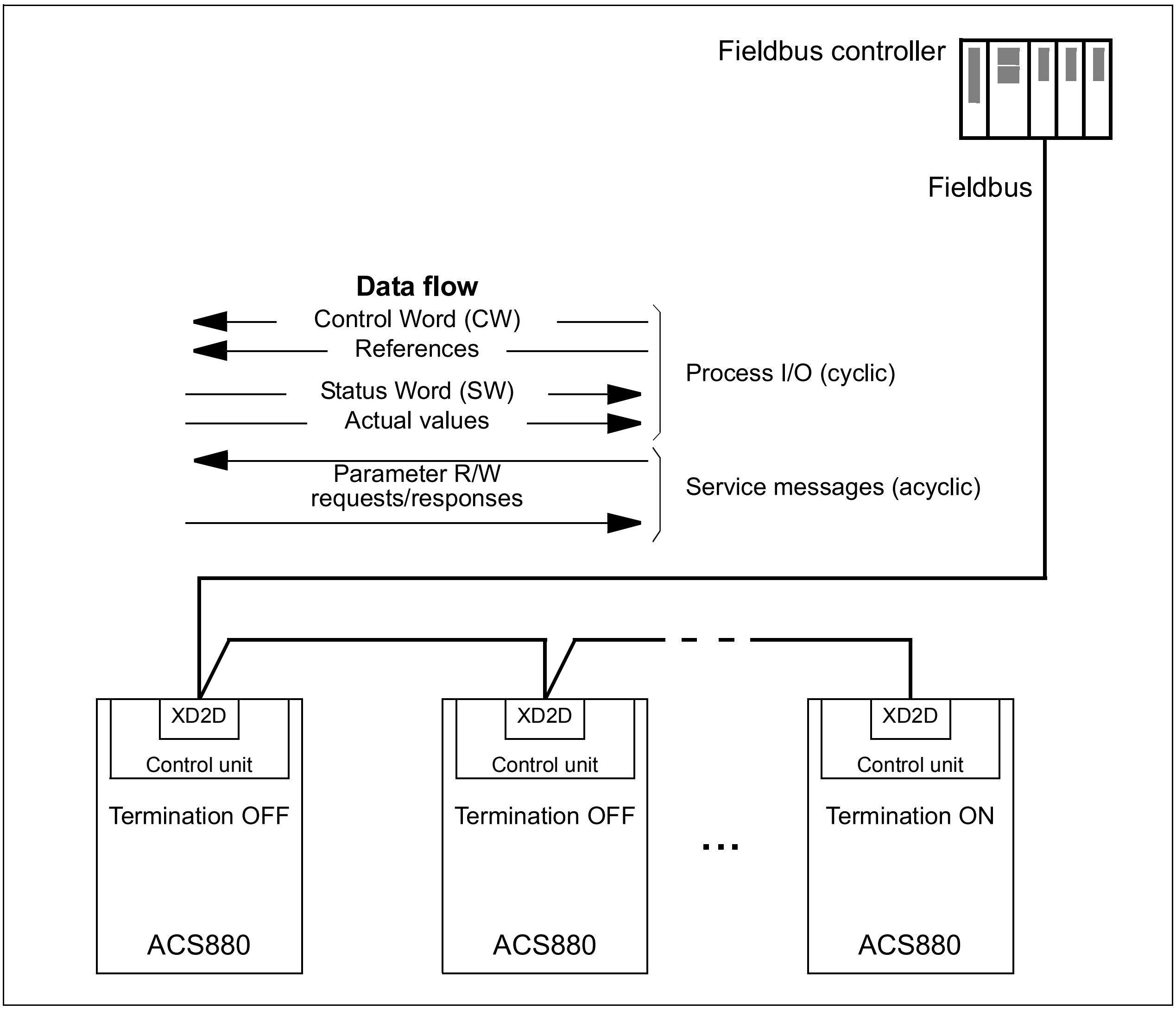
The chapter describes how the drive can be controlled by external devices over a communication network (fieldbus) using the embedded fieldbus interface.

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 *626*).
58.26 … *58.29*	*EFB ref1 type* … *EFB act2 type*	*Speed or frequency*, *Transparent*, *General*, *Torque*, *Speed*, *Frequency*	Selects the reference and actual value types. With the *Speed or frequency* setting, the type is selected automatically according to the currently active drive control mode.
58.30	*EFB status word transparent source*	*Other*	Defines the source of status word when *58.25 Control profile* = *Transparent*.
58.31	*EFB act1 transparent source*	*Other*	Defines the source of actual value 1 when *58.28 EFB act1 type* = *Transparent* or *General*.
58.32	*EFB act2 transparent source*	*Other*	Defines the source of actual value 2 when *58.29 EFB act2 type* = *Transparent* or *General*.

Parameter	Setting for fieldbus control	Function/Information
58.33 Addressing mode	*Mode 1* (default)	Defines the mapping between parameters and holding registers in the 400001…465536 (100…65535) Modbus register range.
58.34 Word order	*LO-HI* (default)	Defines the order of the data words in the Modbus message frame.
58.101 Data I/O 1 … *58.124 Data I/O 24*	For example, the default settings (I/Os 1…6 contain the control word, the status word, two references and two actual values)	Define the address of the drive parameter which the Modbus master accesses when it reads from or writes to the register address corresponding to Modbus In/Out parameters. Select the parameters that you want to read or write through the Modbus I/O words.
	RO/DIO control word, *AO1 data storage*, *AO2 data storage*	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.

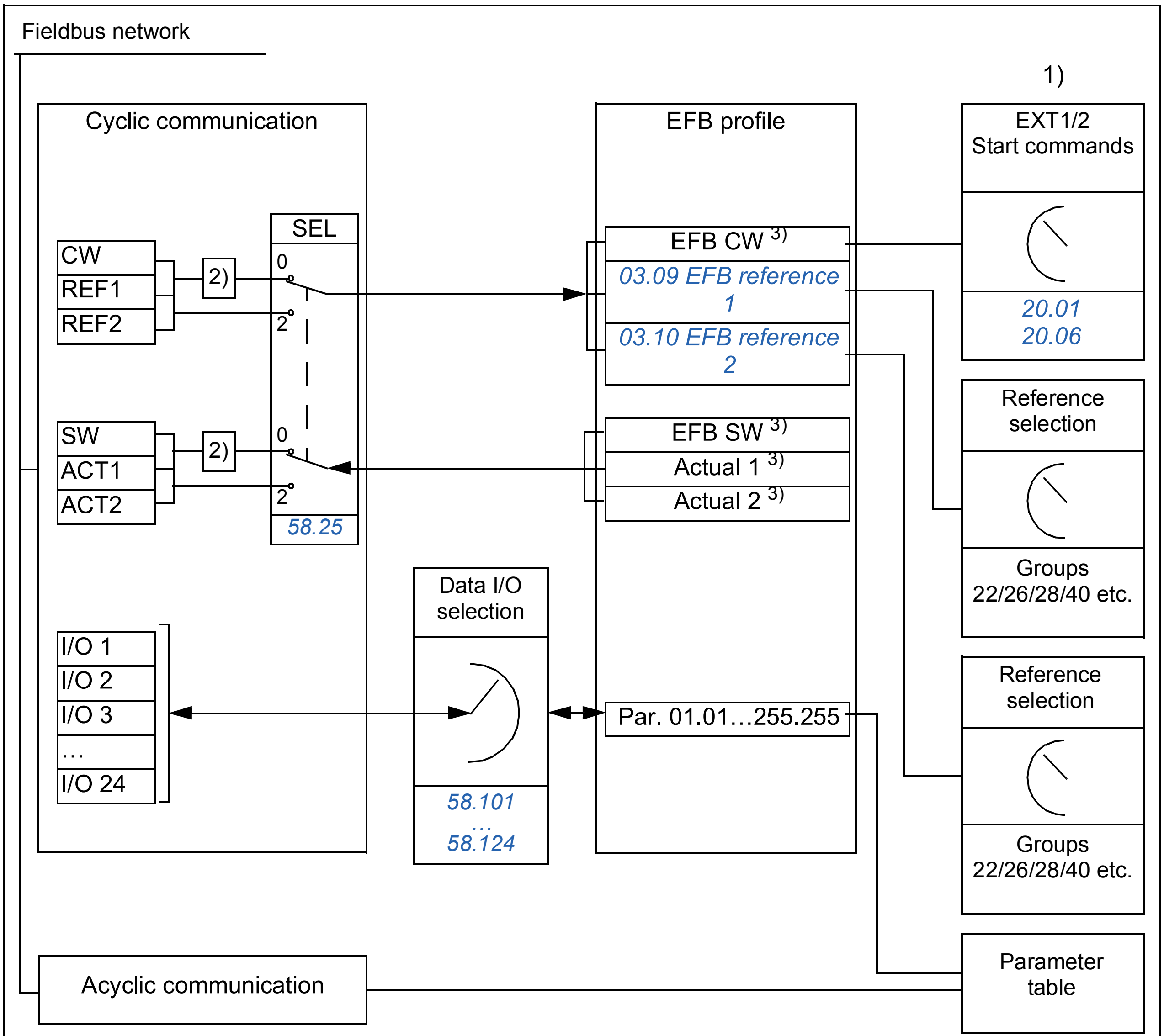
Parameter	Setting for fieldbus control	Function/Information
CONTROL COMMAND SOURCE SELECTION		
20.01 Ext1 commands	*Embedded fieldbus*	Selects fieldbus as the source for the start and stop commands when EXT1 is selected as the active control location.
20.06 Ext2 commands	*Embedded fieldbus*	Selects fieldbus as the source for the start and stop commands when EXT2 is selected as the active control location.
SPEED REFERENCE SELECTION		
22.11 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.
26.12 Torque ref2 source	*EFB ref1* or *EFB ref2*	Selects a reference received through the embedded fieldbus interface as torque reference 2.
OTHER SELECTIONS		
EFB references can be selected as the source at virtually any signal selector parameter by selecting *Other*, then either *03.09 EFB reference 1* or *03.10 EFB reference 2*.		
CONTROL OF RELAY OUTPUTS, ANALOG OUTPUTS AND DIGITAL INPUT/OUTPUTS		
10.24 RO1 source	*RO/DIO control word bit0*	Connects bit 0 of storage parameter *10.99 RO/DIO control word* to relay output RO1.
10.27 RO2 source	*RO/DIO control word bit1*	Connects bit 1 of storage parameter *10.99 RO/DIO control word* to relay output RO2.
10.30 RO3 source	*RO/DIO control word bit2*	Connects bit 2 of storage parameter *10.99 RO/DIO control word* to relay output RO3.
11.05 DIO1 function *11.09 DIO2 function*	*Output* (default)	Sets the digital input/output to output mode.
11.06 DIO1 output source	*RO/DIO control word bit8*	Connects bit 8 of storage parameter *10.99 RO/DIO control word* to digital input/output DIO1.
11.10 DIO2 output source	*RO/DIO control word bit9*	Connects bit 9 of storage parameter *10.99 RO/DIO control word* to digital input/output DIO2.
13.16 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 *629*).
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 *629*).

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 *629*).

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 *629*).

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 *629*).

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.

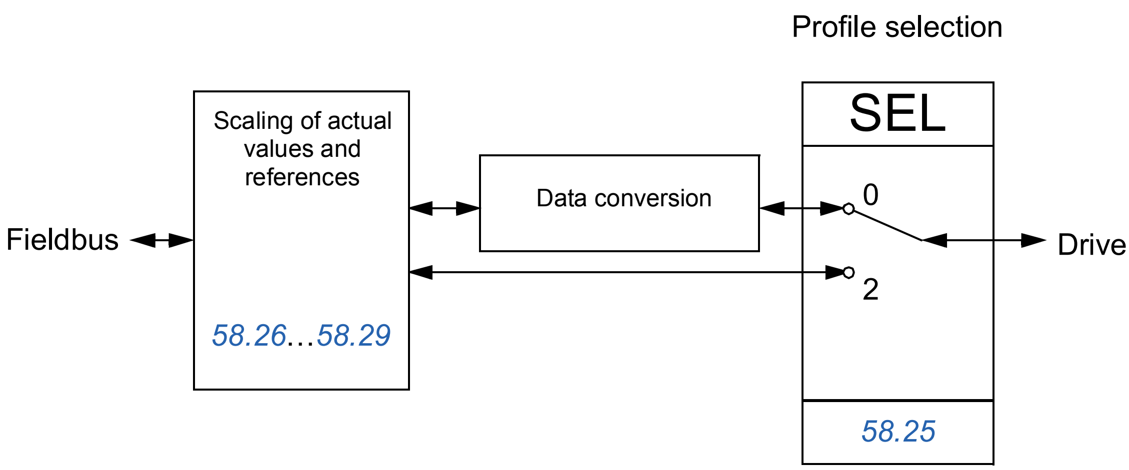
Note: Register addresses of 32-bit parameters cannot be accessed by using 5-digit register numbers.

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 *633*.

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.
		0	Jogging 1 disabled.
9	JOGGING_2	1	Accelerate to jogging 2 reference. See notes at bit 8.
		0	Jogging 2 disabled.
10	REMOTE_CMD	1	Fieldbus control enabled.
		0	Control Word <> 0 or Reference <> 0: Retain last Control Word and Reference. Control Word = 0 and Reference = 0: Fieldbus control enabled. Reference and deceleration/acceleration ramp are locked.
11	EXT_CTRL_LOC	1	Select External Control Location EXT2. Effective if the control location is parameterized to be selected from the fieldbus.
		0	Select External Control Location EXT1. Effective if the control location is parameterized to be selected from the fieldbus.
12…15	Reserved		

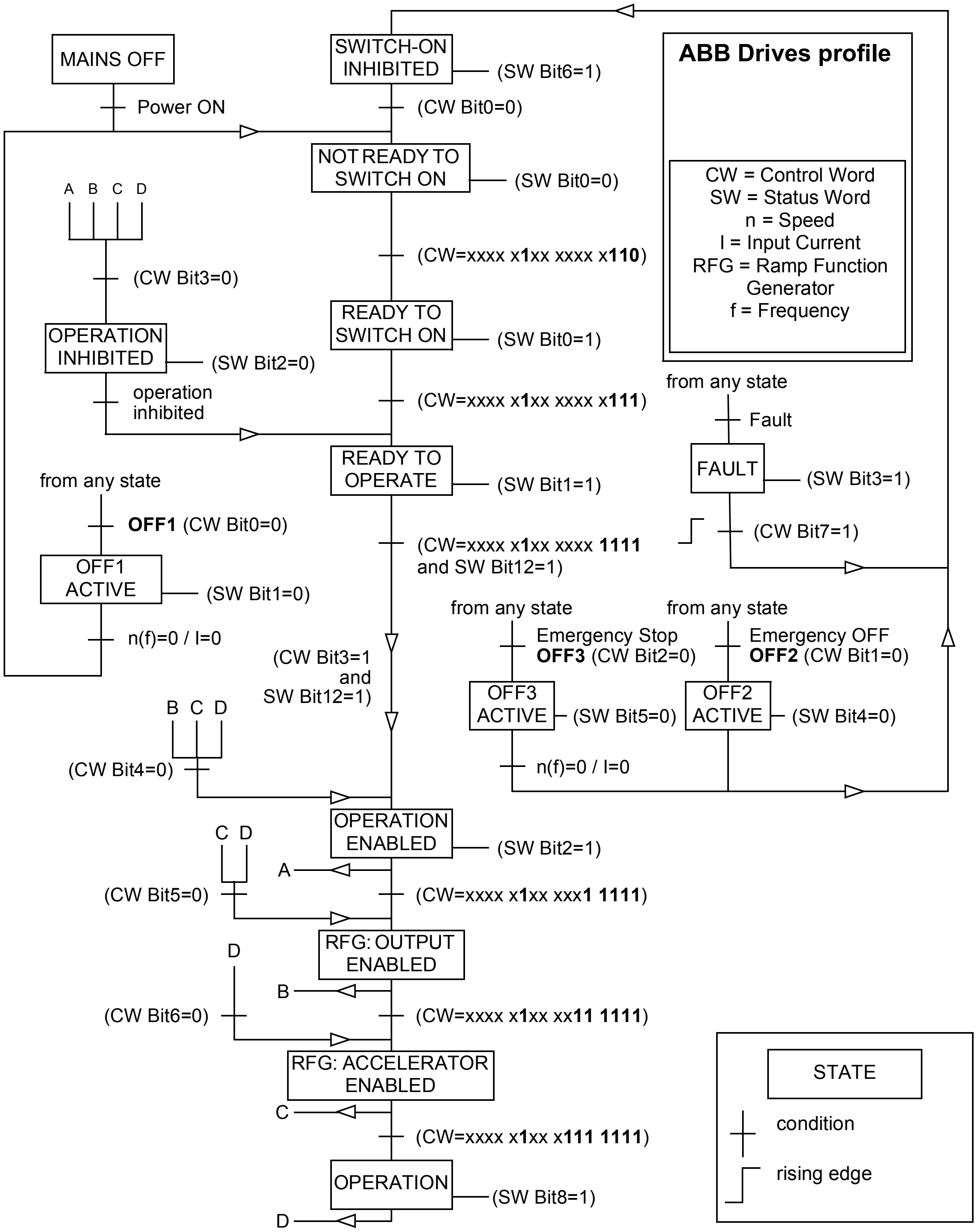
Status Word

The table below shows the fieldbus Status Word for the ABB Drives control profile. The embedded fieldbus interface converts the drive Status Word into this form for the fieldbus. The upper case boldface text refers to the states shown in *State transition diagram* on page *633*.

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

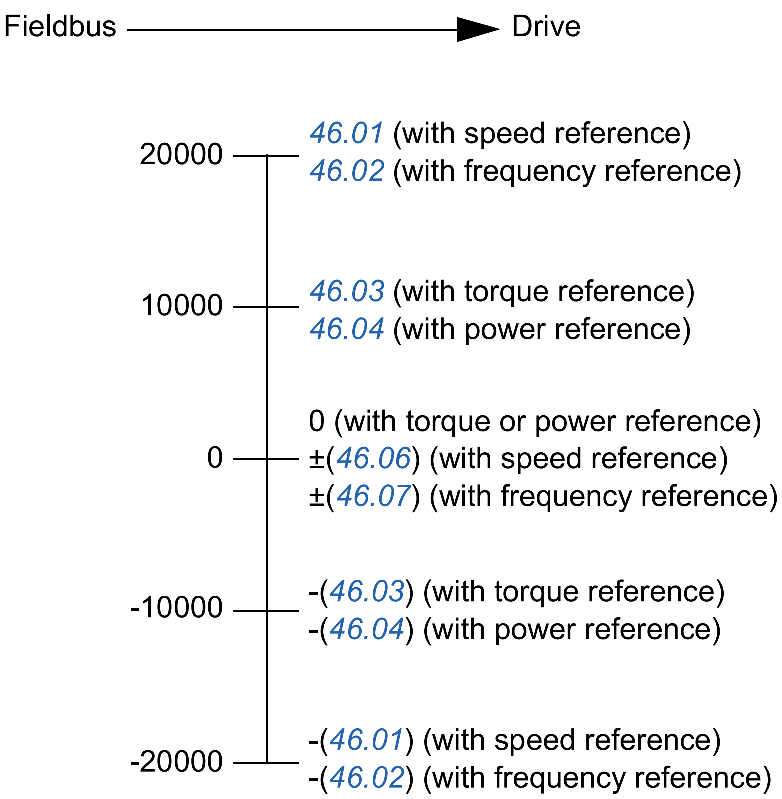
The diagram below shows the state transitions in the drive when the drive is using the ABB Drives profile, and configured to follow the commands of the control word from the embedded fieldbus interface. The upper case texts refer to the states which are used in the tables representing the fieldbus Control and Status words. See sections *Control Word* on page 630 and *Status Word* on page 632.



References

The ABB drives profile supports the use of two references, EFB reference 1 and EFB reference 2. The references are 16-bit words each containing a sign bit and a 15-bit integer. A negative reference is formed by calculating the two's complement from the corresponding positive reference.

The references are scaled as defined by parameters *46.01…46.07*; which scaling is in use depends on the setting of *58.26 EFB ref1 type* and *58.27 EFB ref2 type* (see page *423*).

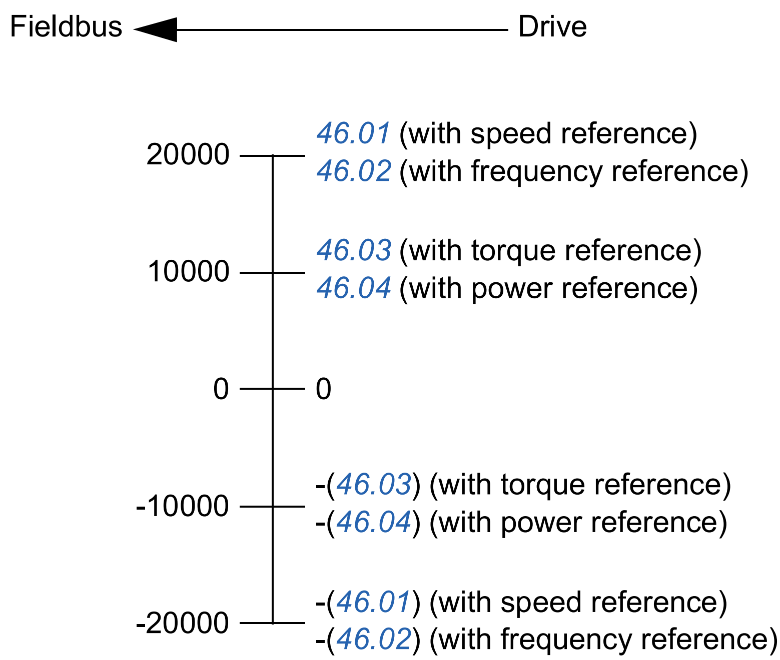


The scaled references are shown by parameters *03.09 EFB reference 1* and *03.10 EFB reference 2*.

Actual values

The ABB Drives profile supports the use of two fieldbus actual values, ACT1 and ACT2. The actual values are 16-bit words each containing a sign bit and a 15-bit integer. A negative value is formed by calculating the two’s complement from the corresponding positive value.

The actual values are scaled as defined by parameters *46.01…46.04*; which scaling is in use depends on the setting of parameters *58.28 EFB act1 type* and *58.29 EFB act2 type* (see page *424*).



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 *630*). 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 *632*). 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 *643*).
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 *636*).

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 *643*.
06h	SLAVE DEVICE BUSY	The server is engaged in processing a long-duration program command.

Coils (0xxxx reference set)

Coils are 1-bit read/write values. Control Word bits are exposed with this data type. The table below summarizes the Modbus coils (0xxxx reference set).

Reference	ABB drives profile	Transparent profile
00001	OFF1_CONTROL	Control Word bit 0
00002	OFF2_CONTROL	Control Word bit 1
00003	OFF3_CONTROL	Control Word bit 2
00004	INHIBIT_OPERATION	Control Word bit 3
00005	RAMP_OUT_ZERO	Control Word bit 4
00006	RAMP_HOLD	Control Word bit 5
00007	RAMP_IN_ZERO	Control Word bit 6
00008	RESET	Control Word bit 7
00009	JOGGING_1	Control Word bit 8
00010	JOGGING_2	Control Word bit 9
00011	REMOTE_CMD	Control Word bit 10
00012	EXT_CTRL_LOC	Control Word bit 11
00013	User-defined (0)	Control Word bit 12
00014	User-defined (1)	Control Word bit 13
00015	User-defined (2)	Control Word bit 14
00016	User-defined (3)	Control Word bit 15
00017	Reserved	Control Word bit 16
00018	Reserved	Control Word bit 17
00019	Reserved	Control Word bit 18
00020	Reserved	Control Word bit 19
00021	Reserved	Control Word bit 20
00022	Reserved	Control Word bit 21
00023	Reserved	Control Word bit 22
00024	Reserved	Control Word bit 23
00025	Reserved	Control Word bit 24
00026	Reserved	Control Word bit 25
00027	Reserved	Control Word bit 26
00028	Reserved	Control Word bit 27
00029	Reserved	Control Word bit 28
00030	Reserved	Control Word bit 29
00031	Reserved	Control Word bit 30
00032	Reserved	Control Word bit 31
00033	Reserved	*10.99 RO/DIO control word*, bit 0
00034	Reserved	*10.99 RO/DIO control word*, bit 1

Reference	ABB drives profile	Transparent profile
00035	Reserved	*10.99 RO/DIO control word*, bit 2
00036	Reserved	*10.99 RO/DIO control word*, bit 3
00037	Reserved	*10.99 RO/DIO control word*, bit 4
00038	Reserved	*10.99 RO/DIO control word*, bit 5
00039	Reserved	*10.99 RO/DIO control word*, bit 6
00040	Reserved	*10.99 RO/DIO control word*, bit 7
00041	Reserved	*10.99 RO/DIO control word*, bit 8
00042	Reserved	*10.99 RO/DIO control word*, bit 9

Discrete inputs (1xxxx reference set)

Discrete inputs are 1-bit read-only values. Status Word bits are exposed with this data type. The table below summarizes the Modbus discrete inputs (1xxxx reference set).

Reference	ABB drives profile	Transparent profile
10001	RDY_ON	Status Word bit 0
10002	RDY_RUN	Status Word bit 1
10003	RDY_REF	Status Word bit 2
10004	TRIPPED	Status Word bit 3
10005	OFF_2_STA	Status Word bit 4
10006	OFF_3_STA	Status Word bit 5
10007	SWC_ON_INHIB	Status Word bit 6
10008	ALARM	Status Word bit 7
10009	AT_SETPOINT	Status Word bit 8
10010	REMOTE	Status Word bit 9
10011	ABOVE_LIMIT	Status Word bit 10
10012	User-defined (0)	Status Word bit 11
10013	User-defined (1)	Status Word bit 12
10014	User-defined (2)	Status Word bit 13
10015	User-defined (3)	Status Word bit 14
10016	Reserved	Status Word bit 15
10017	Reserved	Status Word bit 16
10018	Reserved	Status Word bit 17
10019	Reserved	Status Word bit 18
10020	Reserved	Status Word bit 19
10021	Reserved	Status Word bit 20
10022	Reserved	Status Word bit 21
10023	Reserved	Status Word bit 22
10024	Reserved	Status Word bit 23

Reference	ABB drives profile	Transparent profile
10025	Reserved	Status Word bit 24
10026	Reserved	Status Word bit 25
10027	Reserved	Status Word bit 26
10028	Reserved	Status Word bit 27
10029	Reserved	Status Word bit 28
10030	Reserved	Status Word bit 29
10031	Reserved	Status Word bit 30
10032	Reserved	Status Word bit 31
10033	Reserved	*10.02 DI delayed status*, bit 0
10034	Reserved	*10.02 DI delayed status*, bit 1
10035	Reserved	*10.02 DI delayed status*, bit 2
10036	Reserved	*10.02 DI delayed status*, bit 3
10037	Reserved	*10.02 DI delayed status*, bit 4
10038	Reserved	*10.02 DI delayed status*, bit 5
10039	Reserved	*10.02 DI delayed status*, bit 6
10040	Reserved	*10.02 DI delayed status*, bit 7
10041	Reserved	*10.02 DI delayed status*, bit 8
10042	Reserved	*10.02 DI delayed status*, bit 9
10043	Reserved	*10.02 DI delayed status*, bit 10
10044	Reserved	*10.02 DI delayed status*, bit 11
10045	Reserved	*10.02 DI delayed status*, bit 12
10046	Reserved	*10.02 DI delayed status*, bit 13
10047	Reserved	*10.02 DI delayed status*, bit 14
10048	Reserved	*10.02 DI delayed status*, bit 15

Error code registers (holding registers 400090…400100)

These registers contain information about the last query. The error register is cleared when a query has finished successfully.

Reference	Name	Description
89	Reset Error Registers	1 = Reset internal error registers (91…95).
90	Error Function Code	Function code of the failed query.
91	Error Code	Set when exception code 04h is generated (see table above). • 00h No error • 02h Low/High limit exceeded • 03h Faulty Index: Unavailable index of an array parameter • 05h Incorrect Data Type: Value does not match the data type of the parameter • 65h General Error: Undefined error when handling query
92	Failed Register	The last register (discrete input, coil, or holding register) that failed to be read or written.
93	Last Register Written Successfully	The last register that was written successfully.
94	Last Register Read Successfully	The last register that was read successfully.

11

Fieldbus control through a fieldbus adapter

Contents of this chapter

This chapter describes how the drive can be controlled by external devices over a communication network (fieldbus) through an optional fieldbus adapter module.

The fieldbus control interface of the drive is described first, followed by a configuration example.

System overview

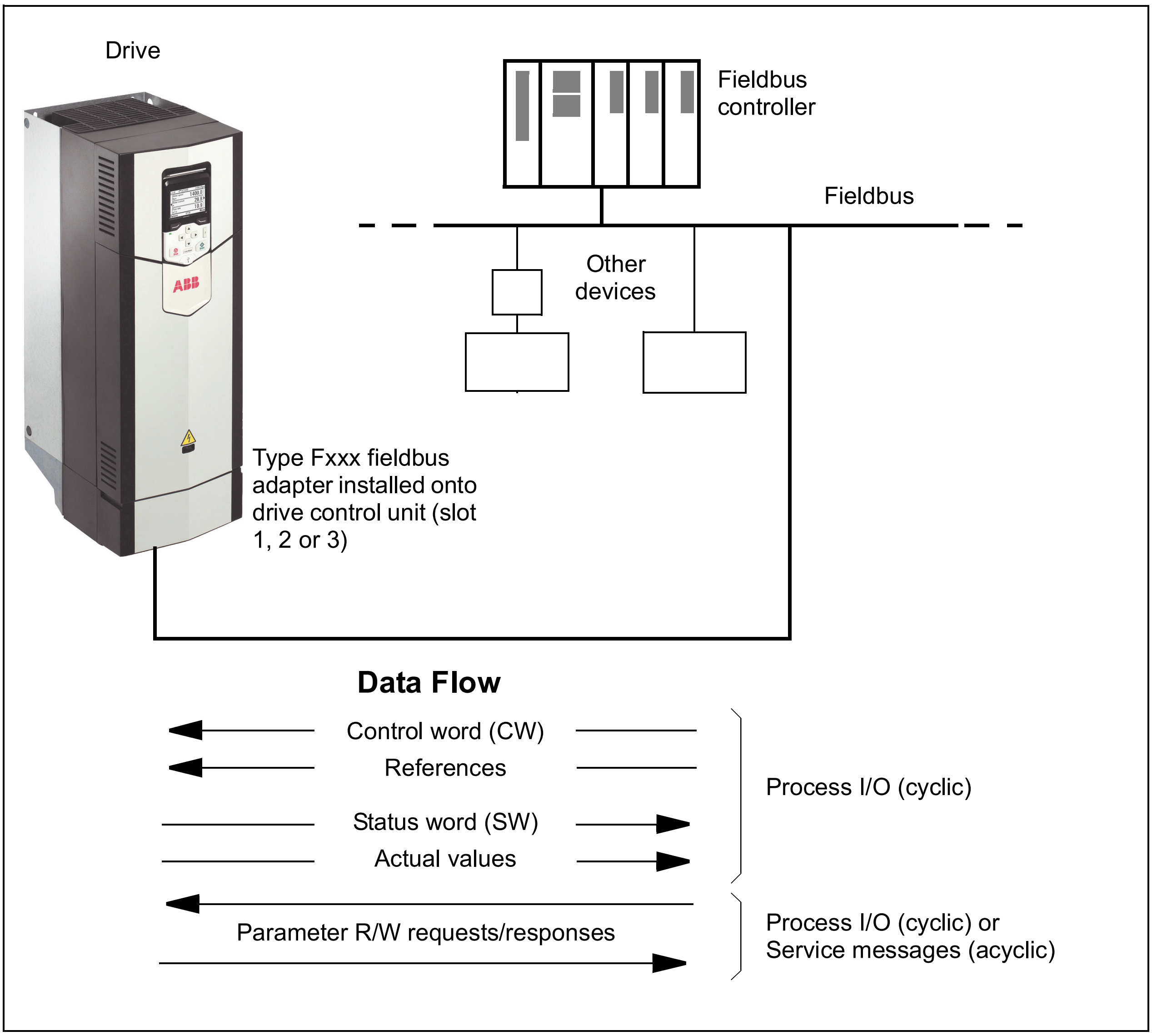
The drive can be connected to an external control system through an optional fieldbus adapter mounted onto the control unit of the drive. The drive actually has two independent interfaces for fieldbus connection, called “fieldbus adapter A” (FBA A) and “fieldbus adapter B” (FBA B). The drive can be configured 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: It is recommended that the FBA B interface is only used for monitoring.

Fieldbus adapters are available for various communication systems and protocols, for example

- CANopen (FCAN-01 adapter)
- ControlNet (FCNA-01 adapter)
- DeviceNet (FDNA-01 adapter)
- EtherCAT® (FECA-01 adapter)
- EtherNet/IP™ (FENA-11 or FENA-21 adapter)
- Modbus/RTU (FSCA-01 adapter)
- Modbus/TCP (FENA-11 or FENA-21 adapter)
- POWERLINK (FEPL-02 adapter)
- PROFIBUS DP (FPBA-01 adapter)
- PROFINET IO (FENA-11 or FENA-21 adapter).

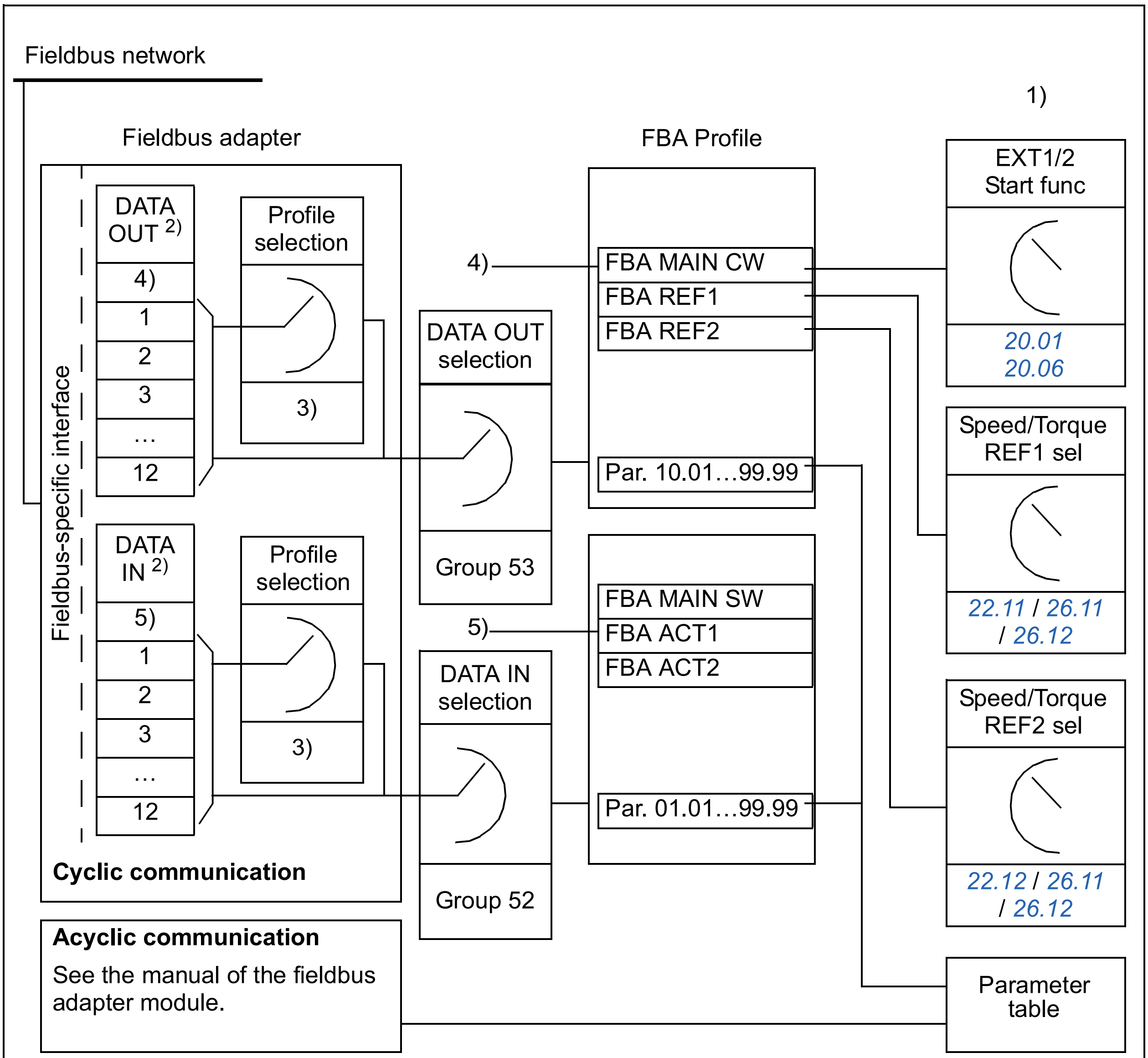
Note: The text and examples in this chapter describe the configuration of one fieldbus adapter (FBA A) by parameters *50.01*…*50.21* and parameter groups 51…53. The second adapter (FBA B), if present, is configured in a similar fashion by parameters *50.31*…*50.51* and parameter groups 54…56.



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 used data words is protocol-dependent.
3) Profile/instance selection parameters. Fieldbus module specific parameters. For more information, see the *User's Manual* of the appropriate fieldbus adapter module.
4) With DeviceNet, the control part is transmitted directly.
5) With DeviceNet, the actual value part is transmitted directly.

Control word and Status word

The Control word is the principal means for controlling the drive from a fieldbus system. It is sent by the fieldbus master station to the drive through the adapter module. The drive switches between its states according to the bit-coded instructions in the Control word, and returns status information to the master in the Status word.

The contents of the Control word and the Status word are detailed on pages *651* and *653* respectively. The drive states are presented in the state diagram (page *654*).

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.

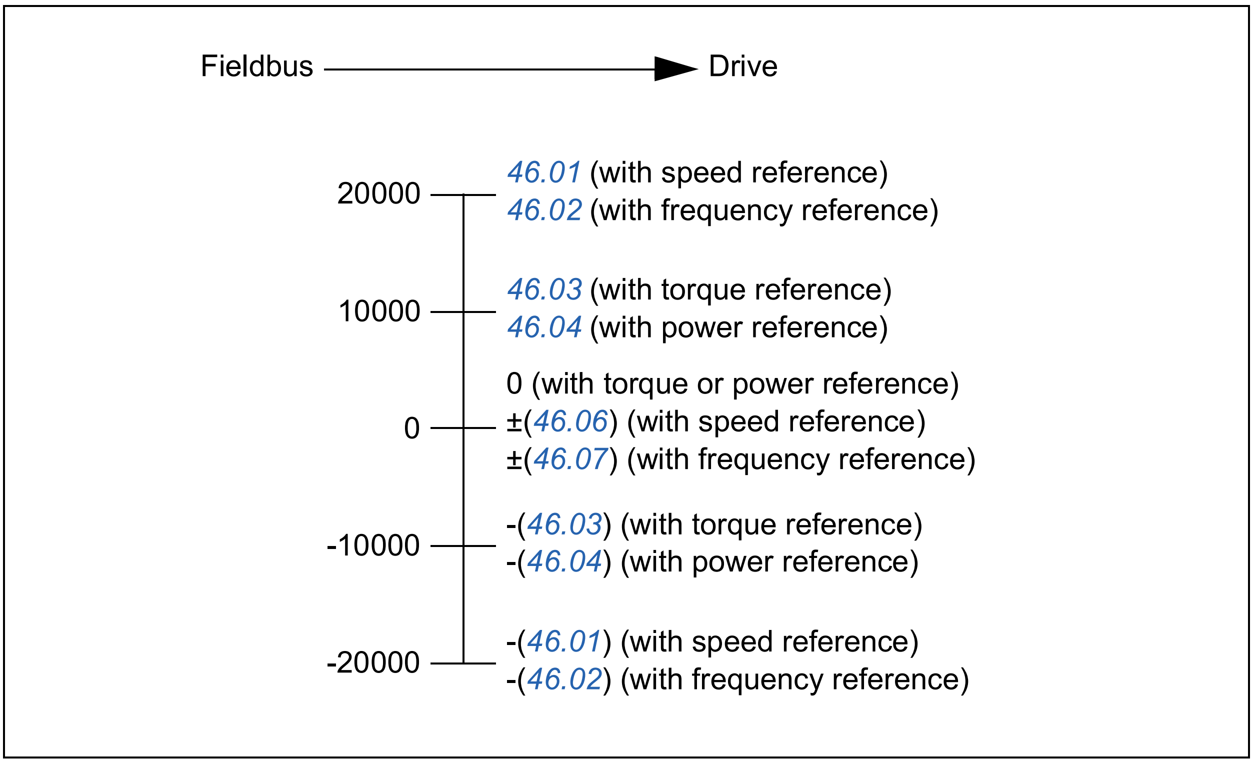
ABB drives can receive control information from multiple sources including analog and digital inputs, the drive control panel and a fieldbus adapter module. In order to have the drive controlled through the fieldbus, the module must be defined as the source for control information such as reference. 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

The references are scaled as defined by parameters *46.01…46.07*; which scaling is in use depends on the setting of *50.04 FBA A ref1 type* and *50.05 FBA A ref2 type*.



The scaled references are shown by parameters *03.05 FB A reference 1* and *03.06 FB A reference 2*.

Actual values

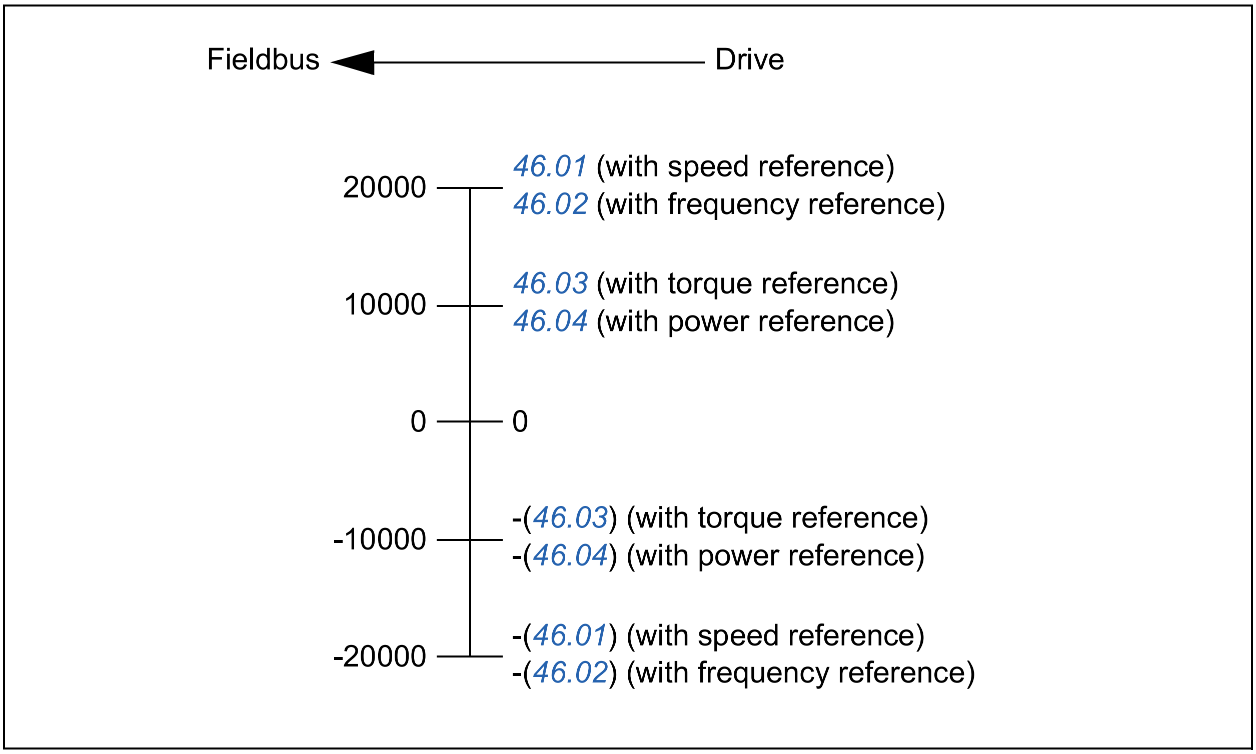
Actual values are 16-bit words containing information on the operation of the drive. The types of the monitored signals are selected by parameters *50.07 FBA A actual 1 type* and *50.08 FBA A actual 2 type*.

Debugging the network words

If parameter *50.12 FBA A debug mode* is set to *Fast*, the actual values sent to the fieldbus are displayed by *50.17 FBA A actual value 1* and *50.18 FBA A actual value 2*.

Scaling of actual values

The actual values are scaled as defined by parameters *46.01…46.04*; which scaling is in use depends on the setting of parameters *50.04* and *50.05*.



Contents of the fieldbus Control word

The upper case boldface text refers to the states shown in the state diagram (page *654*).

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.
		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. **Note:** Bits 4…6 must be 0.
		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.

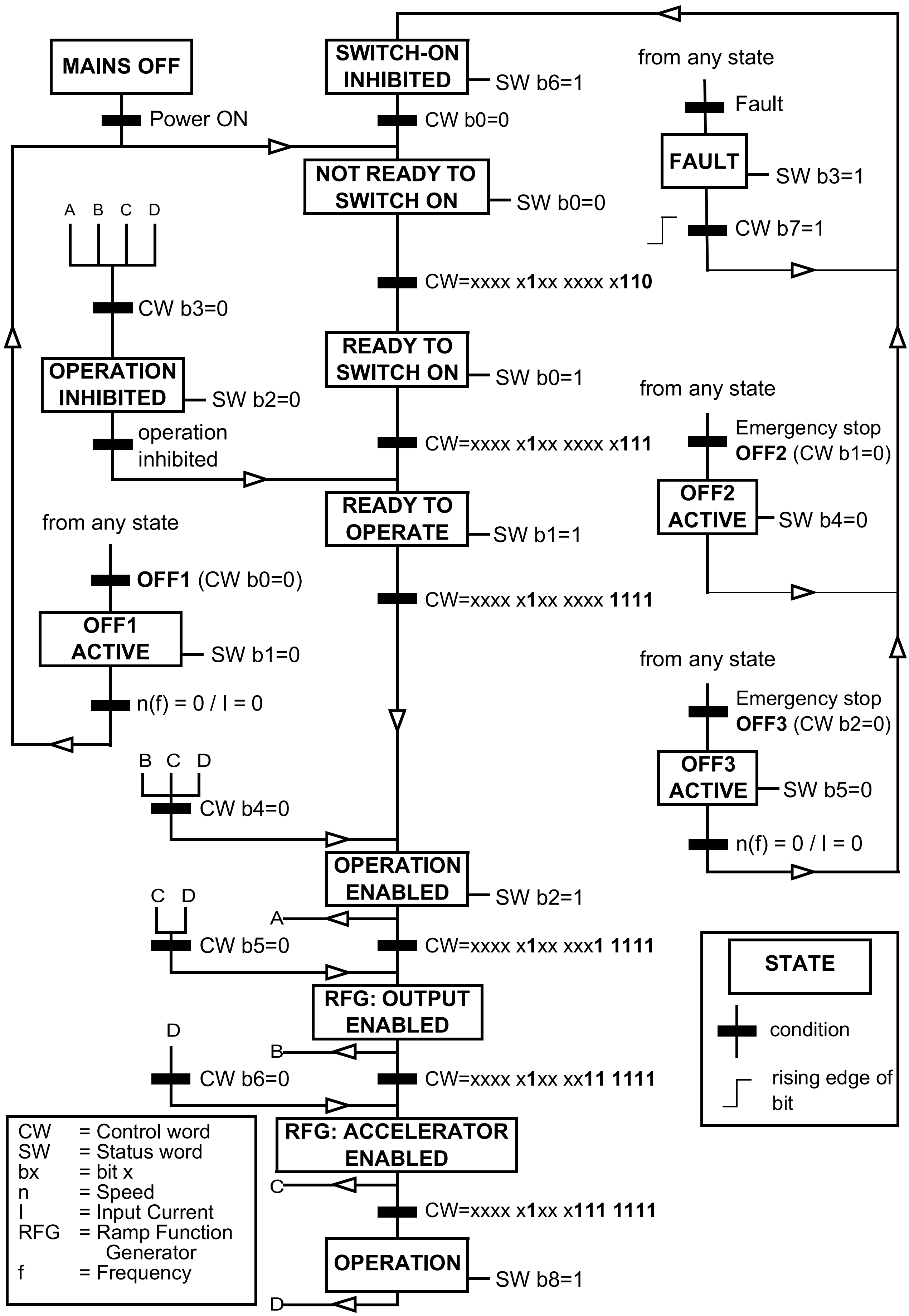
Bit	Name	Value	STATE/Description
11	Ext ctrl loc	1	Select External Control Location EXT2. Effective if control location is parameterized to be selected from fieldbus.
		0	Select External Control Location EXT1. Effective if control location is parameterized to be selected from fieldbus.
12 to 15	Reserved.		

Contents of the fieldbus Status word

The upper case boldface text refers to the states shown in the state diagram (page *654*).

Bit	Name	Value	STATE/Description
0	Ready to switch ON	1	**READY TO SWITCH ON**.
		0	**NOT READY TO SWITCH ON**.
1	Ready run	1	**READY TO OPERATE**.
		0	**OFF1 ACTIVE**.
2	Ready ref	1	**OPERATION ENABLED**.
		0	**OPERATION INHIBITED**.
3	Tripped	1	**FAULT**.
		0	No fault.
4	Off 2 inactive	1	OFF2 inactive.
		0	**OFF2 ACTIVE**.
5	Off 3 inactive	1	OFF3 inactive.
		0	**OFF3 ACTIVE**.
6	Switch-on inhibited	1	**SWITCH-ON INHIBITED**.
		0	–
7	Warning	1	Warning active.
		0	No warning active.
8	At setpoint	1	**OPERATING**. Actual value equals reference = is within tolerance limits, i.e. in speed control, speed error is 10% max. of nominal motor speed.
		0	Actual value differs from reference = is outside tolerance limits.
9	Remote	1	Drive control location: REMOTE (EXT1 or EXT2).
		0	Drive control location: LOCAL.
10	Above limit	-	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



CW	= Control word
SW	= Status word
bx	= bit x
n	= Speed
I	= Input Current
RFG	= Ramp Function Generator
f	= Frequency

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 communication profile.
8. Define the process data transferred to and from the drive in parameter groups *52 FBA A data in* and *53 FBA A data out*.

   Note: Depending on the communication protocol and profile being used, the Control word and Status word may already be configured to be sent/received by the communication system.
9. Save the valid parameter values to permanent memory by setting parameter *96.07 Parameter save manually* to *Save*.
10. Validate the settings made in parameter groups 51, 52 and 53 by setting parameter *51.27 FBA A par refresh* to *Refresh*.
11. Configure control locations EXT1 and EXT2 to allow control and reference signals to come from the fieldbus. Examples of appropriate values are shown in the tables below.

Parameter setting example: FPBA (PROFIBUS DP)

This example shows how to configure a basic speed control application that uses the PROFIdrive communication profile with PPO Type 2. The start/stop commands and reference are according to the PROFIdrive profile, speed control mode.

The reference values sent over the fieldbus have to be scaled within the drive so they have the desired effect. The reference value ±16384 (4000h) corresponds to the range of speed set in parameter *46.01 Speed scaling* (both forward and reverse directions). For example, if *46.01* is set to 480 rpm, then 4000h sent over fieldbus will request 480 rpm.

Direction	**PZD1**	**PZD2**	**PZD3**	**PZD4**	**PZD5**	**PZD6**
Out	Control word	Speed reference	Acc time 1		Dec time 1	
In	Status word	Speed actual value	Motor current		DC voltage	

The table below gives the recommended drive parameter settings.

Drive parameter	**Setting for ACS880 drives**	**Description**
50.01 FBA A enable	**1…3** = [slot number]	Enables communication between the drive and the fieldbus adapter module.
50.04 FBA A ref1 type	**4** = *Speed*	Selects the fieldbus A reference 1 type and scaling.
50.07 FBA A actual 1 type	**0** = *Speed or frequency*	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)

Drive parameter	Setting for ACS880 drives	Description
53.03 FBA data out3	23.12 2)	Acceleration time 1
53.05 FBA data out5	23.13 2)	Deceleration time 1
51.27 FBA A par refresh	**1** = *Refresh*	Validates the configuration parameter settings.
19.12 Ext1 control mode	**2** = *Speed*	Selects speed control as the control mode 1 for external control location EXT1.
20.01 Ext1 commands	**12** = *Fieldbus A*	Selects fieldbus adapter A as the source of the start and stop commands for external control location EXT1.
20.02 Ext1 start trigger type	**1** = *Level*	Selects a level-triggered start signal for external control location EXT1.
22.11 Speed ref1 source	**4** = *FB A ref1*	Selects fieldbus A reference 1 as the source for speed reference 1.

1) Read-only or automatically detected/set

2) Example

The start sequence for the parameter example above is given below.

Control word:

- 477h (1143 decimal) –> READY TO SWITCH ON
- 47Fh (1151 decimal) –> OPERATING (Speed mode)

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Drive-to-drive link

The firmware supports the use of the drive-to drive (D2D) link through application programming (IEC 61131-3) only. In the crane application this has been used to create Master/Follower and Antisway communication, therefore any additional drive-to-drive (D2D) link modifications are locked and cannot be modified by the user.

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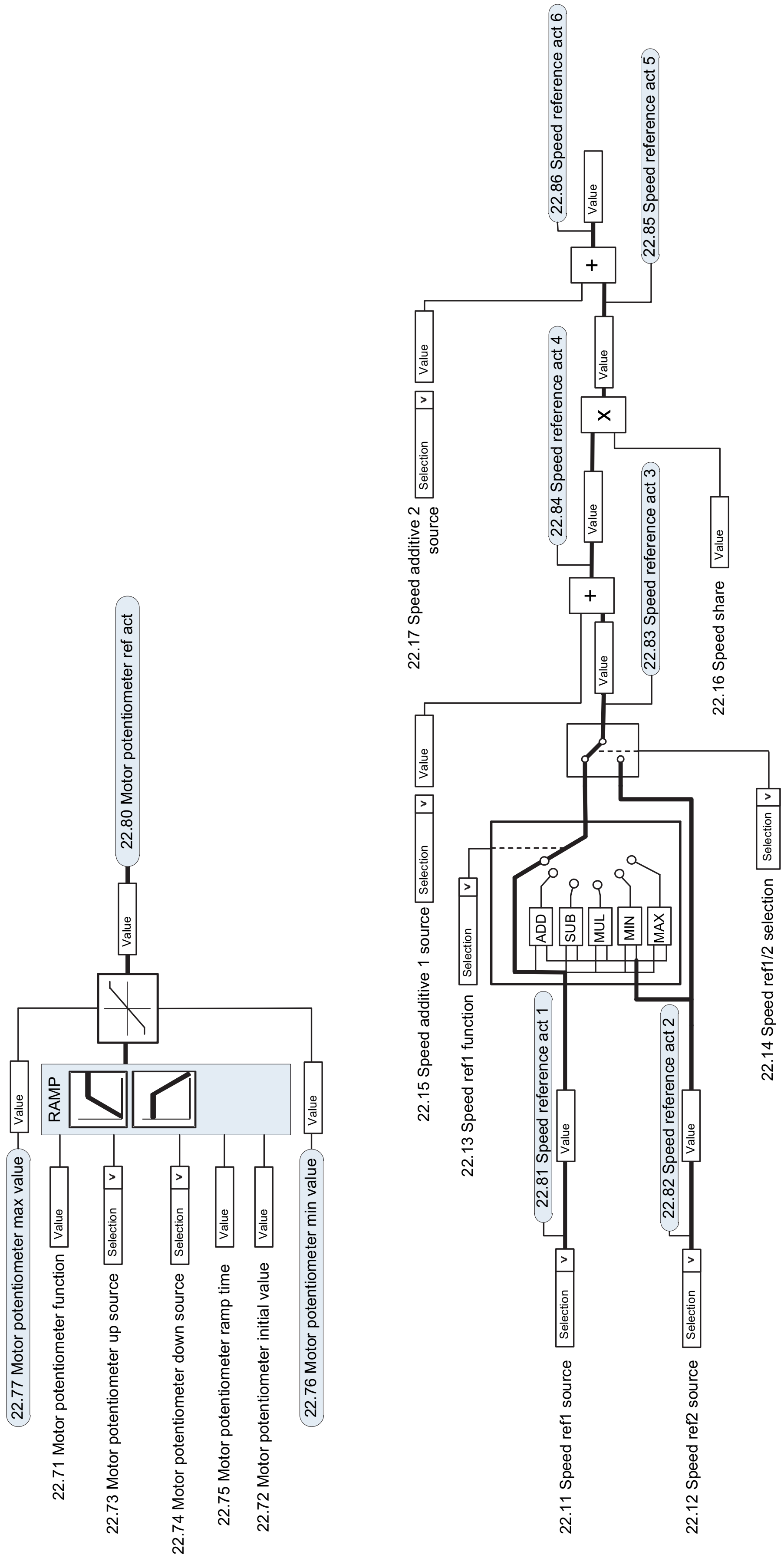
Control chain diagrams

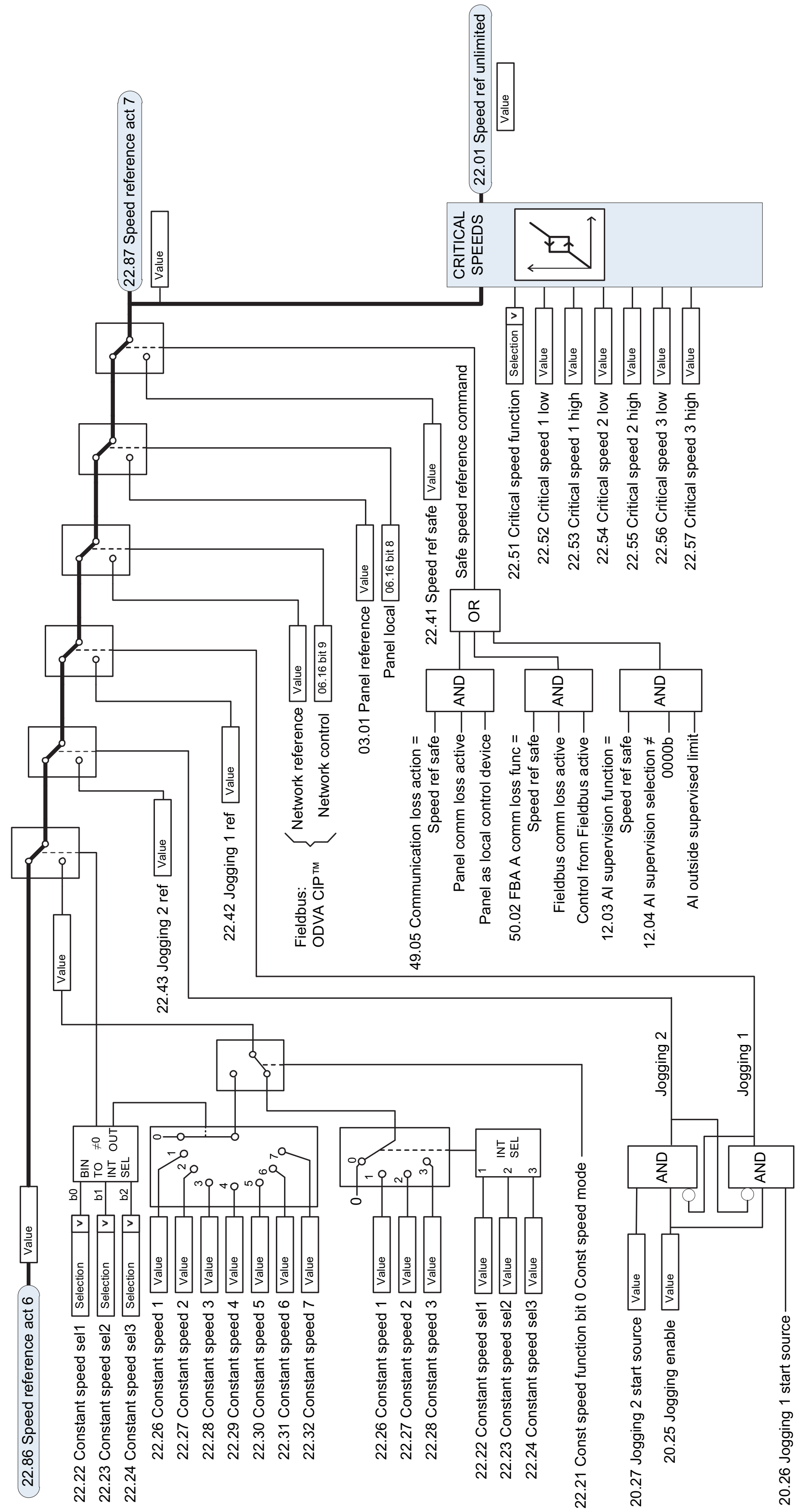
Contents of this chapter

The chapter presents the reference chains of a drive equipped with the crane 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.

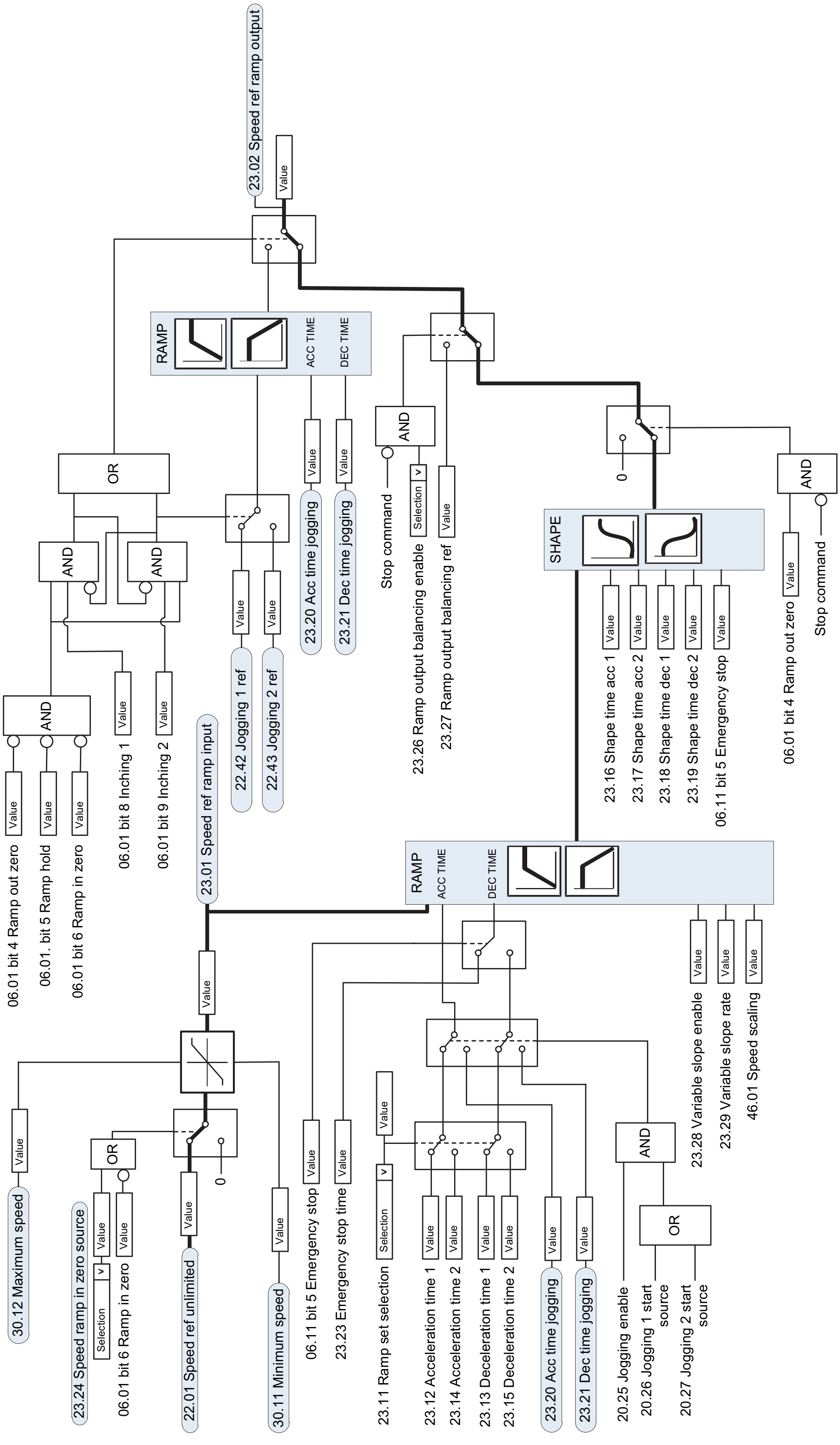
Speed reference source selection I



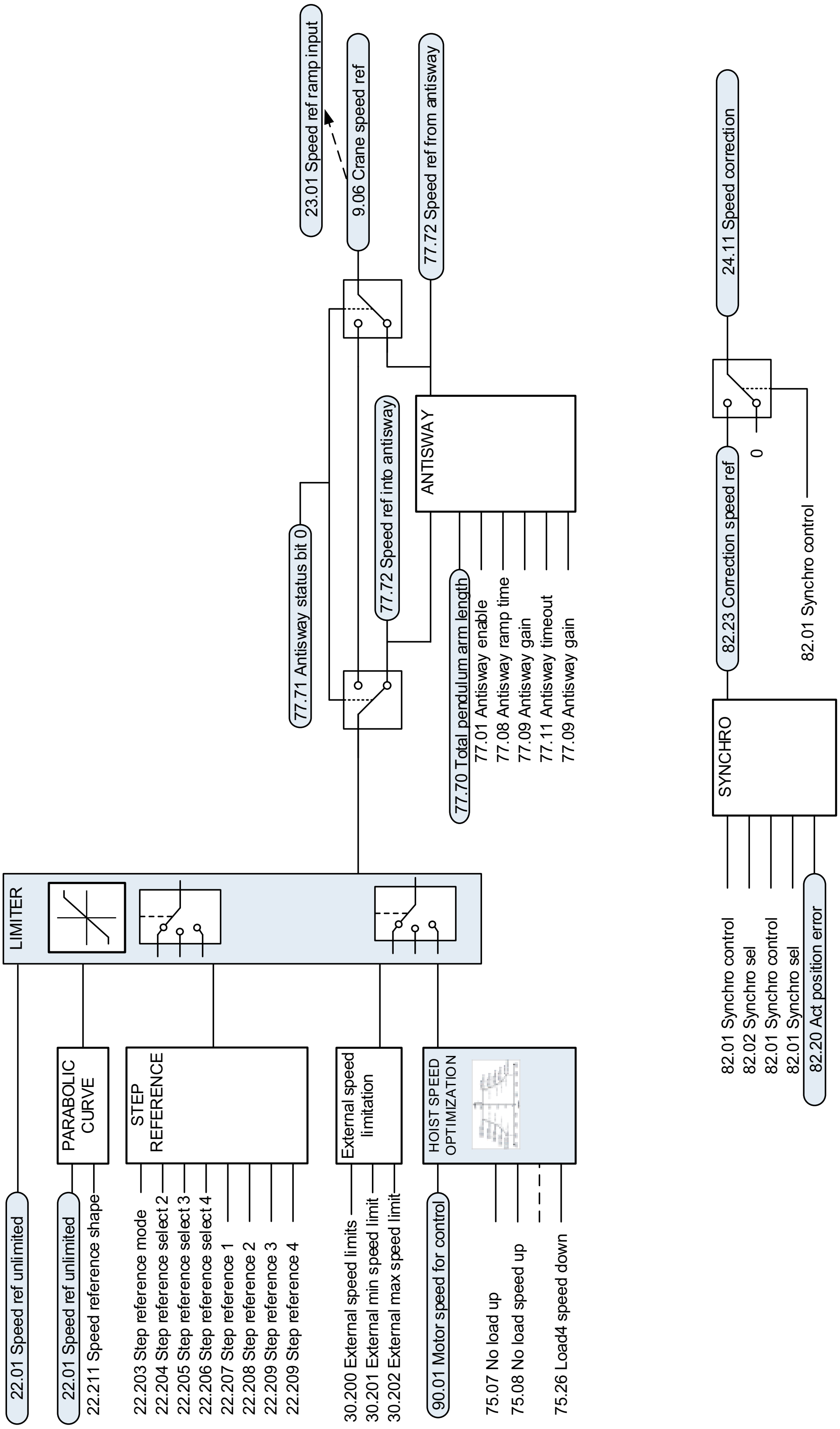
Speed reference source selection II



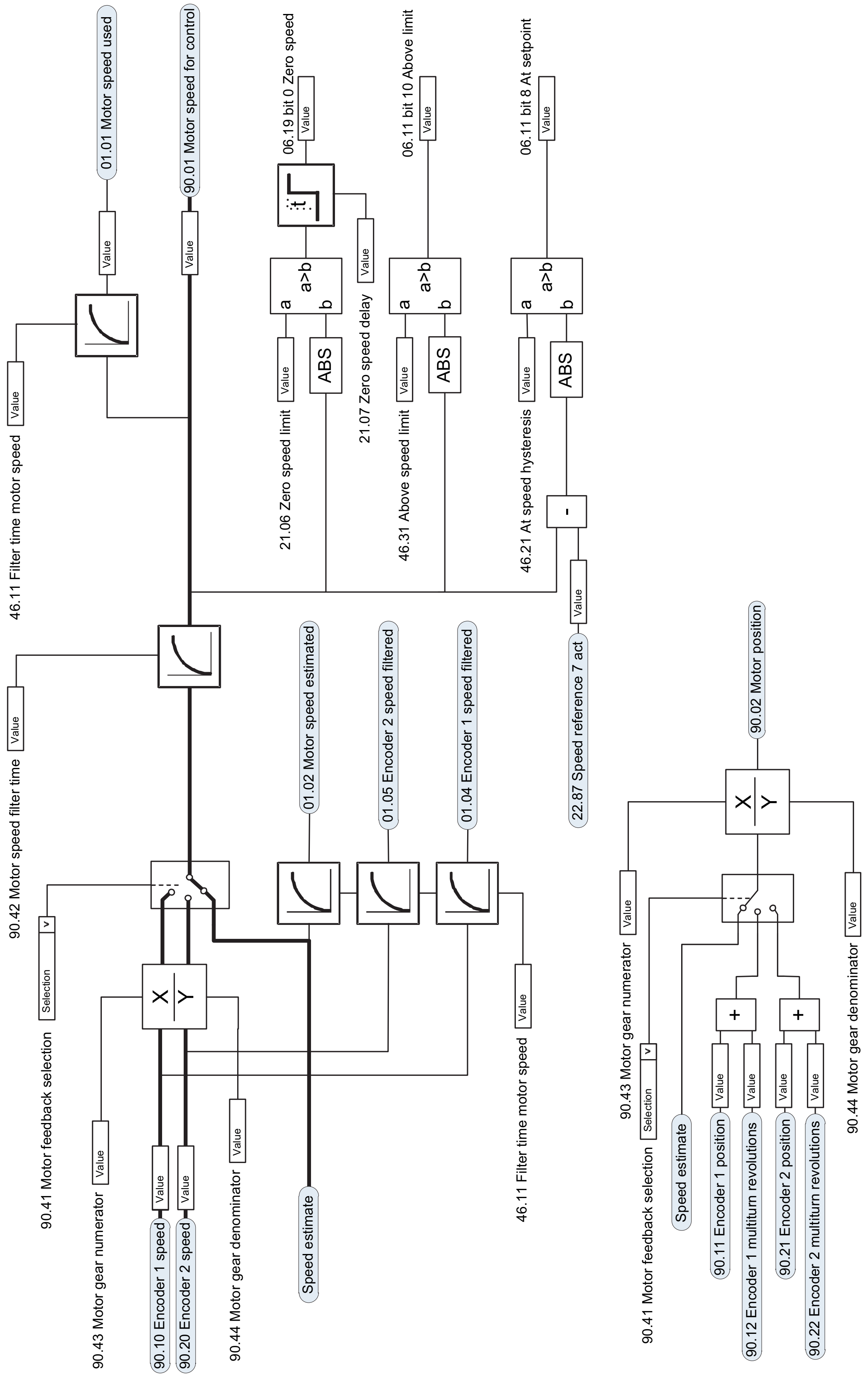
Speed reference ramping and shaping



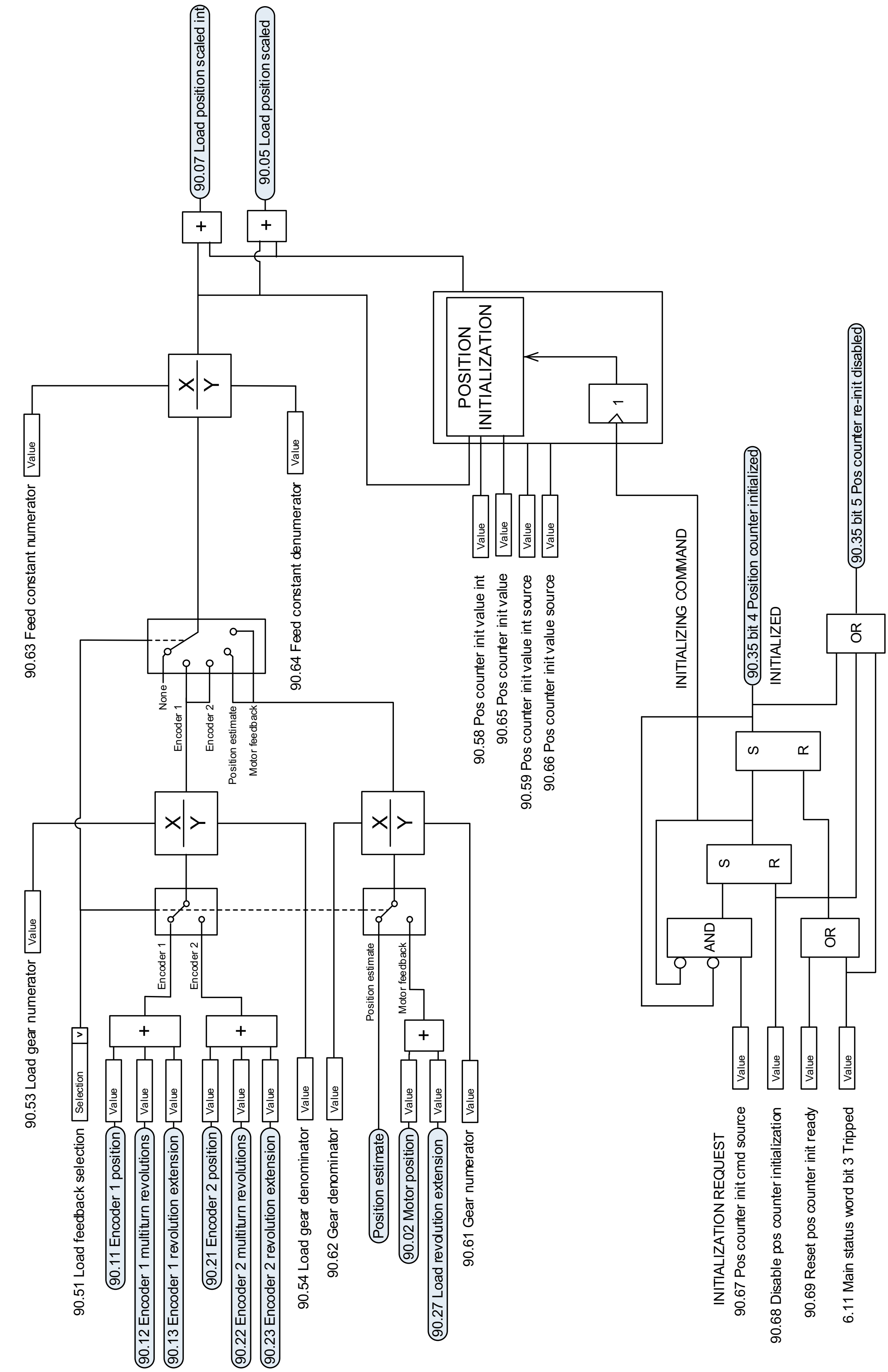
Crane speed reference



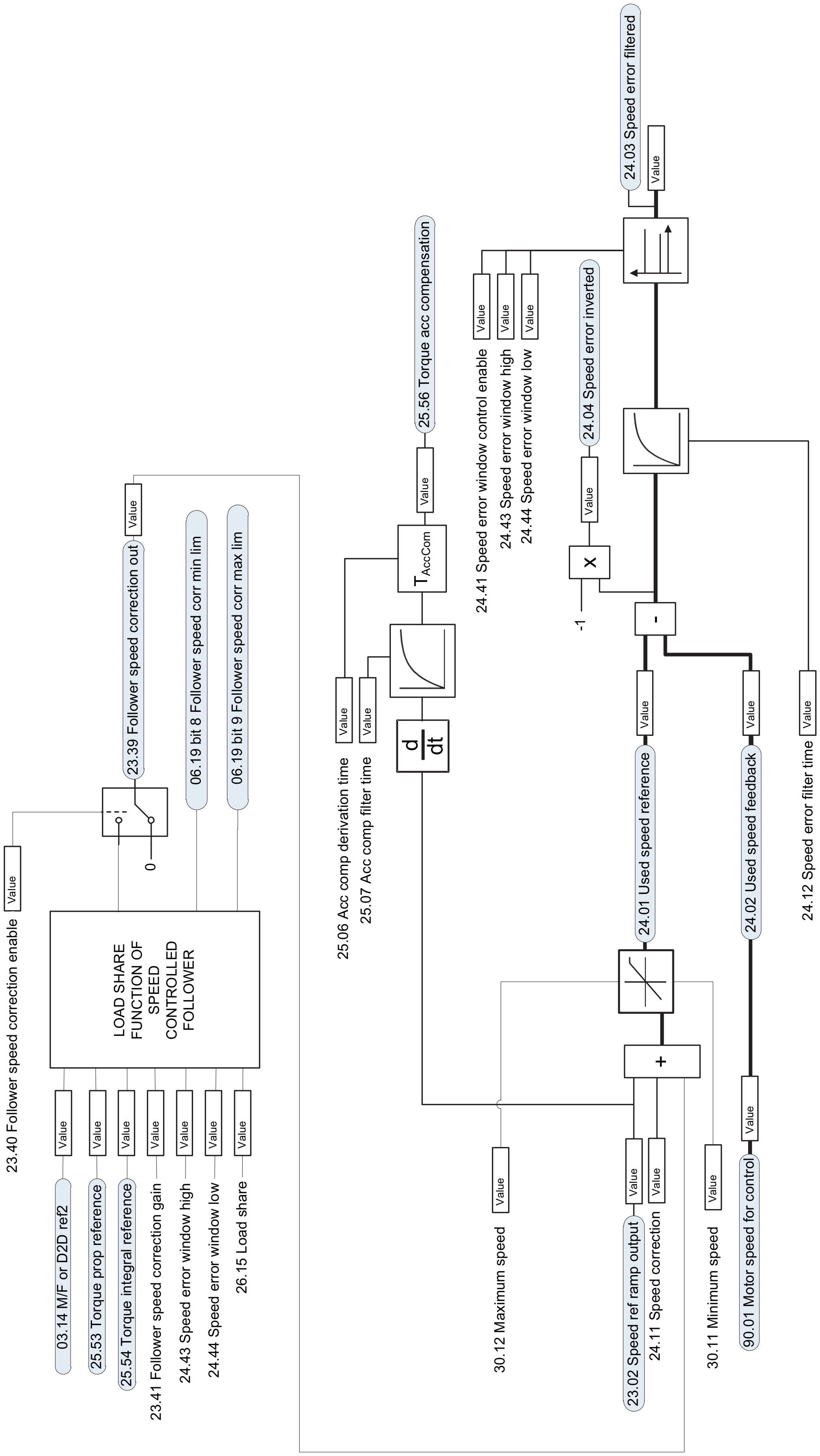
Motor feedback configuration



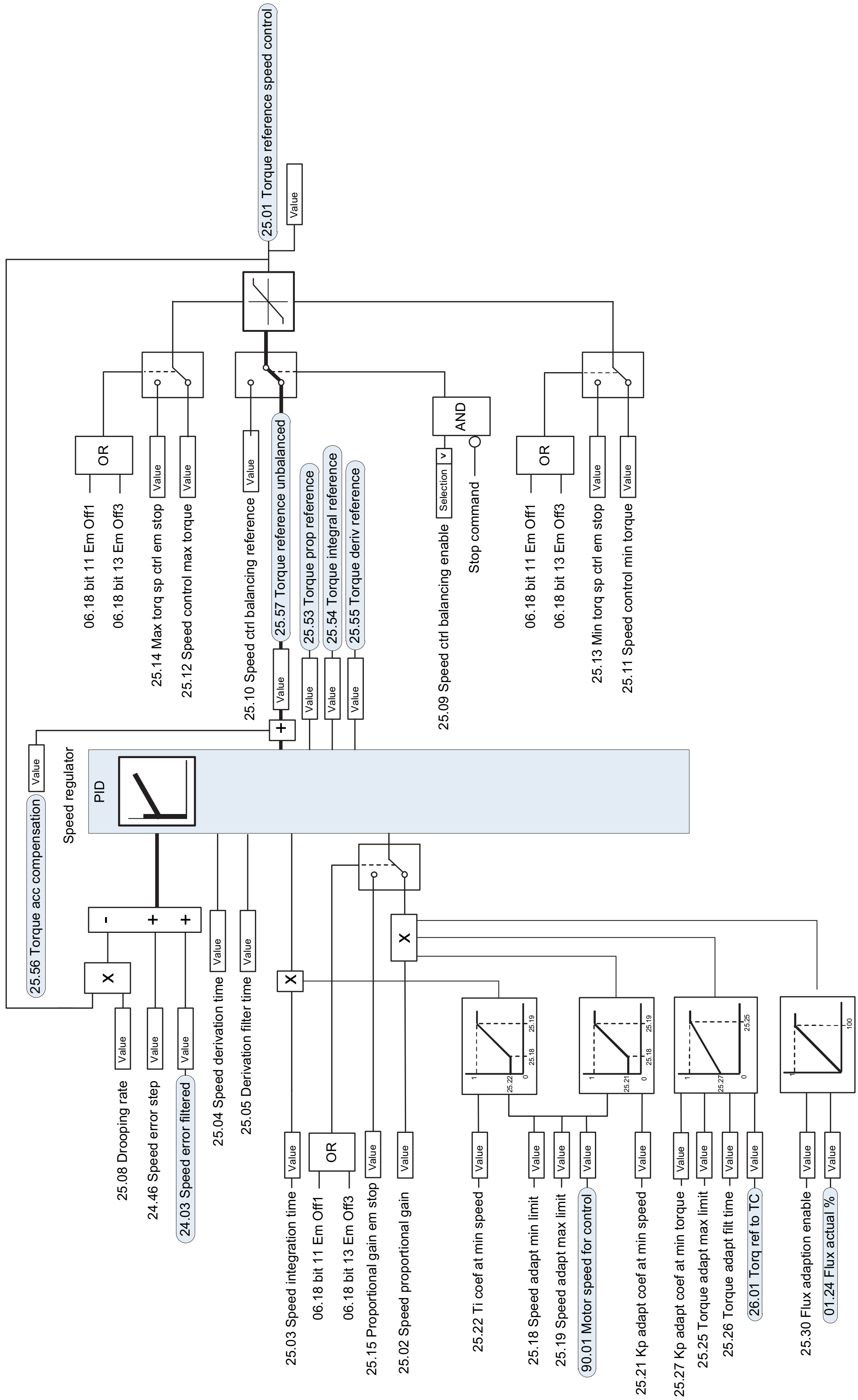
Load feedback and position counter configuration



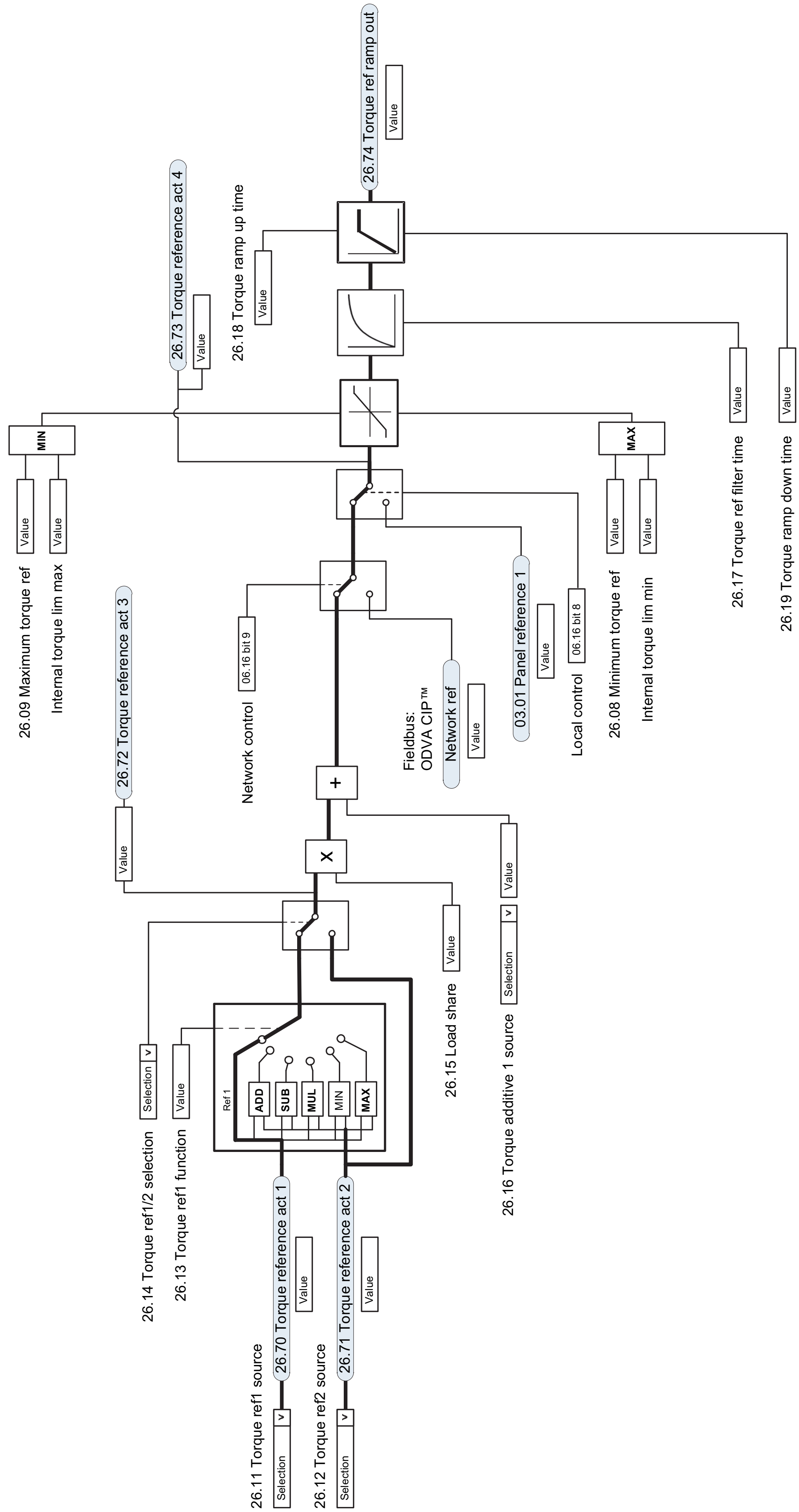
Speed error calculation



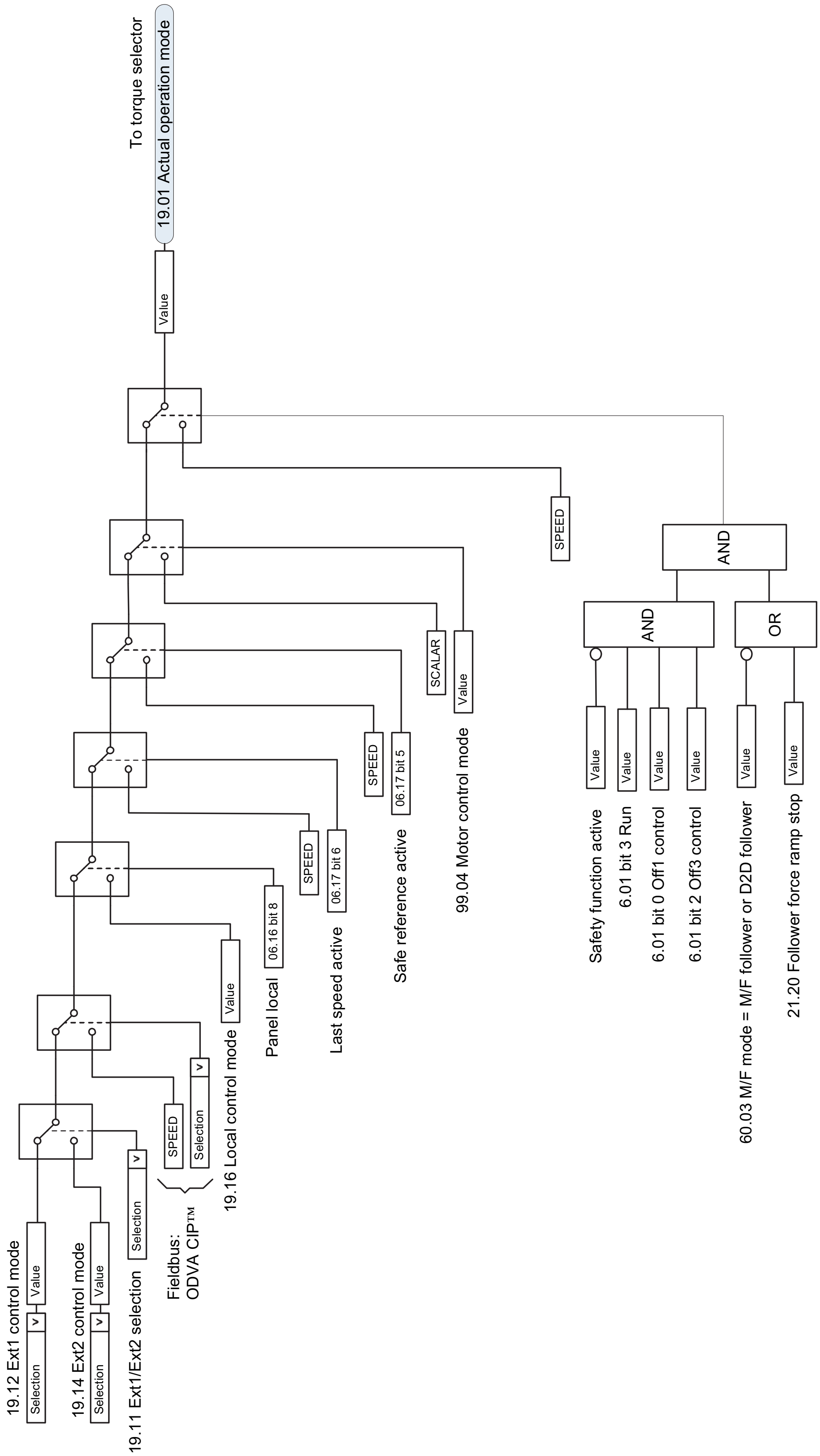
Speed controller



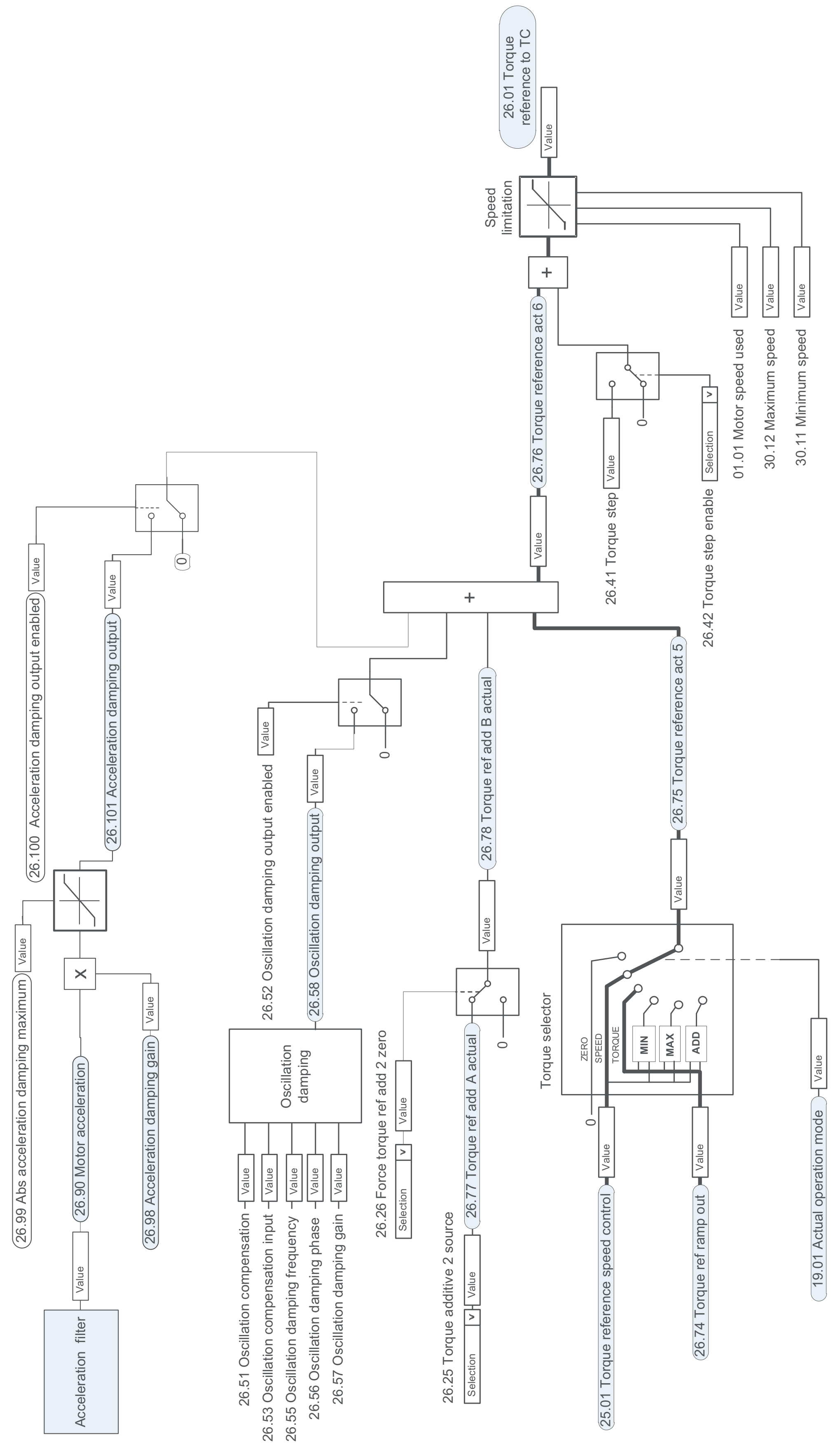
Torque reference source selection and modification



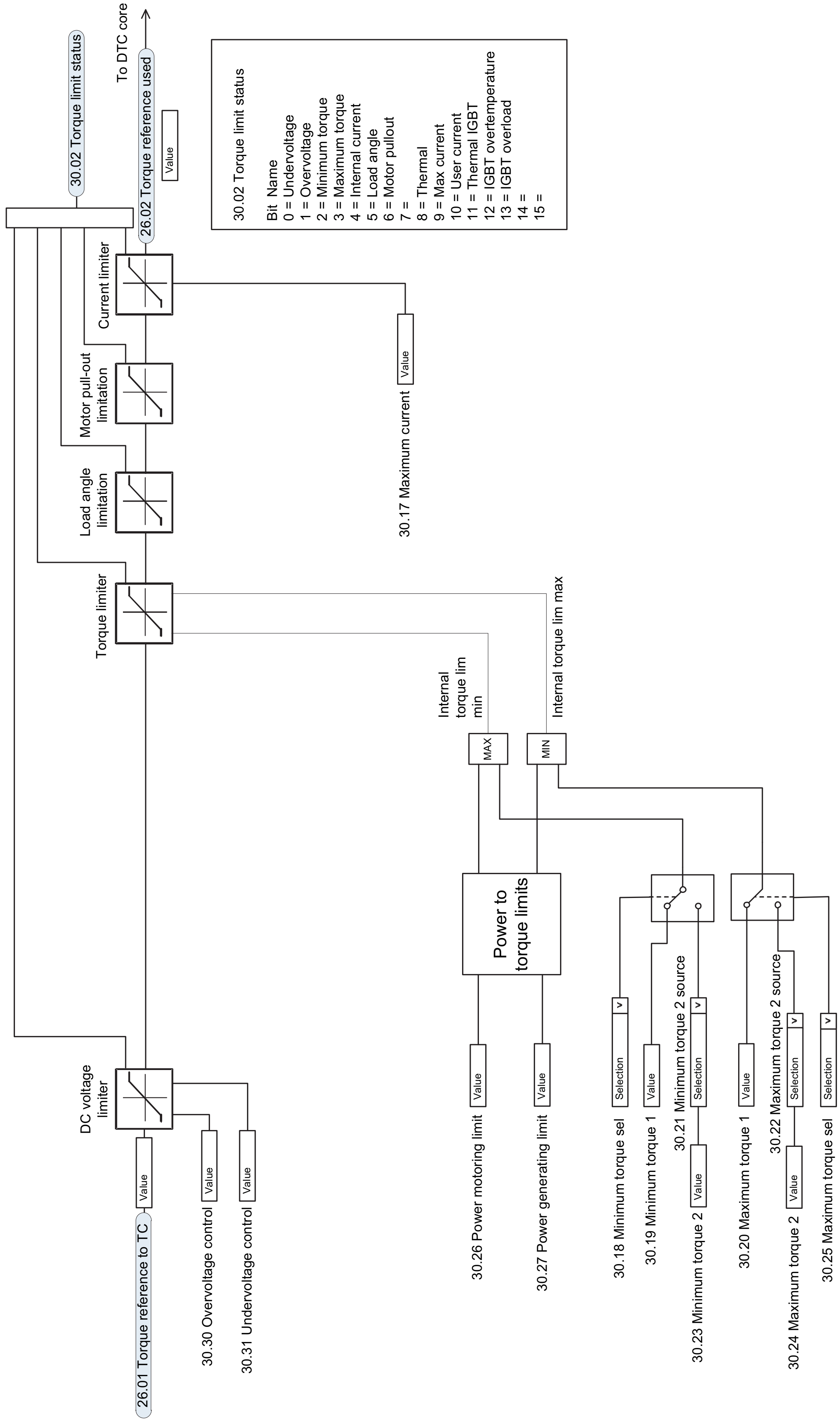
Operating mode selection



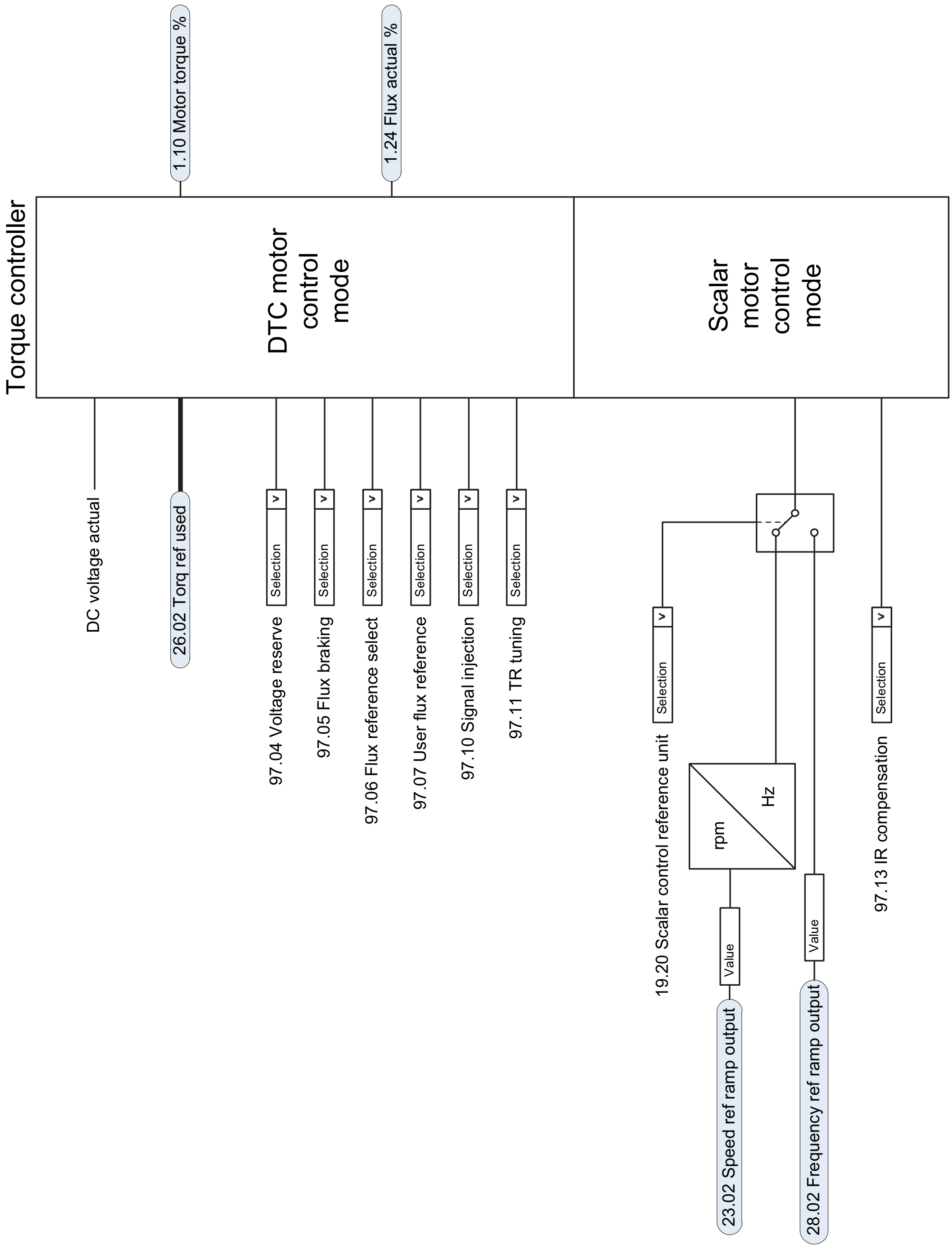
Reference selection for torque controller



Torque limitation

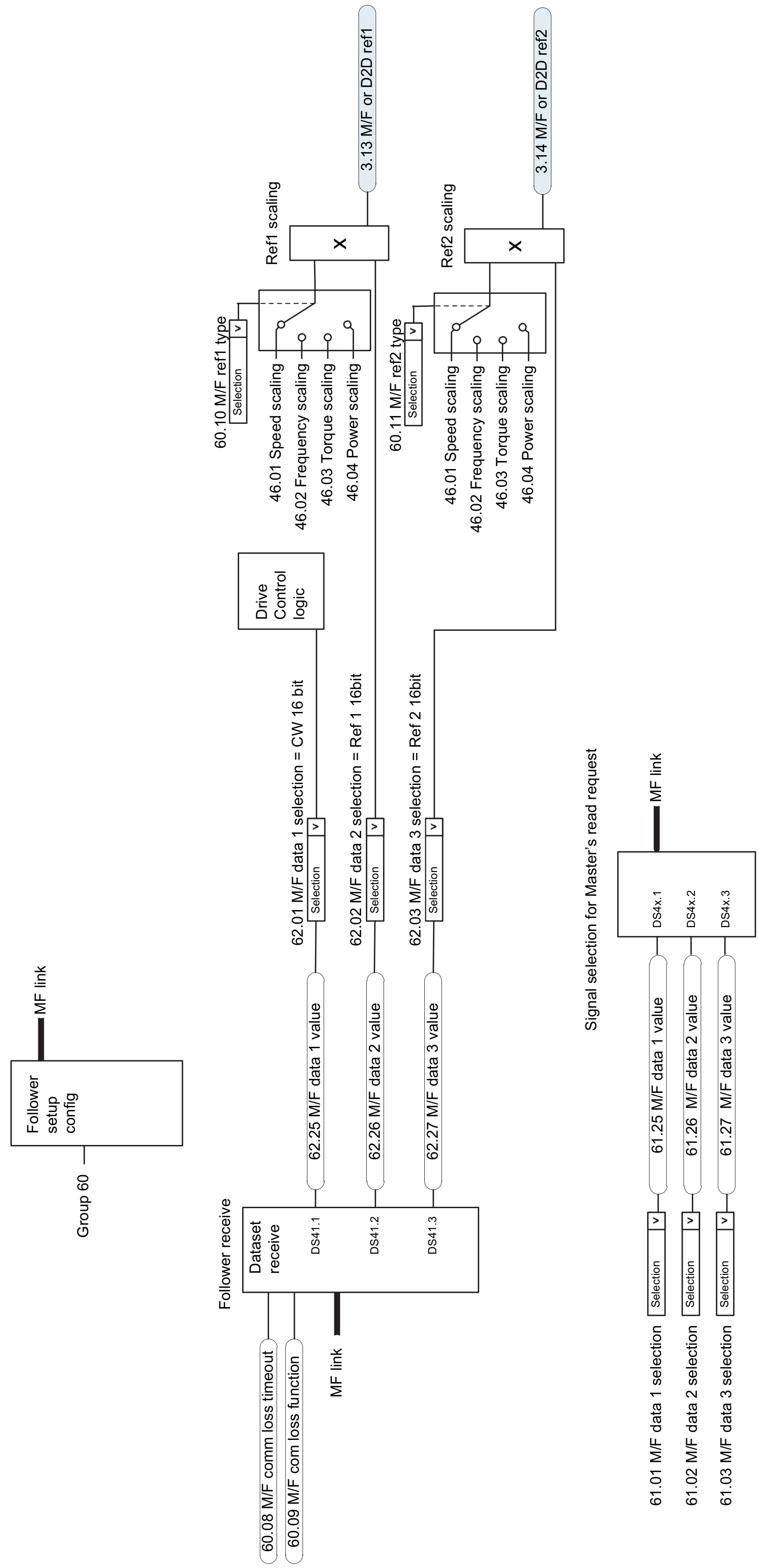


Torque controller



Master/Follower communication I (Master)

Master/Follower communication II (Follower)



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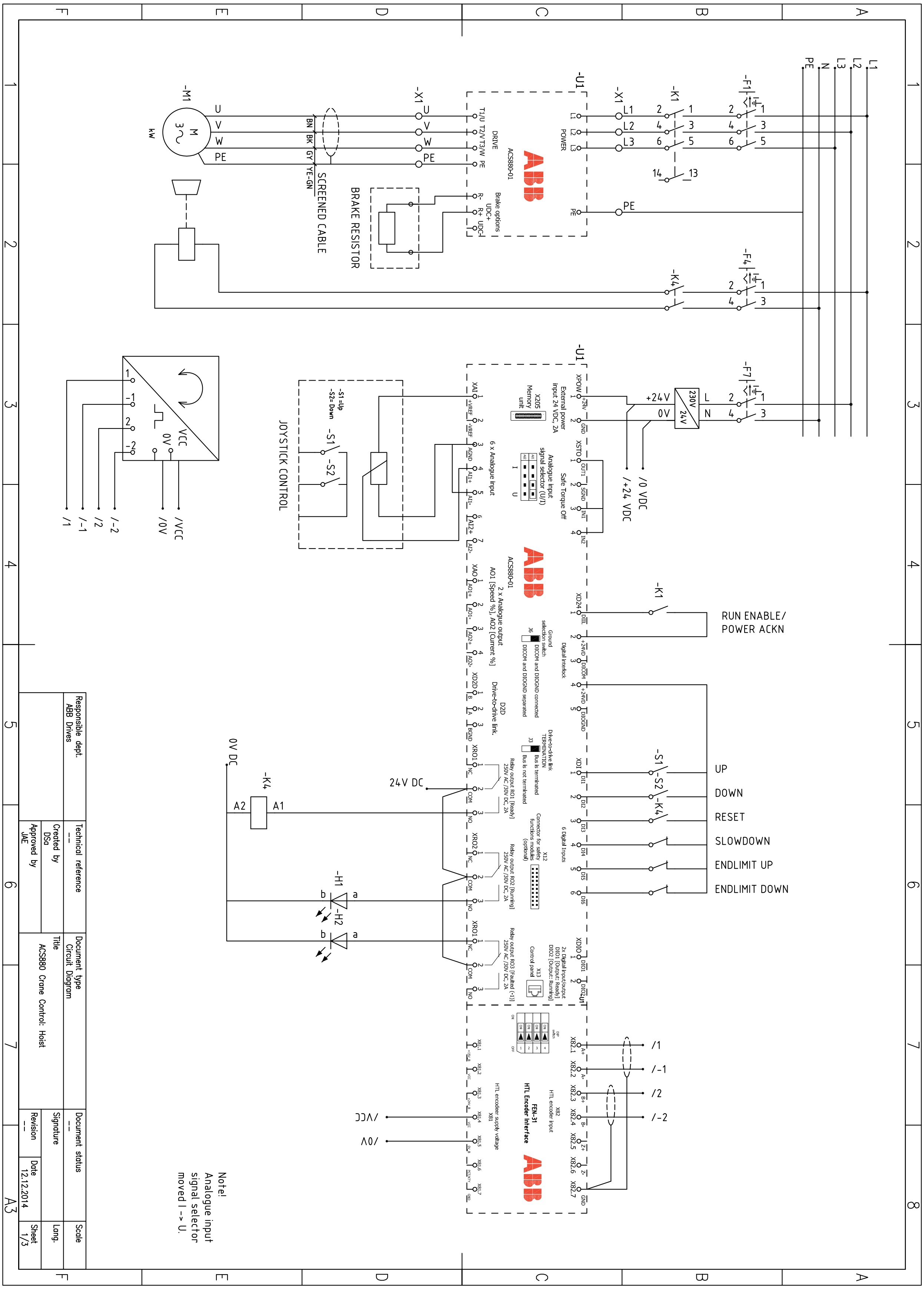
Example circuit diagrams

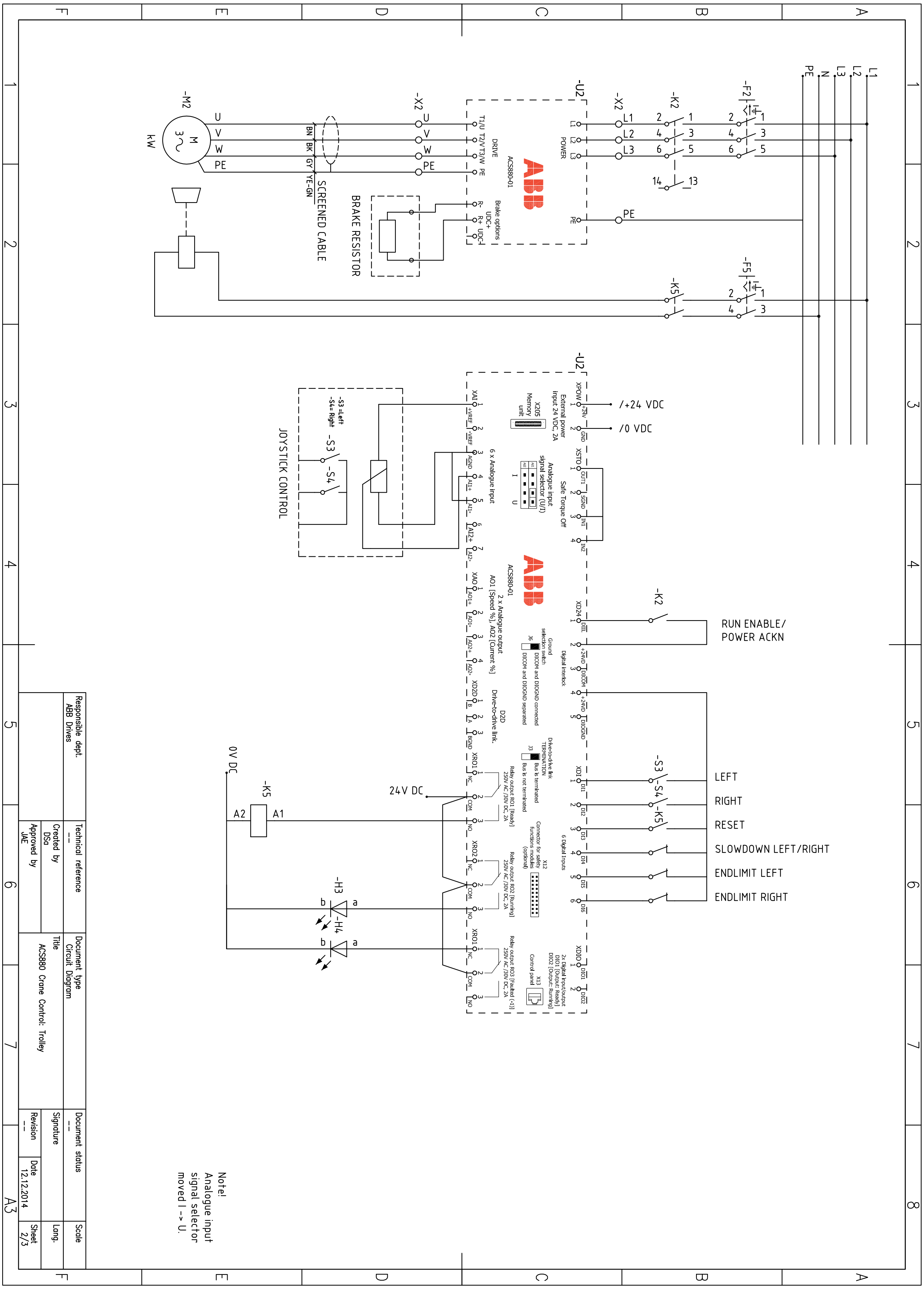
Contents of this chapter

The chapter presents example circuit diagrams of crane application.

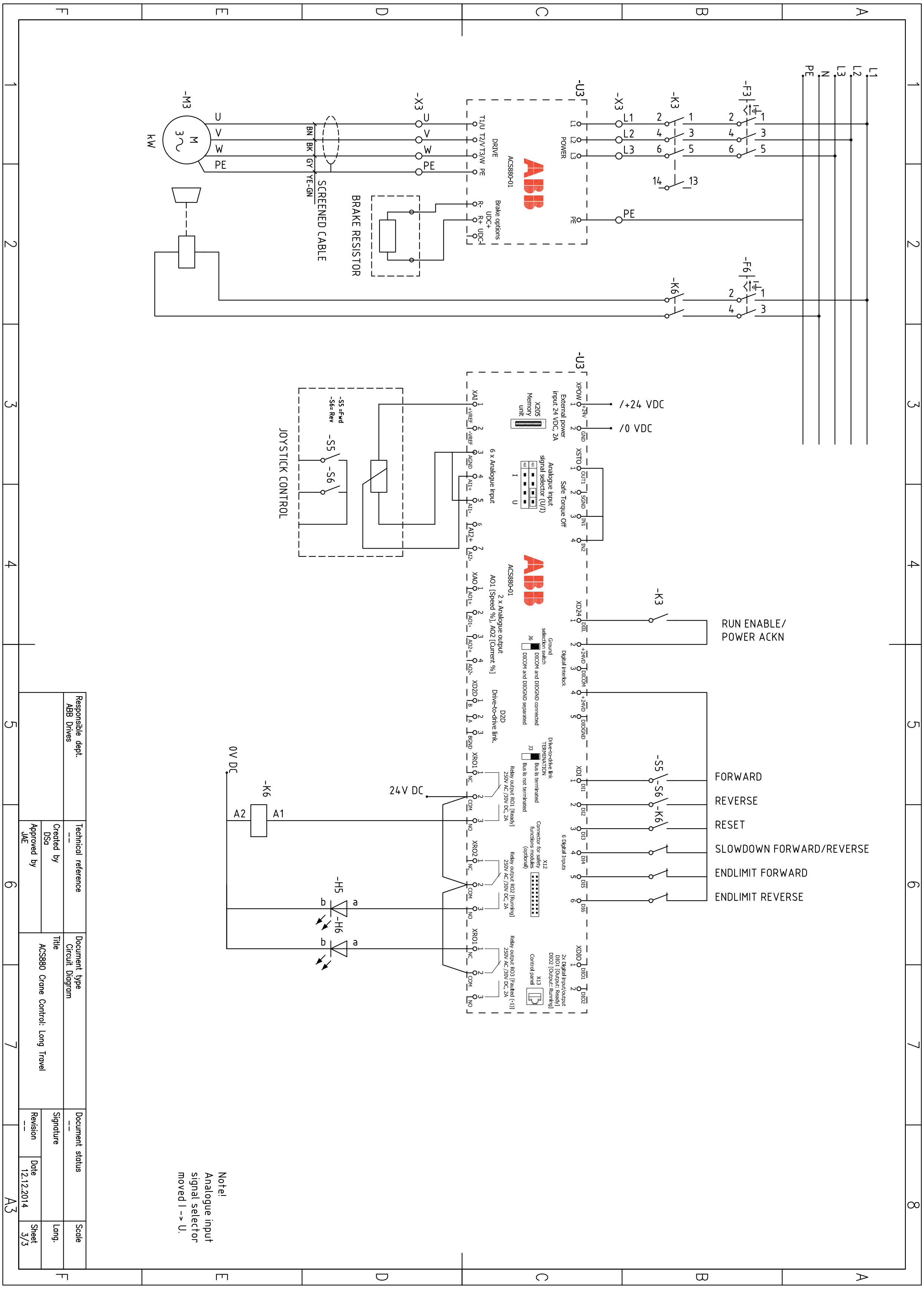
ACS880 crane control: Hoist



ACS880 crane control: Trolley



ACS880 crane control: Long travel



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