ABB MACHINERY DRIVES

ACS380 machinery control program

Firmware manual

List of related manuals

Drive hardware manuals and guides	Code (English)
Drive/converter/inverter safety instructions	3AXD50000037978
ACS380 Hardware manual	3AXD50000029274
Drive firmware manuals and guides	
ACS380 Firmware manual	3AXD50000029275
ACS380 Quick installation and start-up guide	3AXD50000018553
ACS380 User interface guide	3AXD50000022224
Option manuals and guides	
ACS-AP-x Assistant control panels user's manual	3AUA0000085685
ACS-BP-S Basic control panel user's manual	3AXD50000032527
BMIO-01 module quick installation guide	3AXD50000779468
FCAN-01 CANopen adapter module user's manual	3AFE68615500
FECA-01 EtherCAT adapter module user's manual	3AUA0000068940
FENA-01/-11/-21 Ethernet adapter module user's manual	3AUA0000093568
FPBA-01 PROFIBUS DP adapter module user's manual	3AFE68573271
FEPL-02 Ethernet POWERLINK adapter module user's manual	3AUA0000123527
Tool and maintenance manuals and guides	
Drive Composer PC tool user's manual	3AUA0000094606
Adaptive Programming Application guide	3AXD50000028574
NETA-21 remote monitoring tool user's manual	3AUA0000096939
NETA-21 remote monitoring tool installation and start-up guide	3AUA0000096881

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.

The code below opens an online listing of the manuals applicable to the product:

Firmware manual

ACS380 machinery control program

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3. Start-up, ID run and use

3AXD50000029275 Rev F
EN
EFFECTIVE: 2021-12-15

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1

Introduction to the manual

Contents

Applicability

The manual applies to the ACS380 machinery control program AMCK6 v2.15.0.12 or later.

To check the version of the control program, see parameter *07.05 Firmware version*.

Safety instructions

Follow all safety instructions.

- Read the complete safety instructions in the Hardware manual of the drive before you install, commission, or use the drive.
- Read the firmware function-specific warnings before changing parameter values. Chapter *Parameters* lists the relevant parameters and related warnings.

Target audience

The reader is expected to know the fundamentals of electricity, wiring, electrical components and electrical schematic symbols.

The manual is written for readers worldwide. Both SI and imperial units are shown.

Purpose of the manual

This manual provided information for designing, commissioning, or operating the drive system.

Terms and abbreviations

Term/abbreviation	Explanation
ACS-AP-x	Assistant control panel, advanced operator keypad for communication with the drive. The ACS380 support types ACS-AP-I, ACS-AP-S and ACS-AP-W (with a Bluetooth interface).
ACS-BP-S	Basic control panel, basic operator keypad for communication with the drive.
AI	Analog input; interface for analog input signals
AO	Analog output; interface for analog output signals
AsynM	Asynchronous motor
BAPO-01	Optional side-mounted auxiliary power extension module
BCAN-11	CANopen interface
BCBL-01	Optional USB to RJ45 cable
BMIO-01	I/O and Modbus module
Brake chopper	Conducts the surplus energy from the intermediate circuit of the drive to the brake resistor when necessary. The chopper operates when the DC link voltage exceeds a certain maximum limit. The voltage rise is typically caused by deceleration (braking) of a high inertia motor.
Brake resistor	Dissipates the drive surplus braking energy conducted by the brake chopper to heat. Essential part of the brake circuit. See chapter *Resistor breaking* in the hardware manual of the drive.
BREL-01	Optional side-mounted relay output extension module
BTAC-02	Optional side-mounted pulse encoder interface module
Capacitor bank	See *DC link capacitors*.
CCA-01	Optional cold configuration adapter
Control board	Circuit board in which the control program runs
DC link	DC circuit between rectifier and inverter
DC link capacitors	Energy storage which stabilizes the intermediate circuit DC voltage
DI	Digital input; interface for digital input signals
DO	Digital output; interface for digital output signals
Drive	Frequency converter for controlling AC motors
EFB	Embedded fieldbus
FBA	Fieldbus adapter
FCAN-01	Optional CANopen adapter module
FCNA-01	Optional ControlNet adapter module
FDNA-01	Optional DeviceNet adapter module
FECA-01	Optional EtherCAT adapter module

Term/abbreviation	Explanation
FENA -21	Optional Ethernet adapter module for EtherNet/IP, Modbus TCP and PROFINET IO protocols
FEPL-02	Ethernet POWERLINK adapter module
FPBA-01	Optional PROFIBUS DP adapter module
Frame (size)	Refers to the drive physical size, for example R1 and R2. The type designation label attached to the drive shows the frame of the drive, see the hardware manual of the drive.
ID run	Motor identification run. During the identification run, the drive will identify the characteristics of the motor for optimum motor control. Applies to vector control mode only.
Hexadecimal	Describes binary numbers using a numbering system that has 16 sequential numbers as base units. The hexadecimal numbers are 0-9 and the letters A-F.
IGBT	Insulated gate bipolar transistor
Intermediate circuit	See *DC link*.
Inverter	Converts direct current and voltage to alternating current and voltage.
I/O	Input/Output
LSW	Least significant word
Macro	Pre-defined default values of parameters in a drive control program. Each macro is intended for a specific application. See chapter *Control macros*.
NETA-21	Optional remote monitoring tool
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
PDO	Process data object
PID controller	Proportional–integral–derivative controller
PLC	Programmable logic controller
PMSM	Permanent magnet synchronous motor
PM	Permanent magnet
PROFIBUS, PROFIBUS DP, PROFINET IO	Registered trademarks of PI - PROFIBUS & PROFINET International

Term/abbreviation	Explanation
R0, R1,…	Frame (size)
RCD	Residual current device
Rectifier	Converts alternating current and voltage to direct current and voltage.
RFI	Radio frequency interference
RO	Relay output; interface for a digital output signal. Implemented with a relay.
SDO	Service data object
SIL	Safety integrity level. See chapter *Safe torque off function* in the drive hardware manual.
STO	Safe torque off. See chapter *Safe torque off function* in the drive hardware manual.

Related manuals

The related manuals are listed behind the front cover under *List of related manuals*.

Cybersecurity disclaimer

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

See also section *User lock* (page *119*).

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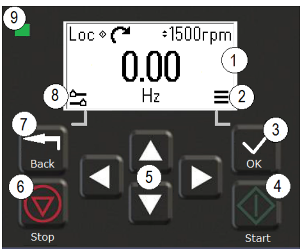
Control panel

Contents

Control panel

By default, ACS 380 has an integrated panel. If required, you can use external control panels such as assistant control panel or a basic panel. For more information, refer *ACX-AP-x assistant control panel's user's manual* (3AUA0000085685 [English]) or *ACS-BP-S basic control panel's user's manual* (3AXD50000032527 [English])



1. Display - shows the *Home* view as default.
2. Main menu.
3. OK button - open the Main menu, select and save settings.
4. Start button - start the drive.
5. Menu navigation buttons - move in the menus and set values.
6. Stop button - stop the drive.
7. Back button - open the Options menu, and move back in the menu.
8. Options menu.
9. Status light - green and red colors indicate the state and potential problems.

Home view and Message view

The *Home* view is the main view. Open the Main menu and Options menu from the *Home* view.

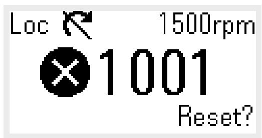
Home view

1. Control selection - local or remote
2. Local start/stop control - enabled
3. Rotation direction - forward or reverse
4. Local reference setting - enabled
5. Speed - target
6. Speed - current
7. Main menu - menu list
8. Options menu - quick access menu

The *Message* view shows fault and warning messages. If there is an active fault or warning, the panel shows the *Message* view directly.

You can open the *Message* view from the Options menu or Diagnostics submenu.

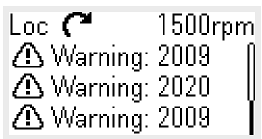
Message view: Fault



Fault messages require your immediate attention.

Check the code in the Fault messages table on page 504 to troubleshoot the problem.

Message view: Warning



Warning messages show possible problems.

Check the code in the Warning messages table on page 490 to troubleshoot the problem.

Options menu and Main menu

Options menu

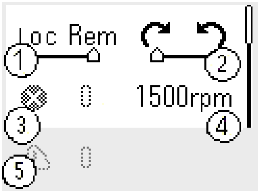
1. To open: press the Back button in the *Home* view.

Main menu

2. To open: press the OK button in the *Home* view.

Options menu

The Options menu is a quick access menu.

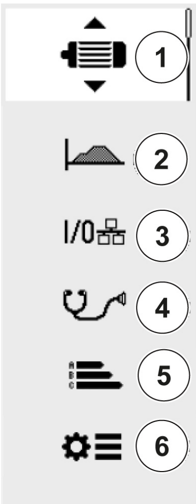


1. Control location - set to local or remote control
2. Rotation direction - set to forward or reverse
3. Active faults - view possible faults
4. Reference speed - set the reference speed
5. Active warnings - view possible warnings

Main menu

The Main menu is a scroll menu. The menu icons represent specific groups. The groups have submenus.

Note: You can define which Main menu items are visible (see parameter *49.30*).

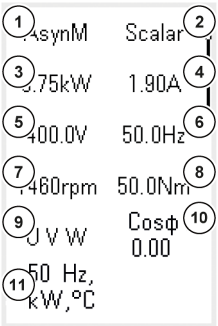


1. Motor data - motor parameters
2. Motor control - motor settings
3. Control macros
4. Diagnostics - faults, warnings, fault log and connection status
5. Energy efficiency - energy savings
6. Parameters - parameters

Submenus

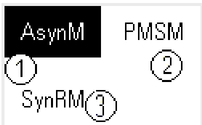
The Main menu items have submenus. Some submenus also have menus and/or option lists. The content of the submenus depend on the drive type.

Motor Data



1. Motor type - AsynM, PMSM, SynRM
2. Control mode - Scalar, Vector
3. Nominal power
4. Nominal current
5. Nominal voltage
6. Nominal frequency
7. Nominal speed
8. Nominal torque
9. Phase order - U V W, U W V
10. Nominal Cosphi
11. Unit selection - SI or US units

Motor Data: Motor type



1. AsynM
2. PMSM
3. SynRM

Motor Data: Control mode

1. Scalar
2. Vector

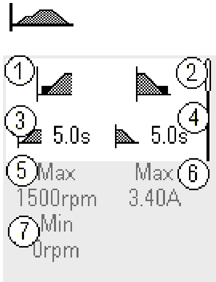
Motor Data: Phase order

1. U V W
2. U W V

Motor Data: Unit selection

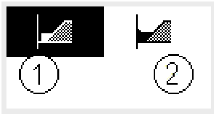
1. SI units
2. US units

Motor Control



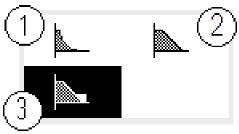
1. Start mode - Const time, Automatic
2. Stop mode - Coast, Ramp, DC hold
3. Acceleration time
4. Deceleration time
5. Maximum allowed speed
6. Maximum allowed current
7. Minimum allowed speed

Motor Control: Start modes



1. Const time
2. Automatic

Motor Control: Stop modes



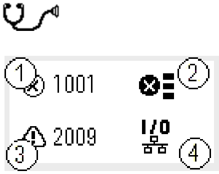
1. Coast
2. Ramp
3. DC hold

Control macros

The available control macros depend on the installed option modules:

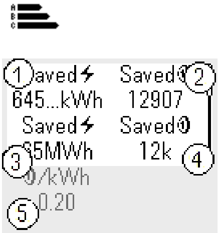
- ABB standard
- AC500 modbus RTU
- Alternate
- Motor potentiometer
- PID control
- Torque control

Diagnostics



1. Active Fault - shows the fault code
2. Fault History - list of latest fault codes (newest first)
3. Active Warnings - shows the warning code
4. Connection Status - Fieldbus and I/O signals

Energy Efficiency



1. Saved energy in kWh
2. Saved money
3. Saved energy in MW
4. Saved money x 1000
5. Cost per kWh h

Parameters

1. Complete parameter list - groups menu with complete parameters and parameter levels
2. Modified parameter list
3. Parameter restore - reset to factory default parameters

3

Start-up, ID run and use

Contents

Note: In this chapter the drive uses an integrated panel to perform the start-up, ID run, and other actions. You can also perform these functions using an external control panel or the Drive Composer PC tool.

Automatic option configuration

Ensure that the value of parameter 07.35 (Drive configuration) matches the installed option modules. If the parameter value is wrong, use automatic option configuration to update the configuration.

The drive automatically recognizes option modules that are attached to the drive during start-up. If you add or remove option modules, perform the following steps to automatically update the drive configuration to match the new set of option modules:

1. Set the value of parameters 07.35 (Drive configuration) and 07.36 (Drive configuration 2) to *0x0000*.
2. Turn the drive power off, wait for a minute, and then power-up the drive again. (It is also possible to reboot the drive using parameter 96.08 Control board boot.) The drive recognizes the currently attached optional modules and sets the correct settings. This may take a few seconds.

For more information, see section *Automatic drive configuration for fieldbus control* on page *600*.

Start up the drive

1. Energize the drive.
2. Enter the *Control macros* view and select the applicable macro.
   For units with a fieldbus adapter connected: you can see the fieldbus in the *Control macros* view. There are certain parameters that you need to change, e.g. the station ID. See chapter *Fieldbus control through a fieldbus adapter*.
3. Enter the *Motor data* view and select the units (international or US).
4. Set the motor type:

   AsynM: Asynchronous motor

   PMSM: Permanent magnet motor, or
   SynRM: Synchronous reluctance motor
5. Set the motor control mode:

   Vector: Speed reference. This is suitable for most cases. The drive does an automatic stand-still ID run.

   Scalar: Frequency reference.
   Use this mode when:

   - The number of motors can change.
   - The nominal motor current is less than 20% of the nominal drive current.

   Scalar mode is not recommended for permanent magnet motors.
6. Set the nominal motor values:
   - Nominal power
   - Nominal current
   - Nominal voltage
   - Nominal frequency
   - Nominal speed
   - Nominal torque (optional)
   - Nominal cosphi.
7. In the *Motor control* view, set the start and stop mode.
8. Set the acceleration time and the deceleration time.

Note: The speed acceleration and deceleration ramp times are based on the value in parameter *46.01 Speed scaling*/*46.02 Frequency scaling*.

9. Set the maximum and minimum speed or frequency. For more information, see parameters *30.11 Minimum speed* /*30.13 Minimum frequency* and *30.12 Maximum speed*/*30.14 Maximum frequency* on page *267*.
10. Tune the drive parameters to the application. You can use the Assistant control panel (ACS-AP-x), or the Drive Composer PC tool with the drive.

Do the identification (ID) run

Background information

If parameter *99.04* value is set to *Vector*, ID run is mandatory. In most applications, performing the standstill ID run is enough, but for more demanding applications other ID run modes may be needed.

The drive automatically estimates motor characteristics using Standstill ID run when the drive is started for the first time, and after any motor parameter (group *99 Motor data*) is changed. This is valid when:

- parameter *99.13 ID run requested* selection is *Standstill*, or
- parameter *99.04 Motor control mode* selection is*Vector*.

Use ID run for demanding motor control connections. For example:

- a permanent magnet motor (PMSM) is used
- the drive operates near zero speed references, or
- operation at torque range above the motor nominal torque, over a wide speed range is needed.

Note: If you change the motor parameters after the ID run, you need to repeat the ID run.

Note: If you have already parameterized your application using scalar motor control mode and you need to change to vector:

- in the *Motor data* submenu, set *Motor control* to *Vector*, or set parameter *99.04 Motor control mode* selection to *Vector*.
- for I/O controlled drive, check parameters in groups *22 Speed reference selection*, *23 Speed reference ramp*, *12 Standard AI*, *30 Limits* and *46 Monitoring/scaling settings*.
- for torque controlled drive, check also parameters in group *26 Torque reference chain*.

ID run steps

Warning! Make sure it is safe to start the motor and run it in either direction.

1. Open the *Main* menu.
2. Select the *Parameters* submenu.
3. Select *All parameters*.
4. Select *99 Motor data* and press OK.
5. Ensure that the nominal motor values have been defined correctly.
6. Select *99.13 ID run requested*, select the wanted ID mode and press OK.

   An *AFF6 Identification run* warning message is shown before you press Start.

   The panel LED starts to blink green to indicate an active warning.
7. Press Start to start the ID run.

   Do not press any control panel keys during the ID run. If you need to stop the ID run, press Stop.

After the ID run is completed, the status light stops blinking.

If the ID run fails, the panel shows the fault *FF61 ID run*.

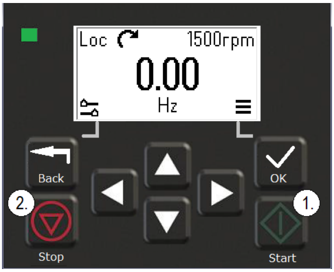
Check motor direction

Examine the actual direction of the motor:

1. Go back to the *Home* view.
2. Adjust the motor reference to a small value.
3. Make sure that is is safe to start the motor in either direction.
4. Start the motor and examine the actual rotation direction of the motor axis. If it is necessary, change the motor direction with the Phase order setting in the *Motor data* view or change the phase order of the motor cable.

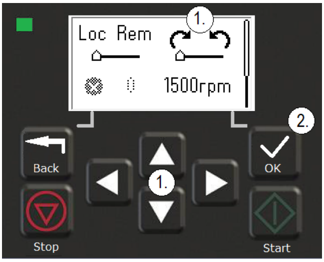
Warning! Changing the phase order of the motor cable is only allowed for an electrical professional. Before the operation, disconnect the power, wait for 5 minutes for discharging, and measure that there is no voltage.

Start and stop the drive



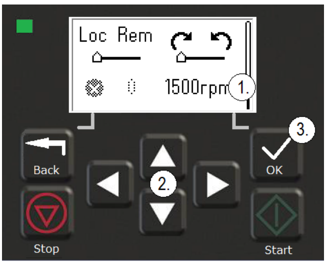
1. Press the Start button to start the drive.
2. Press the Stop button to stop the drive.

Change the rotation direction



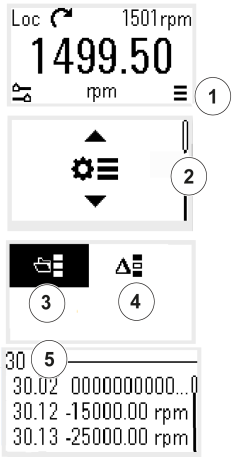
1. In the *Options* menu, move to the rotation direction item with the arrow buttons.
2. Press the OK button to change the rotation direction.

Set the speed or frequency reference



1. In the *Options* menu, move to the speed or frequency reference item and press OK.
2. Press the arrow buttons to edit the value.
3. Press the OK button to confirm the new value.

Set the drive parameters

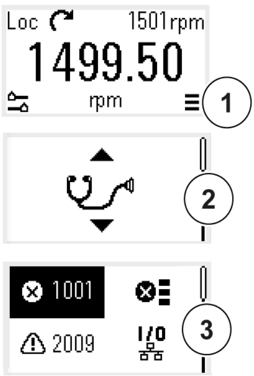


1. Select the Main menu from the *Home* view.
2. Scroll to Parameters, and press the OK button to open the submenu.
3. Select the complete parameters list with the arrow button and press the OK button, or
4. Select the modified parameters list with the arrow button and press the OK button.
5. Select the parameter and press the OK button.

   The parameters are shown in respective groups. The first two digits of the parameter number represent the parameter group. For example, parameters starting with 30 are in the Limits group.

See chapter *Parameters* for more information.

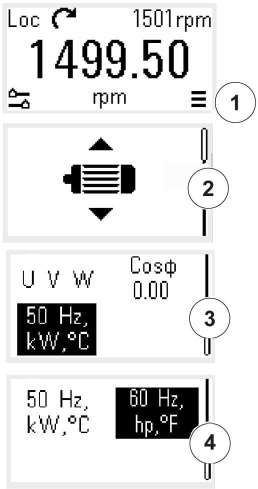
Open Diagnostics



1. Select the Main menu from the *Home* view.
2. Scroll to Diagnostics and press the OK button to open the submenu.
3. Select the warning or fault with the arrow button and press the OK button.

See chapter *Fault tracing* for more information.

Change the units



1. Select the Main menu from the *Home* view.
2. Scroll to Motor data and press the OK button to open the submenu.
3. Scroll to the unit selection item and press the OK button.
4. Select the unit with the arrow button, then press the OK button.

   You can see the selected unit on the *Home* view.

4

Control macros

Contents

Control macros are sets of default parameter values that apply to a specific control configuration. They make it faster and easier to set up a drive for use.

By default, a macro for the I/O controlled drive is set as the ABB standard macro.

ABB standard macro

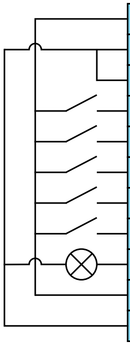
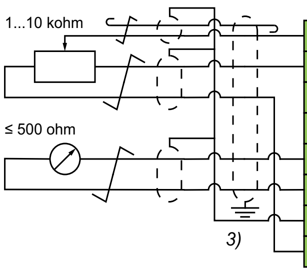
ABB standard macro is suitable for an IO-controlled drive. Digital inputs control start/stop (2-wire), direction and constant speed selection (3 speeds) and acceleration and deceleration ramp selection.

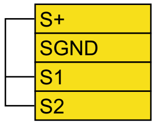
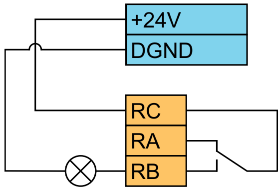
You can activate the macro from the *Control macros* view, or by setting parameter *96.04 Macro select* to value *ABB standard.*

This is the default macro for all ACS380 types.

Default control connections for the ABB standard macro

This connection diagram is valid for the drive with the BMIO-01 option (for example ACS380-04xS or ACS380-04xC+L538).

Terminals	Description
Digital I/O connections	
	
+24V	Aux. +24 V DC, max 200 mA
DGND	Aux. voltage output common
DCOM	Digital input common
DI1	Stop (0) / Start (1)
DI2	Forward (0) / Reverse (1)
DI3	Constant frequency / speed selection 1)
DI4	Constant frequency / speed selection 1)
DIO1	Ramp set 1 input (0) / Ramp set 2 input (1) 2)
DIO2	Not ready output (0) / Ready run output (1)
DIO SRC	Digital output auxiliary voltage
DIO COM	Digital input/output common
Analog I/O	
	
AI1	Speed / freq.(0…10V) 4)
AGND	Analog input circuit common
AI2	Not configured 4)
AGND	Analog input circuit common
AO	Output frequency (0…20 mA)
AGND	Analog output circuit common
SCR	Signal cable shield (screen)
+10V	Ref. voltage +10 V DC
Safe Torque Off (STO)	

Terminals	**Description**
Digital I/O connections	
	Safe torque off. Connected at factory. Drive starts only if both circuits are closed.
Relay output 1	
	No fault [Fault (-1)]

Notes:

Terminal sizes: 0.14 mm² … 1.5 mm²

Tightening torques: 0.5 N·m (0.4 lbf·ft).

Terminals DGND, AGND and SGND are internally connected to same reference potential.

Reference from the integrated panel.

1) In scalar control (default): See parameter group *28 Frequency reference chain*. In vector control: See parameter group *22 Speed reference selection*. Select the correct control mode from the *Motor data* view or with parameter *99.04 Motor control mode*.

DI3	**DI4**	**Operation/Parameter**	
		Scalar control (default)	**Vector control**
0	0	Set frequency through AI1	Set speed through AI1
1	0	*28.26 Constant frequency 1*	*22.26 Constant speed 1*
0	1	*28.27 Constant frequency 2*	*22.27 Constant speed 2*
1	1	*28.28 Constant frequency 3*	*22.28 Constant speed 3*

2)

DIO1	**Ramp set**	**Parameters**
0	1	*28.71 Freq ramp set selection*,…,
1	2	*28.74 Freq acceleration time 2*

[3] Ground the outer shield of the cable 360 degrees under the grounding clamp on the grounding shelf for the control cables.

[4] Select the unit for analog input AI1 in the parameter *12.15* and for AI2 in the parameter *12.25*.

Input signals

- Start/Stop selection (DI1)
- Forward (0) / Reverse (1) (DI2)
- Speed selection (DI3)
- Speed selection (DI4)
- Ramp set 1 (0) / Ramp set 2 (1) selection (DIO1)
- Output frequency or motor speed reference (AI1)

Output signals

- Output frequency (AO)
- Ready to run (0) / Not ready (1) (DIO2)
- No Fault [Fault (-1)]

AC500 modbus RTU macro

The AC500 Modbus RTU macro configures the drive communication and control parameters to work with AC500 PLC and Modbus RTU communication. The drive uses the embedded Modbus RTU on the BMIO-01 board.

The macro is available with firmware version 2.15 or later.

You can activate the macro from the Control macros view, or by setting the parameter *96.04 Macro select* value as *AC500 Modbus RTU*.

Activation of the macro changes some values from their default values. For details, see section *Parameter default values for different macros* on page *46*.

Settings

- parameter *96.04 Macro select* value

Alternate macro

This macro provides an I/O configuration where one signal starts the motor in the forward direction and another signal starts the motor in the reverse direction.

You can activate the macro from the *Control macros* view, or by setting parameter *96.04 Macro select* to value *Alternate.*

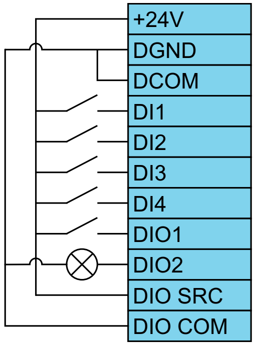
The macro is optimized for the standard drive variant (ACS380-04xS) and configured drive variant ACS380-04xC +L538. You can use it also with the base drive variant (ACS380-04xN) but then you cannot use all the I/O available in the macro.

Activation of the macro changes some values from their default values. For details, see section *Parameter default values for different macros* on page 46.

Default control connections for the Alternate macro

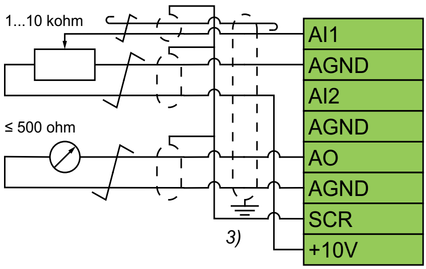
This connection diagram is valid for the drive with the BMIO-01 option (for example ACS380-04xS or ACS380-04xC+L538) (with the Alternate macro selected).

Digital I/O connections



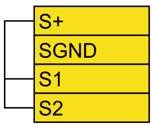
Terminals	Description
+24V	Aux. +24 V DC, max 200 mA
DGND	Aux. voltage output common
DCOM	Digital input common
DI1	Start forward; If DI1 = DI2: stop
DI2	Start reverse
DI3	Constant speed / frequency selection [1)]
DI4	Constant speed / frequency selection [1)]
DIO1	Ramp set 1(0) / Ramp set 2 (1) [2)]
DIO2	Ready run (0) / not ready run
DIO SRC	Digital output auxiliary voltage
DIO COM	Digital input/output common

Analog I/O



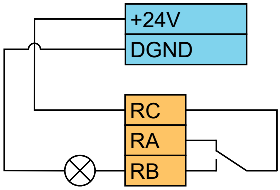
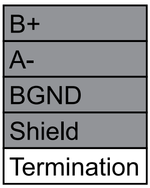
Terminals	Description
AI1	Output freq./Speed ref.(0…10V) [4)]
AGND	Analog input circuit common
AI2	Not configured [4)]
AGND	Analog input circuit common
AO	Output frequency (0…20 mA)
AGND	Analog output circuit common
SCR	Signal cable shield (screen)
+10V	Ref. voltage +10 V DC

Safe Torque Off (STO)



Terminals	Description
S+	Safe torque off. Connected at factory. Drive starts only if both circuits are closed.
SGND	
S1	
S2	

Relay output 1

<table>
<tr><th>Terminals</th><th>Description</th></tr>
<tr><td colspan="2">Digital I/O connections</td></tr>
<tr><td>
</td><td>No fault [Fault (-1)]</td></tr>
<tr><td colspan="2">EIA-485 Modbus RTU</td></tr>
<tr><td>
</td><td>Embedded Modbus RTU (EIA-485). See chapter Fieldbus control through the embedded fieldbus interface (EFB).</td></tr>
</table>

Notes:

Terminal sizes: 0.14 mm² … 1.5 mm²

Tightening torque: 0.5 N·m (0.4 lbf·ft).

Terminals DGND, AGND and SGND are internally connected to same reference potential.

[1)] In scalar control (default): See parameter group *28 Frequency reference chain*.
In vector control: See parameter group *22 Speed reference selection*.

Select the correct control mode from the *Motor data* view or with parameter *99.04 Motor control mode*.

DI3	DI4	Operation/Parameter	
		Scalar control (default)	**Vector control**
0	0	Set frequency through AI1	Set speed through AI1
1	0	*28.26 Constant frequency 1*	*22.26 Constant speed 1*
0	1	*28.27 Constant frequency 2*	*22.27 Constant speed 2*
1	1	*28.28 Constant frequency 3*	*22.28 Constant speed 3*

[2)] In scalar control (default): See parameter group *28 Frequency reference chain*.
In vector control: See parameter group *23 Speed reference ramp*.

Select the correct control mode from the *Motor data* view or with parameter *99.04 Motor control mode*.

DIO2	Ramp set	Parameters	
		Scalar control (default)	Vector control
0	1	*28.72 Freq acceleration time 1* *28.73 Freq deceleration time 1*	*23.12 Acceleration time 1* *23.13 Deceleration time 1*
1	2	*28.74 Freq acceleration time 2* *28.75 Freq deceleration time 2*	*23.14 Acceleration time 2* *23.15 Deceleration time 2*

3) Ground the outer shield of the cable 360 degrees under the grounding clamp on the grounding shelf for the control cables.

4) Select the unit for analog input AI1 in the parameter *12.15* and for AI2 in the parameter *12.25*.

Input signals

- Start motor forward (DI1)
- Start motor in reverse (DI2)
- Constant output frequency / motor speed selection (DI3)
- Constant output frequency / motor speed selection (DI4)
- Ramp set selection (DIO1)

Output signals

- Output frequency or motor speed reference (AI1)
- Output frequency (AO1)
- No Fault [Fault (-1)]

Motor potentiometer macro

This macro provides a way to adjust the speed with the help of two push buttons, or a cost-effective interface for PLCs that vary the speed of the motor using only digital signals.

You can activate the macro from the *Control macros* view, or by setting parameter *96.04 Macro select* to value *Motor potentiometer.*

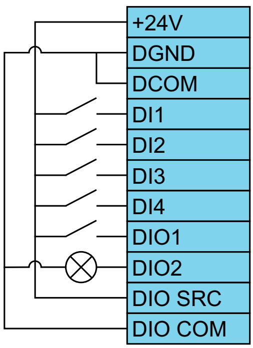
For more information on the motor potentiometer counter, see section *Motor potentiometer* on page *119*.

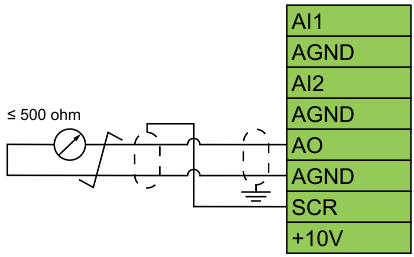
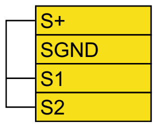
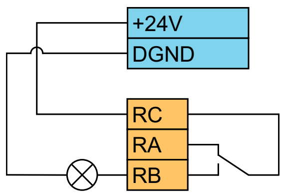
The macro is optimized for the standard drive variant (ACS380-04xS) and configured drive variant ACS380-04xC +L538.

Activation of the macro changes some values from their default values. For details, see section *Parameter default values for different macros* on page *46*.

Default control connections for the Motor potentiometer macro

This connection diagram is valid for drives with the standard drive variant ACS380-04xS and the configured drive variant ACS380-04xC +L538 (with the Motor potentiometer macro selected).

Terminals	Description
Digital I/O connections 	
+24V	Aux. +24 V DC, max 200 mA
DGND	Aux. voltage output common
DCOM	Digital input common
DI1	Stop (0) / Start (1)
DI2	Forward (0) / Reverse (1)
DI3	Frequency / speed up [1)]
DI4	Frequency / speed down [1)]
DIO1	Constant speed sel 1 [2)]
DIO2	Ready run (0) / Not ready run (1)
DIO SRC	Digital output auxiliary voltage
DIO COM	Digital input/output common
Analog I/O	

Terminals	Description
Digital I/O connections	
	
AI1	Not configured [4]
AGND	Analog input circuit common
AI2	Not configured [4]
AGND	Analog input circuit common
AO	Not configured
AGND	Analog output circuit common
SCR	Signal cable shield (screen)
+10V	Ref. voltage +10 V DC
Safe Torque Off (STO)	
	Safe torque off. Connected at factory. Drive starts only if both circuits are closed.
S+	
SGND	
S1	
S2	
Relay output 1	
	No fault [Fault (-1)]
+24V	
DGND	
RC	
RA	
RB	

Notes:

Terminal sizes: 0.14 mm² … 1.5 mm²

Tightening torque: 0.5 N·m (0.4 lbf·ft).

Terminals DGND, AGND and SGND are internally connected to same reference potential.

[1] When the input signal is on, the speed/frequency increase or decrease along a parameter-defined change rate. See parameters *22.75*, *22.76*, and *22.77*. If DI3 and DI4 are both active or inactive, the frequency/speed reference is unchanged. The existing frequency/speed reference is stored during stop and power down.

[2] In scalar control (default): See parameter group *28 Frequency reference chain*. In vector control: See parameter group *23 Speed reference ramp*.

Select the correct control mode from the *Motor data* view or with parameter *99.04 Motor control mode*.

DIO1	Ramp set	Parameters	
		Scalar control (default)	Vector control
0	1	*28.72 Freq acceleration time 1* *28.73 Freq deceleration time 1*	*23.12 Acceleration time 1* *23.13 Deceleration time 1*
1	2	*28.74 Freq acceleration time 2* *28.75 Freq deceleration time 2*	*23.14 Acceleration time 2* *23.15 Deceleration time 2*

3) Ground the outer shield of the cable 360 degrees under the grounding clamp on the grounding shelf for the control cables.

4) Select the unit for analog input AI1 in the parameter *12.15* and for AI2 in the parameter *12.25*.

Input signals

- Stop (0) / Start (1) (DI1)
- Forward (0) / Reverse (1) (DI2)
- Frequency / speed up (DI3)
- Frequency / speed down (DI4)
- Constant speed selection 1 (DIO1)

Output signals

- No Fault [Fault (-1)]

PID control macro

This macro is suitable for applications where the drive is always controlled by PID and the reference comes from analog input AI1.

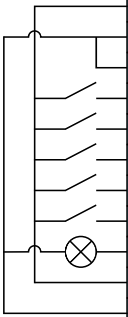
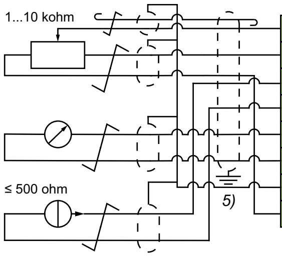
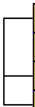
You can activate the macro from the *Control macros* view, or by setting parameter *96.04 Macro select* to value *PID.*

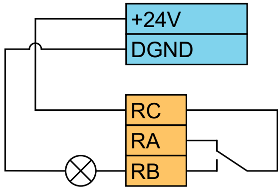
The macro is optimized for the standard drive variant ACS380-04xS and the configured drive variant ACS380-04xC +L538.

Activation of the macro changes some values from their default values. For details, see section *Parameter default values for different macros* on page *46*.

Default control connections for PID control macro

This connection diagram is valid for the standard drive variant ACS380-04xS and the configured drive variant ACS380-04xC +L538 (with the PID control macro selected).

Terminals	Description
Digital I/O connections 	
+24V	Aux. +24 V DC, max 200 mA
DGND	Aux. voltage output common
DCOM	Digital input common
DI1	Stop (0) / Start (1)
DI2	Internal setpoint sel1 [1)]
DI3	Internal setpoint sel2 [1)]
DI4	Constant speed / frequency selection [2)]
DIO1	Run enable 1 source
DIO2	Ready run
DIO SRC	Digital output auxiliary voltage
DIO COM	Digital input/output common
Analog I/O 	
AI1	External PID ref [3) 6)]
AGND	Analog input circuit common
AI2	Actual PID feedback [4) 6)]
AGND	Analog input circuit common
AO	Output frequency (0…20 mA)
AGND	Analog output circuit common
SCR	Signal cable shield (screen)
+10V	Ref. voltage +10 V DC
Safe Torque Off (STO) 	
S+ SGND S1 S2	Safe torque off. Connected at factory. Drive starts only if both circuits are closed.
Relay output 1	

Terminals	Description
Digital I/O connections	
	No fault [Fault (-1)]

Notes:

Terminal sizes: 0.14 mm² … 1.5 mm²

Tightening torque: 0.5 N·m (0.4 lbf·ft).

Terminals DGND, AGND and SGND are internally connected to same reference potential.

1) See parameters *40.19 Set 1 internal setpoint sel1* and *40.20 Set 1 internal setpoint sel2* source table.

Source defined by par. *40.19* DI2	Source defined by par. *40.20* DI3	Internal setpoint active
0	0	Setpoint source: AI1 (par. *40.16*)
1	0	1 (par. *40.21*)
0	1	2 (par. *40.22*)
1	1	3 (par.*40.23*)

2) Select the correct control mode from the *Motor data* view or with parameter *99.04 Motor control mode*.

DI4	Operation/Parameter	
	Scalar control (default)	**Vector control**
0	Set frequency through AI1	Set speed through AI1
1	*28.26 Constant frequency 1*	*22.26 Constant speed 1*

3) PID: 0…10 V -> 0…100% PID setpoint.

4) The signal source is powered externally. See the manufacturer's instructions. To use sensors supplied by the drive aux. voltage output, see connection examples of two-wire and three-wire sensors in the hardware manual of the drive.

5) Ground the outer shield of the cable 360 degrees under the grounding clamp on the grounding shelf for the control cables.

[6)] Select the unit for analog input AI1 in the parameter *12.15* and for AI2 in the parameter *12.25*.

Input signals

- External PID ref (AI1)
- Actual feedback from PID (AI2)
- Start/Stop selection (DI1)
- Constant setpoint 1 (DI2)
- Constant setpoint 2 (DI3)
- Speed/freq selection (DI4)
- Ramp pair selection (DIO1)

Output signals

- Output frequency (AO)
- No Fault [Fault (-1)]

Torque control macro

Note: The torque control macro requires that the BMIO-01 module (option +L538) is connected to the drive.

You can use this macro for applications in which torque control of the motor is required. These are typically tension applications, where a particular tension needs to be maintained in the mechanical system.

The control program reads the torque reference from analog input AI2, typically as a current signal in the range of 0…20 mA (corresponding to 0…100% of rated motor torque).

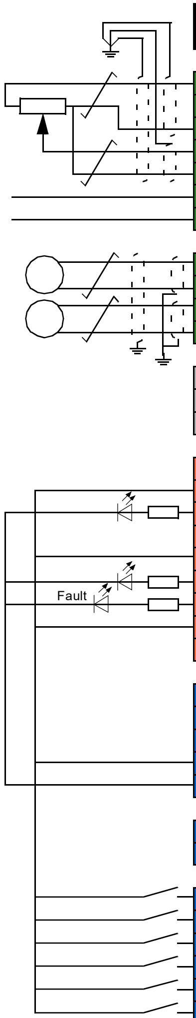
Connect the start/stop signal to digital input DI1. Digital input DI2 determines the direction. Digital input DI3 allows you to select speed control (EXT1) instead of torque control (EXT2). As with the PID control macro, you can use speed control to commission the system and to check the motor direction.

You can change to local control (control panel or PC tool) if you press the Loc/Rem key. By default, the local reference is speed; if you need a torque reference, change the value of parameter *19.16* to *Torque*.

You can activate a constant speed (by default, 300 rpm) through DI4. DI5 switches between acceleration/deceleration time sets 1 and 2. Parameters *23.12*…*23.15* define the acceleration and deceleration times, as well as ramp shapes.

Activation of the macro changes some values from their default values. For details, see section *Parameter default values for different macros* on page *46*.

Default control connections for the Torque control macro



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+	**Ext1 speed reference**
5	AI1-	0(2)…10 V, R_{in} > 200 kohm
6	AI2+	**Torque reference**
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	Master/follower, drive-to-drive or embedded fieldbus interface connection
2	A	
3	BGND	
XRO1, XRO2, XRO3	Relay outputs	
1	NC	***Ready run***
2	COM	250 V AC / 30 V DC
3	NO	2 A
1	NC	***Running***
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	Digital interlock. By default, not in use.
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	Ramp 1 (0) / Ramp 2 (1)
2	DIO2	Run enable source
XDI	Digital inputs	
1	DI1	Stop (0) / Start (1)
2	DI2	Speed control: Forward (0) / Reverse (1)
3	DI3	Speed control (0) / Torque control (1)
4	DI4	Speed control: Constant speed 1 (1 = On)
5	DI5	Acc/Dec time set 1 (0) / set 2 (1)
6	DI6	Run enable (1 = On)
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	

Parameter default values for different macros

Chapter *Parameters* shows the default values of all parameters for the ABB standard macro (factory macro). Some parameters have different default values for other macros. The tables below lists the default values for those parameters for each macro.

96.04	***Macro select***	**1 = *ABB standard***	**5 = AC500 Modbus RTU**	**12 = *Alternate***	**13 = *Motor potentiometer***	**14 = *PID***	**28 = Torque control**
10.24	*RO1 source*	15 = *Fault (-1)*	15 = *Fault (-1)*	15 = *Fault (-1)*	15 = *Fault (-1)*	15 = *Fault (-1)*	2 = *Ready run*
12.20	*AI1 scaled at AI1 max*	50.000	50.000	50.000	50.000	50.000	1500.000
13.12	*AO1 source*	3 = *Output frequency*	3 = *Output frequency*	3 = *Output frequency*	3 = *Output frequency*	3 = *Output frequency*	1 = *Motor speed used*
13.18	*AO1 source max*	50.0	50.0	50.0	50.0	50.0	1500.000
19.11	*Ext1/Ext2 selection*	0 = *EXT1*	0 = *EXT1*	0 = *EXT1*	0 = *EXT1*	0 = *EXT1*	5 = *DI3*
20.01	*Ext1 commands*	2 = *In1 Start; In2 Dir*	14 = *Embedded*	3 = *In1 Start fwd; In2*	2 = *In1 Start; In2 Dir*	1 =*In1 Start*	2 = *In1 Start; In2 Dir*
20.03	*Ext1 in1 source*	2 = *DI1*	0 = *Always off*	2 = *DI1*	2 = *DI1*	2 = *DI1*	2 = *DI1*
20.04	*Ext1 in2 source*	3 = *DI2*	0 = *Always off*	3 = *DI2*	3 = *DI2*	0 = *Always off*	3 = *DI2*
20.05	*Ext1 in3 source*	0 = *Always off*	0 = *Always off*	0 = *Always off*	0 = *Always off*	0 = *Always off*	0 = *Always off*
20.06	*Ext2 commands*	0 = *Not selected*	0 = *Not selected*	0 = *Not selected*	0 = *Not selected*	0 = *Not selected*	1 = *In1 Start*
20.08	*Ext2 in1 source*	0 = *Always off*	0 = *Always off*	0 = *Always off*	0 = *Always off*	0 = *Always off*	2 = *DI1*
20.09	*Ext2 in2 source*	0 = *Always off*	0 = *Always off*	0 = *Always off*	0 = *Always off*	0 = *Always off*	3 = *DI2*
20.12	*Run enable 1 source*	1 = *Selected*	1 = *Selected*	1 = *Selected*	1 = *Selected*	10 = *DIO1*	11 = *DIO2*
21.05	*Emergency stop source*	1= *Inactive (true)*	1= *Inactive (true)*	1= *Inactive (true)*	1= *Inactive (true)*	1= *Inactive (true)*	1= *Inactive (true)*
22.11	*Ext1 speed ref1*	1 = *AI1 scaled*	8 = *EFB ref1*	1 = *AI1 scaled*	15 = *Motor potentiomet*	16 = *PID*	1 = *AI1 scaled*
22.18	*Ext2 speed ref1*	0 = *Zero*	0 = *Zero*	0 = *Zero*	0 = *Zero*	0 = *Zero*	0 = *Zero*
22.22	*Constant speed sel1*	4 = *DI3*	0 = *Always off*	4 = *DI3*	10 = *DIO1*	5 = *Always offAlways*	5 = *DI4*
22.23	*Constant speed sel2*	5 = *Always offAlways*	0 = *Always off*	5 = *Always offAlways*	0 = *Always off*	0 = *Always off*	5 = *DI4*

96.04 Macro select	**1 = *ABB standard***	**5 = AC500 Modbus RTU**	**12 = *Alternate***	**13 = *Motor potentiometer***	**14 = *PID***	**28 = Torque control**
22.71 Motor potentiometer function	0 = *Disabled*	0 = *Disabled*	0 = *Disabled*	1 = *Enabled (init at power-up)*	0 = *Disabled*	0 = *Disabled*
22.73 Motor potentiometer up source	0 = *Not selected*	0 = *Not selected*	0 = *Not selected*	4 = *DI3*	0 = *Not selected*	Not used
22.74 Motor potentiometer down source	0 = *Not selected*	0 = *Not selected*	0 = *Not selected*	5 = *DI4*	0 = *Not selected*	Not used
23.11 Ramp set selection	10 = *DIO1*	0 = *Acc/Dec time 1*	10 = *DIO1*	0 = *Acc/Dec time 1*	0 = *Acc/Dec time 1*	10 = *DIO1*
28.11 Ext1 frequency ref1	1 = *AI1 scaled*	8 = *EFB ref1*	1 = *AI1 scaled*	15 = *Motor potentiomet*	16 = *PID*	1 = *AI1 scaled*
28.15 Ext1 frequency ref2	0 = *Zero*	0 = *Zero*	0 = *Zero*	0 = *Zero*	0 = *Zero*	0 = *Zero*
28.22 Constant frequency sel1	4 = *DI3*	0 = *Always off*	4 = *DI3*	10 = *DIO1*	5 = *DI4*	4 = *DI3*
28.23 Constant frequency sel2	5 = *DI4*	0 = *Always off*	5 = *DI4*	0 = *Always off*	0 = *Always off*	5 = *DI4*
28.71 Freq ramp set selection	10 = *DIO1*	0 = *Acc/Dec time 1*	10 =*DIO1*	0 = *Acc/Dec time 1*	0 = *Acc/Dec time 1*	0 = *Acc/Dec time 1*
40.07 Process PID operation	0 = *Off*	0 = *Off*	0 = *Off*	0 = *Off*	2 = *On when drive running*	0 = *Off*
40.16 Set 1 setpoint 1 source	11 = *AI1 percent*	11 = *AI1 percent*	11 = *AI1 percent*	11 = *AI1 percent*	11 = *AI1 percent*	0 = *Not selected*
40.17 Set 1 setpoint 2 source	0 = *Not selected*	0 = *Not selected*	0 = *Not selected*	0 = *Not selected*	2 = *Internal setpoint*	0 = *Not selected*
40.19 Set 1 internal setpoint sel1	0 = *Not selected*	0 = *Not selected*	0 = *Not selected*	0 = *Not selected*	3 = *DI2*	0 = *Not selected*
40.20 Set 1 internal setpoint sel2	0 = *Not selected*	0 = *Not selected*	0 = *Not selected*	0 = *Not selected*	4 = *DI3*	0 = *Not selected*
40.32 Set 1 gain	1.00	1.00	1.00	1.00	1.00	1.00
40.33 Set 1 integration time	60.0	60.0	60.0	60.0	60.0	60.0

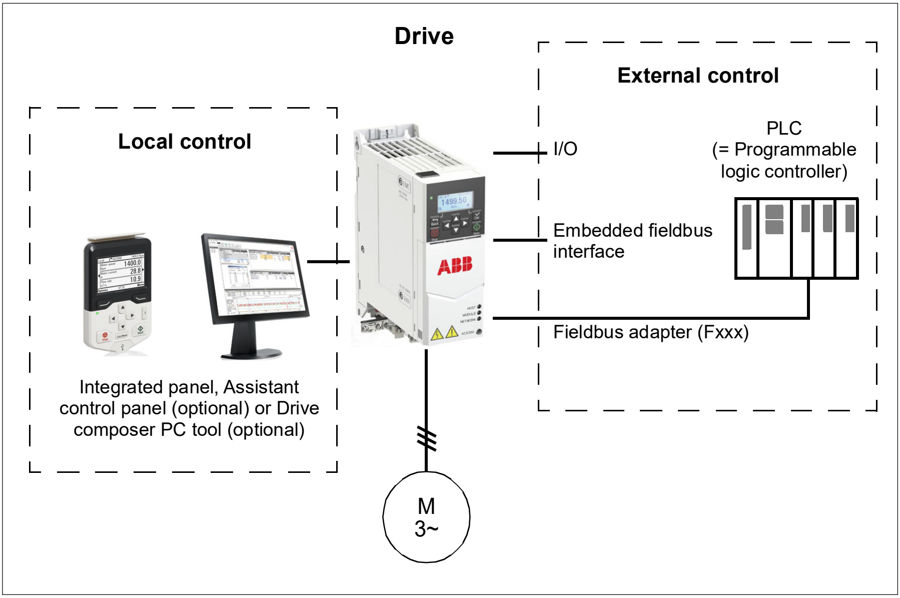
5

Program features

Contents

Local and external control locations

There are two main control locations: local and external. Select the control by pressing the Loc/Rem key on the panels, or from the Drive Composer PC tool.



Local control

The control commands are given from control panels or from a PC equipped with Drive Composer when the drive is in local control. Local control is mainly used during commissioning and maintenance. The control panel 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*.

Note: You can use both the control panel or the Drive Composer tool at the same time, but only one can be in local control at a time.

Settings and diagnostics

- Parameters: *19.17 Local control disable* (page *182*) and *49.05 Communication loss action* (page *379*).

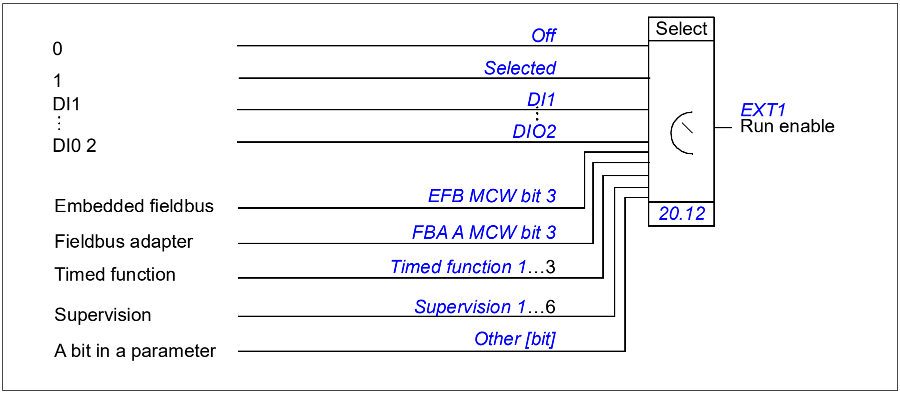
External control

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

- the I/O terminals (digital and analog inputs)
- the fieldbus interface (via the embedded fieldbus interface or an optional fieldbus adapter module)
- an external panel.

Two external control locations, EXT1 and EXT2, are available. You can select the sources of the start and stop commands separately for each location by setting parameters *20.01*…*20.10*. The operating mode can be selected separately for each location, which enables quick switching between different operating modes, for example speed and torque control. Selection between EXT1 and EXT2 is done via parameter *19.11 Ext1/Ext2 selection*. You can also select the source of reference for each operating mode separately, and the operation mode.**Block diagram: Run enable source for EXT1**

The figure below shows the parameters that select the interface for run enable for external control location *EXT1*.



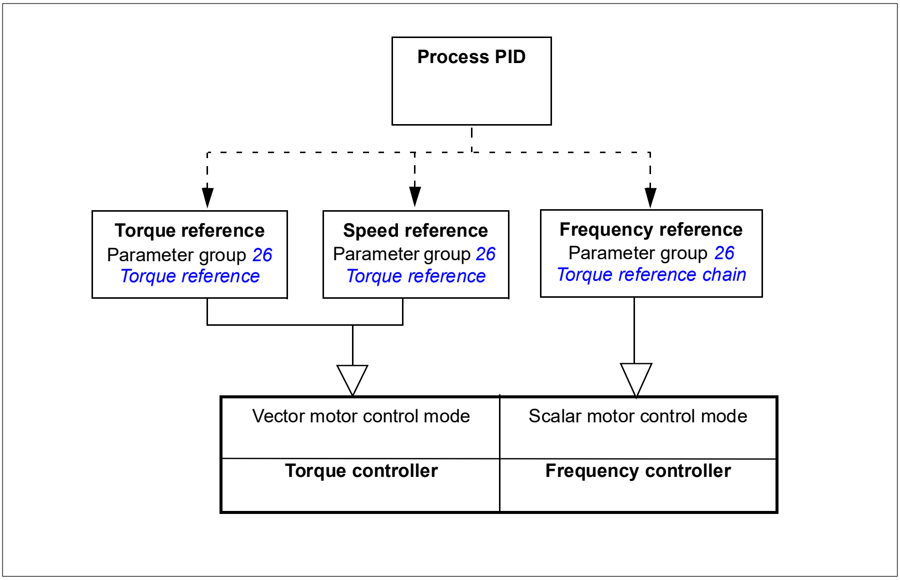
Settings and diagnostics

- Parameters: *19.11 Ext1/Ext2 selection* (page *180*), *20.01*…*20.10*, and *20.30*.

Operating modes and motor control modes

The drive can operate in several operating modes with different types of reference. The operating mode is selectable for each control location (*Local*, *EXT1* and *EXT2*) when the motor control mode is *Vector* (*99.04*). If the motor control mode is *Scalar*, the drive operation mode is fixed to frequency control mode.

An overview of the control hierarchy and different reference types and control chains is shown below.

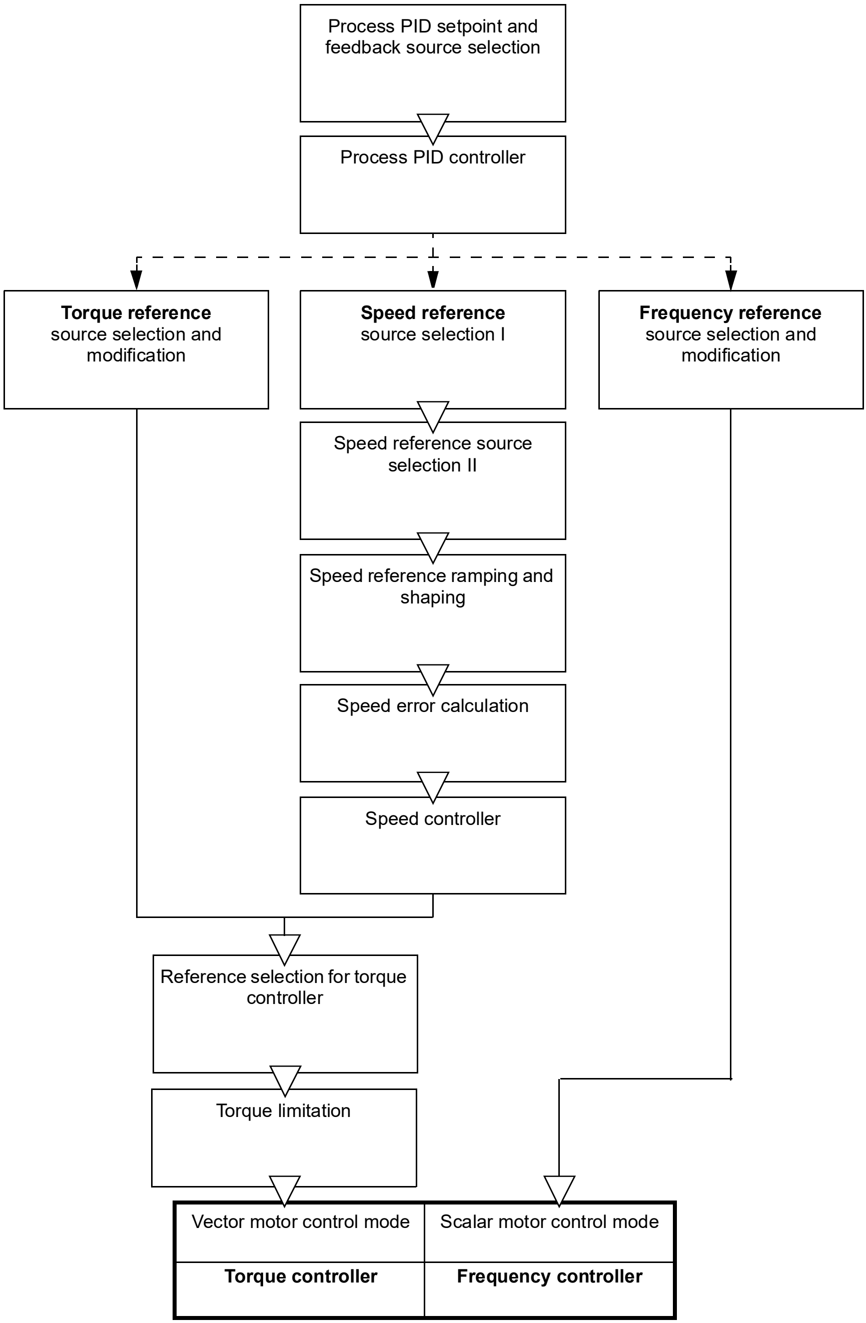


Settings and diagnostics

- Parameters: group *19 Operation mode* (page *180*).

Overview diagram of control hierarchy

The following is a more detailed representation of the drive control hierarchy reference types and control chains.



Process PID setpoint and feedback source selection
Process PID controller
Torque reference source selection and modification
Speed reference source selection I
Frequency reference source selection and modification
Speed reference source selection II
Speed reference ramping and shaping
Speed error calculation
Speed controller
Reference selection for torque controller
Torque limitation
Vector motor control mode
Scalar motor control mode
Torque controller
Frequency controller

Speed control mode

In speed control mode, the motor follows a speed reference given to the drive. This mode can be used with either estimated or measured speed used as feedback.

Speed control mode is available in both local and external control locations. It is supported in vector motor control only.

Speed control uses speed reference chain. Select speed reference with parameters in group *22 Speed reference selection* on page *212*.

Torque control mode

In torque control mode, the motor torque follows a torque reference given to the drive. Torque control mode is available in both local and external control locations. It is supported in vector motor control only.

Torque control uses torque reference chain. Select torque reference with parameters in group *26 Torque reference chain* on page *240*.

Frequency control mode

In frequency control mode, the motor follows the drive output frequency reference. Frequency control is available in both local and external control location. It is supported in scalar motor control only.

Frequency control uses frequency reference chain. Select frequency reference with parameters in group *28 Frequency reference chain* on page *247*.

Special control modes

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

- Process PID control. For more information, see section *Process PID control* on page *88*.
- Emergency stop modes OFF1 and OFF3: Drive stops along the defined deceleration ramp and drive modulation stops.
- Jogging mode: Drive starts and accelerates to the defined speed when the jogging signal is activated. For more information, see section *Jogging* on page *71*.
- Pre-magnetization: DC magnetization of the motor before start. For more information, see section *Pre-magnetization* on page *78*.
- DC hold: Locking the rotor at (near) zero speed in the middle of normal operation. For more information, see section *DC hold* on page *78*.
- Pre-heating (motor heating): Keeping the motor warm when the drive is stopped. For more information, see section *Pre-heating (Motor heating)* on page *79*.

Settings and diagnostics

- Parameters: group *19 Operation mode* (page*180*) and *99.04 Motor control mode* (page *450*).

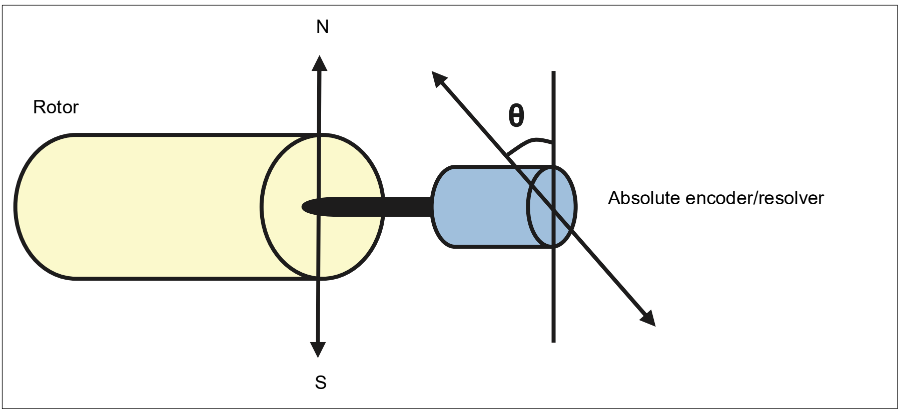
Autophasing

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

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

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

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



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

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

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

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

The rotor position offset used in motor control can also be given by the user – see parameter *98.15 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 control, the motor always turns when it is started as the shaft is turned towards the remanence flux.

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

Autophasing modes

The ACS380 uses turning mode (see parameter *21.13 Autophasing mode*).

The turning mode (*Turning*) 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.

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
- The wrong motor type is selected in *99.03 Motor type*
- Motor ID run has failed.

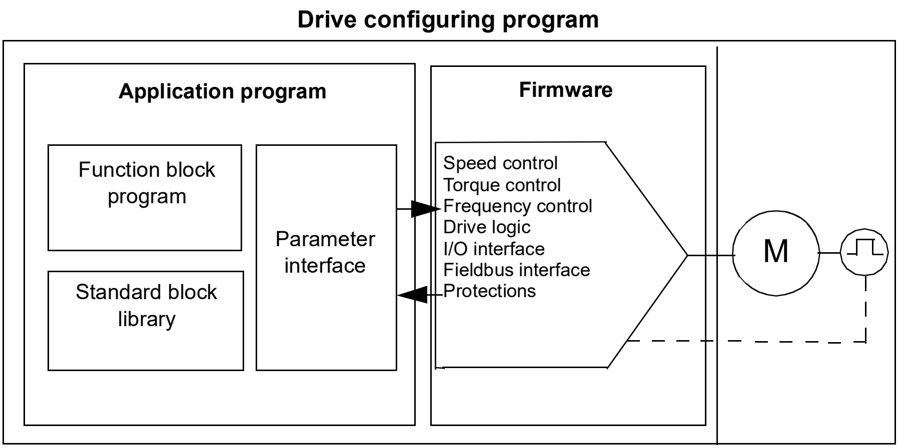
Settings and diagnostics

- Parameters: *06.21 Drive status word 3* (page *145*), *21.13 Autophasing mode* (page *90*), *98.15 Position offset user* (page *449*), *99.03 Motor type* (page *449*), and *99.13 ID run requested* (page *454*).

Drive configuration and programming

The drive control program is divided into two parts:

- firmware program
- application program



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

Programming via parameters

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

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

All parameter settings are stored automatically to the permanent memory of the drive. However, if an external +24 V DC power supply is used for the drive control unit, it is highly recommended to force a save by using parameter *96.07 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, you can control the operation of the drive by parameters. However, the standard parameters have a fixed set of choices or a setting range. To further customize the operation of the drive, an adaptive program can be constructed out of a set of function blocks.

The Drive Composer PC tool (version 1.11 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 e.g., selection, comparison and timer blocks. The adaptive program is executed on a 10 ms time level.

The physical inputs, drive status information, actual values, constants and parameters can be used as the input for the program. The output of the program can be used e.g., as a start signal, external event or reference, or connected to the drive outputs. See the table below for a listing of the available inputs and outputs.

If you connect the output of the adaptive program to a selection parameter that is a pointer parameter, the selection parameter will be write-protected.

Example:

If parameter *31.01 External event 1 source* is connected to an adaptive programming block output, the parameter value is shown as *Adaptive program* on a control panel or PC-tool. The parameter is write-protected (= the selection cannot be changed).

The status of the adaptive program is shown by parameter *07.30 Adaptive program status*.The adaptive program needs to be enabled for programming and program usage (see 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 *1)*
DI4	*10.02 DI delayed status*, bit 3 *1)*
AI1	*12.11 AI1 actual value 1)*
AI2	*12.21 AI2 actual value 1)*
DIO1	*11.02 DIO delayed status*, bit 0 *1)*
DIO2	*11.02 DIO delayed status*, bit 1 *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
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*

1) Available only if I/O and Modbus module is connected and in use.

Outputs available to the adaptive program	
Output	*Target*
I/O	
RO1	*10.24 RO1 source*
AO1	*13.12 AO1 source 2)*
DIO1	*11.06 DIO1 output source 2)*
DIO2	*11.10 DIO2 output source 2)*
Start control	
Ext1/Ext2 selection	*19.11 Ext1/Ext2 selection*
Run enable 1	*20.12 Run enable 1 source*
Ext1 in1 cmd	*20.03 Ext1 in1 source*

Outputs available to the adaptive program	
Output	*Target*
Ext1 in2 cmd	*20.04 Ext2 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 Fault reset selection*
Speed control	
Ext1 speed reference	*22.11 Ext1 speed ref1*
Speed proportional gain	*25.02 Speed proportional gain*
Speed integration time	*25.03 Speed integration time*
Acceleration time 1	*23.12 Acceleration time 1*
Deceleration time 1	*23.13 Deceleration time 1*
Frequency control	
Ext1 frequency reference	*28.11 Ext1 frequency ref1*
Torque control	
Ext1 torque reference	*26.11 Torque ref1 source*
Ext2 torque reference	*26.12 Torque ref2 source*
Limit function	
Minimum torque 2	*30.21 Min torque 2 source*
Maximum torque 2	*30.22 Max 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	
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*
Process PID	
Set 1 setpoint 1	*40.16 Set 1 setpoint 1 source*
Set 1 setpoint 2	*40.17 Set 1 setpoint 2 source*
Set 1 feedback 1	*40.08 Set 1 feedback 1 source*
Set 1 feedback 2	*40.09 Set 1 feedback 2 source*
Set 1 gain	*40.32 Set 1 gain*
Set 1 integration time	*40.33 Set 1 integration time*
Set 1 tracking mode	*40.49 Set 1 tracking mode*
Set 1 track reference	*40.50 Set 1 tracking ref selection*

[2] Available only if I/O and Modbus module is connected and in use.

Adaptive program fault and aux code formats

The format of the aux code:

Bits 24-31: State number	Bits 16-23: block number	Bits 0-15: error code

If the state number is zero but the block number has a value, the fault is related to a function block in the base program. If both state number and block number are zero, the fault is a generic fault that is not related to a specific block.

Sequence program

An adaptive program can contain base program and sequence program parts. Base program is run continuously when adaptive program is in running mode. The functionality of the base program is programmed using function blocks and system inputs and outputs.

Sequence program is a state machine. This means that only one state of the sequence program is run at a time. You can create a sequence program by adding states and programming the state programs using the same program elements as in the base program. You can program state transitions by adding state transition outputs to the state programs. The state transition rules are programmed using function blocks.

The number of the active state of the sequence program is shown by parameter *07.31 AP sequence state*.

Control interfaces

The number of inputs and outputs depend on the product variant and if the drive is equipped with any optional I/O extension modules.

S variant:

- 4 x Digital Inputs
- 2 x Digital Inputs/Outputs
- 2 x Analog Inputs
- 1 x Analog Output
- 1 x Relay Output

C variant:

- 2 x Digital Inputs
- 1 x Relay Output

Programmable analog inputs

There are max two programmable analog inputs. Each of the inputs can be independently set as a voltage (0/2…10 V) or current (0/4…20 mA) input by a switch on the control unit. Each input can be filtered, inverted and scaled.

Settings and diagnostics

- Parameters: group *12 Standard AI* (page *163*).

Programmable analog outputs

There is max one current (0…20mA) analog output. The output can be filtered, inverted and scaled.

Settings and diagnostics

- Parameters: group *13 Standard AO* (page*170*).

Programmable digital inputs and outputs

There are max four digital inputs, and two digital inputs/outputs (I/O that can be set as either an input or an output).

Digital inputs DI3 and DI4 can be used as frequency input and digital outputs DIO1 and DIO2 can be used as frequency output.

Settings and diagnostics

- Parameters: groups *10 Standard DI, RO* (page *150*) and *11 Standard DIO, FI, FO* (page *156*).

Programmable relay outputs

There is one relay output as standard. The signal indicated by the output can be selected by parameters.

Settings and diagnostics

- Parameters: groups *10 Standard DI, RO* (page *150*).

Programmable I/O extensions

Inputs and outputs can be added by using I/O extension modules.

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 outputs (DO)	Digital I/Os (DIO)	Analog inputs (AI)	Analog outputs (AO)	Relay outputs (RO)
Base unit	2	-	-	-	-	1
BREL	-	-	-	-	-	4
BIO-01 (original model)	3	1	-	1	-	-
BIO-01 (2020 revision)	Max 3	Max. 1	-	1	Max. 1	-

Note: The configuration parameter group *15 I/O extension module* (page *175*) contains parameters that display the values of the inputs on the extension module.

These parameters are the only way of utilizing the inputs on an I/O extension module as signal sources.

BIO-01 extension module

ABB introduced an updated revision of the BIO-01 extension module in 2020. The firmware supports both the 2020 revision and original BIO-01 extension modules.

The new BIO-01 has two DIP switches to specify the port usage. One switch changes S1 port from digital output (DO1) to analog output (AO1) and the second switch S2 port from digital input (DI3) to digital output (DO1).

Note that the new BIO-01 has maximum one digital output (DO1) (the combination of setting the DIP switches so that both ports would be digital outputs is not supported).**Settings and diagnostics**

- Parameters: group *15 I/O extension module* (page *175*) and *05.99 BIO-01 DIP switch status*.

Fieldbus control

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

Settings and diagnostics

- Parameters: groups *50 Fieldbus adapter (FBA)* (page *382*), *51 FBA A settings* (page *388*), *52 FBA A data in* (page *390*), *53 FBA A data out* (page *391*) and *58 Embedded fieldbus* (page *391*).

Motor control

Motor types

The drive supports the following motor types:

- Asynchronous AC induction motors
- Permanent magnet (PM) motors
- Synchronous reluctance motors (SynRM).

Settings and diagnostics

- Parameters: *99.03 Motor type* (page *449*).

Motor identification

The performance of vector control is based on an accurate motor model determined during the motor start-up.

A motor Identification magnetization is automatically performed the first time the start command is given. During this first start-up, the motor is magnetized at zero speed for several seconds to allow the motor model to be created. This identification method is suitable for most applications.

In demanding applications a separate Identification run (ID run) can be performed.

Settings and diagnostics

- Parameters: *99.13 ID run requested* (page *454*).

Power loss ride-through

See section *Undervoltage control (power loss ride-through)* on page *103*.

Vector control

Vector control is the motor control mode which is intended for applications where high control accuracy is needed. It requires an identification run at startup. Vector control cannot be used in all applications.

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 vector control 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 *Speed control performance figures* on page *74*.

Settings and diagnostics

- Parameters: *99.04 Motor control mode* (page *450*) and *99.13 ID run requested* (page *454*).

Reference ramping

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

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

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

Variable slope

Variable slope controls the slope of the speed ramp during a reference change. With this feature a constantly variable ramp can be used.

Variable slope is only supported in remote control.

Settings and diagnostics

- Parameters: *23.28 Variable slope enable* (page *231*) and *23.29 Variable slope rate* (page *231*).

Special acceleration/deceleration ramps

The acceleration/deceleration times for the jogging function can be defined separately; see section *Jogging* on page *71*.

The change rate of the motor potentiometer function (page *119*) is adjustable. The same rate applies in both directions.

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

Settings and diagnostics

- Speed reference ramping - Parameters: *23.11*…*23.15*, *23.32 Shape time 1* (page *232*), *23.33 Shape time 2* (page *232*) and *46.01 Speed scaling* (page *373*).
- Torque reference ramping - Parameters: *01.30 Nominal torque scale* (page *130*), *26.18 Torque ramp up time* (page *244*) and *26.19 Torque ramp down time* (page *244*).
- Frequency reference ramping - Parameters: *28.71*…*28.75* and *46.02 Frequency scaling* (page *374*).
- Jogging - Parameters: *23.20 Acc time jogging* (page *230*) and *23.21 Dec time jogging* (page *230*).
- Motor potentiometer - Parameters: *22.75 Motor potentiometer ramp time* (page *224*).
- Emergency stop (“Off3” mode) - Parameters: *23.23 Emergency stop time* (page *230*).

Constant speeds/frequencies

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

WARNING: Speeds and frequencies override the normal reference irrespective of where the reference is coming from.

Settings and diagnostics

- Parameters: groups *22 Speed reference selection* (page *212*) and *28 Frequency reference chain* (page *247*).

Critical speeds/frequencies

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

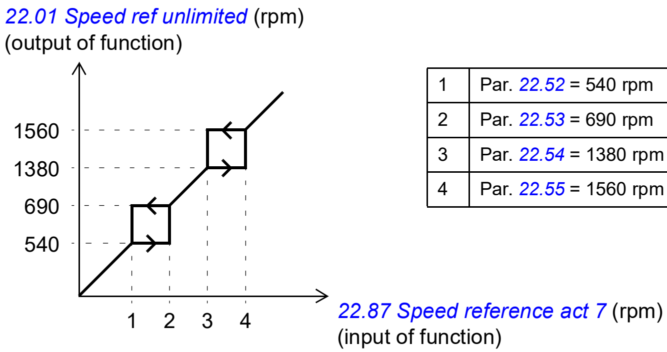
The critical speeds function prevents the reference from dwelling within a critical band for extended times. When a changing reference enters a critical range, the output of the function freezes until the reference exits the range. Any instant change in the output is smoothed out by the ramping function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

When the drive is limiting the allowed output speeds/frequencies, it limits to the absolutely lowest critical speed (critical speed low or critical frequency low) when accelerating from standstill, unless the speed reference is over the upper critical speed/ frequency limit.

Example

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

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



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

Settings and diagnostics

- Critical speeds - Parameters: *22.51*…*22.57*.
- Critical frequencies - Parameters: *28.51*…*28.57*.
- Function input (speed) - Parameters: *22.01 Speed ref unlimited* (page *212*).
- Function output (speed) - Parameters: *22.87 Speed reference act 7* (page *225*).
- Function input (frequency) - Parameters: *28.96 Frequency ref act 7* (page *261*).
- Function output (frequency) - Parameters: *28.97 Frequency ref unlimited* (page *261*).

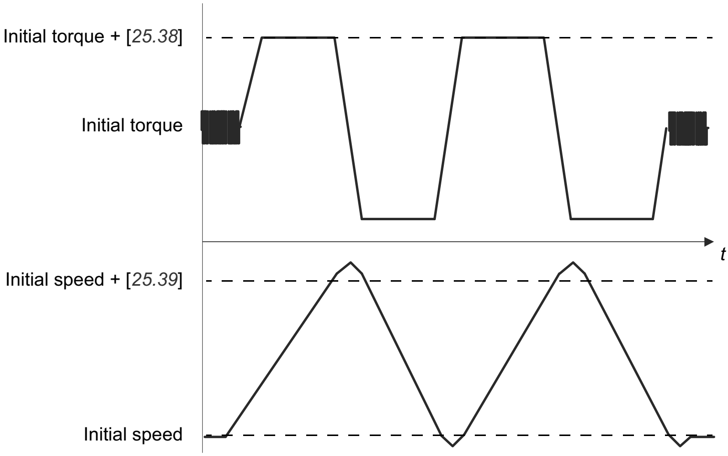
Speed controller autotune

You can adjust the speed controller of the drive automatically with the autotune function. Autotuning is based on an estimation of the mechanical time constant (inertia) of the motor and machine.

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

The maximum torque reference used during autotuning will be the initial torque (i.e. torque when the routine is activated) plus the value of *25.38*, unless limited by the maximum torque limit (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) + the value of *25.39*, unless limited by parameter *30.12* or *99.09*.

The diagram below shows the behavior of speed and torque during the autotune routine. In this example, parameter *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 will not be as accurate as with full braking power.
- The motor will exceed the calculated maximum speed slightly at the end of each acceleration stage.

Before activating the autotune routine

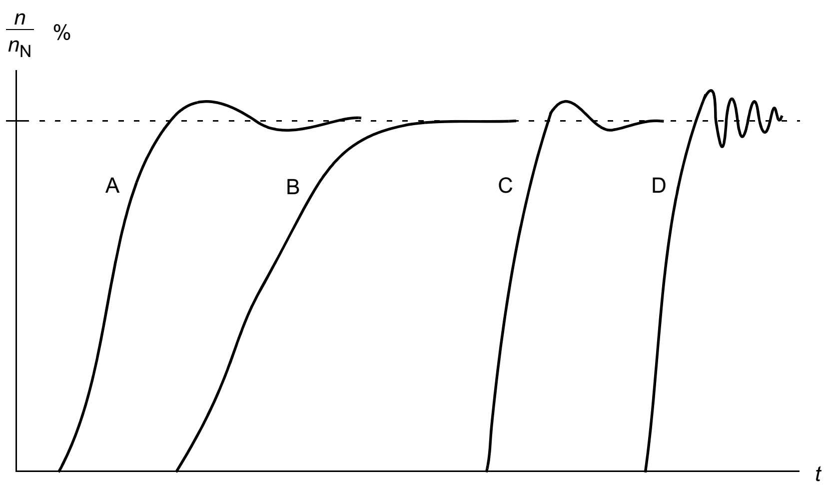
The prerequisites for performing the autotune routine are the following:

- User has started and the drive has successfully completed the motor identification run (ID run) - see parameter *99.13*
- User has defined the speed and torque limits (group *30 Limits*)
- User has monitored the speed feedback for noise, vibrations and other disturbances caused by the mechanics of the system (Drive Composer PC tool), and user has set the following parameters in order to eliminate the disturbances:
  - speed feedback filtering (group *90 Feedback selection*)
  - speed error filtering (group *24 Speed reference conditioning*), and
  - zero speed (*21.06* and *21.07*).
- User has started the drive and it is running in speed control mode (*99.04*).

After these conditions have been fulfilled, user can activate autotuning by parameter *25.33* (or the signal source selected by it).

Autotune modes

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



A: Undercompensated

B: Normally tuned (autotuning)

C: Normally tuned (manually). Better dynamic performance than with B

D: Overcompensated speed controller

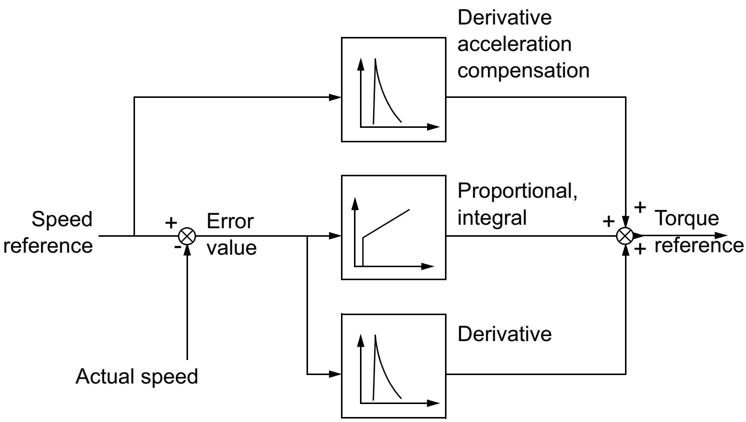
Autotune results

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

- *25.02* Speed proportional gain (proportional gain of the speed controller)
- *25.03* Speed integration time (integration time of the speed controller)
- *25.06* Acceleration Compensation Derivation Time (derivation time for acceleration compensation)
- *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.

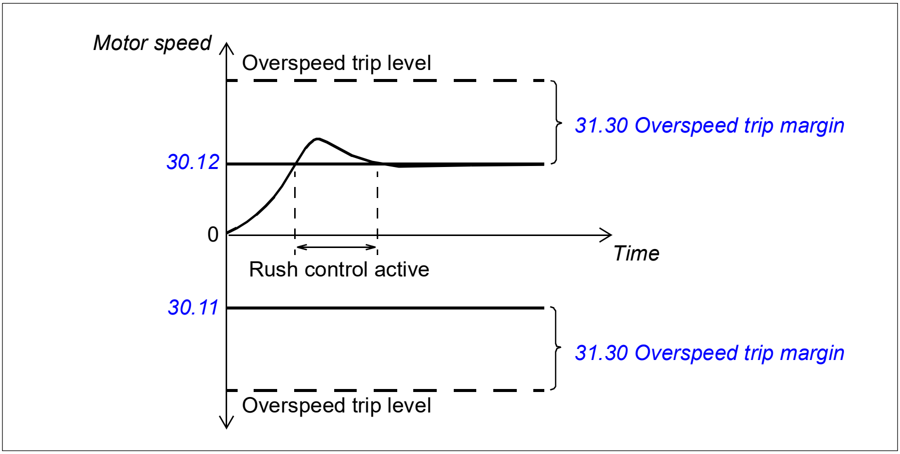


Settings and diagnostics

- Parameters: *25.33*…*25.40*.
- Events: A warning message, *AF90 Speed controller autotuning* (page *502*), will be generated if the autotune routine does not complete successfully.

Rush control

Rush control is automatically on when the operation mode is torque. 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 the set minimum speed or maximum speed.



The program sets the proportional gain to 10.0 and integration time to 2.0 s.

Settings and diagnostics

- Parameters: *30.11 Minimum speed* (page *264*), *30.12 Maximum speed* (page *265*) and *31.30 Overspeed trip margin* (page *281*).

Encoder echo support

The connection of one encoder to several drives with the BTAC-02 encoder interface module can be done by using a daisy chain wiring scheme. This means wiring channels A, B, Z and GND of multiple encoder modules together with the encoder.

Settings and diagnostics

- Parameters: groups *90 Feedback selection* (page *424*), *91 Encoder module settings* (page *426*) and *92 Encoder 1 configuration* (page *426*).

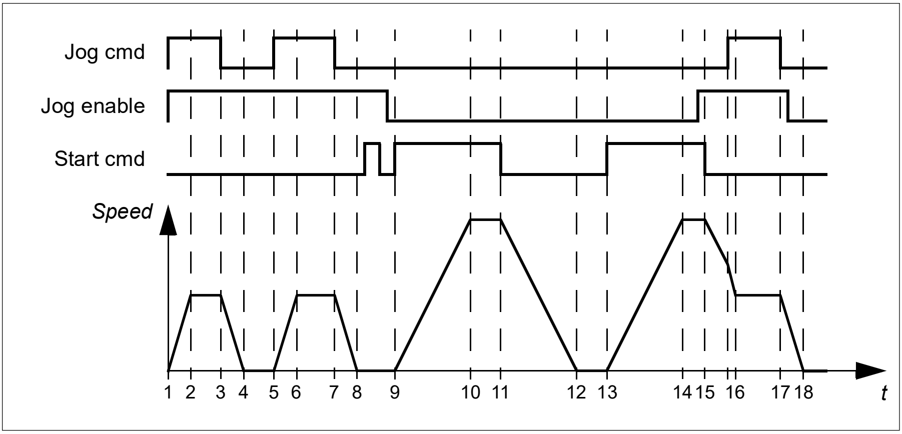
Jogging

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

Two jogging functions (1 and 2) are available, each with their own activation sources and references. The signal sources are selected by parameters *20.26* and *20.27*. When jogging is activated, the drive starts and accelerates to the defined jogging speed along the defined jogging acceleration ramp. After the activation signal switches off, the drive decelerates to a stop along the defined jogging deceleration ramp.

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

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



Phase	Jog cmd	Jog enable	Start cmd	Description
1-2	1	1	0	Drive accelerates to the jogging speed along the acceleration ramp of the jogging function.
2-3	1	1	0	Drive follows the jog reference.
3-4	0	1	0	Drive decelerates to zero speed along the deceleration ramp of the jogging function.
4-5	0	1	0	Drive is stopped.
5-6	1	1	0	Drive accelerates to the jogging speed along the acceleration ramp of the jogging function.
6-7	1	1	0	Drive follows the jog reference.
7-8	0	1	0	Drive decelerates to zero speed along the deceleration ramp of the jogging function.
8-9	0	1->0	0	Drive is stopped. As long as the jog enable signal is on, start commands are ignored. After jog enable switches off, a fresh start command is required.
9-10	x	0	1	Drive accelerates to the speed reference along the selected acceleration ramp (*23.11*…*23.15*).
10-11	x	0	1	Drive follows the speed reference.

Phase	Jog cmd	Jog enable	Start cmd	Description
11-12	x	0	0	Drive decelerates to zero speed along the selected deceleration ramp (*23.11*…*23.15*).
12-13	x	0	0	Drive is stopped.
13-14	x	0	1	Drive accelerates to the speed reference along the selected acceleration ramp (*23.11*…*23.15*).
14-15	x	0->1	1	Drive follows the speed reference. As long as the start command is on, the jog enable signal is ignored. If the jog enable signal is on when the start command switches off, jogging is enabled immediately.
15-16	0->1	1	0	Start command switches off. The drive starts to decelerate along the selected deceleration ramp (*23.11*…*23.15*). When the jog command switches on, the decelerating drive adopts the deceleration ramp of the jogging function.
16-17	1	1	0	Drive follows the jog reference.
17-18	0	1->0	0	Drive decelerates to zero speed along the deceleration ramp of the jogging function.

Notes:

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

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

- If both jogging functions are activated, the one that was activated first has priority.
- Jogging can be used in vector and scalar control modes.
- The inching functions activated through fieldbus (*06.01* bits 8…9) use the references and ramp times defined for jogging, but do not require the jog enable signal.

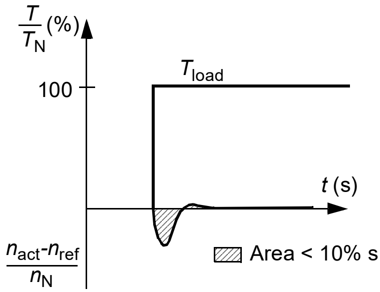
Settings and diagnostics

- Parameters: *20.25 Jog enable* (page *194*), *20.26 Jog 1 start* (page *195*), *20.27 Jog 2 start* (page *196*), *22.42 Jogging 1 ref* (page *221*), *22.43 Jogging 2 ref* (page *221*), *23.20 Acc time jogging* (page *230*), *23.21 Dec time jogging* (page *230*), *28.42 Jogging 1 frequency ref* (page *256*), and *28.43 Jogging 2 frequency ref* (page *256*).

Speed control performance figures

The table below shows typical performance figures for speed control with induction motor (asynchronous motor).

Speed control	Performance
Static accuracy	20% of motor nominal slip
Dynamic accuracy	< 1% s with 100% torque step



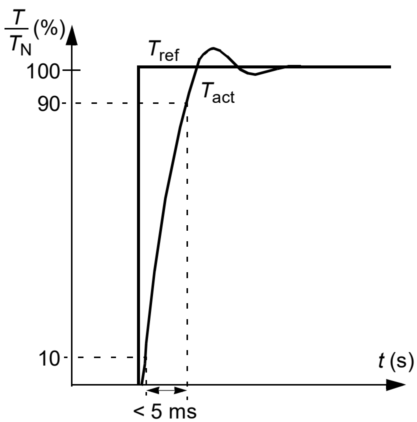
T_N = rated motor torque
n_N = rated motor speed
n_{act} = actual speed
n_{ref} = speed reference

Note: By activating the energy optimizer parameter *45.11* it is possible to improve static accuracy at low speeds with low torque. This will slightly reduce the torque dynamics if rapid torque response is required.

Torque control performance figures

The drive can perform precise torque control without any speed feedback from the motor shaft. The table below shows typical performance figures for torque control.

Torque control	Performance
Non-linearity	± 5% with nominal torque (± 20% at the most demanding operating point)
Torque step rise time	< 10 ms with nominal torque



T_N = rated motor torque
T_{ref} = torque reference
T_{act} = actual torque

Scalar motor control

Scalar motor control is the default motor control method. It is suitable for applications which do not require the control accuracy available in vector control. In scalar control, you control the drive output frequency reference, and you do not need to do any motor identification run at the first start.

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

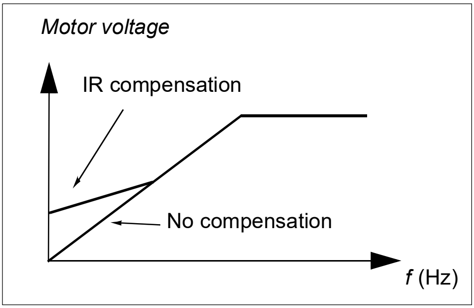
- In multimotor drives: 1) if the load is not equally shared between the motors, 2) if the motors are of different sizes, or 3) if the motors are going to be changed after motor identification (ID run)
- If the nominal current of the motor is less than 1/6 of the nominal output current of the drive
  Note: During this time, do not activate the motor phase loss fault (*31.19 Motor phase loss*) as the drive cannot measure the motor current accurately.
- If the drive is used without a motor connected (for example, for test purposes)
- If the drive runs a medium-voltage motor through a step-up transformer.

In scalar control, some features are not available.

See also section *Operating modes and motor control modes* on page *52*.

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 vector control, no IR compensation is possible or needed as it is applied automatically.

Settings and diagnostics

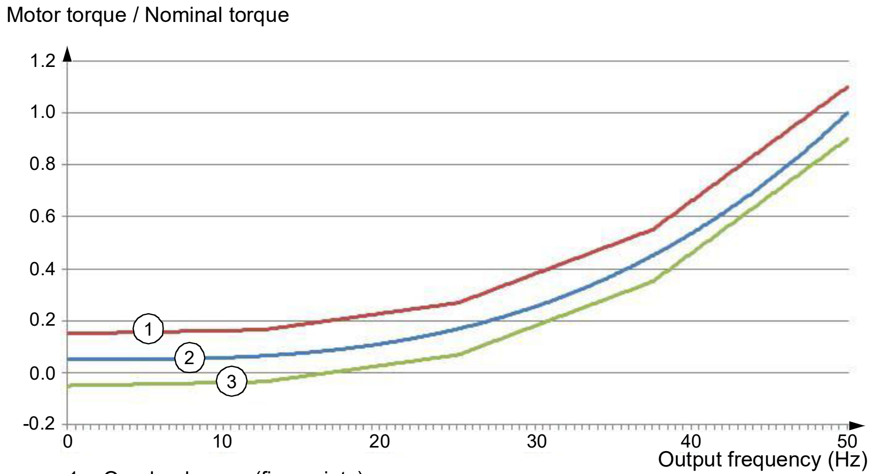
Parameters: group *28 Frequency reference chain* (page *247*), *97.13 IR compensation* (page *444*) and *99.04 Motor control mode* (page *450*).

User load curve

The User load curve provides a supervisory function that monitors an input signal as a function of frequency or speed, and load. It shows the status of the monitored signal and can give a warning or fault based on the violation of a user defined profile.

The user load curve consists of an overload and an underload curve, or just one of them. Each curve is formed by five points that represent the monitored signal as a function of frequency or speed.

In the example below, the user load curve is constructed from the motor nominal torque to which a 10% margin is added and subtracted. The margin curves define a working envelope for the motor so that excursions outside the envelope can be supervised, timed and detected.



1 = Overload curve (five points)
2 = Nominal process load curve
3 = Underload curve (five points)

An overload warning and/or fault can be set to occur if the monitored signal stays continuously over the overload curve for a defined time. An underload warning and/or fault can be set to occur if the monitored signal stays continuously under the underload for a defined time.

Overload can be for example used to monitor for a saw blade hitting a knot or fan load profiles becoming too high.

Underload can be for example used to monitor for load dropping and breaking of conveyer belts or fan belts.

Settings and diagnostics

- Parameters: group *37 User load curve* (page *329*).

U/f ratio

The *U*/f function is only available in scalar motor control mode, which uses frequency control.

The function has two modes: linear and squared.

In linear mode, the ratio of voltage to frequency is constant below the field weakening point. This is used in constant torque applications where it may be necessary to produce torque at or near the rated torque of the motor throughout the frequency range

In squared mode, the ratio of the voltage to frequency increases as the square of the frequency below the field weakening point. This is typically used in centrifugal pump or fan applications. For these applications, the torque required follows the square relationship with frequency. Therefore, if the voltage is varied using the square relationship, the motor operates at improved efficiency and lower noise levels in these applications.

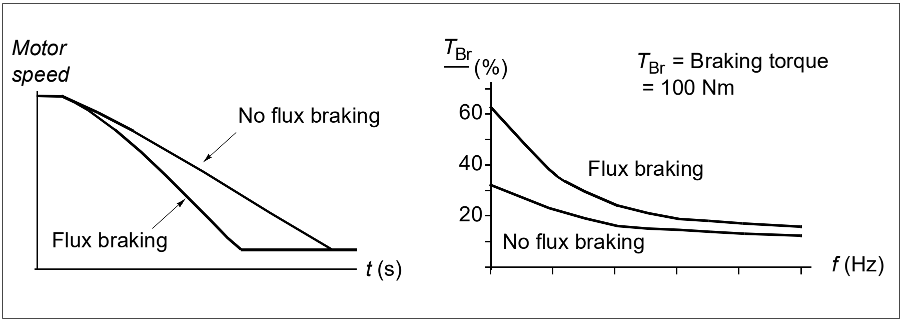
The *U*/f function cannot be used with energy optimization; if parameter *45.11 Energy optimizer* is set to *Enable*, parameter *97.20 U/F ratio* is ignored.

Settings and diagnostics

- Parameters: *97.20 U/F ratio* (page *445*).

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 motors.

Two braking power levels are available:

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

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

Settings and diagnostics

- Parameters: *97.05 Flux braking* (page *442*).

DC magnetization

The drive has different magnetization functions for different phases of motor start/rotation/stop: pre-magnetization, DC hold, post-magnetization and pre-heating (motor heating).

Pre-magnetization

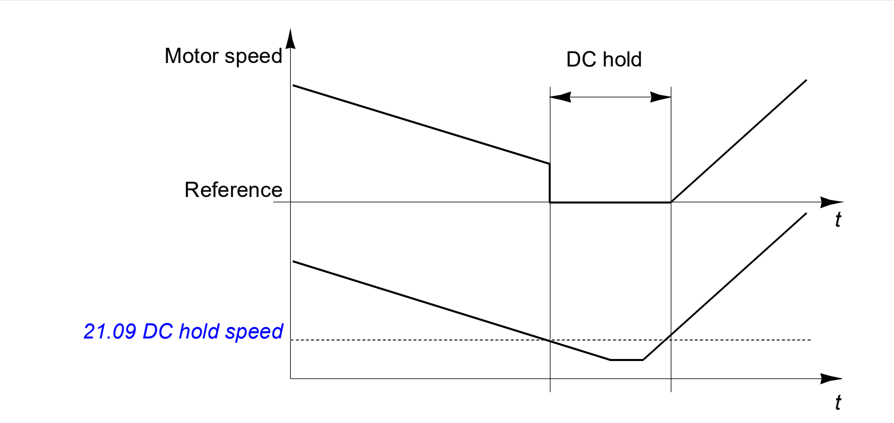
Pre-magnetization refers to DC magnetization of the motor before start. Depending on the selected start mode (vector or scalar) pre-magnetization can be applied to guarantee the highest possible breakaway torque, up to 200% of the nominal torque of the motor. By adjusting the pre-magnetization time,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

Settings and diagnostics

- Parameters: *21.01 Vector start mode* (page *200*), *21.19 Scalar start mode* (page *207*) and *21.02 Magnetization time* (page *201*).

DC hold

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



Settings and diagnostics

- Parameters: *21.08 DC current control* (page *205*), *21.09 DC hold speed* (page *205*) and *21.10 DC current reference* (page *205*).

Post-magnetization

The function keeps the motor magnetized for a certain period 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*. The magnetization current is set by parameter *21.10*.

Note: Post-magnetization is only available when ramping is the selected stop mode.

Settings and diagnostics

- Parameters: *21.01 Vector start mode* (page *200*), *21.02 Magnetization time* (page *201*), *21.03 Stop mode* (page *201*), *21.08 DC current control* (page *205*), *21.09 DC hold speed* (page *205*) and *21.11 Post magnetization time* (page *205*).

Pre-heating (Motor heating)

The pre-heating function keeps the motor warm and prevents condensation inside the motor by feeding it with DC current when the drive has been stopped. The heating can only be activated when the drive is in the stopped state, and starting the drive stops the heating.

When pre-heating is activated and the stop command is given, pre-heating starts immediately if the drive is running below the zero speed limit (see bit 0 in parameter *06.19 Speed control status word*). If the drive is running above the zero speed limit, pre-heating is delayed by the time defined by parameter *21.15 Pre-heating time delay* to prevent excessive current.

The function can be defined to be always active when the drive is stopped or it can be activated by a digital input, fieldbus, timed function or supervision function. For example, with the help of signal supervision function, the heating can be activated by a thermal measurement signal from the motor.

The pre-heating current fed to the motor can be defined as 0…30% of the nominal motor current.

Notes:

- In applications where the motor keeps rotating for a long time after the modulation is stopped, it is recommended to use ramp stop with pre-heating to prevent a sudden pull at the rotor when the pre-heating is activated.
- The heating function requires that STO is not triggered.
- The heating function requires that the drive is not faulted.
- Pre-heating uses DC hold to produce current.

Settings and diagnostics

- Parameters: *21.14 Pre-heating input source* (page *206*), *21.15 Pre-heating time delay* and *21.16 Pre-heating current* (page *206*).

Energy optimization

The Energy optimization function optimizes the motor flux so that total energy consumption and motor noise level are reduced when the drive operates below the nominal load. The total efficiency (motor and drive) can be improved by 1…20% depending on load torque and speed.

Note: With a permanent magnet motor and synchronous reluctance motor, energy optimization is always enabled.

Settings and diagnostics

- Parameters: *45.11 Energy optimizer* (page *370*).

Switching frequency

The drive has two switching frequencies: reference switching frequency and minimum switching frequency. The drive tries to keep the highest allowed switching frequency (= reference switching frequency) if thermally possible, and then adjusts dynamically between the reference and minimum switching frequencies depending on the drive temperature. When the drive reaches the minimum switching frequency (= lowest allowed switching frequency), it starts to limit output current as the heating up continues.

For derating, see the hardware manual of the drive.

Example 1: If you need to fix the switching frequency to a certain value as with some external filters, e.g. with EMC C1 filters (see the hardware manual), set both the reference and the minimum switching frequency to this value and the drive will retain this switching frequency.

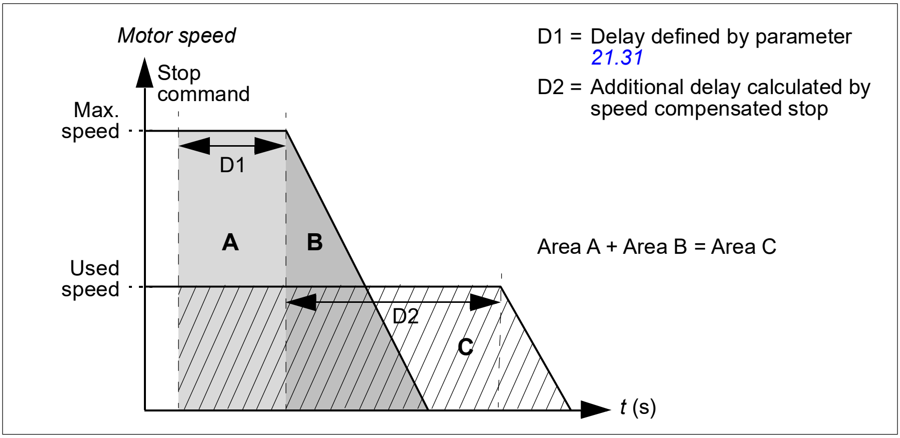
Example 2: If the reference switching frequency is set to 12 kHz and the minimum switching frequency is set to 1.5 kHz (or 1 kHz), the drive maintains the highest possible switching frequency to reduce motor noise and only when the drive heats it will decrease the switching frequency. This is useful, for example, in applications where low noise is necessary but higher noise can be tolerated when the full output current is needed.

Settings and diagnostics

- Parameters: *97.01 Switching frequency reference* (page *441*) and *97.02 Minimum switching frequency* (page *441*).

Speed compensated stop

Speed compensation stop is available for example for applications where a conveyer needs to travel a certain distance after receiving the stop command. At maximum speed, the motor is stopped normally along the defined deceleration ramp, after the application of a user defined delay to adjust the distance traveled. Below maximum speed, stop is delayed still more by running the drive at current speed before the motor is ramped to a stop. As shown in the figure, the distance traveled after the stop command is the same in both cases, that is, area A + area B equals area C.



Speed compensation does not take into account shape times (*23.32 Shape time 1* and *23.33 Shape time 2*). Positive shape times lengthen the distance traveled.

Speed compensation can be restricted to forward or reverse rotating direction. Speed compensation is supported in both vector and scalar motor control.

Settings and diagnostics

- Parameters: *21.30 Speed compensated stop mode* (page *211*), *21.31 Speed compensated stop delay* (page *211*) and *21.32 Speed comp stop threshold* (page *211*).

Motor thermal protection

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

The motor temperature can be monitored using

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

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

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

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

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

Implementing a motor temperature sensor connection

WARNING! IEC 60664 and IEC 61800-5-1 require double or reinforced insulation between live parts and the surface of accessible parts of electrical equipment which are either non-conductive or conductive but not connected to the protective earth.

You have four implementation alternatives:

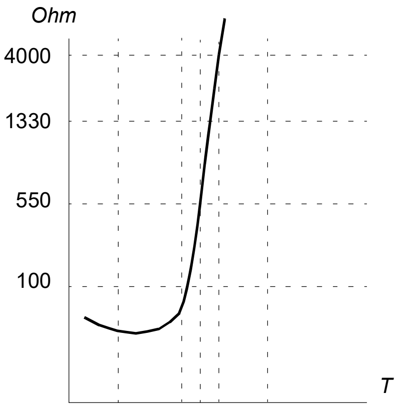
- If there is double or reinforced insulation between the sensor and the live parts of the motor, you can connect the sensor directly to the analog/digital input(s) of the drive.
- If there is basic insulation between the sensor and the live parts of the motor, you can connect the sensor to the analog/digital input(s) of the drive if all other circuits connected to the digital and analog inputs (typically extra-low voltage circuits) are protected against contact and insulated with basic insulation from other low-voltage circuits. The insulation must be rated for the same voltage level as the drive main circuit. Note that extra-low voltage circuits (such as 24 V DC) typically do not meet these requirements.
  - Alternative: You can connect the sensor with a basic insulation to the analog/digital input(s) of the drive if you do not connect any other external control circuits to drive digital and analog inputs.
- You can connect a sensor to a digital input of the drive via an external thermistor relay. The insulation of the relay of must be rated for the main circuit voltage of the motor.

Temperature monitoring using PTC sensors

1…3 PTC sensors can 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.



When analog output is not available or used for other purposes, it is possible to set up a voltage divider utilizing internal resistance of a digital input. 1…3 PTC sensors are connected in series to 10V reference and Digital and Analog inputs. The voltage over the digital input internal resistance varies depending on the PTC resistance. The temperature measurement function reads the voltage over the sensor from the analog input and calculates the resistance.

Note: It is important to ensure that the DI used for this is not configured to start any action.

PTC analog I/O hardware connection and parameter setting example

- *35.11 Temperature 1 source* = *PTC analog I/O* (20)
- *35.14 Temperature 1 AI source* = *AI1 actual value* (1)
- *12.15 AI1 actual value* = *V*
- *13.12 AO1 source* = *Temp sensor 1 excitation* (20)
- *35.12 Temperature 1 fault limit* = xx (set to desired value)

In this example, AI1 is used as input for Temperature 1 and AO1 is used to feed the excitation current to the PTC.

PTC AI/DI Voltage Divider tree HW connection and parameter setting example

- *35.11 Temperature 1 source* = *PTC AI/DI Voltage divider tree* (23)
- *35.14 Temperature 1 AI source* = *AI1 actual value* (1)
- *12.15 AI1 actual value* = *V*
- *35.12 Temperature 1 fault limit* = xx (set to desired value)

In this example, AI1 is used as input for Temperature 1.

Temperature monitoring using Pt100 sensors

1…3 Pt100 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 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.

It is possible to adjust the motor temperature supervision limits and select how the drive reacts when overtemperature is detected.

For the wiring of the sensor, see chapter *Electrical installation, AI1 and AI2 as Pt100, Pt1000, Ni1000, KTY83 and KTY84 sensor inputs (X1)* in the *Hardware manual* of the drive.

Temperature monitoring using Pt1000 sensors

1…3 Pt1000 sensors can be connected in series to an analog input and an analog output.

The analog output feeds a constant excitation current of 0.1 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.

For the wiring of the sensor, see chapter *Electrical installation, AI1 and AI2 as Pt100, Pt1000, Ni1000, KTY83 and KTY84 sensor inputs (X1)* in the *Hardware manual* of the drive.

Temperature monitoring using Ni1000 sensors

One Ni1000 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 9.1 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.

For the wiring of the sensor, see chapter *Electrical installation, AI1 and AI2 as Pt100, Pt1000, Ni1000, KTY83 and KTY84 sensor inputs (X1)* in 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.

The figure and table on page 146 show typical KTY84 sensor resistance values as a function of the motor operating temperature.

For the wiring of the sensor, see chapter *Electrical installation, AI1 and AI2 as Pt100, Pt1000, Ni1000, KTY83 and KTY84 sensor inputs (X1)* in the *Hardware manual* of the drive.

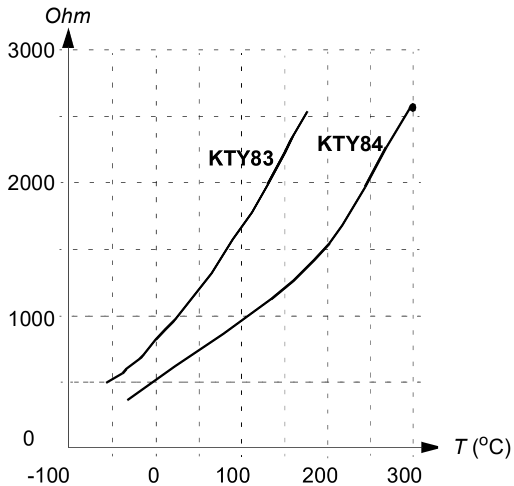
Temperature monitoring using KTY83 sensors

One KTY83 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 1.0 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.

The figure and table below show typical KTY83 sensor resistance values as a function of the motor operating temperature.

	Scaling	
	KTY84	KTY83
°C	ohm	ohm
90	936	1569
110	1063	1774
130	1197	1993
150	1340	2225



It is possible to adjust the motor temperature supervision limits and select how the drive reacts when overtemperature is detected.

For the wiring of the sensor, see chapter *Electrical installation, AI1 and AI2 as Pt100, Pt1000, Ni1000, KTY83 and KTY84 sensor inputs (X1)* in the *Hardware manual* of the drive.

Settings and diagnostics

- Parameters: group *35 Motor thermal protection* (page *310*).

Motor overload protection

This section describes motor overload protection without using the motor thermal protection model, either with estimated or measured temperature. For protection with the motor thermal protection model, see section *Motor thermal protection* on page *76*.

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

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

Motor overload protection requires that you specify a motor current tripping level. This is defined by a curve using parameters *35.51 Motor load curve*, *35.52 Zero speed load* and *35.53 Break point*. The tripping level is the motor current at which the overload protection will ultimately trip if the motor current remains at this level continuously.

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

Using class 20 satisfies the UL 508C requirements.

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

With parameter *35.56 Motor overload action* you can define that when *35.05 Motor overload level* reaches 88%, a motor overload warning will be generated, and when it reaches 100%, the drive will trip on the motor overload fault. The rate at which this internal value is increased depends on the actual current, tripping level current and the overload class selected.

Parameters *35.51 Motor load curve*, *35.52 Zero speed load* and *35.53 Break point* serve a dual purpose. They determine the load curve for temperature estimate when using motor thermal protection model as well as specify the overload tripping level.

Motor overload protection fulfills standard IEC/EN 61800-5-1 ed. 2.1 requirements for thermal memory retention and speed sensitivity. The motor overload state is retained over power down. Speed dependency is set by parameters *35.51 Motor load curve*, *35.52 Zero speed load* and *35.53 Break point*.

Settings and diagnostics

- Parameters common to motor thermal protection and motor overload protection: *35.51 Motor load curve*, *35.52 Zero speed load* and *35.53 Break point*.
- Parameters specific to motor overload protection: *35.05 Motor overload level*, *35.56 Motor overload action* and *35.57 Motor overload class*..

Application control

Control macros

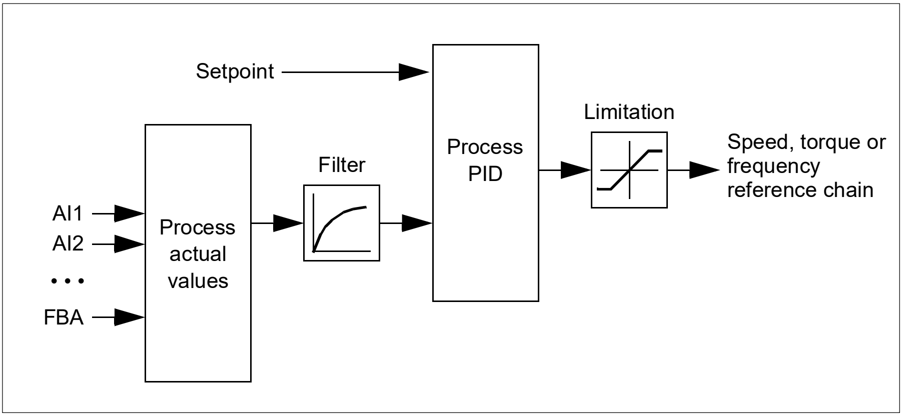
Control macros are predefined parameter edits and I/O configurations. See chapter *Control macros*.

Process PID control

There is a built-in process PID controller in the drive. The controller can be used to control process such as pressure or flow in the pipe or fluid level in the container.

In process PID control, a process reference (setpoint) is connected to the drive instead of a speed reference. An actual value (process feedback) is also brought back to the drive. The process PID control adjusts the drive speed in order to keep the measured process quantity (actual value) at the desired level (setpoint). This means that user does not need to set a frequency/speed/torque reference to the drive but the drive adjust its operation according to the process PID.

The simplified block diagram below illustrates the process PID control.



The drive contains two complete sets of process PID controller settings that can be alternated whenever necessary; see parameter *40.57 PID set1/set2 selection*.

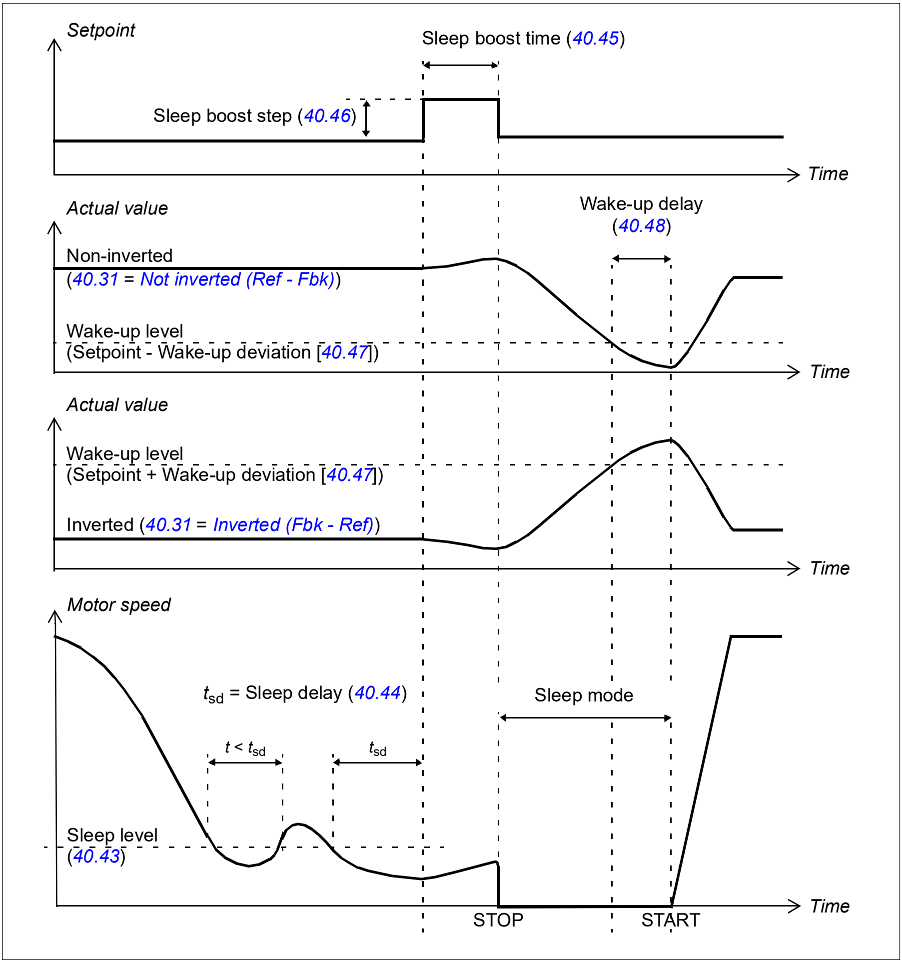
Note: Process PID control is only available in external control; see section *Local and external control locations* on page *50*.

Sleep and boost functions for process PID control

The sleep function is suitable for PID control applications where the consumption varies, such as clean water pumping systems. When used, it stops the pump completely during low demand, instead of running the pump slowly below its efficient operating range. The following example visualizes the operation of the function.

Example: The drive controls a pressure boost pump. The water consumption falls at night. As a consequence, the process PID controller decreases the motor speed. However, due to natural losses in the pipes and the low efficiency of the centrifugal pump at low speeds, the motor would never stop rotating. The sleep function detects the slow rotation and stops the unnecessary pumping after the sleep delay has passed. The drive shifts into sleep mode, still monitoring the pressure. The pumping resumes when the pressure falls under the predefined minimum level and the wake-up delay has passed.

The user can extend the PID sleep time by the boost functionality. The boost functionality increases the process setpoint for a predetermined time before the drive enters the sleep mode.


Setpoint
Sleep boost time (40.45)
Sleep boost step (40.46)
Time
Actual value
Wake-up delay
(40.48)
Non-inverted
(40.31 = Not inverted (Ref - Fbk))
Wake-up level
(Setpoint - Wake-up deviation [40.47])
Time
Actual value
Wake-up level
(Setpoint + Wake-up deviation [40.47])
Inverted (40.31 = Inverted (Fbk - Ref))
Time
Motor speed
t_{sd} = Sleep delay (40.44)
Sleep mode
$t < t_{sd}$
t_{sd}
Sleep level
(40.43)
STOP
START
Time

Tracking

In tracking mode, the PID block output is set directly to the value of parameter *40.50 Set 1 tracking ref selection* (or *41.50 Set 2 tracking ref selection*).The internal I term of the PID controller is set so that no transient is allowed to pass on to the output, so when the tracking mode is left, normal process control operation can be resumed without a significant bump.

Settings and diagnostics

Parameters: *96.04 Macro select* (page *432*), groups *40 Process PID set 1*(page *335*) and *41 Process PID set 2* (page *353*).

PID trim function

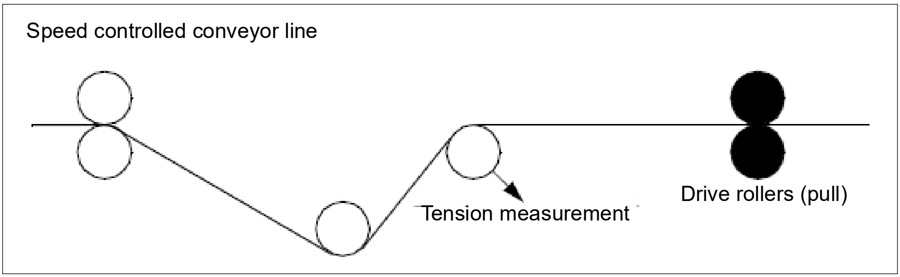
The PID trim function helps to maintain the set tension either by trimming the drive main speed reference or torque reference (speed controller output).

WARNING: Make sure that the drive acceleration and deceleration time is set to 0 when using the PID trim function. This is required to do quick tension control by speed correction.

PID trim is implemented as one of the Process PID functions (groups *40 Process PID set 1* and *41 Process PID set 2*). Both PID set 1 and PID set 2 can be used for this functionality.

The trimmed output is calculated from parameter *40.01 Process PID output actual* or *40.03 Process PID setpoint actual*. In most cases *40.01 Process PID output actual* is used. This is based on the selection in parameter *40.56 Set 1 trim source* (for process PID set 1) or *41.56 Set 2 trim source* (for process PID set 2). In most of the use cases, the value of parameter *40.56* or *41.56* is set as *PID output*.

The PID trim functionality in drives is used in applications where tension control of the material is essential. For example, auxiliary drives in metal process industries, infeed and outfeed of rotogravure printing machines, and surface winders.



The examples provided in this chapter are based on PID set 1. You can set the desired values for the PID trim function parameters to get the expected result.

When PID trim is activated, bit 5 Trim mode is set to 1 in parameter *40.06 Process PID status word*.

See the speed, torque and frequency reference chains in chapter *Control chain diagrams* for more information on the PID trim addition to the respective reference chains.

The following PID trim modes are available:

- *Direct*
- *Proportional*
- *Combined*.

Direct

The direct method is suitable when you need tension control at fixed rpm/line speed.

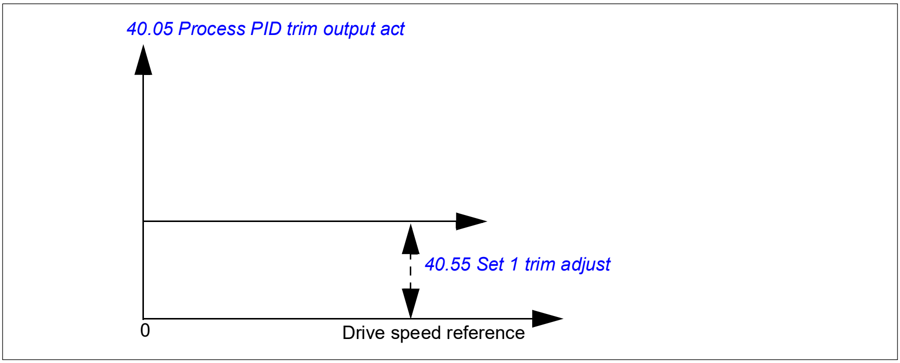
In this mode, the PID trim output (*40.05*) is relative to the maximum speed (*30.12*), torque (*30.20*) or frequency (*30.14*). You can make the selection with parameter *40.52*.

The calculated trimmed output actual is the same throughout the speed range with respect to the stable PID output.

The *40.05* value is calculated using the following formula:

$$\mathrm{Par40.05} = \left(\frac{\mathrm{Par40.01}}{100}\right) \times (\mathrm{Par30.12\ or\ 30.20\ or\ 30.14}) \times \mathrm{Par40.55}$$

The graph below shows the PID trim output in direct mode throughout the speed range. A fixed trim speed reference is added throughout the speed range.



Note: In the above graph, it is assumed that the PID output is limited or stable at 100. This is for clarity only. In real life scenarios, the PID output can vary based on the setpoint and the actual value.

Example:

If:
parameter *40.52 Set 1 trim selection* = Speed
parameter *40.56 Set 1 trim source* = PID output
parameter *30.12 Maximum speed* = 1500 rpm
parameter *40.01 Process PID output actual* = 100 (limited to 100)
parameter *40.55 Set 1 trim adjust* = 0.5,
then:

$$\text{Par40.05} = \left(\frac{100}{100}\right) \times 1500 \times 0.5$$

$$\text{Par40.05} = 750$$

Proportional

The proportional method is suitable for applications where tension control is required throughout the speed range but not near zero speed.

In this mode, the PID trim output actual (*40.05*) is relative to the reference selected by *40.53* and with *40.01* or *40.03*.

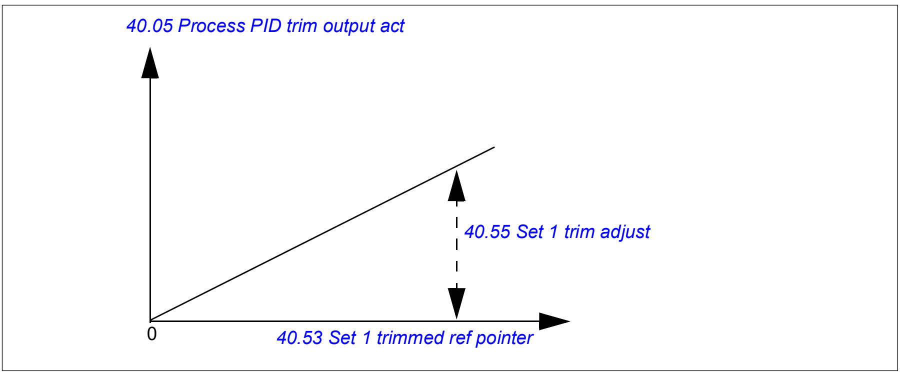
It is recommended that the speed reference selected in *40.53* and the reference source in *22.11* are equal. This is required to make the proportional mode active.

In most of the use cases, the process speed reference is connected in *40.53*. For example, if EXT1 control mode is used and the reference source is AI scaled, then *22.11* and *40.53* should be configured to *AI1 scaled*.

Parameter *40.05* is calculated using the following formula:

$$\text{Par40.05} = \left(\frac{\text{Par40.01}}{100}\right) \times \text{Par40.53} \times \text{Par40.55}$$

The below graph shows the PID trim output in proportional mode throughout the speed range. Here, the trimmed output is directly proportional to the value of parameter *40.53 Set 1 trimmed ref pointer*.



Note: In the above graph, it is assumed that the PID output is limited or stable at 100. This is for understanding purpose only. In real case scenario, PID output can vary based on the setpoint and actual.

Example:

If:
parameter *40.52 Set 1 trim selection* = *Speed*
parameter *40.56 Set 1 trim source* = *PID output*
parameter *40.53 Set 1 trimmed ref pointer* = *AI1 scaled*
parameter *22.11 Ext1 speed ref1* = *AI1 scaled*
parameter *12.20 AI1 scaled at AI1 max* = 1500
parameter *12.12 AI1 scaled value* = 750 (AI1 actual scaled value)
parameter *40.01 Process PID output actual* = 100 (limited to 100)
parameter *40.55 Set 1 trim adjust* = 0.5,

then:

$$\text{Par40.05} = \left(\frac{100}{100}\right) \times 750 \times 0.5$$

$$\text{Par40.05} = 375$$

At zero speed, the *40.05 Process PID trim output act* value depends on both the *40.55 Set 1 trim adjust* and *40.54 Set 1 trim mix* parameter values. However, adjusting *40.54 Set 1 trim mix* near to zero speed will give quick correction.

Example:

If,
parameter *40.52 Set 1 trim selection* = *Speed*
parameter *40.56 Set 1 trim source* = *PID output*
parameter *30.12 Maximum speed* = 1500 rpm
parameter *40.53 Set 1 trimmed ref pointer* = *AI1 scaled*
parameter *22.11 Ext1 speed ref1* = *AI1 scaled*
parameter *12.20 AI1 scaled at AI1 max* = 1500
parameter *12.12 AI1 scaled value* = 750 (AI1 actual scaled value)
parameter *40.01 Process PID output actual* = 100 (limited to 100)
parameter *40.54 Set 1 trim mix* = 0.1
parameter *40.55 Set 1 trim adjust* = 0.5

then

$$\text{Par40.05} = \left(\frac{100}{100}\right) \times 750 \times 0.5$$

$$\text{Par40.05} = 375$$

Combined

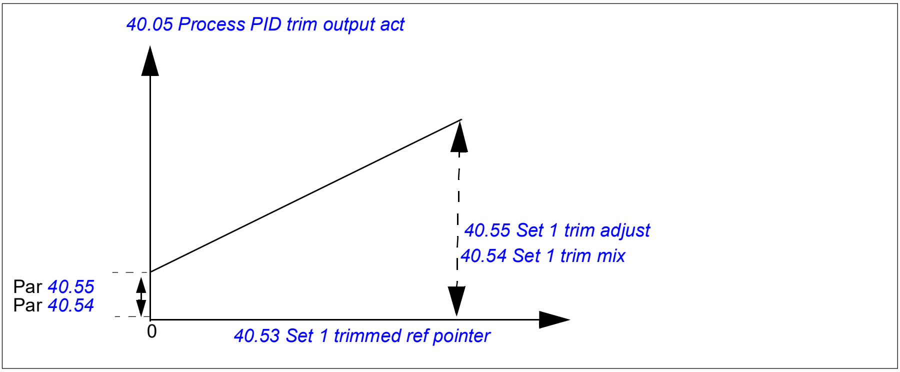
The combined mode is suitable for applications where the user needs to maintain tension from zero speed to maximum speed. The combined mode is a combination of direct and proportional modes. Here, the trim for zero speed is defined by parameter *40.54 Set 1 trim mix* and the trim for speed greater than zero speed is defined by parameter *40.55 Set 1 trim adjust*. The trim value is directly proportional to the value of parameter *40.53 Set 1 trimmed ref pointer*.

The process speed reference is connected in parameter *40.53 Set 1 trimmed ref pointer*. For example, if EXT1 control mode is used and the reference source is *AI1 scaled*, then *22.11 Ext1 speed ref1* and *40.53 Set 1 trimmed ref pointer* shall be configured to *AI1 scaled*.

The *40.05 Process PID trim output act* is calculated using the following formula:

$$\text{Par40.05} = \{(\text{Par30.12} \times \text{Par40.54}) + [(1 - \text{Par40.54}) \times \text{Par40.53}]\} \times \text{Par40.55}$$

The following graph shows the trim increase in combined mode.



Note: In the above graph, it is assumed that the PID output is limited or stable at 100. This is for clarity only. In real life scenarios, PID output can vary based on the setpoint and actual.

At zero speed, the *40.05 Process PID trim output act* value depends on both parameters *40.54 Set 1 trim mix* and *40.55 Set 1 trim adjust*. However, adjusting *40.54 Set 1 trim mix* near to zero speed will give quick correction.

Example:

If:

Parameter *40.52 Set 1 trim selection* = Speed
Parameter *40.56 Set 1 trim source* = PID output
Parameter *30.12 Maximum speed* = 1500 rpm

Parameter *40.53 Set 1 trimmed ref pointer* = AI1 scaled
Parameter *22.11 Ext1 speed ref1* = AI1 scaled
Parameter *12.20 AI1 scaled at AI1 max* = 1500
Parameter *12.12 AI1 scaled value* = 750 (AI1 actual scaled value)
Parameter *40.01 Process PID output actual* = 100 (limited to 100)
Parameter *40.54 Set 1 trim mix* = 0.1
Parameter *40.55 Set 1 trim adjust* = 1

Then:

If *12.12 AI1 scaled value* is 0:

$$\text{Par40.05} = \{(1500 \times 0.1) + [(1 - 0.1) \times 0]\} \times 1$$

$$\text{Par40.05} = 150$$

Par40.05 = (100/100) x {(1500 × 0.1) + [(1 – 0.1) × 0]} × 1
Par40.05 = 150

If *12.12 AI1 scaled value* is 750:

$$\text{Par40.05} = \{(1500 \times 0.1) + [(1 - 0.1) \times 750]\} \times 1$$

$$\text{Par40.05} = 825$$

Par40.05 = (100/100) x {(1500 × 0.1) + [(1 – 0.1) × 750]} × 1
Par40.05 = 825

If *12.12 AI1 scaled value* is 1500:

$$\text{Par40.05} = \{(1500 \times 0.1) + [(1 - 0.1) \times 1500]\} \times 1$$

$$\text{Par40.05} = 1500$$

Par40.05 = (100/100) x {(1500 × 0.1) + [(1 – 0.1) × 1500]} × 1
Par40.05 = 1500

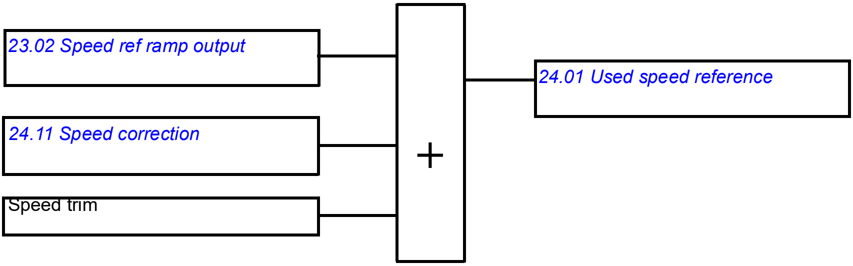
PID trim auto connection

Parameter *40.65 Trim auto connection* activates the connection of PID trim output actual (*40.05*) to the respective speed, torque and frequency reference chains. The respective reference chains can be selected with *40.52* (for PID set 1) or *41.52* (for PID set 2).

Parameter *99.04 Motor control mode* is also taken into consideration while passing the PID trimmed output actual (*40.05*) to the speed, torque and frequency reference chains. In scalar control mode, the speed trim and torque trim values are zero and in vector control mode, the frequency trim value is zero.

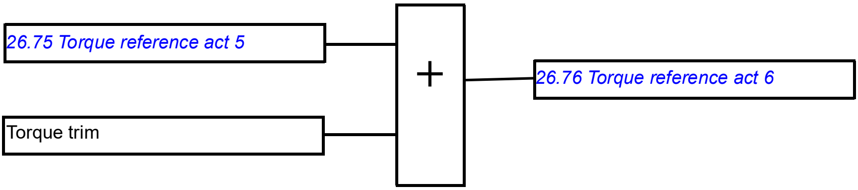
Speed trim connection

Speed trim is added at *23.02* and *24.11* and the final speed reference after the trim addition is available in *24.01*.



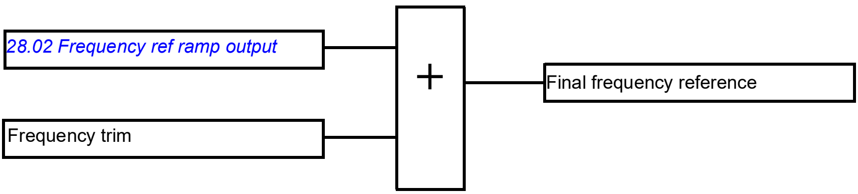
Torque trim connection

Torque trim is added at *26.75 Torque reference act 5* and the final torque reference after the trim addition is available in parameter *26.76 Torque reference act 6*.



Frequency trim connection

Frequency trim is added at *28.02 Frequency ref ramp output* and the final frequency reference is generated after the trim addition. At the moment, no parameter is available to see the final frequency reference after adding frequency trim.



Note: PID trim output auto connection is disabled in the firmware when the drive is stopped with the *21.04 Emergency stop mode* value *Ramp stop (Off1)* or value *Eme ramp stop (Off3)*. In other words, PID trim output actual (*40.05 Process PID trim output act*) will not be added to the respective speed, torque and frequency reference chains during ramp stop or emergency stop.

Mechanical brake control

A mechanical brake can be 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, and moves between the states presented in the diagram on page *99*. The tables below the state diagram detail the states and transitions. The timing diagram on page *101* shows an example of a close-open-close sequence.

For application example, see section *Crane mechanical brake control* on page *649*.

Inputs of the brake control logic

The start command of the drive (bit 5 of *06.16 Drive status word 1*) is the main control source of the brake control logic. An optional external open/close signal can be selected by *44.12 Brake close request*. The two signals interact as follows:

- Start command = 1 **AND** signal selected by *44.12 Brake close request* = 0
  → Request brake to **open**
- Start command = 0 **OR** signal selected by *44.12 Brake close request* = 1
  → Request brake to **close**

Another external signal – for example, from a higher-level control system – can be connected via parameter *44.11 Keep brake closed* to prevent the brake from opening.

Other signals that affect the state of the control logic are

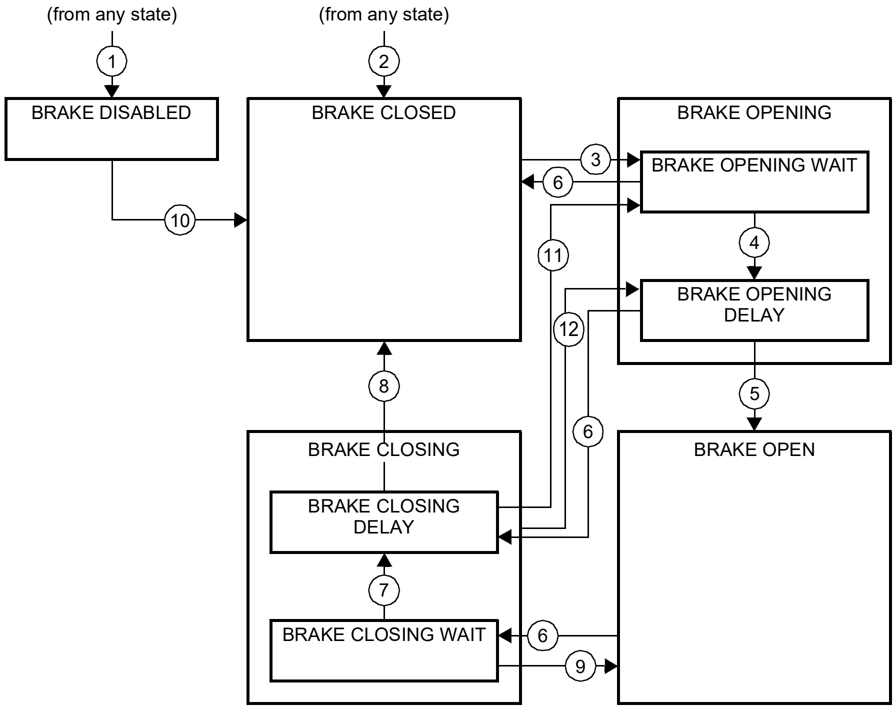
- brake status acknowledgment (optional, defined by parameter *44.07 Brake acknowledge selection*),
- bit 2 of *06.11 Main status word* (indicates whether the drive is ready to follow the given reference or not),
- bit 6 of *06.16 Drive status word 1* (indicates whether the drive is modulating or not).

Outputs of the brake control logic

The mechanical brake is controlled by bit 0 of parameter *44.01 Brake control status*. This bit should be selected as the source of a relay output (or a digital input/output in output mode) which is then wired to the brake actuator through a relay. See the wiring example on page *102*.

The brake control logic, in various states, will request the drive control logic to hold the motor, increase the torque, or ramp down the speed. These requests are visible in parameter *44.01 Brake control status*.

Brake state diagram



State descriptions

State name	Description
BRAKE DISABLED	Brake control is disabled (*44.06* = 0, and *44.01* b4 = 0). The open signal is active (*44.01* b0 = 1).
BRAKE OPENING	
BRAKE OPENING WAIT	Brake has been requested to open. The drive logic is requested to increase the torque up to opening torque to hold the load in place (*44.01* b1 = 1 and b2 = 1). The state of *44.11* is checked; if it is not 0 within a reasonable time, the drive trips on a *71A5* fault *).

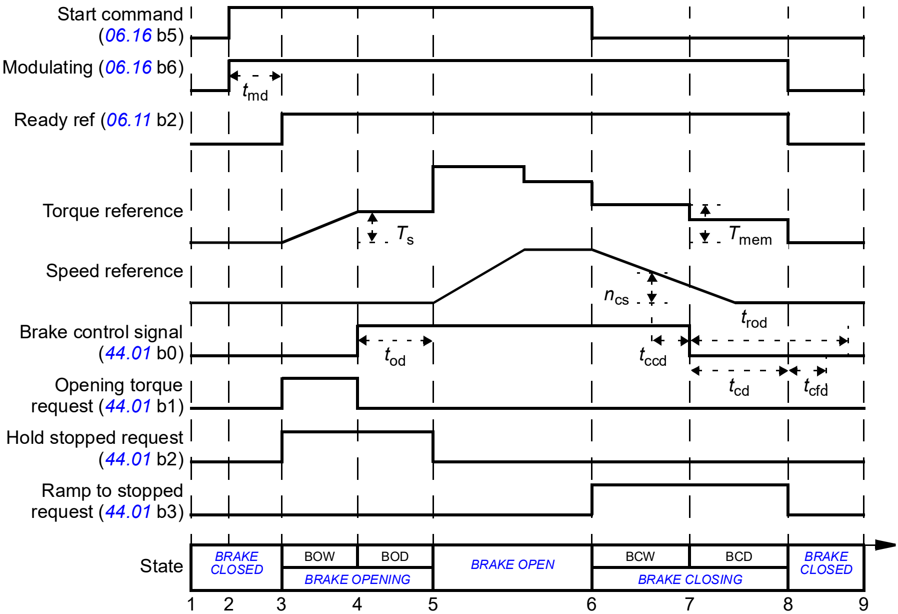
State name	Description
BRAKE OPENING DELAY	Opening conditions have been met and open signal activated (*44.01 Brake control status* b0 is set). The opening torque request is removed (*44.01 Brake control status* b1 → 0). The load is held in place by the speed control of the drive until *44.08 Brake open delay* elapses. At this point, if *44.07 Brake acknowledge selection* is set to *No acknowledge*, the logic proceeds to BRAKE OPEN state. If an acknowledgement signal source has been selected, its state is checked; if the state is not "brake open", the drive trips on a *71A3 Mechanical brake opening failed* fault *).
BRAKE OPEN	The brake is open (*44.01 Brake control status* b0 = 1). Hold request is removed (*44.01 Brake control status* b2 = 0), and the drive is allowed to follow the reference.
BRAKE CLOSING	
BRAKE CLOSING WAIT	Brake has been requested to close. The drive logic is requested to ramp down the speed to a stop (*44.01 Brake control status* b3 = 1). The open signal is kept active (*44.01 Brake control status* b0 = 1). The brake logic will remain in this state until the motor speed is below *44.14 Brake close level* for the time defined by *44.15 Brake close level delay*.
BRAKE CLOSING DELAY	Closing conditions have been met. The open signal is deactivated (*44.01 Brake control status* b0 → 0). The ramp-down request is maintained (*44.01 Brake control status* b3 = 1). The brake logic will remain in this state until *44.13 Brake close delay* has elapsed. At this point, if *44.07 Brake acknowledge selection* is set to *No acknowledge*, the logic proceeds to BRAKE CLOSED state. If an acknowledgment signal source has been selected, its state is checked; if the state is not "brake closed", the drive generates an *A7A1 Mechanical brake closing failed* warning. If *44.17 Brake fault function* = Fault, the drive will trip on a *71A2 Mechanical brake closing failed* fault after *44.18 Brake fault delay*.
BRAKE CLOSED	The brake is closed (*44.01 Brake control status* b0 = 0). The drive is not necessarily modulating. **Note concerning open-loop (encoder-less) applications:** If the brake is kept closed by a brake close request (either from parameter *44.12*) against a modulating drive for longer than 5 seconds, the brake is forced to closed state and the drive trips on a fault, *71A5 Mechanical brake opening not allowed*.
*) A warning can alternatively be selected by parameter *44.17 Brake fault function*; if so, the drive will keep modulating and remain in this state.	

<u>State change conditions</u> (n)

1 Brake control disabled (*44.06 Brake control enable* → 0).
2 *06.11 Main status word*, bit 2 = 0.
3 Brake has been requested to open and *44.16 Brake reopen delay* has expired.
4 Brake open conditions (such as *44.10 Brake open torque*) fulfilled and *44.11 Keep brake closed* = 0.
5 *44.08 Brake open delay* has elapsed and brake open acknowledgement (if chosen by *44.07 Brake acknowledge selection*) has been received.
6 Brake has been requested to close.
7 Motor speed has remained below closing speed *44.14 Brake close level* for the duration of *44.15 Brake close level delay*.
8 *44.13 Brake close delay* has elapsed and brake close acknowledgment (if chosen by *44.07 Brake acknowledge selection*) has been received.
9 Brake has been requested to open.
10 Brake control enabled (*44.06 Brake control enable* → 1).
11 1) Brake has been requested to open and *44.16 Brake reopen delay* has expired, while brake acknowledge feedback is CLOSED, or
2) Brake has been requested to open and *44.16 Brake reopen delay* has expired and *44.07 Brake acknowledge selection* is *No acknowledge* and *44.13 Brake close delay* has expired.
12 Brake has been requested to open and *44.16 Brake reopen delay* has expired, while brake acknowledge feedback is OPEN.

Timing diagram

The simplified timing diagram below illustrates the operation of the brake control function. Refer to the Brake state diagram on page 99.



T_s	Start torque at brake open (*44.03*)
T_{mem}	Stored torque value at brake close (*44.02*)
t_{md}	Motor magnetization delay
t_{od}	Brake open delay (*44.08*)
n_{cs}	Brake close speed (*44.14*)
t_{ccd}	Brake close command delay (*44.15*)
t_{cd}	Brake close delay (*44.13*)
t_{cfd}	Brake close fault delay (*44.18*)
t_{rod}	Brake reopen delay (*44.16*)
BOW	*BRAKE OPENING WAIT*
BOD	*BRAKE OPENING DELAY*
BCW	*BRAKE CLOSING WAIT*
BCD	*BRAKE CLOSING DELAY*

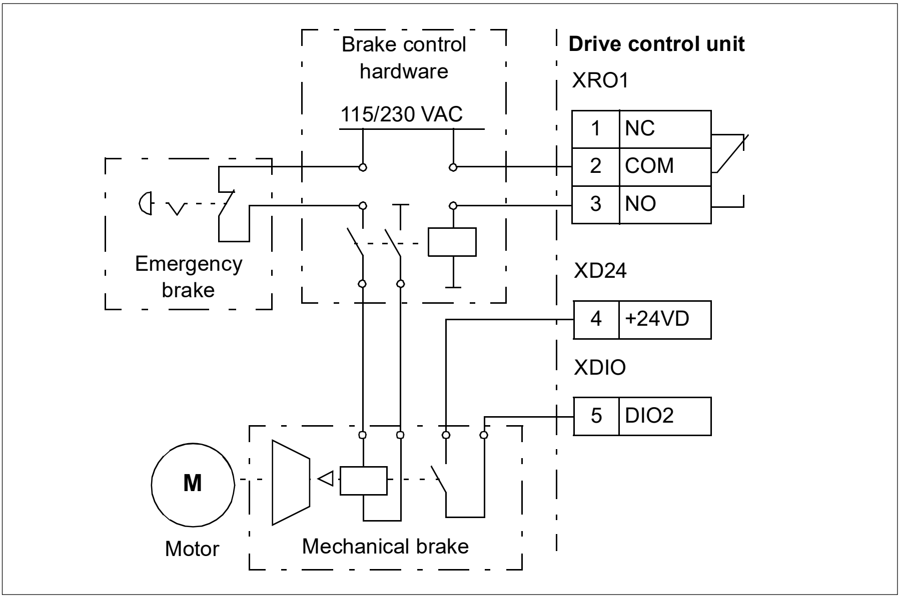
Wiring example

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

WARNING! Make sure that the machinery into which the drive with brake control function is integrated fulfills the personnel safety regulations. Note that the frequency converter (a Complete Drive Module or a Basic Drive Module, as defined in IEC/EN 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.

The brake is controlled by bit 0 of parameter *44.01 Brake control 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 *Open brake command* (ie. bit 0 of *44.01 Brake control status*), and
- parameter *44.07 Brake acknowledge selection* is set to *DIO1*.



Settings and diagnostics

- Parameters: *06.11 Main status word* (page *140*), *06.16 Drive status word 1* (page *141*) and parameter group *44 Mechanical brake control* (page *359*).
- Events: *A7A1 Mechanical brake closing failed* (page *498*), *71A2 Mechanical brake closing failed* (page *515*), *71A3 Mechanical brake opening failed* (page *515*) and *71A5 Mechanical brake opening not allowed* (page *515*).

DC voltage control

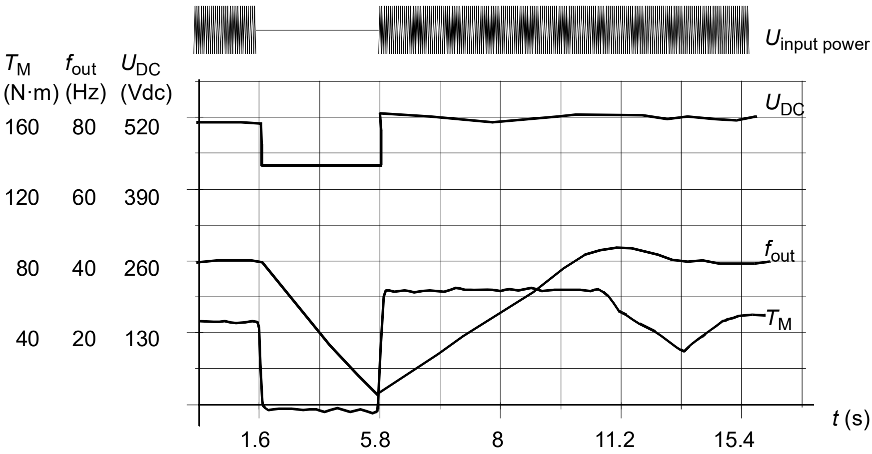
Overvoltage control

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 input power 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.

Implementing the undervoltage control (power loss ride-through)

Implement the undervoltage control function as follows:

- Check that the undervoltage control function of the drive is enabled with parameter *30.31 Undervoltage control*.
- Parameter *21.01 Vector start mode* must be set to *Automatic* (in vector mode) or parameter *21.19 Scalar start mode* to *Automatic* (in scalar mode) to make flying start (starting into a rotating motor) possible.

If the installation is equipped with a main contactor, prevent its tripping at the input power break. For example, use a time delay relay (hold) in the contactor control circuit.

WARNING! Make sure that the flying restart of the motor will not cause any danger. If you are in doubt, do not implement the undervoltage control function.

Automatic restart

It is possible to restart the drive automatically after a short (max. 10 seconds) power supply failure by using the Automatic restart function, provided that the drive is allowed to run for 10 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, *3220 DC link undervoltage*.

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 actual measured DC voltage (U_{DC}) is displayed by parameter *01.11 DC voltage*. Supply voltage is displayed by parameter *96.03 Estimated AC supply voltage*, which is based on the measured DC voltage (UDC/1.41).

The necessary drive DC limits are calculated based on parameters *95.01* (*Supply voltage*) and *95.02* (*Adaptive voltage limits*).

The following table shows the values of the selected DC voltage levels in volts. Note that the absolute voltages vary according to drive/inverter type and AC supply voltage range.

When adaptive voltage limit is enabled in parameter *95.02* (*Adaptive voltage limits*):

DC voltage level [V]	**95.01 Supply Voltage**			
See *95.01 Supply voltage*.	**AC supply voltage range [V] 208…240**	**AC supply voltage range [V] 380…415**	**AC supply voltage range [V] 440…480**	**Automatic / Not selected**
Overvoltage fault limit	421	842	842	842
Overvoltage control limit	389	779	779	779
Internal brake chopper start limit	389	779	779	779
Internal brake chopper stop limit	379	759	759	759

DC voltage level [V]	95.01 Supply Voltage			
See *95.01 Supply voltage*.	**AC supply voltage range [V] 208…240**	**AC supply voltage range [V] 380…415**	**AC supply voltage range [V] 440…480**	**Automatic / Not selected**
Overvoltage warning limit	372	745	745	745
Undervoltage warning limit	0.85×1.41× par *95.03* value [1] 0.85×1.41×208 = 249 [2]	0.85×1.41× par *95.03* value [1] 0.85×1.41×380 = 455 [2]	0.85×1.41×par *95.03* value [1] 0.85×1.41×440 = 527 [2]	0.85×1.41× par *95.03* value [1]
Undervoltage control limit	0.78×1.41×par *95.03* value [1] 0.78×1.41×208 = 229 [2]	0.78×1.41×par *95.03* value [1] 0.78×1.41×380 = 418 [2]	0.78×1.41×par *95.03* value [1] 0.78×1.41×440 = 484 [2]	0.78×1.41×par *95.03* value [1]
Charging relay closing limit / charging deactivation	0.78×1.41×par *95.03* value [1] 0.78×1.41×208 = 229 [2]	0.78×1.41×par *95.03* value [1] 0.78×1.41×380 = 418 [2]	0.78×1.41×par *95.03* value [1] 0.78×1.41×440 = 484 [2]	0.78×1.41×par *95.03* value [1]
Charging relay opening limit / charging activation	0.73×1.41×par *95.03* value [1] 0.73×1.41×208 = 214 [2]	0.73×1.41×par *95.03* value [1] 0.73×1.41×380 = 391 [2]	0.73×1.41 ×par *95.03* value [1] 0.73×1.41×440 = 453 [2]	0.73×1.41×par *95.03* value [1]
DC voltage at upper bound of supply voltage range (U_{DCmax})	324	560	648	(variable)
DC voltage at lower bound of supply voltage range (U_{DCmin})	281	513	594	(variable)
Standby limit	0.73×1.41×par *95.03* value [1] 0.73×1.41×208 = 214 [2]	0.73×1.41×par *95.03* value [1] 0.73×1.41×380 = 391 [2]	0.73×1.41×par *95.03* value [1] 0.73×1.41×440 = 453 [2]	0.73×1.41×par *95.03* value [1]
Undervoltage fault limit [3]	0.73×1.41×par *95.03* value [1] 0.73×1.41×208 = 214 [2]	0.73×1.41×par *95.03* value [1] 0.73×1.41×380 = 391 [2]	0.73×1.41×par *95.03* value [1] 0.73×1.41×440 = 453[2]	0.73×1.41×par *95.03* value [1]

[1] If parameter *95.01 Supply voltage* is set to *Automatic / not selected* and *95.02 Adaptive voltage limits* is set to *Enable*, the value of parameter *95.03 Estimated AC supply voltage* is used, [2] otherwise the lower limit of the range selected with parameter *95.01 Supply voltage* is used.

[3] The system throws an undervoltage fault when parameter *21.18* (*Auto restart time*) elapses or the value of parameter *21.18* is 0. In that case the standby limit is used as the undervoltage trip level. The system throws the undervoltage fault only if the drive is modulating when the DC voltage drops below the undervoltage trip level.

Note: In the above table, *95.03* is the *Estimated AC supply voltage* while powering up the drive and will not be continuously updated during run time.

When adaptive voltage limit is disabled in parameter *95.02* (*Adaptive voltage limits*):

DC voltage level [V]		**95.01 Supply Voltage**			
See *95.01 Supply voltage*.	**AC supply voltage range [V] 200…240**	**AC supply voltage range [VAC] 380…415**	**AC supply voltage range [VAC] 440…480**	**Automatic / Not selected**	
				if *95.03* < 456AC	**if *95.03* > 456AC**
Overvoltage fault limit	421	842	842	842	842
Overvoltage control limit	389	779	779	779	779
Internal brake chopper start limit	389	779	779	779	779
Internal brake chopper stop limit	379	759	759	759	759
Overvoltage warning limit	372	745	745	745	745
Undervoltage warning limit	0.85×1.35×208 = 239	0.85×1.35×380 = 436	0.85×1.35×440 = 505	0.85×1.35×380 = 436	0.85×1.35×440 = 505
Undervoltage control limit	0.78×1.35×208 = 219	0.78×1.35×380 =400	0.78×1.35×440 = 463	0.78×1.35×380 = 400	0.78×1.35×440 = 463
Charging relay closing limit / charging deactivation	0.78×1.35×208 = 219	0.78×1.35×380 = 400	0.78×1.35×440 = 463	0.78×1.35×380 = 400	0.78×1.35×440 = 463
Charging relay opening limit / charging activation	0.73×1.35x208 = 205	0.73×1.35x380 = 374	0.73×1.35x440 = 434	0.73×1.35x380 = 374	0.73×1.35x440 = 434
DC voltage at upper bound of supply voltage range (U_{DCmax})	324	560	648	(variable)	(variable)
DC voltage at lower bound of supply voltage range (U_{DCmin})	281	513	594	(variable)	(variable)
Standby limit	0.73×1.35×208 = 205	0.73×1.35×380 = 374	0.73×1.35×440 = 434	0.73×1.35×380 = 374	0.73×1.35×440 = 434
Undervoltage fault limit [1)]	0.73×1.35×208 = 205	0.73×1.35×380 = 374	0.73×1.35×440 = 434	0.73×1.35×380 = 374	0.73×1.35×440 = 434

1) The drive trips on the undervoltage fault when parameter *21.18* (*Auto restart time*) elapses or the value of parameter *21.18* is 0. In that case the standby limit is used as the undervoltage trip level. The undervoltage fault occurs only if the drive is modulating when the DC voltage drops below the undervoltage trip level.

The conditions to trigger undervoltage warning

Undervoltage warning is triggered if one of below conditions is active:

- If the DC link voltage goes below the undervoltage warning limit (85%) when the drive is not modulating.
- If the DC link voltage goes below the standby limit (73%) when the drive is modulating, and auto restart is enabled (i.e parameter *21.18 Auto restart time*

value > 0 sec). The warning will continue to appear if the actual DC link voltage is continuously below the standby limit and until the auto restart time has elapsed. The control board of the drive must be externally powered by 24 VDC to have this functionality. Otherwise the control board may be switched off if the voltage goes below the hardware limit.

The conditions to trigger undervoltage fault

Undervoltage fault is triggered if the drive is modulating and one of the below conditions is active:

- If the DC link voltage goes below the undervoltage trip limit (73%) and auto restart is not enabled (i.e parameter *21.18 Auto restart time* value = 0.0 sec).
- If the DC link voltage goes below the undervoltage trip limit (73%) and auto restart is enabled (i.e parameter *21.18 Auto restart time* value >0 sec), then undervoltage trip will occur if only the DC link voltage is continuously below the undervoltage trip limit and after auto restart time has elapsed. Control board of the drive must be externally powered by 24 VDC source to have this functionality. Otherwise the control board may be switched off, just showing an undervoltage warning.

Settings and diagnostics

- Parameters: *01.11 DC voltage* (page *129*), *30.30 Overvoltage control* (page *271*), *30.31 Undervoltage control* (page *271*), *95.01 Supply voltage* (page *427*) and *95.02 Adaptive voltage limits* (page *427*).

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 operation is based on hysteresis.

The internal brake choppers in the drive (in frames R0…R3) start conducting at internal brake chopper start limit 780 V and stop conducting at internal brake chopper stop limit 760 V (AC supply 380…480 V).

For information on external brake choppers, refer to the respective user manual.

Note: Overvoltage control needs to be disabled for the chopper to operate.

Settings and diagnostics

- Parameters: *01.11 DC voltage* (page *129*), *30.30 Overvoltage control* (page *271*) and parameter group *43 Brake chopper* (page *356*).

Limit to limit control

The Limit to limit control function restricts the forward and reverse movement of a load inside two extreme points. The function supports the monitoring of two sensors at both ends of the movement range: one for the slow down point and the other for the stop point. The system installer must install the sensors (eg, limit switches) and connect them to the drive.

In the forward direction, the function allows normal operation of the drive until the movement reaches the forward limiting points:

- When the drive receives the forward slow down signal, it decelerates the speed to the slow down speed. Slow down speed allows smooth transition to stop at a later stage. Vector mode uses the Speed reference ramp (*23.11*…*23.15*) and Scalar mode the Freq reference ramp (*28.71*…*28.75*).
- When the drive receives the forward stop signal, it stops the motor. It uses the drive stop mode selection (*21.03*). The function allows start only in the reverse direction.

In the reverse direction, the function monitors reverse slow down and reverse stop signals. The operation is similar as in the forward direction.

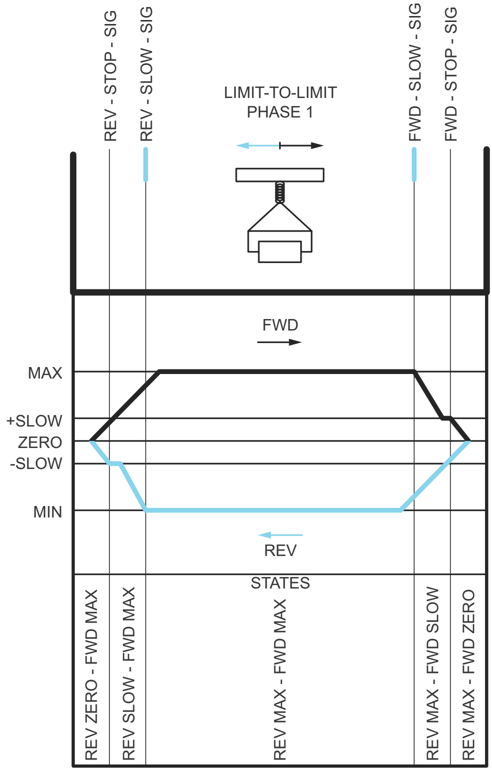
You can enable the function with parameter *76.02* and define the signal sources for the forward slow down, forward stop, reverse slow down and reverse stop. You can also define the slow down speed by a parameter.

The Limit to limit function detects the signal status changes only when the function is active, and the load is moved by the drive and motor. The function does not update the signal states in its state machine despite of the actual status changes:

1. when the user has deactivated or disabled the function
2. when the function has stopped the motor but the load is moved by a force other than the drive and motor (e.g., by a gravity).

For application example, see sections *Crane stop limit function* on page *662*, *Crane slowdown function* on page *664*, and *Fast stop* on page *666*.

Limit to limit control function



Limitations

- The external stop or slow down signals (in either direction) must not be on when the Limit to limit function is activated for the first time. If that is not possible, change the state manually to match the actual status in the Limit to limit state parameter (*76.01*).
- When drive is stopped, the load must not be moved with external force (the drive cannot monitor direction). If this happens, the Limit to limit state can be manually changed to the correct one in parameter Limit to limit state parameter (*76.01*).
- Coast stop without mechanical brake may cause load moving without Limit to limit control (drive is not controlling load movement). If this happens, the Limit to limit state can be manually changed to the correct one in parameter Limit to limit state parameter (*76.01*).
- When Limit to limit control is in Pulse mode then the state is saved over power cycle. The load must not be moved when the drive is powered off. If this happens, then Limit to limit state can be manually changed to the correct one in parameter Limit to limit state parameter (*76.01*).

Tips

- You can connect Slow down and Stop signals into the same signal source by setting the Stop limit and Slow down parameters to the same digital input (*76.01* Forward stop limit = DI2 and *76.05* Forward slow down limit = DI2).
- You can change the Limit to limit state machine state with the parameter Limit to limit state parameter (*76.01*), in case of maintenance.

Settings and diagnostics

Parameters: groups *21 Start/stop mode* (page *200*), *23 Speed reference ramp* (page *228*) and *28 Frequency reference chain* (page *247*), *76.01 Limit to limit control status* (page *417*), *76.02 Enable limit to limit control* (page *418*), *76.03 Limit to limit trigger type* (page *418*), *76.04 Forward stop limit* (page *419*), *76.05 Forward slow down limit* (page *420*), *76.06 Reverse stop limit* (page *421*), *76.07 Reverse slow down limit* (page *421*), *76.08 Slow down speed* (page *421*) and *76.09 Slow down frequency* (page *421*).

Safety and protections

Fixed/Standard protections

Overcurrent

If the output current exceeds the internal overcurrent limit, the IGBTs are shut down immediately to protect the drive.

DC overvoltage

See section *Overvoltage control* on page *103*.

DC undervoltage

See section *Undervoltage control (power loss ride-through)* on page *103*.

Drive temperature

If the temperature rises high enough, the drive first starts to limit the switching frequency and then the current to protect itself. If it is still keeps heating up, for example because of a fan failure, an overtemperature fault is generated.

Short circuit

In case of a short circuit, the IGBTs are shut down immediately to protect the drive.

Emergency stop

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

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

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

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

Notes:

- 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.
- 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.
- During an emergency stop, the speed and torque reference parameters such as reference ramp shapes (*23.32 Shape time 1* and *23.33 Shape time 2*) are not considered.

Settings and diagnostics

- Parameters: *21.04 Emergency stop mode* (page *202*), *21.05 Emergency stop source* (page *203*), *23.23 Emergency stop time* (page *230*), *31.32 Emergency ramp supervision* (page *283*) and *31.33 Emergency ramp supervision delay* (page *283*).

Programmable protection functions

External events (*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.

Motor phase loss detection (*31.19*)

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

The motor phase loss detection is enabled by default and displays fault *3381 Output phase loss* whenever the drive detects a phase loss. The motor phase loss detection needs to be enabled or disabled based on the motor control mode and the nominal current as follows:

- With the vector control, the motor phase loss detection is always on and there are no operational limits.
- With the scalar control, the motor phase loss detection activates when the motor frequency is above 10% of the motor nominal frequency. This limit cannot be changed.
- With motors having nominal current below 1/6 of drive nominal current, the supervision must be disabled as the drive cannot measure the motor current accurately.

Earth (Ground) fault detection (*31.20*)

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 (*31.20*)

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

Safe torque off detection (*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 of the drive.

Swapped supply and motor cabling (*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.

Stall protection (*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 (*31.30*)

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

Local control loss detection (*49.05*)

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

AI supervision (*12.03*…*12.04*)

The parameters select how the drive reacts when an analog input signal moves out of the minimum and/or maximum limits specified for the input.

Automatic fault resets

The drive can automatically reset itself after overcurrent, overvoltage, undervoltage and external faults. The user can also specify a fault that is automatically reset.

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

Settings and diagnostics

- Parameters: *31.12*…*31.16*.

Diagnostics

Signal supervision

Six 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 supervised signal is low-pass filtered.

Settings and diagnostics

- Parameters: group *32 Supervision* (page *285*).

Energy saving calculators

This feature consists of the following functionalities:

- An energy optimizer that adjusts the motor flux in such a way that the total system efficiency is maximized
- A counter that monitors used and saved energy by the motor and displays them in kWh, currency or volume of CO_2 emissions, and
- A load analyzer showing the load profile of the drive (see section *Load analyzer* on page *115*).

In addition, there are counters that show energy consumption in kWh of the current and previous hour as well as the current and previous day.

Note: The accuracy of the energy savings calculation is directly dependent on the accuracy of the reference motor power given in parameter *45.19 Comparison power*.

Settings and diagnostics

Parameters: group *45 Energy efficiency* (page *368*), *01.50 Current hour kWh* (page *130*), *01.51 Previous hour kWh* (page *130*), *01.52 Current day kWh* (page *130*) and *01.53 Previous day kWh* (page *130*).

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.

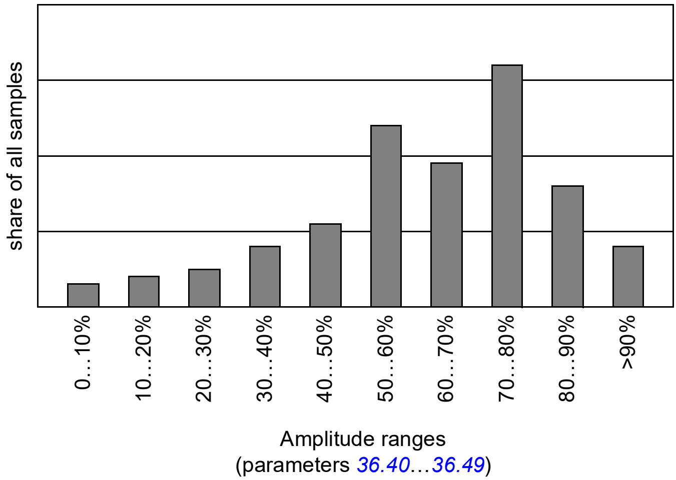
Amplitude loggers

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.

- Parameter *36.40* shows the share of samples that have fallen in range 0...10% of the reference value during the time that the logging has been active.
- Parameter *36.41* shows that share of samples that have fallen in range 10...20% of the reference value during the time that the logging has been active
- etc.

You can view this graphically with the assistant panel or the Drive Composer PC tool.



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}). The maximum output current values are listed in the section *Ratings* in the *Hardware manual* of the drive. The measured current is logged continuously. The distribution of samples is shown by parameters *36.20*…*36.29*.

Settings and diagnostics

- Parameters: group *36 Load analyzer* (page *325*).

Miscellaneous

Backup and restore

You can make backups of the settings manually to the assistant panel. The panel also keeps one automatic backup. You can restore a backup to another drive, or a new drive replacing a faulty one. You can make backups and restore on the panel, or with the Drive Composer PC tool.

See the relevant assistant control panel for more information on backing up and settings.

Backup

Manual backup

Make a backup when necessary, for example, after you have started up the drive or when you want to copy the settings to another drive.

Parameter changes from fieldbus interfaces are ignored unless you have forced parameter saving.

Automatic backup

The assistant panel has space for one automatic backup. An automatic backup is created two hours after the last parameter change. After completing the backup, the panel waits for 24 hours before checking if there are additional parameter changes. If there are, it creates a new backup overwriting the previous one when two hours have passed after the latest change.

You cannot adjust the delay time or disable the automatic backup function.

Parameter changes from fieldbus interfaces are ignored unless you have forced parameter saving.

Restore

The backups are shown on the panel. Automatic and manual backups are separately marked.

Note: To restore a backup, the drive has to be in Local control.

Settings and diagnostics

- Parameters: *96.07 Parameter save manually* (page 434).

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. To change a user parameter set, the drive has to be stopped.

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

- I/O extension module settings (*15 I/O extension module*)
- Data storage parameters (*47 Data storage*)
- Fieldbus communication settings (*50 Fieldbus adapter (FBA)*…*53 FBA A data out* and *58 Embedded fieldbus*).

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 and diagnostics

- Parameters: *96.10*…*96.13*.

Data storage parameters

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

Settings and diagnostics

- Parameters: group *47 Data storage* (page *377*).

Parameter checksum calculation

Parameter checksums A and B can be calculated from a set of parameters to monitor changes in the drive configuration. The parameter sets are different for A and B. Each of the calculated checksum is compared to corresponding reference checksum. If a mismatch occurs, the drive generates an event (a pure event, warning or fault). The calculated checksum can be set as the new reference checksum.

The set of parameters for checksum A does not include fieldbus settings parameters.

The parameters included in the checksum A calculation are user editable parameters in parameter groups 10, 15, 19, 20, 21, 22, 23, 24, 25, 28, 30, 31, 32, 34, 35, 36, 37, 40, 41, 43, 45, 46, 71, 76, 90, 91, 92, 95, 96, 97, 98, and 99.

The set of parameters for checksum B does not include:

- fieldbus settings
- motor data settings, and
- energy data settings parameters.

The parameters included in the checksum B calculation are user editable parameters in parameter groups 10, 15, 19, 20, 21, 22, 23, 24, 25, 28, 30, 31, 32, 34, 35, 36, 37, 40, 41, 43, 46, 71, 76, 90, 91, 92, 95, 96, and 97.

Settings and diagnostics

- Parameters: *96.54*…*96.55*, *96.68*…*96.69* and *96.71*…*96.72*.
- Events: *A686 Checksum mismatch* (page *494*), *B686 Checksum mismatch* (page *503*) and *6200 Checksum mismatch* (page *511*).

Motor potentiometer

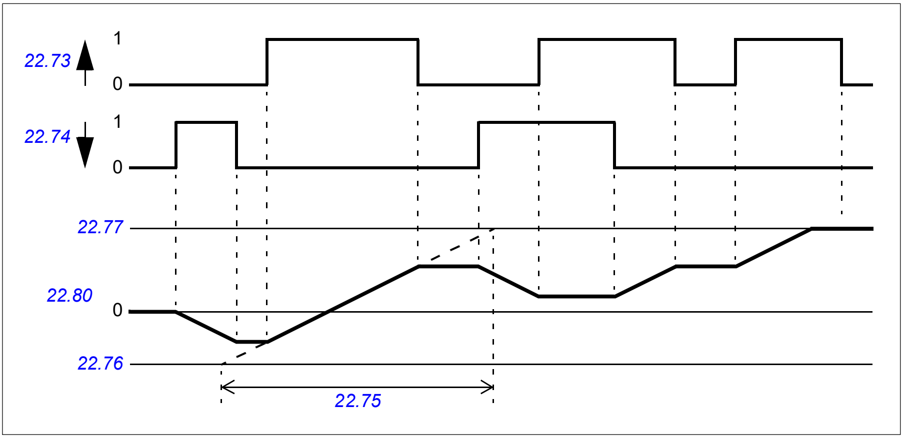
The motor potentiometer is a counter whose value can be adjusted up and down using two digital signals selected by parameters.

When enabled, the motor potentiometer assumes a set value. Depending on the mode selected, the motor potentiometer value is either retained or reset over a power cycle.

The change rate is defined as the time it would take for the value to change from the minimum to the maximum, 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, and it can be directly set as the reference source in the main selector parameters, or used as an input by other source selector parameters.

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



For application example, see section *Crane motor potentiometer* on page *673*.

Settings and diagnostics

- Parameters: *22.71*…*22.80*.

User lock

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

WARNING! ABB will not be liable for damages or losses caused by the failure to activate the user lock using a new pass code. See *Cybersecurity disclaimer* (page 15).

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 and diagnostics

- Parameters: *96.02 Pass code* (page 431) and *96.100*…*96.102*.

AI dead band

User can define a dead band value (*12.110*) for the analog input signals. The value is valid both for analog input AI1 and AI2, and both for the voltage and milliampere signals. The dead band value of 100% corresponds to 10 V for a voltage signal and 20 mA for a current signal.

- In case of voltage: 10 V x (parameter *12.110* value) x 0.01
- In case of current: 20 mA x (parameter *12.110* value) x 0.01

The control program automatically calculates a hysteresis value for the AI dead band:

- AI dead band hysteresis value = AI dead band value x 0.1

Example

Parameter *12.110* (AI dead band) value is set to 50%.

In case of voltage signal:

- AI unit selection = V
- AI dead band value = 10 x 50 x 0.01 = 5 V
- AI Hysteresis value = 5 x 0.1 = 0.5 V
- AI dead band hysteresis positive value = 5 + 0.5 = 5.5 V
- AI dead band hysteresis negative value = 5 - 0.5 = 4.5 V

Now, when AI input voltage is increasing up to 5.5 V, AI actual shows 0. As soon as AI input voltage reaches 5.5 V, AI actual shows 5.5 V and continues to detect the AI input voltage up to AI max which is in range of 0 V to 10 V. When AI input voltage is decreasing, AI actual shows the actual AI applied up to 4.5 V. As soon as AI input goes below 4.5 V, AI actual shows 0 till input voltage reaches 0 V.

High speed counter

High speed counter counts pulses from the input source selected by user (*33.71*). User can also define how to enable or disable the counter (*33.80*).

The counter value can be read from parameter *33.02*, which is an unsigned 32-bit integer. The counter update time is 2 ms. The counter has configurable direction, preset source and value, and high and low limits (parameters *33.73* to *33.77*).

The counter value can be configured to roll over or to saturate to limit values (*33.72*). There is also a divider (*33.79*) that can be used for scaling down fast pulse counting to a more comprehensive scale (for example when encoder counting divided by encoder pulse number would result in counting the number of axis rotations). The remainder of the division is kept until preset is done. The counter has a status word (*33.04*) indicating the current count status.

The following counter inputs are supported:

- Frequency input (up to 16 kHz) [1)]
- Encoder, where the rising and falling edges are calculated
- Encoder with direction, where the rising and falling edges are calculated.[2)]
- Digital inputs 1…5 (up to 125 Hz)
- DIOs as input (up to 250 Hz)
- Pointer to any bit in the parameters (maximum frequency depends on the source bit update cycle).

[1)] When a digital input (DI3/BMIO-01, DI4/BIO-01) is configured as counter and that is used as the counter source (*33.71* = Frequency input 1), then frequency inputs are not available. See configuration parameters for DI3, DI4 and DI5 (*11.13*, *11.17* and *11.21*).

[2)] When an encoder with direction is selected, the direction parameter *33.73* has no effect.

It is possible to configure two digital inputs as frequency inputs. However, if counter needs to be used, only one input can be configured as frequency input. This is a hardware limitation.

When a digital input (DI1, DI2 / DI3-DI5 or DIO configured as a digital input) is used as the counter source, then the maximum signal frequency is limited to 125 Hz. Higher frequencies can cause aliasing and result in wrong counter values.

The reason for the maximum signal frequency limitation is the 2 ms update time. With two samples required (in the same state), only the rising edge is calculated. The minimum cycle time of 8 ms results in a maximum signal frequency of 125 Hz.

Signal supervision function (group *32 Supervision*) can be used to tell when a certain value has been reached outside of the counter status word content.

Settings and diagnostics

- Counter parameters: *33.02*…*33.79*
- Frequency input parameters: *11.13*, *11.17* and *11.21*
- Encoder configuration parameters: groups *90 Feedback selection*, *91 Encoder module settings* and *92 Encoder 1 configuration*.

6

Parameters

Contents

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. In addition to the “Other” selection, the parameter may offer other pre-selected settings. Not in this version.
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. Not in this version.
Default	The default is shown on the same row as the parameter name. The default value of a parameter for the ABB standard macro with BMIO-01. For information on other macro-specific parameter values, see chapter *Control macros*.
FbEq16/32	The fieldbus equivalent for 16-bit and 32-bit. They are 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 fieldbus communication when the user selects a 16-bit value in parameter group *52 FBA A data in* or *53 FBA A data out*. A dash (-) indicates that the user cannot access the parameter in 16-bit format. 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.
List	Selection list.
No.	Parameter number.
PB	Packed Boolean (bit list).
Real	Real number.
Type	Type (analogue src, binary src, list, PPB, real).
Other	The value is taken from another parameter. Choosing “Other” displays a parameter list in which the user can specify the source parameter.
Other [bit]	The value is taken from a specific bit in another parameter. The user selects the source from a parameter list.
Parameter	Either a user-adjustable operating instruction for the drive, or an *Actual signal*.
p.u.	Per unit
[parameter number]	Value of the parameter

Fieldbus addresses

Refer to the fieldbus adapter user's manual.

Summary of parameter groups

Group	Contents	Page
01 Actual values	Basic signals for monitoring the drive.	*128*
03 Input references	Values of references received from various sources.	*132*
04 Warnings and faults	Information on warnings and faults that occurred last.	*133*
05 Diagnostics	Various run-time-type counters and measurements related to drive maintenance.	*135*
06 Control and status words	Drive control and status words.	*139*
07 System info	Drive hardware and firmware information.	*146*
09 Crane application signals	Signals related to crane applications.	*149*
10 Standard DI, RO	Configuration of digital inputs and relay outputs.	*150*
11 Standard DIO, FI, FO	Configuration of the digital input/outputs.	*156*
12 Standard AI	Configuration of standard analog inputs.	*163*
13 Standard AO	Configuration of standard analog outputs.	*170*
15 I/O extension module	Configuration of the I/O extension module.	*175*
19 Operation mode	Selection of local and external control location sources and operating modes.	*180*
20 Start/stop/direction	Start/stop/direction and run/start/jog enable signal source selection; positive/negative reference enable signal source selection.	*183*
21 Start/stop mode	Start and stop modes; emergency stop mode and signal source selection; DC magnetization settings.	*200*
22 Speed reference selection	Speed reference selection; motor potentiometer settings.	*212*
23 Speed reference ramp	Speed reference ramp settings (programming of the acceleration and deceleration rates for the drive).	*228*
24 Speed reference conditioning	Speed error calculation; speed error window control configuration; speed error step.	*233*
25 Speed control	Speed controller settings.	*234*
26 Torque reference chain	Settings for the torque reference chain.	*240*
28 Frequency reference chain	Settings for the frequency reference chain.	*247*
30 Limits	Drive operation limits.	*262*
31 Fault functions	Configuration of external events; selection of behavior of the drive upon fault situations.	*274*
32 Supervision	Configuration of signal supervision functions 1…3.	*285*

Parameter listing

No.	Name/Value	Description	Default FbEq 16
01 Actual values		Basic signals for monitoring the drive. All parameters in this group are read-only unless otherwise noted. **Note:** Values of these actual signals are filtered with the filter time defined in group *46 Monitoring/scaling settings*. The selection lists for parameters in other groups mean the raw value of the actual signal instead. For example, if a selection is "Output frequency" it does not point to the value of parameter *01.06 Output frequency* but to the raw value.	
01.01	*Motor speed used*	Measured or Estimated motor speed depending on the type of feedback used in parameter *96.01 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 %*	Actual speed in percent of the motor synchronous speed. The filter time constant can be adjusted by parameter *46.11 Filter time motor speed*.	-
	-1000.00… 1000.00%	Motor speed.	See par. *46.01*
01.04	*Encoder 1 speed filtered*	Measured motor speed from Encoder 1. The filter time constant can be adjusted by parameter *46.11 Filter time motor speed*.	-
	-30000 … 30000		1=1
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	Motor current.	See par. *46.05*

No.	Name/Value	Description	Default FbEq 16
01.08	*Motor current % of motor nom*	Motor current (drive output current) in percent of the nominal motor current.	-
	0.0…1000.0%	Motor current.	1=1%
01.09	*Motor current % of drive nom*	Motor current (drive output current) in percent of the nominal drive current.	-
	0.0…1000.0%	Motor current.	1=1%
01.10	*Motor torque*	Motor torque in percent of the nominal motor torque. See also parameter *01.30 Nominal torque scale*. A filter time constant for this signal can be defined by parameter *46.13 Filter time motor torque*.	-
	-1600.0…1600.0%	Motor torque.	See par. *46.03*
01.11	*DC voltage*	Measured intermediate circuit DC Link voltage.	-
	0.00…2000.00 V	DC link voltage.	10 = 1 V
01.13	*Output voltage*	Calculated motor voltage in V AC.	-
	0…2000 V	Motor voltage.	1 = 1 V
01.14	*Output power*	Measured output power in kW. The filter time constant can be adjusted by parameter *46.14 Filter time power*.	-
	-32768.00… 32767.00 kW	Output power.	See par. *46.04*
01.15	*Output power % of motor nom*	Measured output power in % of nominal motor power.	-
	-300.00… 300.00%	Output power.	10 = 1%
01.17	*Motor shaft power*	Estimated mechanical power at motor shaft in kW or hp. Parameter*96.16* defines the unit. . The filter time constant can be adjusted by parameter *46.14 Filter time power*.	-
	-32768.00… 32767.00 kW or hp	Motor shaft power.	See par. *46.04*
01.18	*Inverter GWh counter*	Amount of energy that has passed through the drive (in either direction) in full gigawatt-hours. The minimum value is zero.	-
	0…65535 GWh	Energy in GWh.	1 = 1 GWh
01.19	*Inverter MWh counter*	Amount of energy that has passed through the drive (in either direction) in full megawatt-hours. Whenever the counter rolls over, *01.18 Inverter GWh counter* is incremented. The minimum value is zero.	-
	0…1000 MWh	Energy in MWh.	1 = 1 MWh

No.	Name/Value	Description	Default FbEq 16
01.20	*Inverter kWh counter*	Amount of energy that has passed through the drive (in either direction) in full kilowatt-hours. Whenever the counter rolls over, *01.19 Inverter MWh counter* is incremented. The minimum value is zero.	-
	0…1000 kWh	Energy in kWh.	10 = 1 kWh
01.24	*Flux actual %*	Used flux in percent of nominal flux of motor.	-
	0…200%	Flux value.	1 = 1%
01.30	*Nominal torque scale*	Nominal torque in N•m which corresponds to 100%. **Note:** This parameter is copied from parameter *99.12 Motor nominal torque* if given. Otherwise the value is calculated from other motor data.	0
	0.000…4000000 N·m or lb·ft	Nominal torque.	1 = 100 unit
01.50	*Current hour kWh*	Current hour energy consumption. This is the energy of the last 60 minutes (not necessarily continuous) the drive has been running, not the energy of a calendar hour. The value is set to the value before the power cycle when the drive is again up and running.	- / -
	0.00…1000000.00 kWh	Energy.	1 = 1 kWh
01.51	*Previous hour kWh*	Previous hour energy consumption. The value *Current hour kWh* is stored here when its values has been cumulated for 60 minutes. The value is set to the value before the power cycle when the drive is again up and running.	-
	0.00…1000000.00 kWh	Energy.	1 = 1 kWh
01.52	*Current day kWh*	Current day energy consumption. This is the energy of the last 24 hours (not necessarily continuous) the drive has been running, not the energy of a calendar day. The value is set to the value before the power cycle when the drive is again up and running.	-
	0.00…1000000.00 kWh	Energy.	1 = 1 kWh
01.53	*Previous day kWh*	Previous day energy consumption. The value is set to the value before the power cycle when the drive is again up and running.	-
	0.00 … 1000000.00 kWh	Energy.	1 = 1 kWh

No.	Name/Value	Description	Default FbEq 16
01.54	*Cumulative inverter energy*	Amount of energy that has passed through the drive (in either direction) in full kilowatt-hours. The minimum value is zero.	-
	-200000000.0… 200000000.0 kWh	Energy in kWh.	10 = 1 kWh
01.55	*Inverter GWh counter (resettable)*	Amount of energy that has passed through the drive (in either direction) in full gigawatt-hours. The minimum value is zero. You can reset the value by setting it to zero. Resetting any of parameters *01.55*…*01.58* resets all of them.	-
	0…65535 GWh	Energy in GWh.	1 = 1 GWh
01.56	*Inverter MWh counter (resettable)*	Amount of energy that has passed through the drive (in either direction) in full megawatt-hours. Whenever the counter rolls over, *01.55 Inverter GWh counter (resettable)* is incremented. The minimum value is zero. You can reset the value by setting it to zero. Resetting any of parameters *01.55*…*01.58* resets all of them.	-
	0…1000 MWh	Energy in MWh.	1 = 1 MWh
01.57	*Inverter kWh counter (resettable)*	Amount of energy that has passed through the drive (in either direction) in full kilowatt-hours. Whenever the counter rolls over, *01.56 Inverter MWh counter (resettable)* is incremented. The minimum value is zero. You can reset the value by setting it to zero. Resetting any of parameters *01.55*…*01.58* resets all of them.	-
	0…1000 kWh	Energy in kWh.	10 = 1 kWh
01.58	*Cumulative inverter energy (resettable)*	Amount of energy that has passed through the drive (in either direction) in full kilowatt-hours. The minimum value is zero. You can reset the value by setting it to zero. Resetting any of parameters *01.55*…*01.58* resets all of them.	-
	-200000000.0… 200000000.0 kWh	Energy in kWh.	10 = 1 kWh
01.61	*Abs motor speed used*	Absolute value of the motor speed used *01.01 Motor speed used*.	-
	0.00… 30000.00 rpm		1 = 1 rpm

No.	Name/Value	Description	Default FbEq 16
01.62	*Abs motor speed %*	Absolute value of the motor speed % *01.03 Motor speed %.*	-
	0.00… 1000.00%		10 = 1%
01.63	*Abs output frequency*	Absolute value of the output frequency *01.06 Output frequency*.	-
	0.00…500.00 Hz		1 = 1 Hz
01.64	*Abs motor torque*	Absolute value of the motor torque *01.10 Motor torque*.	-
	0.0… 1600.0%		1 = 1%
01.65	*Abs output power*	Absolute value of the output power *01.14 Output power*.	-
	0.00… 32767.00 kW		1 = 1 kW
01.66	*Abs output power % mot nom*	Absolute value of the output power % of motor nominal *01.15 Output power % of motor nom*.	-
	0.00… 300.00%		1 = 1%
01.68	*Abs motor shaft power*	Absolute value of the motor shaft power *01.17 Motor shaft power*.	-
	0.00… 332767.00 kW		1 = 1 kW

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 mode reference is given from the control panel.	0
	-100000.00… 100000.00 rpm, Hz or %	Control panel or PC tool reference.	1 = 10 unit
03.02	*Panel reference remote*	Remote mode reference given from the control panel.	-
	-100000.00… 100000.00 rpm, Hz or %	Control panel or PC tool reference.	1 = 10 unit
03.05	*FB A reference 1*	Scaled fieldbus A reference 1. See parameter *50.14 FBA A reference 1*.	0
	-100000.00 … 100000.00	Reference from fieldbus adapter A.	1 = 10
03.06	*FB A reference 2*	Scaled fieldbus A reference 2. See parameter *50.15 FBA A reference 2*.	0
	-100000.00 … 100000.00	Reference 2 from fieldbus adapter A.	1 = 10

No.	Name/Value	Description	Default FbEq 16
03.09	*EFB reference 1*	Scaled reference 1 received through the embedded fieldbus interface. The scaling is defined by *58.26 EFB ref1 type*	-
	-30000.00 … 30000.00	Scaled reference 1 received through the embedded fieldbus interface.	1 = 10
03.10	*EFB reference 2*	Scaled embedded fieldbus reference 2.	-
	-30000.00 … 30000.00	Scaled reference 2 received through the embedded fieldbus interface. The scaling is defined by *58.27 EFB ref2 type*	1 = 10
03.17	*Integrated Panel ref*	Local mode reference given from the integrated control panel. The unit (rpm, Hz or %) is set from parameter.	0
	-100000.00 … 100000.00 rpm, Hz or %	Integrated control panel reference.	1 = 10
03.18	*Integrated Panel ref remote*	Remote mode reference given from the integrated control panel.	0
	-100000.00 … 100000.00 rpm, Hz or %	Integrated control panel reference.	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 drive to trip as it arrived at the trip register).	-
	0000h…FFFFh	Fault code.	1=1
04.02	*Active fault 2*	2nd active fault in the trip register.	-
	0000h…FFFFh	Fault code.	1=1
04.03	*Active fault 3*	3rd active fault in the trip register.	-
	0000h…FFFFh	Fault code.	1=1
04.06	*Active warning 1*	1st active warning in warning register.	-
	0000h…FFFFh	Warning code.	1=1
04.07	*Active warning 2*	2nd active warning in warning register.	-
	0000h…FFFFh	Warning code.	1=1
04.08	*Active warning 3*	3rd active warning in warning register.	-
	0000h…FFFFh	Warning code.	1=1

No.	Name/Value	Description	Default FbEq 16
04.11	*Latest fault*	Latest fault in the trip log store. The trip log store is loaded with the active faults in the order they occur.	-
	0000h…FFFFh	Fault code.	1=1
04.12	*2nd latest fault*	2nd fault in trip log store.	-
	0000h…FFFFh	Fault code.	1=1
04.13	*3rd latest fault*	3rd fault in trip log store.	-
	0000h…FFFFh	Fault code.	1=1
04.16	*Latest warning*	Latest warning in the warning log store. The warning log store is loaded with the active warnings in the order they occur.	-
	0000h…FFFFh	Warning code.	1=1
04.17	*2nd latest warning*	2nd warning in trip log store.	-
	0000h…FFFFh	Warning code.	1=1
04.18	*3rd latest warning*	3rd warning in trip log store.	-
	0000h…FFFFh	Warning code.	1=1
04.40	*Event word 1*	Shows the user-defined event word. This word collects the status of the events (warnings, faults or pure events) selected by parameters *04.41*…*04.71*. See chapter *Fault tracing* (page *123*) for the list of event codes. This parameter is read-only.	-

Bit	Name	Description
0	User bit 0	1 = Event selected by parameter *04.41* is active.
1	User bit 1	1 = Event selected by parameter *04.43* is active.
…	…	…
15	User bit 15	1 = Event selected by parameter *04.71* is active.

No.	Name/Value	Description	Default FbEq 16
	0b0000…0b1111	Event word.	1 = 1
04.41	*Event word 1 bit 0 code*	Selects the hexadecimal code of an event (warning, fault or pure event) whose status is shown as bit 0 of parameter *04.40*. See chapter *Fault tracing* (page *487*) for the event codes.	0x2310h
	0000h…FFFFh	Code of event.	1 = 1
04.43	*Event word 1 bit 1 code*	Selects the hexadecimal code of an event (warning, fault or pure event) whose status is shown as bit 1 of parameter *04.40*. See chapter *Fault tracing* (page *487*) for the event codes.	0x3210h
	0000h…FFFFh	Code of event.	1 = 1

No.	Name/Value	Description	Default FbEq 16
04.45	*Event word 1 bit 2 code*	…	0x4310h
04.47	*Event word 1 bit 3 code*	…	0x2340h
04.49	*Event word 1 bit 4 code*	…	0x0000h
04.51	*Event word 1 bit 5 code*	…	0x3220h
04.53	*Event word 1 bit 6 code*	…	0x80A0h
04.55	*Event word 1 bit 7 code*	…	0x0000h
04.57	*Event word 1 bit 8 code*	…	0x7122h
04.59	*Event word 1 bit 9 code*	…	0x7081h
04.61	*Event word 1 bit 10 code*	…	0xFF61h
04.63	*Event word 1 bit 11 code*	…	0x7121h
04.65	*Event word 1 bit 12 code*	…	0x4110h
04.67	*Event word 1 bit 13 code*	…	0x9081h
04.69	*Event word 1 bit 14 code*	…	0x9082h
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 parameter *04.40*. See chapter *Fault tracing* (page *487*) for the event codes.	0x2330h
	0000h…FFFFh	Code of event.	1 = 1

05 Diagnostics		Various run-time-type counters and measurements related to drive maintenance. All parameters in this group are read-only unless otherwise noted.	
05.01	*On-time counter*	Drive on-time counter. The counter runs when the drive is powered.	-
	0…65535 d	On-time counter (number of days).	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

No.	Name/Value	Description	Default FbEq 16
05.03	Hours run	Corresponding parameter to 05.02 Run-time counter in hours, that is, 24 * 05.02 value + fractional part of a day.	-
	0… 429496729.5 h	Hours.	1 = 1 h
05.04	Fan on-time counter	Running time of the drive cooling fan. Can be reset from the control panel by keeping Reset down for over 3 seconds.	-
	0…65535 d	Cooling fan run-time.	1 = 1 d
05.10	Control board temperature	Measured temperature of the control board.	-
	-100… 300 °C or °F	Temperature in degrees Celsius for Fahrenheit.	1 = unit
05.11	Inverter temperature	Estimated drive temperature in percent of fault limit. The fault limit varies according to the type of the drive. 0.0% = 0 °C (32 °F) 100.0% = Fault limit	-
	-40.0…160.0%	Temperature in percent.	1 = 1%
05.20	Diagnostic word 1	Diagnostic word 1. For possible causes and remedies, see chapter Fault tracing.	0b0000

Bit	Name	Value
0	Any warning or fault	1 = Drive has generated a warning or tripped on a fault.
1	Any warning	1 = Drive has generated a warning.
2	Any fault	1 = Drive has tripped on a fault.
3	Reserved	
4	Overcurrent fault	1 = Drive has tripped on fault 2310 Overcurrent.
5	Reserved	
6	DC overvoltage	1 = Drive has tripped on fault 3210 DC link overvoltage.
7	DC undervoltage	1 = Drive has tripped on fault 3220 DC link undervoltage.
8	Reserved	
9	Device overtemp flt	1 = Drive has tripped on fault 4310 Excess temperature.
10...15	Reserved	

No.	Name/Value	Description	Default FbEq 16
	0b0000…0b1111	Diagnostic word 1.	1 = 1

No.	Name/Value	Description	Default FbEq 16
05.21	*Diagnostic word 2*	Diagnostic word 2 For possible causes and remedies, see chapter *Fault tracing*.	0b0000

Bit	Name	Value
0...9	Reserved	
10	Motor overtemp flt	1 = Drive has tripped on fault *4981 External temperature 1* or *4982 External temperature 2*.
11…15	Reserved	

No.	Name/Value	Description	Default FbEq 16
	0b0000…0b1111	Diagnostic word 2.	1 = 1
05.22	*Diagnostic word 3*	Diagnostic word 3. For possible causes and remedies, see chapter *Fault tracing*.	0b0000

Bit	Name	Value
0...8	Reserved	
9	kWh pulse	1 = kWh pulse is active.
10	Reserved	
11	Fan command	1 = The drive fan is rotating above the minimum fan speed. In case of an On/Off fan that is not stopped, this bit is 1.
12…15	Reserved	

No.	Name/Value	Description	Default FbEq 16
	0b0000…0b1111	Diagnostic word 3.	1 = 1
05.80	*Motor speed at fault*	Copy of parameter *24.02 Used speed feedback* (in both scalar and speed control modes) at the occurrence of the latest fault.	-
	-30000.00… 30000.00 rpm	Motor speed at fault.	See par. *46.01*
05.81	*Output frequency at fault*	Displays the output frequency (*01.06*) at which fault occurred.	-
	-500.00…500.00 Hz	Output frequency at fault.	See par. *46.02*
05.82	*DC voltage at fault*	Displays the DC link volt age (*01.11*) at which fault occurred.	-
	0.00…2000.00 V	DC voltage at fault.	10 = 1 V
05.83	*Motor current at fault*	Displays the motor current (*01.07*) at which fault occurred.	-
	0.00…30000.00 A	Motor current at fault.	See par. *46.05*
05.84	*Motor torque at fault*	Displays the motor torque (*01.10*) at which fault occurred	-
	-1600.0…1600.0%	Motor torque at fault.	See par. *46.03*

No.	Name/Value	Description	Default FbEq 16
05.85	*Main status word at fault*	Copy of parameter *06.11 Main status word* at the occurrence of the latest fault.	-
	0000h…FFFFh	Main status word.	1 = 1
05.86	*DI delayed status at fault*	Displays the DI delayed status (*10.02*) at which fault occurred. For the bit list, see parameter *10.02 DI delayed status*.	0000h
	0000h…FFFFh	DI delayed status at fault.	1 = 1
05.87	*Inverter temperature at fault*	Displays the inverter temperature (*05.11*) at which fault occurred.	-
	-40…160°C	Inverter temperature at fault.	1 = 1°C
05.88	*Reference used at fault*	Displays the reference used (*28.01*/*26.73*/*23.01*) at which fault occurred. The type of the reference depends on the selected operation mode (*19.01*).	-
	-500.00… 500.00 Hz/ -1600.0…1600.0%/ 30000.00… 30000.00 rpm	Reference used at fault.	See par. *46.02*/ See par. *46.03*/ See par. *46.01*

No.	Name/Value	Description	Default FbEq 16
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 597. The related status word and state diagram are presented on pages 598 and 599 respectively. This parameter is read-only. **Note:** With the fieldbus control, the parameter value is not same as the value that it receives from the PLC. For the correct value, see parameter 50.12 FBA A debug mode.	0000h
	0000h…FFFFh	Main control word.	1 = 1

Bit	Name
0	Off1 control
1	Off2 control
2	Off3 control
3	Run
4	Ramp out zero
5	Ramp hold
6	Ramp in zero
7	Reset
8	Inching 1
9	Inching 2
10	Remote cmd
11	Ext ctrl loc
12	User bit 0
13	User bit 1
14	User bit 2
15	User bit 3

No.	Name/Value	Description	Default FbEq 16
06.11	*Main status word*	ABB Drives Profile Main status word. Reflects the status of the drive irrespective of control source e.g. a fieldbus system, control panel (keypad), PC-Tool, standard I/O, application program or sequence programming, and irrespective of the actual control profile which is used to control the drive. The bit assignments are described on page *597* (Contents of the fieldbus control word). The state diagram (valid for ABB drives profile) is on page *599*. This parameter is read-only. **Note:** With the fieldbus control, the parameter value is not same as the value that it receives from the PLC. For the correct value, see parameter *50.12 FBA A debug mode*.	0000h

Bit	Name
0	*Ready to switch ON*
1	*Ready run*
2	*Ready ref*
3	*Tripped*
4	*Off 2 inactive*
5	*Off 3 inactive*
6	*Switch-on inhibited*
7	*Warning*
8	*At setpoint*
9	*Remote*
10	*Above limit*
11	*User bit 0*
12	*User bit 1*
13	*User bit 2*
14	*User bit 3*
15	*Reserved*

	0000h…FFFFh	Main status word.	1 = 1

No.	Name/Value	Description	Default FbEq 16
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. To start the drive, the inhibiting signal (see par. *06.18*) must be removed and the start signal cycled.
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 control	1 = Drive is in *Network control* (see page *14*).
10	Ext1 active	1 = Control location EXT1 active
11	Ext2 active	1 = Control location EXT2 active
12	Reserved	
13	Start request	1 = Start requested. 0 = When Enable to rotate signal (see par. *20.22*) is 0 (rotating of the motor is disabled).
14	Running	1 = One of the following statuses is active: • Started + Run Permissive granted + no faults • Started + Run Permissive granted + faulted + auto reset not expired • Started + Run Permissive granted + DC hold • Started + Run Permissive granted + PID sleep (w/wo motor heating) • Started + Run Permissive granted + Pre-magnetization • Not started or start inhibited + in ramp stop

	0000h…FFFFh	Drive status word 1.	1 = 1

No.	Name/Value	Description	Default FbEq 16
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	Reserved	
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	Reserved	
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	Actual speed, frequency or torque equals or exceeds the limit (defined by parameters 46.31...45.33). Valid for both directions of rotation.
11…12	Reserved	
13	Start delay active	1 = Start delay (par. *21.22*) active.
14…15	Reserved	

	0000h…FFFFh	Drive status word 2.	1 = 1

No.	Name/Value	Description	Default FbEq 16
06.18	*Start inhibit status word*	Start inhibit status word. This word specifies the source of the inhibiting signal that is preventing the drive from starting. The conditions marked with an asterisk (*) only require that the start command is cycled. In all other instances, the inhibiting condition must be removed first. See also parameter *06.16 Drive status word 1*, bit 1. This parameter is read-only.	-

Bit	Name	Description
0	Not ready run	1 = DC voltage is missing or drive has not been parametrized correctly. Check the parameters in groups 95 and 99.
1	Ctrl location changed	* 1 = Control location has changed
2	SSW inhibit	1 = Control program is keeping itself in inhibited state
3	Fault reset	* 1 = A fault has been reset
4	Lost start enable	1 = Start enable signal missing
5	Lost run enable	1 = Run enable signal missing
6	Reserved	
7	STO	1 = Safe torque off function active
8	Current calibration ended	* 1 = Current calibration routine has finished
9	ID run ended	* 1 = Motor identification run has finished
10	Reserved	-
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	Default FbEq 16
06.19	*Speed control status word*	Speed control status word. This parameter is read-only.	--

Bit	Name	Description
0	Zero speed	1 = Drive has been running below zero speed limit (par. *21.06*) for a time defined by parameter *21.07 Zero speed delay*
1	Forward	1 = Drive is running in forward direction above zero speed limit (par. *21.06*)
2	Reverse	1 = Drive is running in reverse direction above zero speed limit (par. *21.06*)
3	Out of window	Speed out of speed window
4	Internal speed feedback	Estimate used for motor control
5	Encoder 1 feedback	Encoder 1 feedback used for motor control
6	Encoder 2 feedback	Encoder 2 feedback used for motor control
7	Any constant speed request	1 = A constant speed or frequency has been selected; see par. *06.20* below.
8	Follower speed correction min lim	Minimum limit of speed correction is reached by speed controlled follower application.
9	Follower speed correction max lim	Maximum limit of speed correction is reached by speed controlled follower application.
10...15	Reserved	

No.	Name/Value	Description	Default FbEq 16
	0000h…FFFFh	Speed control status word.	1 = 1
06.20	*Constant speed status word*	Constant speed/frequency status word. Indicates which constant speed or frequency is active (if any). See also parameter *06.19 Speed control status word*, bit 7, and section Constant speeds/frequencies. This parameter is read-only.	-

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	Default FbEq 16
	0000h…FFFFh	Constant speed/frequency status word.	1 = 1

No.	Name/Value	Description	Default FbEq 16
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
1	Post-magnetizing active	1 = Post-magnetizing is active
2	Motor pre-heating active	1 = Motor pre-heating is active
3…15	Reserved	

No.	Name/Value	Description	Default FbEq 16
	0000h…FFFFh	Drive status word 1.	1 = 1
06.29	*MSW bit 10 selection*	Selects a binary source whose status is transmitted as bit 10 (User bit 0) of parameter *06.11 Main status word*.	*Above limit*
	False	0.	0
	True	1.	1
	Above limit	Bit 10 of *06.17 Drive status word 2*.	2
	Other [bit]	Source selection (see *Terms and abbreviations*).	-
06.30	*MSW bit 11 selection*	Selects a binary source whose status is transmitted as bit 11 (User bit 0) 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*.	2
	Other [bit]	Source selection (see *Terms and abbreviations*).	-
06.31	*MSW bit 12 selection*	Selects a binary source whose status is transmitted as bit 12 (User bit 1) of *06.11 Main status word*.	*Ext run enable*
	False	0.	0
	True	1.	1
	Ext run enable	Status of the external run enable signal (see parameter *20.12 Run enable 1 source*).	2
	Other [bit]	Source selection (see *Terms and abbreviations*).	-
06.32	*MSW bit 13 selection*	Selects a binary source whose status is transmitted as bit 13 (User bit 2) of *06.11 Main status word*.	*False*
	False	0.	0
	True	1.	1
	Other [bit]	Source selection (see *Terms and abbreviations*).	-

No.	Name/Value	Description	Default FbEq 16
06.33	*MSW bit 14 selection*	Selects a binary source whose status is transmitted as bit 14 (User bit 3) of *06.11 Main status word*.	*False*
	False	0.	0
	True	1.	1
	Other [bit]	Source selection (see *Terms and abbreviations*).	-

07 System info		Drive hardware and firmware information. All parameters in this group are read-only.	
07.03	*Drive rating id*	Type of the drive/inverter unit.	-
07.04	*Firmware name*	Firmware identification.	-
07.05	*Firmware version*	Version number of the firmware.	-
07.06	*Loading package name*	Name of the firmware loading package.	-
07.07	*Loading package version*	Version number of the firmware loading package.	-
07.11	*Cpu usage*	Microprocessor load in percent.	-
	0…100%	Microprocessor load.	1 = 1-
07.25	*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* on page *58*.	-

Bit	Name	Description
0	Initialized	Adaptive program initialized.
1	Editing	Adaptive program in editing state.
2	Edit done	Editing of the adaptive program finished.
3	Running	Adaptive program running.
4-13	Reserved	
14	State changing	State changing on-going in the adaptive programming engine.
15	Faulted	Adaptive program faulted.

	0000h…FFFFh	Adaptive program status	1 = 1

No.	Name/Value	Description	Default FbEq 16
07.31	*AP sequence state*	Shows the number of the active state of the sequence program part of the adaptive program (AP). If adaptive programming is not running, or it does not contain a sequence program, the parameter is zero.	
	0…20		1 = 1
07.35	*Drive configuration*	Plug ‘n’ play configuration. Performs HW initialization, and shows the detected module configuration of the drive. During the HW initialization, if the drive is not able to detect any module, the value is set to 1, Base unit. For more information, see section *Automatic drive configuration for fieldbus control* on page *600*.	0x0000

Bit	Name	Description
0	Reserved	
1	Base unit	
2	BMIO-01	1 = I/O and Modbus module included
3	FENA-21	1 = Ethernet adapter module included
4	FECA-01	1 = EtherCAT adapter module included
5	FPBA-01	1 = PROFIBUS DP adapter module included
6	FCAN-01	1 = CANopen adapter module included
7	BCAN-01	1 = CANopen adapter module included
8	BIO-01	1 = binary I/O module included
9	RIIO-01	1 = modbus power module included
10	FSCA-01	1 = RS-485 adapter module included
11	FEIP-21	1 = EtherNet/IP adapter module included
12	FMBT-21	1 = Modbus/TCP adapter module included
13	Reserved	

No.	Name/Value	Description	Default FbEq 16
	0x0000…oxffff	Drive configuration.	1 = 1
07.36	*Drive configuration 2*	Shows the detected option module configuration. See parameter *07.35*.	0x0000

No.	Name/Value	Description	Default FbEq 16

Bit	Name	Description
0	Reserved	
1	FDNA-01	1 = FDNA-01 DeviceNet™ adapter module included
2	FCNA-01	1 = FCNA-01 ControlNet™ adapter module included
3...6	Reserved	
7	FSPS-21	1 = FSPS-21 adapter module included
8...15	Reserved	

No.	Name/Value	Description	Default FbEq 16
	0000h…FFFFh	Drive configuration	1 = 1

No.	Name/Value	Description	Default FbEq 16
09 Crane application signals		Signals related to crane applications. All parameters in this group are read-only.	
09.01	*Crane SW1*	Shows the crane status word 1.	0000h

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	Forward slowdown limit	1 = Slowdown command is inactive in the forward direction.
3	Reverse slowdown limit	1 = Slowdown command is inactive in the reverse direction.
4	Reserved	
5	Reserved	
6	Reserved	
7	Forward stop limit	1 = Forward limit command is inactive.
8	Reverse stop limit	1 = Reverse limit command is inactive.
9	Reserved	
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 acknowledgment circuit is open, main contactor is open, warning *D20B Power on acknowledge* is generated. 0 = Power on acknowledgment circuit is closed, main contactor is closed. See parameter *20.212 Power on acknowledge* (page *197*) and section *Power on acknowledgment* (page *667*).

	0000h...FFFFh	Crane status word 1.	1 = 1

No.	Name/Value	Description	Default FbEq 16
09.03	*Crane FW1*	Shows the crane fault status word 1 with fault bits.	0000h

Bit	Name	Description
0	Reserved	
1	Speed match	1 = *D105 Speed match* (page 523)
2	Reserved	
3	Reserved	
4	Stops limits IO error	1 = *D108 Stop limits I/O error* (page 523)
5	Reserved	
6	Torque prove	1 = *D100 Torque prove* (page 522)
7	Brake slip	1 = *D101 Brake slip* (page 522)
8	Brake safe closure	1 = *D102 Brake safe closure* (page 522)
9…15	Reserved	

No.	Name/Value	Description	Default FbEq 16
	0000h...FFFFh	Crane fault status word 1 with fault bits.	1 = 1
09.06	*Crane speed reference*	Shows the final speed reference received from the signal source.	0.00 rpm
	-30000.00 … 30000.00 rpm	Final crane speed reference.	1 = 1 rpm
09.16	*Crane frequency reference*	Shows the final frequency received from the signal source.	0.00 Hz
	-500.00...500.00	Final crane frequency reference.	10 = 1 Hz
10	***Standard DI, RO***	Configuration of digital inputs and relay outputs.	
10.01	*DI status*	Displays the electrical status of digital inputs DI1…DI6. The activation/deactivation delays of the inputs (if any are specified) are ignored. Bits 0…5 reflect the status of DI1…DI6. **Example**: 0000000000010011b = DI5, DI2 and DI1 are on, DI3, DI4 and DI6 are off. This parameter is read-only.	-

Bit	Value
0	DI1 = Sstatus of digital input 1.
1	DI2 = Status of digital input 2.
2	DI3 = Status of digital input 3.
3	DI4 = Status of digital input 4.
4	DI5 = Status of digital input 5.
5	DI6 = Status of digital input 6.
6...15	Reserved.

No.	Name/Value	Description	Default FbEq 16
	0000h…FFFFh	Status of digital inputs.	1 = 1

No.	Name/Value	Description	Default FbEq 16
10.02	*DI delayed status*	Displays the status of digital inputs. This word is updated only after activation / deactivation delays.	0000h

Bit	Value
0	DI1 = Delayed status of digital input 1.
1	DI2 = Delayed status of digital input 2.
2	DI3 = Delayed status of digital input 3.
3	DI4 = Delayed status of digital input 4.
4	DI5 = Delayed status of digital input 5.
5	DI6 = Delayed status of digital input 6.
6...15	Reserved.

No.	Name/Value	Description	Default FbEq 16
	0000h…FFFFh	Delayed status of digital inputs.	1 = 1
10.03	*DI force selection*	Selects the digital inputs, states of which will be controlled by parameter *10.04 DI forced data*. A bit in parameter *10.04 DI forced data* is provided for each digital input, and its value is applied whenever the corresponding bit in this parameter is 1. **Note:** Boot and power cycle reset the force selections (parameters *10.03* and *10.04*).	0000h

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

No.	Name/Value	Description	Default FbEq 16
	0000h…FFFFh	Override selection for digital inputs.	1 = 1

No.	Name/Value	Description	Default FbEq 16
10.04	*DI forced data*	Defines the forced values for the digital inputs selected by parameter *10.03 DI force selection*. It is only possible to force an input that has been selected in parameter *10.03 DI force selection*. Bit 0 is the forced value for DI1.	0000h

Bit	Value
0	Force the value of this bit to D1, if so defined in parameter *10.03 DI force selection*.
1	Force the value of this bit to D2, if so defined in parameter *10.03 DI force selection*.
2	Force the value of this bit to D3, if so defined in parameter *10.03 DI force selection*.
3	Force the value of this bit to D4, if so defined in parameter *10.03 DI force selection*.
4	Force the value of this bit to D5, if so defined in parameter *10.03 DI force selection*.
5	Force the value of this bit to D6, if so defined in parameter *10.03 DI force selection*.
6...15	Reserved.

No.	Name/Value	Description	Default FbEq 16
	0000h…FFFFh	Forced values of digital inputs.	1 = 1
10.05	*DI1 ON delay*	Defines the activation delay for digital input DI1.	0.00 s
	0.00 … 3000.00 s	Activation delay for DI1.	10 = 1 s
10.06	*DI1 OFF delay*	Defines the deactivation delay for digital input DI1.	0.00 s
	0.00 … 3000.00 s	Deactivation delay for DI1.	10 = 1 s
10.07	*DI2 ON delay*	Defines the activation delay for digital input DI2.	0.00 s
	0.00 … 3000.00 s	Activation delay for DI2.	10 = 1 s
10.08	*DI2 OFF delay*	Defines the deactivation delay for digital input DI2.	0.00 s
	0.00 … 3000.00 s	Deactivation delay for DI2.	10 = 1 s
10.21	*RO status*	Status of relay outputs R01...RO5.	-

Bit	Value
0	1 = RO1 is energized.
1	1 = RO4 is energized.
2	1 = RO5 is energized.
3...15	Reserved.

No.	Name/Value	Description	Default FbEq 16
	0000h…FFFFh	Status of relay outputs.	1 = 1

No.	Name/Value	Description	Default FbEq 16
10.22	*RO force selection*	Selects the relay outputs that will be controlled by parameter *10.23*. The signals connected to the relay outputs can be overridden for eg. testing purposes. A bit in parameter *10.23 RO forced data* is provided for each relay output, and its value is applied whenever the corresponding bit in this parameter is 1. **Note:** Boot and power cycle reset the force selections (parameters *10.22* and *10.23*).	0000h

Bit	Value
0	1 = Force RO1 to value of bit 0 of parameter *10.23 RO forced data* (0 = Normal mode).
1	1 = Force RO4 to value of bit 0 of parameter *10.23 RO forced data* (0 = Normal mode).
2	1 = Force RO5 to value of bit 0 of parameter *10.23 RO forced data* (0 = Normal mode).
3…15	Reserved

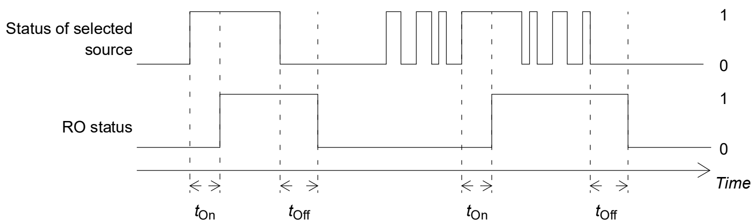
No.	Name/Value	Description	Default FbEq 16
	0000h…FFFFh	Override selection for relay outputs.	1 = 1
10.23	*RO forced data*	Contains the values of relay outputs that are used instead of the connected signals if selected in parameter *10.22 RO force selection*. Bit 0 is the forced value for RO1. This provides the possibility to test the drive functionality without the plant wiring. Ton and Toff delays are passed.	

Bit	Value
0	1 = Force the value of this bit to RO1, if so defined in parameter *10.22 RO force selection*.
1	1 = Force the value of this bit to RO4, if so defined in parameter *10.22 RO force selection*.
2	1 = Force the value of this bit to RO5, if so defined in parameter *10.22 RO force selection*.
3…15	Reserved

No.	Name/Value	Description	Default FbEq 16
	0000h…FFFFh	Forced RO values.	1 = 1
10.24	*RO1 source*	Selects a drive signal to be connected to relay output RO1.	*Fault (-1)*
	Not energized	Output is not energized.	0
	Energized	Output is energized.	1
	Ready run	Bit 1 of *06.11 Main status word*.	2
	Enabled	Bit 0 of *06.16 Drive status word 1*.	4

No.	Name/Value	Description	Default FbEq 16
	Started	Bit 5 of *06.16 Drive status word 1*.	5
	Magnetized	Bit 1 of *06.17 Drive status word 2*.	6
	Running	Bit 14 of *06.16 Drive status word 1*.	7
	Ready ref	Bit 2 of *06.11 Main status word*.	8
	At setpoint	Bit 8 of *06.11 Main status word*.	9
	Reverse	Bit 2 of *06.19 Speed control status word*.	10
	Zero speed	Bit 0 of *06.19 Speed control status word*.	11
	Above limit	Bit 10 of *06.17 Drive status word 2*.	12
	Warning	Bit 7 of *06.11 Main status word*.	13
	Fault	Bit 3 of *06.11 Main status word*.	14
	Fault (-1)	Inverted bit 3 of *06.11 Main status word*.	15
	Fault/Warning	A warning or fault is active.	16
	Overcurrent	A drive is tripped to overcurrent fault.	17
	Overvoltage	A drive is tripped to overvoltage fault.	18
	Drive temp	A drive is tripped to drive temperature fault.	19
	Undervoltage	A drive is tripped to undervoltage fault.	20
	Motor temp	A drive is tripped to motor temperature fault.	21
	Brake command	Bit 0 of *44.01 Brake control status*.	22
	Ext2 active	Bit 11 of *06.16 Drive status word 1*.	23
	Remote control	Bit 9 of *06.11 Main status word*.	24
	Timed function 1	Bit 0 of *34.01 Timed functions status*.	27
	Timed function 2	Bit 1 of *34.01 Timed functions status*.	28
	Timed function 3	Bit 2 of *34.01 Timed functions status*.	29
	Reserved	Bit 3 of *34.01 Timed functions status*.	30
	Reserved	Bit 4 of *34.01 Timed functions status*.	31
	Reserved	Bit 5 of *34.01 Timed functions status*.	32
	Supervision 1	Bit 0 of *32.01 Supervision status*.	33
	Supervision 2	Bit 1 of *32.01 Supervision status*.	34
	Supervision 3	Bit 2 of *32.01 Supervision status*.	35
	Start delay	Bit 13 of *06.17 Drive status word 2*.	39
	RO/DIO control word bit0	Bit 0 of *10.99 RO/DIO control word*.	40
	RO/DIO control word bit1	Bit 1 of *10.99 RO/DIO control word*.	41
	RO/DIO control word bit2	Bit 2 of *10.99 RO/DIO control word*.	42
	Event word 1	Parameter *04.40 Event word 1*.	53

No.	Name/Value	Description	Default FbEq 16
	User load curve	Bit 3 (Outside load limit) of *37.01 ULC output status word* (see page *329*).	61
	RO/DIO control word	Maps to corresponding bit in parameter *10.99 RO/DIO control word*. For example, Bit 0 of *10.99 RO/DIO control word* controls RO1, Bit 1 of *10.99 RO/DIO control word* controls RO4, and so on.	62
	Other [bit]	Source selection (see *Terms and abbreviations*).	-
10.25	*RO1 ON delay*	Defines the activation delay for relay output RO1.	0.0 -



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

No.	Name/Value	Description	Default FbEq 16
	0.0 … 3000.0 s	Activation delay for RO1.	10 = 1 -
10.26	*RO1 OFF delay*	Defines the deactivation delay for relay output RO1. See parameter *10.25 RO1 ON delay*.	0.0 -
	0.0 … 3000.0 s	Deactivation delay for RO1.	10 = 1 -
10.99	*RO/DIO control word*	Storage parameter for controlling the relay outputs eg. through the embedded fieldbus interface. To control the relay outputs (RO) 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*…*58.114*) 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…RO5 (see parameter *10.24*).
1	RO4	
2	RO5	
3	RO6	
4	RO7	
5…7	RO8-10	
8...15	DIO1-8	

No.	Name/Value	Description	Default FbEq 16
	0000h…FFFFh	RO control word.	1 = 1

No.	Name/Value	Description	Default FbEq 16
10.101	RO1 toggle counter	Displays the number of times relay output RO1 has changed states.	-
	0…4294967000	State change count.	1 = 1

No.	Name/Value	Description	Default FbEq 16
11 Standard DIO, FI, FO		Configuration of the digital inputs/outputs (DIO) for use as digital inputs,	
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, DIO1 is off. This parameter is read-only.	-
	0000b…0011b	Status of digital input/outputs.	1 = 1
11.03	DIO force selection	Selects the digital inputs, states which will be controlled by parameter 11.04. A bit in parameter 11.04 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 DIO1 to value of bit 0 of parameter 11.04 DIO force data.
1	1 = Force DIO2 to value of bit 1 of parameter 11.04 DIO force data.
2...15	Reserved

No.	Name/Value	Description	Default FbEq 16
	0000h...FFFFh	Forced selections of digital inputs/outputs.	1=1
11.04	DIO force data	Defines the forced values for the digital inputs selected by parameter 11.03 DIO force selection. It is only possible to force an input that has been selected in parameter 10.03 DI force selection. Bit 0 is the forced value for DIO1.	0000h

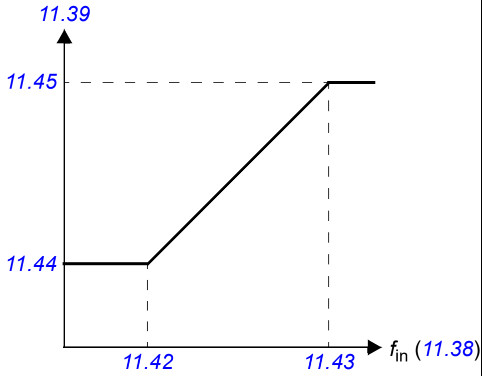
Bit	Value
0	Set state of DIO1.
1	Set state of DIO2.
2...15	Reserved

No.	Name/Value	Description	Default FbEq 16
	0000h...FFFFh	Forced values of digital inputs/outputs.	1=1
11.05	DIO1 configuration	Selects whether DIO1 is used as a digital output, digital input, or frequency output. **Note:** DIOs cannot be used as frequency inputs.	Input
	Digital output	DIO1 is used as a digital output.	0
	Input	Digital input.	1
	Frequency output	DIO1 is used as frequency output.	2

No.	Name/Value	Description	Default FbEq 16
11.06	*DIO1 output source*	Selects a drive signal to be connected to digital input/output DIO1 when it is configured to digital output by parameter *11.05*.	*Not energized*
	Not energized	Output is not energized.	0
	Energized	Output is energized.	1
	Ready run	Bit 1 of *06.11 Main status word*.	2
	Enabled	Bit 0 of *06.16 Drive status word 1*.	4
	Started	Bit 5 of *06.16 Drive status word 1*.	5
	Magnetized	Bit 1 of *06.17 Drive status word 2*.	6
	Running	Bit 6 of *06.16 Drive status word 1*.	7
	Ready ref	Bit 2 of *06.11 Main status word*.	8
	At setpoint	Bit 8 of *06.11 Main status word*.	9
	Reverse	Bit 2 of *06.19 Speed control status word*.	10
	Zero speed	Bit 0 of *06.19 Speed control status word*.	11
	Above limit	Bit 10 of *06.17 Drive status word 2*.	12
	Warning	Bit 7 of *06.11 Main status word*.	13
	Fault	Bit 3 of *06.11 Main status word*.	14
	Fault (-1)	Inverted bit 3 of *06.11 Main status word*.	15
	Fault/Warning	A warning or fault is active.	16
	Overcurrent	A drive is tripped to overcurrent fault.	17
	Overvoltage	A drive is tripped to overvoltage fault.	18
	Drive temp	A drive is tripped to drive temperature fault.	19
	Undervoltage	A drive is tripped to undervoltage fault.	20
	Motor temp	A drive is tripped to motor temperature fault.	21
	Brake command	Bit 0 of *44.01 Brake control status*.	22
	Ext2 active	Bit 11 of *06.16 Drive status word 1*.	23
	Remote control	Bit 9 of *06.11 Main status word*.	24
	Timed function 1	Bit 0 of *34.01 Timed functions status*.	27
	Timed function 2	Bit 1 of *34.01 Timed functions status*.	28
	Timed function 3	Bit 2 of *34.01 Timed functions status*.	29
	Reserved	Bit 3 of *34.01 Timed functions status*.	30
	Reserved	Bit 4 of *34.01 Timed functions status*.	31
	Reserved	Bit 5 of *34.01 Timed functions status*.	32
	Supervision 1	Bit 0 of *32.01 Supervision status*.	33
	Supervision 2	Bit 1 of *32.01 Supervision status*.	34
	Supervision 3	Bit 2 of *32.01 Supervision status*.	35
	Start delay	Bit 13 of *06.17 Drive status word 2*.	39

No.	Name/Value	Description	Default FbEq 16
	RO/DIO control word bit0	Bit 0 of *10.99 RO/DIO control word*.	40
	RO/DIO control word bit1	Bit 1 of *10.99 RO/DIO control word*.	41
	RO/DIO control word bit2	Bit 2 of *10.99 RO/DIO control word*.	42
	User load curve	Bit 3 (Outside load limit) of *37.01 ULC output status word* (see page *329*).	61
	RO/DIO control word	Maps to corresponding bit in parameter *10.99 RO/DIO control word*. For example, Bit 0 of *10.99 RO/DIO control word* controls RO1, Bit 1 of *10.99 RO/DIO control word* controls RO4, and so on.	62
	Other [bit]	Source selection (see *Terms and abbreviations*).	-
11.07	*DIO1 ON delay*	Defines the on (activation) delay for digital input/output DIO1 (when used as a digital output or digital input).	0.00 s
	0.0 … 3000.0 s	Activation delay for DIO1.	10 = 1 s
11.08	*DIO1 OFF delay*	Defines the deactivation delay for digital input/output DIO1 (when used as a digital output or digital input). See parameter *11.07 DIO1 ON delay*.	0.00 s
	0.0 … 3000.0 s	Deactivation delay for DIO1.	10 = 1 s
11.09	*DIO2 configuration*	Selects whether DIO2 is used as a digital output or input, or a frequency output. **Note:** DIOs cannot be used as frequency inputs.	*Digital output*
	Digital output	DIO2 is used as a digital output.	0
	Input	DIO2 is used as a digital input.	1
	Frequency output	DIO2 is used as 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 configuration* is set to *Digital output*. For the available selections, see parameter *11.06 DIO1 output source*.	*Ready run*
11.11	*DIO2 ON delay*	Defines the activation delay for digital input/output DIO2 (when used as a digital output or digital input).	0.00 s
	0.0 … 300.0 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 DIO1 ON delay*.	0.00 s
	0.0 … 3000.0 s	Deactivation delay for DIO2.	10 = 1 s
11.13	*DI3 configuration*	Selects the type of digital input DI3: normal digital input or frequency input.	*Digital input*

No.	Name/Value	Description	Default FbEq 16
	Digital input	Digital input. See parameter *11.42* for more information.	0
	Frequency input	Frequency input.	1
	Counter	This value is available only when the BMIO-01 module is attached. If DI3 is configured as Counter, DI4 will not function as Frequency Input 2 due to hardware limitation.	0
11.17	*DI4 configuration*	Selects the type of digital input DI4: normal digital input or frequency input.	
	Digital input	Digital input.	0
	Frequency input	Frequency input.	1
	Counter	Available only when the BMIO-01 module is attached. If DI3 is configured as Counter, DI4 will not function as Frequency Input 2 due to hardware limitation.	0
11.21	*DI5 configuration*	Selects the type of digital input DI5: normal digital input or frequency input.	
	Digital input	Digital input.	0
	Frequency input	Frequency input.	1
	Counter	This value is available only when the BIO-01 module is attached. If DI5 is configured as Counter, DI6 will not function as Frequency Input 2 due to hardware limitation.	0
11.38	*Freq in 1 actual value*	Displays the value of frequency input 1 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 value*	Displays the value of frequency input 1 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	Default FbEq 16
11.42	*Freq in 1 min*	Defines the minimum for the frequency actually arriving at frequency input 1. The incoming frequency signal (*11.38 Freq in 1 actual value*) is scaled into an internal signal (*11.39 Freq in 1 scaled value*) by parameters *11.42*…*11.45* as follows:  	0 Hz
	0 … 16000 Hz	Minimum frequency of frequency input 1.	1 = 1 Hz
11.43	*Freq in 1 max*	Defines the maximum value of the frequency signal actually arriving at frequency input 1. See parameter *11.42 Freq in 1 min*.	16000 Hz
	0 … 16000 Hz	Maximum frequency of frequency input 1.	1 = 1 Hz
11.44	*Freq in 1 at scaled min*	Defines the value that corresponds to the actual minimum input frequency defined by 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 corresponds to the actual maximum input frequency defined by parameter *11.43 Freq in 1 max*. See parameter *11.42 Freq in 1 min*.	1500.000
	-32768.000… 32767.000	Value corresponding to maximum of frequency input 1.	1 = 1
11.46	*Freq in 2 actual value*	Displays the value of frequency input 2 before scaling. See parameter *11.50 Freq in 2 min* This parameter is read-only.	-
	0 … 16000 Hz	Unscaled value of frequency input 2.	1 = 1 Hz
11.47	*Freq in 2 scaled*	Displays the value of frequency input 2 after scaling. See parameter *11.50 Freq in 2 min*. This parameter is read-only.	-

No.	Name/Value	Description	Default FbEq 16
	-32768.000… 32767.000	Scaled value of frequency input 2.	1 = 1
11.50	*Freq in 2 min*	Defines the minimum value for frequency input 2.	0 Hz
	0 … 16000 Hz	Minimum frequency of frequency input 2.	1 = 1 Hz
11.51	*Freq in 2 max*	Defines the maximum value for frequency input 2.	16000 Hz
	0 … 16000 Hz	Maximum frequency for frequency input 2.	1 = 1 Hz
11.52	*Freq in 2 at scaled min*	Defines the real value that corresponds to the minimum frequency input 2 value defined by parameter Freq in 2 min.	0.000
	-32768.000 … 32767.000	Value corresponding to minimum of frequency input 2.	1 = 1
11.53	*Freq in 2 at scaled max*	Defines the real value that corresponds to the maximum frequency input 2 value defined by parameter Freq in 2 max.	1500.000
	-32768.000 … 32767.000	Value corresponding to maximum of frequency input 2.	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	Unscaled value of frequency input 2.	1 = 1 Hz
11.55	*Freq out 1 source*	Selects a signal to be connected to frequency output 1.	*Motor speed used*
	Not selected	None	0
	Motor speed used	*01.01 Motor speed used*	1
	Output frequency	*01.06 Output frequency*	3
	Motor current	*01.07 Motor current*	4
	Motor torque	*01.10 Motor torque*	6
	DC voltage	*01.11 DC voltage*	7
	Output power	*01.13 Output power*	8
	Speed ref ramp in	*23.02 Speed ref ramp input*	10
	Speed ref ramp out	*23.01 Speed ref ramp output*	11
	Speed ref used	*24.01 Used speed reference*	12
	Torque ref used	*26.02 Torque reference used*	13
	Freq ref used	*28.02 Frequency ref ramp output*	14
	Process PID out	*40.04 Process PID deviation actual*	16
	Other	Source selection (see *Terms and abbreviations*).	-

No.	Name/Value	Description	Default FbEq 16
11.58	*Freq out 1 src min*	Defines the real value of the signal (selected by parameter *11.55 Freq out 1 source* and shown by parameter *11.54 Freq out 1 actual value*) that corresponds to the minimum value of frequency output 1 (defined by parameter *11.60 Freq out 1 at src min*).	0.000
	-32768.000 … 32767.000	Real signal value corresponding to minimum value of frequency output 1.	1 = 1
11.59	*Freq out 1 src max*	Defines the minimum value for frequency output 1.	1500.000
	-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 real value that corresponds to the minimum frequency output 1 value defined by parameter Freq out 1 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 real value that corresponds to the maximum frequency output 1 value defined by parameter Freq out 1 max.	16000 Hz
	0 … 16000 Hz	Maximum value of frequency output 1.	1 = 1 Hz
11.62	*Freq out 2 actual value*	Displays the value of frequency output 2 after scaling. See parameter *11.66 Freq out 2 source min*. This parameter is read-only.	-
	0 … 16000 Hz	Unscaled value of frequency input 2.	1 = 1 Hz
11.63	*Freq out 2 source*	Selects a drive signal to be connected to the frequency output 2. For the available selections, see parameter *11.55 Freq out 1 source*.	*Not selected*
11.66	*Freq out 2 source min*	Defines the minimum value for frequency output 2.	0.000
	-32768.000 … 32767.000	Real signal value corresponding to minimum value of frequency output 2.	1 = 1
11.67	*Freq out 2 source max*	Defines the minimum value for frequency output 2.	1500.000
	-32768.000 … 32767.000	Real signal value corresponding to maximum value of frequency output 2.	1 = 1
11.68	*Freq out 2 at src min*	Defines the real value that corresponds to the minimum frequency output 2 value defined by parameter Freq out 2 min.	0 Hz
	0 … 16000 Hz	Minimum value of frequency output 2.	1 = 1 Hz
11.69	*Freq out 2 at src max*	Defines the real value that corresponds to the maximum frequency output 2 value defined by parameter Freq out 2 max.	16000 Hz

No.	Name/Value	Description	Default FbEq 16
	0 … 16000 Hz	Maximum value of frequency output 2.	1 = 1 Hz
12 Standard AI		Configuration of standard analog inputs.	
12.02	*AI force selection*	The true readings of the analog inputs can be overridden for e.g. 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. **Note:** AI filter times (parameters *12.16 AI1 filter time* and *12.26 AI1 filter time*) have no effect on forced AI values (parameters *12.13 AI1 forced value* and *12.23 AI2 forced value*). **Note:** Boot and power cycle reset the force selections (parameter *12.02*).	0000h

Bit	Value
0	1 = Force AI1 to value of parameter *12.13 AI1 forced value*.
1	1 = Force AI2 to value of parameter *12.23 AI2 forced value*.
2…15	Reserved

No.	Name/Value	Description	Default FbEq 16
	0000h…FFFFh	Forced values selector for analog inputs AI1 and AI2.	1 = 1
12.03	*AI supervision function*	Selects how the drive reacts when an analog input signal moves out of the minimum and/or maximum limits specified for the input. The supervision applies a margin of 0.5 V or 1.0 mA to the limits. For example, if the maximum limit for the input is 7.000 V, the maximum limit supervision activates at 7.500 V. The inputs and the limits to be observed are selected by parameter *12.04 AI supervision selection*.	*No action*
	No action	No action taken.	0
	Fault	Drive trips on *80A0 AI supervision*.	1
	Warning	Drive generates an *A8A0 AI supervision* warning.	2
	Last speed	Drive generates a warning (*A8A0 AI supervision*) and freezes the speed (or frequency) to the level the drive was operating at. The speed/frequency is determined on the basis of actual speed using 850 ms low-pass filtering. **WARNING!** Make sure that it is safe to continue operation in case of a communication break.	3

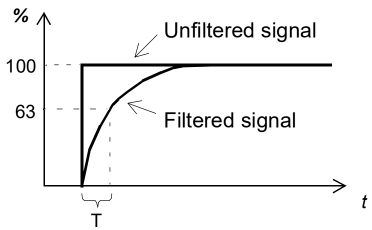
No.	Name/Value	Description	Default FbEq 16
	Speed ref safe	Drive generates a warning (*A8A0 AI supervision*) and sets the speed to the speed defined by parameter *22.41 Speed ref safe* (or *28.41 Frequency ref safe* when frequency reference is being used). **WARNING!** Make sure that it is safe to continue operation in case of a communication break.	4
12.04	*AI supervision selection*	Specifies the analog input limits to be supervised. See parameter *12.03 AI supervision function*.	0000h

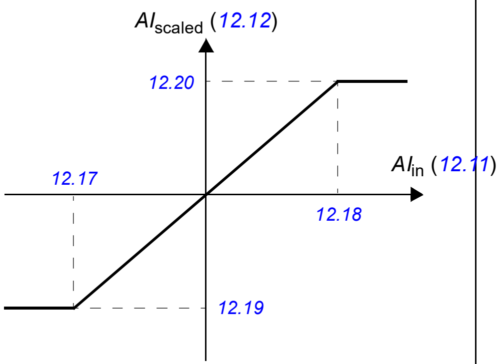
Bit	Name	Description
0	AI1 < MIN	1 = Minimum limit supervision of AI1 active.
1	AI1 > MAX	1 = Maximum limit supervision of AI1 active.
2	AI2 < MIN	1 = Minimum limit supervision of AI2 active.
3	AI2 > MAX	1 = Maximum limit supervision of AI2 active.
4…15	Reserved	

No.	Name/Value	Description	Default FbEq 16
	0000h…FFFFh	Activation of analog input supervision.	1 = 1
12.05	*AI supervision force*	Activates/deactivate the Analog Input supervision for each control location (EXT1, EXT2, Local). When a particular control location is not utilizing AI for referencing, then the AI supervision can be deactivated using this parameter, by deactivating particular AI supervision force bit. The user can mask the fault/warning for the selected control location.	0000 0000b

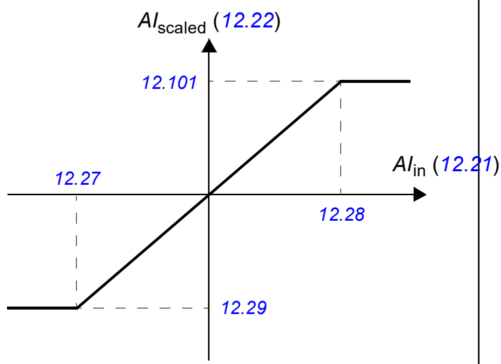
Bit	Name	Description
0	AI1 Ext1	0 = AI1 supervision not active when EXT1 control is being used.
1	AI1 Ext2	0 = AI1 supervision not active when EXT2 control is being used.
2	AI1 Local	0 = AI1 supervision not active when Local control is being used.
3	Reserved	
4	AI2 Ext1	0 = AI2 supervision not active when EXT1 control is being used.
5	AI2 Ext2	0 = AI2 supervision not active when EXT2 control is being used.
6	AI2 Local	0 = AI2 supervision not active when Local control is being used.
7…15	Reserved	

No.	Name/Value	Description	Default FbEq 16
	AI1 Ext1	If active control location is EXT1, and AI supervision selection is high for AI1 (either bit0 AI1 < MIN or bit1 AI1 > MAX is true) and Supervision force bit 0 (AI1 Ext1) is deactivated, then the corresponding supervision function (fault/warning) can be masked.	0
	AI1 Ext2	If active control location is EXT2, and AI supervision selection is high for AI1 (either bit0 AI1 < MIN or bit1 AI1 > MAX is true) and Supervision force bit 1 (AI1 Ext2) is deactivated, then the corresponding supervision function (fault/warning) can be masked.	1
	AI1 Local	If active control location is Local, and AI supervision selection is high for AI1 (either bit0 AI1 < MIN or bit1 AI1 > MAX is true) and Supervision force bit 1 (AI1 Local) is deactivated, then the corresponding supervision function (fault/warning) can be masked.	2
	AI2 Ext1	If active control location is EXT1, and AI supervision selection is high for AI2 (either bit2 AI2 < MIN or bit3 AI2 > MAX is true) and Supervision force bit 4 (AI2 Ext1) is deactivated, then the corresponding supervision function (fault/warning) can be masked.	4
	AI2 Ext2	If active control location is EXT1, and AI supervision selection is high for AI2 (either bit2 AI2 < MIN or bit3 AI2 > MAX is true) and Supervision force bit 4 (AI2 Ext1) is deactivated, then the corresponding supervision function (fault/warning) can be masked.	5
	AI2 Local	If active control location is Local, and AI supervision selection is high for AI1 (either bit2 AI2 < MIN or bit3 AI2 > MAX is true) and Supervision force bit 6 (AI2 Local) is deactivated, then the corresponding supervision function (fault/warning) can be masked.	6
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.	-
	0.000…22.000 mA or 0.000…11.000 V	Value of analog input AI1.	1000 = 1 unit

No.	Name/Value	Description	Default FbEq 16
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 … 32767	Scaled value of analog input AI1.	1 = 1
12.13	*AI1 forced value*	Defines the forced value that can be used instead of the true reading of the input. See parameter *12.02 AI force selection*.	-
	-		1000 = 1 -
12.15	*AI1 unit selection*	Selects the unit for readings and settings related to analog input AI1. See the default control connections of the macro in use, in chapter *Control macros* (page *31*).	*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 **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

No.	Name/Value	Description	Default FbEq 16
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.	4.000 mA or 0.000 V
	0.000…22.000 mA or 0.000…11.00 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.	20.000 mA or 10.00 V
	0.000…22.000 mA or 0.000…11.00 V	Maximum value of AI1.	1000 = 1 mA or V
12.19	*AI1 scaled at AI1 min*	Defines the real internal value that corresponds to the minimum analog input AI1 value defined by parameter *12.17 AI1 min*. (Changing the polarity settings of *12.19* and *12.20* can effectively invert the analog input.)  	0
	-32768.000… 32767.000		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*.	50.000
	-32768.000… 32767.000	Real value corresponding to maximum AI1 value.	1 = 1

No.	Name/Value	Description	Default FbEq 16
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.	-
	0.000…22.000 mA or 0.000…11.000 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 12.101 AI1 percent value. This parameter is read-only.	-
	-32768.000… 32767.000	Scaled value of analog input AI2.	1 = 1
12.23	AI2 forced value	Forced value that can be used instead of the true reading of the input. See parameter 12.02 AI force selectionn.	-
	0.000…22.000 mA or 0.000…11.000 V	Forced value of analog input AI2.	1000 = 1 mA or V
12.25	AI2 unit selection	Selects the unit for readings and settings related to analog input AI2. See the default control connections of the macro in use, in chapter Control macros (page 31).	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. **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
12.27	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.	4.000 mA or 0.000 V
	0.000…22.000 mA or 0.000…11.000 V	Minimum value of AI2.	1000 = 1 mA or V

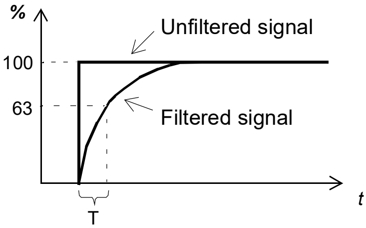
No.	Name/Value	Description	Default FbEq 16
12.28	*AI2 max*	Defines the maximum site value for analog input AI2. Set the value actually sent to the drive when the analog signal from plant is wound to its maximum setting.	20.000 mA or 10.000 V
	0.000…22.000 mA or 0.000…11.000 V	Maximum value of AI2.	1000 = 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 *12.101* 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 of *12.29 AI2 scaled at AI2 min*	50.000
	-32768.000… 32767.000	Real value corresponding to maximum AI2 value.	1 = 1
12.101	*AI1 percent value*	Value of analog input AI1 in percent of AI1 scaling (*12.18 AI1 max* - *12.17 AI1 min*).	-
	0.00… 100.00	AI1 value	100 = 1%
12.102	*AI2 percent value*	Value of analog input AI2 in percent of AI1 scaling (*12.28 AI2 max* - *12.27 AI2 min*).	-
	0.00… 100.00	AI2 value	100 = 1%

No.	Name/Value	Description	Default FbEq 16
12.110	*AI dead band*	AI dead band value in percentage where 100% = 10V in voltage mode and 100% = 20mA in current mode. Applicable for both AI1 and AI2. **Note**: 10% of AI dead band value is internally added in firmware as AI dead band hysteresis positive and negative. See section *AI dead band* on page *139*,	0.40 %
	0…100 %	AI dead band value	100
13 Standard AO		Configuration of standard analog outputs.	
13.02	*AO force selection*	Selects the analog outputs that will be forced to values defined by parameters. The true source signals of the analog outputs can be overridden for eg. testing purposes. A forced value parameter is provided for each analog output, and its value is applied whenever the corresponding bit in this parameter is 1. **Note:** Boot and power cycle reset the force selections (parameters *13.02* and *13.11*).	0000h

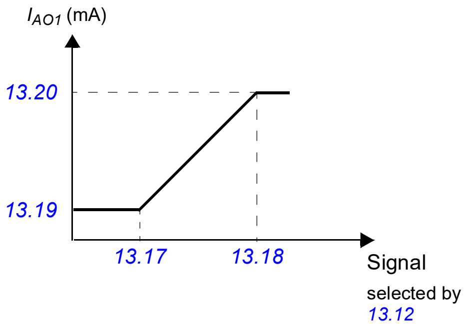
Bit	Value
0	1 = Force AO1 to value of parameter *13.13 AO1 forced value*.
1…15	Reserved.

No.	Name/Value	Description	Default FbEq 16
	0000h…FFFFh	Forced values selector for analog output AO1.	1 = 1
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.	1 = 1 mA
13.12	*AO1 source*	Selects a signal to be connected to analog output AO1.	*Output frequency*
	Zero	None.	0
	Motor speed used	*01.01 Motor speed used*	1
	Output frequency	*01.06 Output frequency*	3
	Motor current	*01.07 Motor current*	4
	Motor current % of motor nom	*01.08 Motor current % of motor nom*	5
	Motor torque	*01.10 Motor torque*	6
	DC voltage	*01.11 DC voltage*	7
	Output power	*01.14 Output power*	8
	Speed ref ramp in	*23.01 Speed ref ramp input*.	10

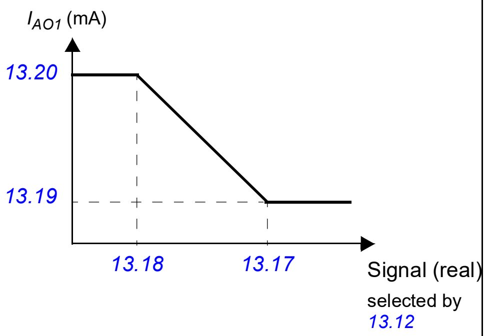
No.	Name/Value	Description	Default FbEq 16
	Speed ref ramp out	*23.02 Speed ref ramp output*	11
	Speed ref used	*24.01 Used speed reference*	12
	Freq ref used	*28.02 Frequency ref ramp output*	14
	Process PID out	*40.01 Process PID output actual*	16
	Temp sensor 1 excitation	The output is used to feed an excitation current to the temperature sensor 1, see parameter *35.11 Temperature 1 source*. See also section *Motor thermal protection*.	20
	Temp sensor 2 excitation	The output is used to feed an excitation current to the temperature sensor 2, see parameter *35.21 Temperature 2 source*. See section *Motor thermal protection* in chapter *Program features*.	21
	Abs motor speed used	*01.61 Abs motor speed used*	26
	Abs motor speed %	*01.62 Abs motor speed %*	27
	Abs output frequency	*01.63 Abs output frequency*	28
	Abs motor torque	*01.64 Abs motor torque*	30
	Abs output power	*01.65 Abs output power*	31
	Abs motor shaft power	*01.68 Abs motor shaft power*	32
	External PID1 out	*71.01 External PID act value*	33
	AO1 data storage	*13.91 AO1 data storage*	37
	Other	Source selection (see *Terms and abbreviations*).	-
13.13	*AO1 forced value*	Forced value that can be used instead of the selected output signal. See parameter *13.02 AO force selection*.	0.000 mA
	-		1000 = 1 -
13.15	*AO1 unit selection*	Selects the unit for readings and settings related to analog output AO1.	*mA*
	V	Volts.	10
	mA	Milliamperes.	1

No.	Name/Value	Description	Default FbEq 16
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	0.100 s
	0.000 … 30.000 s	Filter time constant.	1000 = 1 s

<table>
<tr><th>No.</th><th>Name/Value</th><th>Description</th><th>Default
FbEq 16</th></tr>
<tr><td>13.17</td><td>AO1 source min</td><td>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).



Setting 13.17 to the maximum value and 13.18 to the minimum value inverts the output.


</td><td>0.0</td></tr>
</table>

No.	Name/Value	Description	Default FbEq 16

AO has automatic scaling. Every time the source for the AO is changed, the scaling range is changed accordingly. User given minimum and maximum values override the automatic values.

	13.12 AO1 source, *13.22 AO2 source*	*13.17 AO1 source min*, *13.27 AO2 source min*	*13.18 AO1 source max*, *13.28 AO2 source max*
0	*Zero*	N/A (Output is constant zero.)	
1	*Motor speed used*	0	*46.01 Speed scaling*
3	*Output frequency*	0	*46.02 Frequency scaling*
4	*Motor current*	0	Max. value of *30.17 Maximum current*
5	*Motor current % of motor nom*	0%	100%
6	*Motor torque*	0	*46.03 Torque scaling*
7	*DC voltage*	Min. value of *01.11 DC voltage*	Max. value of *01.11 DC voltage*
8	*Output power*	0	*46.04 Power scaling*
10	*Speed ref ramp in*	0	*46.01 Speed scaling*
11	*Speed ref ramp out*	0	*46.01 Speed scaling*
12	*Speed ref used*	0	*46.01 Speed scaling*
14	*Freq ref used*	0	*46.02 Frequency scaling*
16	*Process PID out*	Min. value of *40.01 Process PID output actual*	Max. value of *40.01 Process PID output actual*
20	*Temp sensor 1 excitation*	N/A (Analog output is not scaled; it is determined by the sensor's triggering voltage.)	
21	*Temp sensor 2 excitation*		
26	*Abs motor speed used*	0	*46.01 Speed scaling*
27	*Abs motor speed %*	0	*46.01 Speed scaling*
28	*Abs output frequency*	0	*46.02 Frequency scaling*
30	*Abs motor torque*	0	*46.03 Torque scaling*
31	*Abs output power*	0	*46.04 Power scaling*
32	*Abs motor shaft power*	0	*46.04 Power scaling*
33	*External PID1 out*	Min. value of *71.01 External PID act value*	Max. value of *71.01 External PID act value*
	Other	Min. value of the selected parameter	Max. value of the selected parameter

No.	Name/Value	Description	Default FbEq 16
	-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*.	50.0
	-32768.0…32767.0	Real signal value corresponding to maximum AO1 output value.	1 = 1

No.	Name/Value	Description	Default FbEq 16
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…22.00 mA 0.000…11.000 V	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 0.000…11.000 V	Maximum AO1 output value.	1000 = 1 mA
13.91	*AO1 data storage*	Storage parameter for controlling analog output AO1 eg. through fieldbus. In parameter *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

15 I/O extension module		Configuration of the I/O extension module. **Note:** The contents of the parameter group vary according to the selected I/O extension module type.	
15.01	*Extension module type*	Activates (and specifies the type of) I/O extension module. If the value is *None*, when an extension module has been installed and the dive is powered, the drive automatically sets the value to the type it has detected (= value of parameter *15.02 Detected extension module*); otherwise warning *A7AB Extension I/O configuration failure* is generated and you have to set the value of this parameter manually.	*None*
	None	Inactive.	0
	BREL	External relay option BREL-01.	5
	BAPO-01	Auxiliary power extension module option BAPO-01.	6
	BTAC-02	BTAC-02 pulse encoder interface module option BTAC-02.	7
15.02	*Detected extension module*	Shows the I/O extension module that the control program has automatically detected on the drive.	*None*
	None	Inactive.	0

No.	Name/Value	Description	Default FbEq 16
	BREL	External relay option BREL-01.	5
	BAPO-01	Auxiliary power extension module option BAPO-01.	6
	BTAC-02	Pulse encoder interface module option BTAC-02.	7
15.04	*RO status*	Displays the status of the relay outputs RO4, RO5, RO6 and RO7 on the extension module.	0000h

Bit	Value
0	Status of RO4 (1= relay closed, 0=relay open)
1	Status of RO5 (1= relay closed, 0=relay open)
2	Status of RO6 (1= relay closed, 0=relay open)
3	Status of RO7 (1= relay closed, 0=relay open)
4...15	Reserved

No.	Name/Value	Description	Default FbEq 16
	0000h…FFFFh	Status of relay outputs.	1 = 1
15.05	*RO force selection*	The electrical statuses of the relay outputs can be overridden for e.g. testing purposes. A bit in parameter *15.06 RO forced data* is provided for each relay output, and its value is applied whenever the corresponding bit in this parameter is 1. **Note:** Boot and power cycle reset the force selections (parameters *15.05* and *15.06*).	0000h

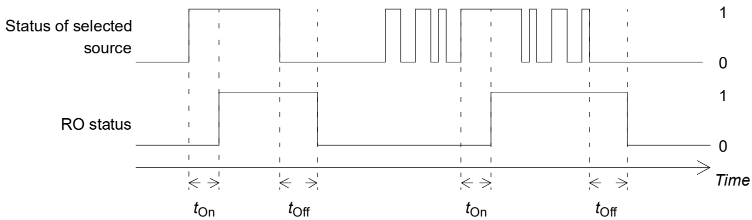
Bit	Value
0	1= Force RO4 to value of bit 0 of parameter *15.06 RO forced data*.
1	1= Force RO5 to value of bit 1 of parameter *15.06 RO forced data*.
2	1= Force RO6 to value of bit 2 of parameter *15.06 RO forced data*.
3	1= Force RO7 to value of bit 3 of parameter *15.06 RO forced data*.
4…15	Reserved

No.	Name/Value	Description	Default FbEq 16
	0000h…FFFFh	Override selection for relay outputs.	1 = 1
15.06	*RO forced data*	Allows the data value of a forced relay or relay output to be changed from 0 to 1. It is only possible to force an output that has been selected in parameter *15.05 RO force selection* Bits 0…3 are the forced values for RO4…RO7.	0000h

Bit	Value
0	1= Force RO4 to value of bit 0 of parameter *15.05 RO force selection*
1	1= Force RO5 to value of bit 1 of parameter *15.05 RO force selection*
2	1=Force RO6 to value of bit 2 of parameter *15.05 RO force selection*
3	1= Force RO7 to value of bit 3 of parameter *15.05 RO force selection*
4...15	Reserved

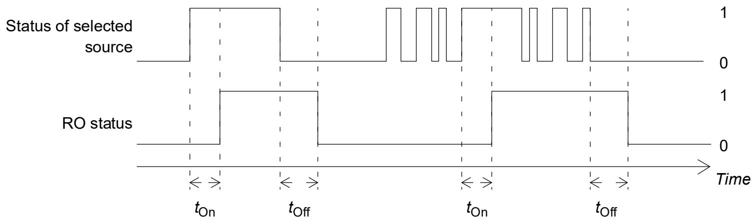
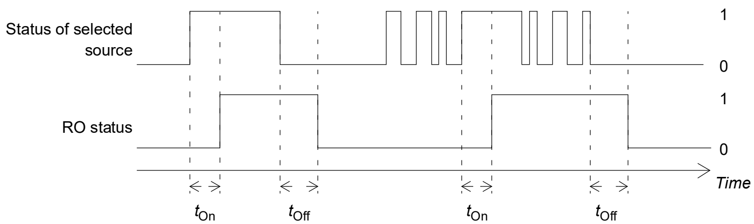
No.	Name/Value	Description	Default FbEq 16
	0000h…FFFFh	Forced values of relay outputs.	1 = 1
15.07	*RO4 source*	Selects a drive signal to be connected to relay output RO4.	*Not energized*
	Not energized	Output is not energized.	0
	Energized	Output is energized.	1
	Ready run	Bit 1 of *06.11 Main status word*	2
	Enabled	Bit 0 of *06.16 Drive status word 1*.	4
	Started	Bit 5 of *06.16 Drive status word 1*.	5
	Magnetized	Bit 1 of *06.17 Drive status word 2*.	6
	Running	Bit 6 of *06.16 Drive status word 1*.	7
	Ready ref	Bit 2 of *06.11 Main status word*.	8
	At setpoint	Bit 8 of *06.11 Main status word*.	9
	Reverse	Bit 2 of *06.19 Speed control status word*.	10
	Zero speed	Bit 0 of *06.19 Speed control status word*.	11
	Above limit	Bit 10 of *06.17 Drive status word 2*.	12
	Warning	Bit 7 of *06.11 Main status word*.	13
	Fault	Bit 3 of *06.11 Main status word*.	14
	Fault (-1)	Inverted bit 3 of *06.11 Main status word*.	15
	Fault/Warning	Bit 3 OR bit 7 of *06.11 Main status word*.	16
	Overcurrent	Relay is energized when drive is tripped to overcurrent fault.	17
	Overvoltage	Relay is energized when drive is tripped to overvoltage fault.	18
	Drive temp	Relay is energized when drive is tripped to drive temperature fault.	19
	Undervoltage	Relay is energized when drive is tripped to undervoltage fault.	20
	Motor temp	Relay is energized when drive is tripped to motor temperature fault.	21
	Brake command	Bit 0 of *44.01 Brake control status*.	22
	Ext2 active	Bit 11 of *06.16 Drive status word 1*.	23
	Remote control	Bit 9 of *06.11 Main status word*.	24
	Timed function 1	Bit 0 of *34.01 Timed functions status*.	27
	Timed function 2	Bit 1 of *34.01 Timed functions status*.	28
	Timed function 3	Bit 2 of *34.01 Timed functions status*.	29
	Supervision 1	Bit 0 of *32.01 Supervision status*.	33
	Supervision 2	Bit 1 of *32.01 Supervision status*.	34
	Supervision 3	Bit 2 of *32.01 Supervision status*.	35

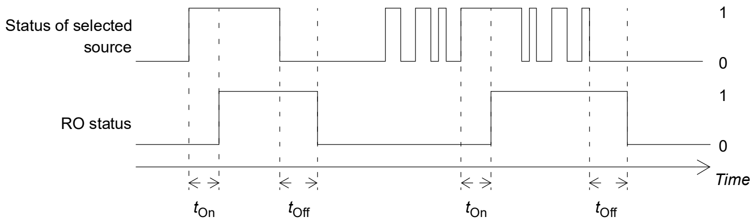
No.	Name/Value	Description	Default FbEq 16
	Start delay		39
	RO/DIO control word bit0	Bit 0 of *10.99 RO/DIO control word*.	40
	RO/DIO control word bit1	Bit 1 of *10.99 RO/DIO control word*.	41
	RO/DIO control word bit2	Bit 2 of *10.99 RO/DIO control word*.	42
	Event word 1	Parameter *04.40 Event word 1*.	53
	User load curve	Bit 3 (Outside load limit) of *37.01 ULC output status word* (see page *329*).	61
	RO/DIO control word	Maps to corresponding bit in parameter *10.99 RO/DIO control word*. For example, Bit 0 of *10.99 RO/DIO control word* controls RO1, Bit 1 of *10.99 RO/DIO control word* controls RO4, and so on.	62
	Other [bit]	Source selection (see *Terms and abbreviations*).	-
15.08	*RO4 ON delay*	Defines the activation delay for relay output RO4.	0.0 s



t_{On} = *15.08 RO4 ON delay*
t_{Off} = *15.09 RO2 OFF delay*

	0.0 … 3000.0 s	Activation delay for RO4.	1 = 1 s
15.09	*RO4 OFF delay*	Defines the deactivation delay for relay output RO4. See parameter *15.08 RO4 ON delay*.	0.0 s
	0.0 … 3000.0 s	Deactivation delay for RO4.	1 = 1 s
15.10	*RO5 source*	Selects a drive signal to be connected to relay output RO5.	*Not energized*
		See parameter *15.07 RO4 source* for the available selections.	

No.	Name/Value	Description	Default FbEq 16
15.11	*RO5 ON delay*	Defines the activation delay for relay output RO5.	0.0 s
	 t_{On} = *15.11 RO5 ON delay* t_{Off} = *15.12 RO5 OFF delay*		
	0.0 … 3000.0 s	Activation delay for RO5.	1 = 1 s
15.12	*RO5 OFF delay*	Defines the deactivation delay for relay output RO5. See parameter *15.11 RO5 ON delay*.	0.0 s
	0.0 … 3000.0 s	Deactivation delay for RO5.	1 = 1 s
15.13	*RO6 source*	Selects a drive signal to be connected to relay output RO6.	*Not energized*
		See parameter *15.07 RO4 source* for the available selections.	
15.14	*RO6 ON delay*	Defines the activation delay for relay output RO6.	0.0 s
	 t_{On} = *15.08 RO6 ON delay* t_{Off} = *15.09 RO6 OFF delay*		
	0.0 … 3000.0 s	Activation delay for RO6.	1 = 1 s
15.15	*RO6 OFF delay*	Defines the deactivation delay for relay output RO6. See parameter *15.14 RO6 ON delay*.	0.0 s
	0.0 … 3000.0 s	Deactivation delay for RO6.	1 = 1 s
15.16	*RO7 source*	Selects a drive signal to be connected to relay output RO7.	*Not energized*
		See parameter *15.07 RO4 source* for the available selections.	
15.17	*RO7 ON delay*	Defines the activation delay for relay output RO7.	0.0 s

No.	Name/Value	Description	Default FbEq 16
		 t_{On} = *15.17 RO5 ON delay* t_{Off} = *15.18 RO7 OFF delay*	
	0.0 … 3000.0 s	Activation delay for RO7.	1 = 1 s
15.18	*RO7 OFF delay*	Defines the deactivation delay for relay output RO7. See parameter *15.17 RO5 ON delay*.	0.0 s
	0.0 … 3000.0 s	Deactivation delay for RO7.	1 = 1 s

19 Operation mode		Selection of local and external control location sources and operating modes. See section *Operating modes and motor control modes* in chapter *Program features*.	
19.01	*Actual operation mode*	Displays the operating mode currently used. See parameters *19.11*…*19.14*. This parameter is read-only.	-
	Zero	Zero.	1
	Speed	Speed control (in vector motor control mode).	2
	Torque	Torque control (in vector motor control mode).	3
	Min	The torque selector is comparing the output of the speed controller (*25.01*) and torque reference (*26.74*) and the smaller of the two is used (in vector motor control mode).	4
	Max	The torque selector is comparing the output of the speed controller (*25.01*) and torque reference (*26.74*) and the greater of the two is used (in vector motor control mode).	5
	Scalar (Hz)	Frequency control in scalar motor control mode (in scalar motor control mode).	10
	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

No.	Name/Value	Description	Default FbEq 16
	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
	*Always off*Always offDI4	Digital input DI4 (*10.02 DI delayed status*, bit 3).	6
	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
	Timed function 1	Bit 0 of *34.01 Timed functions status*.	19
	Timed function 2	Bit 1 of *34.01 Timed functions status*.	20
	Timed function 3	Bit 2 of *34.01 Timed functions status*.	21
	Supervision 1	Bit 0 of *32.01 Supervision status*.	25
	Supervision 2	Bit 1 of *32.01 Supervision status*.	26
	Supervision 3	Bit 2 of *32.01 Supervision status*.	27
	Supervision 4	Bit 3 of *32.01 Supervision status*.	28
	Supervision 5	Bit 4 of *32.01 Supervision status*.	29
	Supervision 6	Bit 5 of *32.01 Supervision status*.	30
	EFB MCW bit 11	Control word bit 11 received through the embedded fieldbus interface.	32
	FBA A connection loss	Detected communication loss of fieldbus interface A changes control mode to EXT2.	33
	EFB connection loss	Detected communication loss of embedded fieldbus interface changes control mode to EXT2.	35
	Other [bit]	Source selection (see *Terms and abbreviations*).	-
19.12	*Ext1 control mode*	Selects the operating mode for external control location EXT1 in vector motor control mode.	*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

No.	Name/Value	Description	Default FbEq 16
	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
19.14	*Ext2 control mode*	Selects the operating mode for external control location EXT2 in vector motor control mode. For the selections, see parameter *19.12 Ext1 control mode*.	*Speed*
19.16	*Local control mode*	Selects the operating mode for local control in vector motor control mode.	*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>Default
FbEq 16</th></tr>
<tr><td colspan="2">20 Start/stop/direction</td><td>Start/stop/direction and run/start/jog enable signal source selection; positive/negative reference enable signal source selection.
For information on control locations, see section Local and external control locations (page 50).</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. See parameter 20.21 for the determination of the actual direction.</td><td>In1 Start; In2 Dir</td></tr>
<tr><td></td><td>Not selected</td><td>No start or stop command sources selected.</td><td>0</td></tr>
<tr><td></td><td>In1 Start</td><td>The source of the start and stop commands is selected by parameter 20.03 Ext1 in1 source. The state transitions of the source bits are interpreted as follows:
<table>
<tr><th>State of source 1 (20.03)</th><th>Command</th></tr>
<tr><td>0 -> 1 (20.02 = Edge)
1 (20.02 = Level)</td><td>Start</td></tr>
<tr><td>0</td><td>Stop</td></tr>
</table></td><td>1</td></tr>
<tr><td></td><td>In1 Start; In2 Dir</td><td>The source selected by 20.03 Ext1 in1 source is the start signal; the source selected by 20.04 Ext1 in2 source determines the direction. The state transitions of the source bits are interpreted as follows:
<table>
<tr><th>State of source 1 (20.03)</th><th>State of source 2 (20.04)</th><th>Command</th></tr>
<tr><td>0</td><td>Any</td><td>Stop</td></tr>
<tr><td rowspan="2">0 -> 1 (20.02 = Edge)
1 (20.02 = Level)</td><td>0</td><td>Start forward</td></tr>
<tr><td>1</td><td>Start reverse</td></tr>
</table></td><td>2</td></tr>
</table>

<table>
<tr><th>No.</th><th>Name/Value</th><th>Description</th><th>Default
FbEq 16</th></tr>
<tr><td></td><td>In1 Start fwd; In2 Start rev</td><td>The source selected by *20.03 Ext1 in1 source* is the forward start signal; the source selected by *20.04 Ext1 in2 source* is the reverse start signal. The state transitions of the source bits are interpreted as follows:
<table>
<tr><th>State of source 1 (20.03)</th><th>State of source 2 (20.04)</th><th>Command</th></tr>
<tr><td>0</td><td>0</td><td>Stop</td></tr>
<tr><td>0 -> 1 (20.02 = Edge)
1 (20.02 = Level)</td><td>0</td><td>Start forward</td></tr>
<tr><td>0</td><td>0 -> 1 (20.02 = Edge)
1 (20.02 = Level)</td><td>Start reverse</td></tr>
<tr><td>1</td><td>1</td><td>Stop</td></tr>
</table></td><td>3</td></tr>
<tr><td></td><td>In1P Start; In2 Stop</td><td>The sources of the start and stop commands are selected by parameters *20.03 Ext1 in1 source* and *20.04 Ext1 in2 source*. The state transitions of the source bits are interpreted as follows:
<table>
<tr><th>State of source 1 (20.03)</th><th>State of source 2 (20.04)</th><th>Command</th></tr>
<tr><td>0 -> 1</td><td>1</td><td>Start</td></tr>
<tr><td>Any</td><td>0</td><td>Stop</td></tr>
</table>
Notes:
• Parameter *20.02 Ext1 start trigger type* has no effect with this setting.
• When source 2 is 0, the Start and Stop keys on the control panel are disabled.</td><td>4</td></tr>
</table>

<table>
<tr><th>No.</th><th>Name/Value</th><th>Description</th><th>Default
FbEq 16</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>
Notes:

Parameter 20.02 Ext1 start trigger type has no effect with this setting.
When source 2 is 0, the Start and Stop keys on the control panel are disabled.
</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 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>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: Parameter 20.02 Ext1 start trigger type has no effect with this setting.</td><td>6</td></tr>
<tr><td></td><td>Control panel</td><td>Start; stop and direction commands through control panel; when EXT1 is active. Applies also for PC-Tool when it is connected via panel port.</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>
</table>

No.	Name/Value	Description	Default FbEq 16
	Integrated Panel	Start; stop and direction commands from Integrated Panel	23
20.02	*Ext1 start trigger type*	Defines whether the start signal for external control location EXT1 is edge-triggered or level-triggered. **Note:** This parameter is not effective if a pulse-type start signal is selected. See the descriptions of the selections of parameter *20.01 Ext1 commands*.	*Level*
	Edge	The start signal is edge-triggered.	0
	Level	The start signal is level-triggered.	1
20.03	*Ext1 in1 source*	Selects source 1 for parameter *20.01 Ext1 commands*.	*DI1*
	Always off	0 (always off).	0
	Always on	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
	DIO1	Digital input/output DIO1 (*11.02 DIO delayed status*, bit 0).	10
	DIO2	Digital input/output (*11.02 DIO delayed status*, bit 1).	11
	Timed function 1	Bit 0 of *34.01 Timed functions status*.	18
	Timed function 2	Bit 1 of *34.01 Timed functions status*.	19
	Timed function 3	Bit 2 of *34.01 Timed functions status*.	20
	Supervision 1	Bit 0 of *32.01 Supervision status*.	24
	Supervision 2	Bit 1 of *32.01 Supervision status*.	25
	Supervision 3	Bit 2 of *32.01 Supervision status*.	26
	Supervision 4	Bit 3 of *32.01 Supervision status*.	27
	Supervision 5	Bit 4 of *32.01 Supervision status*.	28
	Supervision 6	Bit 5 of *32.01 Supervision status*.	29
	Other [bit]	Source selection (see *Terms and abbreviations*).	-
20.04	*Ext1 in2 source*	Selects source 2 for parameter *20.01 Ext1 commands*. For the available selections, see parameter *20.03 Ext1 in1 source*.	*DI2*
20.05	*Ext1 in3 source*	Selects source 3 for parameter *20.01 Ext1 commands*. For the available selections, see parameter *20.03 Ext1 in1 source*.	*Always off*

<table>
<tr><th>No.</th><th>Name/Value</th><th>Description</th><th>Default
FbEq 16</th></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*. See parameter *20.21* for the determination of the actual direction.</td><td>*Not selected*</td></tr>
<tr><td></td><td>Not selected</td><td>No start or stop command sources selected.</td><td>0</td></tr>
<tr><td></td><td>In1 Start</td><td>The source of the start and stop commands is selected by parameter *20.08 Ext2 in1 source*. The state transitions of the source bits are interpreted as follows:
<table>
<tr><th>State of source 1 (*20.08*)</th><th>Command</th></tr>
<tr><td>0 -> 1 (*20.07* = *Edge*)
1 (*20.07* = *Level*)</td><td>Start</td></tr>
<tr><td>0</td><td>Stop</td></tr>
</table></td><td>1</td></tr>
<tr><td></td><td>In1 Start; In2 Dir</td><td>The source selected by *20.08 Ext2 in1 source* is the start signal; the source selected by *20.09 Ext2 in2 source* determines the direction. The state transitions of the source bits are interpreted as follows:
<table>
<tr><th>State of source 1 (*20.08*)</th><th>State of source 2 (*20.09*)</th><th>Command</th></tr>
<tr><td>0</td><td>Any</td><td>Stop</td></tr>
<tr><td rowspan="2">0 -> 1 (*20.07* = *Edge*)
1 (*20.07* = *Level*)</td><td>0</td><td>Start forward</td></tr>
<tr><td>1</td><td>Start reverse</td></tr>
</table></td><td>2</td></tr>
<tr><td></td><td>In1 Start fwd; In2 Start rev</td><td>The source selected by *20.08 Ext2 in1 source* is the forward start signal; the source selected by *20.09 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 (*20.08*)</th><th>State of source 2 (*20.09*)</th><th>Command</th></tr>
<tr><td>0</td><td>0</td><td>Stop</td></tr>
<tr><td>0 -> 1 (*20.07* = *Edge*)
1 (*20.07* = *Level*)</td><td>0</td><td>Start forward</td></tr>
<tr><td>0</td><td>0 -> 1 (*20.07* = *Edge*)
1 (*20.07* = *Level*)</td><td>Start reverse</td></tr>
<tr><td>1</td><td>1</td><td>Stop</td></tr>
</table></td><td>3</td></tr>
</table>

<table>
<tr><th>No.</th><th>Name/Value</th><th>Description</th><th>Default
FbEq 16</th></tr>
<tr><td></td><td>In1P Start; In2 Stop</td><td>The sources of the start and stop commands are selected by parameters 20.08 Ext2 in1 source and 20.09 Ext1 in2 source. The state transitions of the source bits are interpreted as follows:
<table>
<tr><th>State of source 1 (20.08)</th><th>State of source 2 (20.09)</th><th>Command</th></tr>
<tr><td>0 -> 1</td><td>1</td><td>Start</td></tr>
<tr><td>Any</td><td>0</td><td>Stop</td></tr>
</table>
Notes:

Parameter 20.07 Ext2 start trigger type has no effect with this setting.
When source 2 is 0, the Start and Stop keys on the control panel are disabled.
</td><td>4</td></tr>
<tr><td></td><td>In1P Start; In2 Stop; In3 Dir</td><td>The sources of the start and stop commands are selected by parameters 20.08 Ext2 in1 source and 20.09 Ext1 in2 source. The source selected by 20.10 Ext2 in3 source determines the direction. The state transitions of the source bits are interpreted as follows:
<table>
<tr><th>State of source 1 (20.08)</th><th>State of source 2 (20.09)</th><th>State of source 3 (20.10)</th><th>Command</th></tr>
<tr><td>0 -> 1</td><td>1</td><td>0</td><td>Start forward</td></tr>
<tr><td>0 -> 1</td><td>1</td><td>1</td><td>Start reverse</td></tr>
<tr><td>Any</td><td>0</td><td>Any</td><td>Stop</td></tr>
</table>
Notes:

Parameter 20.07 Ext2 start trigger type has no effect with this setting.
When source 2 is 0, the Start and Stop keys on the control panel are disabled.
</td><td>5</td></tr>
</table>

<table>
<tr><th>No.</th><th>Name/Value</th><th>Description</th><th>Default
FbEq 16</th></tr>
<tr><td></td><td>In1P Start fwd; In2P Start rev; In3 Stop</td><td>The sources of the start and stop commands are selected by parameters 20.08 Ext2 in1 source, 20.09 Ext1 in2 source and 20.10 Ext2 in3 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>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: Parameter 20.07 Ext2 start trigger type has no effect with this setting.</td><td>6</td></tr>
<tr><td></td><td>Control panel</td><td>Start; stop and direction commands through control panel; when EXT1 is active. Applies also for PC-Tool when it is connected via panel port.</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>Start; stop and direction commands through embedded fieldbus protocol when EXT1 is active.
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>Integrated Panel</td><td>Start; stop and direction commands from Integrated Panel</td><td>23</td></tr>
<tr><td>20.07</td><td>Ext2 start trigger type</td><td>Defines whether the start signal for external control location EXT2 is edge-triggered or level-triggered.
Note: This parameter is not effective if a pulse-type start signal is selected. See the descriptions of the selections of parameter 20.06 Ext2 commands.</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>20.08</td><td>Ext2 in1 source</td><td>Selects source 1 for parameter 20.06 Ext2 commands.
For the available selections, see parameter 20.03 Ext1 in1 source.</td><td>Always off</td></tr>
</table>

No.	Name/Value	Description	Default FbEq 16
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*.	*Always off*
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*.	*Always off*
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*
	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*.	1
	Torque limit	Stop according to torque limits (parameters *30.19* and *30.20*).	2
20.12	*Run enable 1 source*	Selects the source of the external run enable signal. If the run enable signal is switched off, the drive will not start. If already running, the drive will stop according to the setting of parameter *20.11 Run enable stop mode*. 1 = Run enable signal on. See also parameter *20.19 Enable start signal*	*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
	DIO1	Digital input/output DIO1 (*11.02 DIO delayed status*, bit 0)	10
	DIO2	Digital input/output DIO2 (*11.02 DIO delayed status*, bit 0)	11
	Timed function 1	Bit 0 of *34.01 Timed functions status*.	18
	Timed function 2	Bit 1 of *34.01 Timed functions status*.	19

No.	Name/Value	Description	Default FbEq 16
	Timed function 3	Bit 2 of *34.01 Timed functions status*.	20
	Supervision 1	Bit 0 of *32.01 Supervision status*.	24
	Supervision 2	Bit 1 of *32.01 Supervision status*.	25
	Supervision 3	Bit 2 of *32.01 Supervision status*.	26
	Supervision 4	Bit 3 of *32.01 Supervision status*.	27
	Supervision 5	Bit 4 of *32.01 Supervision status*.	28
	Supervision 6	Bit 5 of *32.01 Supervision status*.	29
	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
	Other [bit]	Source selection (see *Terms and abbreviations*).	-
20.19	*Enable start signal*	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.) See also parameter *20.12 Run enable 1 source*.	*On*
	Off	0.	0
	On	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
	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
	Timed function 1	Bit 0 of *34.01 Timed functions status*.	18
	Timed function 2	Bit 1 of *34.01 Timed functions status*.	19
	Timed function 3	Bit 2 of *34.01 Timed functions status*.	20
	Supervision 1	Bit 0 of *32.01 Supervision status*.	24
	Supervision 2	Bit 1 of *32.01 Supervision status*.	25
	Supervision 3	Bit 2 of *32.01 Supervision status*.	26
	Supervision 4	Bit 3 of *32.01 Supervision status*.	27
	Supervision 5	Bit 4 of *32.01 Supervision status*.	28
	Supervision 6	Bit 5 of *32.01 Supervision status*.	29
	Other [bit]	Source selection (see *Terms and abbreviations*).	-

No.	Name/Value	Description	Default FbEq 16
20.21	*Direction*	Reference direction lock. Defines the direction of the drive rather than the sign of the reference, except in some cases. In the table the actual drive rotation is shown as a function of parameter *20.21 Direction* and Direction command (from parameter *20.01 Ext2 commands* or *20.06 Ext2 commands*).	*Request*

	Direction command = Forward	Direction command = Reverse	Direction command not defined
Par. *20.21 Direction* = *Forward*	Forward	Forward	Forward
Par. *20.21 Direction* = *Reverse*	Reverse	Reverse	Reverse
Par. *20.21 Direction* = *Request*	Forward, but • If reference from Constant, Motor potentiometer, PID, Safe speed, Last, Jogging or Panel reference, reference used as is. • If reference from the network, reference used as is.	Reverse, but • If reference from Constant, PID or Jogging reference, reference used as is. • If reference from the network, Panel, Analog input, Motor potentiometer, Safe speed or Last reference, reference multiplied by -1.	Forward

No.	Name/Value	Description	Default FbEq 16
	Request	In external control the direction is selected by a direction command (parameter *20.01 Ext2 commands* or *20.06 Ext2 commands*). If the reference comes from Constant (constant speeds/frequencies), Motor potentiometer, PID, Fail, Last (last speed reference), Jogging (jogging speed) or Panel reference, the reference is used as is. If the reference comes from a fieldbus: • if the direction command is forward, the reference is used as is • if the direction command is reverse, the reference is multiplied by -1.	0

No.	Name/Value	Description	Default FbEq 16
	Forward	Motor rotates forward regardless of the sign of the external reference. (Negative reference values are replaced by zero. Positive reference values are used as is.)	1
	Reverse	Motor rotates reverse regardless of the sign of the external reference. (Negative reference values are replaced by zero. Positive reference values are multiplied by -1.)	2
20.22	*Enable to rotate*	Setting this parameter to 0 stops motor rotating but does not affect any other conditions for rotating. Setting the parameter back to 1 starts motor rotating again. This parameter can be used for example with a signal from some external equipment to prevent the motor rotating before the equipment is ready. When this parameter is 0 (rotating of the motor is disabled), bit 13 of parameter *06.16 Drive status word 1* is set to 0.	*Selected*
	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
	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
	Timed function 1	Bit 0 of *34.01Timed functions status*.	18
	Timed function 2	Bit 1 of *34.01 Timed functions status*.	19
	Timed function 3	Bit 2 of *34.01 Timed functions status*.	20
	Supervision 1	Bit 0 of *32.01 Supervision status*.	24
	Supervision 2	Bit 1 of *32.01 Supervision status*.	25
	Supervision 3	Bit 2 of *32.01 Supervision status*.	26
	Supervision 4	Bit 3 of *32.01 Supervision status*.	27
	Supervision 5	Bit 4 of *32.01 Supervision status*.	28
	Supervision 6	Bit 5 of *32.01 Supervision status*.	29
	Other [bit]	Source selection (see *Terms and abbreviations*).	-

No.	Name/Value	Description	Default FbEq 16
20.25	Jog enable	Selects the source for a jog enable signal. (The sources for jogging activation signals are selected by parameters 20.26 Jog 1 start and 20.27 Jog 2 start.) 1 = Jogging is enabled. 0 = Jogging is disabled. **Notes:** • Jogging is supported in vector control mode only. • Jogging can be enabled only when no start command from an external control location is active. On the other hand, if jogging is already enabled, the drive cannot be started from an external control location (apart from inching commands through fieldbus). See section Rush control on page 71.	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
	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
	Timed function 1	Bit 0 of 34.01 Timed functions status.	18
	Timed function 2	Bit 1 of 34.01 Timed functions status.	19
	Timed function 3	Bit 2 of 34.01 Timed functions status.	20
	Supervision 1	Bit 0 of 32.01 Supervision status.	24
	Supervision 2	Bit 1 of 32.01 Supervision status.	25
	Supervision 3	Bit 2 of 32.01 Supervision status.	26
	Supervision 4	Bit 3 of 32.01 Supervision status.	27
	Supervision 5	Bit 4 of 32.01 Supervision status.	28
	Supervision 6	Bit 5 of 32.01 Supervision status.	29
	Other [bit]	Source selection (see Terms and abbreviations).	-

No.	Name/Value	Description	Default FbEq 16
20.26	*Jog 1 start*	If enabled by parameter *20.25 Jog enable*, selects the source for the activation of jogging function 1. (Jogging function 1 can also be activated through fieldbus regardless of parameter *20.25*.) 1 = Jogging 1 active. **Notes:** • Jogging is supported in vector control mode only. • If both jogging 1 and 2 are activated, the one that was activated first has priority. • 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
	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
	Timed function 1	Bit 0 of *34.01 Timed functions status*.	18
	Timed function 2	Bit 1 of *34.01 Timed functions status*.	19
	Timed function 3	Bit 2 of *34.01 Timed functions status*.	20
	Supervision 1	Bit 0 of *32.01 Supervision status*.	24
	Supervision 2	Bit 1 of *32.01 Supervision status*.	25
	Supervision 3	Bit 2 of *32.01 Supervision status*.	26
	Supervision 4	Bit 3 of *32.01 Supervision status*.	27
	Supervision 5	Bit 4 of *32.01 Supervision status*.	28
	Supervision 6	Bit 5 of *32.01 Supervision status*.	29
	Other [bit]	Source selection (see *Terms and abbreviations*).	-

No.	Name/Value	Description	Default FbEq 16
20.27	*Jog 2 start*	If enabled by parameter *20.25 Jog enable*, selects the source for the activation of jogging function 2. (Jogging function 2 can also be activated through fieldbus regardless of parameter *20.25*.) 1 = Jogging 2 active. For the selections, see parameter *20.26 Jog 1 start*. **Notes:** • Jogging is supported in vector control mode only. • If both jogging 1 and 2 are activated, the one that was activated first has priority. • This parameter cannot be changed while the drive is running. For the selections, see parameter *20.26 Jog 1 start*.	*Not selected*
20.30	*Enable signal warning function*	Selects the enable signal warnings that will be suppressed. This parameter can be used to prevent these warnings from being added to the event log. Whenever a bit of this parameter is set to 1, the corresponding warning is suppressed.	0000h

Bit	Name	Description
0	Enable to rotate	1 = Warning *AFED Enable to rotate* is suppressed.
1	Run enable missing	1 = Warning *AFEB Run enable missing* is suppressed.
3…15	Reserved	

No.	Name/Value	Description	Default FbEq 16
	0000h…FFFFh	Word for disabling enable signal warnings.	1 = 1
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)	Fast stop command is enabled.	0
	Inactive (true)	Fast stop command is disabled.	1
	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	Default FbEq 16
	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 *124*).	-
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 acknowledgment signal. 1 = Power on acknowledgment circuit is closed, main contactor is closed. 0 = Power on acknowledgment circuit is open, main contactor is open, warning *D20B Power on acknowledge* generated. For more information on the function, see section *Power on acknowledgment* on page *667*.	*Selected*
	Not Selected	Power on acknowledge function is disabled.	0
	Selected	Power on acknowledge 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
	DIO1	Digital input/output DIO1 (*11.02 DIO delayed status*, bit 0)	10
	DIO2	Digital input/output DIO2 (*11.02 DIO delayed status*, bit 0)	11
	Timed function 1	Bit 0 of *34.01 Timed functions status*.	18
	Timed function 2	Bit 1 of *34.01 Timed functions status*.	19
	Timed function 3	Bit 2 of *34.01 Timed functions status*.	20
	Supervision 1	Bit 0 of *32.01 Supervision status*.	24
	Supervision 2	Bit 1 of *32.01 Supervision status*.	25
	Supervision 3	Bit 2 of *32.01 Supervision status*.	26
	Supervision 4	Bit 3 of *32.01 Supervision status*.	27

No.	Name/Value	Description	Default FbEq 16
	Supervision 5	Bit 4 of *32.01 Supervision status*.	28
	Supervision 6	Bit 5 of *32.01 Supervision status*.	29
	Other [bit]	Source selection (see *Terms and abbreviations* on page *124*).	-
20.213	*Power on ackn reset delay*	Defines the time delay for a fault reset after the Power on acknowledgment 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 *659*.	*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
	DIO1	Digital input/output DIO1 (*11.02 DIO delayed status*, bit 0)	10
	DIO2	Digital input/output DIO2 (*11.02 DIO delayed status*, bit 0)	11
	Timed function 1	Bit 0 of *34.01 Timed functions status*.	18
	Timed function 2	Bit 1 of *34.01 Timed functions status*.	19
	Timed function 3	Bit 2 of *34.01 Timed functions status*.	20
	Supervision 1	Bit 0 of *32.01 Supervision status*.	24
	Supervision 2	Bit 1 of *32.01 Supervision status*.	25
	Supervision 3	Bit 2 of *32.01 Supervision status*.	26
	Supervision 4	Bit 3 of *32.01 Supervision status*.	27
	Supervision 5	Bit 4 of *32.01 Supervision status*.	28
	Supervision 6	Bit 5 of *32.01 Supervision status*.	29
	Other [bit]	Source selection (see *Terms and abbreviations* on page *124*).	-
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

No.	Name/Value	Description	Default FbEq 16
	0…30000 ms	Time delay.	1 = 1 ms
20.216	*Crane control word 1*	Shows the control signals as received from the selected sources. The parameter updates based on the parameter group *53 FBA A data out* selections. **Note:** These bits are not connected to any functions by default. The bit names exists already for which you need to make connections separately.	0000h

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 forward	1 = Deactivate the Slowdown command in the forward direction.
8	Slowdown reverse	1 = Deactivate the Slowdown command in the reverse direction.
9	Forward stop limit	1 = Deactivate the forward stop limit command.
10	Reverse stop limit	1 = Deactivate the reverse stop limit command.
11	Fast stop	1 = Activate the Fast stop command.
12	Reserved	
13	Reserved	
14	Reserved	
15	Reserved	

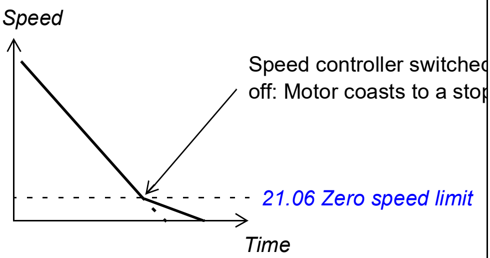
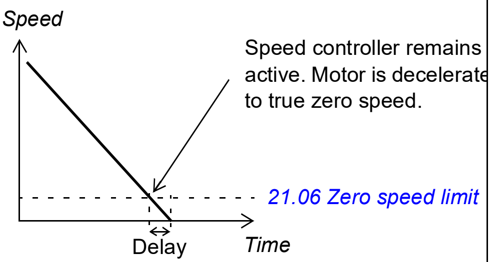
	0000h…FFFFh	Crane control program control word 1.	1 = 1

No.	Name/Value	Description	Default FbEq 16
21 Start/stop mode		Start and stop modes; emergency stop mode and signal source selection; DC magnetization settings.	
21.01	*Vector start mode*	Selects the motor start function for the vector motor control mode, ie. when *99.04 Motor control mode* is set to *Vector*. **Notes:** • The start function for the scalar motor control mode is selected by parameter *21.19 Scalar start mode*. • Starting into a rotating motor is not possible when DC magnetizing is selected (*Fast* or *Const time*). • 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* on page *78*.	*Const time*
	Fast	The drive pre-magnetizes the motor before start. The pre-magnetizing time is determined automatically, typically 200 ms to 2 s depending on motor size. Select this mode if a high break-away torque is required.	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. **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

<table>
<tr><th>No.</th><th>Name/Value</th><th>Description</th><th>Default
FbEq 16</th></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. 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.
Note: If parameter 99.04 Motor control mode is set to Scalar, no flying start or automatic restart is possible unless parameter 21.19 Scalar start mode is set to Automatic.</td><td>2</td></tr>
<tr><td>21.02</td><td>Magnetization time</td><td>Defines the pre-magnetization time when
• parameter 21.01 Vector start mode is set to Const time (in vector motor control mode), or
• parameter 21.19 Scalar start mode is set to Const time (in scalar motor control mode).
After the start command, the drive automatically premagnetizes the motor for the set time. To ensure full magnetizing, set this parameter to the same value as, or higher than, the rotor time constant. If not known, use the rule-of-thumb value given in the table below:
<table>
<tr><th>Motor rated power</th><th>Constant magnetizing time</th></tr>
<tr><td>< 1 kW</td><td>≥ 50 to 100 ms</td></tr>
<tr><td>1 to 10 kW</td><td>≥ 100 to 200 ms</td></tr>
<tr><td>10 to 200 kW</td><td>≥ 200 to 1000 ms</td></tr>
<tr><td>200 to 1000 kW</td><td>≥ 1000 to 2000 ms</td></tr>
</table>
Note: This parameter cannot be changed while the drive is running.</td><td>500 ms</td></tr>
<tr><td></td><td>0…10000 ms</td><td>Constant DC magnetizing time.</td><td>1 = 1 ms</td></tr>
<tr><td>21.03</td><td>Stop mode</td><td>Selects the way the motor is stopped when a stop command is received.
Additional braking is possible by selecting flux braking (see parameter 97.05 Flux braking).</td><td>Ramp</td></tr>
<tr><td></td><td>Coast</td><td>Stop by switching off the output semiconductors of the drive. The motor coasts to a stop.
WARNING! If a mechanical brake is used, make sure it is safe to stop the drive by coasting.</td><td>0</td></tr>
</table>

No.	Name/Value	Description	Default FbEq 16
	Ramp	Stop along the active deceleration ramp. See parameter group *23 Speed reference ramp* or *28 Frequency reference chain*.	1
	Torque limit	Stop according to torque limits (parameters *30.19* and *30.20*). This mode is only possible in vector motor control mode.	2
21.04	*Emergency stop mode*	Selects the way the motor is stopped when an emergency stop command is received. The source of the emergency stop signal is selected by parameter *21.05 Emergency stop source*.	*Ramp stop (Off1)*
	Ramp stop (Off1)	With the drive running: • 1 = Normal operation. • 0 = Normal stop along the standard deceleration ramp defined for the particular reference type (see section *Reference ramping* on page *65*). After the drive has stopped, it can be restarted by removing the emergency stop signal and switching the start signal from 0 to 1. With the drive stopped: • 1 = Starting allowed. • 0 = Starting not allowed.	0
	Coast stop (Off2)	With the drive running: • 1 = Normal operation. • 0 = Stop by coasting. With the drive stopped: • 1 = Starting allowed. • 0 = Starting not allowed.	1
	Eme ramp stop (Off3)	With the drive running: • 1 = Normal operation • 0 = Stop by ramping along emergency stop ramp defined by parameter *23.23 Emergency stop time*. After the drive has stopped, it can be restarted by removing the emergency stop signal and switching the start signal from 0 to 1. With the drive stopped: • 1 = Starting allowed • 0 = Starting not allowed	2

No.	Name/Value	Description	Default FbEq 16
21.05	*Emergency stop source*	Selects the source of the emergency stop signal. The stop mode is selected by parameter *21.04 Emergency stop mode*. 0 = Emergency stop active 1 = Normal operation **Note:** This parameter cannot be changed while the drive is running.	*Inactive (true)*
	Active (false)	0.	0
	Inactive (true)	1.	1
	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
	DIO1	Digital input DIO1 (*11.02 DIO delayed status* bit 0).	10
	DIO2	Digital input DIO2 (*11.02 DIO delayed status* bit 0).	11
21.06	*Zero speed limit*	Defines the zero speed limit. The motor is stopped along a speed ramp (when ramped stop is selected or emergency stop time is used) until the defined zero speed limit is reached. After the zero speed delay, the motor coasts to a stop.	30.00 rpm
	0.00…30000.00 rpm	Zero speed limit.	See par. *46.01*

No.	Name/Value	Description	Default FbEq 16
21.07	*Zero speed delay*	Defines the delay for the zero speed delay function. The function is useful in applications where a smooth and quick restarting is essential. During the delay, the drive knows the rotor position accurately. 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. Zero speed delay can be used e.g. with the jogging function. 	0 ms
	0…30000 ms	Zero speed delay.	1 = 1 ms

No.	Name/Value	Description	Default FbEq 16
21.08	*DC current control*	Activates/deactivates the DC hold and post-magnetization functions. See section *DC magnetization* on page *78*. **Note:** 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.	0b0000

Bit	Value
0	1 = DC hold. See section *DC hold* on page *78*. **Note:** The DC hold function has no effect if the start signal is switched off.
1	1 = Post-magnetization. See section *Post-magnetization* on page *79*. **Note:** Post-magnetization is only available when ramping is the selected stop mode (see parameter *21.03 Stop mode*).
2…15	Reserved

No.	Name/Value	Description	Default FbEq 16
	0b0000…0b1111	DC magnetization selection.	1 = 1
21.09	*DC hold speed*	Defines the DC hold speed in speed control mode. See parameter *21.08 DC current control*, and section *DC hold* on page *78*.	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 and post magnetization current in percent of the motor nominal current. See parameter *21.08 DC current control*, and section *DC magnetization* on page *78*. After 100 s post-magnetization time, the maximum magnetization current is limited to the magnetization current corresponding to the actual flux reference.	30.0%
	0.0…100.0%	DC hold current.	1 = 1%
21.11	*Post magnetization time*	Defines the length of time for which post-magnetization is active after stopping the motor. The magnetization current is defined by parameter *21.10 DC current reference*. See parameter *21.08 DC current control*	0 s
	0…3000 s	Post-magnetization time.	1 = 1 s

No.	Name/Value	Description	Default FbEq 16
21.14	*Pre-heating input source*	Selects the source for triggering pre-heating for the motor. The status of the pre-heating is shown as bit 2 of *06.21 Drive status word 3*. **Notes:** • The heating function requires that STO is not triggered. • The heating function requires that the drive is not faulted. • Pre-heating uses DC hold to produce current.	*Off*
	Off	0. Pre-heating is always deactivated.	0
	On	1. Pre-heating is always activated when the drive is stopped.	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
	Supervision 1	Bit 0 of *32.01 Supervision status* (see page *285*).	8
	Supervision 2	Bit 1 of *32.01 Supervision status* (see page *285*).	9
	Supervision 3	Bit 2 of *32.01 Supervision status* (see page *285*).	10
	Timed function 1	Bit 0 of *34.01 Timed functions status* (see page *302*)	11
	Timed function 2	Bit 1 of *34.01 Timed functions status* (see page *302*).	12
	Timed function 3	Bit 2 of *34.01 Timed functions status* (see page *302*)	13
	DIO1	Digital input/output DIO1 (*11.02 DIO delayed status,* bit 0).	14
	DIO2	Digital input/output DIO2 (*11.02 DIO delayed status,* bit 1).	15
	Other [bit]	Source selection (see *Terms and abbreviations*).	-
21.15	*Pre-heating time delay*	Time delay before pre-heating starts after the drive is stopped.	60 s
	10...3000 s	Pre-heating time delay.	1 = 1 s
21.16	*Pre-heating current*	Defines the DC current used to heat the motor. The value is in percent of the nominal motor current.	0.0%
	0.0…30.0%	Pre-heating current.	1 = 1%

No.	Name/Value	Description	Default FbEq 16
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* on page *105*. 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.	10.0 s
	0.0 s	Automatic restart disabled.	0
	0.0…10.0 s	Maximum power failure duration.	1 = 1 s
21.19	*Scalar start mode*	Selects the motor start function for the scalar motor control mode, ie. when *99.04 Motor control mode* is set to *Scalar*. **Notes:** • The start function for the vector motor control mode is selected by parameter *21.01 Vector 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* on page *78*.	*Const time*
	Normal	Immediate start from zero speed.	0

No.	Name/Value	Description	Default FbEq 16
	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	The drive automatically selects the correct output frequency to start a rotating motor. This is useful for flying starts: if the motor is already rotating, the drive will start smoothly at the current frequency. **Note:** Cannot be used in multimotor systems.	2
	Torque boost	Torque boost is applied at start, ending when output frequency exceeds 40% of nominal frequency or when output frequency is equal to reference.	3
	Automatic + boost	If the Flystart routine does not detect rotating motor, torque boost is applied.	4

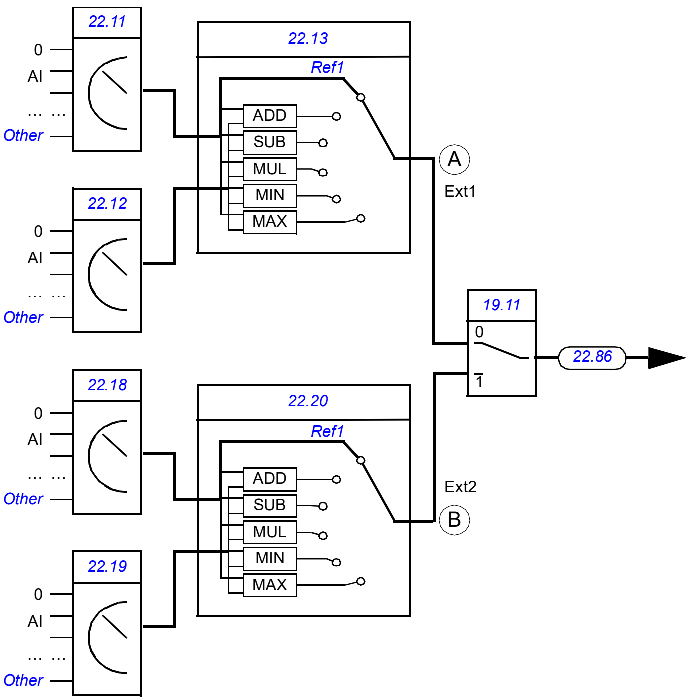
No.	Name/Value	Description	Default FbEq 16
	Flying start	The drive automatically selects the correct output frequency to start a rotating motor. If the motor is already rotating, drive will start smoothly at the current frequency. The mode will start the motor with vector control and switch to scalar control on the fly when the motor speed has been found. Compared to the Automatic start mode, Flying start detects the motor speed faster. Flying start requires more accurate information about motor model. Therefore standstill ID run is done automatically when the drive is started for the first time after selecting Flying start. Motor plate values should be accurate. Wrong plate values may decrease the starting performance. **Notes:** • Flying start cannot be used in multimotor systems. • During flying start, the drive will at first run in vector control mode. This is why, when using flying start, the drive nominal current setting must be in the allowed range for vector control mode. See parameter *99.06*.	5
	Flying start+boost	Flying start with torque boost. Flying start is performed first and the motor is magnetized. If the speed is found to be zero, torque boost is applied.	6
21.21	*DC hold frequency*	Defines the DC hold frequency, which is used instead of parameter *21.09 DC hold speed* when the operating mode in use is *Scalar frequency mode*. See parameters *19.01 Actual operation mode*, *21.08 DC current control*, and section *DC hold* on page *78*.	5.00 Hz
	0.00…1000.00 Hz	DC hold frequency.	1 = 1 Hz
21.22	*Start delay*	Defines the start delay. After the conditions for start have been fulfilled, the drive waits until the delay has elapsed and then starts the motor. During the delay, warning *AFE9 Start delay* is shown. Start delay can be used with all start modes.	0.00 s
	0.00…60.00 s	Start delay	1 = 1 s

No.	Name/Value	Description	Default FbEq 16
21.23	*Smooth start*	Enables smooth start function. Smooth start function restricts the motor current below the limit defined by parameter *21.24 Smooth start current* when the motor speed is below *21.25 Smooth start speed*. Can be used for permanent magnet synchronous motors only.	*Disabled*
	Disabled	Smooth start disabled	0
	Enabled always	Smooth start function is always active when the speed is below the smooth start speed.	1
	Start only	Smooth start function is only active during starting until the smooth start speed is reached..	2
21.24	*Smooth start current*	Current applied to motor when the smooth start is active.	50.0%
	10.0... 200.0%		1=1%
21.25	*Smooth start speed*	Set the smooth start speed until when the current is applied.	10.0%
	2.0... 100.0%		1=1%
21.26	*Torque boost current*	Defines the maximum supplied current to motor during 'Torque boost' –starting mode. Parameter value is in percent of the motor nominal current. Nominal value of the parameter is 100.0%. 'Torque boost' –starting mode can be used only when motor control mode is 'Scalar'. Torque boost is only applied at start, ending when output frequency exceeds 40% of nominal frequency or when output frequency is equal to reference.	100.0%
	15.0... 300.0%		0.01 = 1%
21.27	*Torque boost time*	Defines the minimum and maximum torque boost time. If torque boost time is less than 40% of frequency acceleration time (see parameters *28.72* and *28.74*), torque boost time is set at 40% of the frequency acceleration time. **WARNING!** Long run operation of smooth start at low speed with high current may heat the motor.	20.0 s
	0.0... 60.0s	Nominal motor time.	1=1s

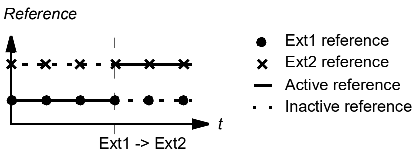
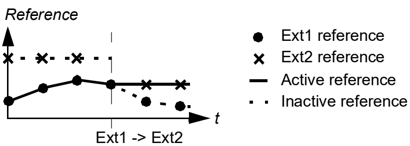
No.	Name/Value	Description	Default FbEq 16
21.30	*Speed compensated stop mode*	Selects the method used to stop the drive. See also section *Speed compensated stop* on page *81*. Speed compensated stop is active only if • the operation mode is not torque, and •parameter *21.03 Stop mode* is *Ramp*, or •parameter *20.11 Run enable stop mode* is *Ramp* (in case Run enable is missing).	*Off*
	Off	Stop according parameter *21.03 Stop mode*, no speed compensated stop.	0
	Speed comp FWD	If the direction of rotation is forward, speed compensation is used for constant distance braking. Speed difference (between used speed and maximum speed) is compensated by running the drive with current speed before the motor is stopped along a ramp. If the direction of rotation is reverse, the drive is stopped along a ramp.	1
	Speed comp REV	If the direction of rotation is reverse, speed compensation is used for constant distance braking. Speed difference (between used speed and maximum speed) is compensated by running the drive with current speed before the motor is stopped along a ramp. If the direction of rotation is forward, the drive is stopped along a ramp.	2
	Speed comp bipolar	Regardless of the direction of rotation, speed compensation is used for constant distance braking. Speed difference (between used speed and maximum speed) is compensated by running the drive with current speed before the motor is stopped along a ramp.	3
21.31	*Speed compensated stop delay*	This delay adds distance to the total distance traveled during a stop from maximum speed. It is used to adjust the distance to match requirements so that the distance traveled is not solely determined by the deceleration rate.	0.00 s
	0.00…1000.00 s	Speed delay.	1 = 1 s
21.32	*Speed comp stop threshold*	This parameter sets a speed threshold below which the Speed compensated stop feature is disabled. In this speed region, the speed compensated stop is not attempted and the drive stops as it would, using the ramp option.	10%
	0…100%	Speed threshold as a percent of the motor nominal speed.	1 = 1%

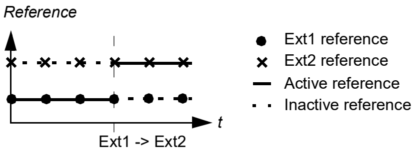
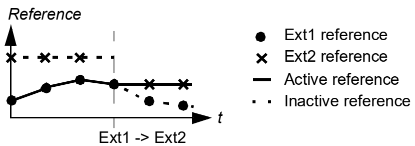
No.	Name/Value	Description	Default FbEq 16
21.34	*Force auto restart*	Forces automatic restart. The parameter is applicable only if parameter *95.04 Control board supply* is set to *External 24V*.	*Disable*
	Disable	Force auto restart disabled. Parameter *21.18 Auto restart time* is in effect if its value is more than 0.0 s.	0
	Enable	Force auto restart enabled. Parameter *21.18 Auto restart time* is ignored. The drive never trips on the undervoltage fault and the start signal is on forever. When he DC voltage is restored, the normal operation continues.	1
22 Speed reference selection		Speed reference selection; motor potentiometer settings. See the control chain diagrams on pages *612…616*.	
22.01	*Speed ref unlimited*	Displays the output of the speed reference selection block. See the control chain diagram on page *612*. This parameter is read-only.	0.00 rpm
	-30000.00… 30000.00 rpm	Value of the selected speed reference.	See par. *46.01*

No.	Name/Value	Description	Default FbEq 16
22.11	*Ext1 speed ref1*	Selects Ext1 speed reference source 1. Two signal sources can be defined by this parameter and *22.12 Ext1 speed ref2*. A mathematical function (*22.13 Ext1 speed function*) applied to the two signals creates an Ext1 reference (A in the figure below). A digital source selected by *19.11 Ext1/Ext2 selection* can be used to switch between Ext1 reference and the corresponding Ext2 reference defined by parameters *22.18 Ext2 speed ref1*, *22.19 Ext2 speed ref2* and *22.20 Ext2 speed function* (B in the figure below). **Note:** The default value depends on plug and play configuration and/or the selected macro. See *Control macros* on page *31*.	The default depends on the drive configuration: AI1 scaled with an IO controlled drive and FB A ref 1 with a fieldbus controlled drive.

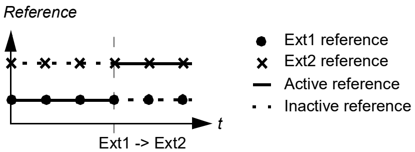
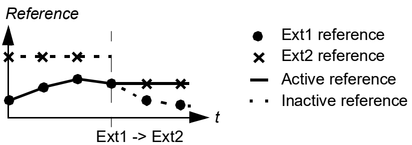


	Zero	None.	0
	AI1 scaled	*12.12 AI1 scaled value*.	1
	AI2 scaled	*12.22 AI2 scaled value*.	2

No.	Name/Value	Description	Default FbEq 16
	FB A ref1	*03.05 FB A reference 1*	4
	FB A ref2	*03.06 FB A reference 2*.	5
	EFB ref1	*03.09 EFB reference 1*.	8
	EFB ref2	*03.10 EFB reference 2*.	9
	Motor potentiometer	*22.80 Motor potentiometer ref act* (output of the motor potentiometer).	15
	PID	*40.01 Process PID output actual* (output of the process PID controller).	16
	Frequency input 1	*11.38 Freq in 1 actual value* (when DI3 or DI4 is used as a frequency input).	17
	Control panel (ref saved)	Panel reference (*03.01 Panel reference*, see page *132*) saved by the control system for the location where the control returns is used as the reference. 	18
	Control panel (ref copied)	Panel reference (*03.01 Panel reference* for the previous control location is used as the reference when the control location changes if the references for the two locations are of the same type (eg frequency/speed/torque/PID); otherwise, the actual signal is used as the new reference. 	19
	Integrated panel (ref saved)	See above Control panel (ref saved).	20
	Integrated panel (ref copied)	See above Control panel (ref copied).	21
	Frequency input 2	*11.46 Freq in 2 actual value* (when DI3 or DI4 is used as a frequency input).	22
	MotPot Crane	Output of the crane motor potentiometer. See *22.230 Crane motpot ref act.*	31
	Other	Source selection (see *Terms and abbreviations*).	-
22.12	*Ext1 speed ref2*	Selects Ext1 speed reference source 2. For the diagram of reference source selection, see parameter *22.11 Ext1 speed ref1*.	*Zero*

No.	Name/Value	Description	Default FbEq 16
	Zero	None.	0
	AI1 scaled	*12.12 AI1 scaled value*.	1
	AI2 scaled	*12.22 AI2 scaled value*.	2
	FB A ref1	*03.05 FB A reference 1*	4
	FB A ref2	*03.06 FB A reference 2*.	5
	EFB ref1	*03.09 EFB reference 1*.	8
	EFB ref2	*03.10 EFB reference 2*.	9
	Motor potentiometer	*22.80 Motor potentiometer ref act* (output of the motor potentiometer).	15
	PID	*40.01 Process PID output actual* (output of the process PID controller).	16
	Frequency input 1	*11.38 Freq in 1 actual value* (when DI3 or DI4 is used as a frequency input).	17
	Control panel (ref saved)	Panel reference (*03.01 Panel reference*, see page *132*) saved by the control system for the location where the control returns is used as the reference.  	18
	Control panel (ref copied)	Panel reference (*03.01 Panel reference* for the previous control location is used as the reference when the control location changes if the references for the two locations are of the same type (eg frequency/speed/torque/PID); otherwise, the actual signal is used as the new reference.  	19
	Integrated panel (ref saved)	See above Control panel (ref saved).	20
	Integrated panel (ref copied)	See above Control panel (ref copied).	21
	Frequency input 2	*11.46 Freq in 2 actual value* (when DI3 or DI4 is used as a frequency input).	22
	Other	Source selection (see *Terms and abbreviations*).	-

No.	Name/Value	Description	Default FbEq 16
22.13	*Ext1 speed function*	Selects a mathematical function between the reference sources selected by parameters *22.11 Ext1 speed ref1* and *22.12 Ext1 speed ref2*. See diagram at *22.11 Ext1 speed ref1*.	*Ref1*
	Ref1	Signal selected by *22.11 Ext1 speed ref1* 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 Ext1 speed ref1*] - [*22.12 Ext1 speed ref2*]) 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
	Abs (ref1)	The absolute value of the reference sources is used as speed reference 1	6
22.18	*Ext2 speed ref1*	Selects Ext2 speed reference source 1. Two signal sources can be defined by this parameter and *22.19 Ext2 speed ref2*. A mathematical function (*22.20 Ext2 speed function*) applied to the two signals creates an Ext2 reference. See diagram at *28.11 Ext1 frequency ref1*.	*Zero*
	Zero	None.	0
	AI1 scaled	*12.12 AI1 scaled value*.	1
	AI2 scaled	*12.22 AI2 scaled value*.	2
	FB A ref1	*03.05 FB A reference 1*.	4
	FB A ref2	*03.06 FB A reference 2*	5
	EFB ref1	*03.09 EFB reference 1*.	8
	EFB ref2	*03.10 EFB reference 2*.	9
	Motor potentiometer	*22.19 Motor potentiometer ref act* (output of the motor potentiometer).	15
	PID	*40.01 Process PID output actual* (output of the process PID controller).	16
	Frequency input 1	*11.38 Freq in 1 actual value* (when DI3 or DI4 is used as a frequency input).	17

No.	Name/Value	Description	Default FbEq 16
	Control panel (ref saved)	Panel reference (*03.01 Panel reference*, see page *132*) saved by the control system for the location where the control returns is used as the reference. 	18
	Control panel (ref copied)	Panel reference (*03.01 Panel reference*, see page *132*) for the previous control location is used as the reference when the control location changes if the references for the two locations are of the same type (eg frequency/speed/torque/PID); otherwise, the actual signal is used as the new reference. 	19
	Integrated panel (ref saved)	See above Control panel (ref saved).	20
	Integrated panel (ref copied)	See above Control panel (ref copied).	21
	Frequency input 2	*11.46 Freq in 2 actual value* (when DI3 or DI4 is used as a frequency input).	22
	Other	Source selection (see *Terms and abbreviations*).	-
22.19	*Ext2 speed ref2*	Selects Ext2 speed reference source 2. For the selections, and a diagram of reference source selection, see parameter *22.18 Ext2 speed ref1*.	*Zero*
22.20	*Ext2 speed function*	Selects a mathematical function between the reference sources selected by parameters *22.18 Ext2 speed ref1* and *22.19 Ext2 speed ref2*. See diagram at *22.18 Ext2 speed ref1*.	*Ref1*
	Ref1	Signal selected by *Ext2 speed ref1* 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 Ext1 speed ref1*] - [*22.12 Ext1 speed ref2*]) of the reference sources is used as speed reference 1.	2
	Mul (ref1 × ref2)	The multiplication of the reference sources is used as speed reference 1.	3

No.	Name/Value	Description	Default FbEq 16
	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
	Abs (ref1)	The absolute value of the reference sources is used as speed reference 1	6
22.21	*Constant speed function*	Determines how constant speeds are selected, and whether the rotation direction signal is considered or not when applying a constant speed.	0b0001

Bit	Name	Information
0	Constant speed mode	1 = Packed: 7 constant speeds are selectable using the three sources defined by parameters *22.22*, *22.23* and *22.24*.
		0 = Separate: Constant speeds 1, 2 and 3 are separately activated by the sources defined by parameters *22.22*, *22.23* and *22.24* respectively. In case of conflict, the constant speed with the smaller number takes priority.
1	Direction enable	1 = Start dir: To determine running direction for a constant speed, the sign of the constant speed setting (parameters *22.26…22.32*) is multiplied by the direction signal (forward: +1, reverse: -1). This effectively allows the drive to have 14 (7 forward, 7 reverse) constant speeds if all values in *22.26…22.32* are positive. **WARNING:** If the direction signal is reverse and the active constant speed is negative, the drive will run in the forward direction.
		0 = According to Par: The running direction for the constant frequency is determined by the sign of the constant speed setting (parameters *28.26…28.32*).
2	Speed step	1 = Speed step enable; 0 = Speed step disable
3…15	Reserved	

	0b0000...ob1111	Constant speed configuration word.	1 = 1

No.	Name/Value	Description	Default FbEq 16
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. **Note:** The default value depends on the selected macro. See *Control macros* on page *31*. 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:	*DI2*

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	Default FbEq 16
	Always off	0 (always off).	0
	Always on	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
	DIO1	Digital input/output DIO1 (*11.02 DIO delayed status*, bit 0)	10
	DIO2	Digital input/output DIO2 (*11.02 DIO delayed status*, bit 0)	11
	Timed function 1	Bit 0 of *34.01 Timed functions status*.	18
	Timed function 2	Bit 1 of *34.01 Timed functions status*.	19
	Timed function 3	Bit 2 of *34.01 Timed functions status*.	20
	Supervision 1	Bit 0 of *32.01 Supervision status*.	24
	Supervision 2	Bit 1 of *32.01 Supervision status*.	25
	Supervision 3	Bit 2 of *32.01 Supervision status*.	26
	Supervision 4	Bit 3 of *32.01 Supervision status*.	27
	Supervision 5	Bit 4 of *32.01 Supervision status*.	28
	Supervision 6	Bit 5 of *32.01 Supervision status*.	29

No.	Name/Value	Description	Default FbEq 16
	Other [bit]	Source selection (see *Terms and abbreviations*).	-
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. For the selections, see parameter *22.22 Constant speed sel1*. **Note:** The default value depends on the selected macro. See *Control macros* on page *31*.	*Always off*
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*.	*Always off*
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.	600.00 rpm
	-30000.00… 30000.00 rpm	Constant speed 2.	See par. *46.01*
22.28	*Constant speed 3*	Defines constant speed 3.	900.00 rpm
	-30000.00… 30000.00 rpm	Constant speed 3.	See par. *46.01*
22.29	*Constant speed 4*	Defines constant speed 4.	1200.00 rpm
	-30000.00… 30000.00 rpm	Constant speed 4.	See par. *46.01*
22.30	*Constant speed 5*	Defines constant speed 5.	1500.00 rpm
	-30000.00… 30000.00 rpm	Constant speed 5.	See par. *46.01*

No.	Name/Value	Description	Default FbEq 16
22.31	*Constant speed 6*	Defines constant speed 6.	2400.00 rpm
	-30000.00… 30000.00 rpm	Constant speed 6.	See par. *46.01*
22.32	*Constant speed 7*	Defines constant speed 7.	3000.00 rpm
	-30000.00… 30000.00 rpm	Constant speed 7.	See par. *46.01*
22.41	*Speed ref safe*	Defines a safe speed reference value that is used with supervision functions such as • *12.03 AI supervision function* • *49.05 Communication loss action* • *50.02 FBA A comm loss func*.	0.00 rpm
	-30000.00… 30000.00 rpm	Safe speed reference.	See par. *46.01*
22.42	*Jogging 1 ref*	Defines the speed reference for jogging function 1. For more information on jogging, see page *71*.	0.00 rpm
	-30000.00… 30000.00 rpm	Speed reference for jogging function 1.	See par. *46.01*
22.43	*Jogging 2 ref*	Defines the speed reference for jogging function 2. For more information on jogging, see page *71*.	0.00 rpm
	-30000.00… 30000.00 rpm	Speed reference for jogging function 2.	See par. *46.01*
22.51	*Critical speed function*	Enables/disables the critical speeds function. Also determines whether the specified ranges are effective in both rotating directions or not. See also section *Critical speeds/frequencies* on page *66*.	0000h

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	Default FbEq 16
	0000h...FFFFh	Critical speeds configuration word.	1 = 1

No.	Name/Value	Description	Default FbEq 16
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*.	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 parameter *22.55*.	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 parameter *22.54*.	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 parameter *22.57* .	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 parameter *22.56*.	0.00 rpm
	-30000.00…30000.00 rpm	High limit for critical speed 3.	See par. *46.01*
22.70	Motor potentiometer reference enable	Determines when 22.73 and 22.74 may change 22.80.	*Selected*
	Not selected	Motor potentiometer up and down sources (22.73 and 22.74) are disabled.	0
	Selected	Motor potentiometer up and down sources (22.73 and 22.74) are enabled.	1
	While running	Motor potentiometer reference enable follows bit 4 *Following reference* of parameter 06.16.	2

No.	Name/Value	Description	Default FbEq 16
22.71	*Motor potentiometer function*	Activates and selects the mode of the motor potentiometer. See section *Speed control performance figures* in chapter *Program features*.	*Disabled*
	Disabled	Motor potentiometer is disabled and its value set to 0.	0
	Enabled (init at power-up)	When enabled, the motor potentiometer first adopts the value defined by parameter *22.72*. The value can then be adjusted from the up and down sources defined by parameters *22.73* and *22.74*. A power cycle will reset the motor potentiometer to the predefined initial value (*22.72*).	1
	Enabled (resume always)	As *Enabled (init at power-up)*, but the motor potentiometer value is retained over a power cycle.	2
	Enabled (init to actual)	Whenever another reference source is selected, the value of the motor potentiometer follows that reference. After the source of reference returns to the motor potentiometer, its value can again be changed by the up and down sources (defined by *22.73* and *22.74*).	3
	Enabled (resume/init to Actual)	As *Enabled (init to actual)*, but the motor potentiometer ref act value is retained over power cycle.	4
22.72	*Motor potentiometer initial value*	Defines an initial value (starting point) for the motor potentiometer. See the selections of parameter *22.71*.	0.00
	-32768.00… 32767.00	Initial value for motor potentiometer.	1 = 1
22.73	*Motor potentiometer up source*	Selects the source of motor potentiometer up signal. 0 = No change 1 = Increase motor potentiometer value. (If both the up and down sources are on, the potentiometer value will not change.)	*Not selected*
	Not selected	0.	0
	Selected	1.	1
	DI1	Digital input DI1 (*10.02 DI delayed status*, bit 0).	2
	DI2	Digital input DI2 (*10.02 DI delayed status*, bit 1).	3
	DI3	Digital input DI3 (*10.02 DI delayed status*, bit 2).	4
	DI4	Digital input DI4 (*10.02 DI delayed status*, bit 3).	5
	DIO1	Digital input/output DIO1 (*11.02 DIO delayed status*, bit 0)	10

No.	Name/Value	Description	Default FbEq 16
	DIO2	Digital input/output DIO2 (*11.02 DIO delayed status*, bit 0)	11
	Timed function 1	Bit 0 of *34.01 Timed functions status*.	18
	Timed function 2	Bit 1 of *34.01 Timed functions status*.	19
	Timed function 3	Bit 2 of *34.01 Timed functions status*.	20
	Supervision 1	Bit 0 of *32.01 Supervision status*.	24
	Supervision 2	Bit 1 of *32.01 Supervision status*.	25
	Supervision 3	Bit 2 of *32.01 Supervision status*.	26
	Supervision 4	Bit 3 of *32.01 Supervision status*.	27
	Supervision 5	Bit 4 of *32.01 Supervision status*.	28
	Supervision 6	Bit 5 of *32.01 Supervision status*.	29
	Other [bit]	Source selection (see *Terms and abbreviations*).	-
22.74	*Motor potentiometer down source*	Selects the source of motor potentiometer down signal. 0 = No change 1 = Decrease motor potentiometer value. (If both the up and down sources are on, the potentiometer value will not change.) For the selections, see parameter *22.73*.	*Not selected*
22.75	*Motor potentiometer ramp time*	Defines the change rate of the motor potentiometer. This parameter specifies the time required for the motor potentiometer to change from minimum (parameter *22.76*) to maximum (parameter *22.77*). The same change rate applies in both directions.	40.0 s
	0.0…3600.0 s	Motor potentiometer change time.	1 = 1 s
22.76	*Motor potentiometer min value*	Defines the minimum value of the motor potentiometer. **Note:** If vector control mode is used, the value of this parameter must be changed.	-50.00
	-32768.00… 32767.00	Motor potentiometer minimum.	1 = 1
22.77	*Motor potentiometer max value*	Defines the maximum value of the motor potentiometer. **Note:** If vector control mode is used, the value of this parameter must be changed.	50.00
	-32768.00… 32767.00	Motor potentiometer maximum.	1 = 1

No.	Name/Value	Description	Default FbEq 16
22.80	*Motor potentiometer ref act*	Shows 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
22.86	*Speed reference act 6*	Displays the value of the speed reference (Ext1 or Ext2) that has been selected by *19.11 Ext1/Ext2 selection*. See diagram at *22.11 Ext1 speed ref1* or the control chain diagram on page *612*. This parameter is read-only.	0.00 rpm
	-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 *612*. The value is received from *22.86 Speed reference act 6* unless overridden by • any constant speed • a jogging reference • network control reference • control panel reference • safe speed reference. This parameter is read-only.	0.00 rpm
	-30000.00… 30000.00 rpm	Speed reference before application of critical speeds.	See par. *46.01*
22.211	*Speed reference shape*	Defines the speed reference shape. See also section *Parabolic speed reference* on page *670*.	*Linear*
	Linear	Linear speed reference.	0
	Parabolic 1	X^2 speed reference.	1
	Parabolic 2	X^3 speed reference.	2
22.220	*Crane motpot enable*	Enables or selects the source to activate the Crane motor potentiometer function. See section *Crane motor potentiometer* on page *673*.	*Not selected*
	Not selected	Crane motor potentiometer function is disabled.	0
	Selected	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

No.	Name/Value	Description	Default FbEq 16
	DIO1	Digital input/output DIO1 (*11.02 DIO delayed status*, bit 0)	10
	DIO2	Digital input/output DIO2 (*11.02 DIO delayed status*, bit 0)	11
	Timed function 1	Bit 0 of *34.01 Timed functions status*.	18
	Timed function 2	Bit 1 of *34.01 Timed functions status*.	19
	Timed function 3	Bit 2 of *34.01 Timed functions status*.	20
	Supervision 1	Bit 0 of *32.01 Supervision status*.	24
	Supervision 2	Bit 1 of *32.01 Supervision status*.	25
	Supervision 3	Bit 2 of *32.01 Supervision status*.	26
	Supervision 4	Bit 3 of *32.01 Supervision status*.	27
	Supervision 5	Bit 4 of *32.01 Supervision status*.	28
	Supervision 6	Bit 5 of *32.01 Supervision status*.	29
	Other [bit]	Source selection (see *Terms and abbreviations* on page *124*).	-
22.223	*Crane motpot accel sel*	Selects the source of Crane motor potentiometer accelerate signal. See section *Crane motor potentiometer* on page *673*.	*Not selected*
	Not selected	No change.	0
	Selected	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
	DIO1	Digital input/output DIO1 (*11.02 DIO delayed status*, bit 0)	10
	DIO2	Digital input/output DIO2 (*11.02 DIO delayed status*, bit 0)	11
	Timed function 1	Bit 0 of *34.01 Timed functions status*.	18
	Timed function 2	Bit 1 of *34.01 Timed functions status*.	19
	Timed function 3	Bit 2 of *34.01 Timed functions status*.	20
	Supervision 1	Bit 0 of *32.01 Supervision status*.	24
	Supervision 2	Bit 1 of *32.01 Supervision status*.	25
	Supervision 3	Bit 2 of *32.01 Supervision status*.	26
	Supervision 4	Bit 3 of *32.01 Supervision status*.	27
	Supervision 5	Bit 4 of *32.01 Supervision status*.	28

No.	Name/Value	Description	Default FbEq 16
	Supervision 6	Bit 5 of *32.01 Supervision status*.	29
	Other [bit]	Source selection (see *Terms and abbreviations* on page *124*).	-
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 *673*.	0.00
	0.00...30000	Minimum speed.	1 = 1
22.225	*Crane motpot sw*	Crane motor potentiometer status word.	0000h

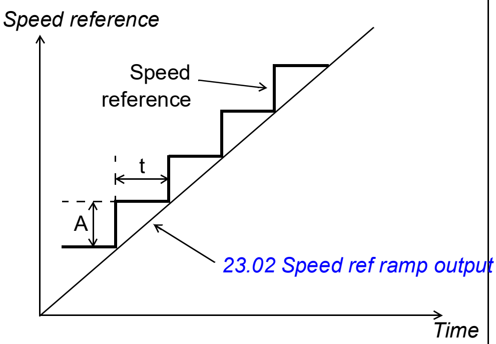
Bit	Name	Description
0	Crane motpot enabled	Status of the Crane motor potentiometer function. 1 = Crane motor potentiometer enabled. 0 = Crane motor potentiometer disabled.
1...2	Reserved	
3	Crane motpot up source	Used as source for four inputs of the motor potentiometer to increase the output value. 1 = Crane motor potentiometer with increased output reference. 0 = Crane motor potentiometer without increased output reference.
4	Crane motpot dn source	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.
5…15	Reserved	

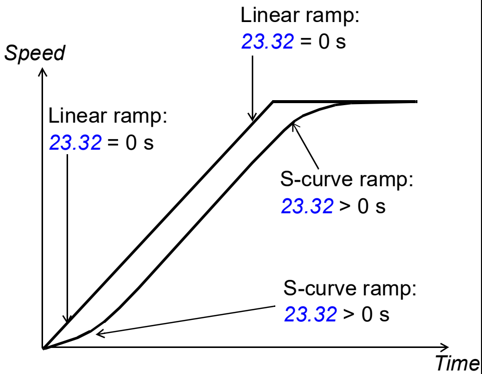
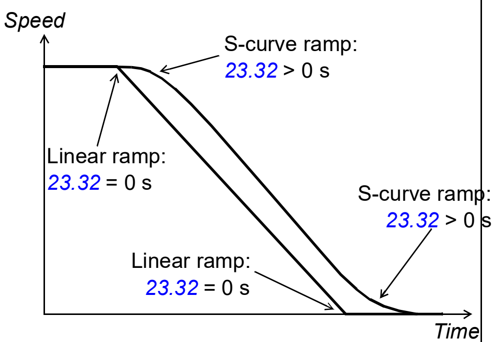
No.	Name/Value	Description	Default FbEq 16
	0000h...FFFFh	Status word.	1 = 1
22.226	*Crane motpot min value*	Defines the minimum value of the Crane motor potentiometer.	-50.00
	-30000.00... 30000.00	Minimum value	1= 1
22.227	*Crane motpot max value*	Defines the maximum value of Crane motor potentiometer.	50.00
	-30000.00... 30000.00	Maximum value	1 = 1
22.230	*Crane motpot ref act*	Displays the output of the motor potentiometer function.	0.00
	-30000.00... 30000.00		1 = 1

No.	Name/Value	Description	Default FbEq 16
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 *614*.	
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 *614*. 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 *614*. This parameter is read-only.	-
	-30000.00… 30000.00 rpm	Speed reference after ramping and shaping.	See par. *46.01*
23.11	*Ramp set selection*	Selects the source that switches between the two sets of acceleration/deceleration ramp times defined by parameters *23.12*… *23.15* 0 = Acceleration time 1 and deceleration time 1 are active 1 = Acceleration time 2 and deceleration time 2 are active.	*DIO1*
	Acc/Dec time 1	0.	0
	Acc/Dec time 2	1.	1
	DI1	Digital input DI1 (*10.02 DI delayed status*, bit 0).	2
	DI2	Digital input DI2 (*10.02 DI delayed status*, bit 1).	3
	DI3	Digital input DI3 (*10.02 DI delayed status*, bit 2).	4
	DI4	Digital input DI4 (*10.02 DI delayed status*, bit 3).	5
	DIO1	Digital input/output DIO1 (*11.02 DIO delayed status*, bit 0)	10
	DIO2	Digital input/output DIO2 (*11.02 DIO delayed status*, bit 0)	11
	FBA A	Only for the Transparent16 or Transparent32 profile. Transparent16 or Transparent32 control word bit received through the fieldbus A interface.	18
	EFB DCU CW bit 10	Only for the DCU profile. DCU control word bit 10 received through the embedded fieldbus interface.	20
	Other [bit]	Source selection (see *Terms and abbreviations*).	-

No.	Name/Value	Description	Default FbEq 16
23.12	*Acceleration time 1*	Defines acceleration time 1 as the time required for the speed to change from zero to the speed defined by parameter *46.01 Speed scaling* (**not** to parameter *30.12 Maximum speed*). If the speed reference increases faster than the set acceleration rate, the motor speed will follow the acceleration rate. If the speed reference increases slower than the set acceleration rate, the motor speed will follow the reference. If the acceleration time is set too short, the drive will automatically prolong the acceleration in order not to exceed the drive torque limits.	3.000 s
	0.000 …1800.000 s	Acceleration time 1.	10 = 1 s
23.13	*Deceleration time 1*	Defines deceleration time 1 as the time required for the speed to change from the speed defined by parameter *46.01 Speed scaling* (**not** from parameter *30.12 Maximum speed*) to zero. If the speed reference decreases slower than the set deceleration rate, the motor speed will follow the reference. If the reference changes faster than the set deceleration rate, the motor speed will follow the deceleration rate. If the deceleration rate is set too short, the drive will automatically prolong the deceleration in order not to exceed drive torque limits (or not to exceed a safe DC link voltage). If there is any doubt about the deceleration time being too short, ensure that DC overvoltage control is on (parameter *30.30 Overvoltage control*). **Note:** If a short deceleration time is needed for a high inertia application, the drive should be equipped with braking equipment such as a brake chopper and brake resistor.	3.000 s
	0.000 …1800.000 s	Deceleration time 1.	10 = 1 s
23.14	*Acceleration time 2*	Defines acceleration time 2. See parameter *23.12 Acceleration time 1*.	60.000 s
	0.000 …1800.000 s	Acceleration time 2.	10 = 1 s
23.15	*Deceleration time 2*	Defines deceleration time 2. See parameter *23.13 Deceleration time 1*.	60.000 s
	0.000 …1800.000 s	Deceleration time 2.	10 = 1 s

No.	Name/Value	Description	Default FbEq 16
23.20	*Acc time jogging*	Defines the acceleration time for the jogging function ie. the time required for the speed to change from zero to the speed value defined by parameter *46.01 Speed scaling*. See section *Rush control* on page *71*.	60.000 s
	0.000 …1800.000 s	Acceleration time for jogging.	10 = 1 s
23.21	*Dec time jogging*	Defines the deceleration time for the jogging function ie. the time required for the speed to change from the speed value defined by parameter *46.01 Speed scaling* to zero. See section *Rush control* on page *71*.	60.000 s
	0.000 …1800.000 s	Deceleration time for jogging.	10 = 1 s
23.23	*Emergency stop time*	Defines the time inside which the drive is stopped if an emergency stop Off3 is activated (ie. the time required for the speed to change from the speed value defined by parameter *46.01 Speed scaling* or *46.02 Frequency scaling* to zero). Emergency stop mode and activation source are selected by parameters *21.04 Emergency stop mode* and *21.05 Emergency stop source* respectively. Emergency stop can also be activated through fieldbus. **Notes:** • Emergency stop Off1 uses the standard deceleration ramp as defined by parameters *23.11*…*23.15*. • The same parameter value is also used in frequency control mode (ramp parameters *28.71*…*28.75*).	3.000 s
	0.000 …1800.000 s	Emergency stop Off3 deceleration time.	10 = 1 s

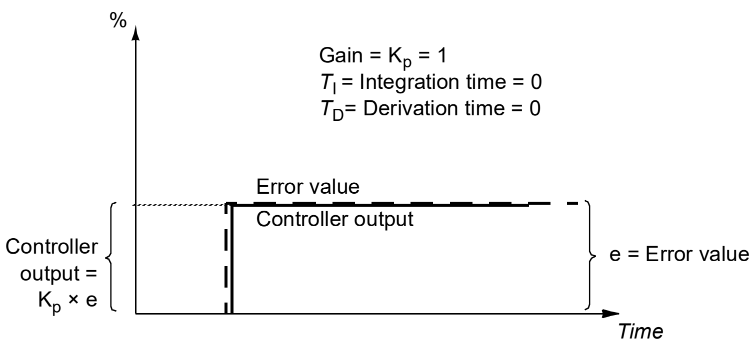
No.	Name/Value	Description	Default FbEq 16
23.28	*Variable slope enable*	Activates the variable slope function, which controls the slope of the speed ramp during a speed reference change. This allows for a constantly variable ramp rate to be generated, instead of just the standard two ramps normally available. If the update interval of the signal from an external control system and the variable slope rate (*23.32 Variable slope rate*) are equal, 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
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

No.	Name/Value	Description	Default FbEq 16
23.32	*Shape time 1*	Defines the shape of the acceleration and deceleration ramps used with the set 1. 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
	0.100…1800.000 s	Ramp shape at start and end of acceleration and deceleration.	10 = 1 s
23.33	*Shape time 2*	Defines the shape of the acceleration and deceleration ramps used with the set 2. See parameter *23.32 Shape time 1*.	0.000 s
	0.100…1800.000 s	Ramp shape at start and end of acceleration and deceleration.	10 = 1 s

No.	Name/Value	Description	Default FbEq 16
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*).	0.500 s
	0.00 …3000.000 s	Fast stop deceleration time.	10 = 1 s
24 Speed reference conditioning		Speed error calculation; speed error window control configuration; speed error step. See the control chain diagram on page *612*.	
24.01	*Used speed reference*	Displays the ramped and corrected speed reference (before speed error calculation). See the control chain diagram on page *612*. 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 *612*. 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 *612*. 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 *612*. This parameter is read-only.	-
	-30000.0…30000.0 rpm	Inverted speed error.	See par. *46.01*
24.11	*Speed correction*	Defines a speed reference correction, ie. a value added to the existing reference between ramping and limitation. This is useful to trim the speed if necessary, for example to adjust draw between sections of a paper machine. See the control chain diagram on page *612*.	0.00 rpm
	-10000.00… 10000.00 rpm	Speed reference correction.	See par. *46.01*

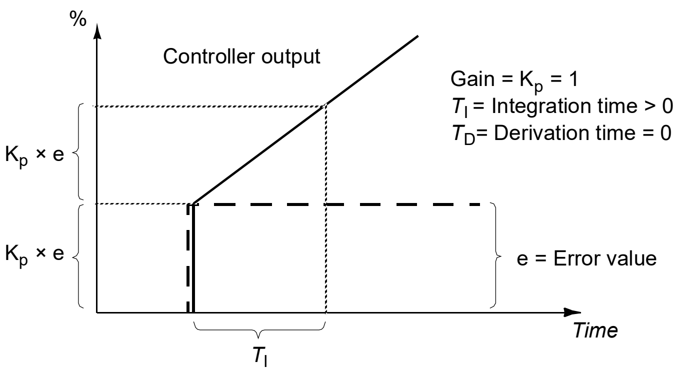
No.	Name/Value	Description	Default FbEq 16
24.12	*Speed error filter time*	Defines the time constant of the speed error low-pass filter. If the used speed reference changes rapidly, the possible interferences in the speed measurement can be filtered with the speed error filter. Reducing the ripple with 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

25 Speed control		Speed controller settings. See the control chain diagram on page *616.*	
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 *616*. This parameter is read-only.	-
	-1600.0…1600.0%	Limited speed controller output torque.	See par. *46.03*
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.	10.00

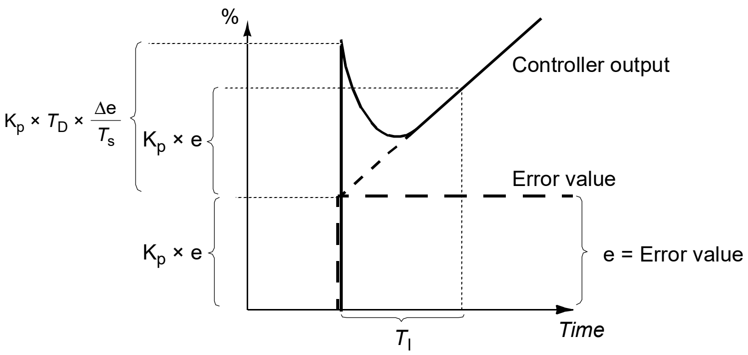


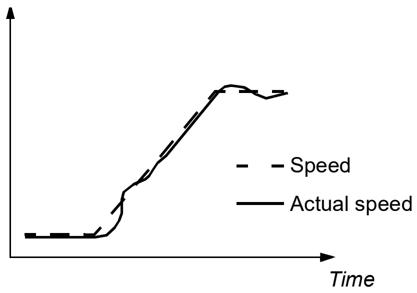
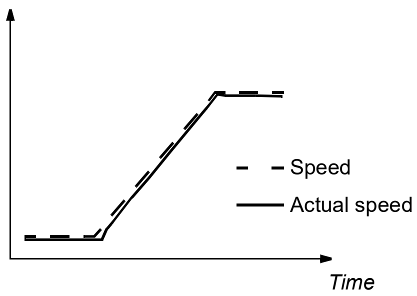
		If gain is set to 1, a 10% change in error value (reference - actual value) causes the speed controller output to change by 10%, ie. the output value is input × gain.	
	0.00 …250.00	Proportional gain for speed controller.	100 = 1

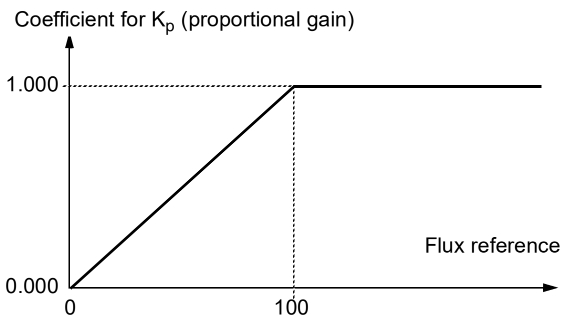
No.	Name/Value	Description	Default FbEq 16
25.03	*Speed integration time*	Defines the integration time of the speed controller. The integration time defines the rate at which the controller output changes when the error value is constant and the proportional gain of the speed controller is 1. The shorter the integration time, the faster the continuous error value is corrected. This time constant must be set to the same order of magnitude as the time constant (time to respond) of the actual mechanical system being controlled, otherwise instability will result. Setting the integration time to zero disables the I-part of the controller. This is useful to do when tuning the proportional gain; adjust the proportional gain first, then return the integration time. Anti-windup (the integrator just integrates up to 100%) stops the integrator if the controller output is limited. See 06.05 Limit word1. The figure below shows the speed controller output after an error step when the error remains constant.	2.50 s



	0.00…1000.00 s	Integration time for speed controller.	10 = 1 s

No.	Name/Value	Description	Default FbEq 16
25.04	*Speed derivation time*	Defines the derivation time of the speed controller. Derivative action boosts the controller output if the error value changes. The longer the derivation time, the more the speed controller output is boosted during the change. If the derivation time is set to zero, the controller works as a PI controller, otherwise as a PID controller. The derivation makes the control more responsive for disturbances. For simple applications (especially those without a pulse encoder), derivative time is not normally required and should be left at zero. The speed error derivative must be filtered with a low pass filter to eliminate disturbances. The figure below shows the speed controller output after an error step when the error remains constant.	0.000 s
		 Gain = K_p = 1 T_I = Integration time > 0 T_D= Derivation time > 0 T_s= Sample time period = 250 µs	
	0.000…10.000 s	Derivation time for speed controller.	1000 = 1 s
25.05	*Derivation filter time*	Defines the derivation filter time constant. See parameter *25.04 Speed derivation time*.	8 ms
	0…10000 ms	Derivation filter time constant.	1 = 1 ms

No.	Name/Value	Description	Default FbEq 16
25.06	*Acc comp derivation time*	Defines the derivation time for acceleration(/deceleration) compensation. In order to compensate for a high inertia load during acceleration, a derivative of the reference is added to the output of the speed controller. The principle of a derivative action is described under parameter *25.04 Speed derivation time*. **Note:** As a general rule, set this parameter to the value between 50 and 100% of the sum of the mechanical time constants of the motor and the driven machine. The figure below shows the speed responses when a high inertia load is accelerated along a ramp. **No acceleration compensation:**  **Acceleration compensation:** 	0.00 s
	0.00…1000.00 s	Acceleration compensation derivation time.	10 = 1 s

No.	Name/Value	Description	Default FbEq 16
25.07	*Acc comp filter time*	Defines the acceleration (or deceleration) compensation filter time constant. See parameters *25.04 Speed derivation time* and *25.06 Acc comp derivation time*.	8.0 ms
	0.0…1000.0 ms	Acceleration/deceleration compensation filter time.	1 = 1 ms
25.15	*Proportional gain em stop*	Defines the proportional gain for the speed controller when an emergency stop is active. See parameter *25.02 Speed proportional gain*.	10.00
	1.00…250.00	Proportional gain upon an emergency stop.	100 = 1
25.30	*Flux adaptation enable*	Enables/disables speed controller adaptation based on motor flux reference (*01.24 Flux actual %*). The proportional gain of the speed controller is multiplied by a coefficient of 0…1 between 0…100% flux reference respectively.	*Enable*
			
	Disable	Speed controller adaptation based on flux reference disabled.	0
	Enable	Speed controller adaptation based on flux reference enabled.	1
25.33	*Speed controller auto tune*	Activates (or selects a source that activates) the speed controller auto tune function. See section *Speed controller autotune* (page *67*). The autotune will automatically set parameters *25.02 Speed proportional gain*, *25.03 Speed integration time* and *25.37 Mechanical time constant*..	*Off*
	Off	Not activated.	0
	On	Activated.	1
	Other [bit]	Source selection (see *Terms and abbreviations*).	-

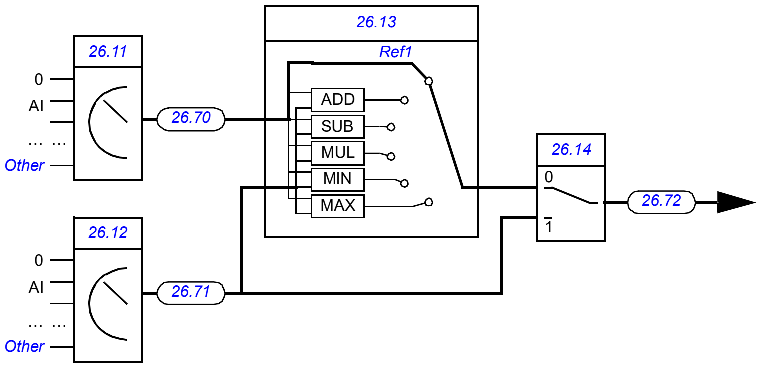
No.	Name/Value	Description	Default FbEq 16
25.34	*Autotune control preset*	Defines a control preset for the speed controller auto tune function. The setting affects the way the torque reference will respond to a speed reference step.	*Normal*
	Smooth	Slow yet robust response.	0
	Normal	Normal response.	1
	Tight	Fast response which can produce high gain value.	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 auto tune function. This value is scaled to the motor nominal torque. **Note:** The torque used by the auto tune function can also be limited by the torque limits (in parameter group *30 Limits*) and the nominal motor torque.	10.00
	0.00 … 20.00 %		
25.39	*Autotune speed step*	Defines a speed value added to the initial speed for the auto tune function. The initial speed (speed used when auto tune is activated) plus the value of this parameter is the calculated maximum speed used by the auto tune 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 the motor nominal speed. **Note:** The motor will exceed the calculated maximum speed slightly at the end of each acceleration stage.	10.00
	0.00 … 20.00 %		
25.40	*Autotune repeat times*	Determines how many acceleration/deceleration cycles are performed during the auto tune routine. Increasing the value will improve the accuracy of the auto tune function, and allow the use of smaller torque or speed step values	10
	0 … 10		

No.	Name/Value	Description	Default FbEq 16
25.53	Torque prop reference	Displays the output of the proportional (P) part of the speed controller. See the control chain diagram on page 616. 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 616. 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 616. This parameter is read-only.	-
	-30000.0… 30000.0%	D-part output of speed controller.	See par. 46.03
25.56	Torque acc compensation	Displays the output of the acceleration compensation function. See the control chain diagram on page 616. This parameter is read-only.	-
	-30000.0… 30000.0%	Output of acceleration compensation function.	See par. 46.03

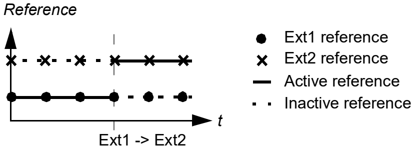
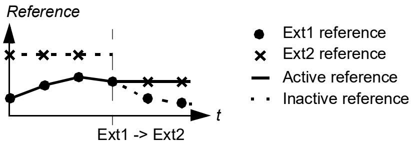
26 Torque reference chain		Settings for the torque reference chain. See the control chain diagrams on pages 549 and 617.	
26.01	Torque reference to TC	Displays the final torque reference given to the torque controller in percent. This reference is then acted upon by various final limiters, like power, torque, load etc. See the control chain diagrams on pages 549 and 617. This parameter is read-only.	-
	-1600.0…1600.0%	Torque reference for torque control.	See par. 46.03

No.	Name/Value	Description	Default FbEq 16
26.02	*Torque reference used*	Displays the final torque reference (in percent of motor nominal torque) given to the torque controller, and comes after frequency, voltage and torque limitation. See the control chain diagram on page *549*. 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	Default FbEq 16
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 *166*).	1
	AI2 scaled	*12.22 AI2 scaled value* (see page *168*).	2
	FB A ref1	*03.05 FB A reference 1* (see page *132*).	4
	FB A ref2	*03.06 FB A reference 2* (see page *132*).	5
	EFB ref1	*03.09 EFB reference 1* (see page *133*).	8
	EFB ref2	*03.10 EFB reference 2* (see page *133*).	9
	Motor potentiometer	*22.80 Motor potentiometer ref act* (output of the motor potentiometer).	15
	PID	*40.01 Process PID output actual* (output of the process PID controller).	16
	Frequency input	*11.38 Freq in 1 actual value* (when DI3 or DI4 is used as a frequency input).	17

No.	Name/Value	Description	Default FbEq 16
	Control panel (ref saved)	Panel reference (*03.01 Panel reference*, see page *132*) saved by the control system for the location where the control returns is used as the reference.  	18
	Control panel (ref copied)	Panel reference (*03.01 Panel reference*, see page *132*) for the previous control location is used as the reference when the control location changes if the references for the two locations are of the same type (eg frequency/speed/torque/PID); otherwise, the actual signal is used as the new reference.  	19
	Integrated panel (ref saved)	See above Control panel (ref saved)	20
	Integrated panel (ref copied)	See above Control panel (ref copied).	21
	Frequency input 2	*11.46 Freq in 2 actual value* (when DI3 or DI4 is used as a frequency input).	22
	Other	Source selection (see *Terms and abbreviations*).	-
26.12	*Torque ref2 source*	Selects torque reference source 2. For the selections, and a diagram of reference source selection, see parameter *26.11 Torque ref1 source*.	*Zero*
26.13	*Torque ref1 function*	Selects a mathematical function between the reference sources selected by 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

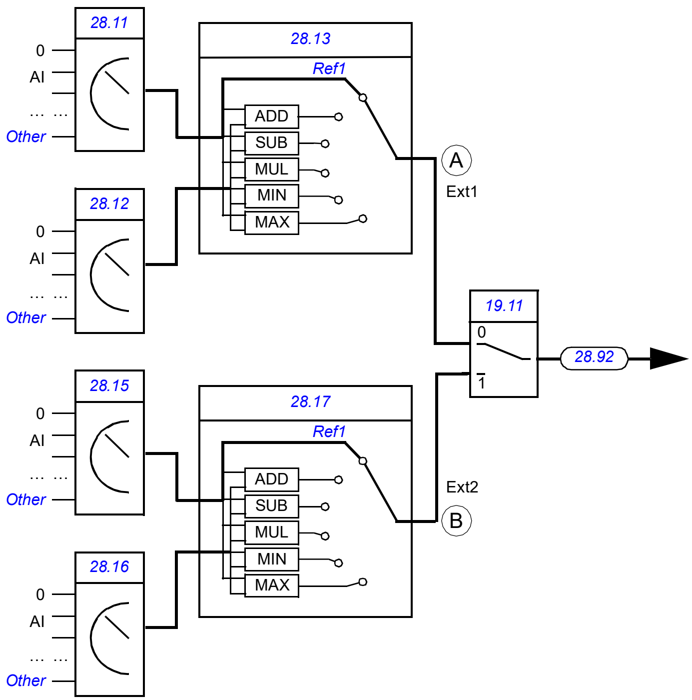
No.	Name/Value	Description	Default FbEq 16
	Mul (ref1 × ref2)	The multiplication of the reference sources is used as torque reference 1.	3
	Min (ref1, ref2)	The smaller of the reference sources is used as torque reference 1.	4
	Max (ref1, ref2)	The greater of the reference sources is used as torque reference 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
	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*).	-
26.17	*Torque ref filter time*	Defines a low-pass filter time constant for the torque reference.	0.000 s
	0.000…30.000 s	Filter time constant for torque reference.	1000 = 1 s
26.18	*Torque ramp up time*	Defines the torque reference ramp-up time, ie. the time for the reference to increase from zero to nominal motor torque.	0.000 s
	0.000…60.000 s	Torque reference ramp-up time.	100 = 1 s
26.19	*Torque ramp down time*	Defines the torque reference ramp-down time, ie. the time for the reference to decrease from nominal motor torque to zero.	0.000 s
	0.000…60.000 s	Torque reference ramp-down time.	100 = 1 s

No.	Name/Value	Description	Default FbEq 16
26.20	*Torque reversal*	Inverts the torque reference or selects the source for the inversion signal. Torque reversal is located in the torque reference chain after torque reference act 3 signal, so the inversion is visible in torque reference act 4 signal.	*Always off*
	Always off	Torque reference is not inverted.	0
	Always on	Torque reference is inverted.	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
	DIO1	Digital input/output DIO1 (*11.02 DIO delayed status*, bit 0).	10
	DIO2	Digital input/output (*11.02 DIO delayed status*, bit 1).	11
	Timed function 1	Bit 0 of *34.01 Timed functions status*.	18
	Timed function 2	Bit 1 of *34.01 Timed functions status*.	19
	Timed function 3	Bit 2 of *34.01 Timed functions status*.	20
	Supervision 1	Bit 0 of *32.01 Supervision status*.	24
	Supervision 2	Bit 1 of *32.01 Supervision status*.	25
	Supervision 3	Bit 2 of *32.01 Supervision status*.	26
	Supervision 4	Bit 3 of *32.01 Supervision status*.	27
	Supervision 5	Bit 4 of *32.01 Supervision status*.	28
	Supervision 6	Bit 5 of *32.01 Supervision status*.	29
	Other [bit]	Source selection (see *Terms and abbreviations*).	-
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 *549*. 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 *549*. This parameter is read-only.	-
	-1600.0…1600.0%	Value of torque reference source 2.	See par. *46.03*

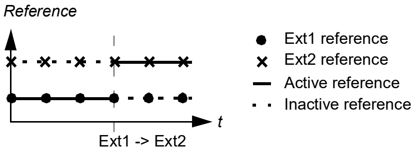
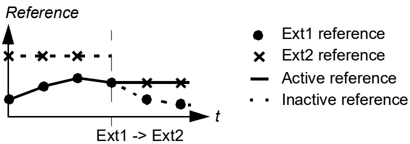
No.	Name/Value	Description	Default FbEq 16
26.72	*Torque reference act 3*	Displays the torque reference after the function applied by parameter *26.13 Torque ref1 function* (if any), and after selection (*26.14 Torque ref1/2 selection*). See the control chain diagram on page *549*. This parameter is read-only.	-
	-1600.0…1600.0%	Torque reference after selection.	See par. *46.03*
26.73	*Torque reference act 4*	Displays the torque reference after application of reference additive 1. See the control chain diagram on page *549*. 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 *549*. 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 *617*. 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 torque trim. See the control chain diagram on page *617*. This parameter is read-only.	-
	-1600.0…1600.0%	Torque reference	See par. *46.03*
26.81	*Rush control gain*	Rush controller gain term. See section *Rush control* (page *71*).	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

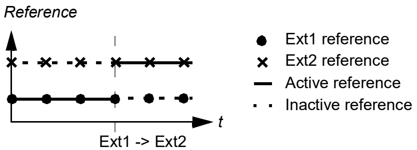
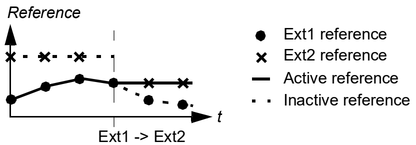
No.	Name/Value	Description	Default FbEq 16
28 Frequency reference chain		Settings for the frequency reference chain. See the control chain diagrams on pages *549* and *617*.	
28.01	*Frequency ref ramp input*	Displays the used frequency reference before ramping. See the control chain diagram on page *549*. This parameter is read-only.	-
	-500.00…500.00 Hz	Frequency reference before ramping.	See par. *46.02*
28.02	*Frequency ref ramp output*	Displays the final frequency reference (after selection, limitation and ramping). See the control chain diagram on page *549*. This parameter is read-only.	-
	-500.00…500.00 Hz	Final frequency reference.	See par. *46.02*

No.	Name/Value	Description	Default FbEq 16
28.11	*Ext1 frequency ref1*	Selects Ext1 frequency reference source 1. Two signal sources can be defined by this parameter and *28.12 Ext1 frequency ref2*. A mathematical function (*28.13 Ext1 frequency function*) applied to the two signals creates an Ext1 reference (A in the figure below). A digital source selected by *19.11 Ext1/Ext2 selection* can be used to switch between Ext1 reference and the corresponding Ext2 reference defined by parameters *28.15 Ext2 frequency ref1*, *28.16 Ext2 frequency ref2* and *28.17 Ext2 frequency function* (B in the figure below). **Note:** The default value depends on the selected macro. See chapter *Control macros* on page *31*.	*Integrated panel (ref saved)*

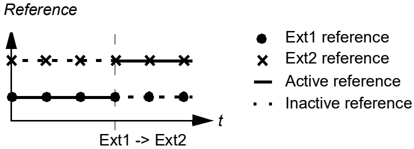
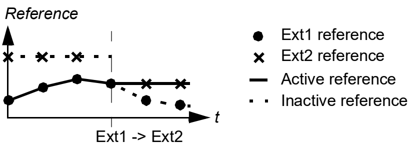


	Zero	None.	0
	AI1 scaled	*12.12 AI1 scaled value* (see page *166*).	1
	AI2 scaled	*12.22 AI2 scaled value* (see page *168*).	2
	FB A ref1	*03.05 FB A reference 1* (see page *132*).	4

No.	Name/Value	Description	Default FbEq 16
	FB A ref2	*03.06 FB A reference 2* (see page *132*).	5
	EFB ref1	*03.09 EFB reference 1* (see page *133*).	8
	EFB ref2	*03.10 EFB reference 2* (see page *133*).	9
	Motor potentiometer	*22.80 Motor potentiometer ref act* (output of the motor potentiometer).	15
	PID	*40.01 Process PID output actual* (output of the process PID controller).	16
	Frequency input 1	*11.38 Freq in 1 actual value* (when DI3 or DI4 is used as a frequency input).	17
	Control panel (ref saved)	Panel reference (*03.01 Panel reference*, see page *132*) saved by the control system for the location where the control returns is used as the reference. 	18
	Control panel (ref copied)	Panel reference (*03.01 Panel reference*, see page *132*) for the previous control location is used as the reference when the control location changes if the references for the two locations are of the same type (eg frequency/speed/torque/PID); otherwise, the actual signal is used as the new reference. 	19
	Integrated panel (ref saved)	See above Control panel (ref saved).	20
	Integrated panel (ref copied)	See above Control panel (ref copied).	21
	Frequency input 2	*11.46 Freq in 2 actual value* (when DI3 or DI4 is used as a frequency input).	22
	MotPot Crane	Output of the crane motor potentiometer. See *22.230*.	31
	Other	Source selection (see *Terms and abbreviations*).	-
28.12	*Ext1 frequency ref2*	Selects Ext1 frequency reference source 2. For the diagram of reference source selection, see parameter *28.11 Ext1 frequency ref1*.	*Zero*
	Zero	None.	0

No.	Name/Value	Description	Default FbEq 16
	AI1 scaled	*12.12 AI1 scaled value* (see page *166*).	1
	AI2 scaled	*12.22 AI2 scaled value* (see page *168*).	2
	FB A ref1	*03.05 FB A reference 1* (see page *132*).	4
	FB A ref2	*03.06 FB A reference 2* (see page *132*).	5
	EFB ref1	*03.09 EFB reference 1* (see page *133*).	8
	EFB ref2	*03.10 EFB reference 2* (see page *133*).	9
	Motor potentiometer	*22.80 Motor potentiometer ref act* (output of the motor potentiometer).	15
	PID	*40.01 Process PID output actual* (output of the process PID controller).	16
	Frequency input 1	*11.38 Freq in 1 actual value* (when DI3 or DI4 is used as a frequency input).	17
	Control panel (ref saved)	Panel reference (*03.01 Panel reference*, see page *132*) saved by the control system for the location where the control returns is used as the reference. 	18
	Control panel (ref copied)	Panel reference (*03.01 Panel reference*, see page *132*) for the previous control location is used as the reference when the control location changes if the references for the two locations are of the same type (eg frequency/speed/torque/PID); otherwise, the actual signal is used as the new reference. 	19
	Integrated panel (ref saved)	See above Control panel (ref saved).	20
	Integrated panel (ref copied)	See above Control panel (ref copied).	21
	Frequency input 2	*11.46 Freq in 2 actual value* (when DI3 or DI4 is used as a frequency input).	22
	Other	Source selection (see *Terms and abbreviations*).	-

No.	Name/Value	Description	Default FbEq 16
28.13	*Ext1 frequency function*	Selects a mathematical function between the reference sources selected by parameters *28.11 Ext1 frequency ref1* and *28.12 Ext1 frequency ref2*. See diagram at *28.11 Ext1 frequency ref1*.	*Ref1*
	Ref1	Signal selected by *28.11 Ext1 frequency ref1* is used as frequency reference 1 as such (no function applied).	0
	Add (ref1 + ref2)	The sum of the reference sources is used as frequency reference 1.	1
	Sub (ref1 - ref2)	The subtraction ([*28.11 Ext1 frequency ref1*] - [*28.12 Ext1 frequency ref2*]) of the reference sources is used as frequency reference 1.	2
	Mul (ref1 × ref2)	The multiplication of the reference sources is used as frequency reference 1.	3
	Min (ref1, ref2)	The smaller of the reference sources is used as frequency reference 1.	4
	Max (ref1, ref2)	The greater of the reference sources is used as frequency reference 1.	5
	Abs (ref1)	The absolute value of the reference sources is used as frequency reference 1.	6
28.15	*Ext2 frequency ref1*	Selects Ext2 frequency reference source 1. Two signal sources can be defined by this parameter and *28.16 Ext2 frequency ref2*. A mathematical function (*28.17 Ext2 frequency function*) applied to the two signals creates an Ext2 reference. See diagram at *28.11 Ext1 frequency ref1*.	*Zero*
	Zero	None.	0
	AI1 scaled	*12.12 AI1 scaled value* (see page *166*).	1
	AI2 scaled	*12.22 AI2 scaled value* (see page *168*).	2
	FB A ref1	*03.05 FB A reference 1* (see page *132*).	4
	FB A ref2	*03.06 FB A reference 2* (see page *132*).	5
	EFB ref1	*03.09 EFB reference 1* (see page *133*).	8
	EFB ref2	*03.10 EFB reference 2* (see page *133*).	9
	Motor potentiometer	*22.80 Motor potentiometer ref act*(output of the motor potentiometer).	15
	PID	*40.01 Process PID output actual* (output of the process PID controller).	16
	Frequency input 1	*11.38 Freq in 1 actual value* (when DI3 or DI4 is used as a frequency input).	17

No.	Name/Value	Description	Default FbEq 16
	Control panel (ref saved)	Panel reference (*03.01 Panel reference*, see page *132*) saved by the control system for the location where the control returns is used as the reference. 	18
	Control panel (ref copied)	Panel reference (*03.01 Panel reference*, see page *132*) for the previous control location is used as the reference when the control location changes if the references for the two locations are of the same type (eg frequency/speed/torque/PID); otherwise, the actual signal is used as the new reference. 	19
	Integrated panel (ref saved)	See above Control panel (ref saved).	20
	Integrated panel (ref copied)	See above Control panel (ref copied).	21
	Frequency input 2	*11.46 Freq in 2 actual value* (when DI3 or DI4 is used as a frequency input).	22
	Other	Source selection (see *Terms and abbreviations*).	-
28.16	*Ext2 frequency ref2*	Selects Ext2 frequency reference source 2. For the selections, and a diagram of reference source selection, see parameter *28.15 Ext2 frequency ref1*.	*Zero*
28.17	*Ext2 frequency function*	Selects a mathematical function between the reference sources selected by parameters *28.15 Ext2 frequency ref1* and *28.16 Ext2 frequency ref2*. See diagram at *28.15 Ext2 frequency ref1*.	*Ref1*
	Ref1	Signal selected by *28.15 Ext2 frequency ref1* is used as frequency reference 1 as such (no function applied).	0
	Add (ref1 + ref2)	The sum of the reference sources is used as frequency reference 1.	1
	Sub (ref1 - ref2)	The subtraction ([*28.15 Ext2 frequency ref1*] - [*28.16 Ext2 frequency ref2*]) of the reference sources is used as frequency reference 1.	2

No.	Name/Value	Description	Default FbEq 16
	Mul (ref1 × ref2)	The multiplication of the reference sources is used as frequency reference 1.	3
	Min (ref1, ref2)	The smaller of the reference sources is used as frequency reference 1.	4
	Max (ref1, ref2)	The greater of the reference sources is used as frequency reference 1.	5
	Abs (ref1)	Selects a mathematical function between the frequency reference sources.	6
28.21	*Constant frequency function*	Determines how constant frequencies are selected, and whether the rotation direction signal is considered or not when applying a constant frequency.	0b00001

Bit	Name	Information
0	Const freq mode	1 = Packed: 7 constant frequencies are selectable using the three sources defined by parameters *28.22*, *28.23* and *28.24*.
		0 = Separate: Constant frequencies 1, 2 and 3 are separately activated by the sources defined by parameters *28.22*, *28.23* and *28.24* respectively. In case of conflict, the constant frequency with the smaller number takes priority.
1	Direction enable	1 = Start dir: To determine running direction for a constant frequency, the sign of the constant frequency setting (parameters *28.26*…*28.32*) is multiplied by the direction signal (forward: +1, reverse: -1). This effectively allows the drive to have 14 (7 forward, 7 reverse) constant frequencies if all values in *28.26*…*28.32* are positive. **WARNING:** If the direction signal is reverse and the active constant frequency is negative, the drive will run in the forward direction.
		0 = According to Par: The running direction for the constant frequency is determined by the sign of the constant speed setting (parameters *28.26*…*28.32*).
2	Frequency step	Frequency step: 1 = Freq step enable; 0 = Freq step disable

No.	Name/Value	Description	Default FbEq 16
	0b0000...0b1111	Constant frequency configuration word.	1 = 1

No.	Name/Value	Description	Default FbEq 16
28.22	*Constant frequency sel1*	When bit 0 of parameter *28.21 Constant frequency function* is 0 (Separate), selects a source that activates constant frequency 1. **Note:** The default value depends on the selected macro. See chapter *Control macros* on page *31*. When bit 0 of parameter *28.21 Constant frequency function* is 1 (Packed), this parameter and parameters *28.23 Constant frequency sel2* and *28.24 Constant frequency sel3* select three sources whose states activate constant frequencies as follows:	*DI2*

Source defined by par. *28.22*	Source defined by par. *28.23*	Source defined by par. *28.24*	Constant frequency active
0	0	0	None
1	0	0	Constant frequency 1
0	1	0	Constant frequency 2
1	1	0	Constant frequency 3
0	0	1	Constant frequency 4
1	0	1	Constant frequency 5
0	1	1	Constant frequency 6
1	1	1	Constant frequency 7

No.	Name/Value	Description	Default FbEq 16
	Always off	0 (always off).	0
	Always on	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
	DIO1	Digital input/output DIO1 (*11.02 DIO delayed status*, bit 0)	10
	DIO2	Digital input/output DIO2 (*11.02 DIO delayed status*, bit 0)	11
	Timed function 1	Bit 0 of *34.01 Timed functions status*.	18
	Timed function 2	Bit 1 of *34.01 Timed functions status*.	19
	Timed function 3	Bit 2 of *34.01 Timed functions status*.	20
	Supervision 1	Bit 0 of *32.01 Supervision status*.	24
	Supervision 2	Bit 1 of *32.01 Supervision status*.	25
	Supervision 3	Bit 2 of *32.01 Supervision status*.	26
	Supervision 4	Bit 3 of *32.01 Supervision status*.	27

No.	Name/Value	Description	Default FbEq 16
	Supervision 5	Bit 4 of *32.01 Supervision status*.	28
	Supervision 6	Bit 5 of *32.01 Supervision status*.	29
	Other [bit]	Source selection (see *Terms and abbreviations*).	-
28.23	*Constant frequency sel2*	When bit 0 of parameter *28.21 Constant frequency function* is 0 (Separate), selects a source that activates constant frequency 2. When bit 0 of parameter *28.21 Constant frequency function* is 1 (Packed), this parameter and parameters *28.22 Constant frequency sel1* and *28.24 Constant frequency sel3* select three sources that are used to activate constant frequencies. See table at parameter *28.22 Constant frequency sel1*. For the selections, see parameter *28.22 Constant frequency sel1*. **Note:** The default value depends on the selected macro. See *Control macros* on page *31*.	*Always off*
28.24	*Constant frequency sel3*	When bit 0 of parameter *28.21 Constant frequency function* is 0 (Separate), selects a source that activates constant frequency 3. When bit 0 of parameter *28.21 Constant frequency function* is 1 (Packed), this parameter and parameters *28.22 Constant frequency sel1* and *28.23 Constant frequency sel2* select three sources that are used to activate constant frequencies. See table at parameter *28.22 Constant frequency sel1*. For the selections, see parameter *28.22 Constant frequency sel1*.	*Always off*
28.26	*Constant frequency 1*	Defines constant frequency 1 (the frequency the motor will turn when constant frequency 1 is selected).	5.00 Hz
	-500.00…500.00 Hz	Constant frequency 1.	See par. *46.02*
28.27	*Constant frequency 2*	Defines constant frequency 2.	10.00 Hz
	-500.00…500.00 Hz	Constant frequency 2.	See par. *46.02*
28.28	*Constant frequency 3*	Defines constant frequency 3.	15.00 Hz
	-500.00…500.00 Hz	Constant frequency 3.	See par. *46.02*
28.29	*Constant frequency 4*	Defines constant frequency 4.	20.00 Hz
	-500.00…500.00 Hz	Constant frequency 4.	See par. *46.02*

No.	Name/Value	Description	Default FbEq 16
28.30	*Constant frequency 5*	Defines constant frequency 5.	25.00 Hz
	-500.00…500.00 Hz	Constant frequency 5.	See par. *46.02*
28.31	*Constant frequency 6*	Defines constant frequency 6.	40.00 Hz
	-500.00…500.00 Hz	Constant frequency 6.	See par. *46.02*
28.32	*Constant frequency 7*	Defines constant frequency 7.	50.00 Hz
	-500.00…500.00 Hz	Constant frequency 7.	See par. *46.02*
28.41	*Frequency ref safe*	Defines a safe frequency reference value that is used with supervision functions such as • *12.03 AI supervision function* • *49.05 Communication loss action* • *50.02 FBA A comm loss func.*	0.00 Hz
	-500.00…500.00 Hz	Safe frequency reference.	See par. *46.02*
28.42	*Jogging 1 frequency ref*	Defines the frequency reference for jogging function 1 in scalar control mode.	0.00 Hz
	-500.00…500.00 Hz	Jogging 1 frequency reference.	See par. *46.02*
28.43	*Jogging 2 frequency ref*	Defines the frequency reference for jogging function 2 in scalar control mode.	0.00 Hz
	-500.00…500.00 Hz	Jogging 2 frequency reference.	See par. *46.02*
28.51	*Critical frequency function*	Enables/disables the critical frequencies function. Also determines whether the specified ranges are effective in both rotating directions or not. See also section *Critical speeds/frequencies* on page *66*.	0000h

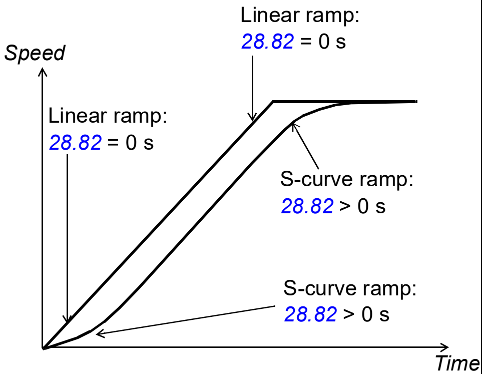
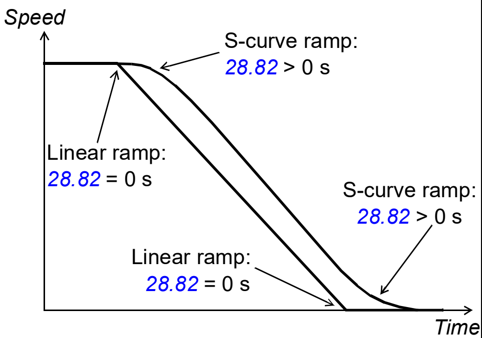
Bit	Name	Information
0	Crit freq	1 = Enable: Critical frequencies enabled.
		0 = Disable: Critical frequencies disabled.
1	Sign mode	1 = According to par: The signs of parameters *28.52…28.57* are taken into account.
		0 = Absolute: Parameters *28.52…28.57* are handled as absolute values. Each range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

	0000h…FFFFh	Critical frequencies configuration word.	1 = 1

No.	Name/Value	Description	Default FbEq 16
28.52	*Critical frequency 1 low*	Defines the low limit for critical frequency 1. **Note:** This value must be less than or equal to the value of *28.53 Critical frequency 1 high*.	0.00 Hz
	-500.00…500.00 Hz	Low limit for critical frequency 1.	See par. *46.02*
28.53	*Critical frequency 1 high*	Defines the high limit for critical frequency 1. **Note:** This value must be greater than or equal to the value of *28.52 Critical frequency 1 low*.	0.00 Hz
	-500.00…500.00 Hz	High limit for critical frequency 1.	See par. *46.02*
28.54	*Critical frequency 2 low*	Defines the low limit for critical frequency 2. **Note:** This value must be less than or equal to the value of *28.55 Critical frequency 2 high*.	0.00 Hz
	-500.00…500.00 Hz	Low limit for critical frequency 2.	See par. *46.02*
28.55	*Critical frequency 2 high*	Defines the high limit for critical frequency 2. **Note:** This value must be greater than or equal to the value of *28.54 Critical frequency 2 low*.	0.00 Hz
	-500.00…500.00 Hz	High limit for critical frequency 2.	See par. *46.02*
28.56	*Critical frequency 3 low*	Defines the low limit for critical frequency 3. **Note:** This value must be less than or equal to the value of *28.57 Critical frequency 3 high*.	0.00 Hz
	-500.00…500.00 Hz	Low limit for critical frequency 3.	See par. *46.02*
28.57	*Critical frequency 3 high*	Defines the high limit for critical frequency 3. **Note:** This value must be greater than or equal to the value of *28.56 Critical frequency 3 low*.	0.00 Hz
	-500.00…500.00 Hz	High limit for critical frequency 3.	See par. *46.02*
28.71	*Freq ramp set selection*	Selects a source that switches between the two sets of acceleration/deceleration times defined by parameters *28.72*…*28.75*. 0 = Acceleration time 1 and deceleration time 1 are in force. 1 = Acceleration time 2 and deceleration time 2 are in force. **Note:** The default value depends on the selected macro. See chapter *Control macros* on page *31*.	*Acc/Dec time 1*
	Acc/Dec time 1	0	0
	Acc/Dec time 2	1	1
	DI1	Digital input DI1 (*10.02 DI delayed status*, bit 0).	2

No.	Name/Value	Description	Default FbEq 16
	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
	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	Only for the Transparent16 or Transparent32 profile. Transparent16 or Transparent32 control word bit received through the fieldbus A interface.	18
	EFB DCU CW bit 10	Only for the DCU profile. DCU control word bit 10 received through the embedded fieldbus interface.	20
	Other [bit]	Source selection (see *Terms and abbreviations*).	-
28.72	*Freq acceleration time 1*	Defines acceleration time 1 as the time required for the frequency to change from zero to the frequency defined by parameter *46.02 Frequency scaling*. After this frequency has been reached, the acceleration continues with the same rate to the value defined by parameter *30.14 Maximum frequency*. If the reference increases faster than the set acceleration rate, the motor will follow the acceleration rate. If the reference increases slower than the set acceleration rate, the motor frequency will follow the reference. If the acceleration time is set too short, the drive will automatically prolong the acceleration in order not to exceed the drive torque limits.	3.000 s
	0.000…1800.000 s	Acceleration time 1.	10 = 1 s
28.73	*Freq deceleration time 1*	Defines deceleration time 1 as the time required for the frequency to change from the frequency defined by parameter *46.02 Frequency scaling* (**not** from parameter *30.14 Maximum frequency*) to zero. If there is any doubt about the deceleration time being too short, ensure that DC overvoltage control (*30.30 Overvoltage control*) is on. **Note:** If a short deceleration time is needed for a high inertia application, the drive should be equipped with braking equipment such as a brake chopper and brake resistor.	3.000 s
	0.000…1800.000 s	Deceleration time 1.	10 = 1 s

No.	Name/Value	Description	Default FbEq 16
28.74	*Freq acceleration time 2*	Defines acceleration time 2. See parameter *28.72 Freq acceleration time 1*.	60.000 s
	0.000…1800.000 s	Acceleration time 2.	10 = 1 s
28.75	*Freq deceleration time 2*	Defines deceleration time 2. See parameter *28.73 Freq deceleration time 1*.	60.000 s
	0.000…1800.000 s	Deceleration time 2.	10 = 1 s
28.76	*Freq ramp in zero source*	Selects a source that forces the frequency reference to zero. 0 = Force frequency reference to zero 1 = Normal operation	*Inactive*
	Active	0.	0
	Inactive	1.	1
	DI1	Digital input DI1 (*10.02 DI delayed status*, bit 0).	2
	DI2	Digital input DI2 (*10.02 DI delayed status*, bit 1).	3
	DI3	Digital input DI3 (*10.02 DI delayed status*, bit 2).	4
	DI4	Digital input DI4 (*10.02 DI delayed status*, bit 3).	5
	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*).	-

No.	Name/Value	Description	Default FbEq 16
28.82	*Shape time 1*	Defines the shape of the acceleration and deceleration ramps used with the set 1. 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 and end of acceleration and deceleration.	10 = 1 s
28.83	*Shape time 2*	Defines the shape of the acceleration and deceleration ramps used with the set 2. See parameter *28.82 Shape time 1*.	0.000 s
	0.000…1800.000 s	Ramp shape at start and end of acceleration and deceleration.	10 = 1 s

No.	Name/Value	Description	Default FbEq 16
28.92	*Frequency ref act 3*	Displays the frequency reference after the function applied by parameter *28.13 Ext1 frequency function* (if any), and after selection (*19.11 Ext1/Ext2 selection*). See the control chain diagram on page *610*. This parameter is read-only.	0.00 Hz
	-500.00…500.00 Hz	Frequency reference after selection.	See par. *46.02*
28.96	*Frequency ref act 7*	Displays the frequency reference after application of constant frequencies, control panel reference, etc. See the control chain diagram on page *610*. This parameter is read-only.	0.00 Hz
	-500.00…500.00 Hz	Frequency reference 7.	See par. *46.02*
28.97	*Frequency ref unlimited*	Displays the frequency reference after application of critical frequencies, but before ramping and limiting. See the control chain diagram on page *610*. This parameter is read-only.	0.00 Hz
	-500.00…500.00 Hz	Frequency reference before ramping and limiting.	See par. *46.02*
28.211	*Frequency reference shape*	Defines the Frequency reference shape.	*Linear*
	Linear	Linear frequency reference.	0
	Parabolic 1	X^2 frequency reference.	1
	Parabolic 2	X^3 frequency reference.	2

No.	Name/Value	Description	Default FbEq 16
30 Limits		Drive operation limits.	
30.01	*Limit word 1*	Displays limit word 1. This parameter is read-only.	-

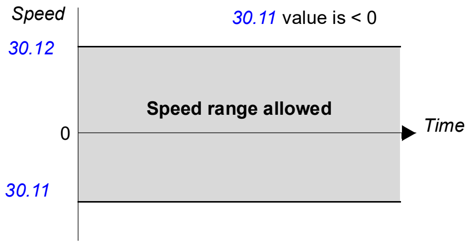
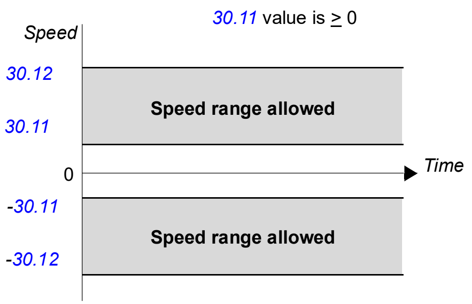
Bit	Name	Description
0	Torq lim	1 = Drive torque is being limited by the motor control (undervoltage control, current control, load angle control or pull-out control), or by the torque limits defined by parameters.
1…2	Reserved	
3	Torq ref max	1 = Torque reference is being limited by *26.09 Maximum torque ref* or *30.20 Maximum torque 1*
4	Torq ref min	1 = Torque reference is being limited by *26.08 Minimum torque ref* or *30.19 Minimum torque 1*
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…15	Reserved	

	0000h…FFFFh	Limit word 1.	1 = 1

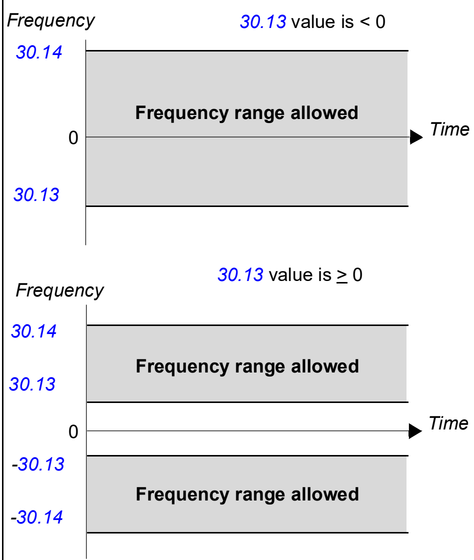
No.	Name/Value	Description	Default FbEq 16
30.02	*Torque limit status*	Displays the torque controller limitation status word. This parameter is read-only.	-

Bit	Name	Description
0	Undervoltage	*1 = Intermediate DC circuit undervoltage
1	Overvoltage	*1 = Intermediate DC circuit overvoltage
2	Minimum torque	*1 = Torque is being limited by *30.19 Minimum torque 1*, *30.26 Power motoring limit* or *30.27 Power generating limit*
3	Maximum torque	*1 = Torque is being limited by *30.20 Maximum torque 1*, *30.26 Power motoring limit* or *30.27 Power generating limit*
4	Internal current	1 = An inverter current limit (identified by bits 8…11) is active
5	Load angle	(With permanent magnet motors and 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 any more torque
7	Reserved	
8	Thermal	1 = Input current is being limited by the main circuit thermal limit
9	Max current	*1 = Maximum output current (I_{MAX}) is being limited
10	User current	*1 = Output current is being limited by *30.17 Maximum current*
11	Thermal IGBT	*1 = Output current is being limited by a calculated thermal current value
12	IGBT overtemperature	*1 = Output current is being limited because of the estimated IGBT temperature
13	IGBT overload	*1 = Output current is being limited because of the 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.		

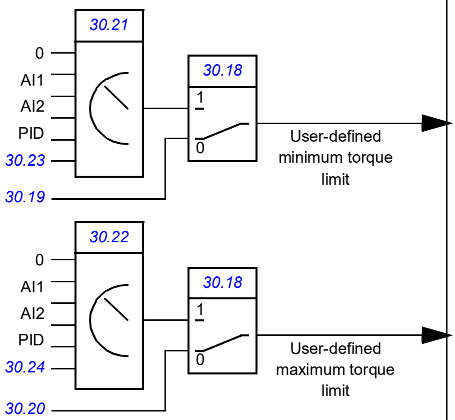
No.	Name/Value	Description	Default FbEq 16
	0000h…FFFFh	Torque limitation status word.	1 = 1

No.	Name/Value	Description	Default FbEq 16
30.11	*Minimum speed*	Defines together with *30.12 Maximum speed* allowed speed range. See the figure below. A positive (or zero) minimum speed value defines two ranges, one positive and one negative. A negative minimum speed value defines one range. **WARNING!** The absolute value of *30.11 Minimum speed* must not be higher than the *30.12 Maximum speed*. **WARNING!** In speed control mode only. In frequency control mode, use frequency limits (*30.13* and *30.14*).  	-1500.00 rpm
	-30000.00…30000.00 rpm	Minimum allowed speed.	See par. *46.01*

No.	Name/Value	Description	Default FbEq 16
30.12	*Maximum speed*	Defines together with *30.11 Minimum speed* allowed speed range. See parameter *30.11 Minimum speed.* **Note:** This parameter does not affect the speed acceleration and deceleration ramp times. See parameter *46.01 Speed scaling*. ⚠ **WARNING!** The absolute value of *30.12 Maximum speed* must not be lower than *30.11 Minimum speed*. ⚠ **WARNING!** In speed control mode only. In frequency control mode, use frequency limits (*30.13* and *30.14*).	1500.00 rpm
	-30000.00…30000.00 rpm	Maximum speed.	See par. *46.01*

No.	Name/Value	Description	Default FbEq 16
30.13	*Minimum frequency*	Defines together with *30.14 Maximum frequency* allowed frequency range. See the figure below. A positive (or zero) minimum frequency value defines two ranges, one positive and one negative. A negative minimum frequency value defines one range. ⚠ **WARNING!** The absolute value of *30.13 Minimum frequency* must not be higher than *30.14 Maximum frequency*. ⚠ **WARNING!** in frequency control mode only. 	-50.00 Hz
	-500.00…500.00 Hz	Minimum frequency.	See par. *46.02*

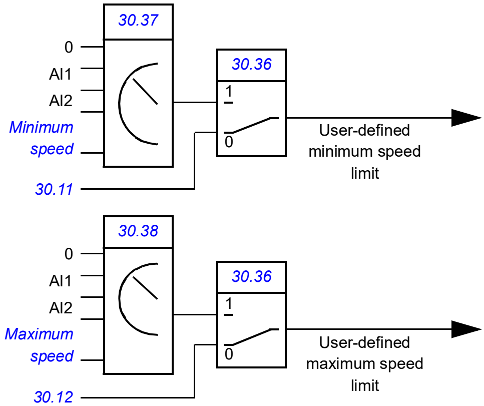
No.	Name/Value	Description	Default FbEq 16
30.14	*Maximum frequency*	Defines together with *30.13 Minimum frequency* allowed frequency range. See *30.13 Minimum frequency*. **Note:** This parameter does not affect the speed acceleration and deceleration ramp times. See parameter *46.02 Frequency scaling*. ⚠ **WARNING!** This absolute value of *30.14 Maximum frequency* must not be lower than *30.13 Minimum frequency*. ⚠ **WARNING!** In frequency control mode only.	50.00 Hz
	-500.00…500.00 Hz	Maximum frequency.	See par. *46.02*
30.17	*Maximum current*	Defines the maximum allowed motor current. The system sets the default value to 90% of the rated current. If required, you can increase the parameter value by 10%. **Note:** The maximum current range and default value depends on the drive type.	2.88 A
	0.00…3.20 A	Maximum motor current.	1 = 1 A

No.	Name/Value	Description	Default FbEq 16
30.18	*Torq lim sel*	Selects a source that switches between two different predefined minimum torque limit sets. 0 = minimum torque limit defined by *30.19* and maximum torque limit defined by *30.20* are active 1 = minimum torque limit selected by *30.21* and maximum torque limit defined by *30.22* are 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 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 *547*.	*Torque limit set 1*
	Torque limit set 1	0 (minimum torque limit defined by *30.19* and maximum torque limit defined by *30.20* are active).	0
	Torque limit set 2	1 (minimum torque limit selected by *30.21* and maximum torque limit defined by *30.22* are 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

No.	Name/Value	Description	Default FbEq 16
	DIO1	Digital input/output DIO1 (*11.02 DIO delayed status*, bit 0).	6
	DIO2	Digital input/output DIO2 (*11.02 DIO delayed status*, bit 1)	7
	EFB	Only for the DCU profile. DCU control word bit 15 received through the embedded fieldbus interface.	11
	Other [bit]	Source selection (see *Terms and abbreviations*).	-
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 Torq lim sel*. The limit is effective when • the source selected by *30.18 Torq lim sel* is 0, or • *30.18* is set to *Torque limit set 1*. ⚠ **WARNING!** Do not use minimum torque to stop reverse rotation of the motor. Usage of minimum torque limits disables the drive to reach zero speed and fails to stop the motor.	-300.0%
	-1600.0…0.0%	Minimum torque limit 1.	See par. *46.03*
30.20	*Maximum torque 1*	Defines a maximum torque limit for the drive (in percent of nominal motor torque). See diagram at parameter *30.18 Torq lim sel*. The limit is effective when • the source selected by *30.18 Torq lim sel* is 0, or • *30.18* is set to *Torque limit set 1*.	300.0%
	0.0…1600.0%	Maximum torque 1.	See par. *46.03*
30.21	*Min 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 Torq lim sel* is 1, or • *30.18* is set to *Torque limit set 2*. See diagram at *30.18 Torq lim 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 *166*).	1
	AI2 scaled	*12.22 AI2 scaled value* (see page *168*).	2
	PID	*40.01 Process PID output actual* (output of the process PID controller).	15
	Minimum torque 2	*30.23 Minimum torque 2*.	16

No.	Name/Value	Description	Default FbEq 16
	Other	Source selection (see *Terms and abbreviations*).	-
30.22	*Max 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 *30.18 Torq lim sel* is 1, or • *30.18* is set to *Torque limit set 2*. See diagram at *30.18 Torq lim 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 *166*).	1
	AI2 scaled	*12.22 AI2 scaled value* (see page *168*).	2
	PID	*40.01 Process PID output actual* (output of the process PID controller).	15
	Maximum torque 2	*30.24 Maximum torque 2*.	16
	Other	Source selection (see *Terms and abbreviations*).	-
30.23	*Minimum torque 2*	Defines the minimum torque limit for the drive (in percent of nominal motor torque) when • the source selected by *30.18 Torq lim sel* is 1, or • *30.18* is set to *Torque limit set 2* and • *30.21 Min torque 2 source* is set to *Minimum torque 2*. See diagram at *30.18 Torq lim 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 limit is effective when • the source selected by *30.18 Torq lim sel* is 1, or • *30.18* is set to *Torque limit set 2* and • *30.22 Max torque 2 source* is set to *Maximum torque 2*. See diagram at *30.18 Torq lim sel*.	300.0%
	0.0…1600.0%	Maximum torque limit 2.	See par. *46.03*

No.	Name/Value	Description	Default FbEq 16
30.26	*Power motoring limit*	Defines the maximum allowed power fed by the inverter to the motor in percent of nominal motor power.	300.00%
	0.00…600.00%	Maximum motoring power.	1 = 1%
30.27	*Power generating limit*	Defines the maximum allowed power fed by the motor to the inverter in percent of nominal motor power.	-300.00%
	-600.00…0.00%	Maximum generating power.	1 = 1%
30.30	*Overvoltage control*	Enables the overvoltage control of the intermediate DC link. Fast braking of a high inertia load causes the voltage to rise to the overvoltage control limit. To prevent the DC voltage from exceeding the limit, the overvoltage controller automatically decreases the braking torque. **Note:** If the drive is equipped with a brake chopper and resistor, or a regenerative supply unit, the controller must be disabled.	*Enable*
	Disable	Overvoltage control disabled.	0
	Enable	Overvoltage control enabled.	1
30.31	*Undervoltage control*	Enables the undervoltage control of the intermediate DC link. If the DC voltage drops due to input power cut off, the undervoltage controller will automatically decrease the motor torque in order to keep the voltage above the lower limit. By decreasing the motor torque, the inertia of the load will cause regeneration back to the drive, keeping the DC link charged and preventing an undervoltage trip until the motor coasts to a stop. This will act as a power-loss ride-through functionality in systems with high inertia, such as a centrifuge or a fan.	*Enable*
	Disable	Undervoltage control disabled.	0
	Enable	Undervoltage control enabled.	1
30.35	*Thermal current limitation*	Enables/disables temperature-based output current limitation. The limitation should only be disabled if required by the application.	*Enable*
	Disable	Thermal current limitation disabled.	0
	Enable	Thermal current limitation enabled.	1

No.	Name/Value	Description	Default FbEq 16
30.36	*Speed limit selection*	Selects a source that switches between two different predefined adjustable speed limit sets. 0 = minimum speed limit defined by *30.11* and maximum speed limit defined by *30.12* are active 1 = minimum speed limit selected by *30.37* and maximum speed limit defined by *30.38* are active. The user can define two sets of speed limits, and switch between the sets using a binary source such as a digital input. The user can define two sets of speed limits, and switch between the sets using a binary source such as a digital input. The first set of limits is defined by parameters *30.11 Minimum speed* and *30.12 Maximum speed*. The second set has selector parameters for both the minimum (*30.37*) and maximum (*30.38*) limits that allows the use of a selectable analog source (such as an analog input).  	*Not selected*
	Not selected	Adjustable speed limits are disabled. (Minimum speed limit defined by *30.11 Minimum speed* and maximum speed limit defined by *30.12 Maximum speed* are active).	0
	Selected	Adjustable speed limits are enabled. (Minimum speed limit defined by *30.37 Min speed source* source and maximum speed limit defined by *30.38 Max speed source* are active).	1

No.	Name/Value	Description	Default FbEq 16
	Ext1 active	Adjustable speed limits are enabled if EXT1 is active.	2
	Ext2 active	Adjustable speed limits are enabled if EXT2 is active.	3
	Torque control	Adjustable speed limits are enabled if Torque control mode (vector motor control) is active.	4
	DI1	Digital input DI1 (*10.02 DI delayed status*, bit 0).	5
	DI2	Digital input DI2 (*10.02 DI delayed status*, bit 1).	6
	DI3	Digital input DI2 (*10.02 DI delayed status*, bit 2).	7
	DI4	Digital input DI2 (*10.02 DI delayed status*, bit 3).	8
	Other [bit]	Source selection (see *Terms and abbreviations*).	-
30.37	*Min speed source*	Defines the source of a minimum speed limit for the drive when the source is selected by *30.36 Speed limit selection*. **WARNING!** In vector motor control mode only. In scalar motor control mode, use frequency limits *30.13* and *30.14*.	*Minimum speed*
	Zero	None.	0
	AI1 scaled	*12.12 AI1 scaled value*	1
	AI2 scaled	*12.22 AI2 scaled value*	2
	Minimum speed	*30.11 Minimum speed*.	11
	Other	Source selection (see *Terms and abbreviations*).	-
30.38	*Max speed source*	Defines the source of a maximum speed limit for the drive when the source is selected by *30.36 Speed limit selection*. **WARNING!** In vector motor control mode only. In scalar motor control mode, use frequency limits *30.13* and *30.14*.	*Maximum speed*
	Zero	None.	0
	AI1 scaled	*12.12 AI1 scaled value*	1
	AI2 scaled	*12.22 AI2 scaled value*	2
	Maximum speed	*30.12 Maximum speed*.	12
	Other	Source selection (see *Terms and abbreviations*).	-
30.203	*Deadband forward*	Defines the dead-band area for the positive speed reference when the speed reference is taken from an analog input.	0.00%
	0.00...100.00%		10=1%
30.204	*Deadband reverse*	Defines the dead-band area for the negative speed reference when the speed reference is taken from an analog input.	0.00%

No.	Name/Value	Description	Default FbEq 16
	0.00...100.00%		10=1%

No.	Name/Value	Description	Default FbEq 16
31 Fault functions		Configuration of external events; selection of behavior of the drive upon fault situations.	
31.01	*External event 1 source*	Defines the source of external event 1. See also parameter *31.02 External event 1 type*. 0 = Trigger event 1 = Normal operation	*Inactive (true)*
	Active (false)	0.	0
	Inactive (true)	1.	1
	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
	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*).	-
31.02	*External event 1 type*	Selects the type of external event 1.	*Fault*
	Fault	The external event generates a fault.	0
	Warning	The external event generates a warning.	1
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)*
31.04	*External event 2 type*	Selects the type of external event 2.	*Fault*
	Fault	The external event generates a fault.	0
	Warning	The external event generates a warning.	1
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
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)*

No.	Name/Value	Description	Default FbEq 16
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
31.09	*External event 5 source*	Defines the source of external event 5. See also parameter *31.10 External event 5 type*. For the selections, see parameter *31.01 External event 1 source*.	*Inactive (true)*
31.10	*External event 5 type*	Selects the type of external event 5.	*Fault*
	Fault	The external event generates a fault.	0
	Warning	The external event generates a warning.	1
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 via FBA A and EFB MCW bit 7 is useful when the start stop signal is through DIs (parameter *20.01* or *20.06*) or from local control mode and the user wants a fault reset through the fieldbus. Whenever the remote control mode is in fieldbus (Start stop command and reference is through fieldbus), the fault can be reset from the fieldbus regardless of the selection of the parameter.	*Not used*
	Not used	Not used	0
	Not used	Not used	1
	DI1	Digital input DI1 (*10.02 DI delayed status*, bit 0).	2
	DI2	Digital input DI2 (*10.02 DI delayed status*, bit 1).	3
	DI3	Digital input DI3 (*10.02 DI delayed status*, bit 2).	4
	DI4	Digital input DI4 (*10.02 DI delayed status*, bit 3).	5
	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
	Timed function 1	Bit 0 of *34.01 Timed functions status*.	18
	Timed function 2	Bit 1 of *34.01 Timed functions status*.	19
	Timed function 3	Bit 2 of *34.01 Timed functions status*.	20
	Supervision 1	Bit 0 of *32.01 Supervision status.*	24
	Supervision 2	Bit 1 of *32.01 Supervision status.*	25
	Supervision 3	Bit 2 of *32.01 Supervision status*.	26
	Supervision 4	Bit 3 of *32.01 Supervision status*.	27

No.	Name/Value	Description	Default FbEq 16
	Supervision 5	Bit 4 of *32.01 Supervision status*.	28
	Supervision 6	Bit 5 of *32.01 Supervision status*.	29
	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*).	-
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. ⚠ **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 fault. The bits of this binary number correspond to the following faults:	0000h

Bit	Fault
0	Overcurrent
1	Overvoltage
2	Undervoltage
3	AI supervision fault
4…9	Reserved
10	Selectable fault (see parameter *31.13 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*)

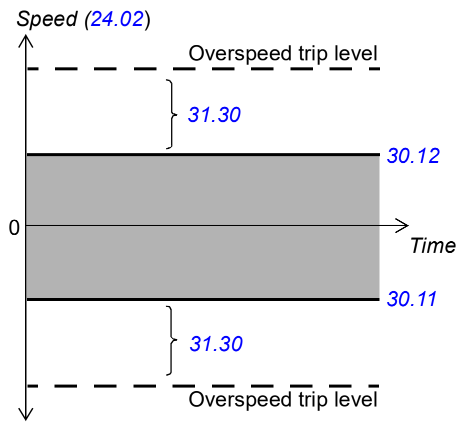
No.	Name/Value	Description	Default FbEq 16
	0000h…FFFFh	Automatic reset configuration word.	1 = 1

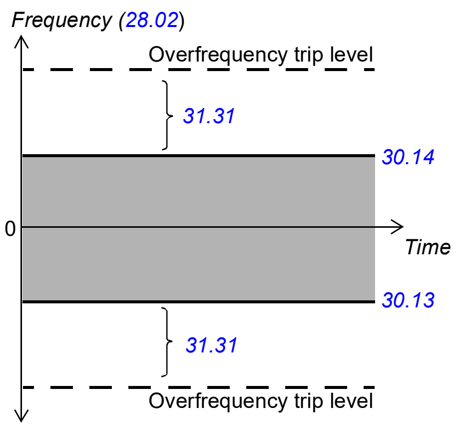
No.	Name/Value	Description	Default FbEq 16
31.13	*Selectable fault*	Defines the fault that can be automatically reset using parameter *31.12 Autoreset selection*, bit 10. Faults are listed in chapter *Fault tracing* (page *487*). **Note:** The fault codes are in hexadecimal. The selected code must be converted to decimal for this parameter.	0
	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 defined by parameter *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.	10 = 1
31.15	*Total trials time*	Defines a time window for automatic fault resets. The maximum number of attempts made during any period of this length is defined by *31.14 Number of trials*. **Note:** If the fault condition remains and cannot be reset, each reset attempt will generate an event and start a new time window. In practice, if the specified number of resets (*31.14*) at specified intervals (*31.16*) take longer than the value of *31.15*, the drive will continue to attempt resetting the fault until the cause is eventually removed.	30.0 s
	1.0…600.0 s	Time for automatic resets.	10 = 1 s
31.16	*Delay time*	Defines the time that the drive will wait after a fault 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. See section *Motor phase loss detection (31.19)* on page *112*.	*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 (ground) 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

<table>
<tr><th>No.</th><th>Name/Value</th><th>Description</th><th>Default
FbEq 16</th></tr>
<tr><td></td><td>Fault</td><td>The drive trips on fault 2330 Earth leakage.</td><td>2</td></tr>
<tr><td>31.21</td><td>Supply phase loss</td><td>Selects how the drive reacts when a supply phase loss is
detected.</td><td>Fault</td></tr>
<tr><td></td><td>No action</td><td>No action taken.
Note: When this option is selected, the drive will eventually overheat or the supply bridge may be damaged if one supply phase is lost, unless 50% derating is done when dimensioning the system.</td><td>0</td></tr>
<tr><td></td><td>Fault</td><td>The drive trips on fault 3130 Input phase loss.</td><td>1</td></tr>
<tr><td>31.22</td><td>STO indication run/stop</td><td>Selects which indications are given when one or both Safe torque off (STO) signals are switched off or lost. The indications also depend on whether the drive is running or stopped when this occurs.
The tables at each selection below show the indications generated with that particular setting.
Notes:
This parameter does not affect the operation of the STO function itself. The STO function will operate regardless of the setting of this parameter: a running drive will stop upon removal of one or both STO signals, and will not start until both STO signals are restored and all faults reset.
The loss of only one STO signal always generates a fault as it is interpreted as a malfunction.
For more information on the STO, see chapter The Safe torque off function in the hardware manual of the drive.</td><td>Fault/Fault</td></tr>
<tr><td></td><td>Fault/Fault</td><td><table>
<tr><th colspan="2">Inputs</th><th rowspan="2">Indication (running or stopped)</th></tr>
<tr><th>IN1</th><th>IN2</th></tr>
<tr><td>0</td><td>0</td><td>Fault 5091 Safe torque off</td></tr>
<tr><td>0</td><td>1</td><td>Fault FA81 Safe torque off 1</td></tr>
<tr><td>1</td><td>0</td><td>Fault FA82 Safe torque off 2</td></tr>
<tr><td>1</td><td>1</td><td>(Normal operation)</td></tr>
</table></td><td>0</td></tr>
</table>

<table>
<tr><th>No.</th><th>Name/Value</th><th>Description</th><th>Default
FbEq 16</th></tr>
<tr><td></td><td>Fault/Warning</td><td>
<table>
<tr><th colspan="2">Inputs</th><th colspan="2">Indication</th></tr>
<tr><th>IN1</th><th>IN2</th><th>Running</th><th>Stopped</th></tr>
<tr><td>0</td><td>0</td><td>Fault 5091 Safe torque off</td><td>Warning A5A0 Safe torque off</td></tr>
<tr><td>0</td><td>1</td><td>Fault FA81 Safe torque off 1</td><td>Fault FA81 Safe torque off 1</td></tr>
<tr><td>1</td><td>0</td><td>Fault FA82 Safe torque off 2</td><td>Fault FA82 Safe torque off 2</td></tr>
<tr><td>1</td><td>1</td><td colspan="2">(Normal operation)</td></tr>
</table>
</td><td>1</td></tr>
<tr><td></td><td>Fault/Event</td><td>
<table>
<tr><th colspan="2">Inputs</th><th colspan="2">Indication</th></tr>
<tr><th>IN1</th><th>IN2</th><th>Running</th><th>Stopped</th></tr>
<tr><td>0</td><td>0</td><td>Fault 5091 Safe torque off</td><td>Event B5A0 Safe torque off</td></tr>
<tr><td>0</td><td>1</td><td>Fault FA81 Safe torque off 1</td><td>Fault FA81 Safe torque off 1</td></tr>
<tr><td>1</td><td>0</td><td>Fault FA82 Safe torque off 2</td><td>Fault FA82 Safe torque off 2</td></tr>
<tr><td>1</td><td>1</td><td colspan="2">(Normal operation)</td></tr>
</table>
</td><td>2</td></tr>
<tr><td></td><td>Warning/Warning</td><td>
<table>
<tr><th colspan="2">Inputs</th><th rowspan="2">Indication (running or stopped)</th></tr>
<tr><th>IN1</th><th>IN2</th></tr>
<tr><td>0</td><td>0</td><td>Warning A5A0 Safe torque off</td></tr>
<tr><td>0</td><td>1</td><td>Fault FA81 Safe torque off 1</td></tr>
<tr><td>1</td><td>0</td><td>Fault FA82 Safe torque off 2</td></tr>
<tr><td>1</td><td>1</td><td>(Normal operation)</td></tr>
</table>
</td><td>3</td></tr>
<tr><td></td><td>Event/Event</td><td>
<table>
<tr><th colspan="2">Inputs</th><th rowspan="2">Indication (running or stopped)</th></tr>
<tr><th>IN1</th><th>IN2</th></tr>
<tr><td>0</td><td>0</td><td>Event B5A0 Safe torque off</td></tr>
<tr><td>0</td><td>1</td><td>Event B5A0 Safe torque off and fault FA81 Safe torque off 1</td></tr>
<tr><td>1</td><td>0</td><td>Event B5A0 Safe torque off and fault FA82 Safe torque off 2</td></tr>
<tr><td>1</td><td>1</td><td>(Normal operation)</td></tr>
</table>
</td><td>4</td></tr>
<tr><td></td><td>No Indication/No Indication</td><td>
<table>
<tr><th colspan="2">Inputs</th><th rowspan="2">Indication (running or stopped)</th></tr>
<tr><th>IN1</th><th>IN2</th></tr>
<tr><td>0</td><td>0</td><td>None</td></tr>
<tr><td>0</td><td>1</td><td>Fault FA81 Safe torque off 1</td></tr>
<tr><td>1</td><td>0</td><td>Fault FA82 Safe torque off 2</td></tr>
<tr><td>1</td><td>1</td><td>(Normal operation)</td></tr>
</table>
</td><td>5</td></tr>
</table>

No.	Name/Value	Description	Default FbEq 16
31.23	*Wiring or earth fault*	Selects how the drive reacts to incorrect input power and motor cable connection (ie. input power cable is connected to drive motor connection).	*Fault*
	No action	No action taken.	0
	Fault	The drive trips on fault *3181 Cross connectionOutput wiring or earth fault*.	1
31.24	*Stall function*	Selects how the drive reacts to a motor stall condition. A stall condition is defined as follows: • The drive exceeds the stall current limit (*31.25 Stall current limit*), and • the output frequency is below the level set by parameter *31.27 Stall frequency limit* or the motor speed is below the level set by parameter *31.26 Stall speed limit*, and • the conditions above have been true longer than the time set by parameter *31.28 Stall time*.	*No action*
	No action	None (stall supervision disabled).	0
	Warning	The drive generates an *A780 Motor stall* warning.	1
	Fault	The drive trips on fault *7121 Motor stall*.	2
31.25	*Stall current limit*	Stall current limit in percent of the nominal current of the motor. See parameter *31.24 Stall function*.	200.0%
	0.0…1600.0%	Stall current limit.	-
31.26	*Stall speed limit*	Stall speed limit in rpm. See parameter *31.24 Stall function*.	150.00 rpm
	0.00…10000.00 rpm	Stall speed limit.	See par. *46.01*
31.27	*Stall frequency limit*	Stall frequency limit. See parameter *31.24 Stall function*. **Note:** Setting the limit below 10 Hz is not recommended.	15.00 Hz
	0.00…1000.00 Hz	Stall frequency limit.	See par. *46.02*
31.28	*Stall time*	Stall time. See parameter *31.24 Stall function*.	20 s
	0…3600 s	Stall time.	-

No.	Name/Value	Description	Default FbEq 16
31.30	*Overspeed trip margin*	Defines, together with *30.11 Minimum speed* and *30.12 Maximum speed*, the maximum allowed speed of the motor (overspeed protection). If the speed (*24.02 Used speed feedback*) 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 vector 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…10000.00 rpm	Overspeed trip margin.	See par. *46.01*

No.	Name/Value	Description	Default FbEq 16
31.31	*Frequency trip margin*	Defines, together with *30.13 Minimum frequency* and *30.14 Maximum frequency*, the maximum allowed frequency of the motor. If the speed (*28.01 Frequency ref ramp input*) exceeds the frequency limit defined by parameter *30.13* or *30.14* by more than the value of this parameter, the drive trips on the *73F0 Overfrequency* fault. **WARNING!** This function only supervises the speed in scalar motor control mode. The function is not effective in vector motor control mode. **Example:** If the maximum speed is 40 Hz and speed trip margin is 10 Hz, the drive trips at 50 Hz.  	15.00 Hz
	0.00…10000.00 Hz	Overfrequency trip margin.	See par. *46.02*

No.	Name/Value	Description	Default FbEq 16
31.32	*Emergency ramp supervision*	Parameters *31.32 Emergency ramp supervision* and *31.33 Emergency ramp supervision delay*, together with the derivative of *24.02 Used speed feedback*, provide a supervision function for emergency stop modes Off1 and Off3. The supervision is based on either • observing the time within which the motor stops, or • comparing the actual and expected deceleration rates. If this parameter is set to 0%, the maximum stop time is directly set in parameter *31.33*. Otherwise, *31.32* defines the maximum allowed deviation from the expected deceleration rate, which is calculated from parameters *23.11*… *23.15* (Off1) or *23.23 Emergency stop time* (Off3). If the actual deceleration rate (*24.02*) deviates too much from the expected rate, the drive trips on *73B0 Emergency ramp failed*, sets bit 8 of *06.17 Drive status word 2*, and coasts to a stop. If *31.32* is set to 0% and *31.33* is set to 0 s, the emergency stop ramp supervision is disabled. See also parameter *21.04 Emergency stop mode*.	0%
	0…300%	Maximum deviation from expected deceleration rate.	1 = 1%
31.33	*Emergency ramp supervision delay*	If parameter *31.32 Emergency ramp supervision* is set to 0%, this parameter defines the maximum time an emergency stop (mode Off1 or Off3) is allowed to take. If the motor has not stopped when the time elapses, the drive trips on *73B0 Emergency ramp failed*, sets bit 8 of *06.17 Drive status word 2*, and coasts to a stop. If *31.32* is set to a value other than 0%, this parameter defines a delay between the receipt of the emergency stop command and the activation of the supervision. It is recommended to specify a short delay to allow the speed change rate to stabilize.	0 s
	0…100 s	Maximum ramp-down time, or supervision activation delay.	1 = 1 s
31.40	*Disable warning messages*	Selects the warnings to be suppressed. This parameter is a 16-bit word with each bit corresponding to a warning. Whenever a bit is set to 1, the corresponding warning is not logged to event log.	0000h

No.	Name/Value	Description	Default FbEq 16
		<table><tr><th>Bit</th><th>Name</th><th>Description</th></tr><tr><td>0</td><td>Reserved</td><td></td></tr><tr><td>1</td><td>DC link undervoltage</td><td>1 = Warning *A3A2 DC link undervoltage* is suppressed.</td></tr><tr><td>2…4</td><td>Reserved</td><td></td></tr><tr><td>5</td><td>Emergency stop off2</td><td>1 = Warning *AFE1 Emergency stop (off2)* is suppressed.</td></tr><tr><td>6</td><td>Emergency stop off1, off3</td><td>1 = Warning *AFE2 Emergency stop (off1 or off3)* is suppressed.</td></tr><tr><td>7…15</td><td>Reserved</td><td></td></tr></table>	
	0000h…FFFFh	Word for disabling warnings.	1 = 1
31.54	*Fault action*	Selects the stop mode when a non-critical fault occurs.	Coast
	Coast	The drive coasts to stop.	0
	Emergency ramp	The drive follows the ramp specified for an emergency stop by parameter *22.23*.	1
31.205	*Crane warning masking*	Selects which crane 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*.The bits of this binary number correspond to the following warnings:	FFFFh

Bit	Name	Description
0	Brake slip at standstill	D200 Brake slip at standstill2
1	Slowdown forward/reverse	D201 Forward slowdown limit, D202 Reverse slowdown limit
2	Reserved	
3	Reserved	
4	End limit forward/reverse	D205 Forward stop limit, D206 Reverse stop limit
5	Reserved	
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	Reserved	
10	Fast stop	D20A Fast stop
11…15	Reserved	

No.	Name/Value	Description	Default FbEq 16
	0000h...FFFFh	Crane warning masking status word	1 = 1
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 *114*).	
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*, *32.26*, *32.36*, *32.46* and *32.56*.	0000h

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	Supervision 4 active	1 = Signal selected by *32.37* is outside its limits.
4	Supervision 5 active	1 = Signal selected by *32.47* is outside its limits.
5	Supervision 6 active	1 = Signal selected by *32.57* is outside its limits.
6…15	Reserved	

No.	Name/Value	Description	Default FbEq 16
	0000h...FFFFh	Signal supervision status word.	1 = 1
32.05	*Supervision 1 function*	Selects the mode of signal supervision function 1. Determines how the monitored signal (see parameter *32.07*) is compared to its lower and upper limits (*32.09* and *32.10* respectively). The action to be taken when the condition is fulfilled is selected by *32.06*.	*Disabled*
	Disabled	Signal supervision 1 not in use.	0
	Low	Action is taken whenever the signal is below the Supervision 1 low limit - 0.5 * hysteresis. Action is deactivated whenever the signal is above the Supervision 1 low limit + 0.5 * hysteresis.	1
	High	Action is taken whenever the signal is above the Supervision 1 high limit + 0.5 * hysteresis. Action is deactivated whenever the signal is below the Supervision 1 high limit - 0.5 * hysteresis.	2

No.	Name/Value	Description	Default FbEq 16
	Abs low	Action is taken whenever the absolute value of the signal is below the absolute value of the Supervision 1 low limit - 0.5 * hysteresis. Action is deactivated whenever the absolute value of the signal is above the absolute value of the Supervision 1 low limit + 0.5 * hysteresis.	3
	Abs high	Action is taken whenever the absolute value of the signal is above the absolute value of the Supervision 1 high limit + 0.5 * hysteresis. Action is deactivated whenever the absolute value of the signal is below the absolute value of the Supervision 1 high limit - 0.5 * hysteresis.	4
	Both	Action is taken whenever the signal is above the Supervision 1 high limit + 0.5 * hysteresis or below the Supervision 1 low limit - 0.5*hysteresis. Action is deactivated whenever the signal is in between the Supervision 1 high limit - 0.5 * hysteresis and the Supervision 1 low limit + 0.5*hysteresis.	5
	Abs both	Action is taken whenever the absolute value of the signal is above the absolute value of the Supervision 1 high limit + 0.5 * hysteresis or below the absolute value of the Supervision 1 low limit - 0.5*hysteresis. Action is deactivated whenever the absolute value of the signal is in between the absolute value of the Supervision 1 high limit - 0.5 * hysteresis and the absolute value of the Supervision 1 low limit + 0.5*hysteresis.	6
	Hysteresis	Action is taken whenever the signal is above the Supervision 1 high limit + 0.5 * hysteresis. Action is deactivated whenever the signal is below the Supervision 1 low limit - 0.5 * hysteresis. The status is unchanged when the signal value is in between the Supervision 1 high limit + 0.5 * hysteresis and the Supervision 1 low limit - 0.5 * hysteresis.	7
	Low falling	Action is taken whenever the signal falls from a value higher than the Supervision 1 low limit + 0.5 * hysteresis to a value which is lower than the Supervision 1 low limit - 0.5 * hysteresis. Action is deactivated when the signal rises to higher than the Supervision 1 low limit + 0.5*hysteresis.	8

No.	Name/Value	Description	Default FbEq 16
	High rising	Action taken whenever the signal rises from a value lower than the Supervision 1 high limit - 0.5 * hysteresis to a value which is higher than the Supervision 1 high limit + 0.5 * hysteresis. Action is deactivated when the signal falls to lower than the Supervision 1 high limit - 0.5*hysteresis.	9
32.06	*Supervision 1 action*	Selects whether the drive generates a fault, warning or neither 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 warning or fault generated.	0
	Warning	Warning *A8B0 Signal supervision* is generated.	1
	Fault	The drive trips on fault *80B0 Signal supervision*.	2
	Fault if running	The drive trips on fault *80B0 Signal supervision* if running.	3
32.07	*Supervision 1 signal*	Selects the signal to be monitored by signal supervision function 1.	*Frequency*
	Zero	None.	0
	Speed	*01.01 Motor speed used*.	1
	Frequency	*01.06 Output frequency*.	3
	Current	*01.07 Motor current*.	4
	Torque	*01.10 Motor torque*.	6
	DC voltage	*01.11 DC voltage*.	7
	Output power	*01.14 Output power*.	8
	AI1	*12.11 AI1 actual value*.	9
	AI2	*12.21 AI2 actual value*.	10
	Speed ref ramp in	*23.01 Speed ref ramp input*.	18
	Speed ref ramp out	*23.02 Speed ref ramp output*.	19
	Speed ref used	*24.01 Used speed reference*.	20
	Torque ref used	*26.02 Torque reference used*.	21
	Freq ref used	*28.02 Frequency ref ramp output*.	22
	Inverter temperature	*05.11 Inverter temperature*.	23
	Process PID output	*40.01 Process PID output actual*.	24
	Process PID feedback	*40.02 Process PID feedback actual*.	25
	Process PID setpoint	*40.03 Process PID setpoint actual*.	26
	Process PID deviation	*40.04 Process PID deviation actual*.	27
	Other	Source selection (see *Terms and abbreviations*).	-

No.	Name/Value	Description	Default FbEq 16
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.	-
32.11	*Supervision 1 hysteresis*	Defines the hysteresis for the signal monitored by signal supervision 1. **Note:** This parameter applies to all selections of parameter *32.05*, not just selection Hysteresis (7).	0.00
	0.00…100000.00	Hysteresis.	-
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 is below the Supervision 2 low limit - 0.5 * hysteresis. Action is deactivated whenever the signal is above the Supervision 2 low limit + 0.5 * hysteresis.	1
	High	Action is taken whenever the signal is above the Supervision 2 high limit + 0.5 * hysteresis. Action is deactivated whenever the signal is below the Supervision 2 high limit - 0.5 * hysteresis.	2
	Abs low	Action is taken whenever the absolute value of the signal is below the absolute value of the Supervision 2 low limit - 0.5 * hysteresis. Action is deactivated whenever the absolute value of the signal is above the absolute value of the Supervision 2 low limit + 0.5 * hysteresis.	3
	Abs high	Action is taken whenever the absolute value of the signal is above the absolute value of the Supervision 2 high limit + 0.5 * hysteresis. Action is deactivated whenever the absolute value of the signal is below the absolute value of the Supervision 2 high limit - 0.5 * hysteresis.	4

No.	Name/Value	Description	Default FbEq 16
	Both	Action is taken whenever the signal is above the Supervision 2 high limit + 0.5 * hysteresis or below the Supervision 2 low limit - 0.5*hysteresis. Action is deactivated whenever the signal is in between the Supervision 2 high limit - 0.5 * hysteresis and the Supervision 2 low limit + 0.5*hysteresis.	5
	Abs both	Action is taken whenever the absolute value of the signal is above the absolute value of the Supervision 2 high limit + 0.5 * hysteresis or below the absolute value of the Supervision 2 low limit - 0.5*hysteresis. Action is deactivated whenever the absolute value of the signal is in between the absolute value of the Supervision 2 high limit - 0.5 * hysteresis and the absolute value of the Supervision 2 low limit + 0.5*hysteresis.	6
	Hysteresis	Action is taken whenever the signal is above the Supervision 2 high limit + 0.5 * hysteresis. Action is deactivated whenever the signal is below the Supervision 2 low limit - 0.5 * hysteresis. The status is unchanged when the signal value is in between the Supervision 2 high limit + 0.5 * hysteresis and the Supervision 2 low limit - 0.5 * hysteresis.	7
	Low falling	Action is taken whenever the signal falls from a value higher than the Supervision 2 low limit + 0.5 * hysteresis to a value which is lower than the Supervision 2 low limit - 0.5 * hysteresis. Action is deactivated when the signal rises to higher than the Supervision 2 low limit + 0.5*hysteresis.	8
	High rising	Action taken whenever the signal rises from a value lower than the Supervision 2 high limit - 0.5 * hysteresis to a value which is higher than the Supervision 2 high limit + 0.5 * hysteresis. Action is deactivated when the signal falls to lower than the Supervision 2 high limit - 0.5*hysteresis.	9

No.	Name/Value	Description	Default FbEq 16
32.16	Supervision 2 action	Selects whether the drive generates a fault, warning or neither 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 warning or fault generated.	0
	Warning	Warning A8B0 Signal supervision is generated.	1
	Fault	The drive trips on fault 80B0 Signal supervision.	2
	Fault if running	The drive trips on fault 80B0 Signal supervision if running.	3
32.17	Supervision 2 signal	Selects the signal to be monitored by signal supervision function 2. For the available selections, see parameter 32.07 Supervision 1 signal.	Current
32.18	Supervision 2 filter time	Defines a filter time constant for the signal monitored by signal supervision 2.	0.000 s
	0.000 … 30.000 s	Signal filter time.	1000 = 1 s
32.19	Supervision 2 low	Defines the lower limit for signal supervision 2.	0.00
	-21474830.00… 21474830.00	Low limit.	-
32.20	Supervision 2 high	Defines the upper limit for signal supervision 2.	0.00
	-21474830.00… 21474830.00	Upper limit.	-
32.21	Supervision 2 hysteresis	Defines the hysteresis for the signal monitored by signal supervision 2. **Note:** This parameter applies to all selections of parameter 32.15, not just selection Hysteresis (7).	0.00
	0.00…100000.00	Hysteresis.	-
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 is below the Supervision 3 low limit - 0.5 * hysteresis. Action is deactivated whenever the signal is above the Supervision 3 low limit + 0.5 * hysteresis.	1

No.	Name/Value	Description	Default FbEq 16
	High	Action is taken whenever the signal is above the Supervision 3 high limit + 0.5 * hysteresis. Action is deactivated whenever the signal is below the Supervision 3 high limit - 0.5 * hysteresis.	2
	Abs low	Action is taken whenever the absolute value of the signal is below the absolute value of the Supervision 3 low limit - 0.5 * hysteresis. Action is deactivated whenever the absolute value of the signal is above the absolute value of the Supervision 3 high limit + 0.5 * hysteresis.	3
	Abs high	Action is taken whenever the absolute value of the signal is above the absolute value of the Supervision 3 high limit + 0.5 * hysteresis. Action is deactivated whenever the absolute value of the signal is below the absolute value of the Supervision 3 high limit - 0.5 * hysteresis.	4
	Both	Action is taken whenever the signal is above the Supervision 3 high limit + 0.5 * hysteresis or below the Supervision 3 low limit - 0.5*hysteresis. Action is deactivated whenever the signal is in between the Supervision 3 high limit - 0.5 * hysteresis and the Supervision 3 low limit + 0.5*hysteresis.	5
	Abs both	Action is taken whenever the absolute value of the signal is above the absolute value of the Supervision 3 high limit + 0.5 * hysteresis or below the absolute value of the Supervision 3 low limit - 0.5*hysteresis. Action is deactivated whenever the absolute value of the signal is in between the absolute value of the Supervision 3 high limit - 0.5 * hysteresis and the absolute value of the Supervision 3 low limit + 0.5*hysteresis.	6
	Hysteresis	Action is taken whenever the signal is above the Supervision 3 high limit + 0.5 * hysteresis. Action is deactivated whenever the signal is below the Supervision 3 low limit - 0.5 * hysteresis. The status is unchanged when the signal value is in between the Supervision 3 high limit + 0.5 * hysteresis and the Supervision 3 low limit - 0.5 * hysteresis.	7

No.	Name/Value	Description	Default FbEq 16
	Low falling	Action is taken whenever the signal falls from a value higher than the Supervision 3 low limit + 0.5 * hysteresis to a value which is lower than the Supervision 3 low limit - 0.5 * hysteresis. Action is deactivated when the signal rises to higher than the Supervision 3 low limit + 0.5*hysteresis.	8
	High rising	Action taken whenever the signal rises from a value lower than the Supervision 3 high limit - 0.5 * hysteresis to a value which is higher than the Supervision 3 high limit + 0.5 * hysteresis. Action is deactivated when the signal falls to lower than the Supervision 3 high limit - 0.5*hysteresis.	9
32.26	*Supervision 3 action*	Selects whether the drive generates a fault, warning or neither 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 warning or fault generated.	0
	Warning	Warning *A8B0 Signal supervision* is generated.	1
	Fault	The drive trips on fault *80B0 Signal supervision*.	2
	Fault if running	The drive trips on fault *80B0 Signal supervision* if running.	3
32.27	*Supervision 3 signal*	Selects the signal to be monitored by signal supervision function 3. For the available selections, see parameter *32.07 Supervision 1 signal*.	*Torque*
32.28	*Supervision 3 filter time*	Defines a filter time constant for the signal monitored by signal supervision 3.	0.000 s
	0.000 … 30.000 s	Signal filter time.	1000 = 1 s
32.29	*Supervision 3 low*	Defines the lower limit for signal supervision 3.	0.00
	-21474830.00… 21474830.00	Low limit.	-
32.30	*Supervision 3 high*	Defines the upper limit for signal supervision 3.	0.00
	-21474830.00… 21474830.00	Upper limit.	-
32.31	*Supervision 3 hysteresis*	Defines the hysteresis for the signal monitored by signal supervision 3. **Note:** This parameter applies to all selections of parameter *32.25*, not just selection Hysteresis (7).	0.00
	0.00…100000.00	Hysteresis.	-

No.	Name/Value	Description	Default FbEq 16
32.35	*Supervision 4 function*	Selects the mode of signal supervision function 4. Determines how the monitored signal (see parameter *32.37* is compared to its lower and upper limits (*32.39* and *32.30* respectively). The action to be taken when the condition is fulfilled is selected by *32.36*.	*Disabled*
	Disabled	Signal supervision 4 not in use.	0
	Low	Action is taken whenever the signal is below the Supervision 4 low limit - 0.5 * hysteresis. Action is deactivated whenever the signal is above the Supervision 4 low limit + 0.5 * hysteresis.	1
	High	Action is taken whenever the signal is above the Supervision 4 high limit + 0.5 * hysteresis. Action is deactivated whenever the signal is below the Supervision 4 high limit - 0.5 * hysteresis.	2
	Abs low	Action is taken whenever the absolute value of the signal is below the absolute value of the Supervision 4 low limit - 0.5 * hysteresis. Action is deactivated whenever the absolute value of the signal is above the absolute value of the Supervision 4 low limit + 0.5 * hysteresis.	3
	Abs high	Action is taken whenever the absolute value of the signal is above the absolute value of the Supervision 4 high limit + 0.5 * hysteresis. Action is deactivated whenever the absolute value of the signal is below the absolute value of the Supervision 4 high limit - 0.5 * hysteresis.	4
	Both	Action is taken whenever the signal is above the Supervision 4 high limit + 0.5 * hysteresis or below the Supervision 4 low limit - 0.5*hysteresis. Action is deactivated whenever the signal is in between the Supervision 4 high limit - 0.5 * hysteresis and the Supervision 4 low limit + 0.5*hysteresis.	5
	Abs both	Action is taken whenever the absolute value of the signal is above the absolute value of the Supervision 4 high limit + 0.5 * hysteresis or below the absolute value of the Supervision 4 low limit - 0.5*hysteresis. Action is deactivated whenever the absolute value of the signal is in between the absolute value of the Supervision 4 high limit - 0.5 * hysteresis and the absolute value of the Supervision 4 low limit + 0.5*hysteresis.	6

No.	Name/Value	Description	Default FbEq 16
	Hysteresis	Action is taken whenever the signal is above the Supervision 4 high limit + 0.5 * hysteresis. Action is deactivated whenever the signal is below the Supervision 4 low limit - 0.5 * hysteresis. The status is unchanged when the signal value is in between the Supervision 4 high limit + 0.5 * hysteresis and the Supervision 4 low limit - 0.5 * hysteresis.	7
	Low falling	Action is taken whenever the signal falls from a value higher than the Supervision 4 low limit + 0.5 * hysteresis to a value which is lower than the Supervision 4 low limit - 0.5 * hysteresis. Action is deactivated when the signal rises to higher than the Supervision 4 low limit + 0.5*hysteresis.	8
	High rising	Action taken whenever the signal rises from a value lower than the Supervision 4 high limit - 0.5 * hysteresis to a value which is higher than the Supervision 4 high limit + 0.5 * hysteresis. Action is deactivated when the signal falls to lower than the Supervision 4 high limit - 0.5*hysteresis.	9
32.36	*Supervision 4 action*	Selects whether the drive generates a fault, warning or neither when the value monitored by signal supervision 4 exceeds its limits. **Note:** This parameter does not affect the status indicated by *32.01 Supervision status*.	*No action*
	No action	No warning or fault generated.	0
	Warning	Warning *A8B0 Signal supervision* is generated.	1
	Fault	The drive trips on fault *80B0 Signal supervision*.	2
	Fault if running	The drive trips on fault *80B0 Signal supervision* if running.	3
32.37	*Supervision 4 signal*	Selects the signal to be monitored by signal supervision function 4. For the available selections, see parameter *32.07 Supervision 1 signal*.	*Zero*
32.38	*Supervision 4 filter time*	Defines a filter time constant for the signal monitored by signal supervision 4.	0.000 s
	0.000 … 30.000 s	Signal filter time.	1000 = 1 s
32.39	*Supervision 4 low*	Defines the lower limit for signal supervision 4.	0.00
	-21474830.00… 21474830.00	Low limit.	-

No.	Name/Value	Description	Default FbEq 16
32.40	*Supervision 4 high*	Defines the upper limit for signal supervision 4.	0.00
	-21474830.00… 21474830.00	Upper limit.	-
32.41	*Supervision 4 hysteresis*	Defines the hysteresis for the signal monitored by signal supervision 4. **Note:** This parameter applies to all selections of parameter *32.35*, not just selection Hysteresis (7).	0.00
	0.00…100000.00	Hysteresis.	-
32.45	*Supervision 5 function*	Selects the mode of signal supervision function 5. Determines how the monitored signal (see parameter *32.47*) is compared to its lower and upper limits (*32.49* and *32.40* respectively). The action to be taken when the condition is fulfilled is selected by *32.46*.	*Disabled*
	Disabled	Signal supervision 5 not in use.	0
	Low	Action is taken whenever the signal is below the Supervision 5 low limit - 0.5 * hysteresis. Action is deactivated whenever the signal is above the Supervision 5 low limit + 0.5 * hysteresis.	1
	High	Action is taken whenever the signal is above the Supervision 5 high limit + 0.5 * hysteresis. Action is deactivated whenever the signal is below the Supervision 5 high limit - 0.5 * hysteresis.	2
	Abs low	Action is taken whenever the absolute value of the signal is below the absolute value of the Supervision 5 low limit - 0.5 * hysteresis. Action is deactivated whenever the absolute value of the signal is above the absolute value of the Supervision 5 low limit + 0.5 * hysteresis.	3
	Abs high	Action is taken whenever the absolute value of the signal is above the absolute value of the Supervision 5 high limit + 0.5 * hysteresis. Action is deactivated whenever the absolute value of the signal is below the absolute value of the Supervision 5 high limit - 0.5 * hysteresis.	4
	Both	Action is taken whenever the signal is above the Supervision 5 high limit + 0.5 * hysteresis or below the Supervision 5 low limit - 0.5*hysteresis. Action is deactivated whenever the signal is in between the Supervision 5 high limit - 0.5 * hysteresis and the Supervision 5 low limit + 0.5*hysteresis.	5

No.	Name/Value	Description	Default FbEq 16
	Abs both	Action is taken whenever the absolute value of the signal is above the absolute value of the Supervision 5 high limit + 0.5 * hysteresis or below the absolute value of the Supervision 5 low limit - 0.5*hysteresis. Action is deactivated whenever the absolute value of the signal is in between the absolute value of the Supervision 5 high limit - 0.5 * hysteresis and the absolute value of the Supervision 5 low limit + 0.5*hysteresis.	6
	Hysteresis	Action is taken whenever the signal is above the Supervision 5 high limit + 0.5 * hysteresis. Action is deactivated whenever the signal is below the Supervision 5 low limit - 0.5 * hysteresis. The status is unchanged when the signal value is in between the Supervision 5 high limit + 0.5 * hysteresis and the Supervision 5 low limit - 0.5 * hysteresis.	7
	Low falling	Action is taken whenever the signal falls from a value higher than the Supervision 5 low limit + 0.5 * hysteresis to a value which is lower than the Supervision 5 low limit - 0.5 * hysteresis. Action is deactivated when the signal rises to higher than the Supervision 5 low limit + 0.5*hysteresis.	8
	High rising	Action taken whenever the signal rises from a value lower than the Supervision 5 high limit - 0.5 * hysteresis to a value which is higher than the Supervision 5 high limit + 0.5 * hysteresis. Action is deactivated when the signal falls to lower than the Supervision 5 high limit - 0.5*hysteresis.	9
32.46	*Supervision 5 action*	Selects whether the drive generates a fault, warning or neither when the value monitored by signal supervision 5 exceeds its limits. **Note:** This parameter does not affect the status indicated by *32.01 Supervision status*.	*No action*
	No action	No warning or fault generated.	0
	Warning	Warning *A8B0 Signal supervision* is generated.	1
	Fault	The drive trips on fault *80B0 Signal supervision*.	2
	Fault if running	The drive trips on fault *80B0 Signal supervision* if running.	3

No.	Name/Value	Description	Default FbEq 16
32.47	*Supervision 5 signal*	Selects the signal to be monitored by signal supervision function 5. For the available selections, see parameter *32.07 Supervision 1 signal*.	*Zero*
32.48	*Supervision 5 filter time*	Defines a filter time constant for the signal monitored by signal supervision 5.	0.000 s
	0.000 … 30.000 s	Signal filter time.	1000 = 1 s
32.49	*Supervision 5 low*	Defines the lower limit for signal supervision 5.	0.00
	-21474830.00… 21474830.00	Low limit.	-
32.50	*Supervision 5 high*	Defines the upper limit for signal supervision 5.	0.00
	-21474830.00… 21474830.00	Upper limit.	-
32.51	*Supervision 5 hysteresis*	Defines the hysteresis for the signal monitored by signal supervision 5. **Note:** This parameter applies to all selections of parameter *32.45*, not just selection Hysteresis.	0.00
	0.00…100000.00	Hysteresis.	-
32.55	*Supervision 6 function*	Selects the mode of signal supervision function 6. Determines how the monitored signal (see parameter *32.57*) is compared to its lower and upper limits (*32.59* and *32.50* respectively). The action to be taken when the condition is fulfilled is selected by *32.56*.	*Disabled*
	Disabled	Signal supervision 6 not in use.	0
	Low	Action is taken whenever the signal is below the Supervision 6 low limit - 0.5 * hysteresis. Action is deactivated whenever the signal is above the Supervision 6 low limit + 0.5 * hysteresis.	1
	High	Action is taken whenever the signal is above the Supervision 6 high limit + 0.5 * hysteresis. Action is deactivated whenever the signal is below the Supervision 6 high limit - 0.5 * hysteresis.	2
	Abs low	Action is taken whenever the absolute value of the signal is below the absolute value of the Supervision 6 low limit - 0.5 * hysteresis. Action is deactivated whenever the absolute value of the signal is above the absolute value of the Supervision 6 low limit + 0.5 * hysteresis.	3

No.	Name/Value	Description	Default FbEq 16
	Abs high	Action is taken whenever the absolute value of the signal is above the absolute value of the Supervision 6 high limit + 0.5 * hysteresis. Action is deactivated whenever the absolute value of the signal is below the absolute value of the Supervision 6 high limit - 0.5 * hysteresis.	4
	Both	Action is taken whenever the signal is above the Supervision 6 high limit + 0.5 * hysteresis or below the Supervision 6 low limit - 0.5*hysteresis. Action is deactivated whenever the signal is in between the Supervision 6 high limit - 0.5 * hysteresis and the Supervision 6 low limit + 0.5*hysteresis.	5
	Abs both	Action is taken whenever the absolute value of the signal is above the absolute value of the Supervision 6 high limit + 0.5 * hysteresis or below the absolute value of the Supervision 6 low limit - 0.5*hysteresis. Action is deactivated whenever the absolute value of the signal is in between the absolute value of the Supervision 6 high limit - 0.5 * hysteresis and the absolute value of the Supervision 6 low limit + 0.5*hysteresis.	6
	Hysteresis	Action is taken whenever the signal is above the Supervision 6 high limit + 0.5 * hysteresis. Action is deactivated whenever the signal is below the Supervision 6 low limit - 0.5 * hysteresis. The status is unchanged when the signal value is in between the Supervision 6 high limit + 0.5 * hysteresis and the Supervision 6 low limit - 0.5 * hysteresis.	7
	Low falling	Action is taken whenever the signal falls from a value higher than the Supervision 6 low limit + 0.5 * hysteresis to a value which is lower than the Supervision 6 low limit - 0.5 * hysteresis. Action is deactivated when the signal rises to higher than the Supervision 6 low limit + 0.5*hysteresis.	8
	High rising	Action taken whenever the signal rises from a value lower than the Supervision 6 high limit - 0.5 * hysteresis to a value which is higher than the Supervision 6 high limit + 0.5 * hysteresis. Action is deactivated when the signal falls to lower than the Supervision 6 high limit - 0.5*hysteresis.	9

No.	Name/Value	Description	Default FbEq 16
32.56	*Supervision 6 action*	Selects whether the drive generates a fault, warning or neither when the value monitored by signal supervision 6 exceeds its limits. **Note:** This parameter does not affect the status indicated by *32.01 Supervision status*.	*No action*
	No action	No warning or fault generated.	0
	Warning	Warning *A8B0 Signal supervision* is generated.	1
	Fault	The drive trips on fault *80B0 Signal supervision*.	2
	Fault if running	The drive trips on fault *80B0 Signal supervision* if running.	3
32.57	*Supervision 6 signal*	Selects the signal to be monitored by signal supervision function 6. For the available selections, see parameter *32.07 Supervision 1 signal*.	*Zero*
32.58	*Supervision 6 filter time*	Defines a filter time constant for the signal monitored by signal supervision 6.	0.000 s
	0.000 … 30.000 s	Signal filter time.	1000 = 1 s
32.59	*Supervision 6 low*	Defines the lower limit for signal supervision 6.	0.00
	-21474830.00… 21474830.00	Low limit.	-
32.60	*Supervision 6 high*	Defines the upper limit for signal supervision 6.	0.00
	-21474830.00… 21474830.00	Upper limit.	-
32.61	*Supervision 6 hysteresis*	Defines the hysteresis for the signal monitored by signal supervision 6. **Note:** This parameter applies to all selections of parameter *32.55*, not just selection Hysteresis.	0.00
	0.00…100000.00	Hysteresis.	-
33 Generic timer & counter		Generic timer and counter functions.	
33.02	*HS counter actual value*	Actual value of the high speed counter. The counter is updated every 2 ms.	0
	0...4294967295	Counter value.	1 = 1 (shows only lower bits)
33.04	*HS counter status word*	Status word for the high speed counter.	0000h

No.	**Name/Value**	**Description**	**Default** **FbEq 16**

Bit	**Name**	**Description**
0	Counter rollover	1 = Counter has rolled over to the opposite limit. The bit will remain 1 until the counter has been preset. See parameter *33.72 HS counter limit mode selection*.
1	Counter saturated	1 = Counter is at the minimum/maximum limit. See parameter *33.72 HS counter limit mode selection*.
2	Counter under preset	1 = Counter value below the preset value. See parameter *33.77 HS counter preset value*.
3	Counter at preset	1 = Counter value at the preset value. See parameter *33.77 HS counter preset value*.
4	Counter over preset	1 = Counter value over the preset value. See parameter *33.77 HS counter preset value*.
5…15	Reserved	

	0000h…FFFFh	Status word.	1= 1
33.71	*HS counter source selection*	Selects the signal source for the high speed counter.	*Not in use*
	Not in use	Counter not active.	0
	F1	Counter source is the frequency IO pin of input 1.	1
	Encoder without direction	Encoder pulse edges are used as the counter source. The counter value increases by one per each rising or falling pulse edge.	5
	Encoder with direction	Encoder pulse edges are used as the counter source. The direction of rotation is taken into account. When a rising or a falling edge is detected , • and the direction of the rotation is forward, the counter value increases by one. • and the direction of the rotation is reverse, the counter value decreases by one. With selection *Encoder with direction*, parameter *33.73 HS counter direction selection* is ignored.	6
	DI1 (slow)	Digital input 1.	10
	DI2 (slow)	Digital input 2.	11
	DI3 (slow)	Digital input 3.	12
	DI4 (slow)	Digital input 4.	13
	DI5 (slow)	Digital input 5.	14
	DI6 (slow)	Digital input 6. Not available in ACS380.	15
	DIO1 (slow)	Digital I/O 1. With BMIO-01.	20
	DIO2 (slow)	Digital I/O 2. With BMIO-01.	21
	Other [bit]	Source selection (see *Terms and abbreviations*).	-

No.	Name/Value	Description	Default FbEq 16
33.72	*HS counter limit mode selection*	Selects how the counter value is changed after minimum or maximum limit has been exceeded.	*Rollover*
	Rollover	Counter rolls over when maximum or minimum is reached.	0
	Saturated	Counter saturates to maximum or minimum when reached.	1
33.73	*HS counter direction selection*	Selects the direction of the high speed counter. This parameter has no effect if *Encoder with direction* is selected in parameter *33.71 HS counter source selection*.	*Up*
	Up	Counter counts upwards.	0
	Down	Counter counts downwards.	1
	Motor actual direction	Direction follows parameter *06.19 Speed control status word* bit 2. If the value of the bit is zero, direction is up, otherwise down.	2
	DI1	Digital input 1.	10
	DI2	Digital input 2.	11
	DI3	Digital input 3.	12
	DI4	Digital input 4.	13
	DI5	Digital input 5.	14
	DI6	Digital input 6.	15
	DIO1	Digital I/O 1.	20
	DIO2	Digital I/O 2.	21
	Other [bit]	Source selection (see *Terms and abbreviations*).	-
33.74	*HS counter lower limit*	Defines the lowest possible value for the high speed counter.	0
	0...4294967295	Lower limit value.	1 = 1
33.75	*HS counter upper limit*	Defines the highest possible value for the high speed counter.	4294967295
	0...4294967295	Upper limit value.	1 = 1
33.76	*HS counter preset selection*	Selects the signal source for the high speed counter preset activation. Rising edge of the signal is used.	*Not in use*
	Not in use	Preset is not in use.	0
	Preset	Preset is active. To preset the counter again, *Not in use* must be selected first.	1
	DI1	Digital input 1.	2
	DI2	Digital input 2.	3
	DI3	Digital input 3.	4
	DI4	Digital input 4.	5

No.	Name/Value	Description	Default FbEq 16
	DI5	Digital input 5.	6
	DI6	Digital input 6.	7
	DIO1	Digital I/O 1.	10
	DIO2	Digital I/O 2.	11
	Other [bit]	Source selection (see *Terms and abbreviations*).	-
33.77	*HS counter preset value*	Defines the value to which the high speed counter is set during preset.	0
	0...4294967295	Preset value.	1 = 1
33.79	*HS counter divider*	With high speed counter divider (n), the counter value can be increased after every n pulses received from the selected counter source.	1
	1	Divider is not used.	1 = 1
	2...4294967295	Divider value.	1 = 1
33.80	*HS counter enable*	Enables the high speed counter.	*Off*
	Off	High speed counter is off.	0
	On	High speed counter is on.	1
	DI1	Counter is enabled by Digital Input 1 (see parameter *10.02 DI delayed status bit 0).*	2
	DI2	Counter is enabled by Digital input 2 (see parameter *10.02 DI delayed status bit 1).*	3
	DI3	Counter is enabled by Digital Input 3 (see parameter *10.02 DI delayed status bit 2).*	4
	DI4	Counter is enabled by Digital Input 4 (see parameter *10.02 DI delayed status bit 3).*	5
	DI5	Counter is enabled by Digital Input 5 (see parameter *10.02 DI delayed status bit 4).*	6
	DI6	Counter is enabled by Digital Input 6 (see parameter *10.02 DI delayed status bit 5).*	7
	Other [bit]	Source selection (see *Terms and abbreviations*).	-

34 Timed functions		Configuration of the timed functions	
34.01	*Timed functions status*	Shows the status of the timed functions. The status of a timed function is the logical OR of all timers connected to it. This parameter is read-only. User can select the operation and timer for each timed function from the assistant panel Primary settings menu (Menu > Primary settings > Advanced functions > Time functions). The parameters in this group can be used to set the timers for each function.	-

No.	Name/Value	Description	Default FbEq 16

Bit	Name	Description
0	Timed function 1	1 = Active.
1	Timed function 2	1 = Active.
2	Timed function 3	1 = Active.
3…15	Reserved	

No.	Name/Value	Description	Default FbEq 16
	0000h…0FFFFh	Status of combined timers 1…3.	1 = 1
34.02	*Timer status*	Shows the status of timers 1…12. This parameter is read-only.	-

Bit	Name	Description
0	Timer 1	1 = Active.
1	Timer 2	1 = Active.
2	Timer 3	1 = Active.
3	Timer 4	1 = Active.
4	Timer 5	1 = Active.
5	Timer 6	1 = Active.
6	Timer 7	1 = Active.
7	Timer 8	1 = Active.
8	Timer 9	1 = Active.
9	Timer 10	1 = Active.
10	Timer 11	1 = Active.
11	Timer 12	1 = Active.
12…15	Reserved	

No.	Name/Value	Description	Default FbEq 16
	0000h…FFFFh	Timer status.	1 = 1
34.04	*Season/exception day status*	Shows the status of seasons 1…3, exception workday and exception holiday. Only one season can be active at a time. A day can be a workday and a holiday at the same time. This parameter is read-only.	-

Bit	Name	Description
0	Status of season 1	1 = Active.
1	Status of season 2	1 = Active.
2	Status of season 3	1 = Active.
3	Status of season 4	1 = Active.
4…9	Reserved	
10	Status of exception workday	1 = Active.
11	Status of exception holiday	1 = Active.
12…15	Reserved	

No.	Name/Value	Description	Default FbEq 16
	0000h…FFFFh	Status of the seasons and exception workday and holiday.	1 = 1

No.	Name/Value	Description	Default FbEq 16
34.10	*Timed functions enable*	Selects the source for the timed functions enable signal. 0 = Disabled. 1 = Enabled. **Note:** The ACS380 drives do not have an inbuilt timer. Time needs to be provided through an external assistant control panel or PLC.	*Disabled*
	Disabled	0.	0
	Enabled	1.	1
	DI1	Digital input DI1 (*10.02 DI delayed status*, bit 0).	2
	DI2	Digital input DI2 (*10.02 DI delayed status*, bit 1).	3
	DI3	Digital input DI3 (*10.02 DI delayed status*, bit 2).	4
	DI4	Digital input DI4 (*10.02 DI delayed status*, bit 3).	5
	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*).	-

No.	Name/Value	Description	Default FbEq 16
34.11	*Timer 1 configuration*	Defines when timer 1 is active.	000001111 0000000

Bit	Name	Description
0	Monday	1 = Monday is an active start day.
1	Tuesday	1 = Tuesday is an active start day.
2	Wednesday	1 = Wednesday is an active start day.
3	Thursday	1 = Thursday is an active start day.
4	Friday	1 = Friday is an active start day.
5	Saturday	1 = Saturday is an active start day.
6	Sunday	1 = Sunday is an active start day.
7	Season 1	1 = Timer is active in season 1.
8	Season 2	1 = Timer is active in season 2.
9	Season 3	1 = Timer is active in season 3.
10	Season 4	1 = Timer is active in season 4.
11	Exceptions	0 = Exceptions days are disabled. 1 = Exception days are enabled. Bits 12 and 13 are taken into account.
12	Holidays	0 = Timer is inactive on exception days configured as "Holiday". 1 = Timer is active on exception days configured as "Holiday".
13	Workdays	0 = Timer is inactive on exception days configured as "Workday". 1 = Timer is active on exception days configured as "Workday".
14…15	Reserved	

No.	Name/Value	Description	Default FbEq 16
	0000h…FFFFh	Configuration of timer 1.	1 = 1
34.12	*Timer 1 start time*	Defines the daily start time of timer 1. The time can be changed in second steps. The timer can be started at an other time than the start time. E.g. if the timer's duration is more than one day and the active session starts during the time, the timer is started at 00:00 and stopped when there is no duration left.	00:00:00
	00:00:00…23:59:59	Daily start time of the timer.	1 = 1
34.13	*Timer 1 duration*	Defines the duration of timer 1. The duration can be changed in minute steps. The duration can extend over the change of the day but if an exception day becomes active, the period is interrupted at midnight. In the same way the period started on an exception day stays active only until the end of the day, even if the duration is longer. The timer will continue after a break if there is duration left.	00 00:00

No.	Name/Value	Description	Default FbEq 16
	00 00:00…07 00:00	Timer duration.	1 = 1
34.14	*Timer 2 configuration*	See *34.11 Timer 1 configuration*.	000001111 0000000
34.15	*Timer 2 start time*	See *34.12 Timer 1 start time*.	00:00:00
34.16	*Timer 2 duration*	See *34.13 Timer 1 duration*.	00 00:00
34.17	*Timer 3 configuration*	See *34.11 Timer 1 configuration*.	000001111 0000000
34.18	*Timer 3 start time*	See *34.12 Timer 1 start time*.	00:00:00
34.19	*Timer 3 duration*	See *34.13 Timer 1 duration*.	00 00:00
34.20	*Timer 4 configuration*	See *34.11 Timer 1 configuration*.	000001111 0000000
34.21	*Timer 4 start time*	See *34.12 Timer 1 start time*.	00:00:00
34.22	*Timer 4 duration*	See *34.13 Timer 1 duration*.	00 00:00
34.23	*Timer 5 configuration*	See *34.11 Timer 1 configuration*.	000001111 0000000
34.24	*Timer 5 start time*	See *34.12 Timer 1 start time*.	00:00:00
34.25	*Timer 5 duration*	See *34.13 Timer 1 duration*.	00 00:00
34.26	*Timer 6 configuration*	See *34.11 Timer 1 configuration*.	000001111 0000000
34.27	*Timer 6 start time*	See *34.12 Timer 1 start time*.	00:00:00
34.28	*Timer 6 duration*	See *34.13 Timer 1 duration*.	00 00:00
34.29	*Timer 7 configuration*	See *34.11 Timer 1 configuration*.	000001111 0000000
34.30	*Timer 7 start time*	See *34.12 Timer 1 start time*.	00:00:00
34.31	*Timer 7 duration*	See *34.13 Timer 1 duration*.	00 00:00
34.32	*Timer 8 configuration*	See *34.11 Timer 1 configuration*.	000001111 0000000
34.33	*Timer 8 start time*	See *34.12 Timer 1 start time*.	00:00:00
34.34	*Timer 8 duration*	See *34.13 Timer 1 duration*.	00 00:00
34.35	*Timer 9 configuration*	See *34.11 Timer 1 configuration*.	000001111 0000000
34.36	*Timer 9 start time*	See *34.12 Timer 1 start time*.	00:00:00
34.37	*Timer 9 duration*	See *34.13 Timer 1 duration*.	00 00:00
34.38	*Timer 10 configuration*	See *34.11 Timer 1 configuration*.	000001111 0000000
34.39	*Timer 10 start time*	See *34.12 Timer 1 start time*.	00:00:00
34.40	*Timer 10 duration*	See *34.13 Timer 1 duration*.	00 00:00
34.41	*Timer 11 configuration*	See *34.11 Timer 1 configuration*.	000001111 0000000

No.	Name/Value	Description	Default FbEq 16
34.42	*Timer 11 start time*	See *34.12 Timer 1 start time*.	00:00:00
34.43	*Timer 11 duration*	See *34.13 Timer 1 duration*.	00 00:00
34.44	*Timer 12 configuration*	See *34.11 Timer 1 configuration*.	000001111 0000000
34.45	*Timer 12 start time*	See *34.12 Timer 1 start time*.	00:00:00
34.46	*Timer 12 duration*	See *34.13 Timer 1 duration*.	00 00:00
34.60	*Season 1 start date*	Defines the start date of season 1 in format dd.mm, where dd is the number of the day and mm is the number of the month. The season changes at midnight. One season can be active at a time. Timers are started on exception days even if they are not inside the active season. The season start dates (1…4) must be given in increasing order to use all seasons. The default value is interpreted that the season is not configured. If the season start dates are not in increasing order and the value is something else than the default value, a season configuration warning is given.	01.01.
	01.01…31.12	Season start date.	
34.61	*Season 2 start date*	Defines the start date of season 2. See *34.60 Season 1 start date*.	01.01.
34.62	*Season 3 start date*	Defines the start date of season 3. See *34.60 Season 1 start date*.	01.01.
34.63	*Season 4 start date*	Defines the start date of season 4. See *34.60 Season 1 start date*.	01.01.
34.70	*Number of active exceptions*	Defines how many of the exceptions are active by specifying the last active one. All preceding exceptions are active. Exceptions 1…3 are periods (duration can be defined) and exceptions 4…16 are days (duration is always 24 hours). **Example:** If the value is 4, exceptions 1…4 are active, and exceptions 5…16 are not active.	3
	0…16	Number of active exception periods or days.	-
34.71	*Exception types*	Defines the types of exceptions 1…16 as workday or holiday. Exceptions 1…3 are periods (duration can be defined) and exceptions 4…16 are days (duration is always 24 hours).	0b0000

No.	Name/Value	Description	Default FbEq 16
		<table><tr><th>Bit</th><th>Name</th><th>Description</th></tr><tr><td>0</td><td>Exception 1</td><td>0 = Workday. 1 = Holiday</td></tr><tr><td>1</td><td>Exception 2</td><td>0 = Workday. 1 = Holiday</td></tr><tr><td>2</td><td>Exception 3</td><td>0 = Workday. 1 = Holiday</td></tr><tr><td>3</td><td>Exception 4</td><td>0 = Workday. 1 = Holiday</td></tr><tr><td>4</td><td>Exception 5</td><td>0 = Workday. 1 = Holiday</td></tr><tr><td>5</td><td>Exception 6</td><td>0 = Workday. 1 = Holiday</td></tr><tr><td>6</td><td>Exception 7</td><td>0 = Workday. 1 = Holiday</td></tr><tr><td>7</td><td>Exception 8</td><td>0 = Workday. 1 = Holiday</td></tr><tr><td>8</td><td>Exception 9</td><td>0 = Workday. 1 = Holiday</td></tr><tr><td>9</td><td>Exception 10</td><td>0 = Workday. 1 = Holiday</td></tr><tr><td>10</td><td>Exception 11</td><td>0 = Workday. 1 = Holiday</td></tr><tr><td>11</td><td>Exception 12</td><td>0 = Workday. 1 = Holiday</td></tr><tr><td>12</td><td>Exception 13</td><td>0 = Workday. 1 = Holiday</td></tr><tr><td>13</td><td>Exception 14</td><td>0 = Workday. 1 = Holiday</td></tr><tr><td>14</td><td>Exception 15</td><td>0 = Workday. 1 = Holiday</td></tr><tr><td>15</td><td>Exception 16</td><td>0 = Workday. 1 = Holiday</td></tr></table>	
	0b0000...0b1111	Types of exception period or days.	1 = 1
34.72	*Exception 1 start*	Defines the start date of the exception period in format dd.mm, where dd is the number of the day and mm is the number of the month. The timer started on an exception day is always stopped at 23:59:59 even if it has duration left. The same date can be configured to be holiday and workday. The date is active if any of exception days are active.	01.01.
	01.01.…31.12.	Start date of exception period 1.	
34.73	*Exception 1 length*	Defines the length of the exception period in days. Exception period is handled the same as a number of consecutive exception days.	0
	0…60	Length of exception period 1.	1 = 1
34.74	*Exception 2 start*	See *34.72 Exception 1 start*.	01.01.
34.75	*Exception 2 length*	See *34.73 Exception 1 length*.	0
34.76	*Exception 3 start*	See *34.72 Exception 1 start*.	01.01.
34.77	*Exception 3 length*	See *34.73 Exception 1 length*.	0
34.78	*Exception day 4*	Defines the date of exception day 4.	01.01.
	01.01.…31.12.	Start date of exception day 4. The timer started on an exception day is always stopped at 23:59:59 even if it has duration left.	
34.79	*Exception day 5*	See *34.79 Exception day 4*.	01.01
34.80	*Exception day 6*	See *34.79 Exception day 4*.	01.01

No.	Name/Value	Description	Default FbEq 16
34.81	*Exception day 7*	See *34.79 Exception day 4*.	01.01
34.82	*Exception day 8*	See *34.79 Exception day 4*.	01.01
34.83	*Exception day 9*	See *34.79 Exception day 4*.	01.01
34.84	*Exception day 10*	See *34.79 Exception day 4*.	01.01
34.85	*Exception day 11*	See *34.79 Exception day 4*.	01.01
34.86	*Exception day 12*	See *34.79 Exception day 4*.	01.01
34.87	*Exception day 13*	See *34.79 Exception day 4*.	01.01
34.88	*Exception day 14*	See *34.79 Exception day 4*.	01.01
34.89	*Exception day 15*	See *34.79 Exception day 4*.	01.01
34.90	*Exception day 16*	See *34.79 Exception day 4*.	01.01
34.100	*Timed function 1*	Defines which timers are connected to timed function 1. 0 = Not connected. 1 = Connected. See parameter *34.01 Timed functions status*.	0b0000

Bit	Name	Description
0	Timer 1	0 = Inactive. 1 = Active.
1	Timer 2	0 = Inactive. 1 = Active.
2	Timer 3	0 = Inactive. 1 = Active.
3	Timer 4	0 = Inactive. 1 = Active.
4	Timer 5	0 = Inactive. 1 = Active.
5	Timer 6	0 = Inactive. 1 = Active.
6	Timer 7	0 = Inactive. 1 = Active.
7	Timer 8	0 = Inactive. 1 = Active.
8	Timer 9	0 = Inactive. 1 = Active.
9	Timer 10	0 = Inactive. 1 = Active.
10	Timer 11	0 = Inactive. 1 = Active.
11	Timer 12	0 = Inactive. 1 = Active.
12…15	Reserved	

No.	Name/Value	Description	Default FbEq 16
	0b0000...0b1111	Timers connected to timed function 1.	1 = 1
34.101	*Timed function 2*	Defines which timers are connected to timed function 2. See *34.01 Timed functions status*.	0b0000
34.102	*Timed function 3*	Defines which timers are connected to timed function 3. See *34.01 Timed functions status*.	0b0000
34.110	*Boost time function*	Defines which timed functions (that is, timers that are connected to the timed functions) are activated with the boost time function.	0b0000

No.	Name/Value	Description	Default FbEq 16
		<table><tr><th>Bit</th><th>Name</th><th>Description</th></tr><tr><td>0</td><td>Timed function 1</td><td>0 = Inactive. 1 = Active.</td></tr><tr><td>1</td><td>Timed function 2</td><td>0 = Inactive. 1 = Active.</td></tr><tr><td>2</td><td>Timed function 3</td><td>0 = Inactive. 1 = Active.</td></tr><tr><td>3…15</td><td colspan="2">Reserved</td></tr></table>	
	0000h…FFFFh	Timed functions including the boost timer.	1 = 1
34.111	*Boost time activation source*	Selects the source of boost time activation signal. 0 = Disabled. 1 = Enabled.	*Off*
	Off	0.	0
	On	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
	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*).	-
34.112	*Boost time duration*	Defines the time inside which the boost time is deactivated after boost time activation signal is switched off. **Example:** If parameter *34.111 Boost time activation source source* is set to *DI1* and *34.112* is set to 00 01:30, the boost time is active for 1 hour and 30 minutes after digital input DI is deactivated.	00 00:00
	00 00:00…00 00:00	Boost time duration.	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 *76*).	
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.	20 °C
	-60…1000 °C	Estimated motor temperature.	1 = 1°

No.	Name/Value	Description	Default FbEq 16
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*. This parameter is read-only.	20 °C
	-60…5000 °C, or 0...5000 ohm	Measured temperature 1. **Note:** With a PTC sensor, the unit is ohm. If the measured temperature source selection (*35.11*) is PTC analog I/O or PTC AI/DI Voltage divider tree, the motor thermal protection function converts the analog input signal (*35.14*) to PTC resistance value (ohms), and shows it in this parameter. This is the case even the parameter name and unit refer to motor temperature (°C or °F). You cannot change the unit to ohm for the time being (*96.16*).	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*. This parameter is read-only.	20 °C
	-60…5000 °C, or 0...5000 ohm	Measured temperature 2. **Note:** With a PTC sensor, the unit is ohms. If the measured temperature source selection (*35.21*) is PTC analog I/O or PTC AI/DI Voltage divider tree, the motor thermal protection function converts the analog input signal (*35.24*) to PTC resistance value (ohms), and shows it in this parameter. This is the case even the parameter name and unit refer to motor temperature (°C or °F). You cannot change the unit to ohm for the time being (*96.16*).	1 = 1 unit
35.05	Motor overload level	Shows the motor overload level as a percentage of the motor overload fault limit.See section *Motor overload protection* (page *87*). This parameter is read-only.	0.0%
	0.0...300.0%	Motor overload level. 0.0% No motor overloading. 88.0% Motor overloaded to warning level. 100.0% Motor overloaded to fault level.	10 = 1%

No.	Name/Value	Description	Default FbEq 16
35.11	*Temperature 1 source*	Selects the source from which measured temperature 1 is read. Usually this source is from a sensor connected to the motor controlled by the drive, but it could be used to measure and monitor a temperature from other parts of the process as long as a suitable sensor is used as per the selection list. **Note**: Depending on this parameter selection the control program hides the non-relevant parameters in this group.	*Estimated temperatur e*
	Disabled	None. Temperature monitoring function 1 is disabled.	0
	Estimated temperature	Estimated motor temperature (see parameter *35.01 Motor estimated temperature*). The temperature is estimated from an internal drive calculation. It is important to set up the ambient temperature of the motor in *35.50 Motor ambient temperature*.	1
	KTY84 analog I/O	KTY84 sensor connected to the analog input selected by parameter *35.14 Temperature 1 AI source* and an analog output. The following settings are required: • Set the switch related to the analog input to U (voltage). Any change must be validated by a control unit reboot. • Set the appropriate analog input unit selection parameter in group *12 Standard AI* to *V* (volt). • In parameter group *13 Standard AO*, set the source selection parameter of the analog output to *Temp sensor 1 excitation*. The analog output feeds a constant current through the sensor. As the resistance of the sensor increases along with its temperature, the voltage over the sensor increases. The voltage is read by the analog input and converted into degrees.	2

No.	Name/Value	Description	Default FbEq 16
	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 following settings are required: • Set the hardware jumper or switch related to the analog input to ***U*** (voltage). Any change must be validated by a control unit reboot. • Set the appropriate analog input unit selection parameter in group *12 Standard AI* to *V* (volt). • In parameter group *13 Standard AO*, set the source selection parameter of the analog output to *Temp sensor 1 excitation*. The analog output feeds a constant current through the sensor. As the resistance of the sensor increases along with its temperature, the voltage over the sensor increases. The voltage is read by the analog input and converted into degrees.	5
	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
	Direct temperature	The temperature is taken from the source selected by parameter *35.14*. The value of the source is assumed to be in the unit of temperature specified by parameter 96.16.	11

No.	Name/Value	Description	Default FbEq 16
	KTY83 analog I/O	KTY83 sensor connected to the analog input selected by parameter *35.14 Temperature 1 AI source* and an analog output. The following settings are required: • Set the hardware jumper or switch related to the analog input to **U** (voltage). Any change must be validated by a control unit reboot. • Set the appropriate analog input unit selection parameter in group *12 Standard AI* to *V* (volt). • In parameter group *13 Standard AO*, set the source selection parameter of the analog output to *Temp sensor 1 excitation*. The analog output feeds a constant current through the sensor. As the resistance of the sensor increases along with its temperature, the voltage over the sensor increases. The voltage is read by the analog input and converted into degrees.	12
	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 following settings are required: • Set the hardware jumper or switch related to the analog input to **U** (voltage). Any change must be validated by a control unit reboot. • Set the appropriate analog input unit selection parameter in group *12 Standard AI* to *V* (volt). • In parameter group *13 Standard AO*, set the source selection parameter of the analog output to *Temp sensor 1 excitation*. The analog output feeds a constant current through the sensor. As the resistance of the sensor increases along with its temperature, the voltage over the sensor increases. The voltage is read by the analog input and converted into degrees.	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

No.	Name/Value	Description	Default FbEq 16
	Ni1000	Ni1000 sensor connected to the analog input selected by parameter *35.14 Temperature 1 AI source* and an analog output. The following settings are required: • Set the hardware jumper or switch related to the analog input to **U** (voltage). Any change must be validated by a control unit reboot. • Set the appropriate analog input unit selection parameter in group *12 Standard AI* to *V* (volt). • In parameter group *13 Standard AO*, set the source selection parameter of the analog output to *Temp sensor 1 excitation*. The analog output feeds a constant current through the sensor. As the resistance of the sensor increases along with its temperature, the voltage over the sensor increases. The voltage is read by the analog input and converted into degrees.	16
	PTC analog I/O	PTC sensor connected to the analog input selected by parameter *35.14* and an analog output. The required settings are the same as with selection *KTY84 analog I/O*. **Note:** With this selection, the control program converts the analog signal to PTC resistance value in ohms and shows it in parameter *35.02*. The parameter name and unit still refer to temperature.	20

No.	Name/Value	Description	Default FbEq 16
	PTC AI/DI Voltage divider tree	PTC sensor connected to the analog input selected by parameter *35.14*, DIn and 10 V reference. A special voltage divider connection must be in use instead of the normal PTC connection. The voltage divider connection uses the terminals +10 V, digital input and analog input. See the drive hardware manual for the actual connection. This selection makes it possible to connect the PTC when no analog output is available. The required settings are the same as with selection *KTY84 analog I/O*. In case of PTC the voltage read by the analog input is converted into ohms. **Notes:** • The used DI must not be configured to start any action in this setup. • Make sure that the digital input that you connect to this voltage divider circuit is not used for any other purpose in the control program. • With this selection, the parameter *35.02* shows PTC resistance in ohms, not motor temperature even the parameter name and unit still refer to temperature.	23
35.12	*Temperature 1 fault limit*	Defines the fault limit for temperature supervision function 1. The unit is selected by parameter *96.16 Unit selection*. **Note:** With a PTC sensor, the unit is ohms.	130 °C, or 4500 ohm
	-60…5000 °C, or 0...5000 ohm	Fault limit for temperature monitoring function 1.	1 = 1 unit
35.13	*Temperature 1 warning limit*	Defines the warning limit for temperature supervision function 1. The unit is selected by parameter *96.16 Unit selection*. **Note:** With a PTC sensor, the unit is ohms.	110 °C, or 4000 ohm
	-60…5000 °C, or 0...5000 ohm	Warning limit for temperature monitoring function 1.	1 = 1 unit
35.14	*Temperature 1 AI source*	Selects the input for parameter *35.11 Temperature 1 source* selections *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.	1
	AI2 actual value	Analog input AI2.	2

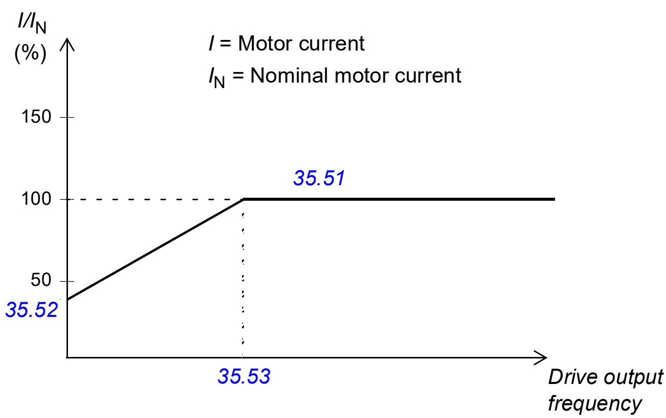
No.	Name/Value	Description	Default FbEq 16
	Other	Source selection (see *Terms and abbreviations*).	-
35.21	*Temperature 2 source*	Selects the source from which measured temperature 2 is read. Usually this source is from a sensor connected to the motor controlled by the drive, but it could be used to measure and monitor a temperature from other parts of the process as long as a suitable sensor is used as per the selection list.	*Estimated temperatur e*
	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 *36.24* and an analog output. The following settings are required: • Set the hardware jumper or switch related to the analog input to U (voltage). Any change must be validated by a control unit reboot. • Set the appropriate analog input unit selection parameter in group *12 Standard AI* to *V* (volt). • In parameter group *13 Standard AO*, set the source selection parameter of the analog output to *Temp sensor 2 excitation*. The analog output feeds a constant current through the sensor. As the resistance of the sensor increases along with its temperature, the voltage over the sensor increases. The voltage is read by the analog input and converted into degrees.	2

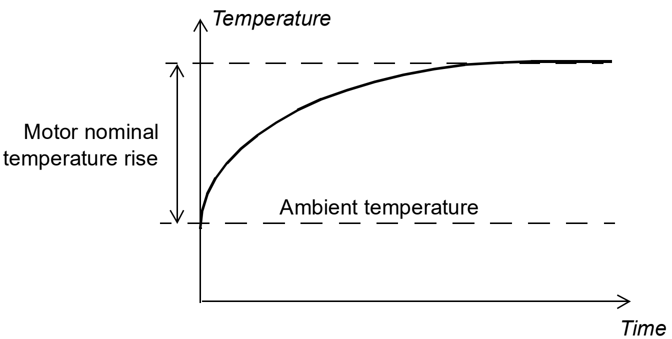
No.	Name/Value	Description	Default FbEq 16
	1 x Pt100 analog I/O	Pt100 sensor connected to a standard analog input selected by parameter *35.24* and an analog output. The following settings are required: • Set the hardware jumper or switch related to the analog input to ***U*** (voltage). Any change must be validated by a control unit reboot. • Set the appropriate analog input unit selection parameter in group *12 Standard AI* to *V* (volt). • In parameter group *13 Standard AO*, set the source selection parameter of the analog output to *Temp sensor 1 excitation*. The analog output feeds a constant current through the sensor. As the resistance of the sensor increases along with its temperature, the voltage over the sensor increases. The voltage is read by the analog input and converted into degrees.	5
	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
	Direct temperature	The temperature is taken from the source selected by parameter *35.24*. The value of the source is assumed to be in the unit of temperature specified by parameter 96.16.	11

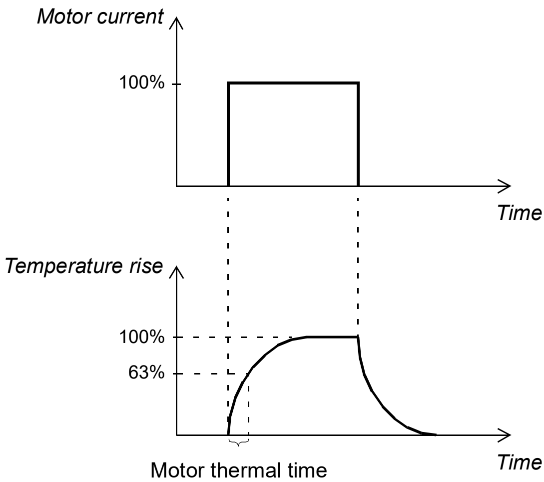
No.	Name/Value	Description	Default FbEq 16
	KTY83 analog I/O	KTY83 sensor connected to the analog input selected by parameter *35.24* and an analog output. The following settings are required: • Set the hardware jumper or switch related to the analog input to **U** (voltage). Any change must be validated by a control unit reboot. • Set the appropriate analog input unit selection parameter in group *12 Standard AI* to *V* (volt). • In parameter group *13 Standard AO*, set the source selection parameter of the analog output to *Temp sensor 1 excitation*. The analog output feeds a constant current through the sensor. As the resistance of the sensor increases along with its temperature, the voltage over the sensor increases. The voltage is read by the analog input and converted into degrees.	12
	1 × Pt1000 analog I/O	Pt1000 sensor connected to a standard analog input selected by parameter *36.24* and an analog output. The following settings are required: • Set the hardware jumper or switch related to the analog input to **U** (voltage). Any change must be validated by a control unit reboot. • Set the appropriate analog input unit selection parameter in group *12 Standard AI* to *V* (volt). • In parameter group *13 Standard AO*, set the source selection parameter of the analog output to *Temp sensor 2 excitation*. The analog output feeds a constant current through the sensor. As the resistance of the sensor increases along with its temperature, the voltage over the sensor increases. The voltage is read by the analog input and converted into degrees.	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

No.	Name/Value	Description	Default FbEq 16
	Ni1000	Ni1000 sensor connected to the analog input selected by parameter *34.24* and an analog output. The following settings are required: • Set the hardware jumper or switch related to the analog input to **U** (voltage). Any change must be validated by a control unit reboot. • Set the appropriate analog input unit selection parameter in group *12 Standard AI* to *V* (volt). • In parameter group *13 Standard AO*, set the source selection parameter of the analog output to *Temp sensor 1 excitation*. The analog output feeds a constant current through the sensor. As the resistance of the sensor increases along with its temperature, the voltage over the sensor increases. The voltage is read by the analog input and converted into degrees.	16
	PTC analog I/O	PTC sensor connected to the analog input selected by parameter *35.24* and an analog output. The required settings are the same as with selection *KTY84 analog I/O*. If a PTC sensor is used, the voltage ready by the analog input is converted into ohms.. **Note:** With this selection, the control program converts the analog signal to PTC resistance value in ohms and shows it in parameter *35.03*. The parameter name and unit still refer to temperature.	20

No.	Name/Value	Description	Default FbEq 16
	PTC AI/DI Voltage divider tree	PTC sensor connected to the analog input selected by parameter *35.24*, DIn and 10 V reference. A special voltage divider connection must be in use instead of the normal PTC connection. The voltage divider connection uses the terminals +10 V, digital input and analog input. See the drive hardware manual for the actual connection. This selection makes it possible to connect the PTC when no analog output is available. The required settings are the same as with selection *KTY84 analog I/O*. In case of PTC the voltage read by the analog input is converted into ohms. **Notes:** • The used DI must not be configured to start any action in this setup. • Make sure that the digital input that you connect to this voltage divider circuit is not used for any other purpose in the control program. • With this selection, the parameter *35.03* shows PTC resistance in ohms, not motor temperature even the parameter name and unit still refer to temperature.	23
35.22	*Temperature 2 fault limit*	Defines the fault limit for temperature supervision function 2. The unit is selected by parameter *96.16 Unit selection*. **Note:** With a PTC sensor, the unit is ohms.	130 °C, or 4500 ohm
	-60…5000 °C, or 0...5000 ohm	Fault limit for temperature monitoring function 2.	1 = 1 unit
35.23	*Temperature 2 warning limit*	Defines the warning limit for temperature supervision function 2. The unit is selected by parameter *96.16 Unit selection*. **Note:** With a PTC sensor, the unit is ohms.	110 °C, or 4000 ohm
	-60…5000 °C, or 0...5000 ohm	Warning limit for temperature monitoring function 2.	1 = 1 unit
35.24	*Temperature 2 AI source*	Selects the input for parameter *35.21 Temperature 2 source* selection *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*).	-

No.	Name/Value	Description	Default FbEq 16
35.50	*Motor ambient temperature*	Defines the ambient temperature of the motor for the motor thermal protection model. The unit is selected by parameter *96.16 Unit selection*. The motor thermal protection model estimates the motor temperature on the basis of parameters *35.50* … *35.55*. The motor temperature increases if it operates in the region above the load curve, and decreases if it operates in the region below the load curve. ⚠ **WARNING!** The model cannot protect the motor if the motor does not cool properly because of dust, dirt, etc.	20 °C or 68 °F
	-60…100 °C or -75 … 212 °F	Ambient temperature.	1 = 1°
35.51	*Motor load curve*	Defines the motor load curve together with parameters *35.52 Zero speed load* and *35.53 Break point*. The load curve is used by the motor thermal protection model to estimate the motor temperature. When the parameter is set to 100%, the maximum load is taken as the value of parameter *99.06 Motor nominal current* (higher loads heat up the motor). The load curve level should be adjusted if the ambient temperature differs from the nominal value set in *35.50 Motor ambient temperature*.	110%
			
	50…150%	Maximum load for the motor load curve.	1 = 1%

No.	Name/Value	Description	Default FbEq 16
35.52	*Zero speed load*	Defines the motor load curve together with parameters *35.51 Motor load curve* and *35.53 Break point*. Defines the maximum motor load at zero speed of the load curve. A higher value can be used if the motor has an external motor fan to boost the cooling. See the motor manufacturer's recommendations. See parameter *35.51 Motor load curve*.	70%
	25…150%	Zero speed load for the motor load curve.	1 = 1%
35.53	*Break point*	Defines the motor load curve together with parameters *35.51 Motor load curve* and *35.52 Zero speed load*. Defines the break point frequency of the load curve ie. the point at which the motor load curve begins to decrease from the value of parameter *35.51 Motor load curve* towards the value of parameter *35.52 Zero speed load*. See parameter *35.51 Motor load curve*.	45.00 Hz
	1.00…500.00 Hz	Break point for the motor load curve.	See par. *46.02*
35.54	*Motor nominal temperature rise*	Defines the temperature rise of the motor above ambient when the motor is loaded with nominal current. See the motor manufacturer's recommendations. The unit is selected by parameter *96.16 Unit selection*.  	80 °C or 176 °F
	0…300 °C or 32…572 °F	Temperature rise.	1 = 1°

No.	Name/Value	Description	Default FbEq 16
35.55	Motor thermal time constant	Defines the thermal time constant for use with the motor thermal protection model, defined as the time to reach 63% of the nominal motor temperature. See the motor manufacturer's recommendations.	256 s
			
	100…10000 s	Motor thermal time constant.	1 = 1 s
35.56	Motor overload action	Defines what action the drive should take when the system detects the motor overload specified by parameter 35.57.	Warning and fault
	No action	No action taken.	0
	Warning only	Drive generates warning A783 Motor overload when the motor is overloaded to the warning level, that is, parameter 35.05 reaches value 88.0%.	1
	Warning and fault	Drive generates warning A783 Motor overload when the motor is overloaded to the warning level, that is, parameter 35.05 reaches value 88.0%. Drive trips on fault 7122 Motor overload when the motor is overloaded to the fault level, that is, parameter 35.05 reaches value 100.0%.	2

No.	Name/Value	Description	Default FbEq 16
35.57	Motor overload class	Defines the motor overload class to be used. The class of protection is specified by the user as the time for tripping in seconds at 6 times the tripping level current. The function shares the following parameters with the Motor thermal model: • *35.51* • *35.52* • *35.53* Together, these three parameters set the tripping level as a function of motor frequency.	Class 20
	Class 5	Motor overload class 5.	0
	Class 10	Motor overload class 10.	1
	Class 20	Motor overload class 20.	2
	Class 30	Motor overload class 30.	3
	Class 40	Motor overload class 40.	4

36 Load analyzer		Peak value and amplitude logger settings. See also section *Load analyzer* (page *115*).	
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.	*Output power*
	Not selected	None (peak value logger disabled).	0
	Motor speed used	*01.01 Motor speed used*.	1
	Output frequency	*01.06 Output frequency*.	3
	Motor current	*01.07 Motor current*.	4
	Motor torque	*01.10 Motor torque*.	6
	DC voltage	*01.11 DC voltage*.	7
	Output power	*01.14 Output power*.	8
	Speed ref ramp in	*23.01 Speed ref ramp input*.	10
	Speed ref ramp out	*23.02 Speed ref ramp output*.	11
	Speed ref used	*24.01 Used speed reference*.	12
	Torque ref used	*26.02 Torque reference used*.	13
	Freq ref used	*28.02 Frequency ref ramp output*.	14

No.	Name/Value	Description	Default FbEq 16
	Process PID out	*40.01 Process PID output actual*.	16
	Other	Source selection (see *Terms and abbreviations*).	-
36.02	*PVL filter time*	Peak value logger filtering time. 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*
		See parameter *36.01* for the selections.	
36.07	*AL2 signal scaling*	Defines the monitored signal value for the amplitude logger AL2 that corresponds to 100% sample value.	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*	Shows the peak value recorded by the peak value logger.	0.00
	-32768.00… 32767.00	Peak value.	1 = 1
36.11	*PVL peak date*	Shows the date when the peak value was recorded.	01/01/1980
	1/1/1980...6/5/2159	Peak occurrence date.	-

No.	Name/Value	Description	Default FbEq 16
36.12	*PVL peak time*	Shows the time when the peak value was recorded.	00:00:00
	-	Peak occurrence time.	-
36.13	*PVL current at peak*	Shows 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*	Shows 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*	Shows the Motor speed at the moment the peak value was recorded.	0.00 rpm
	-30000… 30000 rpm	Motor speed at peak.	See par. *46.01*
36.16	*PVL reset date*	Shows the date on which the peak value logger was last reset.	01/01/1980
	1/1/1980...6/5/2159	Last reset date of the peak value logger.	-
36.17	*PVL reset time*	Shows the time when the peak value logger was last reset.	00:00:00
	-	Last reset time of the peak value logger.	-
36.20	*AL1 0 to 10%*	Shows the percentage of samples recorded by amplitude logger 1 that fall between 0 and 10%. 100% corresponds to the I_{max} value given in the ratings table in chapter Technical data in the hardware manual.	0.00%
	0.00…100.00%	Amplitude logger 1 samples between 0 and 10%.	1 = 1%
36.21	*AL1 10 to 20%*	Shows 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%*	Shows 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%*	Shows 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	*AL2 40 to 50%*	Shows 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%

No.	Name/Value	Description	Default FbEq 16
36.25	*AL1 60 to 70%*	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%*	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%*	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%*	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%*	Percentage of samples recorded by amplitude logger 1 that exceed 90%.	0.00%
	0.00…100.00%	Amplitude logger 1 samples over 90%.	1 = 1%
36.40	*AL2 0 to 10%*	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%*	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%*	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%*	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%*	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%*	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%*	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%*	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%

No.	Name/Value	Description	Default FbEq 16
36.48	*AL2 80 to 90%*	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%*	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*	The date on which amplitude logger 2 was last reset.	01/01/1980
	1/1/1980...6/5/2159	Last reset date of amplitude logger 2.	-
36.51	*AL2 reset time*	The time at which amplitude logger 2 was last reset.	00:00:00
	-	Last reset time of amplitude logger 2.	-

37 User load curve		Settings for user load curve. See also section *User load curve* (page *75*).	
37.01	*ULC output status word*	Displays the status of the monitored signal (*37.02*). The status is shown only while the drive is running. (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.	0000h

Bit	Name	Description
0	Under load limit	1 = Signal lower than the underload curve.
1	Within load range	1 = Signal between the underload and overload curve.
2	Overload limit	1 = Signal higher than the overload curve.
3	Outside load limit	1 = Signal lower than the underload curve or higher than the overload curve.
4…15	Reserved	

	0000h…FFFFh	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.	*Motor torque %*
	Not selected	No signal selected. Monitoring disabled.	0
	Motor speed %	*01.03 Motor speed %*.	1
	Motor current %	*01.08 Motor current % of motor nom*.	2
	Motor torque %	*01.10 Motor torque*.	3
	Output power % of motor nom	*01.15 Output power % of motor nom*.	4
	Other	Source selection (see *Terms and abbreviations*).	-

No.	Name/Value	Description	Default FbEq 16
37.03	*ULC overload actions*	Selects how the drive reacts if the absolute value of the monitored signal stays continuously above the overload curve for longer than the value of *37.41 ULC overload timer*.	*Disabled*
	Disabled	No warnings or fault generated.	0
	Warning	The drive generates an *A8C1 ULC overload warning* if the signal has been continuously over the overload curve for a time defined by parameter *37.41 ULC overload timer*.	1
	Fault	The drive trips on *8002 ULC overload fault* if the signal has been continuously over the overload curve for a time defined by parameter *37.41 ULC overload timer*.	2
	Warning/Fault	The drive generates an *A8C1 ULC overload warning* if the signal has been continuously over the overload curve for half of the time defined by parameter *37.41 ULC overload timer*. The drive trips on *8002 ULC overload fault* if the signal has been continuously over the overload curve for a time defined by parameter *37.41 ULC overload timer*.	3
37.04	*ULC underload actions*	Selects an action taken if the signal (*37.02*) stays under the underload curve for a defined time.	*Disabled*
	Disabled	No warnings or fault generated.	0
	Warning	The drive generates an *A8C4 ULC underload warning* if the signal has been continuously under the underload curve for a time defined by parameter *37.42 ULC underload timer*.	1
	Fault	The drive trips on *8001 ULC underload fault* if the signal has been continuously under the underload curve for a time defined by parameter *37.42 ULC underload timer*.	2
	Warning/Fault	The drive generates an *A8C4 ULC underload warning* if the signal has been continuously under the underload curve for half of the time defined by parameter *37.42 ULC underload timer*. The drive trips on *8001 ULC underload fault* if the signal has been continuously under the underload curve for a time defined by parameter *37.42 ULC underload timer*.	3

No.	Name/Value	Description	Default FbEq 16
37.11	*ULC speed table point 1*	Defines the first of the five speed points on the X-axis of the user load curve. The values of the parameters must satisfy: -30000.0 rpm ≤ *37.11 ULC speed table point 1* < *37.12 ULC speed table point 2* < *37.13 ULC speed table point 3* < *37.14 ULC speed table point 4* < *37.15 ULC speed table point 5* ≤ 30000.0 rpm. Speed points are used if parameter *99.04 Motor control mode* is set to *Vector* or if *99.04 Motor control mode* is set to *Scalar* and the reference unit is rpm. 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
	-30000.0…30000.0 rpm	Speed.	1 = 1 rpm
37.12	*ULC speed table point 2*	Defines the second speed point. See parameter *37.11 ULC speed table point 1*.	750.0 rpm
	-30000.0…30000.0 rpm	Speed.	1 = 1 rpm
37.13	*ULC speed table point 3*	Defines the third speed point. See parameter *37.11 ULC speed table point 1*.	1290.0 rpm
	-30000.0…30000.0 rpm	Speed.	1 = 1 rpm
37.14	*ULC speed table point 4*	Defines the fourth speed point. See parameter *37.11 ULC speed table point 1*.	1500.0 rpm
	-30000.0…30000.0 rpm	Speed.	1 = 1 rpm
37.15	*ULC speed table point 5*	Defines the fifth speed point. See parameter *37.11 ULC speed table point 1*.	1800.0 rpm
	-30000.0…30000.0 rpm	Speed.	1 = 1 rpm

No.	Name/Value	Description	Default FbEq 16
37.16	*ULC frequency table point 1*	Defines the first of the five frequency points on the X-axis of the user load curve. The values of the parameters must satisfy: -500.0 Hz ≤ *37.16 ULC frequency table point 1* < *37.17 ULC frequency table point 2* < *37.18 ULC frequency table point 3* < *37.19 ULC frequency table point 4* < *37.20 ULC frequency table point 5* ≤ 500.0 Hz. Frequency points are used if parameter *99.04 Motor control mode* is set to *Scalar* and the reference unit is Hz. 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
	-500.0…500.0 Hz	Frequency.	1 = 1 Hz
37.17	*ULC frequency table point 2*	Defines the second frequency point. See parameter *37.16 ULC frequency table point 1*.	25.0 Hz
	-500.0…500.0 Hz	Frequency.	1 = 1 Hz
37.18	*ULC frequency table point 3*	Defines the third frequency point. See parameter *37.16 ULC frequency table point 1*.	43.0 Hz
	-500.0…500.0 Hz	Frequency.	1 = 1 Hz
37.19	*ULC frequency table point 4*	Defines the fourth frequency point. See parameter *37.16 ULC frequency table point 1*.	50.0 Hz
	-500.0…500.0 Hz	Frequency.	1 = 1 Hz
37.20	*ULC frequency table point 5*	Defines the fifth frequency point. See parameter *37.16 ULC frequency table point 1*.	60.0 Hz
	-500.0…500.0 Hz	Frequency.	1 = 1 Hz

No.	Name/Value	Description	Default FbEq 16
37.21	*ULC underload point 1*	Defines the first of the five points on the Y-axis that together with the corresponding point on the X-axis (*37.11 ULC speed table point 1*… *37.15 ULC speed table point 5* or *37.15 ULC speed table point 5*…*37.15 ULC frequency table point 5*) define the underload (lower) curve. The following conditions must be fulfilled: • *37.21 ULC underload point 1* <= *37.31 ULC overload point 1* • *37.22 ULC underload point 2* <= *37.32 ULC overload point 2* • *37.23 ULC underload point 3* <= *37.33 ULC overload point 3* • *37.24 ULC underload point 4* <= *37.34 ULC overload point 4* • *37.25 ULC underload point 5* <= *37.35 ULC overload point 5*	10.0%
	-1600.0…1600.0%	Underload point.	1 = 1%
37.22	*ULC underload point 2*	Defines the second underload point. See parameter *37.21 ULC underload point 1*.	15.0%
	-1600.0…1600.0%	Underload point.	1 = 1%
37.23	*ULC underload point 3*	Defines the third underload point. See parameter *37.21 ULC underload point 1*.	25.0%
	-1600.0…1600.0%	Underload point.	1 = 1%
37.24	*ULC underload point 4*	Defines the fourth underload point. See parameter *37.21 ULC underload point 1*.	30.0%
	-1600.0…1600.0%	Underload point.	1 = 1%
37.25	*ULC underload point 5*	Defines the fifth underload point. See parameter *37.21 ULC underload point 1*.	30.0%
	-1600.0…1600.0%	Underload point.	1 = 1%
37.31	*ULC overload point 1*	Defines the first of the five points on the Y-axis that together with the corresponding point on the X-axis (*37.11 ULC speed table point 1*…*37.15 ULC frequency table point 5* or *37.15 ULC frequency table point 5*…*37.20 ULC frequency table point 5*) define the overload (higher) curve. At each of the five points the value of the underload curve point must be equal to or smaller than the value of the overload curve point. See parameter *37.21 ULC underload point 1*.	300.0%
	-1600.0…1600.0%	Overload point.	1 = 1%

No.	Name/Value	Description	Default FbEq 16
37.32	*ULC overload point 2*	Defines the second overload point. See parameter *37.31 ULC overload point 1*.	300.0%
	-1600.0…1600.0%	Overload point.	1 = 1%
37.33	*ULC overload point 3*	Defines the third overload point. See parameter *37.31 ULC overload point 1*.	300.0%
	-1600.0…1600.0%	Overload point.	1 = 1%
37.34	*ULC overload point 4*	Defines the fourth overload point. See parameter *37.31 ULC overload point 1*.	300.0%
	-1600.0…1600.0%	Overload point.	1 = 1%
37.35	*ULC overload point 5*	Defines the fifth overload point. See parameter *37.31 ULC overload point 1*.	300.0%
	-1600.0…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	Time.	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	Time.	1 = 1 s

No.	Name/Value	Description	Default FbEq 16
40 Process PID set 1		Parameter values for process PID control. The drive output can be controlled by the process PID. When the process PID control is enabled, the drive controls the process feedback to the reference value. Two different parameter sets can be defined for the process PID. One parameter set is in use at a time. The first set is made up of parameters *40.07*…*40.50*, the second set is defined by the parameters in group *41 Process PID set 2*. The binary source that defines which set is used is selected by parameter *40.57 PID set1/set2 selection*. See also the PID control chain diagrams in chapter *Control chain diagrams*.	
40.01	*Process PID output actual*	Displays the output of the process PID controller. See the control chain diagram on page *620*. This parameter is read-only.	0.00
	-200000.00…200000.00%	Process PID controller output.	1 = 1%
40.02	*Process PID feedback actual*	Displays the value of process feedback after source selection, mathematical function (parameter *40.10 Set 1 feedback function*), and filtering. See the control chain diagram on page *620*. This parameter is read-only.	0.00
	-200000.00…200000.00 PID customer units	Process feedback.	1 = 1 PID customer unit
40.03	*Process PID setpoint actual*	Displays the value of process PID setpoint after source selection, mathematical function (*40.18 Set 1 setpoint function*), limitation and ramping. See the control chain diagram on page *620*. This parameter is read-only.	0.00
	-200000.00…200000.00 PID customer units	Setpoint for process PID controller.	1 = 1 PID customer unit

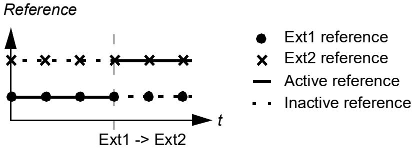
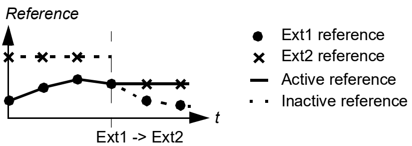
No.	Name/Value	Description	Default FbEq 16
40.04	*Process PID deviation actual*	Displays the process PID deviation. By default, this value equals setpoint - feedback, but deviation can be inverted by parameter *40.31 Set 1 deviation inversion*. See the control chain diagram on page *620*. This parameter is read-only.	0.00
	-200000.00…200000.00 PID customer units	PID deviation.	1 = 1 PID customer unit
40.05	*Process PID trim output act*	Displays the trimmed reference output. This parameter is read-only.	-
	-32768...32767	Trimmed reference.	1 = 1 unit
40.06	*Process PID status word*	Displays status information on process PID control. This parameter is read-only.	0000h

Bit	Name	Value
0	PID active	1 = Process PID control active.
1	Setpoint frozen	1 = Process PID setpoint frozen.
2	Output frozen	1 = Process PID controller output frozen.
3	PID sleep mode	1 = Sleep mode active.
4	Sleep boost	1 = Sleep boost active.
5	Trim mode	1 = Trim function active.
6	Tracking mode	1 = Tracking function active.
7	Output limit high	1 = PID output is being limited by parameter *40.37*.
8	Output limit low	1 = PID output is being limited by parameters *40.36*
9	Deadband active	1 = Deadband active (see parameter *40.39*)
10	PID set	0 = Parameter set 1 in use. 1 = Parameter set 2 in use.
11	Reserved	
12	Internal setpoint active	1 = Internal setpoint active (see parameters *40.16*…*40.23*)
13…15	Reserved	

No.	Name/Value	Description	Default FbEq 16
	0000h…FFFFh	Process PID control status word.	1 = 1
40.07	*Process PID operation mode*	Activates/deactivates process PID control. **Note:** Process PID control is only available in external control; see section *Local and external control locations* (page *50*).	*Off*
	Off	Process PID control inactive.	0
	On	Process PID control active.	1
	On when drive running	Process PID control is active when the drive is running.	2

No.	Name/Value	Description	Default FbEq 16
40.08	*Set 1 feedback 1 source*	Selects the primary source of process feedback. See the control chain diagram on page *619*.	*Not selected*
	Not selected	None.	0
	AI1 scaled	*12.12 AI1 scaled value*	1
	AI2 scaled	*12.22 AI2 scaled value*	2
	Freq in scaled	*11.39 Freq in 1 scaled value*	3
	AI1 percent	*12.101 AI1 percent value*	8
	AI2 percent	*12.102 AI2 percent value*	9
	Feedback storage	*40.91 Feedback data storage*	9
	Other	Source selection (see *Terms and abbreviations*).	-
40.09	*Set 1 feedback 2 source*	Selects the second source of process feedback. The second source is used only if the setpoint function requires two inputs. For the selections, see parameter *40.08 Set 1 feedback 1 source*.	*Not selected*
40.10	*Set 1 feedback function*	Defines how process feedback is calculated from the two feedback sources selected by parameters *40.08 Set 1 feedback 1 source* and *40.09 Set 1 feedback 2 source*.	*In1*
	In1	Source 1.	0
	In1+In2	Sum of sources 1 and 2.	1
	In1-In2	Source 2 subtracted from source 1.	2
	In1*In2	Source 1 multiplied by source 2.	3
	In1/In2	Source 1 divided by source 2.	4
	MIN(In1,In2)	Smaller of the two sources.	5
	MAX(In1,In2)	Greater of the two sources.	6
	AVE(In1,In2)	Average of the two sources.	7
	sqrt(In1)	Square root of source 1.	8
	sqrt(In1-In2)	Square root of (source 1 - source 2).	9
	sqrt(In1+In2)	Square root of (source 1 + source 2).	10
	sqrt(In1)+sqrt(In2)	Square root of source 1 + square root of source 2.	11
40.11	*Set 1 feedback filter time*	Defines the filter time constant for process feedback.	0.000 s
	0.000…30.000 s	Feedback filter time.	1 = 1 s

No.	Name/Value	Description	Default FbEq 16
40.14	*Set 1 setpoint scaling*	Defines, together with parameter *40.15 Set 1 output scaling*, a general scaling factor for the process PID control chain. The scaling can be utilized when, for example, the process setpoint is input in Hz, and the output of the PID controller is used as an rpm value in speed control. In this case, this parameter might be set to 50, and parameter *40.15* to the nominal motor speed at 50 Hz. In effect, the output of the PID controller = [*40.15*] when deviation (setpoint - feedback) = [*40.14*] and [*40.32*] = 1. **Note:** The scaling is based on the ratio between *40.14* and *40.15*. For example, the values 50 and 1500 would produce the same scaling as 1 and 30.	0.00
	32768.00…32767.00	Process setpoint base.	1 = 1
40.15	*Set 1 output scaling*	See parameter *40.14 Set 1 setpoint scaling*.	1500.00; 1800.00 (*95.20* b0)
	32768.00…32767.00	Process PID controller output base.	1 = 1
40.16	*Set 1 setpoint 1 source*	Selects the primary source of process PID setpoint. See the control chain diagram on page *619*.	*Not selected*
	Not selected	None.	0
	Internal setpoint	Internal setpoint. See parameter *40.19 Set 1 internal setpoint sel1*.	2
	AI1 scaled	*12.12 AI1 scaled value*	3
	AI2 scaled	*12.22 AI2 scaled value*	4
	Motor potentiometer	*22.80 Motor potentiometer ref act* (output of the motor potentiometer).	8
	Freq in scaled	*11.39 Freq in 1 scaled value*	10
	AI1 percent	*12.101 AI1 percent value*	11
	AI2 percent	*12.102 AI2 percent value*	12

No.	Name/Value	Description	Default FbEq 16
	Control panel (ref saved)	Panel reference (*03.01 Panel reference*, see page *132*) saved by the control system for the location where the control returns is used as the reference.  	13
	Control panel (ref copied)	Panel reference (*03.01 Panel reference*, see page *132*) for the previous control location is used as the reference when the control location changes if the references for the two locations are of the same type (eg frequency/speed/torque/PID); otherwise, the actual signal is used as the new reference.  	14
	FB A ref1	*03.05 FB A reference 1*	15
	FB A ref2	*03.06 FB A reference 2*	16
	EFB ref1	*03.09 EFB reference 1*	19
	EFB ref2	*03.10 EFB reference 2*	20
	Setpoint data storage	*40.92 Setpoint data storage*	24
	Integrated panel (ref saved)	See above Control panel (ref saved).	26
	Integrated panel (ref copied)	See above Control panel (ref copied.	27
	Other	Source selection (see *Terms and abbreviations*).	-
40.17	*Set 1 setpoint 2 source*	Selects the second source of process setpoint. The second source is used only if the setpoint function requires two inputs. For the selections, see parameter *40.16 Set 1 setpoint 1 source*.	*Not selected*
40.18	*Set 1 setpoint function*	Selects a function between the setpoint sources selected by parameters *40.16 Set 1 setpoint 1 source* and *40.17 Set 1 setpoint 2 source*.	*In1*
	In1	Source 1.	0
	In1+In2	Sum of sources 1 and 2.	1
	In1-In2	Source 2 subtracted from source 1.	2
	In1*In2	Source 1 multiplied by source 2.	3

No.	Name/Value	Description	Default FbEq 16
	In1/In2	Source 1 divided by source 2.	4
	MIN(In1,In2)	Smaller of the two sources.	5
	MAX(In1,In2)	Greater of the two sources.	6
	AVE(In1,In2)	Average of the two sources.	7
	sqrt(In1)	Square root of source 1.	8
	sqrt(In1-In2)	Square root of (source 1 - source 2).	9
	sqrt(In1+In2)	Square root of (source 1 + source 2).	10
	sqrt(In1)+sqrt(In2)	Square root of source 1 + square root of source 2.	11
40.19	*Set 1 internal setpoint sel1*	Selects together with *40.20 Set 1 internal setpoint sel2* the internal setpoint out of the presets defined by parameters *40.21*…*40.23*. **Note:** Parameters *40.16 Set 1 setpoint 1 source* and *40.17 Set 1 setpoint 2 source* must be set to *Internal setpoint*	*Not selected*

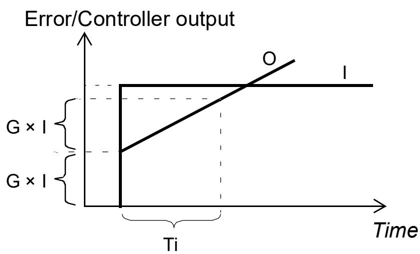
.

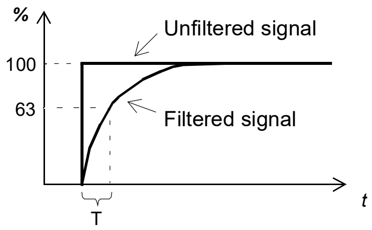
Source defined by par. *40.19*	Source defined by par. *40.20*	Internal setpoint active
0	0	Setpoint source
1	0	1 (par. ***40.21***)
0	1	2 (par. ***40.22***)
1	1	3 (par. ***40.23***)

	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
	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
	Timed function 1	Bit 0 of *34.01 Timed functions status*.	18
	Timed function 2	Bit 1 of *34.01 Combined timer status*.	19
	Timed function 3	Bit 2 of *34.01 Combined timer status*.	20
	Supervision 1	Bit 0 of *32.01 Supervision status*.	21
	Supervision 2	Bit 1 of *32.01 Supervision status*.	22
	Supervision 3	Bit 2 of *32.01 Supervision status*.	23
	Other [bit]	Source selection (see *Terms and abbreviations*).	-

No.	Name/Value	Description	Default FbEq 16
40.20	*Set 1 internal setpoint sel2*	Selects together with *40.19 Set 1 internal setpoint sel1* the internal setpoint used out of the three internal setpoints defined by parameters *40.21*…*40.23*. See table at *40.19 Set 1 internal setpoint sel1*.	*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
	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
	Timed function 1	Bit 0 of *34.01 Timed functions status*.	18
	Timed function 2	Bit 1 of *34.01 Timed functions status*.	19
	Timed function 3	Bit 2 of *34.01 Timed functions status*.	20
	Supervision 1	Bit 0 of *32.01 Supervision status*	21
	Supervision 2	Bit 1 of *32.01 Supervision status*	22
	Supervision 3	Bit 2 of *32.01 Supervision status*	23
	Other [bit]	Source selection (see *Terms and abbreviations*).	-
40.21	*Set 1 internal setpoint 1*	Internal process setpoint 1. See parameter *40.19 Set 1 internal setpoint sel11*.	0.00 PID customer units
	-200000.00… 200000.00 PID customer units	Internal process setpoint 1.	1 = 1 PID customer unit
40.22	*Set 1 internal setpoint 2*	Internal process setpoint 2. See parameter *40.19 Set 1 internal setpoint sel1*.	0.00 PID customer units
	-200000.00… 200000.00 PID customer units	Internal process setpoint 2.	1 = 1 PID customer unit
40.23	*Set 1 internal setpoint 3*	Internal process setpoint 3. See parameter *40.19 Set 1 internal setpoint sel1*.	0.00 PID customer units
	-200000.00… 200000.00 PID customer units	Internal process setpoint 3.	1 = 1 PID customer unit

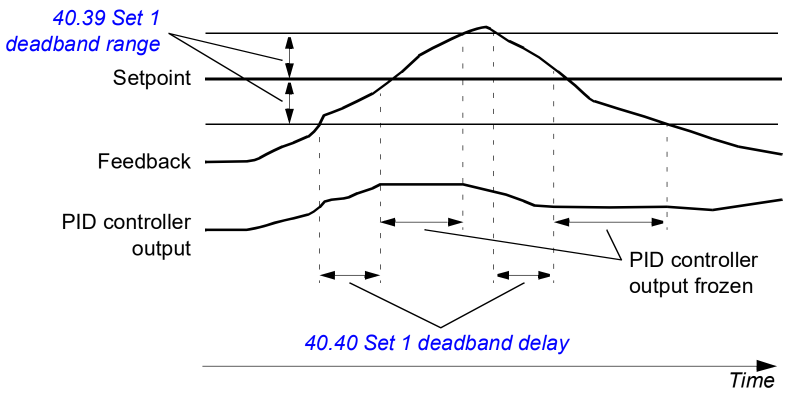
No.	Name/Value	Description	Default FbEq 16
40.24	*Set 1 internal setpoint 0*	Internal process setpoint 0. See parameter *40.19 Set 1 internal setpoint sel1*.	0.00 PID customer units
	-200000.00…200000.00 PID customer units	Internal process setpoint 0.	1 = 1 PID customer unit
40.26	*Set 1 setpoint min*	Defines a minimum limit for the process PID controller setpoint.	0.00
	-200000.00…200000.00	Minimum limit for process PID controller setpoint.	1 = 1
40.27	*Set 1 setpoint max*	Defines a maximum limit for the process PID controller setpoint.	200000.00
	-200000.00…200000.00	Maximum limit for process PID controller setpoint.	1 = 1
40.28	*Set 1 setpoint increase time*	Defines the minimum time it takes for the setpoint to increase from 0% to 100%.	0.0 s
	0.0…1800.0 s	Setpoint increase time.	1 = 1
40.29	*Set 1 setpoint decrease time*	Defines the minimum time it takes for the setpoint to decrease from 100% to 0%.	0.0 s
	0.0…1800.0 s	Setpoint decrease time.	1 = 1
40.30	*Set 1 setpoint freeze enable*	Freezes, or defines a source that can be used to freeze, the setpoint of the process PID controller. This feature is useful when the reference is based on a process feedback connected to an analog input, and the sensor must be serviced without stopping the process. 1 = Process PID controller setpoint frozen See also parameter *40.38 Set 1 output freeze enable*	*Not selected*
	Not selected	Process PID controller setpoint not frozen.	0
	Selected	Process PID controller setpoint frozen.	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
	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
	Timed function 1	Bit 0 of *34.01 Timed functions status*.	18
	Timed function 2	Bit 1 of *34.01 Timed functions status*.	19

No.	Name/Value	Description	Default FbEq 16
	Timed function 3	Bit 2 of *34.01 Timed functions status*.	20
	Supervision 1	Bit 0 of *32.01 Supervision status*	21
	Supervision 2	Bit 1 of *32.01 Supervision status*	22
	Supervision 3	Bit 2 of *32.01 Supervision status*.	23
	Other [bit]	Source selection (see *Terms and abbreviations*).	-
40.31	*Set 1 deviation inversion*	Inverts the input of the process PID controller. 0 = Deviation not inverted (Deviation = Setpoint - Feedback) 1 = Deviation inverted (Deviation = Feedback - Setpoint) See also section *Sleep and boost functions for process PID control* (page *89*).	*Not inverted (Ref - Fbk)*
	Not inverted (Ref - Fbk)	0.	0
	Inverted (Fbk - Ref)	1.	1
	Other [bit]	Source selection (see *Terms and abbreviations*).	-
40.32	*Set 1 gain*	Defines the gain for the process PID controller. See parameter *40.33 Set 1 integration time*.	1.00
	0.01…100.00	Gain for PID controller.	100 = 1
40.33	*Set 1 integration time*	Defines the integration time for the process PID controller. This time needs to be set to the same order of magnitude as the reaction time of the process being controlled, otherwise instability will result.  I = controller input (error) O = controller output G = gain **Note:** Setting this value to 0 disables the “I” part, turning the PID controller into a PD controller.	60.0 s
	0.0…9999.0 s	Integration time.	1 = 1 s

No.	Name/Value	Description	Default FbEq 16
40.34	*Set 1 derivation time*	Defines the derivation time of the process PID controller. The derivative component at the controller output is calculated on basis of two consecutive error values (E_{K-1} and E_K) according to the following formula: PID DERIV TIME × (E_K - E_{K-1})/T_S, in which T_S = 2 ms sample time E = Error = Process reference - process feedback.	0.000 s
	0.000…10.000 s	Derivation time.	1000 = 1 s
40.35	*Set 1 derivation filter time*	Defines the time constant of the 1-pole filter used to smooth the derivative component of the process PID controller.  O = I × (1 - $e^{-t/T}$) I = filter input (step) O = filter output *t* = time	0.0 s
	0.0…10.0 s	Filter time constant.	10 = 1 s
40.36	*Set 1 output min*	Defines the minimum limit for the process PID controller output. Using the minimum and maximum limits, it is possible to restrict the operation range.	0.00
	-200000.00… 200000.00	Minimum limit for process PID controller output.	1 = 1
40.37	*Set 1 output max*	Defines the maximum limit for the process PID controller output. See parameter *40.36 Set 1 output min*.	100.00
	-200000.00… 200000.00	Maximum limit for process PID controller output.	1 = 1

No.	Name/Value	Description	Default FbEq 16
40.38	*Set 1 output freeze enable*	Freezes (or defines a source that can be used to freeze) the output of the process PID controller, keeping the output at the value it was before freeze was enabled. This feature can be used when, for example, a sensor providing process feedback must to be serviced without stopping the process. 1 = Process PID controller output frozen See also parameter *40.30 Set 1 setpoint freeze enable*.	*Not selected*
	Not selected	Process PID controller output not frozen.	0
	Selected	Process PID controller output frozen.	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
	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
	Timed function 1	Bit 0 of *34.01 Timed functions status*.	18
	Timed function 2	Bit 1 of *34.01 Timed functions status*.	19
	Timed function 3	Bit 2 of *34.01 Timed functions status*.	20
	Supervision 1	Bit 0 of *32.01 Supervision status*.	21
	Supervision 2	Bit 1 of *32.01 Supervision status*.	22
	Supervision 3	Bit 2 of *32.01 Supervision status*.	23
	Other [bit]	Source selection (see *Terms and abbreviations*).	-

No.	Name/Value	Description	Default FbEq 16
40.39	*Set 1 deadband range*	Defines a deadband around the setpoint. Whenever process feedback enters the deadband, a delay timer starts. If the feedback remains within the deadband longer than the delay (*40.40 Set 1 deadband delay*), the PID controller output is frozen. Normal operation resumes after the feedback value leaves the deadband.	0.00



	0.00……200000.00	Deadband range.	1 = 1
40.40	*Set 1 deadband delay*	Delay for the deadband. See parameter *40.39 Set 1 deadband range*.	0.0 s
	0.0 … 3600.0 s	Delay for deadband area.	1 = 1 s
40.43	*Set 1 sleep level*	Defines the start limit for the sleep function. If the value is 0.0, set 1 sleep mode is disabled. The sleep function compares the motor speed to the value of this parameter. If the motor speed remains below this value longer than the sleep delay defined by *40.44 Set 1 sleep delay*, the drive enters the sleep mode and stops the motor.	0.0
	0.0…200000.0	Sleep start level.	1 = 1
40.44	*Set 1 sleep delay*	Defines a delay before the sleep function actually becomes enabled, to prevent nuisance sleeping. The delay timer starts when the sleep mode is enabled by parameter *40.43 Set 1 sleep level*, and resets when the sleep mode is disabled.	60.0 s
	0.0…3600.0 s	Sleep start delay.	1 = 1 s
40.45	*Set 1 sleep boost time*	Defines a boost time for the sleep boost step. See parameter *40.46 Set 1 sleep boost step*.	0.0 s
	0.0…3600.0 s	Sleep boost time.	1 = 1 s

No.	Name/Value	Description	Default FbEq 16
40.46	*Set 1 sleep boost step*	When the drive is entering sleep mode, the process setpoint is increased by this value for the time defined by parameter *40.45 Set 1 sleep boost time*. If active, sleep boost is aborted when the drive wakes up.	0.00 PID customer units
	0.00…200000.00 PID customer units	Sleep boost step.	1 = 1 PID customer unit
40.47	*Set 1 wake-up deviation*	Defines the wake-up level as deviation between process setpoint and feedback. When the deviation exceeds the value of this parameter, and remains there for the duration of the wake-up delay (*40.48 Set 1 wake-up delay*), the drive wakes up. See also parameter *40.31 Set 1 deviation inversion*.	0.00 PID customer units
	-200000.00...200000.0 PID customer units	Wake-up level (as deviation between process setpoint and feedback).	1 = 1 PID customer unit
40.48	*Set 1 wake-up delay*	Defines a wake-up delay for the sleep function to prevent nuisance wake-ups. See parameter *40.47 Set 1 wake-up deviation*. The delay timer starts when the deviation exceeds the wake-up level (*40.47 Set 1 wake-up deviation*), and resets if the deviation falls below the wake-up level.	0.50 s
	0.00…60.00 s	Wake-up delay.	1 = 1 s
40.49	*Set 1 tracking mode*	Activates (or selects a source that activates) tracking mode. In tracking mode, the value selected by parameter *40.50 Set 1 tracking ref selection* is substituted for the PID controller output. See also section *Tracking* (page *91*). 1 = Tracking mode 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
	DIO1	Digital input/output DIO1 (*11.02 DIO delayed status*, bit 0).	10

No.	Name/Value	Description	Default FbEq 16
	DIO2	Digital input/output DIO2 (*11.02 DIO delayed status*, bit 1)	11
	Timed function 1	Bit 0 of *34.01 Timed functions status*.	18
	Timed function 2	Bit 1 of *34.01 Timed functions status*.	19
	Timed function 3	Bit 2 of *34.01 Timed functions status*.	20
	Supervision 1	Bit 0 of *32.01 Supervision status*.	21
	Supervision 2	Bit 1 of *32.01 Supervision status*.	22
	Supervision 3	Bit 2 of *32.01 Supervision status*.	23
	Supervision 4	Bit 3 of *32.01 Supervision status*.	24
	Supervision 5	Bit 4 of *32.01 Supervision status*.	25
	Supervision 6	Bit 5 of *32.01 Supervision status*.	26
	Other [bit]	Source selection (see *Terms and abbreviations*).	-
40.50	*Set 1 tracking ref selection*	Selects the value source for tracking mode. See parameter *40.49 Set 1 tracking mode*.	*Not selected*
	Not selected	None.	0
	AI1 scaled	*12.12 AI1 scaled value*.	1
	AI2 scaled	*12.22 AI2 scaled value*.	2
	FB A ref1	*03.05 FB A reference 1*.	3
	FB A ref2	*03.06 FB A reference 2*.	4
	Other	Source selection (see *Terms and abbreviations*).	-
40.51	*Set 1 trim mode*	Activates the trim function and selects between direct and proportional trimming (or a combination of both). With trimming, it is possible to apply a corrective factor to the drive reference (setpoint). The output after trimming is available as parameter *40.05 Process PID trim output act*.	*Off*
	Off	The trim function is inactive.	0
	Direct	The trim function is active. The trimming factor is relative to the maximum speed, torque or frequency; the selection between these is made by parameter *40.52 Set 1 trim selection*.	1
	Proportional	The trim function is active. The trimming factor is relative to the reference selected by parameter *40.53 Set 1 trimmed ref pointer*.	2
	Combined	The trim function is active. The trimming factor is a combination of both *Direct* and *Proportional* modes; the proportions of each are defined by parameter *40.54 Set 1 trim mix*.	3
40.52	*Set 1 trim selection*	Selects whether trimming is used for correcting the speed, torque or frequency reference.	*Speed*
	Torque	Torque reference trimming.	1

No.	Name/Value	Description	Default FbEq 16
	Speed	Speed reference trimming.	2
	Frequency	Frequency reference trimming.	3
40.53	*Set 1 trimmed ref pointer*	Selects the signal source for the trim reference. **Note**: This selection is applicable for Proportional and Combined mode only.	*Not selected*
	Not selected	None.	0
	AI1 scaled	Analog input AI1 scaling.	1
	AI2 scaled	Analog input AI2 scaling.	2
	FBA ref1	*03.05 FB A reference 1* (see page *132*).	3
	FBA ref2	*03.06 FB A reference 2* (see page *132*).	4
	Other	Source selection (see *Terms and abbreviations*).	-
40.54	*Set 1 trim mix*	When parameter *40.51 Set 1 trim mode* is set to *Combined*, defines the effect of direct and proportional trim sources in the final trimming factor. 0.000 = 100% proportional 0.500 = 50% proportional, 50% direct 1.000 = 100% direct **Note:** This parameter is applicable only to the Combined mode.	0.000
	0.000...1.000	Trim mix.	1 = 1
40.55	*Set 1 trim adjust*	Defines a multiplier for the trimming factor. This value is multiplied by the result of parameter *40.51 Set 1 trim mode*. Consequently, the result of the multiplication is used to multiply the result of parameter *40.56 Set 1 trim source*.	1.000
	-100.000...100.000	Multiplier for trimming factor.	1 = 1
40.56	*Set 1 trim source*	Selects the reference to be trimmed.	*PID output*
	PID ref	PID setpoint.	1
	PID output	PID controller output.	2
40.57	*PID set1/set2 selection*	Selects the source that determines whether process PID parameter set 1 (parameters *40.07*…*40.50*) or set 2 (group *41 Process PID set 2*) is used. 0 = PID set 1 in use 1 = PID set 2 in use	*PID set 1*
	PID set 1	PID set 1.	0
	PID set 2	PID set 2.	1
	DI1	Digital input DI1 (*10.02 DI delayed status*, bit 0).	2
	DI2	Digital input DI2 (*10.02 DI delayed status*, bit 1).	3

No.	Name/Value	Description	Default FbEq 16
	DI3	Digital input DI3 (*10.02 DI delayed status*, bit 2).	4
	DI4	Digital input DI4 (*10.02 DI delayed status*, bit 3).	5
	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
	Timed function 1	Bit 0 of *34.01 Timed functions status*.	18
	Timed function 2	Bit 1 of *34.01 Timed functions status*.	19
	Timed function 3	Bit 2 of *34.01 Timed functions status*.	20
	Supervision 1	Bit 0 of *32.01 Supervision status*	21
	Supervision 2	Bit 1 of *32.01 Supervision status*	22
	Supervision 3	Bit 2 of *32.01 Supervision status*.	23
	Other [bit]	Source selection (see *Terms and abbreviations*).	-
40.58	*Set 1 increase prevention*	Activates increase prevention of PID integration term for PID set 1	*No*
	No	Increase prevention not in use.	0
	Limiting	The process PID integration term is not increased. This parameter is valid for the PID set 1.	1
	Other [bit]	Source selection (see *Terms and abbreviations* on page *124*).	-
40.59	*Set 1 decrease prevention*	Activates decrease prevention of PID integration term for PID set 1.	*No*
	No	Decrease prevention not in use.	0
	Limiting	The process PID integration term is not decreased. This parameter is valid for the PID set 1.	1
	Other [bit]	Source selection (see *Terms and abbreviations* on page *124*).	-
40.60	*Set 1 PID activation source*	Selects the source of process PID set 1 activation.	*On*
	Off	Set 1 PID activation source is Off.	0
	On	Set 1 PID activation source is On.	1
	Follow Ext1/Ext2 selection	Selection follows the value of parameter *19.11 Ext1/Ext2 selection*. By changing to Ext2 control location, Process PID set 1 is activated.	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	Default FbEq 16
	DIO2	Digital input/output DIO2 (*11.02 DIO delayed status*, bit 1)	10
	Other [bit]	Source selection (see *Terms and abbreviations* on page *124*).	-
40.61	*Setpoint scaling actual*	Actual setpoint scaling. See parameter *40.14 Set 1 setpoint scaling*.	0.00
	-200000.00… 200000.00 PID customer units	Scaling.	1 = 1 PID customer unit
40.62	*PID internal setpoint actual*	Displays the value of the internal setpoint. See the control chain diagram on page *619*. This parameter is read-only.	0.00 PID unit 1
	-200000.00… 200000.00 PID customer units	Process PID internal setpoint.	1 = 1 PID customer unit
40.65	*Trim auto connection*	Enables the PID trim auto connection and connects the *40.05 Process PID trim output act* to either speed, torque or frequency chains based on the trim selection parameter *40.52* or *41.52*.	
	Disable	Disables PID trim auto connection.	0
	Enable	Enables PID trim auto connecton.	1
40.79	*Set 1 units*	Selects the unit used for PID set 1.	*User text*
	User text	User editable text. User text default is “PID unit 1”.	0
	%	Percentage.	4
	bar	Bar.	74
	kPa	Kilopascal.	75
	Pa	Pascal,	77
	psi	Pound per square inch.	76
	CFM	Cubic feet per minute.	26
	inH_2O	Inch of water.	58
	°C	Centigrade.	150
	°F	Fahrenheit.	151
	mbar	Millibar.	44
	m^3/h	Cubic meters per hour.	78
	dm^3/h	Cubic decimeters per hour.	21
	l/s	Liters per second.	79
	l/min	Liters per minute.	37
	l/h	Liters per hour.	38
	m^3/s	Cubic meter per second.	88

No.	Name/Value	Description	Default FbEq 16
	m^3/min	Cubic meter per minute.	40
	km^3/h	Cubic kilometers per hour.	131
	gal/s	Gallons per second.	47
	ft^3/s	Cubic feet per second.	50
	ft^3/min	Cubic feet per minute.	51
	ft^3/h	Cubic feet per hour.	52
	ppm	Parts per million.	34
	inHg	Inch of mercury.	29
	kCFM	Thousands of cubic feet per hour.	126
	inWC	Inch water column.	65
	gpm	Gallons per minute.	80
	gal/min	Gallons per minute.	48
	in wg	Inch of water.	59
	MPa	Megapascal.	94
	ftWC	Foot water column.	125
40.80	*Set 1 PID output min source*	Selects the source for set 1 PID output minimum.	*Set1 output min*
	None	None.	0
	Set1 output min	*40.36 Set 1 output min*.	1
	Other	Source selection (see *Terms and abbreviations* on page *124*).	-
40.81	*Set 1 PID output max source*	Selects the source for set 1 PID output maximum.	*Set1 output max*
	None	None.	0
	Set1 output max	*40.37 Set 1 output max*.	1
	Other	Source selection (see *Terms and abbreviations* on page *124*).	-
40.89	*Set 1 setpoint multiplier*	Defines the multiplier with which the result of the function specified by parameter *40.18 Set 1 setpoint function* is multiplied.	1.00
	-200000.00… 200000.00	Multiplier.	1 = 1
40.90	*Set 1 feedback multiplier*	Defines the multiplier with which the result of the function specified by parameter *40.10 Set 1 feedback function* is multiplied.	1.00
	-200000.00… 200000.00	Multiplier.	1 = 1

No.	Name/Value	Description	Default FbEq 16
40.91	*Feedback data storage*	Storage parameter for receiving a process feedback value eg. through the embedded fieldbus interface. The value can be sent to the drive as Modbus I/O data. Set the target selection parameter of that particular data (*58.101*…*58.114*) to *Feedback data storage*. In *40.08 Set 1 feedback 1 source* (or *40.09 Set 1 feedback 2 source*), select *Feedback storage*.	0.00
	-327.68 … 327.67	Storage parameter for process feedback.	100 = 1
40.92	*Setpoint data storage*	Storage parameter for receiving a process setpoint value eg. through the embedded fieldbus interface. The value can be sent to the drive as Modbus I/O data. Set the target selection parameter of that particular data (*58.101*…*58.114*) to *Setpoint data storage*. In *40.16 Set 1 setpoint 1 source* (or *40.17 Set 1 setpoint 2 source*), select *Setpoint data storage*.	0.00
	-327.68 … 327.67	Storage parameter for process setpoint.	100 = 1
40.96	*Process PID output %*	Percentage scaled signal of parameter *40.01 Process PID feedback actual*.	0.00%
	-100.00…100.00%	Percentage.	100 = 1%
40.97	*Process PID feedback %*	Percentage scaled signal of parameter *40.02 Process PID feedback actual*.	0.00%
	-100.00…100.00%	Percentage.	100 = 1%
40.98	*Process PID setpoint %*	Percentage scaled signal of parameter *40.03 Process PID setpoint actual*.	0.00%
	-100.00…100.00%	Percentage.	100 = 1%
40.99	*Process PID deviation %*	Percentage scaled signal of parameter *40.04 Process PID deviation actual*.	0.00%
	-100.00…100.00%	Percentage.	100 = 1%

41 Process PID set 2		A second set of parameter values for process PID control. The selection between this set and first set (parameter group *40 Process PID set 1*) is made by parameter *40.57 PID set1/set2 selection*. See also parameters *40.01*…*40.06*, and the control chain diagrams on pages *619* and *620*.	
41.08	*Set 2 feedback 1 source*	See parameter *40.08 Set 1 feedback 1 source*.	*Not selected*
41.09	*Set 2 feedback 2 source*	See parameter *40.09 Set 1 feedback 2 source*.	*Not selected*

No.	Name/Value	Description	Default FbEq 16
41.10	Set 2 feedback function	See parameter 40.10 Set 1 feedback function.	In1
41.11	Set 2 feedback filter time	See parameter 40.11 Set 1 feedback filter time.	0.000 s
41.14	Set 2 setpoint scaling	See parameter 40.14 Set 1 setpoint scaling.	100.00
41.15	Set 2 output scaling	See parameter 40.15 Set 1 output scaling.	1500.00; 1800.00 (95.20 b0)
41.16	Set 2 setpoint 1 source	See parameter 40.16 Set 1 setpoint 1 source.	Not selected
41.17	Set 2 setpoint 2 source	See parameter 40.17 Set 1 setpoint 2 source.	Not selected
41.18	Set 2 setpoint function	See parameter 40.18 Set 1 setpoint function.	In1
41.19	Set 2 internal setpoint sel1	See parameter 40.19 Set 1 internal setpoint sel1.	Not selected
41.20	Set 2 internal setpoint sel2	See parameter 40.20 Set 1 internal setpoint sel2.	Not selected
41.21	Set 2 internal setpoint 1	See parameter 40.21 Set 1 internal setpoint 1.	0.00 PID customer units
41.22	Set 2 internal setpoint 2	See parameter 40.22 Set 1 internal setpoint 2.	0.00 PID customer units
41.23	Set 2 internal setpoint 3	See parameter 40.23 Set 1 internal setpoint 3.	0.00 PID customer units
41.24	Set 2 internal setpoint 0	40.24 Set 1 internal setpoint 0.	0.00 PID customer units
41.26	Set 2 setpoint min	See parameter 40.26 Set 1 setpoint min.	0.00
41.27	Set 2 setpoint max	See parameter 40.27 Set 1 setpoint max.	200000.00
41.28	Set 2 setpoint increase time	See parameter 40.28 Set 1 setpoint increase time.	0.0 s
41.29	Set 2 setpoint decrease time	See parameter 40.29 Set 1 setpoint decrease time.	0.0 s
41.30	Set 2 setpoint freeze enable	See parameter 40.30 Set 1 setpoint freeze enable.	Not selected
41.31	Set 2 deviation inversion	See parameter 40.31 Set 1 deviation inversion.	Not inverted (Ref - Fbk)
41.32	Set 2 gain	See parameter 40.32 Set 1 gain.	1.00
41.33	Set 2 integration time	See parameter 40.33 Set 1 integration time.	60.0 s

No.	Name/Value	Description	Default FbEq 16
41.34	*Set 2 derivation time*	See parameter *40.34 Set 1 derivation time*.	0.000 s
41.35	*Set 2 derivation filter time*	See parameter *40.35 Set 1 derivation filter time*.	0.0 s
41.36	*Set 2 output min*	See parameter *40.36 Set 1 output min*.	0.00
41.37	*Set 2 output max*	See parameter *40.37 Set 1 output max*.	100.00
41.38	*Set 2 output freeze enable*	See parameter *40.38 Set 1 output freeze enable*.	*Not selected*
41.39	*Set 2 deadband range*	See parameter *40.39 Set 1 deadband range*.	0.00
41.40	*Set 2 deadband delay*	See parameter *40.40 Set 1 deadband delay*.	0.0 s
41.43	*Set 2 sleep level*	See parameter *40.43 Set 1 sleep level*.	0.0
41.44	*Set 2 sleep delay*	See parameter *40.44 Set 1 sleep delay*.	60.0 s
41.45	*Set 2 sleep boost time*	See parameter *40.45 Set 1 sleep boost time*.	0.0 s
41.46	*Set 2 sleep boost step*	See parameter *40.46 Set 1 sleep boost step*.	0.00 PID customer units
41.47	*Set 2 wake-up deviation*	See parameter *40.47 Set 1 wake-up deviation*.	0.00 PID customer units
41.48	*Set 2 wake-up delay*	See parameter *40.48 Set 1 wake-up delay*.	0.50 s
41.49	*Set 2 tracking mode*	See parameter *40.49 Set 1 tracking mode*.	*Not selected*
41.50	*Set 2 tracking ref selection*	See parameter *40.50 Set 1 tracking ref selection*.	*Not selected*
41.51	*Set 2 trim mode*	See parameter *40.51 Set 1 trim mode*.	*Off*
41.52	*Set 2 trim selection*	See parameter *40.52 Set 1 trim selection*.	*Speed*
41.53	*Set 2 trimmed ref pointer*	See parameter *40.53 Set 1 trimmed ref pointer*.	*Not selected*
41.54	*Set 2 trim mix*	See parameter *40.54 Set 1 trim mix*.	0.000
41.55	*Set 2 trim adjust*	See parameter *40.55 Set 1 trim adjust*.	1.000
41.56	*Set 2 trim source*	See parameter *40.56 Set 1 trim source*.	*PID output*
41.58	*Set 2 increase prevention*	See parameter *40.58 Set 1 increase prevention*.	*No*
41.59	*Set 2 decrease prevention*	See parameter *40.59 Set 1 decrease prevention*.	*No*
41.60	*Set 2 PID activation source*	See parameter *40.60 Set 1 PID activation source*.	*On*
41.79	*Set 2 units*	See parameter *40.79 Set 1 units*.	*User text*
41.80	*Set 2 PID output min source*	Selects the source for set 2 PID output minimum.	*Set2 output min*
	None	None.	0
	Set2 output min	*41.36 Set 2 output min*.	1

No.	Name/Value	Description	Default FbEq 16
41.81	*Set 2 PID output max source*	Selects the source for set 2 PID output maximum.	*Set2 output max*
	None	None.	0
	Set2 output max	*40.47 Set 2 output max*	1
41.89	*Set 2 setpoint multiplier*	See parameter *40.89 Set 1 setpoint multiplier*.	1.00
41.90	*Set 2 feedback multiplier*	Defines the multiplier k used in formulas of parameter *41.10 Set 2 feedback function*. See parameter *40.90 Set 1 feedback multiplier*.	1.00
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 eventual temperature the resistor would reach when loaded long enough with its rated maximum load capacity (*43.09 Brake resistor Pmax cont*). The temperature calculation is based on the values of parameters *43.08*, *43.09* and *43.10*, and on the assumption that the resistor is installed as instructed by the manufacturer (ie, it cools down as expected).	-
	0.0…120.0%	Estimated brake resistor temperature.	1 = 1%
43.06	*Brake chopper enable*	Enables brake chopper control and selects the brake resistor overload protection method (calculation or measurement). **Note:** Before enabling brake chopper control, ensure that • a brake resistor is connected • overvoltage control is switched off (parameter *30.30 Overvoltage control*) • the supply voltage range (parameter *95.01 Supply voltage*) has been selected correctly.	*Disabled*
	Disabled	Brake chopper control disabled.	0
	Enabled with thermal model	Brake chopper control enabled with the brake resistor protection based on the thermal model. If you select this, you must also specify the values needed by the model, ie. parameters *43.08*, and *43.09*, *43.10*, *43.11* and *43.12*. See the resistor manufacturer data sheet.	1

No.	Name/Value	Description	Default FbEq 16
	Enabled without thermal model	Brake chopper control enabled without resistor overload protection based on the thermal model if the resistor is equipped with a thermal switch that is wired to open the main contactor of the drive if the resistor overheats. For more information, see chapter *Resistor braking* in the hardware manual.	2
	Overvoltage peak protection	Brake chopper control enabled in an overvoltage condition. This setting is intended for situations where • the braking chopper is not needed for runtime operation, ie. to dissipate the inertial energy of the motor, • the motor is able to store a considerable amount 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 runtime enable*	Selects the source for quick brake chopper on/off control. 0 = Brake chopper IGBT pulses are cut off 1 = Normal brake chopper IGBT modulation allowed. This parameter can be used to enable the chopper operation only when the supply is missing from a drive with a regenerative supply unit.	*On*
	Off	0.	0
	On	1.	1
	Other [bit]	Source selection (see *Terms and abbreviations*).	-
43.08	*Brake resistor thermal tc*	Defines the thermal time constant of the brake resistor thermal model.	0 s
	0…10000 s	Brake resistor thermal time constant, ie, the rated time to achieve 63% temperature.	1 = 1 s

No.	Name/Value	Description	Default FbEq 16
43.09	*Brake resistor Pmax cont*	Defines the maximum continuous load of the brake resistor which will eventually raise the resistor temperature to the maximum allowed value (= continuous heat dissipation capacity of the resistor in kW) but not above it. The value is used in the resistor overload protection based on the thermal model. See parameter *43.06 Brake chopper enable*. See the data sheet of the brake resistor used.	0.00 kW
	0.00… 10000.00 kW	Maximum continuous load of the brake resistor.	1 = 1 kW
43.10	*Brake resistance*	Defines the resistance value of the brake resistor. The value is used for the brake resistor protection based on the thermal model. See parameter *43.06 Brake chopper enable*.	0.0 ohm
	0.0…1000.0 ohm	Brake resistor resistance value.	1 = 1 ohm
43.11	*Brake resistor fault limit*	Selects the fault limit for the brake resistor protection based on the thermal model. See parameter *43.06 Brake chopper enable*. When the limit is exceeded, the drive trips on fault *7183 BR excess temperature*. The value is given in percent of the temperature the resistor reaches when loaded with the power defined by parameter *43.09 Brake resistor Pmax cont*.	105%
	0…150%	Brake resistor temperature fault limit.	1 = 1%
43.12	*Brake resistor warning limit*	Selects the warning limit for the brake resistor protection based on the thermal model. See parameter *43.06 Brake chopper enable*. 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	Default FbEq 16
44 Mechanical brake control		Configuration of mechanical brake control. See also parameter groups *40 Process PID set 1* and *41 Process PID set 2*.	
44.01	*Brake control status*	Displays the mechanical brake control status word. This parameter is read-only.	0000h

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	Default FbEq 16
	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 *44.10 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 *44.10 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	*Not selected*
	Not selected	The brake control function is disabled.	0
	Selected	The brake control function is enabled.	1
	DI1	Digital input DI1 (*10.02 DI delayed status*, bit 0).	2

No.	Name/Value	Description	Default FbEq 16
	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
	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
	Timed function 1	Bit 0 of *34.01 Timed functions status*.	18
	Timed function 2	Bit 1 of *34.01 Timed functions status*.	19
	Timed function 3	Bit 2 of *34.01 Timed functions status*.	20
	Supervision 1	Bit 0 of *32.01 Supervision status*	24
	Supervision 2	Bit 1 of *32.01 Supervision status*	25
	Supervision 3	Bit 2 of *32.01 Supervision status*.	26
	Supervision 4	Bit 3 of *32.01 Supervision status*.	27
	Supervision 5	Bit 4 of *32.01 Supervision status*.	28
	Supervision 6	Bit 5 of *32.01 Supervision status*.x	29
	Other [bit]	Source selection (see *Terms and abbreviations*).	-
44.07	*Brake acknowledge selection*	Activates/deactivates (and selects the source for) brake open/close status (acknowledgment) supervision. When a brake control error (unexpected state of the acknowledgment signal) is detected, the drive reacts as defined by parameter *44.17 Brake fault function*. 0 = Brake closed 1 = Brake open	*No acknowledge*
	Off	The brake acknowledge function is disabled.	0
	On	The brake acknowledge function is enabled.	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
	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*).	-

No.	Name/Value	Description	Default FbEq 16
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. Simultaneously with the timer start, the brake control logic energizes the brake control output and the brake starts to open. Set this parameter to the value of mechanical opening delay specified by the brake manufacturer.	0.00 s
	0.00…5.00 s	Brake open delay.	100 = 1 s
44.09	*Brake open torque source*	Defines a source that is used as a brake opening torque reference if • its absolute value is greater than the setting of parameter *44.10 Brake open torque*, and • its sign is the same as the setting of *44.10 Brake open torque*. See parameter *44.10 Brake open torque*.	*Brake open torque*
	Zero	Zero.	0
	AI1 scaled	*12.12 AI1 scaled value*.	1
	AI2 scaled	*12.22 AI2 scaled value*.	2
	FBA ref1	*03.05 FB A reference 1*.	3
	FBA ref2	*03.06 FB A reference 2*.	4
	Brake torque memory	Parameter *44.02 Brake torque memory*.	7
	Brake open torque	Parameter *44.10 Brake open torque*.	8
44.10	*Brake open torque*	Defines the sign (ie. direction of rotation) and minimum absolute value of the brake open torque (motor torque requested at brake release in percent of motor nominal torque). The value of the source selected by parameter *44.09 Brake open torque source* is used as the brake open torque only if it has the same sign as this parameter and has a greater absolute value. **Note:** This parameter is not effective in scalar motor control mode.	0.0%
	-1600.0 … 1600.0%	Minimum torque at brake release.	See par. *46.03*

No.	Name/Value	Description	Default FbEq 16
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
	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
	Timed function 1	Bit 0 of *34.01 Timed functions status*.	18
	Timed function 2	Bit 1 of *34.01 Timed functions status*.	19
	Timed function 3	Bit 2 of *34.01 Timed functions status*.	20
	Supervision 1	Bit 0 of *32.01 Supervision status*	24
	Supervision 2	Bit 1 of *32.01 Supervision status*	25
	Supervision 3	Bit 2 of *32.01 Supervision status*.	26
	Supervision 4	Bit 3 of *32.01 Supervision status*.	27
	Supervision 5	Bit 4 of *32.01 Supervision status*.	28
	Supervision 6	Bit 5 of *32.01 Supervision status*.	29
	Other [bit]	Source selection (see *Terms and abbreviations*).	-

No.	Name/Value	Description	Default FbEq 16
44.12	*Brake close request*	Selects the source of an external brake close request signal. When on, the signal overrides the internal logic and closes the brake. 0 = Normal operation/No external close signal connected 1 = Close brake **Notes:** • In an open-loop (encoderless) application, if the brake is kept closed by a brake close request against a modulating drive for longer than 5 seconds, the brake is forced to close and the drive trips on a fault, *71A5 Mechanical brake opening not allowed* • 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
	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
	Timed function 1	Bit 0 of *34.01 Timed functions status*.	18
	Timed function 2	Bit 1 of *34.01 Timed functions status*.	19
	Timed function 3	Bit 2 of *34.01 Timed functions status*.	20
	Supervision 1	Bit 0 of *32.01 Supervision status.*	24
	Supervision 2	Bit 1 of *32.01 Supervision status.*	25
	Supervision 3	Bit 2 of *32.01 Supervision status*.	26
	Supervision 4	Bit 3 of *32.01 Supervision status*.	27
	Supervision 5	Bit 4 of *32.01 Supervision status*.	28
	Supervision 6	Bit 5 of *32.01 Supervision status*.	29
	Other [bit]	Source selection (see *Terms and abbreviations*).	-

No.	Name/Value	Description	Default FbEq 16
44.13	*Brake close delay*	Specifies a delay between a close command (that is, when the brake control output is de-energized) and when the drive stops modulating. This is to keep the motor live and under control until the brake actually closes. Set this parameter equal to the value specified by the brake manufacturer as the mechanical make-up time of the brake.	0.00 s
	0.00…60.00 s	Brake close delay.	100 = 1 s
44.14	*Brake close level*	Defines the brake close speed as an absolute value. After motor speed has decelerated to this level, a close command is given.	10.00 rpm
	0.00…1000.00 rpm	Brake close speed.	See par. *46.01*
44.15	*Brake close level delay*	Defines a brake close level delay. See parameter *44.14 Brake close level*.	0.00 s
	0.00 … 10.00 s	Brake close level delay.	100 = 1 s
44.16	*Brake reopen delay*	Defines a minimum time between brake closure and a subsequent open command.	0.00 s
	0.00 … 10.00 s	Brake reopen delay.	100 = 1 s
44.17	*Brake fault function*	Determines how the drive reacts upon a mechanical brake control error. **Note:** If parameter *44.07 Brake acknowledge selection* is set to *No acknowledge*, acknowledgment 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* The drive trips on a *A7A5 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* 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

No.	Name/Value	Description	Default FbEq 16
	Open fault	Upon closing the brake, the drive generates a *A7A1 Mechanical brake closing failed* warning if the status of the acknowledgment 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
44.202	*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 *652*. **Note**: For scalar motor control, disable Torque proving and Brake open torque. Select the following: *44.09 Brake open torque source* = *Zero* *44.10 Brake open torque* = 0% *44.202 Torque proving* = *Not selected*	*Not selected*
	Not selected	Torque proving is inactive.	0
	Selected	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
	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
	Timed function 1	Bit 0 of *34.01 Timed functions status*.	18
	Timed function 2	Bit 1 of *34.01 Timed functions status*.	19
	Timed function 3	Bit 2 of *34.01 Timed functions status*.	20
	Supervision 1	Bit 0 of *32.01 Supervision status.*	21
	Supervision 2	Bit 1 of *32.01 Supervision status.*	22
	Supervision 3	Bit 2 of *32.01 Supervision status*.	23
	Supervision 4	Bit 3 of *32.01 Supervision status*.	24
	Supervision 5	Bit 4 of *32.01 Supervision status*.	25
	Supervision 6	Bit 5 of *32.01 Supervision status*.	26

No.	Name/Value	Description	Default FbEq 16
	Other [bit]	Source selection (see *Terms and abbreviations* on page *124*).	-
44.203	*Torque proving reference*	Defines the Torque proving (electrical test) reference to be used when the Torque proving function is enabled.	25.0%
	0.0 … 300.0%	Torque proving (electrical test) reference in percentage of the motor nominal torque (*01.10 Motor torque*).	1 = 1%
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, he drive trips on fault *D100 Torque prove*.	0.30 s
	0.10….30.00 s	Time delay.	1000 = 1 s
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 *653*.	30.00 rpm
	0.00 … 30000.00 rpm	Brake slip speed limit.	1 = 1 rpm
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 *654*.	*Not selected*
	Not selected	Brake safe closure function is inactive.	0
	Selected	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
	DIO1	Digital input/output DIO1 (*11.02 DIO delayed status*, bit 0).	10

No.	Name/Value	Description	Default FbEq 16
	DIO2	Digital input/output DIO2 (*11.02 DIO delayed status*, bit 1)	11
	Timed function 1	Bit 0 of *34.01 Timed functions status*.	18
	Timed function 2	Bit 1 of *34.01 Timed functions status*.	19
	Timed function 3	Bit 2 of *34.01 Timed functions status*.	20
	Supervision 1	Bit 0 of *32.01 Supervision status.*	24
	Supervision 2	Bit 1 of *32.01 Supervision status.*	25
	Supervision 3	Bit 2 of *32.01 Supervision status*.	26
	Supervision 4	Bit 3 of *32.01 Supervision status*.	27
	Supervision 5	Bit 4 of *32.01 Supervision status*.	28
	Supervision 6	Bit 5 of *32.01 Supervision status*.	29
	Other [bit]	Source selection (see *Terms and abbreviations* on page *124*).	-
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
44.211	*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. **Note**: The extended run time function is active only when all these conditions are satisfied: • the drive is set to vector motor control mode (see page *52*) • 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	Default FbEq 16
44.212	Extended runtime sw	Shows the status of the Extended runtime function. This parameter is read-only.	0000h

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	Default FbEq 16
	0000h...FFFFh	Extended runtime status.	-
45 Energy efficiency		Settings for the energy saving calculators. See also section *Energy saving calculators* (page *114*).	
45.01	Saved GW hours	Energy saved in GWh compared to direct-on-line motor connection. This parameter is incremented when *45.02 Saved MW hours* rolls over. This parameter is read-only (see parameter *45.21 Energy calculations reset*).	-
	0…65535 GWh	Energy savings in GWh.	1 = 1 GWh
45.02	Saved MW hours	Energy saved in MWh compared to direct-on-line motor connection. This parameter is incremented when *45.03 Saved kW hours* rolls over. When this parameter rolls over, parameter *45.01 Saved GW hours* is incremented. This parameter is read-only (see parameter *45.21 Energy calculations reset*).	-
	0…999 MWh	Energy savings in MWh.	1 = 1 MWh
45.03	Saved kW hours	Energy saved in kWh compared to direct-on-line motor connection. If the internal brake chopper of the drive is enabled, all energy fed by the motor to the drive is assumed to be converted into heat, but the calculation still records savings made by controlling the speed. If the chopper is disabled, then regenerated energy from the motor is also recorded here. When this parameter rolls over, parameter *45.02 Saved MW hours* is incremented. This parameter is read-only (see parameter *45.21 Energy calculations reset*).	-
	0.0…999.9 kWh	Energy savings in kWh.	10 = 1 kWh

No.	Name/Value	Description	Default FbEq 16
45.04	*Saved energy*	Energy saved in kWh compared to direct-on-line motor connection. This parameter is read-only (see parameter *45.21 Energy calculations reset*).	-
	0.0…214748364.7 kWh	Energy savings in kWh.	1 = 1 kWh
45.05	*Saved money x1000*	Displays the monetary savings in thousands compared to direct-on-line motor connection. This parameter is incremented when parameter *45.06 Saved money* rolls over. This parameter is read-only (see parameter *45.21 Energy calculations reset*).	-
	0…4294967295 thousands	Monetary savings in thousands of units.	1 = 1 unit
45.06	*Saved money*	Monetary savings compared to direct-on-line motor connection. This value is a calculated by multiplying the saved energy in kWh by the currently active energy tariff (*45.14 Tariff selection*). When this parameter rolls over, parameter *45.05 Saved money x1000* is incremented. This parameter is read-only (see parameter *45.21 Energy calculations reset*).	-
	0.00…999.99 units	Monetary savings.	1 = 1 unit
45.07	*Saved amount*	Monetary savings compared to direct-on-line motor connection. This value is a calculated by multiplying the saved energy in kWh by the currently active energy tariff (*45.14 Tariff selection*). This parameter is read-only (see parameter *45.21 Energy calculations reset*).	-
	0.00…21474836.47 units	Monetary savings.	1 = 1 unit
45.08	*CO2 reduction in kilotons*	Reduction in CO_2 emissions in metric kilotons compared to direct-on-line motor connection. This value is incremented when parameter *45.09 CO2 reduction in tons* rolls over. This parameter is read-only (see parameter *45.21 Energy calculations reset*).	-
	0…65535 metric kilotons	Reduction in CO_2 emissions in metric kilotons.	1 = 1 metric kiloton

No.	Name/Value	Description	Default FbEq 16
45.09	CO2 reduction in tons	Reduction in CO_2 emissions in metric tons compared to direct-on-line motor connection. This value is calculated by multiplying the saved energy in MWh by the value of parameter *45.18 CO2 conversion factor* (by default, 0.5 metric tons/MWh). When this parameter rolls over, parameter *45.08 CO2 reduction in kilotons* is incremented. This parameter is read-only (see parameter *45.21 Energy calculations reset*)	-
	0.0…999.9 metric tons	Reduction in CO_2 emissions in metric tons.	1 = 1 metric ton
45.10	Total saved CO2	Reduction in CO_2 emissions in metric tons compared to direct-on-line motor connection. This value is calculated by multiplying the saved energy in MWh by the value of parameter *45.18 CO2 conversion factor* (by default, 0.5 metric tons/MWh). This parameter is read-only (see parameter *45.21 Energy calculations reset*).	-
	0.0…214748364.7 metric tons	Reduction in CO_2 emissions in metric tons.	1 = 1 metric ton
45.11	Energy optimizer	Enables/disables the energy optimization function. The function optimizes the motor flux so that total energy consumption and motor noise level are reduced when the drive operates below the nominal load. The total efficiency (motor and drive) can be improved by 1…20% depending on load torque and speed. **Note:** With a permanent magnet motor or a synchronous reluctance motor, energy optimization is always enabled regardless of this parameter.	*Disable*
	Disable	Energy optimization disabled.	0
	Enable	Energy optimization enabled.	1
45.12	Energy tariff 1	Defines energy tariff 1 (price of energy per kWh). Depending on the setting of parameter *45.14 Tariff selection*, either this value or *45.13 Energy tariff 2* is used for reference when monetary savings are calculated. **Note:** Tariffs are read only at the instant of selection, and are not applied retroactively.	1.000 units
	0.000…4294967.295 units	Energy tariff 1.	-

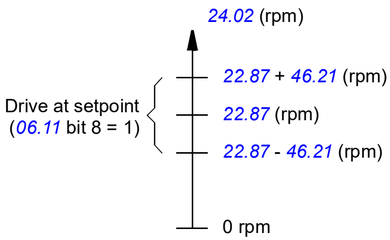
No.	Name/Value	Description	Default FbEq 16
45.13	*Energy tariff 2*	Defines energy tariff 2 (price of energy per kWh). See parameter *45.12 Energy tariff 1*.	2.000 units
	0.000… 4294967.295 units	Energy tariff 2.	-
45.14	*Tariff selection*	Selects (or defines a source that selects) which pre-defined energy tariff is used. 0 = *45.12 Energy tariff 1* 1 = *45.13 Energy tariff 2*	*Energy tariff 1*
	Energy tariff 1	0.	0
	Energy tariff 2	1.	1
	DI1	Digital input DI1 (*10.02 DI delayed status*, bit 0).	2
	DI2	Digital input DI2 (*10.02 DI delayed status*, bit 1).	3
	DI3	Digital input DI3 (*10.02 DI delayed status*, bit 2).	4
	DI4	Digital input DI4 (*10.02 DI delayed status*, bit 3).	5
	Other [bit]	Source selection (see *Terms and abbreviations*).	-
45.18	*CO2 conversion factor*	Defines a factor for conversion of saved energy into CO_2 emissions (kg/kWh or tn/MWh). For example, *45.10 Total saved CO2* = *45.02 Saved kW hours* × *45.18 CO2 conversion factor* (tn/MWh).	0.500 tn/MWh
	0.000…65.535 tn/MWh	Factor for conversion of saved energy into CO_2 emissions.	1 = 1 tn/MWh
45.19	*Comparison power*	Actual power that the motor absorbs when connected direct-on-line and operating the application. The value is used for reference when energy savings are calculated. **Note:** The accuracy of the energy savings calculation is directly dependent on the accuracy of this value. If nothing is entered here, then the nominal motor power is used by the calculation, but that may inflate the energy savings reported as many motors do not absorb nameplate power.	0.00 kW
	0.00…100000.00 kW	Motor power.	1 = 1 kW
45.21	*Energy calculations reset*	Resets the savings counter parameters *45.01*…*45.10*.	*Done*
	Done	Reset not requested (normal operation), or reset complete.	0
	Reset	Reset the savings counter parameters. The value reverts automatically to *Done*.	1

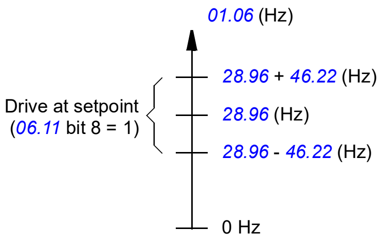
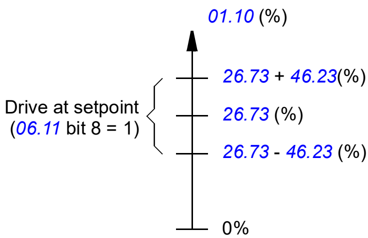
No.	Name/Value	Description	Default FbEq 16
45.24	*Hourly peak power value*	Value of the peak power during the last hour, that is, the most recent 60 minutes after the drive has been powered up. The parameter is updated once every 10 minutes unless the hourly peak is found in the most recent 10 minutes. In that case, the values is shown immediately.	0.00 kW
	-3000.00 … 3000.00 kW	Peak power value.	10 = 1 kW
45.25	*Hourly peak power time*	Time of the peak power value during the last hour.	00:00:00
		Time.	N/A
45.26	*Hourly total energy (resettable)*	Total energy consumption during the last hour, that is, the most recent 60 minutes. You can reset the value by setting it to zero.	0.00 kWh
	-3000.00 … 3000.00 kWh	Total energy.	10 = 1 kWh
45.27	*Daily peak power value (resettable)*	Value of the peak power since midnight of the present day. You can reset the value by setting it to zero.	0.00 kW
	-3000.00 … 3000.00 kW	Peak power value.	10 = 1 kW
45.28	*Daily peak power time*	Time of the peak power since midnight of the present day.	00:00:00
		Time.	N/A
45.29	*Daily total energy (resettable)*	Total energy consumption since midnight of the present day. You can reset the value by setting it to zero.	0.00 kWh
	-30000.00 … 30000.00 kWh	Total energy.	1 = 1 kWh
45.30	*Last day total energy*	Total energy consumption during the previous day, that is, between midnight of the previous day and midnight of the present day	0.00 kWh
	-30000.00 … 30000.00 kWh	Total energy.	1 = 1 kWh
45.31	*Monthly peak power value (resettable)*	Value of the peak power during the present month, that is, since midnight of the first day of the present month. You can reset the value by setting it to zero.	0.00 kW
	-3000.00 … 3000.00 kW	Peak power value.	10 = 1 kW

No.	Name/Value	Description	Default FbEq 16
45.32	*Monthly peak power date*	Date of the peak power during the present month.	1/1/1980
	1/1/1980...6/5/2159	Date.	N/A
45.33	*Monthly peak power time*	Time of the peak power during the present month.	00:00:00
		Time.	N/A
45.34	*Monthly total energy (resettable)*	Total energy consumption from the beginning of the present month. You can reset the value by setting it to zero.	0.00 kWh
	-1000000.00 … 1000000.00 kWh	Total energy.	0.01 = 1 kWh
45.35	*Last month total energy*	Total energy consumption during the previous month, that is, between midnight of the first day or the previous month and midnight of the first day of the present month.	0.00 kWh
	-1000000.00 … 1000000.00 kWh		0.01 = 1 kWh
45.36	*Lifetime peak power value*	Value of the peak power over the drive lifetime.	0.00 kW
	-3000.00 … 3000.00 kW	Peak power value.	10 = 1 kW
45.37	*Lifetime peak power date*	Date of the peak power over the drive lifetime.	1/1/1980
		Date.	N/A
45.38	*Lifetime peak power time*	Time of the peak power over the drive lifetime.	00:00:00
		Time.	N/A

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 eg. fieldbus communication.	1500.00 rpm
	0.10…30000.00 rpm	Acceleration/deceleration terminal/initial speed.	1 = 1 rpm

No.	Name/Value	Description	Default FbEq 16
46.02	*Frequency scaling*	Defines the maximum frequency value used to define the acceleration ramp rate and the initial frequency value used to define deceleration ramp rate (see parameter group *28 Frequency reference chain*). The frequency acceleration and deceleration ramp times are therefore related to this value (**not** to parameter *30.14 Maximum frequency*. Also defines the 16-bit scaling of frequency-related parameters. The value of this parameter corresponds to 20000 in eg. fieldbus communication.	50.00 Hz
	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 eg. fieldbus communication.	100.0%
	0.1…1000.0%	Torque corresponding to 10000 on fieldbus.	10 = 1%
46.04	*Power scaling*	Defines the 16-bit scaling of power parameters. The value of this parameter corresponds to 10000 in the fieldbus communication. The unit is selected by parameter *96.16 Unit selection*. (For 32-bit scaling, see parameter *46.43*)	100.00
	0.10…30000.00	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. (For 32-bit scaling see parameter *46.44*.)	100 A
	0…30000 A	Current corresponding to 10000 on fieldbus.	1 = 1 A
46.06	*Speed ref zero scaling*	Defines a speed corresponding to a zero reference received from fieldbus (either the embedded fieldbus interface, or interface FBA A). 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

No.	Name/Value	Description	Default FbEq 16
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	Speed 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* and *01.02 Motor speed estimated*.	500 ms
	2…20000 ms	Motor speed signal filter time.	1 = 1 ms
46.12	*Filter time output frequency*	Defines a filter time for signal *01.06 Output frequency*.	500 ms
	2…20000 ms	Output frequency signal filter time.	1 = 1 ms
46.13	*Filter time motor torque*	Defines a filter time for signal *01.10 Motor torque*.	100 ms
	2…20000 ms	Motor torque signal filter time.	1 = 1 ms
46.14	*Filter time power*	Defines a filter time for signal *01.14 Output power*.	100 ms
	2…20000 ms	Output power signal filter time.	1 = 1 ms
46.21	*At speed hysteresis*	Defines the “at setpoint” limits for speed control of the drive. When the difference between reference (*22.87 Speed reference act 7*) and the speed (*24.02 Used speed feedback*) 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*.  	50.00 rpm
	0.00…30000.00 rpm	Limit for “at setpoint” indication in speed control.	See par. *46.01*

No.	Name/Value	Description	Default FbEq 16
46.22	*At frequency hysteresis*	Defines the “at setpoint” limits for frequency control of the drive. When the absolute difference between reference (*28.96 Frequency ref ramp input*) 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*.  	2.00 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*  	5.0%
	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. This is indicated by bit 10 of parameter *06.11* and parameter *06.17*. When actual speed exceeds the limit, bit 10 of *06.17 Drive status word 2* is set.	0.00 rpm
	0.00…30000.00 rpm	“Above limit” indication trigger level for speed control.	See par. *46.01*

No.	Name/Value	Description	Default FbEq 16
46.32	*Above frequency limit*	Defines the trigger level for “above limit” indication in frequency control. This is indicated by bit 10 of parameter *06.11* and parameter *06.17*. When actual frequency exceeds the limit, bit 10 of *06.17 Drive status word 2* is set.	0.00 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. This is indicated by bit 10 of parameter *06.11* and parameter *06.17*. When actual torque exceeds the limit, bit 10 of *06.17 Drive status word 2* is set.	0.0%
	0.0…1600.0%	“Above limit” indication trigger level for torque control.	See par. *46.03*
46.41	*kWh pulse scaling*	Defines the trigger level for the “kWh pulse” on for 50 ms. The output of the pulse is bit 9 of *05.22 Diagnostic word 3*.	1.000 kWh
	0.001… 1000.000 kWh	“kWh pulse” on trigger level.	1 = 1 kWh
46.43	Power decimals	Defines the number of display decimal places and 32-bit scaling of power-related parameters. The value of this parameter corresponds to the number of decimals assumed in the 32-bit integer fieldbus communication (for 16-bit scaling, see parameter *46.04*).	2
	0...3	Number of decimals.	1 = 1
46.44	Current decimals	Defines the number of display decimal places and 32-bit scaling of current-related parameters. The value of this parameter corresponds to the number of decimals assumed in the 32-bit integer fieldbus communication (for 16-bit scaling, see parameter *46.05*).	2
	0...3	Number of decimals.	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. See also section *Data storage parameters* (page *118*).	
47.01	*Data storage 1 real32*	Data storage parameter 1. Parameters *47.01*…*47.04* are real 32-bit numbers that can be used as source values of other parameters.	0.000
	-2147483.008… 2147483.008	32-bit real (floating point) number.	-

No.	Name/Value	Description	Default FbEq 16
47.02	Data storage 2 real32	Data storage parameter 2. See also parameter 47.01.	0.000
	-2147483.008… 2147483.008	32-bit real (floating point) number.	-
47.03	Data storage 3 real32	Data storage parameter 3. See also parameter 47.01.	0.000
	-2147483.008… 2147483.008	32-bit real (floating point) number.	-
47.04	Data storage 4 real32	Data storage parameter 4. See also parameter 47.01.	0.000
	-2147483.008… 2147483.008	32-bit real (floating point) number.	-
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.	-
47.21	Data storage 1 int16	Data storage parameter 17.	0
	-32768…32767	16-bit data.	1 = 1
47.22	Data storage 2 int16	Data storage parameter 18.	0
	-32768…32767	16-bit data.	1 = 1
47.23	Data storage 3 int16	Data storage parameter 19.	0
	-32768…32767	16-bit data.	1 = 1
47.24	Data storage 4 int16	Data storage parameter 20.	0
	-32768…32767	16-bit data.	1 = 1

No.	Name/Value	Description	Default FbEq 16
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.	*115.2 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 Control panel loss*.	1
	Last speed	Drive generates an *A7EE Panel loss* warning and freezes the speed to the level the drive was operating at. The speed is determined on the basis of actual speed using 850 ms low-pass filtering. ⚠ **WARNING!** Make sure that it is safe to continue operation in case of a communication break.	2
	Speed ref safe	Drive generates an *A7EE Panel loss* warning and sets the speed to the speed defined by parameter *22.41 Speed ref safe* (or *28.41 Frequency ref safe* when frequency reference is being used). ⚠ **WARNING!** Make sure that it is safe to continue operation in case of a communication break.	3

No.	Name/Value	Description	Default FbEq 16
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
	Configure	Refresh parameters 49.01…49.05. The value reverts automatically to Done.	1
49.19	Basic panel home view 1	Selects the parameters that are shown in *Home view 1* of the integrated or Basic panel (ACS-BP-S).	Zero
	Zero	Shows the factory default parameters.	0
	Motor speed used	01.01 Motor speed used.	1
	Output frequency	01.06 Output frequency.	3
	Motor current	01.07 Motor current.	4
	Motor current % of motor nominal	01.08 Motor current % of motor nom.	5
	Motor torque	01.10 Motor torque.	6
	DC voltage	01.11 DC voltage.	7
	Output power	01.14 Output power.	8
	Speed ref ramp in	23.01 Speed ref ramp input.	10
	Speed ref ramp out	23.02 Speed ref ramp output.	11
	Speed ref used	24.01 Used speed reference.	12
	Freq ref used	28.02 Frequency ref ramp output.	14
	Process PID out	40.01 Process PID output actual.	16
	Temp sensor 1 excitation	The output is used to feed an excitation current to the temperature sensor 1, see parameter 35.11 Temperature 1 source. See also section Motor thermal protection (page 76).	20
	Temp sensor 2 excitation	The output is used to feed an excitation current to the temperature sensor 2, see parameter 35.21 Temperature 2 source. See also section Motor thermal protection (page 76).	21
	Abs motor speed used	01.61 Abs motor speed used.	26
	Abs motor speed %	01.62 Abs motor speed %.	27
	Abs output frequency	01.63 Abs output frequency.	28
	Abs motor torque	01.64 Abs motor torque.	30
	Abs output power	01.66 Abs output power.	31
	Abs motor shaft power	01.68 Abs motor shaft power.	32
	External PID1 out	71.01 External PID act value.	33
	AO1 data storage	13.91 AO1 data storage.	37
	Other		

No.	Name/Value	Description	Default FbEq 16
49.20	*Basic panel home view 2*	Selects the parameters that are shown in *Home view 2* of the integrated or Basic panel (ACS-BP-S). See parameter *49.19* for the selection.	*Zero*
49.21	*Basic panel home view 3*	Selects the parameters that are shown in *Home view 3* of the integrated or Basic panel (ACS-BP-S). See parameter *49.19* for the selection.	*Zero*
49.30	*Basic panel menu hiding*	Parameter to hide main level menus in the integrated or Basic panel (ACS-BP-S). Values are: 0 = Menu visible 1 = Menu hidden	0000h

Bit	Value
0	Motor data
1	Motor control
2	Control macros
3	Diagnostics
4	Energy efficiency
5	Parameters
6...15	Reserved

No.	Name/Value	Description	Default FbEq 16
	0000h…FFFFh		1=1
49.219	*Basic panel home view 4*	Selects the parameters that are shown in Home view 4 of the integrated or Basic panel (ACS-BP-S). For the selections, see parameter *49.19*.	*Zero*
49.220	*Basic panel home view 5*	Selects the parameters that are shown in Home view 5 of the integrated or Basic panel (ACS-BP-S). For the selections, see parameter *49.19*	*Zero*
49.221	*Basic panel home view 6*	Selects the parameters that are shown in Home view 6 of the integrated or Basic panel (ACS-BP-S). For the selections, see parameter *49.19*.	*Zero*

No.	Name/Value	Description	Default FbEq 16
50 Fieldbus adapter (FBA)		Fieldbus communication configuration. See also chapter *Fieldbus control through a fieldbus adapter* (page *591*).	
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
	Enable	Communication between drive and fieldbus adapter A enabled. The adapter is in slot 1.	1
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*.	*Fault*
	No action	No action taken.	0
	Fault	The drive trips on a *7510 FBA A communication*. This only occurs if control is expected from the fieldbus (FBA A selected as source of start/stop/reference in the currently active control location).	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* (or *28.41 Frequency ref safe* when frequency reference is being used). ⚠ **WARNING!** Make sure that it is safe to continue operation in case of a communication break.	3
	Fault always	The machinery control unit trips on a communication fault even though no control is expected from the fieldbus.	4
	Warning	The machinery control unit generates a communication warning even though no control is expected from the fieldbus.	5

No.	Name/Value	Description	Default FbEq 16
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. **Note:** There is a 60-second boot-up delay immediately after power-up. During the delay, the communication break monitoring is disabled (but communication itself can be active).	0.3 s
	0.3…6553.5 s	Time delay.	1 = 1 s
50.04	*FBA A ref1 type*	Selects the type and scaling of reference 1 received from fieldbus adapter A. The scaling of the reference is defined by parameters *46.01*…*46.04*, depending on which reference type is selected by this parameter.	*Speed or frequency*
	Speed or frequency	Type and scaling is chosen automatically according to the currently active operation mode as follows: <table><tr><th>Operation mode (see par. *19.01*)</th><th>Reference 1 type</th></tr><tr><td>Speed control</td><td>*Speed*</td></tr><tr><td>Torque control</td><td>*Speed*</td></tr><tr><td>Scalar (Hz)</td><td>*Frequency*</td></tr></table>	0
	Transparent	No scaling is applied (the scaling is 1 = 1 unit). **Note:** All decimal information is lost, for example, 1.23 = 1.	1
	General	Generic reference with a scaling of 100 = 1 (that is, integer and two decimals). **Note:** All data after two decimals is lost, for example, 1.234 = 123.	2
	Torque	The scaling is defined by parameter *46.03 Torque scaling*.	3
	Speed	The scaling is defined by parameter *46.01 Speed scaling*.	4
	Frequency	The scaling is defined by parameter *46.02 Frequency scaling*.	5

No.	Name/Value	Description	Default FbEq 16
50.05	*FBA A ref2 type*	Selects the type and scaling of reference 2 received from fieldbus adapter A. The scaling of the reference is defined by parameters *46.01*…*46.04*, depending on which reference type is selected by this parameter.	*Speed or frequency*
	Speed or frequency	Type and scaling is chosen automatically according to the currently active operation mode as follows: **Operation mode** (see par. *19.01*) → **Reference 2 type** Speed control → *Torque* Torque control → *Torque* Scalar (Hz) → *Torque*	0
	Transparent	No scaling is applied (the scaling is 100 = 1 unit). **Note:** All decimal information is lost, for example, 1.23 = 1.	1
	General	Generic reference with a scaling of 100 = 1 (that is, integer and two decimals). **Note:** All data after two decimals is lost, for example, 1.234 = 123.	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
50.06	*FBA A SW sel*	Selects the source of the status word to be sent to the fieldbus network through fieldbus adapter A.	*Auto*
	Auto	Source of the status word is chosen automatically.	0
	Transparent mode	The source selected by parameter *50.09 FBA A SW transparent source* is transmitted as the status word to the fieldbus network through fieldbus adapter A.	1
50.07	*FBA A actual 1 type*	Selects the type and scaling of actual value 1 transmitted to the fieldbus network through fieldbus adapter A. The scaling of the value is defined by parameters *46.01*…*46.04*, depending on which actual value type is selected by this parameter.	*Speed or frequency*
	Speed or frequency	Type and scaling is chosen automatically according to the currently active operation mode as follows:	0

No.	Name/Value	Description	Default FbEq 16
		<table><tr><th>Operation mode (see par. *19.01*)</th><th>Actual value 1 type (source)</th><th>Scaling</th></tr><tr><td>Speed control</td><td rowspan="2">*Speed* (*01.01 Motor speed used*)</td><td rowspan="2">*46.01 Speed scaling*</td></tr><tr><td>Torque control</td></tr><tr><td>Scalar (Hz)</td><td>*Frequency* *(01.06 Output*</td><td>*46.02 Frequency scaling*</td></tr></table>	
	Transparent	The value selected by parameter *50.10 FBA A act1 transparent source* is sent as actual value 1. No scaling is applied (the scaling is 1 = 1 unit). **Note:** All decimal information is lost, for example, 1.23 = 1.	1
	General	The value selected by parameter *50.10 FBA A act1 transparent source* is sent as actual value 1 with a scaling of 100 = 1 unit (that is, integer and two decimals). **Note:** All data after two decimals is lost, for example, 1.234 = 123.	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
50.08	*FBA A actual 2 type*	Selects the type and scaling of actual value 2 transmitted to the fieldbus network through fieldbus adapter A. The scaling of the value is defined by parameters *46.01*…*46.04*, depending on which actual value type is selected by this parameter.	*Speed or frequency*
	Speed or frequency	Type and scaling is chosen automatically according to the currently active operation mode as follows:	0

No.	Name/Value	Description	Default FbEq 16

Operation mode (see par. *19.01*)	Actual value 2 type	Scaling
Speed control	*Speed* (*01.01 Motor speed used*)	*46.01 Speed scaling*
Torque control		
Scalar (Hz)	*Frequency* (*01.06 Output*	*46.02 Frequency scaling*

No.	Name/Value	Description	Default FbEq 16
	Transparent	The value selected by parameter *50.11 FBA A act2 transparent source* is sent as actual value 2. No scaling is applied (the scaling is 1 = 1 unit). **Note:** All decimal information is lost, for example, 1.23 = 1.	1
	General	The value selected by parameter *50.11 FBA A act2 transparent source* is sent as actual value 2 with a scaling of 100 = 1 unit (that is, integer and two decimals). **Note:** All data after two decimals is lost, for example, 1.234 = 123.	2
	Torque	*01.01 Motor speed used* 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
50.09	*FBA A SW transparent source*	Selects the source of the fieldbus status word when parameter *50.06 FBA A SW sel* is set to *Transparent mode*.	*Not selected*
	Not selected	No source selected.	-
	Other	Source selection (see *Terms and abbreviations*).	-
50.10	*FBA A act1 transparent source*	When parameter *50.07 FBA A actual 1 type* is set to *Transparent*, this parameter selects the source of actual value 1 transmitted to the fieldbus network through fieldbus adapter A.	*Not selected*
	Not selected	No source selected.	-
	Other	Source selection (see *Terms and abbreviations*).	-

No.	Name/Value	Description	Default FbEq 16
50.11	*FBA A act2 transparent source*	When parameter *50.08 FBA A actual 2 type* is set to *Transparent*, this parameter selects the source of actual value 2 transmitted to the fieldbus network through fieldbus adapter A.	*Not selected*
	Not selected	No source selected.	-
	Other	Source selection (see *Terms and abbreviations*).	-
50.12	*FBA A debug mode*	This parameter enables debug mode. Displays raw (unmodified) data received from and sent to fieldbus adapter A in parameters *50.13*…*50.18*.	*Disable*
	Disable	Debug mode disabled.	0
	Fast	Debug mode enabled. Cyclical data update is as fast as possible which increases CPU load on the drive.	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.	-

No.	Name/Value	Description	Default FbEq 16
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.	-

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*; **0** = None; **1** = PROFIBUS DP; **32** = CANopen; **37** = DeviceNet; **128 =** Ethernet; **132** = PROFINET IO; **135** = EtherCAT; **136** = ETH Pwrlink; **485** = RS-485 comm; **101** = ControlNet; This parameter is read-only.	-
51.02	*FBA A Par2*	Parameters *51.02*…*51.26* are adapter module-specific. For more information, see the documentation of the fieldbus adapter module. Note that not all of these parameters are necessarily in use.	-
	0…65535	Fieldbus adapter configuration parameter.	1 = 1
…	…	…	…
51.26	*FBA A Par26*	See parameter *51.02 FBA A Par2*.	-
	0…65535	Fieldbus adapter configuration parameter.	1 = 1
51.27	*FBA A par refresh*	Validates any changed fieldbus adapter module configuration settings. After refreshing, the value reverts automatically to *Done*. **Note:** This parameter cannot be changed while the drive is running.	*Done*
	Done	Refreshing done.	0
	Configure	Refreshing.	1

No.	Name/Value	Description	Default FbEq 16
51.28	*FBA A par table ver*	Displays the parameter table revision of the fieldbus adapter module mapping file (stored in the memory of the drive). In format axyz, where ax = major table revision number; yz = minor table revision number. This parameter is read-only.	-
		Parameter table revision of adapter module.	-
51.29	*FBA A drive type code*	Displays the drive type code in the fieldbus adapter module mapping file (stored in the memory of the drive). This parameter is read-only.	-
	0…65535	Drive type code stored in the mapping file.	1 = 1
51.30	*FBA A mapping file ver*	Displays the fieldbus adapter module mapping file revision stored in the memory of the drive in decimal format. This parameter is read-only.	-
	0…65535	Mapping file revision.	1 = 1
51.31	*D2FBA A comm status*	Displays the status of the fieldbus adapter module communication.	*Not configured*
	Not configured	Adapter is not configured.	0
	Initializing	Adapter is initializing.	1
	Time out	A timeout has occurred in the communication between the adapter and the drive.	2
	Configuration error	Adapter configuration error: mapping file not found in the file system of the drive, or mapping file upload has failed more than three times.	3
	Off-line	Fieldbus communication is off-line.	4
	On-line	Fieldbus communication is on-line, or fieldbus adapter has been configured not to detect a communication break. For more information, see the documentation of the fieldbus adapter.	5
	Reset	Adapter is performing a hardware reset.	6
51.32	*FBA A comm SW ver*	Displays the common program revision of the adapter module in format axyz, where a = major revision number, xy = minor revision number, z = correction number or letter. **Example:** 190A = revision 1.90A.	
		Common program revision of adapter module.	-

No.	Name/Value	Description	Default FbEq 16
51.33	FBA A appl SW ver	Displays the application program revision of the adapter module in format axyz, where a = major revision number, xy = minor revision number, z = correction number or letter. **Example:** 190A = revision 1.90A.	
		Application program version of adapter module.	-
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

No.	Name/Value	Description	Default FbEq 16
	Other	Source selection (see *Terms and abbreviations*).	-
…	…	…	…
52.12	*FBA A data in12*	See parameter *52.01 FBA A data in1*.	*None*
53 FBA A data out		Selection of data to be transferred from fieldbus controller to drive through fieldbus adapter A. **Note:** 32-bit values require two consecutive parameters. Whenever a 32-bit value is selected in a data parameter, the next parameter is automatically reserved.	
53.01	*FBA A data out1*	Parameters *53.01*…*53.12* select data to be transferred from the fieldbus controller to the drive through fieldbus adapter A.	*None*
	None	None.	0
	CW 16bit	Control Word (16 bits).	1
	Ref1 16bit	Reference REF1 (16 bits).	2
	Ref2 16bit	Reference REF2 (16 bits).	3
	CW 32bit	Control Word (32 bits).	11
	Ref1 32bit	Reference REF1 (32 bits).	12
	Ref2 32bit	Reference REF2 (32 bits).	13
	CW2 16bit	Control Word 2 (16 bits).	21
	Other	Source selection (see *Terms and abbreviations*).	-
…	…	…	…
53.12	*FBA A data out12*	See parameter *53.01 FBA A data out1*.	*None*
58 Embedded fieldbus		Configuration of the embedded fieldbus (EFB) interface. See chapter *Fieldbus control through the embedded fieldbus interface (EFB)*. **Note:** Different embedded fieldbus protocols (Modbus or CANopen) require different hardware options.	
58.01	*Protocol enable*	Enables/disables the embedded fieldbus interface and selects the protocol to use.	*None*
	None	None (communication disabled).	0
	Modbus RTU	Embedded fieldbus interface is enabled and uses the Modbus RTU protocol.	1
	CANopen	Embedded fieldbus interface is enabled and uses the CANopen protocol.	3
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	Default FbEq 16
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* (*Refresh settings*). **Note:** If parameter *58.01* = [3] CANopen, the name of this parameter, *58.03* is **Node ID** (see below)**.**	1
	0…255	Node address (values 1…247 are allowed).	1 = 1
58.03	*Node ID*	Defines the node address for the drive on the CANopen bus. Values 1…127 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 are validated by parameter *58.06 Communication control* (*Refresh settings*). **Note:** If *58.01* = [1] Modbus RTU, the name of this parameter *58.03* is **Node address** (see above).	3
	0…255	Node address (values 1…127 are allowed).	1=1
58.04	*Baud rate*	Selects the transfer rate of the Modbus 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* (*Refresh settings*). **Note:** If parameter *58.01* = [3] CANopen, the Baud rate range and the selection list item names change. See *Baud rate* below.	*19.2 kbps*
	4.8 kbps	4.8 kbit/s.	1
	9.6 kbps	9.6 kbit/s.	2
	19.2 kbps	19.2 kbit/s.	3
	38.4 kbps	38.4 kbit/s.	4
	57.6 kbps	57.6 kbit/s.	5
	76.8 kbps	76.8 kbit/s.	6
	115.2 kbps	115.2 kbit/s.	7

No.	Name/Value	Description	Default FbEq 16
58.04	*Baud rate*	Defines the communication speed of the CANopen bus. Changes to this parameter take effect after the control unit is rebooted or the new settings validated by parameter *58.06 Communication control* (*Refresh settings*).	*125 kbps*
	50 kbps	50 kbit/s.	1
	100 kbps	100 kbit/s.	2
	125 kbps	125 kbit/s.	3
	250 kbps	250 kbit/s.	4
	500 kbps	500 kbit/s.	5
	1 Mbps	1 Mbit/s.	6
58.05	*Parity*	Selects the 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* (*Refresh settings*). **Note:** If parameter *58.01* = [3] CANopen, this parameter is hidden.	*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*	Takes changed EFB settings in use, or activates silent mode.	*Enabled*
	Enabled	Normal operation.	0
	Refresh settings	Refreshes settings (Modbus parameters *58.01*…*58.05*, *58.14*…*58.17*, *58.25*, *58.28*…*58.34*, CANopen parameters *58.03*, *58.04*, *58.06*, *58.14*, *58.23*...*58.29*, *58.70*...*58.93* and *58.101*...*58.124*) and takes changed EFB configuration settings in use. 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. **Note:** If parameter *58.01* = [3] CANopen, this option is not available.	2

No.	Name/Value	Description	Default FbEq 16
58.07	Communication diagnostics	Displays the status of the EFB communication. This parameter is read-only. Note that the name is only visible when the error is present (bit value is 1). **Note:** If parameter 58.01 = [3] CANopen, this parameter is hidden.	-

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	
4	Wiring error	1 = Errors detected (A/B wires possibly swapped)
5	Parity error	1 = Error detected: check parameters 58.04 and 58.05
6	Baud rate error	1 = Error detected: check parameters 58.05 and 58.04
7	No bus activity	1 = 0 bytes received during last 5 seconds
8	No packets	1 = 0 packets (addressed to any device) detected during last 5 seconds
9	Noise or addressing error	1 = Errors detected (interference, or another device with the same address on line)
10	Comm loss	1 = 0 packets addressed to the drive received within timeout (58.16)
11	CW/Ref loss	1 = No control word or references received within timeout (58.16)
12	Not active	Reserved
13	Protocol 1	Reserved
14	Protocol 2	Reserved
15	Internal error	1 = Internal errors detected

No.	Name/Value	Description	Default FbEq 16
	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 down for over 3 seconds. **Note:** If parameter 58.01 = [3] CANopen, this parameter is hidden.	-
	0…4294967295	Number of received packets addressed to the drive.	1 = 1

No.	Name/Value	Description	Default FbEq 16
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 down for over 3 seconds. **Note:** If parameter *58.01* = [3] CANopen, this parameter is hidden.	-
	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 down for over 3 seconds. **Note:** If parameter *58.01* = [3] CANopen, this parameter is hidden.	-
	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 down for over 3 seconds. **Note:** If parameter *58.01* = [3] CANopen, this parameter is hidden.	-
	0…4294967295	Number of UART errors.	1 = 1
58.12	*CRC errors*	Displays a count of packets with a CRC error received by the drive. An increasing count indicates interference on the bus. Can be reset from the control panel by keeping Reset down for over 3 seconds. **Note:** If parameter *58.01* = [3] CANopen, this parameter, is hidden.	-
	0…4294967295	Number of CRC errors.	1 = 1
58.14	*Communication loss action*	Selects how the drive reacts to an EFB communication break. The drive does not trip if only reference is coming from EFB and the communication is lost. Changes to this parameter take effect after the control unit is rebooted or the new settings validated by parameter *58.06 Communication control* (*Refresh settings*). See also parameters *58.15 Communication loss mode* and *58.16 Communication loss time*.	*Fault*
	No action	No action taken (monitoring disabled).	0

No.	Name/Value	Description	Default FbEq 16
	Fault	Drive trips on *6681 EFB comm loss*. This occurs only if control in the currently active control location 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. The speed is determined on the basis of actual speed using 850 ms low-pass filtering. This occurs only if control is expected from the EFB. ⚠ **WARNING!** Make sure that it is safe to continue operation in case of a communication break.	2
	Speed ref safe	Drive generates an *A7CE EFB comm loss* warning and sets the speed to the speed defined by parameter *22.41 Speed ref safe* (or *28.41 Frequency ref safe* when frequency reference is being used). This occurs only 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 happens even thought the drive is in a control location where the EFB start/stop or reference is not used.	4
	Warning	Drive generates an *A7CE EFB comm loss* warning. This occurs even though no control is expected from the EFB. ⚠ **WARNING!** Make sure that it is safe to continue operation in case of a communication break.	5
58.15	*Communication loss mode*	Defines which message types reset the timeout counter for detecting an EFB communication loss. Changes to this parameter take effect after the control unit is rebooted or the new settings validated by parameter *58.06 Communication control* (*Refresh settings*). See also parameters *58.14 Communication loss action* and *58.16 Communication loss time* **Note:** If parameter *58.01* = [3] CANopen, this parameter is hidden.	*Cw / Ref1 / Ref2*
	Any message	Any message addressed to the drive resets the timeout.	1
	Cw / Ref1 / Ref2	A write of the control word or a reference resets the timeout.	2

No.	Name/Value	Description	Default FbEq 16
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* (*Refresh settings*). See also parameter *58.15 Communication loss mode*. **Notes:** • There is a 30-second boot-up delay immediately after power-up. During the delay, the communication break monitoring is disabled (but communication itself can be active). • If parameter *58.01* = [3] CANopen, the default value is set as 0.3 seconds.	3.0 s
	0.0…6000.0 s	EFB communication timeout.	1 = 1
58.17	*Transmit delay*	Defines a minimum response delay in addition to any fixed delay imposed by the protocol. Changes to this parameter take effect after the control unit is rebooted or the new settings validated by parameter *58.06 Communication control* (*Refresh settings*). **Note:** If parameter *58.01* = [3] CANopen, this parameter is hidden.	0 ms
	0…65535 ms	Minimum response delay.	1 = 1
58.18	*EFB control word*	Displays the raw (unmodified) status word sent by the drive to the Modbus controller. For debugging purposes. This parameter is read-only.	-
	0...FFFFFFFFh	Control word sent by the controller to the drive.	1 = 1
58.19	*EFB status word*	Displays the raw (unmodified) status word for debugging purposes. This parameter is read-only.	-
	0...FFFFFFFFh	Status word sent by the drive to the controller.	1 = 1
58.22	*CANopen NMT state*	This parameter tells the CANopen NMT state of the drive. **Note:** If parameter *58.01* = [1] Modbus RTU, this parameter is hidden.	*Uninitialized*
	Uninitialized	Node is not initialized.	0
	Stopped	Node is in STOPPED state.	4

No.	Name/Value	Description	Default FbEq 16
	Operational	Node is in OPERATIONAL state.	5
	Pre-operational	Node is in PRE-OPERATIONAL state.	127
58.23	*Configuration location*	This parameter defines where communication configuration for the device comes from. Changes to this parameter take effect after the control unit is rebooted or the new settings validated by parameter *58.06 Communication control* (*Refresh settings*). **Note:** If parameter *58.01* = [1] Modbus RTU, this parameter is hidden.	*CAN objects*
	Drive parameters		0
	CAN objects	Communication configuration is written by CANopen master to CANopen objects. The configuration can be saved into the drive's non-volatile memory. In that case, the parameters don't need to be set every time the system is powered on	1
58.24	*Transparent 16 scale*	Defines the scaling value for Transparent 16 communication profile. Changes to this parameter take effect after the control unit is rebooted or the new settings validated by parameter *58.06 Communication control* (*Refresh settings*). **Note:** If parameter *58.01* = [1] Modbus RTU, this parameter is hidden.	99
	0...65535	Actual values and reference values are multiplied by this value + 1 in the object dictionary.	1 = 1
58.25	*Control profile*	Defines the communication profile used 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* (*Refresh settings*).	*ABB Drives*
	ABB Drives	ABB Drives control profile (with a 16-bit control word).	0
	DCU Profile	DCU control profile (with a 16 or 32-bit control word).	5
	CiA 402	CiA 402 control profile.	7
	Transparent 16	Transparent control profile (with a 16-bit control word).	8
	Transparent 32	Transparent control profile (with a 32-bit control word).	9

<table>
<tr><th>No.</th><th>Name/Value</th><th>Description</th><th>Default
FbEq 16</th></tr>
<tr><td>58.26</td><td>EFB ref1 type</td><td>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.</td><td>Speed or frequency</td></tr>
<tr><td></td><td>Speed or frequency</td><td>Type and scaling is chosen automatically according to the currently active operation mode as follows.
<table>
<tr><th>Operation mode
(see par. 19.01)</th><th>Reference 1 type</th></tr>
<tr><td>Speed control</td><td>Speed</td></tr>
<tr><td>Torque control</td><td>Speed</td></tr>
<tr><td>Frequency control</td><td>Frequency</td></tr>
</table></td><td>0</td></tr>
<tr><td></td><td>Transparent</td><td>No scaling is applied.</td><td>1</td></tr>
<tr><td></td><td>General</td><td>Generic reference without a specific unit. Scaling: 1 = 100.</td><td>2</td></tr>
<tr><td></td><td>Torque</td><td>Torque reference. The scaling is defined by parameter 46.03 Torque scaling.</td><td>3</td></tr>
<tr><td></td><td>Speed</td><td>Speed reference. The scaling is defined by parameter 46.01 Speed scaling.</td><td>4</td></tr>
<tr><td></td><td>Frequency</td><td>Frequency reference. The scaling is defined by parameter 46.02 Frequency scaling.</td><td>5</td></tr>
<tr><td>58.27</td><td>EFB ref2 type</td><td>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.</td><td>Speed or frequency</td></tr>
<tr><td>58.28</td><td>EFB act1 type</td><td>Selects the type/source and scaling of actual value 1 transmitted to the fieldbus.network through the embedded fieldbus interface.</td><td>Speed or frequency</td></tr>
<tr><td></td><td>Speed or frequency</td><td>Type and scaling is chosen automatically according to the currently active operation mode as follows:</td><td>0</td></tr>
<tr><td colspan="4">
<table>
<tr><th>Operation mode
(see par. 19.01)</th><th>Actual 1 type
(source)</th><th>Scaling</th></tr>
<tr><td>Speed control</td><td rowspan="2">Speed
(01.01 Motor speed used)</td><td rowspan="2">46.01 Speed scaling</td></tr>
<tr><td>Torque control</td></tr>
<tr><td>Frequency control</td><td>Frequency
(01.06 Output</td><td>46.02 Frequency scaling</td></tr>
</table></td></tr>
</table>

<table>
<tr><th>No.</th><th>Name/Value</th><th>Description</th><th>Default
FbEq 16</th></tr>
<tr><td></td><td>Transparent</td><td>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).</td><td>1</td></tr>
<tr><td></td><td>General</td><td>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).</td><td>2</td></tr>
<tr><td></td><td>Torque</td><td>01.10 Motor torque is sent as actual value 1. Scaling is defined by parameter 46.03 Torque scaling.</td><td>3</td></tr>
<tr><td></td><td>Speed</td><td>01.01 Motor speed used is sent as actual value 1. Scaling is defined by parameter 46.01 Speed scaling.</td><td>4</td></tr>
<tr><td></td><td>Frequency</td><td>01.06 Output frequency is sent as actual value 1. Scaling is defined by parameter 46.02 Frequency scaling.</td><td>5</td></tr>
<tr><td>58.29</td><td>EFB act2 type</td><td>Selects the type/source and scaling of actual value 2 transmitted to the fieldbus network through the embedded fieldbus interface.
Note: If parameter 58.01 = [3] CANopen, default value is set as Speed or frequency.</td><td>Transparent</td></tr>
<tr><td></td><td>Speed or frequency</td><td>Type/source and scaling are chosen automatically according to the currently active operation mode as follows:</td><td>0</td></tr>
<tr><td colspan="4">
<table>
<tr><th>Operation mode
(see par. 19.01)</th><th>Actual 1 type
(source)</th><th>Scaling</th></tr>
<tr><td>Speed control</td><td rowspan="2">Speed
(01.01 Motor speed used)</td><td rowspan="2">46.01 Speed scaling</td></tr>
<tr><td>Torque control</td></tr>
<tr><td>Frequency control</td><td>Frequency
(01.06 Output</td><td>46.02 Frequency scaling</td></tr>
</table>
</td></tr>
<tr><td></td><td>Transparent</td><td>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).</td><td>1</td></tr>
<tr><td></td><td>General</td><td>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 (i.e. integer and two decimals).</td><td>2</td></tr>
<tr><td></td><td>Torque</td><td>01.10 Motor torque is sent as actual value 2. Scaling is defined by parameter 46.03 Torque scalingg.</td><td>3</td></tr>
</table>

No.	Name/Value	Description	Default FbEq 16
	Speed	*01.01 Motor speed used* is sent as actual value 2. Scaling is defined by parameter *46.01 Speed scaling*.	4
	Frequency	*01.06 Output frequency* is sent as actual value 2. Scaling is defined by parameter *46.02 Frequency scaling*.	5
58.31	*EFB act1 transparent source*	Selects the source of actual value 1 when parameter *58.28 EFB act1 type* is set to *Transparent*.	*Not selected*
	Not selected	None.	0
	Other	Source selection (see *Terms and abbreviations*).	-
58.32	*EFB act2 transparent source*	Selects the source of actual value 1 when parameter *58.29 EFB act2 type* is set to *Transparent*.	*Not selected*
	Not selected	None.	0
	Other	Source selection (see *Terms and abbreviations*).	-
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* (*Refresh settings*). **Note:** If parameter *58.01* = [3] CANopen, this parameter is hidden.	*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

No.	Name/Value	Description	Default FbEq 16
	Mode 2	32-bit values (groups 1…127, indexes 1…255): Register address = 400000 + 512 × parameter group + 2 × parameter index. For example, parameter 22.80 would be mapped to register 400000 + 11264 + 160 = 411424.	2
58.34	*Word order*	Selects in which order 16-bit registers of 32-bit parameters are transferred. For each register, the first byte contains the high order byte and the second byte contains the low order byte. Changes to this parameter take effect after the control unit is rebooted or the new settings validated by parameter *58.06 Communication control* (*Refresh settings*). **Note:** If parameter *58.01* = [3] CANopen, this parameter is hidden.	*LO-HI*
	HI-LO	The first register contains the high order word, the second contains the low order word.	0
	LO-HI	The first register contains the low order word, the second contains the high order word.	1
58.70	*EFB debug mode*	This parameter enables debug mode. RAW-data is echoed to drive parameters *58.18 EFB control word*, *58.71 EFB reference 1*, *58.72 EFB reference 2*, *58.19 EFB status word*, *58.73 EFB actual value 1* and *58.74 EFB actual value 2* Changes to this parameter take effect after the control unit is rebooted or the new settings validated by parameter *58.06 Communication control* (*Refresh settings*). **Note:** If parameter *58.01* = [1] Modbus RTU, this parameter is hidden.	1
	Disable	Debug mode disabled. *58.18 EFB control word*, *58.71 EFB reference 1*, *58.72 EFB reference 2*, *58.19 EFB status word*, *58.73 EFB actual value 1* and *58.74 EFB actual value 2* are not updated.	0
	Enable	Debug mode enabled. *58.18 EFB control word*, *58.71 EFB reference 1*, *58.72 EFB reference 2*, *58.19 EFB status word*, *58.73 EFB actual value 1* and *58.74 EFB actual value 2* are updated.	1
58.71	*EFB reference 1*	Displays the raw (unmodified) reference value 1for debugging purposes. This parameter is read-only. **Note:** If parameter *58.01* = [1] Modbus RTU, this parameter is hidden.	0

No.	Name/Value	Description	Default FbEq 16
	-100000…100000	Reference value 1	1=1
58.72	*EFB reference 2*	Displays the raw (unmodified) reference value 2 for debugging purposes. This parameter is read-only. **Note:** If parameter *58.01* = [1] Modbus RTU, this parameter is hidden.	0
	-100000…100000	Reference value 2	1=1
58.73	*EFB actual value 1*	Displays the raw (unmodified) actual value 1 for debugging purposes. This parameter is read-only. **Note:** If parameter *58.01* = [1] Modbus RTU, this parameter is hidden.	0
	-100000…100000	Actual value 1	1=1
58.74	*EFB actual value 2*	Displays the raw (unmodified) actual value 2 for debugging purposes. This parameter is read-only. **Note:** If parameter *58.01* = [1] Modbus RTU, this parameter is hidden.	0
	-100000…100000	Actual value 2	1=1
58.76	*RPDO1 COB-ID*	Set the COB-ID of the PDO. Changing this parameter has an effect only if *58.23 Configuration location* is *Drive parameters* and after the control unit is rebooted or the new settings validated by parameter *58.06 Communication control* (*Refresh settings*). **Note:** If parameter *58.01* = [1] Modbus RTU, this parameter is hidden.	0x0001
	0x0000...0x07ff	COB-ID. 0 = RPDO disabled, 1 = use COB-ID from CiA 301 pre-defined connection set, <other value> = use selected COB-ID.	1=1
58.77	*RPDO1 transmission type*	Set the transmission type of the PDO. Changing this parameter has an effect only if *58.23 Configuration location* is *Drive parameters* and after the control unit is rebooted or the new settings validated by parameter *58.06 Communication control* (*Refresh settings*). **Note:** If parameter *58.01* = [1] Modbus RTU, this parameter is hidden.	255

No.	Name/Value	Description	Default FbEq 16
	0...255	Transmission type. 0 = acyclic synchronous 1...240 = cyclic synchronous 252 = synchronous RTR only 253 = asynchronous RTR only 254…255 = asynchronous	1=1
58.78	*RPDO1 event timer*	Set the event timer of the PDO. Changing this parameter has an effect only if *58.23 Configuration location* is *Drive parameters* and after the control unit is rebooted or the new settings validated by parameter *58.06 Communication control* (*Refresh settings*). **Note:** If parameter *58.01* = [1] Modbus RTU, this parameter is hidden.	0
	0...65535	Defines the time-out time for the PDO. 0 = no timeout other = if this PDO is enabled and not received for event timer milliseconds, *58.14 Communication loss time* is performed. **Note:** The timeout supervision is activated upon a successful reception of the RPDO.	1=1 ms
58.79	*TPDO1 COB-ID*	Set the COB-ID of the PDO. Changing this parameter has an effect only if *58.23 Configuration location* is *Drive parameters* and after the control unit is rebooted or the new settings validated by parameter *58.06 Communication control* (*Refresh settings*). **Note:** If parameter *58.01* = [1] Modbus RTU, this parameter is hidden.	0x0001
	0x0000...0x07ff	COB-ID. 0 = RPDO disabled, 1 = use COB-ID from CiA 301 pre-defined connection set, <other value> = use selected COB-ID.	1=1
58.80	*TPDO1 transmission type*	Set the transmission type of the PDO. Changing this parameter has an effect only if *58.23 Configuration location* is *Drive parameters* and after the control unit is rebooted or the new settings validated by parameter *58.06 Communication control* (*Refresh settings*). **Note:** If parameter *58.01* = [1] Modbus RTU, this parameter is hidden.	255

No.	Name/Value	Description	Default FbEq 16
	0...255	Transmission type. 0 = acyclic synchronous 1...240 = cyclic synchronous 252 = synchronous RTR only 253 = asynchronous RTR only 254…255 = asynchronous	1=1
58.81	*TPDO1 event timer*	Set the event timer of the PDO. Changing this parameter has an effect only if *58.23 Configuration location* is *Drive parameters* and after the control unit is rebooted or the new settings validated by parameter *58.06 Communication control* (*Refresh settings*). **Note:** If parameter *58.01* = [1] Modbus RTU, this parameter is hidden.	0
	0...65535	Event timer 0 = no timeout other = if this PDO is enabled and has not been transmitted for event timer milliseconds, a transmission is forced	1=1 ms
58.82	*RPDO6 COB-ID*	Set the COB-ID of the PDO. Changing this parameter has an effect only if *58.23 Configuration location* is *Drive parameters* and after the control unit is rebooted or the new settings validated by parameter *58.06 Communication control* (*Refresh settings*). **Note:** If parameter *58.01* = [1] Modbus RTU, this parameter is hidden.	0x0000
	0x0000...0x07ff	COB-ID. 0 = RPDO disabled, 1 = use COB-ID from CiA 301 pre-defined connection set, <other value> = use selected COB-ID.	1=1
58.83	*RPDO6 transmission type*	Set the transmission type of the PDO. Changing this parameter has an effect only if *58.23 Configuration location* is *Drive parameters* and after the control unit is rebooted or the new settings validated by parameter *58.06 Communication control* (*Refresh settings*). **Note:** If parameter *58.01* = [1] Modbus RTU, this parameter is hidden.	255

No.	Name/Value	Description	Default FbEq 16
	0...255	Transmission type. 0 = acyclic synchronous 1...240 = cyclic synchronous 252 = synchronous RTR only 253 = asynchronous RTR only 254…255 = asynchronous	1=1
58.84	*RPDO6 event timer*	Set the event timer of the PDO. Changing this parameter has an effect only if *58.23 Configuration location* is *Drive parameters* and after the control unit is rebooted or the new settings validated by parameter *58.06 Communication control* (*Refresh settings*). **Note:** If parameter *58.01* = [1] Modbus RTU, this parameter is hidden.	0
	0...65535	Defines the time-out time for the PDO. 0 = no timeout other = if this PDO is enabled and not received for event timer milliseconds, *58.14 Communication loss time* is performed. **Note:** The timeout supervision is activated upon a successful reception of the RPDO.	1=1 ms
58.85	*TPDO6 COB-ID*	Set the COB-ID of the PDO. Changing this parameter has an effect only if *58.23 Configuration location* is *Drive parameters* and after the control unit is rebooted or the new settings validated by parameter *58.06 Communication control* (*Refresh settings*). **Note:** If parameter *58.01* = [1] Modbus RTU, this parameter is hidden.	0x0000
	0x0000...0x07ff	COB-ID. 0 = RPDO disabled, 1 = use COB-ID from CiA 301 pre-defined connection set, <other value> = use selected COB-ID.	1=1
58.86	*TPDO6 transmission type*	Set the transmission type of the PDO. Changing this parameter has an effect only if *58.23 Configuration location* is *Drive parameters* and after the control unit is rebooted or the new settings validated by parameter *58.06 Communication control* (*Refresh settings*). **Note:** If parameter *58.01* = [1] Modbus RTU, this parameter is hidden.	255

No.	Name/Value	Description	Default FbEq 16
	0...255	Transmission type. 0 = acyclic synchronous 1...240 = cyclic synchronous 252 = synchronous RTR only 253 = asynchronous RTR only 254…255 = asynchronous	1=1
58.87	*TPDO6 event timer*	Set the event timer of the PDO. Changing this parameter has an effect only if *58.23 Configuration location* is *Drive parameters* and after the control unit is rebooted or the new settings validated by parameter *58.06 Communication control* (*Refresh settings*). **Note:** If parameter *58.01* = [1] Modbus RTU, this parameter is hidden.	0
	0...65535	Event timer 0 = no timeout other = if this PDO is enabled and has not been transmitted for event timer milliseconds, a transmission is forced	1=1 ms
58.88	*RPDO21 COB-ID*	Set the COB-ID of the PDO. Changing this parameter has an effect only if *58.23 Configuration location* is *Drive parameters*and after the control unit is rebooted or the new settings validated by parameter *58.06 Communication control* (*Refresh settings*). **Note:** If parameter *58.01* = [1] Modbus RTU, this parameter is hidden.	0x0000
	0x0000...0x07ff	COB-ID. 0 = RPDO disabled, 1 = use COB-ID from CiA 301 pre-defined connection set, <other value> = use selected COB-ID.	1=1
58.89	*RPDO21 transmission type*	Set the transmission type of the PDO. Changing this parameter has an effect only if *58.23 Configuration location* is *Drive parameters* and after the control unit is rebooted or the new settings validated by parameter *58.06 Communication control* (*Refresh settings*). **Note:** If parameter *58.01* = [1] Modbus RTU, this parameter is hidden.	255

No.	Name/Value	Description	Default FbEq 16
	0...255	Transmission type. 0 = acyclic synchronous 1...240 = cyclic synchronous 252 = synchronous RTR only 253 = asynchronous RTR only 254…255 = asynchronous	1=1
58.90	*RPDO21 event timer*	Set the event timer of the PDO. Changing this parameter has an effect only if *58.23 Configuration location* is *Drive parameters* and after the control unit is rebooted or the new settings validated by parameter *58.06 Communication control* (*Refresh settings*). **Note:** If parameter *58.01* = [1] Modbus RTU, this parameter is hidden.	0
	0...65535	Defines the time-out time for the PDO. 0 = no timeout other = if this PDO is enabled and not received for event timer milliseconds, *58.14 Communication loss time* is performed. **Note:** The timeout supervision is activated upon a successful reception of the RPDO.	1=1 ms
58.91	*RPDO21 COB-ID*	Set the COB-ID of the PDO. Changing this parameter has an effect only if *58.23 Configuration location* is *Drive parameters* and after the control unit is rebooted or the new settings validated by parameter *58.06 Communication control* (*Refresh settings*). **Note:** If parameter *58.01* = [1] Modbus RTU, this parameter is hidden.	0x0000
	0x0000...0x07ff	COB-ID. 0 = RPDO disabled, 1 = use COB-ID from CiA 301 pre-defined connection set, <other value> = use selected COB-ID.	1=1
58.92	*TPDO21 transmission type*	Set the transmission type of the PDO. Changing this parameter has an effect only if *58.23 Configuration location* is *Drive parameters* and after the control unit is rebooted or the new settings validated by parameter *58.06 Communication control* (*Refresh settings*). **Note:** If parameter *58.01* = [1] Modbus RTU, this parameter is hidden.	255

No.	Name/Value	Description	Default FbEq 16
	0...255	Transmission type. 0 = acyclic synchronous 1...240 = cyclic synchronous 252 = synchronous RTR only 253 = asynchronous RTR only 254…255 = asynchronous	1=1
58.93	*TPDO21 event timer*	Set the event timer of the PDO. Changing this parameter has an effect only if *58.23 Configuration location* is *Drive parameters* and after the control unit is rebooted or the new settings validated by parameter *58.06 Communication control* (*Refresh settings*). **Note:** If parameter *58.01* = [1] Modbus RTU, this parameter is hidden.	0
	0...65535	Event timer 0 = no timeout other = if this PDO is enabled and has not been transmitted for event timer milliseconds, a transmission is forced	1=1 ms
58.101	*Data I/O 1*	Defines the address in the drive which the Modbus master accesses when it reads from or writes to the register address corresponding to Modbus register 1 (400001). The master defines the type of the data (input or output). The value is transmitted in a Modbus frame consisting of two 16-bit words. If the value is 16-bit, it is transmitted in the LSW (least significant word). If the value is 32-bit, the subsequent parameter is also reserved for it and must be set to *None*.	*CW 16bit*
	TPDO1 word 1	Selects a parameter that is mapped to TPDO1 word 1. Changing this parameter has an effect only if *58.23 Configuration location* is *Drive parameters* and after the control unit is rebooted or the new settings validated by parameter *58.06 Communication control* (*Refresh settings*).	*SW 16bit*
	None	No mapping, register is always zero.	0
	CW 16bit	*ABB Drives,* CiA402 and Transparent 16 profiles: 16-bit control word; *DCU Profile*: lower 16 bits of the DCU control word.	1
	Ref1 16bit	Reference REF1 (16 bits).	2
	Ref2 16bit	Reference REF2 (16 bits).	3

No.	Name/Value	Description	Default FbEq 16
	SW 16bit	*ABB Drives* profile: 16-bit ABB drives status word; *DCU Profile*: lower 16 bits of the DCU status word.	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	*ABB Drives* profile, CANopen: not used; *DCU Profile*: upper 16 bits of the DCU control word	21
	SW2 16bit	CANopen: Error code. *ABB Drives* profile: not used / always zero; *DCU Profile*: upper 16 bits of the DCU status word.	24
	RO/DIO control word	CANopen: not used. Parameter *10.99 RO/DIO control word*.	31
	AO1 data storage	CANopen: not used. Parameter *13.91 AO1 data storage*.	32
	Feedback data storage	CANopen: not used. Parameter *40.91 Feedback data storage*.	40
	Setpoint data storage	CANopen: not used. Parameter *40.92 Setpoint data storage*	41
	Other	Source selection (see *Terms and abbreviations*).	-
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*
	TPDO1 word 2	Selects a parameter that is mapped to TPDO1 word 2. For selections, see parameter *58.101 TPDO1 word 1*.	*Act1 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*
	TPDO1 word 3	Selects a parameter that is mapped to TPDO1 word 3. For selections, see parameter *58.101 TPDO1 word 1*.	*Act2 16bit*

No.	Name/Value	Description	Default FbEq 16
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*
	TPDO1 word 4	Selects a parameter that is mapped to TPDO1 word 4. For selections, see parameter *58.101 TPDO1 word 1*.	None
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*
	RPDO1 word 1	Selects a parameter that is mapped to RPDO1 word 1. For selections, see parameter *58.101 TPDO1 word 1*.	*CW 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*
	RPDO1 word 2	Selects a parameter that is mapped to RPDO1 word 2. For selections, see parameter *58.101 TPDO1 word 1*.	*Ref1 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
	RPDO1 word 3	Selects a parameter that is mapped to RPDO1 word 3. For selections, see parameter *58.101 TPDO1 word 1*.	*Ref2 16bit*
58.108	*Data I/O 8*	Parameter selector for Modbus register address 400008. For the selections, see parameter *58.101 Data I/O 1*.	None
	RPDO1 word 4	Selects a parameter that is mapped to RPDO1 word 4. For selections, see parameter *58.101 TPDO1 word 1*.	None

No.	Name/Value	Description	Default FbEq 16
58.109	Data I/O 9	Parameter selector for Modbus register address 400009. For the selections, see parameter 58.101 Data I/O 1.	None
	TPDO6 word 1	Selects a parameter that is mapped to TPDO6 word 1. For selections, see parameter 58.101 TPDO1 word 1.	None
58.110	Data I/O 10	Parameter selector for Modbus register address 400010. For the selections, see parameter 58.101 Data I/O 1.	None
	TPDO6 word 2	Selects a parameter that is mapped to TPDO6 word 2. For selections, see parameter 58.101 TPDO1 word 1.	None
58.111	Data I/O 11	Parameter selector for Modbus register address 400011. For the selections, see parameter 58.101 Data I/O 1.	None
	TPDO6 word 3	Selects a parameter that is mapped to TPDO6 word 3. For selections, see parameter 58.101 TPDO1 word 1.	None
58.112	Data I/O 12	Parameter selector for Modbus register address 400012. For the selections, see parameter 58.101 Data I/O 1.	None
	TPDO6 word 4	Selects a parameter that is mapped to TPDO6 word 4. For selections, see parameter 58.101 TPDO1 word 1.	None
58.113	Data I/O 13	Parameter selector for Modbus register address 400013. For the selections, see parameter 58.101 Data I/O 1.	None
	RPDO6 word 1	Selects a parameter that is mapped to RPDO6 word 1. For selections, see parameter 58.101 TPDO1 word 1.	None
58.114	Data I/O 14	Parameter selector for Modbus register address 400014. For the selections, see parameter 58.101 Data I/O 1.	None
	RPDO6 word 2	Selects a parameter that is mapped to RPDO6 word 2. For selections, see parameter 58.101 TPDO1 word 1.	None

No.	Name/Value	Description	Default FbEq 16
58.115	*RPDO6 word 3*	Selects a parameter that is mapped to RPDO6 word 3. For selections, see parameter *58.101 TPDO1 word 1*. **Note:** If parameter *58.01* = [1] Modbus RTU, this parameter is hidden.	None
58.116	*RPDO6 word 4*	Selects a parameter that is mapped to RPDO6 word 4. For selections, see parameter *58.101 TPDO1 word 1*. **Note:** If parameter *58.01* = [1] Modbus RTU, this parameter is hidden.	None
58.117	*TPDO21 word 1*	Selects a parameter that is mapped to TPDO21 word 1. For selections, see parameter *58.101 TPDO1 word 1*. **Note:** If parameter *58.01* = [1] Modbus RTU, this parameter is hidden.	None
58.118	*TPDO21 word 2*	Selects a parameter that is mapped to TPDO21 word 2. For selections, see parameter *58.101 TPDO1 word 1*. **Note:** If parameter *58.01* = [1] Modbus RTU, this parameter is hidden.	None
58.119	*TPDO21 word 3*	Selects a parameter that is mapped to TPDO21 word 3. For selections, see parameter *58.101 TPDO1 word 1*. **Note:** If parameter *58.01* = [1] Modbus RTU, this parameter is hidden.	None
58.120	*TPDO21 word 4*	Selects a parameter that is mapped to TPDO21 word 4. For selections, see parameter *58.101 TPDO1 word 1*. **Note:** If parameter *58.01* = [1] Modbus RTU, this parameter is hidden.	None
58.121	*RPDO21 word 1*	Selects a parameter that is mapped to RPDO21 word 1. For selections, see parameter *58.101 TPDO1 word 1*. **Note:** If parameter *58.01* = [1] Modbus RTU, this parameter is hidden.	None
58.122	*RPDO21 word 2*	Selects a parameter that is mapped to RPDO21 word 2. For selections, see parameter *58.101 TPDO1 word 1*. **Note:** If parameter *58.01* = [1] Modbus RTU, this parameter is hidden.	None

No.	Name/Value	Description	Default FbEq 16
58.123	RPDO21 word 3	Selects a parameter that is mapped to RPDO21 word 3. For selections, see parameter 58.101 TPDO1 word 1. **Note:** If parameter 58.01 = [1] Modbus RTU, this parameter is hidden.	None
58.124	RPDO21 word 4	Selects a parameter that is mapped to RPDO21 word 4. For selections, see parameter 58.101 TPDO1 word 1. **Note:** If parameter 58.01 = [1] Modbus RTU, this parameter is hidden.	None
71 External PID1		Configuration of external PID.	
71.01	External PID act value	See parameter 40.01 Process PID output actual.	-
71.02	Feedback act value	See parameter 40.02 Process PID feedback actual.	-
71.03	Setpoint act value	See parameter 40.03 Process PID setpoint actual.	-
71.04	Deviation act value	See parameter 40.04 Process PID deviation actual.	-
71.06	PID status word	Displays status information on process external PID control. This parameter is read-only.	-

Bit	Name	Value
0	PID active	1 = Process PID control active.
1	Reserved	
2	Output frozen	1 = Process PID controller output frozen. Bit is set if parameter 71.38 Output freeze enable is TRUE, or the deadband function is active (bit 9 is set).
3…6	Reserved	
7	Output limit high	1 = PID output is being limited by par. 40.37.
8	Output limit low	1 = PID output is being limited by par. 40.36.
9	Deadband active	1 = Deadband is active.
10…11	Reserved	
12	Internal setpoint active	1 = Internal setpoint active (see par. 40.16…40.16)
13…15	Reserved	

No.	Name/Value	Description	Default FbEq 16
	0000h…FFFFh	Process PID control status word.	1 = 1
71.07	PID operation mode	See parameter 40.07 Process PID operation mode.	Off
71.08	Feedback 1 source	See parameter 40.08 Set 1 feedback 1 source.	Not selected
71.11	Feedback filter time	See parameter 40.11 Set 1 feedback filter time.	0.000 s

No.	Name/Value	Description	Default FbEq 16
71.14	*Setpoint scaling*	Defines, together with parameter *71.15 Output scaling*, a general scaling factor for the external PID control chain. The scaling can be utilized when, for example, the process setpoint is input in Hz, and the output of the PID controller is used as an rpm value in speed control. In this case, this parameter might be set to 50, and parameter *71.15* to the nominal motor speed at 50 Hz. In effect, the output of the PID controller [*71.15*] when deviation (setpoint - feedback) = [*71.14*] and [*71.32*] = 1. **Note:** The scaling is based on the ratio between *71.14* and *71.15*. For example, the values 50 and 1500 would produce the same scaling as 1 and 3.	1500.00
	-200000.00... 200000.00	Process setpoint base.	1 = 1
71.15	*Output scaling*	See parameter *71.14 Setpoint scaling*.	1500.00
	-200000.00... 200000.00	Process PID controller output base.	1 = 1
71.16	*Setpoint 1 source*	See parameter *40.16 Set 1 setpoint 1 source*.	*Not selected*
71.19	*Internal setpoint sel1*	See parameter *40.19 Set 1 internal setpoint sel1*.	*Not selected*
71.20	*Internal setpoint sel2*	See parameter *40.20 Set 1 internal setpoint sel2*.	*Not selected*
71.21	*Internal setpoint 1*	See parameter *40.21 Set 1 internal setpoint 1*.	0.00 PID customer units
71.22	*Internal setpoint 2*	See parameter *40.22 Set 1 internal setpoint 2*.	0.00 PID customer units
71.23	*Internal setpoint 3*	See parameter *40.23 Set 1 internal setpoint 3*.	0.00 PID customer units
71.26	*Setpoint min*	See parameter *40.26 Set 1 setpoint min*.	0.00
71.27	*Setpoint max*	See parameter *40.27 Set 1 setpoint max*.	200000.00
71.31	*Deviation inversion*	See parameter *40.31 Set 1 deviation inversion*.	*Not inverted (Ref - Fbk)*
71.32	*Gain*	See parameter *40.32 Set 1 gain*.	1.00
71.33	*Integration time*	See parameter *40.33 Set 1 integration time*.	60.0 s
71.34	*Derivation time*	See parameter *40.34 Set 1 derivation time*.	0.000 s

No.	Name/Value	Description	Default FbEq 16
71.35	Derivation filter time	See parameter 40.35 Set 1 derivation filter time.	0.0 s
71.36	Output min	See parameter 40.36 Set 1 output min.	-200000.00
71.37	Output max	See parameter 40.37 Set 1 output max.	200000.00
71.38	Output freeze enable	See parameter 40.38 Set 1 output freeze enable.	Not selected
71.39	Deadband range	The control program compares the absolute value of parameter 71.04 Deviation act value to the deadband range defined by this parameter. If the absolute value is within the deadband range for the time period defined by parameter 71.40 Deadband delay, PID's deadband mode is activated and 71.06 PID status word bit 9 Deadband active is set. Then PID's output is frozen and 71.06 PID status word bit 2 Output frozen is set. If the absolute value is equal or greater than the deadband range, PID's deadband mode is deactivated.	0.0
	0.0…200000.0	Range.	1 = 1
71.40	Deadband delay	Defines the deadband delay for the deadband function. See parameter 71.39 Deadband range.	0.0 s
	0.0…3600.0 s	Delay.	1 = 1 s
71.58	Increase prevention	Activates increase prevention of PID integration term for Ext PID 1.	No
	No	Increase prevention not in use.	0
	Limiting	The Ext PID integration term is not increased.	1
	Process PID min lim	The Ext PID integration term is not increased when the output of the PID process has reached its minimum limit. In this setup, the external PID is used as a source for the PID process. This parameter is valid for the PID set 1.	2
	Process PID max lim	The Ext PID integration term is not increased when the output of the PID process has reached its maximum limit. In this setup, the external PID is used as a source for the PID process.	3
	Other [bit]	Source selection (see Terms and abbreviations on page 124).	-
71.59	Decrease prevention	Activates decrease prevention of PID integration term for Ext PID 1.	No
	No	Increase prevention not in use.	0
	Limiting	The Ext PID integration term is not decreased.	1

No.	Name/Value	Description	Default FbEq 16
	Process PID min lim	The Ext PID integration term is not decreased when the output of the PID process has reached its minimum limit. In this setup, the external PID is used as a source for the PID process.	2
	Process PID max lim	The Ext PID integration term is not decreased when the output of the PID process has reached its maximum limit. In this setup, the external PID is used as a source for the PID process.	3
	Other [bit]	Source selection (see *Terms and abbreviations* on page *124*).	-
71.62	*Internal setpoint actual*	See parameter *40.62 PID internal setpoint actual*.	-
71.79	*External PID units*	See parameter *40.79 Set 1 units*.	%
76 Application features		Application parameters. See also section *Limit to limit control* on page *109* and *Conical motor control* on page *679*.	
76.01	*Limit to limit control status*	Displays the state of the Limit to limit control state machine.	*Not initialized*
	Not initialized	The initial value of the state machine.	0
	Rev zero, Fwd max speed	The reverse speed is limited to zero speed, and the forward direction speed is not limited by Limit to limit control.	1
	Rev safe, Fwd max speed	The reverse speed is limited to safe speed, and the forward direction speed is not limited by Limit to limit control.	2
	Rev max, Fwd max speed	The reverse speed is not limited, and the forward direction speed is not limited by Limit to limit control.	3
	Rev max, Fwd safe speed	The reverse speed is not limited, and the forward direction speed is limited to safe speed by Limit to limit control.	4
	Rev max, Fwd zero speed	The reverse speed is not limited, and the forward direction speed is limited to zero speed by Limit to limit control.	5
	Rev safe, Fwd zero speed	The reverse speed is limited to safe speed, and the forward direction speed is limited to zero speed by Limit to limit control.	6
	Rev zero, Fwd safe speed	The reverse speed is limited to zero speed, and the forward direction speed is limited to safe speed by Limit to limit control.	7
	Rev safe, Fwd safe speed	The reverse speed is limited to safe speed, and the forward direction speed is limited to safe speed by Limit to limit control.	8

No.	Name/Value	Description	Default FbEq 16
	Rev zero, Fwd zero speed	The reverse speed is limited to zero speed, and the forward direction speed is limited to zero speed by Limit to limit control.	9
	0...9		1 = 1
76.02	*Enable limit to limit control*	Enables the Limit to limit control or selects the source for limit to limit control function. For more information on the function, see section *Limit to limit control* on page *109*.	*Not selected*
	Not selected	The Limit to limit control function is disabled.	0
	Selected	The Limit to limit 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
	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
	Timed function 1	Bit 0 of *34.01 Timed functions status*.	18
	Timed function 2	Bit 1 of *34.01 Timed functions status*.	19
	Timed function 3	Bit 2 of *34.01 Timed functions status*.	20
	Supervision 1	Bit 0 of *32.01 Supervision status.*	24
	Supervision 2	Bit 1 of *32.01 Supervision status.*	25
	Supervision 3	Bit 2 of *32.01 Supervision status.*	26
	Supervision 4	Bit 3 of *32.01 Supervision status.*	27
	Supervision 5	Bit 4 of *32.01 Supervision status.*	28
	Supervision 6	Bit 5 of *32.01 Supervision status.*	29
	Other [bit]	Source selection (see *Terms and abbreviations*).	-
76.03	*Limit to limit trigger type*	Selects the Limit to limit control trigger type.	*Rising Edge*
	Rising Edge	Safe and stop limits are handled as pulses. Limit to limit state machine changes states due to rising edge.	0
	Falling edge	Safe and stop limits are handled as pulses. Limit to limit state machine changes states due to falling edge.	1
	Level high	Safe and stop limits are handled as static signals. Limit to limit state machine changes states due state of high signal.	2

No.	Name/Value	Description	Default FbEq 16
	Level low	Safe and stop limits are handled as static signals. Limit to limit state machine changes states due state of low signal.	3
	Other [bit]	Source selection (see *Terms and abbreviations*).	
76.04	*Forward stop limit*	Selects the source to activate the Forward stop limit function. When the you enable the Forward stop command, the function activates an stop command in the forward direction, and the drive stops as per the stop mode defined in the parameter *76.12*. For more information on the function, see section *Crane stop limit function* on page *662*.	*Not selected*
	Not selected	Disables the stop limit function if the Limit to limit trigger type (*76.03*) is Rising edge or Level high. Enables the function if the trigger type is Falling edge or Level low.	0
	Selected	Enables the stop limit function if the Limit to limit trigger type (*76.03*) is Rising edge or Level high. Disables the function if the trigger type is Falling edge or Level low.	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
	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
	Timed function 1	Bit 0 of *34.01 Timed functions status*.	18
	Timed function 2	Bit 1 of *34.01 Timed functions status*.	19
	Timed function 3	Bit 2 of *34.01 Timed functions status*.	20
	Supervision 1	Bit 0 of *32.01 Supervision status.*	24
	Supervision 2	Bit 1 of *32.01 Supervision status.*	25
	Supervision 3	Bit 2 of *32.01 Supervision status.*	26
	Supervision 4	Bit 3 of *32.01 Supervision status.*	27
	Supervision 5	Bit 4 of *32.01 Supervision status.*	28
	Supervision 6	Bit 5 of *32.01 Supervision status.*	29
	Other [bit]	Source selection (see *Terms and abbreviations*).	-

No.	Name/Value	Description	Default FbEq 16
76.05	*Forward slow down limit*	Selects the source to activate the Forward slowdown function. When the command is active, the drive limits the speed reference to the value of parameter *76.08 Slow down speed*. The slowdown frequency is read from parameter *76.09 Slow down frequency*. For more information on the function, see section *Crane slowdown function* on page *664*.	*Not selected*
	Not selected	Disables the slowdown function if the Limit to limit trigger type (*76.03*) is Rising edge or Level high. Enables the function if the trigger type is Falling edge or Level low.	0
	Selected	Enables the slowdown function if the Limit to limit trigger type (*76.03*) is Rising edge or Level high. Disables the function if the trigger type is Falling edge or Level low.	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
	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
	Timed function 1	Bit 0 of *34.01 Timed functions status*.	18
	Timed function 2	Bit 1 of *34.01 Timed functions status*.	19
	Timed function 3	Bit 2 of *34.01 Timed functions status*.	20
	Supervision 1	Bit 0 of *32.01 Supervision status.*	24
	Supervision 2	Bit 1 of *32.01 Supervision status.*	25
	Supervision 3	Bit 2 of *32.01 Supervision status.*	26
	Supervision 4	Bit 3 of *32.01 Supervision status.*	27
	Supervision 5	Bit 4 of *32.01 Supervision status.*	28
	Supervision 6	Bit 5 of *32.01 Supervision status.*	29
	Other [bit]	Source selection (see *Terms and abbreviations*).	-

No.	Name/Value	Description	Default FbEq 16
76.06	*Reverse stop limit*	Selects the source to activate the Reverse stop limit function. When the command is enabled, the function activates an stop command in the reverse direction, and the drive stops as per the stop mode defined in the parameter *76.12*. For more information on the function, see section *Crane stop limit function* on page *662*.	*Not selected*
		For the available selections, see parameter *76.04 Forward stop limit*.	
76.07	*Reverse slow down limit*	Selects the source to activate the Reverse slowdown function. When the command is active, the drive limits the speed reference to the value of parameter *76.08 Slow down speed*. The Slowdown frequency is read from parameter *76.09 Slow down frequency*. For more information on the function, see section *Crane slowdown function* on page *664*.	*Not selected*
		For the available selections, see parameter *76.05 Forward slow down limit*.	
76.08	*Slow down speed*	Defines the slowdown speed.	0.00
	0.00…30000.00 rpm	Slowdown speed.	1 = 1
76.09	*Slow down frequency*	Defines the slowdown frequency.	0.00
	0.00…500.00 Hz	Slowdown frequency.	1 = 1
76.11	*Limit stop mode*	Selects the stop ramp mode when a limit stop command is activated.	*Normal stop mode*
	Normal stop mode	The motor takes the same stop mode as the mode set by *21.03 Stop mode*.	0
	Limit ramp stop mode	The motor takes ramp stop mode, and the ramp time is defined by *76.12 Limit stop ramp time*.	1
76.12	*Limit stop ramp time*	Defines the time inside which the drive is stopped if *76.11* is *Limit ramp stop mode*. (ie. the time required for the speed to change from the speed value defined by parameter *46.01 Speed scaling* or *46.02 Frequency scaling* to zero).	3.000 s
	0.000...3000.000 s		10 =1 s

No.	Name/Value	Description	Default FbEq 16
76.21	*Conical motor control*	Enables the Conical motor control function. **Note:** Mechanical brake control must be disabled 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
	Other [bit]	Source selection (see *Terms and abbreviations*).	-
76.22	*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 *76.24 Start flux hold time*.	125 %
	0...150 %	Start flux level in percentage of the motor nominal flux.	1 = 1 %
76.23	*Start stop 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 %
76.24	*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
76.25	*Flux ramp up time*	Defines the time for the flux reference to ramp up from 0 to the normal flux level (100%).	2000 ms
	0...10000 ms	Flux ramp-up time.	1 = 1 ms
76.26	*Flux ramp down time*	Defines the time for the flux reference to ramp down from the normal flux level (100%) to 0.	2000 ms
	0...10000 ms	Flux ramp-down time.	1 = 1 ms
76.27	*Flux reference*	Shows the crane flux reference in percent of the nominal flux of the motor. This parameter is read-only and used in the crane application for Conical motor control. See section *Conical motor control* on page *679*.	0 %
	0...200 %	Crane flux reference.	1 = 1 %
76.31	*Motor speed match*	Enables the speed matching function or selects the source for enable/disable signal.	*Not selected*
	Not selected	The motor speed matching function is disabled.	0

No.	Name/Value	Description	Default FbEq 16
	Selected	The motor speed matching function is enabled.	1
	DI1	Digital input DI1 (*10.02 DI delayed status*, bit 0).	2
	DI2	Digital input DI1 (*10.02 DI delayed status*, bit 0).	3
	DI3	Digital input DI1 (*10.02 DI delayed status*, bit 0).	4
	DI4	Digital input DI4 (*10.02 DI delayed status*, bit 3).	5
	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
	Timed function 1	Bit 0 of *34.01 Timed functions status*.	18
	Timed function 2	Bit 1 of *34.01 Timed functions status*.	19
	Timed function 3	Bit 2 of *34.01 Timed functions status*.	20
	Supervision 1	Bit 0 of *32.01 Supervision status.*	24
	Supervision 2	Bit 1 of *32.01 Supervision status.*	25
	Supervision 3	Bit 2 of *32.01 Supervision status.*	26
	Supervision 4	Bit 3 of *32.01 Supervision status.*	27
	Supervision 5	Bit 4 of *32.01 Supervision status.*	28
	Supervision 6	Bit 5 of *32.01 Supervision status.*	29
	Other	Source selection (see *Terms and abbreviations*).	
76.32	*Motor speed steady deviation level*	Defines the allowed motor speed deviation level (absolute value) for the steady state operation (motor started and running).	30.00
	0.00....30000.00 rpm		1 = 1
76.33	*Motor speed ramp deviation level*	Defines the allowed motor speed deviation level (absolute value) for the ramping state (acceleration/deceleration) operation (motor started and running).	70.00
	0.00....30000.00 rpm		1 = 1
76.34	*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		1 = 1

No.	Name/Value	Description	Default FbEq 16
90 Feedback selection		Motor and load feedback configuration. See also sections *Rush control* (page *71*) and *Jogging* (page *71*).	
90.01	*Motor speed for control*	Displays the estimated or measured motor speed that is used for motor control, ie. final motor speed feedback selected by parameter *90.41 Motor feedback selection* and filtered by *90.42 Motor speed filter time*. This parameter is read-only.	-
	-32768.00 … 32767.00 rpm	Motor speed used for control.	See par. *46.01*
90.02	*Motor position*	Displays the motor position (within one revolution) received from the source selected by parameter *90.41 Motor feedback selection*. This parameter is read-only.	-
	0.00000000 … 1.00000000 rev	Motor position.	32767 = 1 rev
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
90.13	*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. This parameter is read-only.	-
	-2147483648… 2147483647	Encoder 1 revolution count extension.	-

No.	Name/Value	Description	Default FbEq 16
90.41	*Motor feedback selection*	Selects the motor speed feedback value used during motor control. **Note:** With a permanent magnet motor, make sure an autophasing routine (see page *55*) is performed using the selected encoder. If necessary, set parameter *99.13 ID run requested* requested to *Autophasing* to request a fresh autophasing routine.	*Estimate*
	Estimate	A calculated speed estimate generated from the vector control 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
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
90.45	*Motor feedback fault*	Selects how the drive reacts to loss of measured motor feedback.	*Fault*
	Fault	Drive trips on a *7301 Motor speed feedback*. or *7381 Encoder* fault.	0
	Warning	Drive generates a *A7B0 Motor speed feedback* or *A7E1 Encoder* warning and continues operation using estimated feedbacks. **Note:** Before using this setting, test the stability of the speed control loop with estimated feedback by running the drive on estimated feedback (see *90.41 Motor feedback selection*).	1
90.46	*Force open loop*	Defines the speed feedback used by the vector 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 the feedback for the speed controller).	1
90.47	*Enable motor encoder drift detection*	Enables/disables the motor encoder drift detection. When drift is detected, fault *7301 Motor speed feedback* and AUX code 4 Drift detected are set.	*Yes*
	No	Drift detection is disabled.	0
	Yes	Drift detection is enabled.	1

No.	Name/Value	Description	Default FbEq 16
91 Encoder module settings		Configuration of encoder interface modules.	
91.10	*Encoder parameter refresh*	Validates any changed encoder interface module parameters. This is needed for any parameter changes in groups 90…93 to take effect. After refreshing, the value reverts automatically to *Done*. **Notes:** • Permanent magnet motors only: The drive will perform a fresh autophasing routine (see page *55*) at next start if the motor feedback encoder settings have been changed. • The parameter cannot be changed while the drive is running.	*Done*
	Done	The refreshing is completed.	0
	Refresh	Refresh function is running.	1
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.	
92.10	*Pulses/revolution*	*(Visible when a TTL, TTL + HTL encoder is selected)* Defines the pulse number per revolution.	2048
	0...65535	Number of pulses.	-

No.	Name/Value	Description	Default FbEq 16
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. See section *Voltage control and trip limits* on page *105*. ⚠ **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.	*Automatic / not selected*
	Automatic / not selected	No voltage range selected. The supply voltage range will be selected automatically based on the measured DC voltage.	0
	208…240 V	200…240 V, available for ACS380-04-xxxx-1/-2 drives	1
	380…415 V	380…480 V, available for ACS380-04-xxxx-4 drives	2
	440…480 V	440…480 V, available for ACS380-04-xxxx-4 drives	3
95.02	*Adaptive voltage limits*	Enables adaptive voltage limits. Adaptive voltage limits can be used if, for example, an IGBT supply unit is used to raise the DC voltage level. If the communication between the inverter and IGBT supply unit is active, the voltage limits are related to the DC voltage reference from the IGBT supply unit. Otherwise the limits are calculated based on the measured DC voltage at the end of the pre-charging sequence. This function is also useful if the AC supply voltage to the drive is high, as the warning levels are raised accordingly.	*Enable*
	Disable	Adaptive voltage limits disabled.	0
	Enable	Adaptive voltage limits enabled.	1
95.03	*Estimated AC supply voltage*	AC supply voltage estimated by calculation. The estimation is done every time the drive is powered up and is based on the measured DC voltage (UDC/1.41).	-

No.	Name/Value	Description	Default FbEq 16
	0.0…65535.0 V	Voltage.	10 = 1 V
95.04	*Control board supply*	Specifies how the control board of the drive is powered.	*Internal 24V*
	Internal 24V	The drive control board is powered from the drive power unit it is connected to.	0
	External 24V	The drive control board is powered from an external power supply.	1
95.15	*Special HW settings*	Contains hardware-related settings that can be enabled and disabled by toggling the specific bits. **Note**: The installation of the hardware specified by this parameter may require derating of drive output, or impose other limitations. Refer to the hardware manual of the drive.	-

Bit	Name	Information
0	Reserved	-
1	ABB Sine filter	1 = An ABB sine filter is connected to the output of the drive/inverter
2...15	Reserved	-

	0…1	Hardware options configuration word.	1 = 1

No.	Name/Value	Description	Default FbEq 16
95.20	*HW options word 1*	Specifies hardware-related options that require differentiated parameter defaults. This parameter is not affected by a parameter restore.	-

Bit	Name	Value
0	Supply frequency 60 Hz	If you change the value of this bit, you have to do a complete reset to the drive after the change. After reset you have to reselect the macro to be used. See section *Differences in the default values between 50 Hz and 60 Hz supply frequency settings* on page *458*. 0 = 50 Hz. 1 = 60 Hz. **Note**: If bit 0 value is 0 (not activated) and parameter *99.06* value is 3.0 A *and* parameter *99.09* value is 1430 rpm (the 50Hz defaults), the motor parameters will be reset to defaults. **Note**: If bit 0 value is 1 (activated) and parameter *99.06* value is 3.4 A *and* parameter *99.09* value is 1750 rpm (the 60Hz defaults), the motor parameters will be reset to defaults.
1…12	Reserved	
13	du/dt filter activation	When active, an external du/dt filter is connected to the drive/inverter output. The setting will limit the output switching frequency, and force the fan of the drive/inverter module to full speed. 0 = du/dt filter inactive. 1 = du/dt filter active.
14…15	Reserved	

	0000h…FFFFh	Hardware options configuration word.	1 = 1

No.	Name/Value	Description	Default FbEq 16
95.26	Motor disconnect detection	Enables the use of the motor disconnect switch, or selects the source for the enable signal. When enabled, the drive does not trip to a fault when it detects the disconnection but remains operational and returns to normal operation after a reconnection. When this parameter is enabled, the drive will go through the following sequence: 1. Motor is disconnected: Drive detects the disconnection and indicates it with warning A784. The drive remains in operation and waits for motor reconnection. 2. Motor is reconnected: Drive detects the reconnection, removes the warning and returns to normal operation. The last active reference before the disconnection is in use. **Note**: This feature is only available in scalar mode. This parameter does not affect vector mode behavior.	Disable
	0	Disable.	1 = 1
	1	Enable.	1 = 1
95.200	Cooling fan mode	Cooling fan operation mode.	Auto
	Auto	Fan runs normally: Fan on/off, fan speed reference can autochange according to the drive state.	0
	Always on	Fan always runs at 100% speed reference.	1

96 System		Language selection; access levels; macro selection; parameter save and restore; control unit reboot; user parameter sets; unit selection; 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** – **Drive default language**.)	Not selected
	Not selected	Select a language.	0
	English	English.	1033
	Deutsch	German.	1031
	Italiano	Italian.	1040
	Español	Spanish.	3082

No.	Name/Value	Description	Default FbEq 16
	Portugues	Portuguese.	2070
	Nederlands	Dutch.	1043
	Français	French.	1036
	Suomi	Finnish.	1035
	Svenska	Swedish.	1053
	Russki	Russian.	1049
	Polski	Polish.	1045
	Türkçe	Turkish.	1055
	Chinese (Simplified, PRC)	Simplified Chinese.	2052
96.02	*Pass code*	Pass codes can be entered into this parameter to activate further access levels, for example additional parameters, parameter lock, etc. See parameter *96.03 Access levels status*. Entering “358” toggles the parameter lock, which prevents the changing of all other parameters through the control panel or the Drive Composer PC tool. Entering the user pass code (by default, “10000000”) enables parameters *96.100…96.102*, which can be used to define a new user pass code and to select the actions that are to be prevented. Entering an invalid pass code will close the user lock if open, ie. hide parameters *96.100…96.102*. After entering the code, check that the parameters are in fact hidden. **Note:** We recommend that you change the default user pass code. See also section *User lock* (page *119*).	0
	0…99999999	Pass code.	-

No.	Name/Value	Description	Default FbEq 16
96.03	*Access levels status*	Shows which access levels have been activated by pass codes entered into parameter *96.02 Pass code*.	0b0000

Bit	Name
0	End user
1	Service
2	Advanced users
3…10	Reserved
11	OEM access level 1
12	OEM access level 2
13	OEM access level 3
14	Parameter lock
15	Reserved

	0b0000...0b1111	Active access levels.	-
96.04	*Macro select*	Selects the control macro. See chapter *Control macros* for more information. After a selection is made, the parameter reverts automatically to *Done*. **Note:** When you change the default parameter values of a macro, the new settings become valid immediately and stay valid even if the power of the drive is switched off and on. However, backup of the default parameter settings (factory settings) of each standard macro is still available.	*Done*
	Done	Macro selection complete; normal operation.	0
	ABB standard	*ABB standard macro*. For scalar motor control.	1
	AC500 Modbus RTU	*AC500 modbus RTU macro*.	5
	Alternate	*Alternate macro*.	12
	Motor potentiometer	*Motor potentiometer macro*.	13
	PID	*PID control macro*.	14
	Torque control	*Torque control macro*.	28
96.05	*Macro active*	Shows which control macro is currently selected. See chapter *Control macros* for more information. To change the macro, use parameter *96.04 Macro select*.	*ABB standard*
	Done	Macro selection complete; normal operation.	0
	ABB standard	*ABB standard macro*. For scalar motor control.	1
	AC500 Modbus RTU	*AC500 modbus RTU macro*.	5
	Alternate	*Alternate macro*.	12
	Motor potentiometer	*Motor potentiometer macro*.	13
	PID	*PID control macro*.	14

No.	Name/Value	Description	Default FbEq 16
	Torque control	*Torque control macro*.	28
96.06	*Parameter restore*	Restores the original settings of the control program, ie. parameter default values. **Note:** This parameter cannot be changed while the drive is running.	*Done*
	Done	Restoring is completed.	0
	Restore defaults	All editable parameter values are restored to default values, except • motor data and ID run results • I/O extension module settings • end user texts, such as customized warnings and faults (external faults and changed), and the drive name • control panel/PC communication settings • fieldbus adapter settings • control macro selection and the parameter defaults implemented by it • parameter *95.20 HW options word 1* and the differentiated defaults implemented by it. • user lock configuration parameters *96.100…96.102*.	8
	Clear all	All editable parameter values are restored to default values, except • end user texts, such as customized warnings and faults (external faults and changed), and the drive name • control panel/PC communication settings • fieldbus adapter settings (clears entire existing settings) • control macro selection and the parameter defaults implemented by it • parameter *95.20 HW options word 1* and the differentiated defaults implemented by it. • user lock configuration parameters *96.100…96.102*. PC tool communication is interrupted during the restoring.	62
	Reset all fieldbus settings	Restores all fieldbus and communication related settings to default values. **Note**: Fieldbus, control panel and PC tool communication are interrupted during the restore.	32
	Reset home view	Restores the Home view layout to show the values of the default parameters defined by the control macro use.	512

No.	Name/Value	Description	Default FbEq 16
	Reset end user texts	Restores all end user texts to default values, including the drive name, contact info, customized fault and warning texts, and currency unit. If the value of parameter *40.79* is set to *User Text,* then the PID unit is also reset. If parameter *40.79* has some other value, the PID unit cannot be reset.	1024
	Reset motor data	Restores all motor nominal values and motor ID run results to default values.	2
	All to factory defaults	Restores settings and all editable parameters back to initial factory values, except • the differentiated defaults implemented by parameter 95.20.	34560
96.07	*Parameter save manually*	Saves the valid parameter values to the permanent memory on the drive control board to ensure that operation can continue after cycling the power. Save the parameters with this parameter • to store values sent from the fieldbus • when using external +24 V DC power supply to the control unit: to save parameter changes before you power down the control unit. The supply has 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. **Warning**: This parameter should not be written with the fieldbus or an adaptive program, as that could cause a continuous boot loop that would paralyze the drive.	0
	0	No action.	1 = 1
	1	Reboot the control unit.	

No.	Name/Value	Description	Default FbEq 16
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 *117*).	-
	n/a	No user parameter sets have been saved.	0
	Loading	A user set is being loaded.	1
	Saving	A user set is being saved.	2
	Faulted	Invalid or empty parameter set.	3
	User1 IO active	User set 1 has been selected by parameters *96.12 User set I/O mode in1* and *96.13 User set I/O mode in2*.	4
	User2 IO active	User set 2 has been selected by parameters *96.12 User set I/O mode in1* and *96.13 User set I/O mode in2*.	5
	User3 IO active	User set 3 has been selected by parameters *96.12 User set I/O mode in1* and *96.13 User set I/O mode in2*.	6
	User4 IO active	User set 4 has been selected by parameters *96.12 User set I/O mode in1* and *96.13 User set I/O mode in2*.	7
	User1 backup	User set 1 has been saved or loaded.	20
	User2 backup	User set 2 has been saved or loaded.	21
	User3 backup	User set 3 has been saved or loaded.	22
	User4 backup	User set 4 has been saved or loaded.	23
96.11	*User set save/load*	Enables the saving and restoring of up to four custom sets of parameter settings. The set that was in use before powering down the drive is in use after the next power-up. **Notes:** • Some hardware configuration settings, such as I/O extension module, fieldbus and encoder configuration parameters (groups 14…16, 47, 50…58 and 92…93) 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. • This parameter cannot be changed while the drive is running	*No action*
	No action	Load or save operation complete; normal operation.	0

<table>
<tr><th>No.</th><th>Name/Value</th><th>Description</th><th>Default
FbEq 16</th></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>
</table></td><td>*Not selected*</td></tr>
<tr><td></td><td>Not selected</td><td>0.</td><td>0</td></tr>
<tr><td></td><td>Selected</td><td>1.</td><td>1</td></tr>
<tr><td></td><td>DI1</td><td>Digital input DI1 (*10.02 DI delayed status*, bit 0).</td><td>2</td></tr>
<tr><td></td><td>DI2</td><td>Digital input DI2 (*10.02 DI delayed status*, bit 1).</td><td>3</td></tr>
<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>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>Timed function 1</td><td>Bit 0 of *34.01 Timed functions status*.</td><td>18</td></tr>
<tr><td></td><td>Timed function 2</td><td>Bit 1 of *34.01 Timed functions status*.</td><td>19</td></tr>
<tr><td></td><td>Timed function 3</td><td>Bit 2 of *34.01 Timed functions status*.</td><td>20</td></tr>
<tr><td></td><td>Supervision 1</td><td>Bit 0 of *32.01 Supervision status*.</td><td>24</td></tr>
<tr><td></td><td>Supervision 2</td><td>Bit 1 of *32.01 Supervision status*.</td><td>25</td></tr>
<tr><td></td><td>Supervision 3</td><td>Bit 2 of *32.01 Supervision status*.</td><td>26</td></tr>
</table>

No.	Name/Value	Description	Default FbEq 16
	Supervision 4	Bit 3 of *32.01 Supervision status*	27
	Supervision 5	Bit 4 of *32.01 Supervision status*.	28
	Supervision 6	Bit 5 of *32.01 Supervision status*.	29
	Other [bit]	Source selection (see *Terms and abbreviations*).	-
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.	0b0000

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

No.	Name/Value	Description	Default FbEq 16
	0b0000...0b1111	Unit selection word.	1 = 1
96.20	*Time sync primary source*	Defines the 1st priority external source for synchronization of the drive's time and date. The date and time can also be directly set with parameters 96.24…96.26 in which case this parameter is ignored.	*Embedded FB*
	Fieldbus A	Fieldbus interface A. FENA/FPNO can get the time from an SNTP server and set it as the time for the drive. Athat	3
	Embedded FB	Embedded fieldbus interface. The EFB BACnet MS/TP Timesync service can be used to set the time for the drive.	6
	Panel link	The time for the drive can be set using a control panel, or a PC tool connected to the panel link.	8
	Ethernet tool link	Drive Composer PC tool through FENA module. The user can set the time manually by using DCP over Ethernet. The time is set in the same way as with USB and panel.	9

No.	Name/Value	Description	Default FbEq 16
96.24	*Full days since 1st Jan 1980*	The number of full days passed since beginning of the year 1980. This parameter, together with *96.25 Time in minutes within 24h* and *96.26 Time in ms within one minute* makes it possible to set the date and time in the drive via the parameter interface from a fieldbus or application program. This may be necessary if the fieldbus protocol does not support time synchronization.	12055
	1…59999	Days since beginning of 1980.	1 = 1
96.25	*Time in minutes within 24h*	The 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*	The number of milliseconds passed since the previous minute. See parameter *96.24 Full days since 1st Jan 1980*.	0 ms
	0…59999	Number of milliseconds since last minute.	1 = 1
96.51	*Clear fault and event logger*	Clears all events from the drive's fault and event logs.	*Done*
	Done	0 = No action.	0
	Reset	1 = Resets (clears) fault and event logger.	1
96.54	*Checksum action*	Selects how the drive reacts • when *96.55 Checksum control word*, bit 8 = 1 (Approved checksum A): if the parameter checksum *96.68 Actual checksum A* does not match *96.71 Approved checksum A*, and/or • when *96.55 Checksum control word*, bit 9 = 1 (Approved checksum B): if the parameter checksum *96.69 Actual checksum B* does not match *96.72 Approved checksum B*.	*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

No.	Name/Value	Description	Default FbEq 16
96.55	*Checksum control word*	Bits 8…9 select which comparison(s) are made: • Bit 8 = 1 (Approved checksum A): *96.68 Actual checksum A* is compared to *96.71 Approved checksum A*, and/or • Bit 9 = 1 (Approved checksum A): if *96.69 Actual checksum B* is compared to *96.72 Approved checksum B*. Bits 12…13 select approved (reference) checksum parameter(s) into which the actual checksum(s) from parameter(s) are copied: • Bit 12 = 1 (Set approved checksum A): Value of *96.68 Actual checksum A* is copied into *96.71 Approved checksum A* and/or • Bit 13 = 1 (Set approved checksum B): Value of *96.69 Actual checksum B* copied into *96.72 Approved checksum B*.	0b0000

Bit	Name	Information
0...7	Reserved	
8	Approved checksum A	1 = Enabled: Checksum A (*96.71*) is observed. 0 = Disabled.
9	Approved checksum B	1 = Enabled: Checksum B (*96.72*) is observed. 0 = Disabled.
10...11	Reserved	
12	Set approved checksum A	1 = Set: Copy value of *96.68* into *96.71*. 0 = Done (copy has been made).
13	Set approved checksum B	1 = Set: Copy value of *96.69* into *96.72*. 0 = Done (copy has been made).
14...15	Reserved	

No.	Name/Value	Description	Default FbEq 16
	0b0000...0b1111	Checksum control word.	1 = 1

No.	Name/Value	Description	Default FbEq 16
96.68	*Actual checksum A*	Displays the actual parameter configuration checksum A. The checksum A is generated and updated whenever an action is selected in *96.54 Checksum action* and *96.55 Checksum control word*, bit 8 = 1 (Approved checksum A) The set of parameters for checksum A calculation does not include fieldbus settings parameters. The parameters included in the checksum A calculation are user editable parameters in parameter groups 10, 15, 19, 20, 21, 22, 23, 24, 25, 28, 30, 31, 32, 34, 35, 36, 37, 40, 41, 43, 45, 46, 71, 76, 90, 91, 92, 95, 96, 97, 98, and 99. See also section *Parameter checksum calculation* (page *118*).	0x0000
	0x0000...0xffff	Actual checksum A.	1 = 1
96.69	*Actual checksum B*	Displays the actual parameter configuration checksum B. The checksum B is generated and updated whenever an action is selected in *96.54 Checksum action* and *96.55 Checksum control word*, bit 9 = 1 (Approved checksum B) The set of parameters for checksum B does not include: • fieldbus settings • motor data settings, and • energy data settings parameters. The parameters included in the checksum B calculation are user editable parameters in parameter groups 10, 15, 19, 20, 21, 22, 23, 24, 25, 28, 30, 31, 32, 34, 35, 36, 37, 40, 41, 43, 46, 71, 76, 90, 91, 92, 95, 96, and 97. See also section *Parameter checksum calculation* (page *118*).	0x0000
	0x0000...0xffff	Actual checksum B.	1 = 1
96.70	*Disable adaptive program*	Selects if the adaptive program is enabled or disabled	
	No	Adaptive program is enabled. Adaptive program is set to running mode automatically when drive is powered on. Commanding adaptive program to running mode is possible from PC tool.	0
	Yes	Adaptive program is disabled. Setting adaptive program to running mode is not possible. If adaptive program was running when disabled, then adaptive program is stopped and set to init state.	1

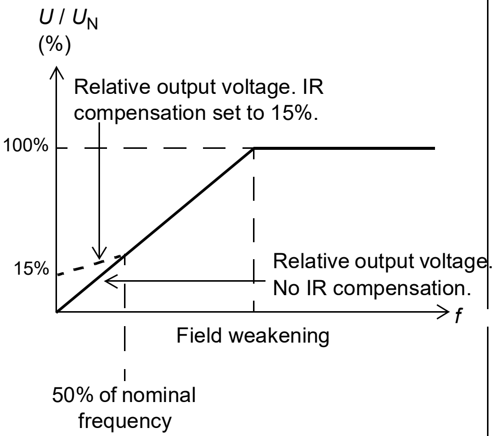
No.	Name/Value	Description	Default FbEq 16
96.71	*Approved checksum A*	Approved (reference) checksum A.	0x0000
	0x0000...0xffff	Approved checksum A.	-
96.72	*Approved checksum B*	Approved (reference) checksum B.	0x0000
	0x0000...0xffff	Approved checksum B.	-

97 Motor control		Switching frequency; slip gain; voltage reserve; flux braking; anti-cogging (signal injection); IR compensation.	
97.01	*Switching frequency reference*	Defines the switching frequency of the drive that is used as long as the drive does not heat too much. See section *Switching frequency* on page *80*. Higher switching frequency results in lower acoustic noise. In multimotor systems, do not change the switching frequency from the default value.	*4 kHz*
	4 kHz	4 kHz.	4
	8 kHz	8 kHz.	8
	12 kHz	12 kHz.	12
97.02	*Minimum switching frequency*	Lowest switching frequency that is allowed. Depends on the frame size.	*1.5 kHz*
	1.5 kHz	1.5 kHz. In some larger frame sizes 1 kHz is used instead.	1.5
	2 kHz	2 kHz.	2
	4 kHz	4 kHz.	4
	8 kHz	8 kHz.	8
	12 kHz	12 kHz.	12
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%

No.	Name/Value	Description	Default FbEq 16
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%
	-5…50%	Voltage reserve. Setting voltage reserve to -5…-4% will enable full output voltage (motor voltage = network voltage at rated frequency). This will increase the current harmonics to the motor and might lead to motor heating.	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*). **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. ⚠ **WARNING!** Using full flux braking heats up the motor especially in cyclic operation. Make sure that the motor can withstand this if you have a cyclic application.	2

No.	Name/Value	Description	Default FbEq 16
97.06	*Flux reference select*	Defines the source of flux reference. **Notes:** • This parameter is not effective if parameter *76.21 Conical motor control* is enabled. • This is an expert level parameter and should not be adjusted without appropriate skill. • Do not use this parameter in scalar control mode, if the parameter *97.20 U/F ratio* is set to *Squared*.	*User flux reference*
	Zero	Minimum value of parameter *97.07 User flux reference*.	0
	User flux reference	Parameter *97.07 User flux reference*.	1
	Other	Source selection (see *Terms and abbreviations*).	-
97.07	*User flux reference*	Defines the flux reference when parameter *97.06 Flux reference select* select is set to *User flux reference*. **Notes:** • This parameter is not effective if parameter *76.21 Conical motor control* is enabled. • ABB recommends the range of 20.00%...120.00%.	100.00%
	0.00...200.00%	User-defined flux reference.	100 = 1%
97.08	*Optimizer minimum torque*	This parameter can be used to improve the control dynamics of a synchronous reluctance motor or a salient permanent magnet synchronous motor. As a rule of thumb, define a level to which the output torque must rise with minimum delay. This will increase the motor current and improve the torque response at low speeds.	0.0%
	0.0...1600.0%	Optimizer torque limit.	10 = 1%
97.11	*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	Default FbEq 16
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 vector control cannot be applied.	3.20%



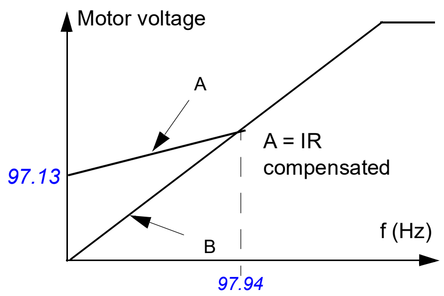
See also section *IR compensation for scalar motor control* on page *75*.

Typical IR compensation values are shown below.

3-phase 380…480V drives								
P_N (kW)	0, 37	0, 75	1, 1	2, 2	4	7, 5	15	22
IR compen s-ation (%)	3, 5	3, 5	3, 2	2, 5	2	1, 5	1, 25	1, 2
3-phase 200…240V drives								
P_N (kW)	0, 37	0, 75	1, 1	2, 2	3	7, 5	11	
IR compen s-ation (%)	3, 5	3, 5	2, 6	2, 4	2, 2	1, 7	1, 5	
1-phase 200…240V drives								
P_N (kW)	0, 37	0, 75	1, 1	1, 5	2, 2			
IR	3, 0	2, 3	2	1, 7	1			

WARNING! Set IR compensation value as low as possible. Large IR compensation value can lead to overheating of the motor and damage to the drive, if operated for longer periods at low speed.

No.	Name/Value	Description	Default FbEq 16
	0.00…50.00%	Voltage boost at zero speed in percent of nominal motor voltage.	1 = 1%
97.15	*Motor model temperature adaptation*	Selects whether the temperature-dependent parameters (such as stator or rotor resistance) of the motor model adapt to actual (measured or estimated) temperature or not. See parameter group *35 Motor thermal protection* for selection of temperature measurement sources.	*Disabled*
	Disabled	Temperature adaptation of motor model disabled.	0
	Estimated temperature	Estimated temperature (*35.01 Motor estimated temperature*) used for adaptation of motor model.	1
97.16	*Stator temperature factor*	Tunes the motor temperature dependence of stator parameters (stator resistance).	50
	0…200 %	Tuning factor.	
97.17	*Rotor temperature factor*	Tunes the motor temperature dependence of rotor parameters (eg. rotor resistance).	100
	0…200 %	Tuning factor.	
97.20	*U/F ratio*	Selects the form for the *U/f* (voltage to frequency) ratio below field weakening point. For scalar control only.	*Disabled*
	Linear	Linear ratio for constant torque applications.	0
	Squared	Squared ratio for centrifugal pump and fan applications. With squared U/f ratio the noise level is lower for most operating frequencies. Not recommended for permanent magnet motors.	1
97.33	*Speed estimate filter time*	Defines a filtering time for estimated speed.	5.00
	0.00...100.00 ms	Filtering time for estimated speed.	1 = 1 ms
97.48	UDC stabilizer	Enables or disables the DC bus voltage stabilizer.	*Disabled*
	Disabled	DC bus voltage stabilizer disabled.	0
	Enabled min	DC bus voltage stabilizer enabled, minimum stabilization.	50
	Enabled mild	DC bus voltage stabilizer enabled, mild stabilization.	100
	Enabled medium	DC bus voltage stabilizer enabled, medium stabilization.	300
	Enabled strong	DC bus voltage stabilizer enabled, strong stabilization.	500

No.	Name/Value	Description	Default FbEq 16
	Enabled max	DC bus voltage stabilizer enabled, maximum stabilization.	800
97.49	*Slip gain for scalar*	Sets gain for slip compensation (in %) while drive is operating in scalar control mode. • A squirrel-cage motor slips under load. Increasing the frequency as the motor torque increases compensates for the slip. • Requires parameter *99.04 Motor control mode* = *Scalar*. 0 = No slip compensation. 1...200 = Increasing slip compensation. 100% means full slip compensation according to parameters *99.08 Motor nominal frequency* and *99.09 Motor nominal speed*.	0
	0...200 %	Slip compensation in %.	1 = 1%
97.94	*IR comp max frequency*	Sets the frequency at which IR compensation (set by parameter *97.13 IR compensation*) reaches 0 V. The unit is % of motor nominal frequency. IR compensation When enabled, IR compensation provides an extra voltage boost to the motor at low speeds. Use IR compensation, for example, in applications that require a high breakaway torque.  	80.0
	1.0...200.0 %	IR compensation maximum frequency in %.	1 = 1%
97.135	*UDC ripple*	Calculated ripple voltage.	0.0 V
	0.0…200.0 V	Voltage.	1 = 1 V

No.	Name/Value	Description	Default FbEq 16
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*…*98.12* and *98.14*. **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*…*98.12* 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 data sheet from a motor manufacturer. • This parameter cannot be changed while the drive is running.	*Not selected*
	Not selected	Parameters *98.02*…*98.12* inactive.	0
	Motor parameters	The values of parameters *98.02*…*98.12*are used as the motor model.	1
98.02	*Rs user*	Defines the stator resistance R_S of the motor model. With a star-connected motor, R_S is the resistance of one winding. With a delta-connected motor, R_S is one-third of the resistance of one winding.	0.00000 p.u.
	0.00000…0.50000 p.u.	Stator resistance in per unit.	-
98.03	*Rr user*	Defines the rotor resistance R_R of the motor model. **Note:** This parameter is valid only for asynchronous motors.	0.00000 p.u.
	0.00000…0.50000 p.u.	Rotor resistance in per unit.	-
98.04	*Lm user*	Defines the main inductance L_M of the motor model. **Note:** This parameter is valid only for asynchronous motors.	0.00000 p.u.
	0.00000… 10.00000 p.u.	Main inductance in per unit.	-

No.	Name/Value	Description	Default FbEq 16
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	*Rs 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

No.	Name/Value	Description	Default FbEq 16
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
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. **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.	0.0 deg
	0.0...360.0 deg	Angle offset.	1 = 1 deg

99 Motor data		Motor configuration settings.	
99.03	*Motor type*	Selects the motor type. **Note:** This parameter cannot be changed while the drive is running.	*Asynchronous motor*
	Asynchronous motor	Standard squirrel cage AC induction motor (asynchronous induction motor).	0
	Permanent magnet motor	Permanent magnet motor. Three-phase AC synchronous motor with permanent magnet rotor and sinusoidal BackEMF voltage. **Note:** With permanent magnet motors special attention must be paid on setting the motor nominal values correctly in this parameter group (*99 Motor data*). You must use vector control. If the nominal BackEMF voltage of the motor is not available, a full ID run should be performed for improving performance.	1
	SynRM motor	Synchronous reluctance motor. Three-phase AC synchronous motor with salient pole rotor without permanent magnets.	2
	PMaSynRM motor	Permanent Magnet Assisted Synchronous Reluctance Motor	3

No.	Name/Value	Description	Default FbEq 16
99.04	Motor control mode	Selects the motor control mode.	Vector
	Vector	Vector control. Vector control has better accuracy than scalar control but cannot be used in all situations (see selection Scalar below). Requires motor identification run (ID run). See parameter *99.13 ID run requested*. **Note:** In vector control the drive performs a standstill ID run at the first start if ID run has not been previously performed. A new start command is required after standstill ID run. **Note:** To achieve a better motor control performance, you can perform a normal ID run without load. See also section *Operating modes and motor control modes* (page *52*).	0
	Scalar	Scalar control. Suitable for most applications, if top performance is not required. Motor identification run is not required. **Note:** Scalar control must 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). **Note:** Correct motor operation requires that the magnetizing current of the motor does not exceed 90% of the nominal current of the inverter. See also section *Speed control performance figures* (page *74*), and section *Operating modes and motor control modes* (page *52*).	1

No.	Name/Value	Description	Default FbEq 16
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. • If parameter *99.06* value is 0 *and* parameter *99.09* value is also 0, the motor parameters will be reset to defaults.	4.0 A
	0.0…(2 × I_N of the drive) A	Nominal current of the motor. The allowable range: • vector control mode: 1/4…2 × I_N of the drive • scalar control mode: 0…2 × I_N of the drive. **Note:** When using flying start in scalar control mode (see parameter 21.19), the nominal current must be in the range allowed for vector control mode.	1 = 0.01 A (see par. *46.05*)
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.	230.0 V
	40.0…480.0	Nominal voltage of the motor.	10 = 1 V
99.08	*Motor nominal frequency*	Defines the nominal motor frequency. This setting must match the value on the rating plate of the motor. **Note:** This parameter cannot be changed while the drive is running.	50.00 Hz
	0.00…500.00 Hz	Nominal frequency of the motor.	10 = 1 Hz

No.	Name/Value	Description	Default FbEq 16
99.09	*Motor nominal speed*	Defines the nominal motor speed. The setting must match the value on the rating plate of the motor. **Notes:** • This parameter cannot be changed while the drive is running. • If parameter *99.06* value is 0 *and* parameter *99.09* value is also 0, the motor parameters will be reset to defaults.	1435 rpm
	0…30000 rpm	Nominal speed of the motor.	1 = 1 rpm
99.10	*Motor nominal power*	Defines the nominal motor power. The setting must match the value on the rating plate of the motor. If multiple motors are connected to the drive, enter the total power of the motors. The unit is selected by parameter *96.16 Unit selection*. **Note:** This parameter cannot be changed while the drive is running.	1.10 kW or hp
	0.00… 10000.00 kW or 0.00… 13404.83 hp	Nominal power of the motor.	1 = 0.01 unit (see par. *46.04*)
99.11	*Motor nominal cos Φ*	Defines the cosphi of the motor for a more accurate motor model. This value is not obligatory, but is useful with an asynchronous motor, especially when performing a standstill identification run. With a permanent magnet or synchronous reluctance motor, this value is not needed. **Notes:** • Do not enter an estimated value. If you do not know the • exact value, leave the parameter at zero. • This parameter cannot be changed while the drive is running.	0.00
	0.00…1.00	Cosphi of the motor.	100 = 1

No.	Name/Value	Description	Default FbEq 16
99.12	*Motor nominal torque*	Defines the nominal motor shaft torque for a more accurate motor model. Not obligatory. The unit is selected by parameter *96.16 Unit selection*. **Note:** This parameter cannot be changed while the drive is running.	0.000 N·m or lb·ft
	0.000…4000000.000 N·m or 0.000…2950248.597 lb·ft	Nominal motor torque.	1 = 100 unit

No.	Name/Value	Description	Default FbEq 16
99.13	ID run requested	Selects the type of the motor identification routine (ID run) performed at the next start of the drive. During the ID run, the drive will identify the characteristics of the motor for optimum motor control. If no ID run has been performed yet (or if default parameter values have been restored using parameter 96.06 Parameter restore), this parameter is automatically set to Standstill, signifying that an ID run must be performed. After the ID run, the drive stops and this parameter is automatically set to None. **Notes:** • To ensure that the ID run can work properly, the drive limits in group 30 Limits (maximum speed and minimum speed, and maximum torque and minimum torque) must to be large enough (the range specified by the limits must be wide enough. If eg. speed limits are less than the motor nominal speed, the ID run cannot be completed. • 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%. • 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. • With scalar control mode (99.04 Motor control mode = Scalar), the ID run is not requested automatically. However, an ID run can be performed for more accurate torque estimation. • 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) has already been performed once.	0

No.	Name/Value	Description	Default FbEq 16
	Normal	Normal ID run. Guarantees good control accuracy for all cases. The ID run takes about 90 seconds. This mode should be selected whenever it is possible. **Notes:** • If the load torque will be higher than 20% of motor nominal torque, or if the machinery is not able to withstand the nominal torque transient during the ID run, then the driven machinery must be de-coupled from the motor during a Normal ID run. • Check the direction of rotation of the motor before starting the ID run. During the run, the motor will rotate in the forward direction. **WARNING!** The motor will run at up to approximately 50…100% of the nominal speed during the ID run. ENSURE THAT IT IS SAFE TO RUN THE MOTOR BEFORE PERFORMING THE ID RUN!	1
	Reduced	Reduced ID run. This mode should be selected instead of the *Normal* or *Advanced* ID Run if • mechanical losses are higher than 20% (ie. the motor cannot be de-coupled from the driven equipment), or if • flux reduction is not allowed while the motor is running (ie. 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

No.	Name/Value	Description	Default FbEq 16
	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, the shaft can rotate up to half a revolution. **Note:** This mode should be selected only if the *Normal*, *Reduced* or *Advanced* ID run is not possible due to the restrictions caused by the connected mechanics (e.g. with lift or crane applications).	3
	Autophasing	The autophasing routine determines the start angle of a permanent magnet or synchronous reluctance motor (see page *55*). Autophasing does not update the other motor model values. Autophasing is automatically performed as part of the *Normal*, *Reduced*, *Standstill*, or *Advanced* 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*, or *Advanced* ID run has already been performed. • Depending on the selected autophasing mode, the shaft can rotate during autophasing.	4
	Advanced	Advanced ID run. Guarantees the best possible control accuracy. The ID run takes a very long time to complete. This mode should be selected when top performance is needed across the whole operating area. **Note:** The driven machinery must be de-coupled from the motor because of high torque and speed transients that are applied. **WARNING!** The motor may run at up to the maximum (positive) and minimum (negative) allowed speed during the ID run. Several accelerations and decelerations are done. The maximum torque, current and speed allowed by the limit parameters may be utilized. ENSURE THAT IT IS SAFE TO RUN THE MOTOR BEFORE PERFORMING THE ID RUN!	6

No.	Name/Value	Description	Default FbEq 16
	Adaptive	The drive makes a Standstill ID run first. After that, the motor parameters will be refined during the normal operation to achieve more optimal performance. After the motor model adaptation process is complete, parameter *99.14* will be changed from *Standstill* to *Adaptive*. Adaptive ID run is used with Permanent Magnet motors to determine the motor back-emf more accurately when normal ID run cannot be performed. Initially standstill ID run is made and when a short period of stable running with above 50% of motor rated speed is done, back emf is recalculated and automatically updated. It is recommended to give back emf as accurately as possible to have the best possible results.	8
99.14	*Last ID run performed*	Shows the type of ID run that was performed last.	*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* ID run.	4
	Advanced	*Advanced* ID run.	6
	Adaptive	*Adaptive* ID run.	
99.15	*Motor polepairs calculated*	Calculated number of pole pairs in the motor.	0
	0…1000	Number of pole pairs.	1 = 1
99.16	*Motor phase order*	Switches the rotation direction of motor. This parameter can be used if the motor turns in the wrong direction (for example, because of the wrong phase order in the motor cable), and correcting the cabling is considered impractical. **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.	*U V W*
	U V W	Normal.	0
	U W V	Reversed rotation direction.	1

Differences in the default values between 50 Hz and 60 Hz supply frequency settings

Parameter *95.20 HW options word 1* bit 0 changes the drive parameter default values according to the supply frequency, 50 Hz or 60 Hz. The bit is set according to the market before the drive is delivered.

If you need to change from 50 Hz to 60 Hz, or vice versa, change the value of the bit and then do a complete reset to the drive (*96.06 Parameter restore*). After that you have to reselect the macro to be used.

The table below shows the parameters whose default values depend on the supply frequency setting. The supply frequency setting, with the type designation of the drive, also affects group *99 Motor data* parameter values (not listed in the table).

No	**Name**	*95.20 HW options word 1* bit 0 *Supply frequency 60 Hz = 50 Hz*	*95.20 HW options word 1* bit 0 *Supply frequency 60 Hz = 60 Hz*
11.45	*Freq in 1 at scaled max*	1500.000	1800.000
12.20	*AI1 scaled at AI1 max*	1500.000	1800.000
13.18	*AO1 source max*	1500.0	1800.0
22.26	*Constant speed 1*	300.00 rpm	360.00 rpm
22.27	*Constant speed 2*	600.00 rpm	720.00 rpm
22.28	*Constant speed 3*	900 .00 rpm	1080.00 rpm
22.29	*Constant speed 4*	1200.00 rpm	1440.00 rpm
22.30	*Constant speed 5*	1500.00 rpm	1800.00 rpm
22.31	*Constant speed 6*	2400.00 rpm	2880.00 rpm
22.32	*Constant speed 7*	3000.00 rpm	3600.00 rpm
28.26	*Constant frequency 1*	5.00 Hz	6.00 Hz
28.27	*Constant frequency 2*	10.00 Hz	12.00 Hz
28.28	*Constant frequency 3*	15.00 Hz	18.00 Hz
28.29	*Constant frequency 4*	20.00 Hz	24.00 Hz
28.30	*Constant frequency 5*	25.00 Hz	30.00 Hz
28.31	*Constant frequency 6*	40.00 Hz	48.00 Hz
28.32	*Constant frequency 7*	50.00 Hz	60.00 Hz

No	**Name**	*95.20 HW options word 1* bit 0 *Supply frequency 60 Hz = 50 Hz*	*95.20 HW options word 1* bit 0 *Supply frequency 60 Hz = 60 Hz*
30.11	*Minimum speed*	-1500.00 rpm	-1800.00 rpm
30.12	*Maximum speed*	1500.00 rpm	1800.00 rpm
30.13	*Minimum frequency*	-50.00 Hz	-60.00 Hz
30.14	*Maximum frequency*	50.00 Hz	60.00 Hz
31.26	*Stall speed limit*	150.00 rpm	180.00 rpm
31.27	*Stall frequency limit*	15.00 Hz	18.00 Hz
31.30	*Overspeed trip margin*	500.00 rpm	500.00 rpm
46.01	*Speed scaling*	1500.00 rpm	1800.00 rpm
46.02	*Frequency scaling*	50.00 Hz	60.00 Hz

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Additional parameter data

Contents

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. 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.
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*.

Term	Definition
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*.
Uint16	16-bit unsigned integer.

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 … 30000	rpm	100 = 1
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
01.08	Motor current % of motor nom	*Real*	0.0…1000.0	%	10 = 1%
01.09	Motor current % of drive nom	*Real*	0.0…1000.0	%	10 = 1%
01.10	Motor torque	*Real*	-1600.0…1600.0	%	10 = 1%
01.11	DC voltage	*Real*	0.00…2000.00	V	100 = 1 V
01.13	Output voltage	*Real*	0…2000	V	1 = 1 V
01.14	Output power	*Real*	-32768.00…32767.00	kW	100 = 1 unit
01.15	Output power % of motor nom	*Real*	-300.00…300.00	%	100 = 1%
01.17	Motor shaft power	*Real*	-32768.00…32767.00	kW or hp	100 = 1 unit
01.18	Inverter GWh counter	*Real*	0…65535	GWh	1 = 1 GWh
01.19	Inverter MWh counter	*Real*	0…1000	MWh	1 = 1 MWh
01.20	Inverter kWh counter	*Real*	0…1000	kWh	1 = 1 kWh
01.24	Flux actual %	*Real*	0…200	%	1 = 1%
01.30	Nominal torque scale	*Real*	0.000…4000000	N·m or lb·ft	1000 = 1 unit
01.50	Current hour kWh	*Real*	-21474836.48… 21474836.47	kWh	100 = 1 kWh
01.51	Previous hour kWh	*Real*	-21474836.48… 21474836.47	kWh	100 = 1 kWh
01.52	Current day kWh	*Real*	-21474836.48… 21474836.47	kWh	100 = 1 kWh
01.53	Previous day kWh	*Real*	-21474836.48… 21474836.47	kWh	100 = 1 kWh
01.54	Cumulative inverter energy	*Real*	-200000000.0… 200000000.0	kWh	1 = 1 kWh
01.55	Inverter GWh counter (resettable)	*Real*	0…65535	GWh	1 = 1 GWh
01.56	Inverter MWh counter (resettable)	*Real*	0…1000	MWh	1 = 1 MWh
01.57	Inverter kWh counter (resettable)	*Real*	0…1000	kWh	1 = 1 kWh
01.58	Cumulative inverter energy (resettable)	*Real*	-200000000.0… 200000000.0	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… 100.00%	%	100 = 1%
01.63	Abs output frequency	*Real*	0.00…500.00 Hz	Hz	100 = 1 Hz
01.64	Abs motor torque	*Real*	0.00…1600.0	%	10 = 1%
01.65	Abs output power	*Real*	0.00… 32767.00	kW	100 = 1 kW
01.66	Abs output power % mot nom	*Real*	0.00…300.00	%	100 = 1%
01.68	Abs motor shaft power	*Real*	0.00… 32767.00	kW	100 = 1 kW
03 Input references					
03.01	Panel reference	*Real*	-100000.00…100000.00	-	100 = 1
03.02	Panel reference remote	*Real*	-100000.00…100000.00	-	100 = 1 unit
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
03.09	EFB reference 1	*Real*	-30000.00…30000.00	-	100 = 1
03.10	EFB reference 2	*Real*	-30000.00…30000.00	-	100 = 1
03.17	Integrated Panel ref	*Real*	-100000.00…100000.00	-	100 = 1
03.18	Integrated Panel ref remote	*Real*	-100000.00…100000.00	-	100 = 1
04 Warnings and faults					
04.01	Tripping fault	*Data*	0000h…FFFFh	-	1 = 1

No.	Name	Type	Range	Unit	FbEq32
04.02	Active fault 2	Data	0000h…FFFFh	-	1 = 1
04.03	Active fault 3	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
04.11	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
04.16	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
04.40	Event word 1	Data	0000h…FFFFh	-	1 = 1
04.41	Event word 1 bit 0 code	Data	0000h…FFFFh	-	1 = 1
04.43	Event word 1 bit 1 code	Data	0000h…FFFFh	-	1 = 1
04.45	Event word 1 bit 2 code	Data	0000h…FFFFh	-	1 = 1
04.47	Event word 1 bit 3 code	Data	0000h…FFFFh	-	1 = 1
04.49	Event word 1 bit 4 code	Data	0000h…FFFFh	-	1 = 1
04.51	Event word 1 bit 5 code	Data	0000h…FFFFh	-	1 = 1
04.53	Event word 1 bit 6 code	Data	0000h…FFFFh	-	1 = 1
04.55	Event word 1 bit 7 code	Data	0000h…FFFFh	-	1 = 1
04.57	Event word 1 bit 8 code	Data	0000h…FFFFh	-	1 = 1
04.59	Event word 1 bit 9 code	Data	0000h…FFFFh	-	1 = 1
04.61	Event word 1 bit 10 code	Data	0000h…FFFFh	-	1 = 1
04.63	Event word 1 bit 11 code	Data	0000h…FFFFh	-	1 = 1
04.65	Event word 1 bit 12 code	Data	0000h…FFFFh	-	1 = 1
04.67	Event word 1 bit 13 code	Data	0000h…FFFFh	-	1 = 1
04.69	Event word 1 bit 14 code	Data	0000h…FFFFh	-	1 = 1
04.71	Event word 1 bit 15 code	Data	0000h…FFFFh	-	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
05.03	Hours run	Real	0.0…429496729.5	h	10 = 1 h
05.04	Fan on-time counter	Real	0…65535	d	1 = 1 d
05.10	Control board temperature	Real	-100…300 °C	°C or °F	10 = 1 °C
05.11	Inverter temperature	Real	-40.0…160.0	%	10 = 1%
05.20	Diagnostic word 1	PB	0b0000…0b1111	-	-
05.21	Diagnostic word 2	PB	0b0000…0b1111	-	-
05.22	Diagnostic word 3	PB	0b0000…0b1111	-	-
05.80	Motor speed at fault	Real	-30000.00…30000.00	rpm	100 = 1 rpm
05.81	Output frequency at fault	Real	-500.00…500.00	Hz	100 = 1 Hz
05.82	DC voltage at fault	Real	0.00…2000.00	V	100 = 1 V
05.83	Motor current at fault	Real	0.00…30000.00	A	100 = 1 A
05.84	Motor torque at fault	Real	-1600.0…1600.0	%	10 = 1%
05.85	Main status word at fault	PB	0000h…FFFFh	-	1 = 1
05.86	DI delayed status at fault	PB	0000h…FFFFh	-	1 = 1
05.87	Inverter temperature at fault	PB	-40.0…160.0	°C	10 = 1°C
05.88	Reference used at fault	Real	-500.00...500.00 Hz/ -1600.0…1600.0%/ 30000.00...30000.00 rpm	Hz/ %/ rpm	100 = 1 Hz/ 10 = 1%/ 100 = 1 rpm
06 Control and status words					
06.01	Main control word	PB	0000h…FFFFh	-	1 = 1
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
06.29	MSW bit 10 selection	*Binary src*	-	-	1 = 1
06.30	MSW bit 11 selection	*Binary src*	-	-	1 = 1
06.31	MSW bit 12 selection	*Binary src*	-	-	1 = 1
06.32	MSW bit 13 selection	*Binary src*	-	-	1 = 1
06.33	MSW bit 14 selection	*Binary src*	-	-	1 = 1
07 System info					
07.03	Drive rating id	*List*	-	-	1 = 1
07.04	Firmware name	*List*	-	-	1 = 1
07.05	Firmware version	*Data*	-	-	1 = 1
07.06	Loading package name	*List*	-	-	1 = 1
07.07	Loading package version	*Data*	-	-	1 = 1
07.11	Cpu usage	*Real*	0…100	%	1 = 1%
07.25	Customization package name	*Data*	-	-	1 = 1
07.26	Customization package version	*Data*	-	-	1 = 1
07.30	Adaptive program status	*PB*	0000h…FFFFh	-	1 = 1
07.31	AP sequence state	*Data*	0...20	-	1 = 1
07.35	Drive configuration	*Binary src*	0x0000...0xffff	-	1 = 1
07.36	Drive configuration 2	*PB*	0000h…FFFFh	-	1 = 1
09 Crane application signals					
09.01	Crane SW1	*PB*	0000h...FFFFh	-	1 = 1
09.03	Crane FW1	*PB*	0000h...FFFFh	-	1 = 1
09.06	Crane speed reference	*Real*	-30000…30000.00	rpm	100 = 1 rpm
09.16	Crane frequency reference	*Real*	-500...500	Hz	100 = 1 Hz

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 forced 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
10.21	RO status	*PB*	0000h…FFFFh	-	1 = 1
10.22	RO force selection	*PB*	0000h…FFFFh	-	1 = 1
10.23	RO forced data	*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
10.99	RO/DIO control word	*PB*	0000h…FFFFh	-	1 = 1
10.101	RO1 toggle counter	*Real*	0…4294967000	-	1 = 1
11 Standard DIO, FI, FO					
11.02	DIO delayed status	*PB*	0000h…FFFFh	-	1 = 1
11.03	DIO force selection	*PB*	0000h…FFFFh	-	1 = 1
11.04	DIO force data	*PB*	0000h…FFFFh	-	1 = 1
11.05	DIO1 configuration	*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 configuration	*List*	0…2	-	1 = 1
11.10	DIO2 output source	*Binary src*	-	-	1 = 1
11.11	DIO2 ON delay	*Real*	0.0…3000.0	s	10 = 1 s
11.12	DIO2 OFF delay	*Real*	0.0…3000.0	s	10 = 1 s
11.13	DI3 configuration	*List*	0, 1	-	1 = 1
11.17	DI4 configuration	*List*	0, 1	-	1 = 1
11.21	DI5 configuration	*List*	-	-	1 = 1
11.38	Freq in 1 actual value	*Real*	0…16000	Hz	1 = 1 Hz
11.39	Freq in 1 scaled value	*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
11.46	Freq in 2 actual value	*Real*	0…16000	Hz	1 = 1
11.47	Freq in 2 scaled	*Real*	-32768.000…32767.000	-	1000 = 1
11.50	Freq in 2 min	*Real*	0…16000	Hz	1 = 1
11.51	Freq in 2 max	*Real*	0…16000	Hz	1 = 1
11.52	Freq in 2 at scaled min	*Real*	-32768.000…32767.000	-	1 = 1
11.53	Freq in 2 at scaled max	*Real*	-32768.000…32767.000	-	1 = 1
11.54	Freq out 1 actual value	*Real*	0…16000	Hz	1 = 1
11.55	Freq out 1 source	*List*	0, 1, 3, 4, 6...8, 10...14, 16	-	1 = 1
11.58	Freq out 1 src min	*Real*	-32768.000…32767.000	-	1 = 1
11.59	Freq out 1 src max	*Real*	-32768.000…32767.000	-	1 = 1
11.60	Freq out 1 at src min	*Real*	0…16000	Hz	1 = 1
11.61	Freq out 1 at src max	*Real*	0…16000	Hz	1 = 1
11.62	Freq out 2 actual value	*Real*	0…16000	Hz	1 = 1
11.63	Freq out 2 source	*List*	0, 1, 3, 4, 6...8, 10...14, 16	-	1 = 1
11.66	Freq out 2 source min	*Real*	-32768.000…32767.000	-	1 = 1
11.67	Freq out 2 source max	*Real*	-32768.000…32767.000	-	1 = 1
11.68	Freq out 2 at src min	*Real*	0…16000	Hz	1 = 1
11.69	Freq out 2 at src max	*Real*	0…16000	Hz	1 = 1

No.	Name	Type	Range	Unit	FbEq32
12 Standard AI					
12.02	AI force selection	*PB*	0000h…FFFFh	-	1 = 1
12.03	AI supervision function	*List*	0…4	-	1 = 1
12.04	AI supervision selection	*PB*	0000h…FFFFh	-	1 = 1
12.11	AI1 actual value	*Real*	4.000…20.000 mA or 0.000…10.000 V	mA or V	1000 = 1 unit
12.12	AI1 scaled value	*Real*	-32768.000…32767.000	-	1000 = 1
12.13	AI1 forced value	*Real*	4.000…20.000 mA or 0.000…10.000 V	mA or V	1000 = 1 unit
12.15	AI1 unit selection	*List*	2, 10	-	1 = 1
12.16	AI1 filter time	*Real*	0.000…30.000	s	1000 = 1 s
12.17	AI1 min	*Real*	4.000…20.000 mA or 0.000…10.000 V	mA or V	1000 = 1 unit
12.18	AI1 max	*Real*	0.000…20.000 mA or 0.000…10.000 V	mA or V	1000 = 1 unit
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*	4.000…20.000 mA or 0.000…10.000 V	mA or V	1000 = 1 unit
12.22	AI2 scaled value	*Real*	-32768.000…32767.000	-	1000 = 1
12.23	AI2 forced value	*Real*	4.000…20.000 mA or 0.000…10.000 V	mA or V	1000 = 1 unit
12.25	AI2 unit selection	*List*	2, 10	-	1 = 1
12.26	AI2 filter time	*Real*	0.000…30.000	s	1000 = 1 s
12.27	AI2 min	*Real*	4.000…20.000 mA or 0.000…10.000 V	mA or V	1000 = 1 unit
12.28	AI2 max	*Real*	4.000…20.000 mA or 0.000…10.000 V	mA or V	1000 = 1 unit
12.29	AI2 scaled at AI2 min	*Real*	-32768.000…32767.000	-	1000 = 1
12.30	AI2 scaled at AI2 max	*Real*	-32768.000…32767.000	-	1000 = 1
12.101	AI1 percent value	*Real*	0.00…100.00	%	100 = 1%
12.102	AI2 percent value	*Real*	0.00…100.00	%	100 = 1%
12.110	AI dead band	*Real*	0.00…100.00	%	100 = 1%
13 Standard AO					
13.02	AO force selection	*PB*	0000h…FFFFh	-	1 = 1
13.11	AO1 actual value	*Real*	0.000…22.000	mA	1000 = 1 mA
13.12	AO1 source	*Analog src*	-	-	1 = 1
13.13	AO1 forced value	*Real*	0.000…22.000	mA	1000 = 1 mA
13.15	AO1 unit selection	*List*	2, 10	-	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
13.91	AO1 data storage	*Real*	-327.68 … 327.67	-	100 = 1
15 I/O extension module					
15.01	Extension module type	*List*	0, 5...7	-	1 = 1
15.02	Detected extension module	*List*	0…3	-	1 = 1
15.04	RO status	*PB*	0000h…FFFFh	-	1 = 1
15.05	RO force selection	*PB*	0000h…FFFFh	-	1 = 1
15.06	RO forced data	*PB*	0000h…FFFFh	-	1 = 1
15.07	RO4 source	*Binary src*	-	-	1 = 1
15.08	RO4 ON delay	*Real*	0.0…3000.0	s	10 = 1 s
15.09	RO4 OFF delay	*Real*	0.0…3000.0	s	10 = 1 s
15.10	RO5 source	*Binary src*	-	-	1 = 1
15.11	RO5 ON delay	*Real*	0.0…3000.0	s	10 = 1 s
15.12	RO5 OFF delay	*Real*	0.0…3000.0	s	10 = 1 s
15.13	RO6 source	*Binary src*	-	-	1 = 1
15.14	RO6 ON delay	*Real*	0.0…3000.0	s	10 = 1 s

No.	Name	Type	Range	Unit	FbEq32
15.15	RO6 OFF delay	Real	0.0…3000.0	s	10 = 1 s
15.16	RO7 source	Binary src	-	-	1 = 1
15.17	RO7 ON delay	Real	0.0…3000.0	s	10 = 1 s
15.18	RO7 OFF delay	Real	0.0…3000.0	s	10 = 1 s
19 Operation mode					
19.01	Actual operation mode	List	1…5, 10, 20	-	1 = 1
19.11	Ext1/Ext2 selection	Binary src	-	-	1 = 1
19.12	Ext1 control mode	List	1…5	-	1 = 1
19.14	Ext2 control mode	List	1…5	-	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	0…6, 11…12, 14...16, 21...23	-	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	0…6, 11…12, 14, 21...23	-	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 signal	Binary src	-	-	1 = 1
20.21	Direction	List	0…2	-	1 = 1
20.22	Enable to rotate	Binary src	-	-	1 = 1
20.25	Jog enable	Binary src	-	-	1 = 1
20.26	Jog 1 start	Binary src	-	-	1 = 1
20.27	Jog 2 start	Binary src	-	-	1 = 1
20.30	Enable signal warning function	PB	0000h…FFFFh	-	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
20.214	Joystick zero position	Binary src	-	-	1 = 1
20.215	Joystick warning delay	Real	0…30000	ms	1 = 1
20.216	Crane control word 1	PB	0000h…FFFFh	-	1 = 1
21 Start/stop mode					
21.01	Vector start mode	List	0…2	-	1 = 1
21.02	Magnetization time	Real	0…10000	ms	1 = 1 ms
21.03	Stop mode	List	0…2	-	1 = 1
21.04	Emergency stop mode	List	0…3	-	1 = 1
21.05	Emergency stop source	Binary src	-	-	1 = 1
21.06	Zero speed limit	Real	0.00…30000.00	rpm	100 = 1 rpm
21.07	Zero speed delay	Real	0…30000	ms	1 = 1 ms
21.08	DC current control	PB	0b0000...0b1111	-	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…3000	s	1 = 1 s
21.14	Pre-heating input source	Binary src	-	-	1 = 1
21.15	Pre-heating time delay	Real	10...3000	s	1 = 1 s
21.16	Pre-heating current	Real	0.0…30.0	%	10 = 1%
21.18	Auto restart time	Real	0.0, 0.1 … 10.0	s	10 = 1 s
21.19	Scalar start mode	List	0…6	-	1 = 1
21.21	DC hold frequency	Real	0.00…1000.00	Hz	100 = 1 Hz
21.22	Start delay	Real	0.00…60.00	s	100 = 1 s

No.	Name	Type	Range	Unit	FbEq32
21.23	Smooth start	*Real*	0…2	-	1 = 1
21.24	Smooth start current	*Real*	10.0…100.0	%	100 = 1%
21.25	Smooth start speed	*Real*	2.0…100.0	%	100 = 1%
21.26	Torque boost current	*Real*	15.0…300.0	%	100 = 1%
21.27	Torque boost time	*Real*	0.0...60.0	%	100 = 1%
21.30	Speed compensated stop mode	*Real*	0…3	-	1 = 1
21.31	Speed compensated stop delay	*Real*	0.00…1000.00	s	100 = 1 s
21.32	Speed comp stop threshold	*Real*	0…100	%	1 = 1%
21.34	Force auto restart	*List*	0…1	-	1 = 1
22 Speed reference selection					
22.01	Speed ref unlimited	*Real*	-30000.00…30000.00	rpm	100 = 1 rpm
22.11	Ext1 speed ref1	*Analog src*	-	-	1 = 1
22.12	Ext1 speed ref2	*Analog src*	-	-	1 = 1
22.13	Ext1 speed function	*List*	0…6	-	1 = 1
22.18	Ext2 speed ref1	*Analog src*	-	-	1 = 1
22.19	Ext2 speed ref2	*Analog src*	-	-	1 = 1
22.20	Ext2 speed function	*List*	0…6	-	1 = 1
22.21	Constant speed function	*PB*	0b0000...0b1111	-	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
22.42	Jogging 1 ref	*Real*	-30000.00…30000.00	rpm	100 = 1 rpm
22.43	Jogging 2 ref	*Real*	-30000.00…30000.00	rpm	100 = 1 rpm
22.51	Critical speed function	*PB*	0000h…FFFFh	-	1 = 1
22.52	Critical speed 1 low	*Real*	-30000.00…30000.00	rpm	100 = 1 rpm
22.53	Critical speed 1 high	*Real*	-30000.00…30000.00	rpm	100 = 1 rpm
22.54	Critical speed 2 low	*Real*	-30000.00…30000.00	rpm	100 = 1 rpm
22.55	Critical speed 2 high	*Real*	-30000.00…30000.00	rpm	100 = 1 rpm
22.56	Critical speed 3 low	*Real*	-30000.00…30000.00	rpm	100 = 1 rpm
22.57	Critical speed 3 high	*Real*	-30000.00…30000.00	rpm	100 = 1 rpm
22.70	Motor potentiometer reference enable	*Real*	0…2	-	1 = 1
22.71	Motor potentiometer function	*List*	0…4	-	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
22.86	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
22.211	Speed reference shape	*List*	0…2	-	1 = 1
22.220	Crane motpot enable	*List*	0…7	-	1 = 1
22.223	Crane motpot accel sel	*List*	0…7	-	1 = 1

No.	Name	Type	Range	Unit	FbEq32
22.224	Crane motpot min speed	*Real*	0...30000	rpm	100 = 1 rpm
22.225	Crane motpot sw	*PB*	0000h...FFFFh	-	100 = 1
22.226	Crane motpot min value	*Real*	-30000.00...30000.00	-	100 = 1
22.227	Crane motpot max value	*Real*	-30000.00...30000.00	-	100 = 1
22.230	Crane motpot ref act	*Real*	-30000.00...30000.00	-	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
23.11	Ramp set selection	*Binary src*	-	-	1 = 1
23.12	Acceleration time 1	*Real*	0.000 …1800.000	s	1000 = 1 s
23.13	Deceleration time 1	*Real*	0.000 …1800.000	s	1000 = 1 s
23.14	Acceleration time 2	*Real*	0.000 …1800.000	s	1000 = 1 s
23.15	Deceleration time 2	*Real*	0.000 …1800.000	s	1000 = 1 s
23.20	Acc time jogging	*Real*	0.000 …1800.000	s	1000 = 1 s
23.21	Dec time jogging	*Real*	0.000 …1800.000	s	1000 = 1 s
23.23	Emergency stop time	*Real*	0.000 …1800.000	s	1000 = 1 s
23.28	Variable slope enable	*List*	0…1	-	1 = 1
23.29	Variable slope rate	*Real*	2…30000	ms	1 = 1 ms
23.32	Shape time 1	*Real*	0.000 …1800.000	s	1000 = 1 s
23.33	Shape time 2	*Real*	0.000 …1800.000	s	1000 = 1 s
23.206	Fast stop deceleration time	*Real*	0.00 …3000.000	s	1000 = 1 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	rpm	100 = 1 rpm
24.12	Speed error filter time	*Real*	0…10000	ms	1 = 1 ms
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
25.15	Proportional gain em stop	*Real*	1.00…250.00	-	100 = 1
25.30	Flux adaptation enable	*Real*	0…1	-	1 = 1
25.33	Speed controller auto tune	*Binary src*	-	-	1 = 1
25.34	Autotune control preset	*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 … 20.00	%	100 = 1%
25.39	Autotune speed step	*Real*	0.00 … 20.00	%	100 = 1%
25.40	Autotune repeat times	*Real*	0 … 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%
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

No.	Name	Type	Range	Unit	FbEq32
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
26.20	Torque reversal	*List*	-	-	1 = 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%
26.81	Rush control gain	*Real*	0.0 … 10000.0	-	10 = 1
26.82	Rush control integration time	*Real*	0.0 … 10.0	s	10 = 1 s
28 Frequency reference chain					
28.01	Frequency ref ramp input	*Real*	-500.00…500.00	Hz	100 = 1 Hz
28.02	Frequency ref ramp output	*Real*	-500.00…500.00	Hz	100 = 1 Hz
28.11	Ext1 frequency ref1	*Analog src*	-	-	1 = 1
28.12	Ext1 frequency ref2	*Analog src*	-	-	1 = 1
28.13	Ext1 frequency function	*List*	0…6	-	1 = 1
28.15	Ext2 frequency ref1	*Analog src*	-	-	1 = 1
28.16	Ext2 frequency ref2	*Analog src*	-	-	1 = 1
28.17	Ext2 frequency function	*List*	0…6	-	1 = 1
28.21	Constant frequency function	*PB*	0000h...FFFFh	-	1 = 1
28.22	Constant frequency sel1	*Binary src*	-	-	1 = 1
28.23	Constant frequency sel2	*Binary src*	-	-	1 = 1
28.24	Constant frequency sel3	*Binary src*	-	-	1 = 1
28.26	Constant frequency 1	*Real*	-500.00…500.00	Hz	100 = 1 Hz
28.27	Constant frequency 2	*Real*	-500.00…500.00	Hz	100 = 1 Hz
28.28	Constant frequency 3	*Real*	-500.00…500.00	Hz	100 = 1 Hz
28.29	Constant frequency 4	*Real*	-500.00…500.00	Hz	100 = 1 Hz
28.30	Constant frequency 5	*Real*	-500.00…500.00	Hz	100 = 1 Hz
28.31	Constant frequency 6	*Real*	-500.00…500.00	Hz	100 = 1 Hz
28.32	Constant frequency 7	*Real*	-500.00…500.00	Hz	100 = 1 Hz
28.41	Frequency ref safe	*Real*	-500.00…500.00	Hz	100 = 1 Hz
28.42	Jogging 1 frequency ref	*Real*	-500.00…500.00	Hz	100 = 1 Hz
28.43	Jogging 2 frequency ref	*Real*	-500.00…500.00	Hz	100 = 1 Hz
28.51	Critical frequency function	*PB*	00b…11b	-	1 = 1
28.52	Critical frequency 1 low	*Real*	-500.00…500.00	Hz	100 = 1 Hz
28.53	Critical frequency 1 high	*Real*	-500.00…500.00	Hz	100 = 1 Hz
28.54	Critical frequency 2 low	*Real*	-500.00…500.00	Hz	100 = 1 Hz
28.55	Critical frequency 2 high	*Real*	-500.00…500.00	Hz	100 = 1 Hz
28.56	Critical frequency 3 low	*Real*	-500.00…500.00	Hz	100 = 1 Hz
28.57	Critical frequency 3 high	*Real*	-500.00…500.00	Hz	100 = 1 Hz
28.71	Freq ramp set selection	*Binary src*	-	-	1 = 1
28.72	Freq acceleration time 1	*Real*	0.000…1800.000	s	1000 = 1 s
28.73	Freq deceleration time 1	*Real*	0.000…1800.000	s	1000 = 1 s
28.74	Freq acceleration time 2	*Real*	0.000…1800.000	s	1000 = 1 s
28.75	Freq deceleration time 2	*Real*	0.000…1800.000	s	1000 = 1 s
28.76	Freq ramp in zero source	*Binary src*	-	-	1 = 1
28.82	Shape time 1	*Real*	0.000…1800.000	s	1000 = 1 s
28.83	Shape time 2	*Real*	0.000…1800.000	s	1000 = 1 s
28.92	Frequency ref act 3	*Real*	-500.00…500.00	Hz	100 = 1 Hz
28.96	Frequency ref act 7	*Real*	-500.00…500.00	Hz	100 = 1 Hz
28.97	Frequency ref unlimited	*Real*	-500.00 … 500.00	Hz	100 = 1 Hz
28.211	Frequency reference shape	*List*	0…2	-	1 = 1
30 Limits					
30.01	Limit word 1	*PB*	0000h…FFFFh	-	1 = 1
30.02	Torque limit status	*PB*	0000h…FFFFh	-	1 = 1

No.	Name	Type	Range	Unit	FbEq32
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
30.17	Maximum current	*Real*	0.00…30000.00	A	100 = 1 A
30.18	Torq lim sel	*Binary src*	-	-	1 = 1
30.19	Minimum torque 1	*Real*	-1600.0…0.0	%	10 = 1%
30.20	Maximum torque 1	*Real*	0.0…1600.0	%	10 = 1%
30.21	Min torque 2 source	*Analog src*	-	-	1 = 1
30.22	Max 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%
30.26	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
30.35	Thermal current limitation	*List*	0...1	-	1 = 1
30.36	Speed limit selection	*Binary src*	-	-	1 = 1
30.37	Min speed source	*Analog src*	-	-	1 = 1
30.38	Max speed source	*Analog src*	-	-	1 = 1
30.203	Deadband forward	*Real*	0.00...100.00	%	100 = 1%
30.204	Deadband reverse	*Real*	0.00...100.00	%	100 = 1%
31 Fault functions					
31.01	External event 1 source	*Binary src*	-	-	1 = 1
31.02	External event 1 type	*List*	0…1	-	1 = 1
31.03	External event 2 source	*Binary src*	-	-	1 = 1
31.04	External event 2 type	*List*	0…1	-	1 = 1
31.05	External event 3 source	*Binary src*	-	-	1 = 1
31.06	External event 3 type	*List*	0…1	-	1 = 1
31.07	External event 4 source	*Binary src*	-	-	1 = 1
31.08	External event 4 type	*List*	0…1	-	1 = 1
31.09	External event 5 source	*Binary src*	-	-	1 = 1
31.10	External event 5 type	*List*	0…1	-	1 = 1
31.11	Fault reset selection	*Binary src*	-	-	1 = 1
31.12	Autoreset selection	*PB*	0000h…FFFFh	-	1 = 1
31.13	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
31.21	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*	0.00…10000.00	rpm	100 = 1 rpm
31.27	Stall frequency limit	*Real*	0.00…1000.00	Hz	100 = 1 Hz
31.28	Stall time	*Real*	0…3600	s	1 = 1 s
31.30	Overspeed trip margin	*Real*	0.00…10000.00	rpm	100 = 1 rpm
31.31	Frequency trip margin	*Real*	0.00…10000.00	Hz	100 = 1 Hz
31.32	Emergency ramp supervision	*Real*	0…300	%	1 = 1%
31.33	Emergency ramp supervision delay	*Real*	0…100	s	1 = 1 s
31.40	Disable warning messages	*PB*	0000h…FFFFh	-	1 = 1
31.54	Fault action	*Uint16*	0…1	-	1 = 1
31.205	Crane warning masking	*Analog src*	0, 1, 4, 6...10, 11...15	-	1 = 1
32 Supervision					
32.01	Supervision status	*PB*	0000h...FFFFh	-	1 = 1

No.	Name	Type	Range	Unit	FbEq32
32.05	Supervision 1 function	*List*	0…7	-	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
32.11	Supervision 1 hysteresis	*Real*	0.00…100000.00	-	100 = 1
32.15	Supervision 2 function	*List*	0…7	-	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
32.21	Supervision 2 hysteresis	*Real*	0.00…100000.00	-	100 = 1
32.25	Supervision 3 function	*List*	0…7	-	1 = 1
32.26	Supervision 3 action	*List*	0…2	-	1 = 1
32.27	Supervision 3 signal	*Analog src*	-	-	1 = 1
32.28	Supervision 3 filter time	*Real*	0.000…30.000	s	1000 = 1 s
32.29	Supervision 3 low	*Real*	-21474830.00… 21474830.00	-	100 = 1
32.30	Supervision 3 high	*Real*	-21474830.00… 21474830.00	-	100 = 1
32.31	Supervision 3 hysteresis	*Real*	0.00…100000.00	-	100 = 1
32.35	Supervision 4 function	*List*	0…7	-	1 = 1
32.36	Supervision 4 action	*List*	0…2	-	1 = 1
32.37	Supervision 4 signal	*Analog src*	-	-	1 = 1
32.38	Supervision 4 filter time	*Real*	0.000…30.000	s	1000 = 1 s
32.39	Supervision 4 low	*Real*	-21474830.00… 21474830.00	-	100 = 1
32.40	Supervision 4 high	*Real*	-21474830.00… 21474830.00	-	100 = 1
32.41	Supervision 4 hysteresis	*Real*	0.00…100000.00	-	100 = 1
32.45	Supervision 5 function	*List*	0…7	-	1 = 1
32.46	Supervision 5 action	*List*	0…2	-	1 = 1
32.47	Supervision 5 signal	*Analog src*	-	-	1 = 1
32.48	Supervision 5 filter time	*Real*	0.000…30.000	s	1000 = 1 s
32.49	Supervision 5 low	*Real*	-21474830.00… 21474830.00	-	100 = 1
32.50	Supervision 5 high	*Real*	-21474830.00… 21474830.00	-	100 = 1
32.51	Supervision 5 hysteresis	*Real*	0.00…100000.00	-	100 = 1
32.55	Supervision 6 function	*List*	0…7	-	1 = 1
32.56	Supervision 6 action	*List*	0…2	-	1 = 1
32.57	Supervision 6 signal	*Analog src*	-	-	1 = 1
32.58	Supervision 6 filter time	*Real*	0.000…30.000	s	1000 = 1 s
32.59	Supervision 6 low	*Real*	-21474830.00… 21474830.00	-	100 = 1
32.60	Supervision 6 high	*Real*	-21474830.00… 21474830.00	-	100 = 1
32.61	Supervision 6 hysteresis	*Real*	0.00…100000.00	-	100 = 1
33 Generic timer & counter					
33.02	HS counter actual value	*Real*	0…4294967295	-	1 = 1
33.04	HS counter status word	*PB*	0000h…FFFFh	-	1 = 1
33.71	HS counter source selection	*Binary src*	-	-	1 = 1

No.	Name	Type	Range	Unit	FbEq32
33.72	HS counter limit mode selection	*List*	0…1	-	1 = 1
33.73	HS counter direction selection	*Binary src*	-	-	1 = 1
33.74	HS counter lower limit	*Real*	0…4294967295	-	1 = 1
33.75	HS counter upper limit	*Real*	0…4294967295	-	1 = 1
33.76	HS counter preset selection	*Binary src*	-	-	1 = 1
33.77	HS counter preset value	*Real*	0…4294967295	-	1 = 1
33.79	HS counter divider	*Real*	1…4294967295	-	1 = 1
33.80	HS counter enable	*Binary src*	-	-	1 = 1
34 Timed functions					
34.01	Timed functions status	*PB*	0000h…FFFFh	-	1 = 1
34.02	Timer status	*PB*	0000h…FFFFh	-	1 = 1
34.04	Season/exception day status	*PB*	0000h…FFFFh	-	1 = 1
34.10	Timed functions enable	*Binary src*	-	-	1 = 1
34.11	Timer 1 configuration	*PB*	0000h…FFFFh	-	1 = 1
34.12	Timer 1 start time	Time	00:00:00…23:59:59	s	1 = 1 s
34.13	Timer 1 duration	Duration	00 00:00…07 00:00	min	1 = 1 min
34.14	Timer 2 configuration	*PB*	0000h…FFFFh	-	1 = 1
34.15	Timer 2 start time	Time	00:00:00…23:59:59	s	1 = 1 s
34.16	Timer 2 duration	Duration	00 00:00…07 00:00	min	1 = 1 min
34.17	Timer 3 configuration	*PB*	0000h…FFFFh	-	1 = 1
34.18	Timer 3 start time	Time	00:00:00…23:59:59	s	1 = 1 s
34.19	Timer 3 duration	Duration	00 00:00…07 00:00	min	1 = 1 min
34.20	Timer 4 configuration	*PB*	0000h…FFFFh	-	1 = 1
34.21	Timer 4 start time	Time	00:00:00…23:59:59	s	1 = 1 s
34.22	Timer 4 duration	Duration	00 00:00…07 00:00	min	1 = 1 min
34.23	Timer 5 configuration	*PB*	0000h…FFFFh	-	1 = 1
34.24	Timer 5 start time	Time	00:00:00…23:59:59	s	1 = 1 s
34.25	Timer 5 duration	Duration	00 00:00…07 00:00	min	1 = 1 min
34.26	Timer 6 configuration	*PB*	0000h…FFFFh	-	1 = 1
34.27	Timer 6 start time	Time	00:00:00…23:59:59	s	1 = 1 s
34.28	Timer 6 duration	Duration	00 00:00…07 00:00	min	1 = 1 min
34.29	Timer 7 configuration	*PB*	0000h…FFFFh	-	1 = 1
34.30	Timer 7 start time	Time	00:00:00…23:59:59	s	1 = 1 s
34.31	Timer 7 duration	Duration	00 00:00…07 00:00	min	1 = 1 min
34.32	Timer 8 configuration	*PB*	0000h…FFFFh	-	1 = 1
34.33	Timer 8 start time	Time	00:00:00…23:59:59	s	1 = 1 s
34.34	Timer 8 duration	Duration	00 00:00…07 00:00	min	1 = 1 min
34.35	Timer 9 configuration	*PB*	0000h…FFFFh	-	1 = 1
34.36	Timer 9 start time	Time	00:00:00…23:59:59	s	1 = 1 s
34.37	Timer 9 duration	Duration	00 00:00…07 00:00	min	1 = 1 min
34.38	Timer 10 configuration	*PB*	0000h…FFFFh	-	1 = 1
34.39	Timer 10 start time	Time	00:00:00…23:59:59	s	1 = 1 s
34.40	Timer 10 duration	Duration	00 00:00…07 00:00	min	1 = 1 min
34.41	Timer 11 configuration	*PB*	0000h…FFFFh	-	1 = 1
34.42	Timer 11 start time	Time	00:00:00…23:59:59	s	1 = 1 s
34.43	Timer 11 duration	Duration	00 00:00…07 00:00	min	1 = 1 min
34.44	Timer 12 configuration	*PB*	0000h…FFFFh	-	1 = 1
34.45	Timer 12 start time	Time	00:00:00…23:59:59	s	1 = 1 s
34.46	Timer 12 duration	Duration	00 00:00…07 00:00	min	1 = 1 min
34.60	Season 1 start date	Date	01.01…31.12	d	1 = 1 d
34.61	Season 2 start date	Date	01.01…31.12	d	1 = 1 d
34.62	Season 3 start date	Date	01.01…31.12	d	1 = 1 d
34.63	Season 4 start date	Date	01.01…31.12	d	1 = 1 d
34.70	Number of active exceptions	*Real*	0…16	-	1 = 1
34.71	Exception types	*PB*	0b0000...0b1111	-	1 = 1
34.72	Exception 1 start	Date	01.01…31.12	d	1 = 1 d
34.73	Exception 1 length	*Real*	0…60	d	1 = 1 d

No.	Name	Type	Range	Unit	FbEq32
34.74	Exception 2 start	Date	01.01…31.12	d	1 = 1 d
34.75	Exception 2 length	*Real*	0…60	d	1 = 1 d
34.76	Exception 3 start	Date	01.01…31.12	d	1 = 1 d
34.77	Exception 3 length	*Real*	0…60	d	1 = 1 d
34.78	Exception day 4	Date	01.01…31.12	d	1 = 1 d
34.79	Exception day 5	Date	01.01…31.12	d	1 = 1 d
34.80	Exception day 6	Date	01.01…31.12	d	1 = 1 d
34.81	Exception day 7	Date	01.01…31.12	d	1 = 1 d
34.82	Exception day 8	Date	01.01…31.12	d	1 = 1 d
34.83	Exception day 9	Date	01.01…31.12	d	1 = 1 d
34.84	Exception day 10	Date	01.01…31.12	d	1 = 1 d
34.85	Exception day 11	Date	01.01…31.12	d	1 = 1 d
34.86	Exception day 12	Date	01.01…31.12	d	1 = 1 d
34.87	Exception day 13	Date	01.01…31.12	d	1 = 1 d
34.88	Exception day 14	Date	01.01…31.12	d	1 = 1 d
34.89	Exception day 15	Date	01.01…31.12	d	1 = 1 d
34.90	Exception day 16	Date	01.01…31.12	d	1 = 1 d
34.100	Timed function 1	*PB*	0b0000...0b1111	-	1 = 1
34.101	Timed function 2	*PB*	0b0000...0b1111	-	1 = 1
34.102	Timed function 3	*PB*	0b0000...0b1111	-	1 = 1
34.110	Boost time function	*PB*	0b0000...0b1111	-	
34.111	Boost time activation source	*Binary src*	-	-	1 = 1
34.112	Boost time duration	Duration	00 00:00…07 00:00	min	1 = 1 min
35 Motor thermal protection					
35.01	Motor estimated temperature	*Real*	-60…1000 °C	°C or °F	1 = 1°
35.02	Measured temperature 1	*Real*	-60…5000 °C	°C, °F or ohm	1 = 1 unit
35.03	Measured temperature 2	*Real*	-60…5000 °C	°C, °F or ohm	1 = 1 unit
35.05	Motor overload level	*Real*	0.0...300.0%	%	10 = 1%
35.11	Temperature 1 source	*List*	0...2, 5…7, 11...16	-	1 = 1
35.12	Temperature 1 fault limit	*Real*	-60 … 5000 °C	°C, °F or ohm	1 = 1 unit
35.13	Temperature 1 warning limit	*Real*	-60 … 5000 °C	°C, °F or ohm	1 = 1 unit
35.14	Temperature 1 AI source	*Analog src*	-	-	1 = 1
35.21	Temperature 2 source	*List*	0, 1, 11	-	1 = 1
35.22	Temperature 2 fault limit	*Real*	-60 … 5000 °C	°C, °F or ohm	1 = 1 unit
35.23	Temperature 2 warning limit	*Real*	-60 … 5000 °C	°C, °F or ohm	1 = 1 unit
35.24	Temperature 2 AI source	*Analog src*	-	-	1 = 1
35.50	Motor ambient temperature	*Real*	-60…100 °C or -75 … 212 °F	°C or °F	1 = 1 °
35.51	Motor load curve	*Real*	50…150	%	1 = 1%
35.52	Zero speed load	*Real*	25…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	°C or °F	1 = 1°
35.55	Motor thermal time constant	*Real*	100…10000	s	1 = 1 s
35.56	Motor overload action	*List*	-	-	10 = 1
35.57	Motor overload class	*List*	-	-	10 = 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

No.	Name	Type	Range	Unit	FbEq32
36.11	PVL peak date	*Data*	1/1/1980...6/5/2159	-	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*	-30000… 30000	rpm	100 = 1 rpm
36.16	PVL reset date	*Data*	1/1/1980...6/5/2159	-	1 = 1
36.17	PVL reset time	*Data*	-	-	1 = 1
36.20	AL1 0 to 10%	*Real*	0.00…100.00	%	100 = 1%
36.21	AL1 10 to 20%	*Real*	0.00…100.00	%	100 = 1%
36.22	AL1 20 to 30%	*Real*	0.00…100.00	%	100 = 1%
36.23	AL1 30 to 40%	*Real*	0.00…100.00	%	100 = 1%
36.24	AL1 40 to 50%	*Real*	0.00…100.00	%	100 = 1%
36.25	AL1 50 to 60%	*Real*	0.00…100.00	%	100 = 1%
36.26	AL1 60 to 70%	*Real*	0.00…100.00	%	100 = 1%
36.27	AL1 70 to 80%	*Real*	0.00…100.00	%	100 = 1%
36.28	AL1 80 to 90%	*Real*	0.00…100.00	%	100 = 1%
36.29	AL1 over 90%	*Real*	0.00…100.00	%	100 = 1%
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*	1/1/1980...6/5/2159	-	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	*Analog src*	-	-	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*	-30000.0…30000.0	rpm	10 = 1 rpm
37.12	ULC speed table point 2	*Real*	-30000.0…30000.0	rpm	10 = 1 rpm
37.13	ULC speed table point 3	*Real*	-30000.0…30000.0	rpm	10 = 1 rpm
37.14	ULC speed table point 4	*Real*	-30000.0…30000.0	rpm	10 = 1 rpm
37.15	ULC speed table point 5	*Real*	-30000.0…30000.0	rpm	10 = 1 rpm
37.16	ULC frequency table point 1	*Real*	-500.0…500.0	Hz	10 = 1 Hz
37.17	ULC frequency table point 2	*Real*	-500.0…500.0	Hz	10 = 1 Hz
37.18	ULC frequency table point 3	*Real*	-500.0…500.0	Hz	10 = 1 Hz
37.19	ULC frequency table point 4	*Real*	-500.0…500.0	Hz	10 = 1 Hz
37.20	ULC frequency table point 5	*Real*	-500.0…500.0	Hz	10 = 1 Hz
37.21	ULC underload point 1	*Real*	-1600.0…1600.0	%	10 = 1%
37.22	ULC underload point 2	*Real*	-1600.0…1600.0	%	10 = 1%
37.23	ULC underload point 3	*Real*	-1600.0…1600.0	%	10 = 1%
37.24	ULC underload point 4	*Real*	-1600.0…1600.0	%	10 = 1%
37.25	ULC underload point 5	*Real*	-1600.0…1600.0	%	10 = 1%
37.31	ULC overload point 1	*Real*	-1600.0…1600.0	%	10 = 1%
37.32	ULC overload point 2	*Real*	-1600.0…1600.0	%	10 = 1%
37.33	ULC overload point 3	*Real*	-1600.0…1600.0	%	10 = 1%
37.34	ULC overload point 4	*Real*	-1600.0…1600.0	%	10 = 1%
37.35	ULC overload point 5	*Real*	-1600.0…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
40 Process PID set 1					
40.01	Process PID output actual	*Real*	-200000.00…200000.00	%	100 = 1%

No.	Name	Type	Range	Unit	FbEq32
40.02	Process PID feedback actual	*Real*	-200000.00…200000.00	PID customer units	100 = 1 PID customer unit
40.03	Process PID setpoint actual	*Real*	-200000.00…200000.00	PID customer units	100 = 1 PID customer unit
40.04	Process PID deviation actual	*Real*	-200000.00…200000.00	PID customer units	100 = 1 PID customer unit
40.05	Process PID trim output act	*Real*	-32768...32767	PID customer units	100 = 1 PID customer unit
40.06	Process PID status word	*PB*	0000h…FFFFh	-	1 = 1
40.07	Process PID operation mode	*List*	0…2	-	1 = 1
40.08	Set 1 feedback 1 source	*Analog src*	-	-	1 = 1
40.09	Set 1 feedback 2 source	*Analog src*	-	-	1 = 1
40.10	Set 1 feedback function	*List*	0…11	-	1 = 1
40.11	Set 1 feedback filter time	*Real*	0.000…30.000	s	1000 = 1 s
40.14	Set 1 setpoint scaling	*Real*	-200000.00…200000.00	-	100 = 1
40.15	Set 1 output scaling	*Real*	-200000.00…200000.00	-	100 = 1
40.16	Set 1 setpoint 1 source	*Analog src*	-	-	1 = 1
40.17	Set 1 setpoint 2 source	*Analog src*	-	-	1 = 1
40.18	Set 1 setpoint function	*List*	0…11	-	1 = 1
40.19	Set 1 internal setpoint sel1	*Binary src*	-	-	1 = 1
40.20	Set 1 internal setpoint sel2	*Binary src*	-	-	1 = 1
40.21	Set 1 internal setpoint 1	*Real*	-200000.00…200000.00	PID customer units	100 = 1 PID customer unit
40.22	Set 1 internal setpoint 2	*Real*	-200000.00…200000.00	PID customer units	100 = 1 PID customer unit
40.23	Set 1 internal setpoint 3	*Real*	-200000.00…200000.00	PID customer units	100 = 1 PID customer unit
40.24	Set 1 internal setpoint 0	*Real*	-200000.00…200000.00	PID customer units	100 = 1 PID customer unit
40.26	Set 1 setpoint min	*Real*	-200000.00…200000.00	-	100 = 1
40.27	Set 1 setpoint max	*Real*	-200000.00…200000.00	-	100 = 1
40.28	Set 1 setpoint increase time	*Real*	0.0…1800.0	s	10 = 1 s
40.29	Set 1 setpoint decrease time	*Real*	0.0…1800.0	s	10 = 1 s
40.30	Set 1 setpoint freeze enable	*Binary src*	-	-	1 = 1
40.31	Set 1 deviation inversion	*Binary src*	-	-	1 = 1
40.32	Set 1 gain	*Real*	0.10…100.00	-	100 = 1
40.33	Set 1 integration time	*Real*	0.0…9999.0	s	10 = 1 s
40.34	Set 1 derivation time	*Real*	0.000…10.000	s	1000 = 1 s
40.35	Set 1 derivation filter time	*Real*	0.0…10.0	s	10 = 1 s
40.36	Set 1 output min	*Real*	-200000.00…200000.00	-	10 = 1
40.37	Set 1 output max	*Real*	-200000.00…200000.00	-	10 = 1
40.38	Set 1 output freeze enable	*Binary src*	-	-	1 = 1
40.39	Set 1 deadband range	*Real*	0.00……200000.00	-	100 = 1
40.40	Set 1 deadband delay	*Real*	0.0 … 3600.0	s	10 = 1 s
40.43	Set 1 sleep level	*Real*	0……200000.0	-	10 = 1
40.44	Set 1 sleep delay	*Real*	0.0…3600.0	s	10 = 1 s
40.45	Set 1 sleep boost time	*Real*	0.0…3600.0	s	10 = 1 s
40.46	Set 1 sleep boost step	*Real*	-0.00……200000.00	PID customer units	100 = 1 PID customer unit

No.	Name	Type	Range	Unit	FbEq32
40.47	Set 1 wake-up deviation	*Real*	-200000.00…200000.00	PID customer units	100 = 1 PID customer unit
40.48	Set 1 wake-up delay	*Real*	0.00…60.00	s	100 = 1 s
40.49	Set 1 tracking mode	*Binary src*	-	-	1 = 1
40.50	Set 1 tracking ref selection	*Analog src*	-	-	1 = 1
40.51	Set 1 trim mode	*List*	0...3	-	1 = 1
40.52	Set 1 trim selection	*List*	1...3	-	1 = 1
40.53	Set 1 trimmed ref pointer	*Analog src*	-	-	1 = 1
40.54	Set 1 trim mix	*Real*	0.000...1.000	-	1 = 1
40.55	Set 1 trim adjust	*Real*	-100.000...100.000	-	1 = 1
40.56	Set 1 trim source	*List*	1...2	-	1 = 1
40.57	PID set1/set2 selection	*Binary src*	-	-	1 = 1
40.58	Set 1 increase prevention	*List*	0…3	-	1 = 1
40.59	Set 1 decrease prevention	*List*	0…3	-	1 = 1
40.60	Set 1 PID activation source	*Binary src*	-	-	1 = 1
40.61	Setpoint scaling actual	*Real*	-200000.00…200000.00	-	100 = 1
40.62	PID internal setpoint actual	*Real*	-200000.00…200000.00	PID customer units	100 = 1 PID customer unit
40.65	Trim auto connection	*List*			
40.79	Set 1 units	*List*	-	-	1 = 1
40.80	Set 1 PID output min source	*Analog src*	-	-	1 = 1
40.81	Set 1 PID output max source	*Analog src*	-	-	1 = 1
40.89	Set 1 setpoint multiplier	*Real*	-200000.00…200000.00	-	100 = 1
40.90	Set 1 feedback multiplier	*Real*	--200000.00…200000.00	-	100 = 1
40.91	Feedback data storage	*Real*	-327.68 … 327.67	-	100 = 1
40.92	Setpoint data storage	*Real*	-327.68 … 327.67	-	100 = 1
40.96	Process PID output %	*Real*	-100.00…100.00	%	100 = 1
40.97	Process PID feedback %	*Real*	-100.00…100.00	%	100 = 1
40.98	Process PID setpoint %	*Real*	-100.00…100.00	%	100 = 1
40.99	Process PID deviation %	*Real*	-100.00…100.00	%	100 = 1
41 Process PID set 2					
41.08	Set 2 feedback 1 source	*Analog src*	-	-	1 = 1
41.09	Set 2 feedback 2 source	*Analog src*	-	-	1 = 1
41.10	Set 2 feedback function	*List*	0…11	-	1 = 1
41.11	Set 2 feedback filter time	*Real*	0.000…30.000	s	1000 = 1 s
41.14	Set 2 setpoint scaling	*Real*	-200000.00…200000.00	-	100 = 1
41.15	Set 2 output scaling	*Real*	-200000.00…200000.00	-	100 = 1
41.16	Set 2 setpoint 1 source	*Analog src*	-	-	1 = 1
41.17	Set 2 setpoint 2 source	*Analog src*	-	-	1 = 1
41.18	Set 2 setpoint function	*List*	0…11	-	1 = 1
41.19	Set 2 internal setpoint sel1	*Binary src*	-	-	1 = 1
41.20	Set 2 internal setpoint sel2	*Binary src*	-	-	1 = 1
41.21	Set 2 internal setpoint 1	*Real*	-200000.00…200000.00	PID customer units	100 = 1 PID customer unit
41.22	Set 2 internal setpoint 2	*Real*	-200000.00…200000.00	PID customer units	100 = 1 PID customer unit
41.23	Set 2 internal setpoint 3	*Real*	-200000.00…200000.00	PID customer units	100 = 1 PID customer unit
41.24	Set 2 internal setpoint 0	*Real*	-200000.00…200000.00	PID customer units	100 = 1 PID customer unit
41.26	Set 2 setpoint min	*Real*	-200000.00…200000.00	-	100 = 1
41.27	Set 2 setpoint max	*Real*	-200000.00…200000.00	-	100 = 1
41.28	Set 2 setpoint increase time	*Real*	0.0…1800.0	s	10 = 1 s

No.	Name	Type	Range	Unit	FbEq32
41.29	Set 2 setpoint decrease time	*Real*	0.0…1800.0	s	10 = 1 s
41.30	Set 2 setpoint freeze enable	*Binary src*	-	-	1 = 1
41.31	Set 2 deviation inversion	*Binary src*	-	-	1 = 1
41.32	Set 2 gain	*Real*	0.01…100.00	-	100 = 1
41.33	Set 2 integration time	*Real*	0.0…9999.0	s	10 = 1 s
41.34	Set 2 derivation time	*Real*	0.000…10.000	s	1000 = 1 s
41.35	Set 2 derivation filter time	*Real*	0.0…10.0	s	10 = 1 s
41.36	Set 2 output min	*Real*	-200000.00… 200000.00	-	10 = 1
41.37	Set 2 output max	*Real*	-200000.00… 200000.00	-	10 = 1
41.38	Set 2 output freeze enable	*Binary src*	-	-	1 = 1
41.39	Set 2 deadband range	*Real*	0.00……200000.00	-	100 = 1
41.40	Set 2 deadband delay	*Real*	0.0 … 3600.0	s	10 = 1 s
41.43	Set 2 sleep level	*Real*	0.0…20000.00	-	10 = 1
41.44	Set 2 sleep delay	*Real*	0.0…3600.0	s	10 = 1 s
41.45	Set 2 sleep boost time	*Real*	0.0…3600.0	s	10 = 1 s
41.46	Set 2 sleep boost step	*Real*	0.00…20000.000	PID customer units	100 = 1 PID customer unit
41.47	Set 2 wake-up deviation	*Real*	-200000.00… 200000.00	PID customer units	100 = 1 PID customer unit
41.48	Set 2 wake-up delay	*Real*	0.00…60.00	s	100 = 1 s
41.49	Set 2 tracking mode	*Binary src*	-	-	1 = 1
41.50	Set 2 tracking ref selection	*Analog src*	-	-	1 = 1
41.51	Set 2 trim mode	*List*	0…3	-	1 = 1
41.52	Set 2 trim selection	*List*	1…3	-	1 = 1
41.53	Set 2 trimmed ref pointer	*Analog src*	-	-	1 = 1
41.54	Set 2 trim mix	*Real*	0.000…1.000	-	1 = 1
41.55	Set 2 trim adjust	*Real*	-100.000…100.000	-	1 = 1
41.56	Set 2 trim source	*List*	1…2	-	1 = 1
41.58	Set 2 increase prevention	*List*	0…3	-	1 = 1
41.59	Set 2 decrease prevention	*List*	0…3	-	1 = 1
41.60	Set 2 PID activation source	*Binary src*	-	-	1 = 1
41.79	Set 2 units	*List*		-	1 = 1
41.80	Set 2 PID output min source	*List*	0…1	-	1 = 1
41.81	Set 2 PID output max source	*List*	0…1	-	1 = 1
41.89	Set 2 setpoint multiplier	*Real*	-200000.00…200000.00	-	100 = 1
41.90	Set 2 feedback multiplier	*Real*	-200000.00…200000.00	-	100 = 1
43 Brake chopper					
43.01	Braking resistor temperature	*Real*	0.0…120.0	%	10 = 1%
43.06	Brake chopper enable	*List*	0…2	-	1 = 1
43.07	Brake chopper runtime enable	*Binary src*	-	-	1 = 1
43.08	Brake resistor thermal tc	*Real*	0…10000	s	1 = 1 s
43.09	Brake resistor Pmax cont	*Real*	0.00…10000.00	kW	100 = 1 kW
43.10	Brake resistance	*Real*	0.0…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*	0000h…FFFFh	-	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
44.10	Brake open torque	*Real*	-1000...1000	%	10 = 1%
44.11	Keep brake closed	*Binary src*	-	-	1 = 1
44.12	Brake close request	*Binary src*	-	-	1 = 1
44.13	Brake close delay	*Real*	0.00…60.00	s	100 = 1 s

No.	Name	Type	Range	Unit	FbEq32
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
44.202	Torque proving	*Binary src*	-	-	1 = 1
44.203	Torque proving reference	*Real*	0.0...300.0	%	10 = 1.0%
44.204	Brake system check time	*Real*	0.10…30	ms	10 = 1 s
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
44.211	Extended runtime	*Real*	0.0…3600.0	s	1000 = 1 s
44.212	Extended runtime sw	*Binary src*	0000h...FFFFh	-	-
45 Energy efficiency					
45.01	Saved GW hours	*Real*	0…65535	GWh	1 = 1 GWh
45.02	Saved MW hours	*Real*	0…999	MWh	1 = 1 MWh
45.03	Saved kW hours	*Real*	0.0…999.0	kWh	10 = 1 kWh
45.04	Saved energy	*Real*	0.0…214748364.7	kWh	10 = 1 kWh
45.05	Saved money x1000	*Real*	0…4294967295 thousands	(selecta-ble)	1 = 1 unit
45.06	Saved money	*Real*	0.00…999.99	(selecta-ble)	100 = 1 unit
45.07	Saved amount	*Real*	0.00…21474836.47	(selecta-ble)	100 = 1 unit
45.08	CO2 reduction in kilotons	*Real*	0…65535	metric kiloton	1 = 1 metric kiloton
45.09	CO2 reduction in tons	*Real*	0.0…999.9	metric ton	10 = 1 metric ton
45.10	Total saved CO2	*Real*	0.0…214748365.7	metric ton	10 = 1 metric ton
45.11	Energy optimizer	*List*	0…1	-	1 = 1
45.12	Energy tariff 1	*Real*	0.000…4294967.295	(selecta-ble)	1000 = 1 unit
45.13	Energy tariff 2	*Real*	0.000…4294967.295	(selecta-ble)	1000 = 1 unit
45.14	Tariff selection	*Binary src*	-	-	1 = 1
45.18	CO2 conversion factor	*Real*	0.000…65.535	metric ton/ MWh	1000 = 1 metric ton/MWh
45.19	Comparison power	*Real*	0.00…100000.00	kW	10 = 1 kW
45.21	Energy calculations reset	*List*	0…1	-	1 = 1
45.24	Hourly peak power value	*Real*	-3000.00 … 3000.00	kW	1 = 1 kW
45.25	Hourly peak power time	*Real*			N/A
45.26	Hourly total energy (resettable)	*Real*	-3000.00 … 3000.00	kWh	1 = 1 kWh
45.27	Daily peak power value (resettable)	*Real*	-3000.00 … 3000.00	kW	1 = 1 kW
45.28	Daily peak power time	*Real*			N/A
45.29	Daily total energy (resettable)	*Real*	-30000.00 … 30000.00	kWh	1 = 1 kWh
45.30	Last day total energy	*Real*	-30000.00 … 30000.00	kWh	1 = 1 kWh
45.31	Monthly peak power value (resettable)	*Real*	-3000.00 … 3000.00	kW	1 = 1 kW
45.32	Monthly peak power date	*Real*	1/1/1980...6/5/2159		N/A
45.33	Monthly peak power time	*Real*			N/A
45.34	Monthly total energy (resettable)	*Real*	-1000000.00 … 1000000.00	kWh	1 = 1 kWh
45.35	Last month total energy	*Real*	-1000000.00 … 1000000.00	kWh	1 = 1 kWh
45.36	Lifetime peak power value	*Real*	-3000.00 … 3000.00	kW	1 = 1 kW

No.	Name	Type	Range	Unit	FbEq32
45.37	Lifetime peak power date	*Real*			N/A
45.38	Lifetime peak power time	*Real*			N/A
46 Monitoring/scaling settings					
46.01	Speed scaling	*Real*	0.00…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	-	10 = 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*	2…20000	ms	1 = 1 ms
46.12	Filter time output frequency	*Real*	2…20000	ms	1 = 1 ms
46.13	Filter time motor torque	*Real*	2…20000	ms	1 = 1 ms
46.14	Filter time power	*Real*	2…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*	0.00…300.00	%	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*	0.0…1600.0	%	10 = 1%
46.41	kWh pulse scaling	*Real*	0.001…1000.000	kWh	1000 = 1 kWh
46.43	Power decimals	*List*	0…3	-	1 = 1
46.44	Current decimals	*List*	0…3	-	1 = 1
47 Data storage					
47.01	Data storage 1 real32	*Real*	-2147483.008… 2147483.008	-	1000 = 1
47.02	Data storage 2 real32	*Real*	-2147483.008… 2147483.008	-	1000 = 1
47.03	Data storage 3 real32	*Real*	-2147483.008… 2147483.008	-	1000 = 1
47.04	Data storage 4 real32	*Real*	-2147483.008… 2147483.008	-	1000 = 1
47.11	Data storage 1 int32	*Real*	-2147483648… 2147483647	-	1 = 1
47.12	Data storage 2 int32	*Real*	-2147483648… 2147483647	-	1 = 1
47.13	Data storage 3 int32	*Real*	-2147483648… 2147483647	-	1 = 1
47.14	Data storage 4 int32	*Real*	-2147483648… 2147483647	-	1 = 1
47.21	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
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…3	-	1 = 1
49.06	Refresh settings	*List*	0…1	-	1 = 1
49.19	Basic panel home view 1		-	-	
49.20	Basic panel home view 2		-	-	
49.21	Basic panel home view 3		-	-	
49.30	Basic panel menu hiding		0000h…FFFFh	-	
49.219	Basic panel home view 4		-	-	
49.220	Basic panel home view 5		-	-	
49.221	Basic panel home view 6		-	-	
50 Fieldbus adapter (FBA)					
50.01	FBA A enable	*List*	0…1	-	1 = 1

No.	Name	Type	Range	Unit	FbEq32
50.02	FBA A comm loss func	*List*	0…3	-	1 = 1
50.03	FBA A comm loss t out	*Real*	0.3…6553.5	s	10 = 1 s
50.04	FBA A ref1 type	*List*	0…5	-	1 = 1
50.05	FBA A ref2 type	*List*	0…5	-	1 = 1
50.06	FBA A SW sel	*List*	0…1	-	1 = 1
50.07	FBA A actual 1 type	*List*	0…5	-	1 = 1
50.08	FBA A actual 2 type	*List*	0…5	-	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…2	-	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
51 FBA A settings					
51.01	FBA A type	*List*	-	-	1 = 1
51.02	FBA A Par2	*Real*	0…65535	-	1 = 1
…	…	…	…	…	
51.26	FBA A Par26	*Real*	0…65535	-	1 = 1
51.27	FBA A par refresh	*List*	0…1	-	1 = 1
51.28	FBA A par table ver	*Data*	-	-	1 = 1
51.29	FBA A drive type code	*Real*	0…65535	-	1 = 1
51.30	FBA A mapping file ver	*Real*	0…65535	-	1 = 1
51.31	D2FBA A comm status	*List*	0…6	-	1 = 1
51.32	FBA A comm SW ver	*Data*	-	-	1 = 1
51.33	FBA A appl SW ver	*Data*	-	-	1 = 1
52 FBA A data in					
52.01	FBA A data in1	*List*	-	-	1 = 1
…	…	…	…	…	
52.12	FBA A data in12	*List*	-	-	1 = 1
53 FBA A data out					
53.01	FBA A data out1	*List*	-	-	1 = 1
…	…	…	…	…	
53.12	FBA A data out12	*List*	-	-	1 = 1
58 Embedded fieldbus					
58.01	Protocol enable	*List*	0, 1, 3	-	1 = 1
71 External PID1					
71.01	External PID act value	*Real*	-200000.00…200000.00	rpm, % or Hz	100 = 1 unit
71.02	Feedback act value	*Real*	-200000.00…200000.00	rpm, % or Hz	100 = 1 unit
71.03	Setpoint act value	*Real*	-200000.00…200000.00	rpm, % or Hz	100 = 1 unit
71.04	Deviation act value	*Real*	-200000.00…200000.00	rpm, % or Hz	100 = 1 unit
71.06	PID status word	*PB*	0000h…FFFFh	-	1 = 1
71.07	PID operation mode	*List*	0…2	-	1 = 1
71.08	Feedback 1 source	*Analog src*	-	-	1 = 1
71.11	Feedback filter time	*Real*	0.000…30.000	s	1000 = 1 s
71.14	Setpoint scaling	*Real*	-200000.00…200000.00	-	100 = 1
71.15	Output scaling	*Real*	-200000.00…200000.00	-	100 = 1

No.	Name	Type	Range	Unit	FbEq32
71.16	Setpoint 1 source	*Analog src*	-	-	1 = 1
71.19	Internal setpoint sel1	*Binary src*	-	-	1 = 1
71.20	Internal setpoint sel2	*Binary src*	-	-	1 = 1
71.21	Internal setpoint 1	*Real*	-200000.00…200000.00	rpm, % or Hz	100 = 1 unit
71.22	Internal setpoint 2	*Real*	-200000.00…200000.00	rpm, % or Hz	100 = 1 unit
71.23	Internal setpoint 3	*Real*	-200000.00…200000.00	rpm, % or Hz	100 = 1 unit
71.26	Setpoint min	*Real*	-200000.00…200000.00	-	100 = 1
71.27	Setpoint max	*Real*	-200000.00…200000.00	-	100 = 1
71.31	Deviation inversion	*Binary src*	-	-	1 = 1
71.32	Gain	*Real*	0.10…100.00	-	100 = 1
71.33	Integration time	*Real*	0.0…9999.0	s	10 = 1 s
71.34	Derivation time	*Real*	0.000…10.000	s	1000 = 1 s
71.35	Derivation filter time	*Real*	0.0…10.0	s	10 = 1 s
71.36	Output min	*Real*	-200000.00…200000.00	-	10 = 1
71.37	Output max	*Real*	-200000.00…200000.00	-	10 = 1
71.38	Output freeze enable	*Binary src*	-	-	1 = 1
71.39	Deadband range	*Real*	0.0…200000.0	-	10 = 1
71.40	Deadband delay	*Real*	0.0...3600.0	s	10 = 1 s
71.58	Increase prevention	*List*	0…3	-	1 = 1
71.59	Decrease prevention	*List*	0…3	-	1 = 1
71.62	Internal setpoint actual	*Real*	-200000.00…200000.00	rpm,% or Hz	100 = 1 unit
71.79	External PID units	*List*		-	1 = 1
76 Application features					
76.01	Limit to limit control status	*List*	0...9	-	1 = 1
76.02	Enable limit to limit control	*Binary src*	-	-	1 = 1
76.03	Limit to limit trigger type	*List*	0…3	-	1 = 1
76.04	Forward stop limit	*Binary src*	-	-	1 = 1
76.05	Forward slow down limit	*Binary src*	-	-	1 = 1
76.06	Reverse stop limit	*Binary src*	-	-	1 = 1
76.07	Reverse slow down limit	*Binary src*	-	-	1 = 1
76.08	Slow down speed	*Real*	0.00…30000.00	rpm	1 = 1
76.09	Slow down frequency	*Real*	0.00…500.00	Hz	1 = 1
76.11	Limit stop mode	*List*	0…1	-	1 = 1
76.12	Limit stop ramp time	*Real*	0.000...3000.000 s	S	1000 = 1
76.21	Conical motor control	*Binary src*	-		1 = 1 %
76.22	Start flux level	*Real*	0...150	%	1 = 1 %
76.23	Start stop level	*Real*	0...100	%	1 = 1 %
76.24	Start flux hold time	*Real*	0...10000	ms	1 = 1 ms
76.25	Flux ramp up time	*Real*	0...10000	ms	1 = 1 ms
76.26	Flux ramp down time	*Real*	0...10000	ms	1 = 1 ms
76.27	Flux reference	*Real*	0...200	%	1 = 1 %
76.31	Motor speed match	*Binary src*	-	-	1 = 1
76.32	Motor speed steady deviation level	*Real*	0.00...30000.00	rpm	1 = 1
76.33	Motor speed ramp deviation level	*Real*	0.00...30000.00	rpm	1 = 1
76.34	Speed match fault delay	*Real*	0...30000	ms	1 = 1
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
90.10	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

No.	Name	Type	Range	Unit	FbEq32
90.13	Encoder 1 revolution extension	*Real*	-2147483648 … 2147483647	-	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
90.45	Motor feedback fault	*List*	0…1	-	1 = 1
90.46	Force open loop	*List*	0…1	-	1 = 1
90.47	Enable motor encoder drift detection	*List*	0…1	-	1 = 1
91 Encoder module settings					
91.10	Encoder parameter refresh	*List*	0…1	-	1 = 1
92 Encoder 1 configuration					
92.10	Pulses/revolution	*Real*	0…65535	-	1 = 1
95 HW configuration					
95.01	Supply voltage	*List*	0…5	-	1 = 1
95.02	Adaptive voltage limits	*List*	0…1	-	1 = 1
95.03	Estimated AC supply voltage	*Real*	0…65535	-	1 = 1 V
95.04	Control board supply	*List*	0…1	-	1 = 1
95.15	Special HW settings	*List*	0…1	.	1 = 1
95.20	HW options word 1	*PB*	0000h…FFFFh	-	1 = 1
95.26	Motor disconnect detection	*List*	0…1	-	1 = 1
95.200	Cooling fan mode	*List*	0…1	-	1 = 1
96 System					
96.01	Language	*List*	-	-	1 = 1
96.02	Pass code	*Data*	0…99999999	-	1 = 1
96.03	Access levels status	*PB*	0b0000...0b1111	-	1 = 1
96.04	Macro select	*List*	0, 1, 5, 8, 9, 12...14	-	1 = 1
96.05	Macro active	*List*	0, 1, 5, 8, 9, 12...14	-	1 = 1
96.06	Parameter restore	*List*	0, 8, 62	-	1 = 1
96.07	Parameter save manually	*List*	0…1	-	1 = 1
96.08	Control board boot	*Real*	0…1	-	1 = 1
96.10	User set status	*List*	0…7, 20…23	-	-
96.11	User set save/load	*List*	0…5, 18…21	-	-
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*	0b0000...0b1111	-	1 = 1
96.20	Time sync primary source	*List*	0, 2, 6, 8, 9	-	1 = 1
96.24	Full days since 1st Jan 1980	*Real*	1…59999	d	1 = 1 d
96.25	Time in minutes within 24h	*Real*	1…1439	min	1 = 1 min
96.26	Time in ms within one minute	*Real*	0…59999	ms	1 = 1 ms
96.51	Clear fault and event logger	*Real*	0…1	-	1 = 1
96.54	Checksum action	*List*	0…4	-	1 = 1
96.55	Checksum control word	*PB*	0b0000...0b1111	-	1 = 1
96.68	Actual checksum A	*Real*	0x0000...0xffff	-	1 = 1
96.69	Actual checksum B	*Real*	0x0000...0xffff	-	1 = 1
96.70	Disable adaptive program	*Real*	0...1	-	1 = 1
96.71	Approved checksum A	*Real*	0x0000...0xffff	-	1 = 1
96.72	Approved checksum B	*Real*	0x0000...0xffff	-	1 = 1
96.78	550 compatibility mode	*List*	0…2	-	1 = 1
(Parameters 96.100…96.102 only visible when enabled by parameter 96.02)					
97 Motor control					
97.01	Switching frequency reference	*List*	4…12	kHz	1 = 1
97.02	Minimum switching frequency	*List*	1…12	kHz	1 = 1
97.03	Slip gain	*Real*	0…200	%	1 = 1%
97.04	Voltage reserve	*Real*	-4…50	%	1 = 1%
97.05	Flux braking	*List*	0…2	-	1 = 1
97.06	Flux reference select	*Binary src*	-	-	1 = 1
97.07	User flux reference	*Real*	0.0...200.0	%	100 = 1%
97.08	Optimizer minimum torque	*Real*	0.0...1600.0	%	10 = 1%

No.	Name	Type	Range	Unit	FbEq32
97.11	TR tuning	*Real*	25…400	%	1 = 1%
97.13	IR compensation	*Real*	0.00…50.00	%	100 = 1%
97.15	Motor model temperature adaptation	*List*	0…1	-	1 = 1
97.16	Stator temperature factor	*Real*	0…200	%	1=1%
97.17	Rotor temperature factor	*Real*	0…200	%	1=1%
97.20	U/F ratio	*List*	*List*	-	1 = 1
97.33	Speed estimate filter time	*Real*	0.00…100.00	ms	0
97.48	UDC stabilizer	*List*	0, 50, 100, 300, 500, 800	-	1 = 1
97.49	Slip gain for scalar	*Real*	0…200	%	1 = 1%
97.94	IR comp max frequency	*Real*	1.0...200.0	%	10 = 1%
97.135	UDC ripple	*Real*	0.0…200.0	V	10 = 1V
98 User motor parameters					
98.01	User motor model mode	*List*	0…1	-	1 = 1
98.02	Rs user	*Real*	0.0000…0.50000	p.u.	100000 = 1 p.u.
98.03	Rr user	*Real*	0.0000…0.50000	p.u.	100000 = 1 p.u.
98.04	Lm user	*Real*	0.00000…10.00000	p.u.	100000 = 1 p.u.
98.05	SigmaL user	*Real*	0.00000…1.00000	p.u.	100000 = 1 p.u.
98.06	Ld user	*Real*	0.00000…10.00000	p.u.	100000 = 1 p.u.
98.07	Lq user	*Real*	0.00000…10.00000	p.u.	100000 = 1 p.u.
98.08	PM flux user	*Real*	0.00000…2.00000	p.u.	100000 = 1 p.u.
98.09	Rs user SI	*Real*	0.00000…100.00000	ohm	100000 = 1 p.u.
98.10	Rr user SI	*Real*	0.00000…100.00000	ohm	100000 = 1 p.u.
98.11	Lm user SI	*Real*	0.00…100000.00	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*	0.0...360	deg	1 = 1
99 Motor data					
99.03	Motor type	*List*	0…1	-	1 = 1
99.04	Motor control mode	*List*	0…1	-	1 = 1
99.06	Motor nominal current	*Real*	0.0…6400.0	A	See P*46.44*.
99.07	Motor nominal voltage	*Real*	0.0…800.0	V	See P*46.43*.
99.08	Motor nominal frequency	*Real*	0.00 … 500.00	Hz	100 = 1 Hz
99.09	Motor nominal speed	*Real*	0 … 30000	rpm	1 = 1 rpm
99.10	Motor nominal power	*Real*	-10000.00…10000.00 kW or -13405.83 … 13405.83 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…4, 6	-	1 = 1
99.14	Last ID run performed	*List*	0…4, 6	-	1 = 1
99.15	Motor polepairs calculated	*Real*	0…1000	-	1 = 1
99.16	Motor phase order	*List*	0…1	-	1 = 1

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Fault tracing

Contents

If the warnings and faults cannot be identified and corrected using the information in this chapter, contact an ABB service representative. If you use the Drive Composer PC tool, send the Support package created by the Drive Composer to the ABB service representative.

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

Safety

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

Indications

Warnings and faults

Warnings and faults indicate an abnormal drive status. The codes and names of active warnings and faults are displayed on the control panel of the drive as well as in the Drive Composer PC tool. Only the codes of warnings and 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 latch inside the drive and cause the drive to trip, and the motor stops. After the cause of a fault has been removed, the fault can be reset from the control panel, the Drive Composer PC tool, the fieldbus, or from some other source (like the digital inputs selected with parameter *31.11*). Reseting the fault creates an event *64FF Fault reset*. After the 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.

Pure events

In addition to warnings and faults, there are pure events that are only recorded in the event log of the drive. The codes of these events are included in the *Warning messages* table on page *490*.

Warning/fault history

Event log

All indications are stored in the event log. The event log stores information on

- the last 8 fault recordings, that is, faults that tripped the drive or fault resets
- the last 10 warnings or pure events that occurred.

See section *Viewing warning/fault information* on page *488*.

Auxiliary codes

Some events generate an auxiliary code that often helps in pinpointing the problem. On the control panel, the auxiliary code is stored as part of the details of the event; in the Drive Composer PC tool, the auxiliary code is shown in the event listing.

Viewing 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 drive also stores a list of faults and warnings that have previously occurred.

For each stored fault, the panel shows the fault code, time and values of nine parameters (actual signals and status words) stored at the time of the fault. The values of the parameters for the latest fault are in parameters *05.80*…*05.88*.

For active faults and warnings, see

- **Main menu - Diagnostics - Active faults**
- **Main menu - Diagnostics - Active warnings**
- **Options menu - Active faults**
- **Options menu - Active warnings**
- parameters in group *04 Warnings and faults* (page *133*).

For previously occurred faults and warnings, see

- **Main menu - Diagnostics - Fault & event log**

  Note: Active faults are also stored in the fault and event log.
- parameters in group *04 Warnings and faults* (page *133*).

The event log can also be accessed (and reset) using the Drive Composer PC tool. See *Drive Composer PC tool user's manual* (3AUA0000094606 [English]).

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 assistant 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.

Warning messages

Note: The list also contains events that only appear in the Event log.

Code (hex)	Warning / Aux. code	Cause	What to do
64FF	Fault reset	A fault has been reset from the panel, Drive Composer PC tool, fieldbus or I/O.	Event. Informative only.
A2B1	Overcurrent	Output current has exceeded internal fault limit. In addition to an actual overcurrent situation, this warning may also be caused by an earth fault or supply phase loss.	Check motor load. Check acceleration times in parameter group *23 Speed reference ramp* (speed control), *26 Torque reference chain* (torque control) or *28 Frequency reference chain* (frequency control). Also check parameters *46.01 Speed scaling*, *46.02 Frequency scaling* and *46.03 Torque scaling*. Check motor and motor cable (including phasing and delta/star connection). Check for an earth fault in motor or motor cables by measuring the insulation resistances of motor and motor cable. See chapter *Electrical installation*, section *Checking the insulation of the assembly* in the hardware manual of the drive. Check there are no contactors opening and closing in motor cable. Check that the start-up data in parameter group *99 Motor data* corresponds to the motor rating plate. Check that there are no power factor correction capacitors or surge absorbers in motor cable.

Cod e (hex)	Warning / Aux. code	Cause	What to do
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. See chapter *Electrical installation*, section *Checking the insulation of the assembly* in the hardware manual of the drive. If an earth fault is found, fix or change the motor cable and/or motor. 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 motor and motor cable (including phasing and delta/star connection). Check for an earth fault in motor or motor cables by measuring the insulation resistances of motor and motor cable. See chapter *Electrical installation*, section *Checking the insulation of the assembly* in the hardware manual of the drive. 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 / Aux. code**	**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. 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.	
A490	Incorrect temperature sensor setup	Sensor type mismatch.	Check the settings of temperature source parameters *35.11* and *35.21*.
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*.
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.

Code (hex)	Warning / Aux. code	Cause	What to do
A4A9	Cooling	Drive module temperature is excessive.	Check ambient temperature. If it exceeds 50 °C /122 °F, ensure that load current does not exceed derated load capacity of drive. See chapter *Technical data*, section *Derating* in the hardware manual of the drive. 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.
A4B1	Excess temperature difference	High temperature difference between the IGBTs of different phases.	Check the motor cabling. Check cooling of drive module(s).
A4F6	IGBT temperature	Drive IGBT temperature is excessive.	Check ambient conditions. Check air flow and fan operation. Check heatsink fins for dust pick-up. Check motor power against drive power.
A580	PU communication	Communication errors detected between the drive control unit and the power unit.	Check the connections between the drive control unit and the power unit. Check the value of parameter *95.04 Control board supply*.
A591	Drive HW initialization	Initialization of the drive hardware.	Check the auxiliary code. See actions for each code below.
	0000	Drive hardware setup is initializing.	Wait for the setup to initialize.
	0001	Initializing HW settings for the first time.	Wait for the setup to initialize.

Code (hex)	Warning / Aux. code	Cause	What to do
A5A0	Safe torque off Programmable warning: *31.22 STO indication run/stop*	Safe torque off function is active, ie safety circuit signal(s) connected to connector STO is lost.	Check safety circuit connections. For more information, chapter *The Safe torque off function* in the hardware manual of the drive and description of parameter *31.22 STO indication run/stop* (page *278*). Check the value of parameter *95.04 Control board supply*.
A5EA	Measurement circuit temperature	Problem with internal temperature measurement of the drive.	Contact your local ABB representative.
A5EB	PU board powerfail	Power unit power supply failure.	Contact your local ABB representative.
A5EC	PU communication internal	Communication errors detected between the drive control unit and the power unit.	Check the connections between the drive control unit and the power unit.
A5ED	Measurement circuit ADC	Measurement circuit fault.	Contact your local ABB representative.
A5EE	Measurement circuit DFF	Measurement circuit fault.	Contact your local ABB representative.
A5EF	PU state feedback	State feedback from output phases does not match control signals.	Contact your local ABB representative.
A5F0	Charging feedback	Charging feedback signal missing.	Check the feedback signal coming from the charging system.
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 (*96.71*…*96.72*) 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 / Aux. code	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*.
A6A4	Motor nominal value	The motor parameters are set incorrectly.	Check the settings of the motor configuration parameters in group 99.
		The drive is not dimensioned correctly.	Check that the drive is sized correctly for the motor.
	0001	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.
	0002	Synchronous and nominal speeds differ too much.	
	0003	Nominal speed is higher than synchronous speed with 1 pole pair.	
	0004	Nominal current is outside limits.	
	0005	Nominal voltage is outside limits.	
	0006	Nominal power is higher than apparent power.	
	0007	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	Voltage category unselected	The voltage category has not been defined.	Set voltage category 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 *119*).

Code (hex)	Warning / Aux. code	Cause	What to do
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)*.
A6E5	AI parametrization	The current/voltage hardware setting of an analog input does not correspond to parameter settings.	Check the event log for an auxiliary code. The code identifies the analog input whose settings are in conflict. Adjust 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. 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.
A783	Motor overload	Motor current is too high.	Check the motor, and the machinery coupled to motor, for overload. Adjust the parameters used for the motor overload function (*35.51*…*35.53*) and *35.55*…*35.56*.

Code (hex)	Warning / Aux. code	Cause	What to do
A784	Motor disconnect	All three output phases are disconnected from motor.	Check if parameter *95.26* enables the use of a motor disconnect switch. If not, check the following: • All switches between drive and motor are closed. • All cables between drive and motor are connected and secured. If no issue was detected and drive output was actually connected to motor, contact ABB.
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.	Check the resistor data settings (parameters *43.08*…*43.10*).
A79C	BC IGBT excess temperature	Brake chopper IGBT temperature has exceeded internal warning limit.	Let chopper cool down. Check for excessive ambient temperature. Check for cooling fan failure. Check for obstructions in the air flow. Check the dimensioning and cooling of the cabinet. Check resistor overload protection function settings (parameters *43.06*…*43.10*). Check minimum allowed resistor value for the chopper being used. Check that braking cycle meets allowed limits. Check that drive supply AC voltage is not excessive.

Code (hex)	Warning / Aux. code	Cause	What to do
A7A1	Mechanical brake closing failed	Mechanical brake control warning.	Check mechanical brake connection. Check mechanical brake settings in parameter group *44 Mechanical brake control*. Check that acknowledgment signal matches the actual status of the brake.
A7A5	Mechanical brake opening not allowed	Open conditions of mechanical brake cannot be fulfilled (e.g., brake has been prevented from opening by parameter 44.11)	Check mechanical brake settings in parameter group *44 Mechanical brake control* (especially *44.11*). Check that the acknowledgment signal (if used) matches the actual status of the brake.
A7AB	Extension I/O configuration failure	The I/O module is not connected to the device or parameterization conflict with currently connected I/O-module. For example, if the drive is connected to an I/O & Modbus module and removed later, the drive displays a warning if connection between any of the parameter and the configured digital/analog output signal is lost.	Make sure that the I/O module is connected to the device and no parameters are connected to non-existing I/O parameters. Make sure that the actual installed options match the values of parameters *07.35* (*Drive configuration*), *07.36* (*Drive configuration 2*), and *15.01* (*Extension module type*),See chapter *Automatic option configuration* on page *23*.
A7AC	I/O module internal error	Calibration data is not stored in the IO module. Analog signals are not working with full accuracy.	Replace the IO module.
A7B0	Motor speed feedback Programmable warning: *90.45 Motor feedback fault*	Motor speed feedback has failed and drive continues operation with open loop control.	Check the settings of the parameters in groups *90 Feedback selection*, *91 Encoder module settings* and *92 Encoder 1 configuration*. Check encoder installation.

Code (hex)	Warning / Aux. code	Cause	What to do
A7C1	FBA A communication Programmable warning: *50.02 FBA A comm loss func*	Cyclical communication between drive and fieldbus adapter module A or between PLC and fieldbus adapter module A is lost.	Check status of fieldbus communication. See user documentation of fieldbus interface. Check settings of parameter groups *50 Fieldbus adapter (FBA)*, *51 FBA A settings*, *52 FBA A data in* and *53 FBA A data out*. Check cable connections. Check if communication master is able to communicate.
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 EIA-485/X5 terminals 29, 30 and 31 on the control unit.
A7E1	Encoder Programmable warning: *90.45 Motor feedback fault*	Encoder error.	Check the auxiliary code. See below for actions.
	0001	Cable fault.	Check the encoder cable connection. If the encoder was working previously, check the encoder, encoder cable, and encoder interface module for damage.
A7EE	Panel loss Programmable warning: *49.05 Communication loss action*	Control panel or PC tool selected as active control location for drive has ceased communicating.	Check PC tool or control panel connection. Check control panel connector. Check mounting platform if being used. Disconnect and reconnect the control panel.
A8A0	AI supervision Programmable warning: *12.03 AI supervision function*	An analog signal is outside the limits specified for the analog input.	Check signal level at the analog input. Check the wiring connected to the input. Check the minimum and maximum limits of the input in parameter group *12 Standard AI*.

Code (hex)	Warning / Aux. code	Cause	What to do
A8A1	RO life warning	The relay has changed states more than the recommended number of times.	Change the control board or stop using the relay output.
	0001	Relay output 1	Change the control board or stop using relay output 1.
A8A2	RO toggle warning	The relay output is changing states faster than recommended, eg. if a fast changing frequency signal is connected to it. The relay lifetime will be exceeded shortly.	Replace the signal connected to the relay output source with a less frequently changing signal.
	0001	Relay output 1	Select a different signal with parameter *10.24 RO1 source*.
A8B0	Signal supervision (Editable message text) Programmable warning: *32.06 Supervision 1 action*	Warning generated by a signal supervision function.	Check the source of the warning (parameter *32.07 Supervision 1 signal*).
A8B1	Signal supervision (Editable message text) Programmable warning: *32.16 Supervision 2 action*	Warning generated by a signal supervision function.	Check the source of the warning (parameter *32.17 Supervision 2 signal*).
A8B2	Signal supervision (Editable message text) Programmable warning: *32.26 Supervision 3 action*	Warning generated by a signal supervision function.	Check the source of the warning (parameter *32.27 Supervision 3 signal*).
A8B3	Signal supervision (Editable message text) Programmable warning: *32.36 Supervision 4 action*	Warning generated by a signal supervision function.	Check the source of the warning (parameter *32.37 Supervision 4 signal*).
A8B4	Signal supervision (Editable message text) Programmable warning: *32.46 Supervision 5 action*	Warning generated by a signal supervision function.	Check the source of the warning (parameter *32.47 Supervision 5 signal*).
A8B5	Signal supervision (Editable message text) Programmable warning: *32.56 Supervision 6 action*	Warning generated by a signal supervision function.	Check the source of the warning (parameter *32.57 Supervision 6 signal*).
A8C0	ULC invalid speed table	User load curve: X-axis points (speed) are not valid.	Check that points fulfill conditions. See parameter *37.11 ULC speed table point 1*.
A8C1	ULC overload warning	User load curve: Signal has been too long over the overload curve.	See parameter *37.03 ULC overload actions*.
A8C4	ULC underload warning	User load curve: Signal has been too long under the underload curve.	See parameter *37.04 ULC underload actions*.

Code (hex)	**Warning / Aux. code**	**Cause**	**What to do**
A8C5	ULC invalid underload table	User load curve: Underload curve points are not valid.	Check that points fulfill conditions. See parameter *37.21 ULC underload point 1*.
A8C6	ULC invalid overload table	User load curve: Overload curve points are not valid.	Check that points fulfill conditions. See parameter *37.31 ULC overload point 1*.
A8C8	ULC invalid frequency table	User load curve: X-axis points (frequency) are not valid.	Check that points fulfill conditions. - 500.0 Hz ≤ *37.16* < *37.17* < *37.18* < *37.19* < *37.20* ≤ 500.0 Hz. See parameter *37.16 ULC frequency table point 1*.
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 5.	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*.
AF88	Season configuration warning	You have configured a season which starts before the previous season.	Configure the seasons with increasing start dates, see parameters *34.60 Season 1 start date*…*34.63 Season 4 start date*.

Code (hex)	Warning / Aux. code	Cause	What to do
AF90	Speed controller autotuning	The autotune routine has been interrupted.	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 *69*).
	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. Then return emergency stop push button to normal position. Restart drive. If the emergency stop was unintentional, check the source selected by parameter *21.05 Emergency stop source*.
AFE2	Emergency stop (off1 or off3)	Drive has received an emergency stop (mode selection off1 or off3) command.	
AFEA	Enable start signal missing (Editable message text)	No enable start signal received.	Check the setting of (and the source selected by) parameter *20.19 Enable start signal*.
AFE9	Start delay	The start delay is active and the drive will start the motor after a predefined delay.	Informative warning. See parameter *21.22 Start delay*.
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.

Code (hex)	Warning / Aux. code	Cause	What to do
AFEC	External power signal missing	*95.04 Control board supply* is set to *External 24V* but no voltage is connected to the control unit.	Check the external 24 V DC power supply to the control unit, or change the setting of parameter *95.04*.
AFED	Enable to rotate	Signal enable to rotate has not been received within a fixed time delay of 240s.	Switch enable to rotate signal on (eg. in digital inputs). Check the setting of (and source selected by) parameter *20.22 Enable to rotate*.
AFF6	Identification run	Motor ID run will occur at next start.	Informative warning.
AFF7	Autophasing	Autophasing will occur at next start.	Informative warning.
B5A0	STO event Programmable event: *31.22 STO indication run/stop*	Safe torque off function is active, ie. safety circuit signal(s) connected to connector STO is lost.	Check safety circuit connections. For more information, see chapter *The Safe torque off function* in the hardware manual of the drive and description of parameter *31.22 STO indication run/stop* (page *278*).
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 *494*).

Fault messages

Code (hex)	Fault / Aux. code	Cause	What to do
1080	Backup/Restore timeout	Panel or PC tool has failed to communicate with the drive when backup was being made or restored.	Request backup or restore again.
1081	Rating ID fault	Drive software has not been able to read the rating ID of the drive.	Reset the fault to make the drive try to reread the rating ID. If the fault reappears, cycle the power to the drive. You may have to be repeat this. If the fault persists, contact your local ABB representative.
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. If the fault persists, contact your local ABB representative.

Cod e (hex)	**Fault / Aux. code**	**Cause**	**What to do**
2310	Overcurrent	Output current has exceeded internal fault limit. In addition to an actual overcurrent situation, this fault may also be caused by an earth fault or supply phase loss.	Check the auxiliary code (format XXXYYYZZ): “ZZ” indicates the overcurrent type and phase that triggered the fault: • bit 7 =1 indicates SW overcurrent • bit 0: Phase U • bit 1: Phase V • bit 2: Phase W For example: Aux code 0x83 indicates SW overcurrent of phase U and V. If there is no aux code, this indicates that hardware overcurrent is triggered. Check motor load. Check acceleration times in parameter group *23 Speed reference ramp* (speed control), *26 Torque reference chain* (torque control) or *28 Frequency reference chain* (frequency control). Also check parameters *46.01 Speed scaling*, *46.02 Frequency scaling* and *46.03 Torque scaling*. Check motor and motor cable (including phasing and delta/star connection). Check there are no contactors opening and closing in motor cable. Check that the start-up data in parameter group *99 Motor data* corresponds to the motor rating plate. Check that 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. See chapter *Electrical installation*, section *Checking the insulation of the assembly* in the hardware manual of the drive.

Code (hex)	Fault / Aux. code	Cause	What to do
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*.) If no earth fault can be detected, contact your local ABB representative.
2340	Short circuit	Short-circuit in motor cable(s) or motor. Aux code 0x0080 indicates that the state feedback from output phases does not match the control signals.	Check motor and motor cable for cabling errors. Check there are no power factor correction capacitors or surge absorbers in motor cable. Cycle the power to the drive.
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.
3130	Input phase loss	Intermediate circuit DC voltage is oscillating due to missing input power line phase or blown fuse.	Check input power line fuses. Check for loose power cable connections. Check for input power supply imbalance.
3181	Output wiring or earth fault Programmable fault: *31.23 Wiring or earth fault*	Incorrect input power and motor cable connection (ie. input power cable is connected to drive motor connection).	Check input power connections.

Code (hex)	Fault / Aux. code	Cause	What to do
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. Check that the brake resistor is dimensioned properly and the resistance is between acceptable range for the drive.
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.
3381	Output phase loss Programmable fault: *31.19 Motor phase loss*	Motor circuit fault due to missing motor connection (any of the three phases not connected). In scalar control mode, the drive detects fault only when the output frequency is above 10% of the motor nominal frequency.	Connect motor cable. If the drive is in scalar mode and nominal current of the motor is less than 1/6 of the nominal output current of the drive, set parameter *31.19 Motor phase loss* to *No action*.

Code (hex)	Fault / Aux. code	Cause	What to do
3385	Autophasing	Autophasing routine (see section *Autophasing* on page *55*) has failed.	Try other autophasing modes (see parameter *21.13 Autophasing mode*) if possible. 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*.
4110	Control board temperature	Control board temperature is too high.	Check proper cooling of the drive. Check the auxiliary cooling fan.
4210	IGBT overtemperature	Estimated drive IGBT temperature is excessive.	Check ambient conditions. Check air flow and fan operation. Check heatsink fins for dust pick-up. Check motor power against drive power.
4290	Cooling	Drive module temperature is excessive.	Check ambient temperature. If it exceeds 50 °C /122 °F, ensure that load current does not exceed derated load capacity of drive. See chapter *Technical data*, section *Derating* in the hardware manual of the drive. 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.

Code (hex)	**Fault / Aux. code**	**Cause**	**What to do**
4310	Excess temperature	Power unit module temperature is excessive.	Check ambient conditions. Check air flow and fan operation. Check heatsink fins for dust pick-up. Check motor power against drive power.
4380	Excess temperature difference	High temperature difference between the IGBTs of different phases.	Check the motor cabling. Check cooling of drive module(s).
4981	External temperature 1 (Editable message text)	Measured temperature 1 has exceeded fault limit.	Check the value of parameter *35.02 Measured temperature 1*. Check the cooling of the motor (or other equipment whose temperature is being measured). Check the value of parameter *35.12 Temperature 1 fault limit*.
4982	External temperature 2 (Editable message text)	Measured temperature 2 has exceeded fault limit.	Check the value of parameter *35.03 Measured temperature 2*. Check the cooling of the motor (or other equipment whose temperature is being measured). Check the value of parameter *35.22 Temperature 2 fault limit*.
5090	STO hardware failure	STO hardware diagnostics has detected hardware failure.	Contact your local ABB representative for hardware replacement.
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 STO is broken during start or run.	Check safety circuit connections. For more information, see chapter *The Safe torque off function* in the hardware manual of the drive and description of parameter *31.22 STO indication run/stop* (page *278*). Check the value of parameter *95.04 Control board supply*.
5092	PU logic error	Power unit memory has cleared.	Contact your local ABB representative.
5093	Rating ID mismatch	The hardware of the drive does not match the information stored in the memory. This may occur e.g. after a firmware update.	Cycle the power to the drive. You may have to be repeat this.

Code (hex)	Fault / Aux. code	Cause	What to do
5094	Measurement circuit temperature	Problem with internal temperature measurement of the drive.	Contact your local ABB representative.
5098	I/O communication loss	Communication failure to standard I/O.	Try resetting the fault or cycle the power to the drive.
50A0	Fan	Cooling fan stuck or disconnected.	Check fan operation and connection. Replace fan if faulty.
5681	PU communication	Communication errors detected between the drive control unit and the power unit.	Check the connection between the drive control unit and the power unit. Check the value of parameter *95.04 Control board supply*.
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.	This is an internal control system failure. If reset or re-powering of the drive unit does not help, or this fault appears frequently, please replace the drive.
5691	Measurement circuit ADC	Measurement circuit fault.	This is an internal control system failure. If reset or re-powering of the drive unit does not help, or this fault appears frequently, please replace the drive.
5692	PU board powerfail	Power unit power supply failure.	This is an internal control system failure. If reset or re-powering of the drive unit does not help, or this fault appears frequently, please replace the drive.
5693	Measurement circuit DFF	Measurement circuit fault.	This is an internal control system failure. If reset or re-powering of the drive unit does not help, or this fault appears frequently, please replace the drive.
5697	Charging feedback	Charging feedback signal missing.	Check the feedback signal coming from the charging system.
6181	FPGA version incompatible	Firmware and FPGA versions 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 / Aux. code	Cause	What to do
6200	Checksum mismatch Programmable event: *96.54 Checksum action*	The calculated parameter checksum does not match any enabled reference checksum.	See *A686 Checksum mismatch* (page *494*).
6306	FBA A mapping file	Fieldbus adapter A 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
64A6	Adaptive program file incompatible or corrupted	Adaptive program has faulted.	Check the auxiliary code. 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 parameter.	Edit the program to correct the parameter reference, or use an existing block.
	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.

Code (hex)	Fault / Aux. code	Cause	What to do
	0023	Program file incompatible with current firmware version.	Adapt the program to current block library and firmware version.
	0024	Program file incompatible with current firmware version.	Adapt the program to current block library and firmware version.
	Other	-	Contact your local ABB representative, quoting the auxiliary code.
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*.
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 EIA-485/X5 terminals 29, 30 and 31 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*.

Code (hex)	Fault / Aux. code	Cause	What to do
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.	
6685	EFB fault 2	Fault reserved for the EFB protocol application.	Check the documentation of the protocol.
6686	EFB fault 3	Fault reserved for the EFB protocol application.	Check the documentation of the protocol.
6882	Text 32-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.
7081	Control panel loss 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.
7082	I/O module comm loss	Communication between IO module and drive is not working properly.	Check the IO module installation.
7086	I/O module AI Over voltage	Overvoltage detected in AI. AI is changed to voltage mode. AI will return automatically back to mA mode when the AI signal level is in accepted limits.	Check AI signal levels.
7087	I/O module configuration	I/O module configuration not supported or illegal.	Check the auxiliary code. See actions for each code below.
	0001	S1/S2 DIP switch position on BIO-01 has changed after power up.	Reboot control unit either by cycling the power or through parameter *96.08 Control board boot* to activate new DIP switch position.
	0002	S1/S2 DIP switch positions are such that DO1 would be in both S1 and S2 pins. This is not a supported combination.	Change S1/S2 DIP switch positions to a supported combination, see parameter *05.99 BIO-01 DIP switch status*.

Code (hex)	Fault / Aux. code	Cause	What to do
7121	Motor stall Programmable fault: *31.24 Stall function*	Motor is operating in stall region because of e.g. excessive load or insufficient motor power.	Check motor load and drive ratings. Check fault function parameters.
7122	Motor overload	Motor current is too high.	Check the motor, and the machinery coupled to motor, for overload. Adjust the parameters used for the motor overload function (*35.51*…*35.53*) and *35.55*…*35.56*.
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.
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 chapter *Resistor braking* in the hardware manual of the drive. Replace brake chopper (if replaceable).

Code (hex)	Fault / Aux. code	Cause	What to do
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 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 e.g., if brake acknowledgment is not as expected during brake closing.	Check mechanical brake connection. Check mechanical brake settings in parameter group *44 Mechanical brake control*. Check that the acknowledgment signal matches the actual status of the brake.
71A3	Mechanical brake opening failed Programmable fault: *44.17 Brake fault function*	Mechanical brake control fault. Activated e.g. if brake acknowledgment is not as expected during brake opening.	Check mechanical brake connection. Check mechanical brake settings in parameter group *44 Mechanical brake control*. Check that acknowledgment signal matches actual status of brake.
71A5	Mechanical brake opening not allowed	Open conditions of mechanical brake cannot be fulfilled (e.g., the brake has been prevented from opening by parameter 44.11).	Check mechanical brake settings in parameter group *44 Mechanical brake control* (especially *44.11*). Check that the acknowledgment signal (if used) matches the actual status of the brake.
7301	Motor speed feedback Programmable fault: *90.45 Motor feedback fault*	No motor speed feedback received. Encoder speed differs too much from internal speed estimate. Aux code 4 = Drift detected. Aux code 3FC = Incorrect motor feedback configuration.	Check the parameter *90.41* setting and the actual source selected. Check electrical connection of the encoder and pulse sin/cos nr.

Code (hex)	Fault / Aux. code	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).
7381	Encoder Programmable fault: *90.45 Motor feedback fault*	Encoder feedback fault.	See *A7E1 Encoder* (page *499*).
73F0	Overfrequency	Maximum allowed output frequency exceeded.	Check minimum/maximum frequency settings, parameters *30.13 Minimum frequency* and *30.14 Maximum frequency*. Check adequacy of motor braking torque. Check applicability of torque control. Check need for brake chopper and resistor(s).
	00FA	Motor is turning faster than the highest allowed frequency due to incorrectly set minimum/maximum frequency or the motor rushes because of too high supply voltage or incorrect supply voltage selection in parameter *95.01 Supply voltage*.	Check minimum/maximum frequency settings, parameters *30.13 Minimum frequency* and *30.14 Maximum frequency*. Check used supply voltage and voltage selection parameter *95.01 Supply voltage*.
	Other	-	Contact your local ABB representative, quoting the auxiliary code.

Code (hex)	**Fault / Aux. code**	**Cause**	**What to do**
73B0	Emergency ramp failed	Emergency stop did not finish within expected time.	Check the settings of parameters *31.32 Emergency ramp supervision* and *31.33 Emergency ramp supervision delay*. Check the predefined ramp times (*23.11*…*23.15* for mode Off1, *23.23* for mode Off3).
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. **Note**: If the module has been changed from FieldBus (for example FPBA) to some other option module (for example BMIO), the factory defaults need to be applied (see parameter *96.06*).
8001	ULC underload fault	User load curve: Signal has been too long under the underload curve.	See parameter *37.04 ULC underload actions*.
8002	ULC overload fault	User load curve: Signal has been too long over the overload curve.	See parameter *37.03 ULC overload actions*.
80A0	AI supervision Programmable fault: *12.03 AI supervision function*	An analog signal is outside the limits specified for the analog input.	Check signal level at the analog input. Check the wiring connected to the input. Check the minimum and maximum limits of the input in parameter group *12 Standard AI*.
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 (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*).

Code (hex)	Fault / Aux. code	Cause	What to do
80B2	Signal supervision (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*).
80B3	Signal supervision (Editable message text) Programmable fault: *32.36 Supervision 4 action*	Fault generated by the signal supervision 4 function.	Check the source of the fault (parameter *32.37 Supervision 4 signal*).
80B4	Signal supervision (Editable message text) Programmable fault: *32.46 Supervision 5 action*	Fault generated by the signal supervision 5 function.	Check the source of the fault (parameter *32.47 Supervision 5 signal*).
80B5	Signal supervision (Editable message text) Programmable fault: *32.56 Supervision 6 action*	Fault generated by the signal supervision 6 function.	Check the source of the fault (parameter *32.57 Supervision 6 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 5.	Check the external device. Check setting of parameter *31.07 External event 4 source*.
9085	External fault 5 (Editable message text) Programmable fault: *31.09 External event 5 source* *31.10 External event 5 type*	Fault in external device 5.	Check the external device. Check setting of parameter *31.09 External event 5 source*.
FA81	Safe torque off 1	Safe torque off function is active, ie. STO circuit 1 is broken.	Check safety circuit connections. For more information, see chapter *The Safe torque off function* in the hardware manual of the drive and description of parameter *31.22 STO indication run/stop* (page *278*). Check the value of parameter *95.04 Control board supply*.
FA82	Safe torque off 2	Safe torque off function is active, ie. STO circuit 2 is broken.	

Code (hex)	Fault / Aux. code	Cause	What to do
FF61	ID run	Motor ID run was not completed successfully.	Check the nominal motor values in parameter group *99 Motor data*. Check that no external control system is connected to the drive. Cycle the power to the drive (and its control unit, if powered separately). Check that no operation limits prevent the completion of the ID run. Restore parameters to default settings and try again. Check that the motor shaft is not locked. Check the auxiliary code. See actions for each code below
	0001	Maximum current limit too low.	Check settings of parameters *99.06 Motor nominal current* and *30.17 Maximum current*. Make sure that *30.17* > *99.06*. Check that the drive is dimensioned correctly according to the motor.
	0002	Maximum speed limit or calculated field weakening point too low.	Check settings of parameters • *30.11 Minimum speed* • *30.12 Maximum speed* • *99.07 Motor nominal voltage* • *99.08 Motor nominal frequency* • *99.09 Motor nominal speed*. Make sure that • *30.12* > (0.55 × *99.09*) > (0.50 × synchronous speed) • *30.11* ≤ 0, and • supply voltage ≥ (0.66 × *99.07*).
	0003	Maximum torque limit too low.	Check settings of parameter *99.12 Motor nominal torque*, and the torque limits in group *30 Limits*. Make sure that the maximum torque limit in force is greater than 100%.
	0004	Current measurement calibration did not finish within reasonable time	Contact your local ABB representative and quote this fault and auxiliary code.
	0005…0008	Internal error.	Contact your local ABB representative and quote this fault and auxliary code.
	0009	(Asynchronous motors only) Acceleration did not finish within reasonable time.	Contact your local ABB representative and quote this fault and auxliary code.

Code (hex)	Fault / Aux. code	Cause	What to do
	000A	(Asynchronous motors only) Deceleration did not finish within reasonable time.	Contact your local ABB representative and quote this fault and auxliary code.
	000B	(Asynchronous motors only) Speed dropped to zero during ID run.	Contact your local ABB representative and quote this fault and auxliary code.
	000C	(Permanent magnet motors only) First acceleration did not finish within reasonable time.	Contact your local ABB representative and quote this fault and auxliary code.
	000D	(Permanent magnet motors only) Second acceleration did not finish within reasonable time.	Contact your local ABB representative and quote this fault and auxliary code.
	000E…0010	Internal error.	Contact your local ABB representative and quote this fault and auxliary code.
	0011	(Synchronous reluctance motors only) Pulse test error.	Contact your local ABB representative and quote this fault and auxliary code.
	0012	Motor too large for advanced standstill ID run.	Check that the motor and drive sizes are compatible. Contact your local ABB representative and quote this fault and auxliary code.
	0013	(Asynchronous motors only) Motor data error.	Check that the motor nominal value settings in the drive are the same as in the motor nameplate. Contact your local ABB representative and quote this fault and auxliary code.
FF81	FB A force trip	A fault trip command has been received through fieldbus adapter A.	Check the fault information provided by the PLC.
FF8E	EFB force trip	A fault trip command has been received through the embedded fieldbus interface.	Check the fault information provided by the PLC.

Code (hex)	Fault / Aux. code	Cause	What to do
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*.

9

Fieldbus control through the embedded fieldbus interface (EFB)

Contents

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.

Two protocols are supported by the embedded fieldbus interface: Modbus and CANopen.

Modbus

Embedded fieldbus is for the following instruments:

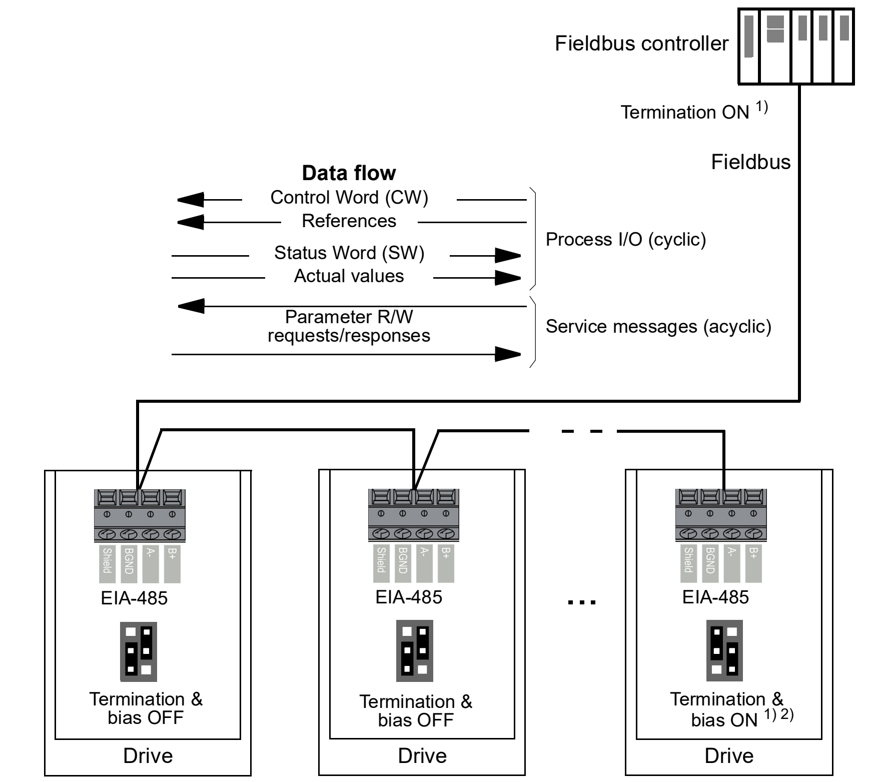
- Standard variant ACS380-04xS
- Configured variant (ACS380-04xC) with the I/0 and Modbus extension module (option +L538).

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 the EIA-485 Modbus RTU terminal on the BMIO-01 module which is attached on the control unit of the drive. The connection diagram is shown below.



1) The device at both ends on the fieldbus must have termination ON.
2) One device, preferably at the end on the fieldbus must have bias ON.

Setting up the embedded fieldbus interface (Modbus)

To take the Modbus into use:

1. Select *Modbus RTU* from the Control macros menu (see section *Submenus* on page *20*).

The following parameters change automatically:

Parameter	**Setting**
20.01 Ext1 commands	Embedded fieldbus
20.03 Ext1 in1	Not selected
20.04 Ext1 in2	Not selected
22.11 Ext1 speed ref1	EFB ref1
22.22 Constant speed sel1	Not selected
22.23 Constant speed sel2	Not selected
23.11 Ramp set selection	Acc/Dec time 1
28.11 Ext1 frequency ref1	EFB ref1
28.22 Constant frequency sel1	Not selected
28.23 Constant frequency sel2	Not selected
28.71 Freq ramp set sel	Acc/Dec time 1
31.11 Fault reset selection	DI1
58.01 Protocol enable	Modbus RTU

You can manually 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.

Modbus parameter settings for embedded fieldbus interface

Parameter	**Setting for fieldbus control**	**Function/Information**
COMMUNICATION INITIALIZATION		
58.01 Protocol enable	*Modbus RTU*	Initializes embedded fieldbus communication.
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.

Parameter	Setting for fieldbus control	Function/Information
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)	Selects the control profile used by the drive. See section *Basics of the embedded fieldbus interface* (page 529).
58.26 EFB ref1 type *58.27 EFB ref2 type*	*Speed or frequency* (default for *58.26*), *Transparent*, *General*, *Torque* (default for *58.27*), *Speed*, *Frequency*	Defines the types of fieldbus references 1 and 2. The scaling for each reference type is defined by parameters *46.01*…*46.03*. With the *Speed or frequency* setting, the type is selected automatically according to the currently active drive control mode.
58.28 EFB act1 type *58.29 EFB act2 type*	*Speed or frequency* (default for *58.28*), *Transparent* (default for *58.29*), *General*, *Torque*, *Speed*, *Frequency*	Defines the types of actual values 1 and 2. The scaling for each actual value type is defined by parameters *46.01*…*46.03*. With the *Speed or frequency* setting, the type is selected automatically according to the currently active drive control mode.
58.31 EFB act1 transparent source *58.32 EFB act2 transparent source*	*Other*	Defines the source of actual values 1 and 2 when the *58.26 EFB ref1 type* (*58.27 EFB ref2 type*) is set to *Transparent*.
58.33 Addressing mode	*Mode 0* (default)	Defines the mapping between parameters and holding registers in the 400001…465536 (100…65535) Modbus register range.
58.34 Word order	*LO-HI* (default)	Defines the order of the data words in the Modbus message frame.
58.101 Data I/O 1 … … *58.114 Data I/O 14*	For example, the default settings (I/Os 1…6 contain the control word, the status word, two references and two actual values)	Defines 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.

Parameter	Setting for fieldbus control	Function/Information
	RO/DIO control word, *AO1 data storage*, *Feedback data storage*, *Setpoint data storage*	These settings write the incoming data into storage parameters *10.99 RO/DIO control word*, *13.91 AO1 data storage*, *40.91 Feedback data storage* or *40.92 Setpoint 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* (*Refresh settings*).

Setting the drive control parameters

After the embedded fieldbus interface has been set up, check and adjust the drive control parameters listed in the table below. The **Setting for fieldbus control** column gives the value or values to use when the embedded fieldbus signal is the desired source or destination for that particular drive control signal. The **Function/Information** column gives a description of the parameter.

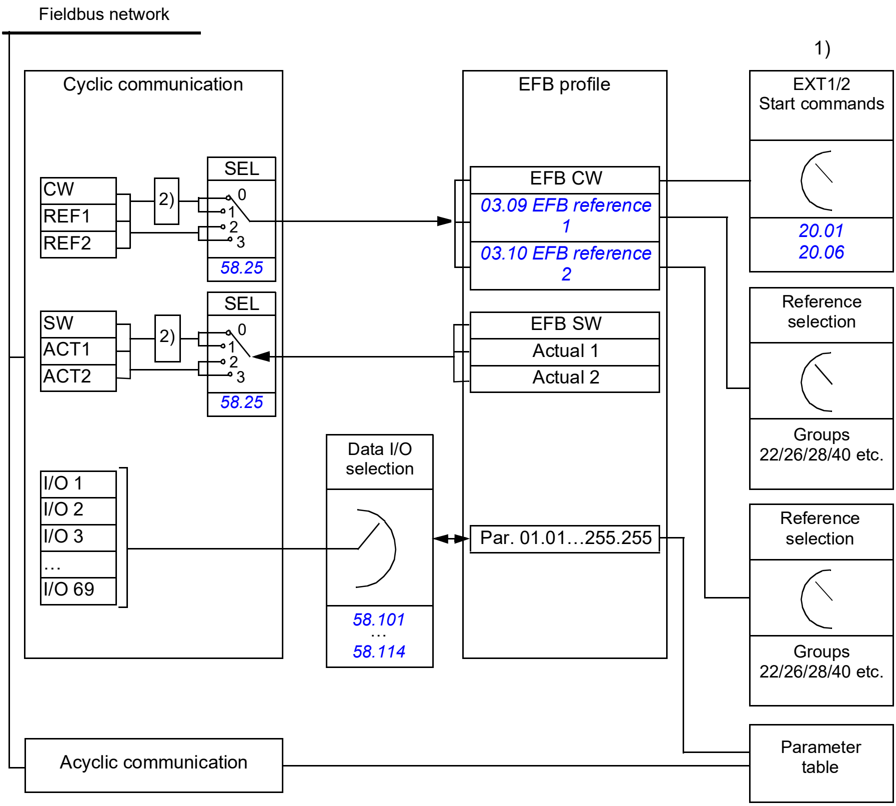
Parameter	Setting for fieldbus control	Function/Information
CONTROL COMMAND SOURCE SELECTION		
20.01 Ext1 commands	*Embedded fieldbus*	Selects fieldbus as the source for the start and stop commands when EXT1 is selected as the active control location.
20.02 Ext2 commands	*Embedded fieldbus*	Selects fieldbus as the source for the start and stop commands when EXT2 is selected as the active control location.
SPEED REFERENCE SELECTION		
22.11 Ext1 speed ref1	*EFB ref1*	Selects a reference received through the embedded fieldbus interface as speed reference 1.
22.18 Ext2 speed ref1	*EFB ref1*	Selects a reference received through the embedded fieldbus interface as speed reference 2.
TORQUE REFERENCE SELECTION		
26.11 Torque ref1 source	*EFB ref1*	Selects a reference received through the embedded fieldbus interface as torque reference 1.
26.12 Torque ref2 source	*EFB ref1*	Selects a reference received through the embedded fieldbus interface as torque reference 2.

Parameter	Setting for fieldbus control	Function/Information
FREQUENCY REFERENCE SELECTION		
28.11 Ext1 frequency ref1	*EFB ref1*	Selects a reference received through the embedded fieldbus interface as frequency reference 1.
28.15 Ext2 frequency ref1	*EFB ref1*	Selects a reference received through the embedded fieldbus interface as frequency 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*.		
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 a transparent control profile).

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* on page *531*.

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. With 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 or the data is converted. See section *About the control profiles* on page *531*.

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* on page *531*.

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* on page *531*.

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* on page *531*.

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* … *58.114 Data I/O 14* define the addresses from which the master either reads data (input) or to which it writes data (output).

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 410000-465536 are inaccessible to these masters. For more information, see parameter *58.33 Addressing mode*.

Note: Register addresses of 32-bit parameters cannot be accessed by using 5-digit register numbers.

About the control profiles

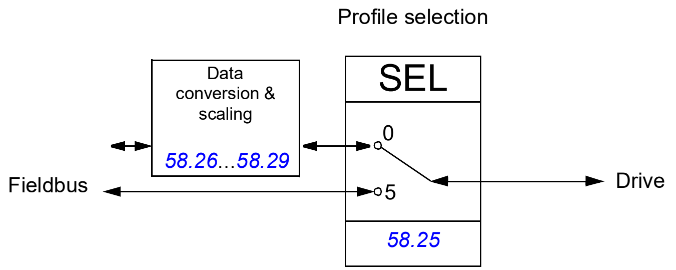
A control profile defines the rules for data transfer between the drive and the fieldbus master, for example:

- if packed boolean words are converted and how
- if signal values are scaled and how
- how drive register addresses are mapped for the fieldbus master.

You can configure the drive to receive and send messages according to one of the two profiles:

- *ABB Drives*
- *DCU Profile*.

For the ABB Drives profile, the embedded fieldbus interface of the drive converts the fieldbus data to and from the native data used in the drive. The DCU Profile involves no data conversion or scaling. The figure below illustrates the effect of the profile selection.



Control profile selection with parameter *58.25 Control profile* is:

- (0) *ABB Drives*
- (5) *DCU Profile*.

Control Word

Control Word for the ABB Drives profile

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 for the ABB Drives profile* on page *537*.

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. See also parameter *06.18 Start inhibit status word* (page *143*).
		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.

Bit	Name	Value	STATE/Description
7	RESET	0=>1	Fault reset if an active fault exists. Proceed to **SWITCH-ON INHIBITED**. **Note:** This bit is effective only if the fieldbus interface is set as the source for this signal by drive parameters.
		0	Continue normal operation.
8	JOGGING_1	1	Request running at Jogging 1 speed. **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.
9	JOGGING_2	1	Request running at Jogging 2 speed. **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.
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	USER_0		Writable control bits that can be combined with drive logic for application-specific functionality.
13	USER_1		
14	USER_2		
15	USER_3		

Control Word for the DCU Profile

The embedded fieldbus interface writes the fieldbus Control Word as is to the drive Control Word bits 0 to 15. Bits 16 to 32 of the drive Control Word are not in use.

Bit	Name	Value	State/Description
0	STOP	1	Stop according to the Stop Mode parameter or the stop mode request bits (bits 7…9).
		0	(no op)
1	START	1	Start the drive.
		0	(no op)
2	REVERSE	1	Reverse direction of motor rotation.
		0	(no op)

Bit	Name	Value	State/Description
3	Reserved		
4	RESET	0=>1	Fault reset if an active fault exists.
		0	(no op)
5	EXT2	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.
6	RUN_DISABLE	1	Run disable. If the drive is set to receive the run enable signal from the fieldbus, this bit deactivates the signal.
		0	Run enable. If the drive is set to receive the run enable signal from the fieldbus, this bit activates the signal.
7	STOPMODE_RAMP	1	Normal ramp stop mode
		0	(no op) Default to parameter stop mode if bits 7…9 are all 0.
8	STOPMODE_EMERGENCY_RAMP	1	Emergency ramp stop mode.
		0	(no op) Default to parameter stop mode if bits 7…9 are all 0.
9	STOPMODE_COAST	1	Coast stop mode.
		0	(no op) Default to parameter stop mode if bits 7…9 are all 0.
10	Reserved for RAMP_PAIR _2		Not yet implemented.
11	RAMP_OUT_ZERO	1	Force Ramp Function Generator output to zero. Drive ramps to stop (current and DC voltage limits in force).
		0	Normal operation.
12	RAMP_HOLD	1	Halt ramping (Ramp Function Generator output held).
		0	Normal operation.
13	RAMP_IN_ZERO	1	Force Ramp Function Generator input to zero.
		0	Normal operation.
14	REQ_LOCAL_LOCK	1	
		0	
15	Reserved for TORQ_LIM_PAIR_2		Not yet implemented.
16	FB_LOCAL_CTL	1	Local mode for control from the fieldbus is requested. Steal control from the active source.
		0	(no op)
17	FB_LOCAL_REF	1	Local mode for reference from the fieldbus is requested. Steal reference from the active source.
		0	(no op)

Bit	Name	Value	State/Description
18	Reserved for RUN_DISABLE_1		Not yet implemented.
19	Reserved		
20	Reserved		
21	Reserved		
22	USER_0		Writable control bits that can be combined with drive logic for application-specific functionality.
23	USER_1		
24	USER_2		
25	USER_3		
26 …31	Reserved		

Status Word

Status Word for the ABB Drives profile

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 for the ABB Drives profile* on page *537*.

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**. See also parameter *06.18 Start inhibit status word* (page *143*).
3	TRIPPED	1	**FAULT**.
		0	No fault.
4	OFF_2_STATUS	1	OFF2 inactive.
		0	**OFF2 ACTIVE**.
5	OFF_3_STATUS	1	OFF3 inactive.
		0	**OFF3 ACTIVE**.
6	SWC_ON_INHIB	1	**SWITCH-ON INHIBITED**.
		0	–
7	ALARM	1	Warning/Alarm.
		0	No warning/alarm.

Bit	Name	Value	STATE/Description
8	AT_ SETPOINT	1	**OPERATING**. Actual value equals Reference (is within tolerance limits, e.g. in speed control, speed error is 10% max. of nominal motor speed).
		0	Actual value differs from Reference (is outside tolerance limits).
9	REMOTE	1	Drive control location: REMOTE (EXT1 or EXT2).
		0	Drive control location: LOCAL.
10	ABOVE_ LIMIT	1	Actual frequency or speed equals or exceeds supervision limit (set by drive parameter). Valid in both directions of rotation.
		0	Actual frequency or speed within supervision limit.
11	USER_0		Status bits that can be combined with drive logic for application-specific functionality.
12	USER_1		
13	USER_2		
14	USER_3		
15	Reserved		

Status Word for the DCU Profile

The embedded fieldbus interface writes the drive Status Word bits 0 to 15 to the fieldbus Status Word as is. Bits 16 to 32 of the drive Status Word are not in use.

Bit	Name	Value	State/Description
0	READY	1	Drive is ready to receive the start command.
		0	Drive is not ready.
1	ENABLED	1	External run enable signal is active.
		0	External run enable signal is not active.
2	Reserved for ENABLED_TO_ROTATE		Not yet implemented.
3	RUNNING	1	Drive is modulating.
		0	Drive is not modulating.
4	ZERO_SPEED	1	Drive is at zero speed.
		0	Drive is not at zero speed.
5	ACCELERATING	1	Not yet implemented.
		0	Not yet implemented.
6	DECELERATING	1	Not yet implemented.
		0	Not yet implemented.
7	AT_SETPOINT	1	Drive is at setpoint.
		0	Drive is not at setpoint.

Bit	Name	Value	State/Description
8	LIMIT	1	Drive operation is limited.
		0	Drive operation is not limited.
9	SUPERVISION	1	Actual value (speed, frequency or torque) is above a limit. Limit is set with parameters 46.31…46.33
		0	Actual value (speed, frequency or torque) is within limits.
10	REVERSE_REF	1	Not yet implemented.
		0	Not yet implemented.
11	REVERSE_ACT	1	Not yet implemented.
		0	Not yet implemented.
12	PANEL_LOCAL	1	Panel/keypad (or PC tool) is in local control mode.
		0	Panel/keypad (or PC tool) is not in local control mode.
13	FIELDBUS_LOCAL	1	Fieldbus is in local control mode.
		0	Fieldbus is not in local control mode.
14	EXT2_ACT	1	External control location EXT2 is active.
		0	External control location EXT1 is active.
15	FAULT	1	Drive is faulted.
		0	Drive is not faulted.
16	ALARM	1	Warning/Alarm is active.
		0	No warning/alarm.
17	Reserved		
18	Reserved for DIRECTION_LOCK		Not yet implemented.
19	Reserved		
20	CTL_MODE	1	Vector motor control mode is active.
		0	Scalar motor control mode is active
21	Reserved		
22	USER_0		Status bits that can be combined with drive logic for application-specific functionality.
23	USER_1		
24	USER_2		
25	USER_3		
26	REQ_CTL	1	Control is requested in this channel.
		0	Control is not requested in this channel.
27 … 31	Reserved		

State transition diagrams

State transition diagram for the ABB Drives profile

The diagram below shows the state transitions in the drive when the drive is using the ABB Drives profile and the drive is 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 for the ABB Drives profile* on page *532* and *Status Word for the ABB Drives profile* on page *535*.

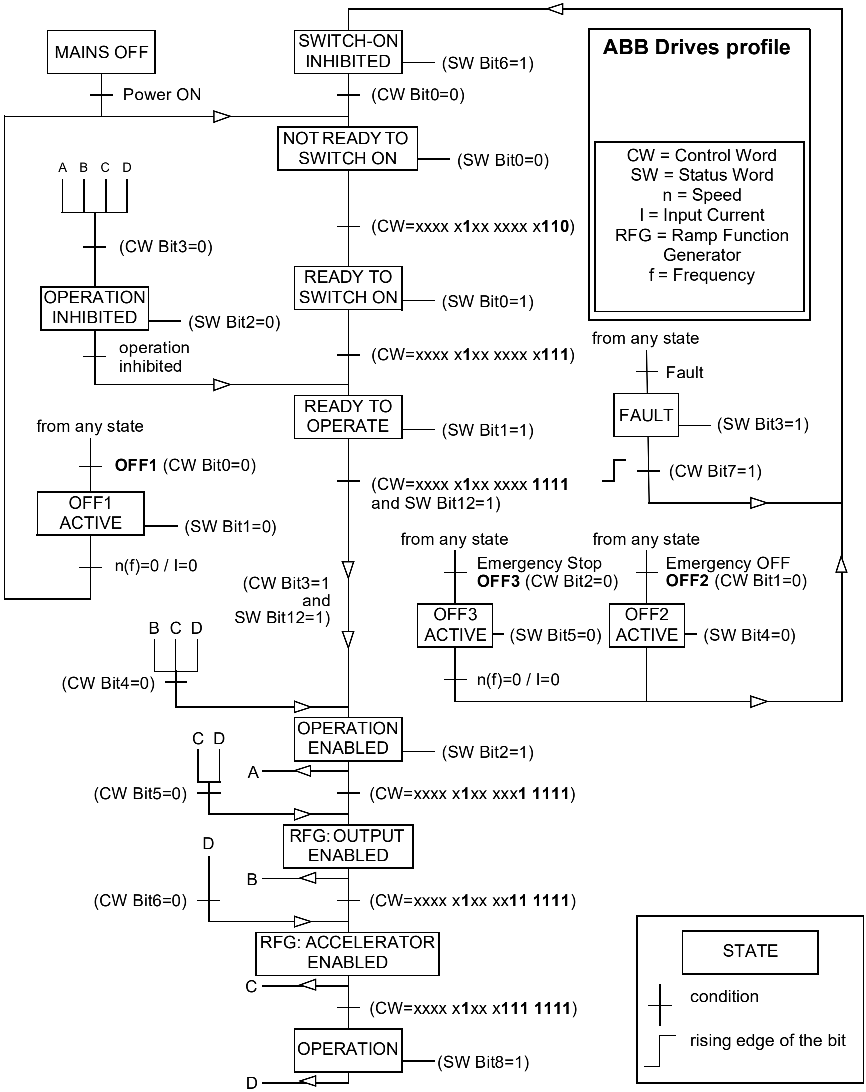


ABB Drives profile
CW = Control Word
SW = Status Word
n = Speed
I = Input Current
RFG = Ramp Function Generator
f = Frequency
MAINS OFF
Power ON
SWITCH-ON INHIBITED
(SW Bit6=1)
(CW Bit0=0)
NOT READY TO SWITCH ON
(SW Bit0=0)
A B C D
(CW Bit3=0)
(CW=xxxx x1xx xxxx x110)
READY TO SWITCH ON
(SW Bit0=1)
OPERATION INHIBITED
(SW Bit2=0)
operation inhibited
(CW=xxxx x1xx xxxx x111)
from any state
Fault
FAULT
(SW Bit3=1)
(CW Bit7=1)
READY TO OPERATE
(SW Bit1=1)
from any state
OFF1 (CW Bit0=0)
OFF1 ACTIVE
(SW Bit1=0)
(CW=xxxx x1xx xxxx 1111 and SW Bit12=1)
n(f)=0 / I=0
from any state
Emergency Stop
OFF3 (CW Bit2=0)
from any state
Emergency OFF
OFF2 (CW Bit1=0)
(CW Bit3=1 and SW Bit12=1)
OFF3 ACTIVE
(SW Bit5=0)
OFF2 ACTIVE
(SW Bit4=0)
B C D
(CW Bit4=0)
n(f)=0 / I=0
OPERATION ENABLED
(SW Bit2=1)
C D
A
(CW Bit5=0)
(CW=xxxx x1xx xxx1 1111)
RFG: OUTPUT ENABLED
D
B
(CW Bit6=0)
(CW=xxxx x1xx xx11 1111)
RFG: ACCELERATOR ENABLED
C
(CW=xxxx x1xx x111 1111)
OPERATION
(SW Bit8=1)
D
STATE
condition
rising edge of the bit

A control word sequence example is given below:

Start:

- 476h --> NOT READY TO SWITCH ON

If MSW bit 0 = 1 then

- 477h --> READY TO SWITCH ON (Stopped)
- 47Fh --> OPERATION (Running)

Stop:

- 477h = Stop according to *21.03 Stop mode*
- 47Eh = OFF1 ramp stop (**Note:** uninterpretable ramp stop)

Fault reset:

- Rising edge of MCW bit 7

Start after STO:

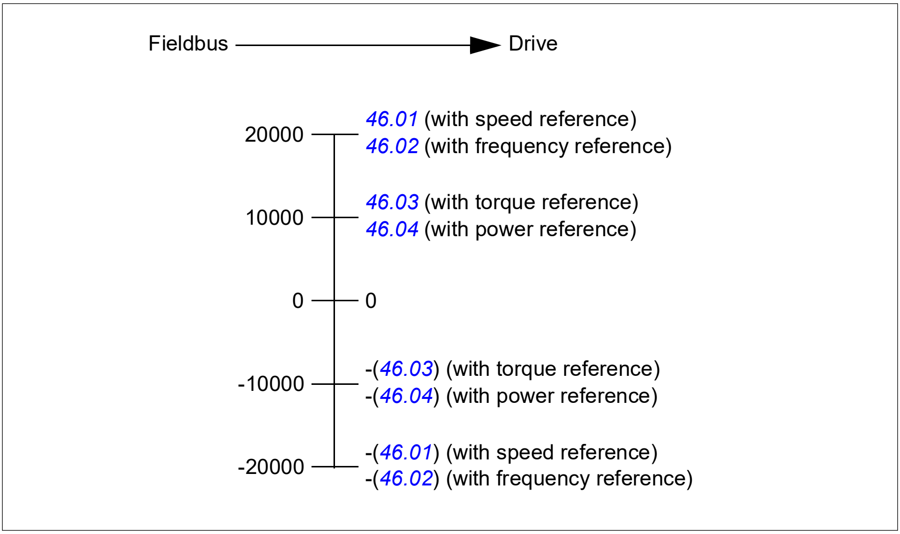
- If *31.22 STO indication run/stop* is not fault/fault make sure that *06.18 Start inhibit status word*, bit 7 STO = 0 before giving a start command.

References

References for the ABB Drives profile and DCU Profile

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…46.04*; which scaling is in use depends on the setting of *58.26 EFB ref1 type* and *58.27 EFB ref2 type* (see page *399*).



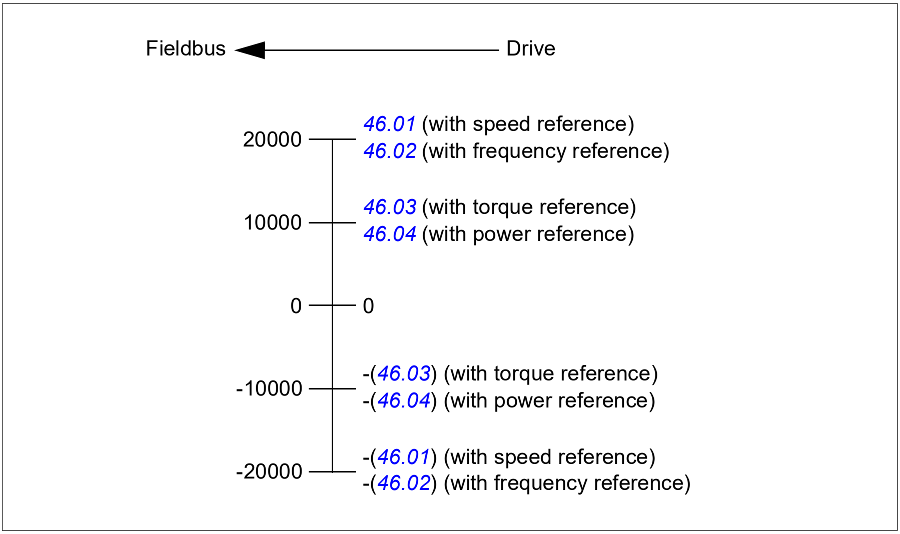
The scaled references are shown by parameters *03.09 EFB reference 1* and *03.10 EFB reference 2*.

Actual values

Actual values for the ABB Drives profile and DCU Profile

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 *399*).



Modbus holding register addresses

Modbus holding register addresses for the ABB Drives profile and DCU Profile

The table below shows the default Modbus holding register addresses for the drive data with the ABB Drives profile. This profile provides a converted 16-bit access to the drive data.

Note: Only the 16 least significant bits of the drive's 32-bit Control and Status Words can be accessed.

Note: Bits 16 through 32 of the DCU Control/Status word are not in use if 16-bit control/status word is used with the DCU Profile.

Register address	Register data (16-bit words)
400001	Default: Control word (*CW 16bit*). See sections *Control Word for the ABB Drives profile* (page *532*) and *Control Word for the DCU Profile* (page *533*). The selection can be changed using parameter *58.101 Data I/O 1*.
400002	Default: Reference 1 (*Ref1 16bit*). The selection can be changed using parameter *58.102 Data I/O 2*.
400003	Default: Reference 2 (*Ref2 16bit*). The selection can be changed using parameter *58.102 Data I/O 2*.
400004	Default: Status Word (*SW 16bit*). See sections *Status Word for the ABB Drives profile* (page *535*) and *Status Word for the DCU Profile* (page *536*). The selection can be changed using parameter *58.102 Data I/O 2*.

400005	Default: Actual value 1 (*Act1 16bit*). The selection can be changed using parameter *58.105 Data I/O 5*.
400006	Actual value 2 (*Act2 16bit*). The selection can be changed using parameter *58.106 Data I/O 6*.
400007…400014	Data in/out 7…14. Selected by parameters *58.107 Data I/O 7* … *58.114 Data I/O 14*.
400015...400089	Unused
400090...400100	Error code access. See section *Error code registers (holding registers 400090…400100)* (page *548*).
400101...465536	Parameter read/write. Parameters are mapped to register addresses according to parameter *58.33 Addressing mode*.

The Transparent profile

The Transparent profile involves no data conversion of the control or status word.

The transparent profile can be set with parameter *58.25 Control profile*, using values *Transparent 16* (for 16-bit control word) and *Transparent 32* (for 32-bit control 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 *562*).

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).

Code	Function name	Description
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, "ASCCL") • 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: ("ACS380").

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 ADDRESS	The data address received in the query is not an allowable address for the server.
03h	ILLEGAL VALUE	The requested quantity of registers is larger than the device can handle. This error does not mean that a value written to the device is outside of the valid range.
04h	DEVICE FAILURE	An unrecoverable error occurred while the server was attempting to perform the requested action. See section *Error code registers (holding registers 400090…400100)* on page *548*.

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). Note that the references are 1-based index which match the address transmitted on the wire.

Reference	ABB Drives profile	DCU Profile
000001	OFF1_CONTROL	STOP
000002	OFF2_CONTROL	START

Reference	ABB Drives profile	DCU Profile
000003	OFF3_CONTROL	Reserved
000004	INHIBIT_OPERATION	Reserved
000005	RAMP_OUT_ZERO	RESET
000006	RAMP_HOLD	EXT2
000007	RAMP_IN_ZERO	RUN_DISABLE
000008	RESET	STOPMODE_RAMP
000009	JOGGING_1	STOPMODE_EMERGENCY_RAMP
000010	JOGGING_2	STOPMODE_COAST
000011	REMOTE_CMD	Reserved
000012	EXT_CTRL_LOC	RAMP_OUT_ZERO
000013	USER_0	RAMP_HOLD
000014	USER_1	RAMP_IN_ZERO
000015	USER_2	Reserved
000016	USER_3	Reserved
000017	Reserved	FB_LOCAL_CTL
000018	Reserved	FB_LOCAL_REF
000019	Reserved	Reserved
000020	Reserved	Reserved
000021	Reserved	CTL_MODE
000022	Reserved	Reserved
000023	Reserved	USER_0
000024	Reserved	USER_1
000025	Reserved	USER_2
000026	Reserved	USER_3
000027	Reserved	Reserved
000028	Reserved	Reserved
000029	Reserved	Reserved
000030	Reserved	Reserved
000031	Reserved	Reserved
000032	Reserved	Reserved
000033	Control for relay output RO1 (parameter *10.99 RO/DIO control word*, bit 0)	Control for relay output RO1 (parameter *10.99 RO/DIO control word*, bit 0)
000034	Control for relay output RO4 (parameter *10.99 RO/DIO control word*, bit 1)	Control for relay output RO4 (parameter *10.99 RO/DIO control word*, bit 1)
000035	Control for relay output RO5 (parameter *10.99 RO/DIO control word*, bit 2)	Control for relay output RO5 (parameter *10.99 RO/DIO control word*, bit 2)

Reference	ABB Drives profile	DCU Profile
000036	Control for relay output RO6 (parameter *10.99 RO/DIO control word*, bit 3)	Control for relay output RO6 (parameter *10.99 RO/DIO control word*, bit 3)
000037	Control for relay output RO7 (parameter *10.99 RO/DIO control word*, bit 4)	Control for relay output RO7 (parameter *10.99 RO/DIO control word*, bit 4)

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). Note that the references are 1-based index which match the address transmitted on the wire.

Reference	ABB Drives profile	DCU Profile
0	RDY_ON	READY
1	RDY_RUN	ENABLED
2	RDY_REF	Reserved
3	TRIPPED	RUNNING
4	OFF_2_STATUS	ZERO_SPEED
5	OFF_3_STATUS	Reserved
6	SWC_ON_INHIB	Reserved
7	ALARM	AT_SETPOINT
8	AT_SETPOINT	LIMIT
9	REMOTE	SUPERVISION
10	ABOVE_LIMIT	Reserved
11	USER_0	Reserved
12	USER_1	PANEL_LOCAL
13	USER_2	FIELDBUS_LOCAL
14	USER_3	EXT2_ACT
15	Reserved	FAULT
16	Reserved	ALARM
17	Reserved	Reserved
18	Reserved	Reserved
19	Reserved	Reserved
20	Reserved	Reserved
21	Reserved	Reserved
22	Reserved	USER_0
23	Reserved	USER_1
24	Reserved	USER_2
25	Reserved	USER_3

Reference	ABB Drives profile	DCU Profile
26	Reserved	REQ_CTL
27	Reserved	Reserved
28	Reserved	Reserved
29	Reserved	Reserved
30	Reserved	Reserved
31	Reserved	Reserved
32	Delayed status of digital input DI1 (parameter *10.02 DI delayed status*, bit 0)	Delayed status of digital input DI1 (parameter *10.02 DI delayed status*, bit 0)
33	Delayed status of digital input DI2 (parameter *10.02 DI delayed status*, bit 1)	Delayed status of digital input DI2 (parameter *10.02 DI delayed status*, bit 1)
34	Delayed status of digital input DI3 (parameter *10.02 DI delayed status*, bit 2)	Delayed status of digital input DI3 (parameter *10.02 DI delayed status*, bit 2)
35	Delayed status of digital input DI4 (parameter *10.02 DI delayed status*, bit 3)	Delayed status of digital input DI4 (parameter *10.02 DI delayed status*, bit 3)
36	Delayed status of digital input DIO1 (parameter *11.02 DIO delayed status*, bit 4)	Delayed status of digital input DI01 (parameter *11.02 DIO delayed status*, bit 4)
37	Delayed status of digital input DI02 (parameter *11.02 DIO delayed status*, bit 5)	Delayed status of digital input DI02 (parameter *11.02 DIO delayed status*, bit 5)

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). 0 = Do nothing.
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

Reference	Name	Description
92	Failed Register	The last register (discrete input, coil, input register or holding register) that failed to be read or written.
93	Last Register Written Successfully	The last register (discrete input, coil, input register or holding register) that was written successfully.
94	Last Register Read Successfully	The last register (discrete input, coil, input register or holding register) that was read successfully.

CANopen

Embedded fieldbus with CANopen protocol is for the following instrument:

- Configured variant (ACS380-04xC) with the BCAN-11 CANopen extension module (option+K495).

The embedded CANopen operates on multiple time levels. High priority cyclical data (control word, references, status word and actual values), and most of CANopen message handling are processed at 2ms time level. SDO messages and drive parameter access are processed at 10ms time level. Saving objects into non-volatile memory and restoring objects from non-volatile memory are processed in the background task.

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.

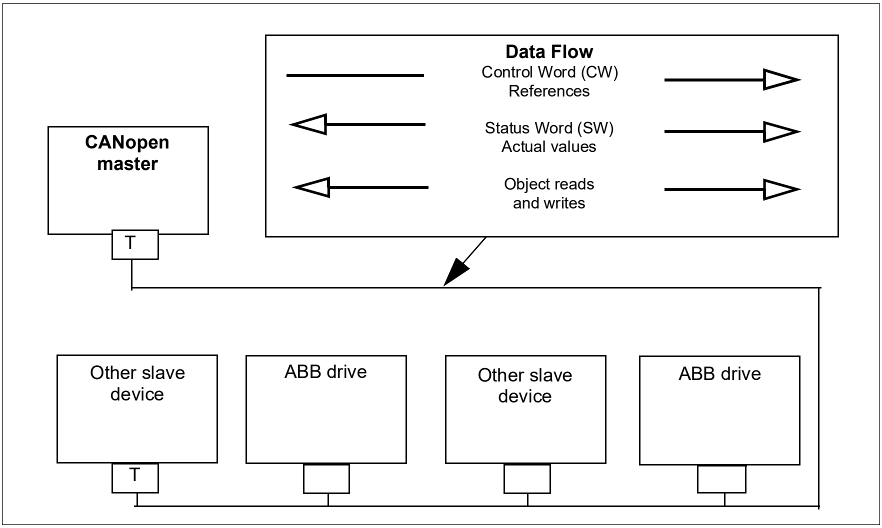
Connecting the fieldbus to the drive

Connect the fieldbus to terminal X1on the BCAN-11, which is attached to the control unit of the drive.

The pins in the connector are identified on the BCAN-11 sticker.

Note: When taking the CANopen module into use, it is recommended that the cord is not connected during the first start. This is to avoid disturbing the CAN bus when the drive attempts to recognize the attached module.

CANopen network example



Setting up the embedded fieldbus interface (CANopen)

Set up the drive automatically

1. Power up the drive.

   The software recognizes the CANopen interface module that is connected to the drive. The software checks that the CANopen adapter is attached.

2. Press OK. The parameters listed in the table *CANopen parameters* are automatically set.

CANopen parameters

Parameter	Setting
20.01 Ext1 commands	Embedded fieldbus
20.03 Ext1 in1	Not selected
20.04 Ext1 in2	Not selected
22.11 Ext1 speed ref1	EFB ref1
22.22 Constant speed sel1	Not selected
22.23 Constant speed sel2	Not selected
23.11 Ramp set selection	Acc/Dec time 1
28.11 Ext1 frequency ref1	EFB ref1
28.22 Constant frequency sel1	Not selected
28.23 Constant frequency sel2	Not selected
28.71 Freq ramp set sel	Acc/Dec time 1
31.11 Fault reset selection	DI1

Parameter	**Setting**
58.01 Protocol enable	CANopen

Set up the drive manually.

1. Power up the drive.

   The software recognizes the CANopen interface module that is connected to the drive. The software checks that the CANopen adapter is attached.

2. Do not press OK. Set up the parameters listed in the table *CANopen parameters*.

3. Set up the drive for the embedded fieldbus communication with the parameters shown in the table below (*CANopen parameter settings for embedded fieldbus interface*).

   The *Setting for fieldbus control* column shows either the value to use, or the default value. The *Function/Information* column describes the parameter.

Note: The CANopen module must be connected to the drive for the CANopen parameters to be visible (*58.01* = [3] CANopen).

CANopen parameter settings for embedded fieldbus interface

Parameter	**Setting for fieldbus control**	**Function/Information**
COMMUNICATION INITIALIZATION		
58.01 Protocol enable	*CANopen*	Initializes embedded fieldbus communication.
EMBEDDED MODBUS CONFIGURATION		
58.03 Node ID	3 (default)	Node address. There must be no two nodes with the same node address online.
58.04 Baud rate	125 kbps (default)	Defines the communication speed of the link. 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.
58.23 Configuration location	CAN objects	Bus: PDOs are configured by the fieldbus master with SDO. Drive parameters: PDO configuration is determined by drive parameters *58.76*, *58.93*, and *58.101*...*58.124*.
58.25 Control profile	CiA 402 (default)	Selects the control profile used by the drive. See section Basics of the user interface.

Parameter	Setting for fieldbus control	Function/Information
58.26 *EFB ref1 type* *58.27* *EFB ref2 type*	*Speed or frequency* (default for *58.26*), *Transparent*, *General*, *Torque* (default for *58.27*), *Speed*, *Frequency*	Defines the types of fieldbus references 1 and 2. The scaling for each reference type is defined by parameters *46.01*…*46.03*. With the *Speed or frequency* setting, the type is selected automatically according to the currently active drive control mode.
58.28 *EFB act1 type* *58.29* *EFB act2 type*	*Speed or frequency* (default for *58.28*), *Transparent* (default for *58.29*), *General*, *Torque*, *Speed*, *Frequency*	Defines the types of actual values 1 and 2. The scaling for each actual value type is defined by parameters *46.01*…*46.03*. With the *Speed or frequency* setting, the type is selected automatically according to the currently active drive control mode.
58.76 *RPDO1 COB-ID* *58.82* *RPDO6 COB-ID* *58.88* *RPDO21 COB-ID*	1 (default) for *58.76*), 0 (default for *58.82* and *58.88*)	Defines the COB-ID for the PDO and also enables or disables it. 0= Disable this PDO 1= Enable this PDO with default COB-ID other= Enable this PDO with given (COB-ID)
58.77 *RPDO1 transmission type* *58.83* *RPDO6 transmission type* *58.89* *RPDO21 transmission type*	255 (default)	Defines the transmission type of the PDO. 0 = acyclic synchronous 1...240 = cyclic synchronous 254…255 = asynchronous
58.78 *RPDO1 event timer* *58.84* *RPDO6 event timer* *58.90* *RPDO21 event timer*	0 (default)	Defines the time-out time for the PDO. 0 = no timeout other = if this PDO is enabled and not received for event timer milliseconds, 58.14 Communication loss action is performed **Note:** The timeout supervision is activated upon a successful reception of the RPDO.

Parameter	**Setting for fieldbus control**	**Function/Information**
58.79 TPDO1 COB-ID *58.85 TPDO6 COB-ID* *58.91 RPDO21 COB-ID*	1 (default for *58.79*), 0 (default for *58.85* and *58.91*)	Defines the COB-ID for the PDO and also enables or disables it. 0 = Disable this PDO 1 = Enable this PDO with default COB-ID other = Enable this PDO with given COB-ID
58.80 TPDO1 transmission type *58.86 TPDO6 transmission type* *58.92 TPDO21 transmission type*	255 (default)	Defines the transmission type of the PDO. 0 = acyclic synchronous 1...240 = cyclic synchronous 252 = synchronous RTR only 253 = asynchronous RTR only 254…255 = asynchronous
58.81 TPDO1 event timer *58.87 TPDO6 event timer* *58.93 TPDO21 event timer*	100 (default for *58.81*) 0 (default for *58.87*, *58.93*)	Defines the time-out time for the PDO. 0 = no timeout other = if this PDO is enabled and has not been transmitted for event timer milliseconds, a transmission is forced
58.101 TPDO1 word 1 … … *58.114 RPDO21 word 4*	With the default settings, TPDO1 contains 16-bit status word and two 16-bit actual values and RPDO1 contains 16-bit control word and two 16-bit reference values.	Defines the objects mapped to PDOs to and from the drive.
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* (*Refresh settings*).

Setting the drive control parameters

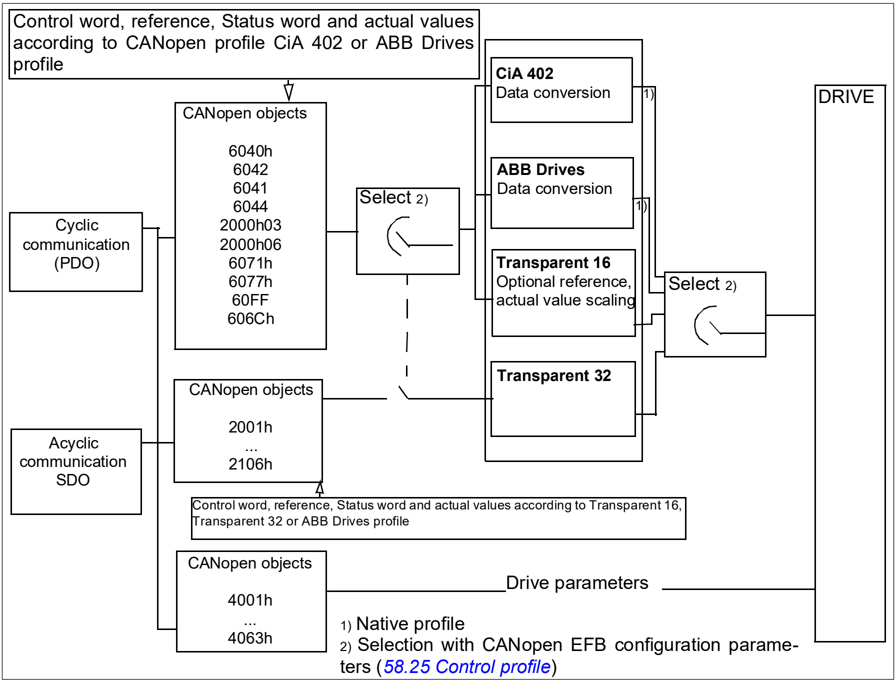
After the embedded fieldbus interface has been set up, check and adjust the drive control parameters listed in the table below. The **Setting for fieldbus control** column gives the value or values to use when the embedded fieldbus signal is the desired source or destination for that particular drive control signal. The **Function/Information** column gives a description of the parameter.

Parameter	Setting for fieldbus control	Function/Information
CONTROL COMMAND SOURCE SELECTION		
20.01 Ext1 commands	*Embedded fieldbus*	Selects fieldbus as the source for the start and stop commands when EXT1 is selected as the active control location.
20.02 Ext2 commands	*Embedded fieldbus*	Selects fieldbus as the source for the start and stop commands when EXT2 is selected as the active control location.
SPEED REFERENCE SELECTION		
22.11 Ext1 speed ref1	*EFB ref1*	Selects a reference received through the embedded fieldbus interface as speed reference 1.
22.18 Ext2 speed ref1	*EFB ref1*	Selects a reference received through the embedded fieldbus interface as speed reference 2.
TORQUE REFERENCE SELECTION		
26.11 Torque ref1 source	*EFB ref1*	Selects a reference received through the embedded fieldbus interface as torque reference 1.
26.12 Torque ref2 source	*EFB ref1*	Selects a reference received through the embedded fieldbus interface as torque reference 2.
FREQUENCY REFERENCE SELECTION		
28.11 Ext1 frequency ref1	*EFB ref1*	Selects a reference received through the embedded fieldbus interface as frequency reference 1.
28.15 Ext2 frequency ref1	*EFB ref1*	Selects a reference received through the embedded fieldbus interface as frequency 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*.		
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. The diagram below illustrates the operation of the CANopen embedded fieldbus interface. The signals transferred in the cyclic communication are explained further below the diagram.

CANopen embedded fieldbus interface operation



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. With 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 or the data is converted. See section *About the control profiles* on page *531*.

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* on page *531*.

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* on page *531*.

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* on page *531*.

About the control profiles

A control profile defines the rules for data transfer between the drive and the fieldbus master, for example:

- if control word and status word are converted and how
- if signal values are scaled and how
- functionality and content of certain objects in section *Object dictionary* on page *573*).

You can configure the drive to receive and send messages according to one of the four profiles:

- CiA 402
- ABB Drives
- Transparent 16
- Transparent 32

For the ABB Drives and CiA 402 profiles, the embedded fieldbus interface of the drive converts the fieldbus data to and from the native data used in the drive. The Transparent profiles perform no data conversion, but the Transparent 16 profile may optionally scale the reference and actual values with a configured scaling value (*58.24 Transparent 16 scale*).

CiA 402 profile

Control Word for the CiA 402 profile

Control word of the CiA 402 profile can be written to the object 6040h.

The table below shows the contents of the fieldbus Control Word for the CiA 402 control profile. The embedded fieldbus interface converts this word to the form in which it is used in the drive.

Bit	**Name**
0	Switch on
1	Enable voltage
2	Quick stop
3	Enable operation
4...6	Operation -mode specific
7	Fault reset
8	Halt
9...10	Reserved
11...15	Drive specific

Operation mode specific bits:

Bit	**Velocity mode**	**Profile velocity mode**	**Profile torque**
4	Ramp function generator enable	Reserved	Reserved
5	Ramp function generator unlock	Reserved	Reserved
6	Ramp function generator use ref	Reserved	Reserved

Device commands are triggered by the Control word bits as follows:

Command	**Control word bit *1)***					
	Fault reset, bit 7	Enable operation, bit 3	Quick stop, bit 2	Enable voltage, bit 1	Switch on, bit 0	State transitions
Shut down	0	x	1	1	0	2,6,8
Switch on	0	0	1	1	1	3 *2)*
Switch on	0	1	1	1	1	3 *2)*
Disable voltage	0	x	x	0	x	7,9,10,12
Quick stop	0	x	0	1	x	7,10,11
Disable operation	0	0	1	1	1	5
Enable operation	0	1	1	1	1	4
Fault reset	0=>1	x	x	x	x	15

1) Bits marked as x are irrelevant

2) When Control word bit 3 (Enable operation) is 1, the drive does not perform any tasks in the *Switched on* state.When bit 3 is 0, the state *Switched on* tasks are performed.

The states and state transitions refer to those shown in the *State transition diagram for the CiA 402 profile* on page *560*.

The following stop modes are associated with the control commands and other events:

Command/Event	Drive stop mode
Quick stop	Emergency stop
Shut down	Coast stop
Disable voltage	Ramp stop
Halt	Ramp stop (configurable with CANopen object 605Dh
Fault	Fault reaction specified by the drive. Typically a Coast stop.

The halt mode is controlled with bit 8 of the CiA 402 control word. When the halt bit is set during the OPERATION ENABLED state, the drive stops and the state machine remains in the OPERATION ENABLED state. When the bit is reset, the drive starts running again. In all modes supporting the halt function, CiA 402 Status Word bit 10 (target reached) is set when the drive is stopped.

Note: The drive may not necessarily stop completely as it is still the in running (OPERATION ENABLED) state.

The following table summarizes the drive features used to perform the ramp stop during the halt function, as well as the different halt option codes supported by each CiA 402 operating mode. The halt option code is selected by CANopen object 605Dh.

Mode	Description	Halt option codes
Profile velocity	Dynamic limiter ramp	1
Profile torque	Sets the torque reference to 0. Ramp depends on the drive parameters	1
Velocity	Halt mode1: Ramp input is set to 0. Halt mode 2,3,4: Ramp output is set to 0.	1, 2, 3, 4
Other modes	Halt bit has no effect.	N/A

Status Word for the CiA 402 profile

Status word of the CiA 402 profile can be read from the object 6041h.The table below shows the fieldbus Status Word for the CiA 402 control profile. The embedded fieldbus interface converts the drive Status Word into this form for the fieldbus.

Bit	Name
0	Ready to switch on
1	Switched on
2	Operation enabled
3	Fault
4	Voltage enabled
5	Quick stop
6	Switch on disabled
7	Warning
8	Drive-specific bit
9	Remote

Bit	Name
10	Target reached
11	Internal limit active
12...13	Operation mode specific
14...15	Drive specific

Operation mode specific bits:

Bit	Velocity mode	Profile velocity mode	Profile torque mode
12	Reserved	Speed is zero	Reserved
13	Reserved	Max slippage reached	Reserved

Modes of operation

The operation mode defines the behavior of the drive. The following CiA 402 operation modes are supported:

- Profile velocity mode
- Profile torque mode
- Velocity mode
- Cyclic synchronous velocity mode
- Cyclic synchronous torque mode

The ACS380 CANopen implementation supports minimal implementation of the operation modes. In this chapter scalings of the reference and actual values are described for each operation mode. Operation-mode-specific objects are defined in section *Object dictionary* on page *573*.

The mode of operation is automatically selected to be either velocity mode or profile torque mode according to the control mode configured with parameter *19.12 Ext1 control mode* or *19.14 Ext2 control mode* (depending on the current control location). The correct reference scaling must be selected with parameters *58.26 EFB ref1 type* and *58.27 EFB ref2 type*. When in Velocity mode, the drive can be switched to Profile velocity mode or Cyclic synchronous velocity mode with the object 6060h. When in Profile torque mode, the drive can be switched to Cyclic synchronous torque mode with the object 6060h.

Velocity mode

Velocity mode is a basic mode to control the velocity of the drive with limits and ramp functions. Target velocity is set with the object 6042h and velocity actual value can be read from the object 6044h. Velocity values are scaled with the dimension factor given in object 604Ch. By default the dimension factor is 1, and the velocity values are given in rpm, e.g. 1 = 1 rpm.

Profile velocity mode

The profile velocity mode is used to control the velocity of the drive with no special regard of the position. Target velocity is set with the object 60FFh and the velocity actual value can be read from the object 606Ch. Velocity values are given in increments per second. Increment resolution is defined by the object 608Fh. The default values in object 608Fh are 65536 increments per 1 revolution. This means that 1 rpm equals 1 [rpm] * 65536 [inc/s] / 60 [s/min] = 1092 inc/s.

Cyclic synchronous velocity mode

In cyclic synchronous velocity mode, the trajectory generator is in the control device and not in the drive. The control device delivers a new target velocity value to the drive periodically at a fixed interval. Target velocity is set with the object 60FFh and the velocity actual value can be read from the object 606Ch. Velocity values are given in increments per second. Increment resolution is defined by the object 608Fh. The default values in object 608Fh are 65536 increments per 1 revolution. This means that 1 rpm equals 1 [rpm] * 65536 [inc/s] / 60 [s/min] = 1092 inc/s.

Profile torque mode

The profile torque mode enables the drive torque to be controlled directly. Target torque is set with the object 6071h and the torque actual value can be read from the object 6077h. Torque values are given in per thousand of the rated torque, e.g. 10 = 1%.

Cyclic synchronous torque mode

In cyclic synchronous torque mode, the trajectory generator is in the control device and not in the drive. The control device delivers a new target torque value to the drive periodically at a fixed interval. Target torque is set with the object 6071h and the torque actual value can be read from the object 6077h. Torque values are given in per thousand of the rated torque, e.g. 10 = 1%.

State transition diagram for the CiA 402 profile

The diagram below shows the state transitions in the drive when the drive is using the CiA 402 profile and the drive is configured to follow the commands of the control word from the embedded fieldbus interface.

CiA 402 profile state machine

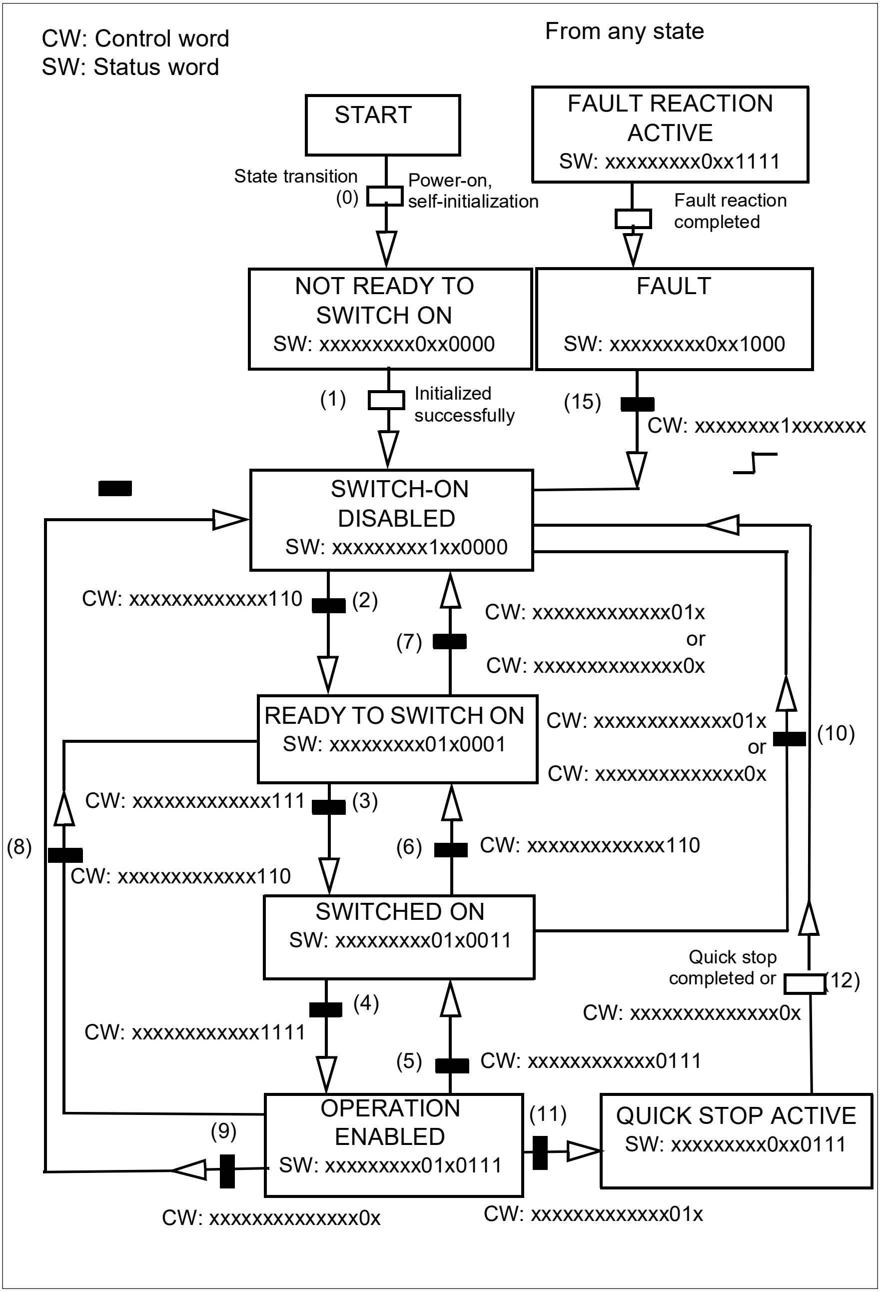


ABB drives profile

Control Word for the ABB Drives profile

Control word of the ABB Drives profile can be written to the object 2101h, or alternatively to the object 6040h.

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 for the ABB Drives profile* on page *566*.

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. 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	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.

Bit	Name	Value	State/Description
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	No warning/alarm.
8	JOGGING 1	1	Request running at Jogging 1 speed. **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.
9	JOGGING 2	1	Request running at Jogging 2 speed. **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.
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	USER_0		Writable control bits that can be combined with drive logic for application-specific functionality.
13	USER_1		
14	USER_2		
15	USER_3		

Status Word for the ABB Drives profile

Status word of the ABB Drives profile can be read from the object 2104h, or alternatively from the object 6041h.

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 for the ABB Drives profile* on page *537*.

Bit	Name	Value	State/Description
0	RDY_ON	1	**READY TO SWITCH ON**.
		0	**NOT READY TO SWITCH ON**.

Bit	Name	Value	State/Description
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_STATUS	1	OFF2 inactive.
		0	**OFF2 ACTIVE**.
5	OFF_3_STATUS	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, e.g. 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. Set by drive parameters: *46.31*, *46.32*, *46.33*. These parameters are indicated by bit 10 of *06.11 Main status word*.
		0	Actual frequency or speed within supervision limit.
11	USER_0		Status bits that can be combined with drive logic for application-specific functionality.
12	USER_1		
13	USER_2		
14	USER_3		
15	Reserved		

References for the ABB Drives profile

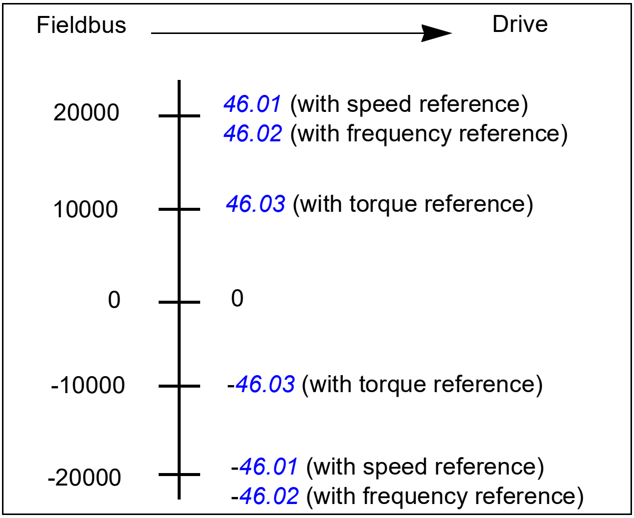
The ABB Drives profile supports the use of two references, EFB reference 1 and EFB reference 2. The references are 16-bit signed integers.

The reference values can be written to the objects 2102h and 2103h, or alternatively to corresponding objects in the CiA 402 profile object area, see *Object dictionary* (p.*573*).

The references are scaled as defined by parameters *46.01*…*46.04*; which scaling is in use depends on the setting of *58.26 EFB ref1 type* and *58.27 EFB ref2 type* (see the table *CANopen parameter settings for embedded fieldbus interface*).

ABB Drives profile scaling from fieldbus to drive

The scaled references are shown by parameters *03.09 EFB reference 2* and *03.10 EFB reference 2*.



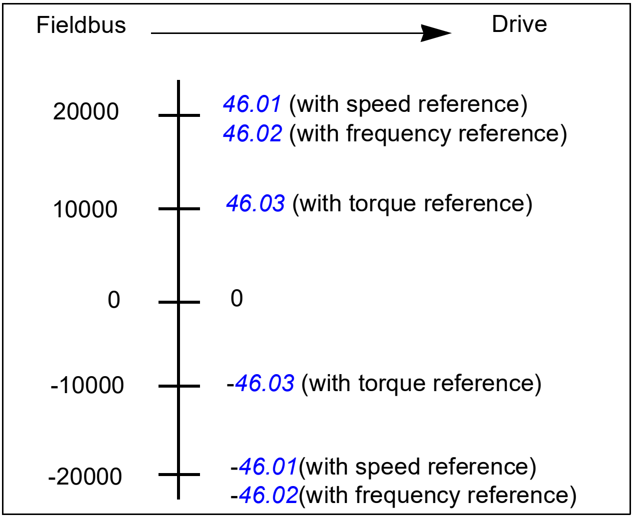
Actual values for the ABB Drives profile

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 can be read from the objects 2105h and 2106h, or alternatively from corresponding objects in the CiA 402 profile object area, see section *Object dictionary* on page *573*.

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*.

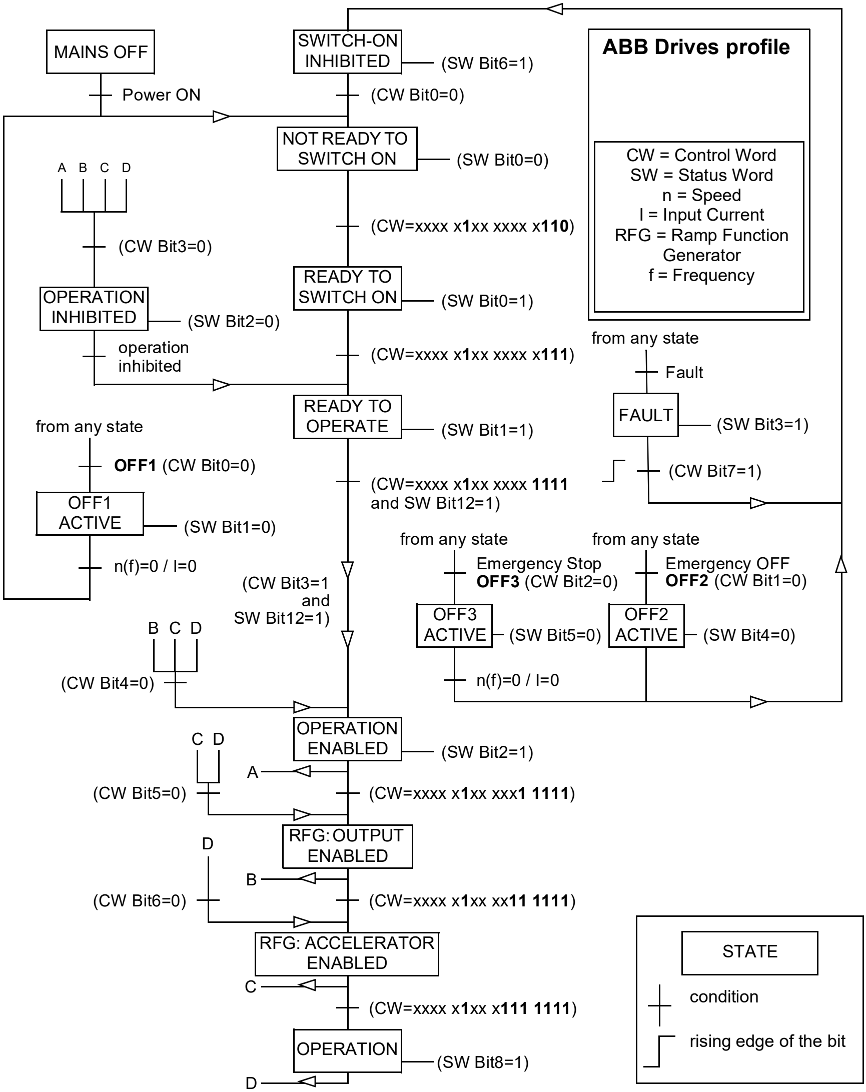
ABB Drives profile scaling from drive to fieldbus



State transition diagram for the ABB Drives profile

The diagram below shows the state transitions in the drive when the drive is using the ABB Drives profile and the drive is 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 for the ABB Drives profile* on page 532 and *Status Word for the ABB Drives profile* on page 535.

ABB Drives profile state machine



Transparent 16 profile

Control Word for the Transparent 16 Profile

Control word of the Transparent 16 profile can be written to the object 2051h. The embedded fieldbus interface writes the fieldbus Control Word as is to the drive.

Bit	Name	Value	State/Description
0	STOP	1	Stop according to the Stop Mode parameter or the stop mode request bits (bits 7…9).
		0	(no op)
1	START	1	Start the drive.
		0	(no op)
2	REVERSE	1	Reverse direction of motor rotation.
		0	(no op)
3	Reserved		
4	RESET	0=>1	Fault reset if an active fault exists.
		0	(no op)
5	EXT2	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.
6	RUN_DISABLE	1	Run disable. If the drive is set to receive the run enable signal from the fieldbus, this bit deactivates the signal.
		0	Run enable. If the drive is set to receive the run enable signal from the fieldbus, this bit activates the signal.
7	STOPMODE_RAMP	1	Normal ramp stop mode
		0	(no op) Default to parameter stop mode if bits 7…9 are all 0.
8	STOPMODE_EMERGENCY_RAMP	1	Emergency ramp stop mode.
		0	(no op) Default to parameter stop mode if bits 7…9 are all 0.
9	STOPMODE_COAST	1	Coast stop mode.
		0	(no op) Default to parameter stop mode if bits 7…9 are all 0.
10	Reserved for RAMP_PAIR _2		Not yet implemented.
11	RAMP_OUT_ZERO	1	Force Ramp Function Generator output to zero. Drive ramps to stop (current and DC voltage limits in force).
		0	Normal operation.
12	RAMP_HOLD	1	Halt ramping (Ramp Function Generator output held).
		0	Normal operation.

Bit	Name	Value	State/Description
13	RAMP_IN_ZERO	1	Force Ramp Function Generator input to zero.
		0	Normal operation.
14	REQ_LOCAL_LOCK	1	Not yet implemented.
		0	Not yet implemented.
15	Reserved for TORQ_LIM_PAIR_2		Not yet implemented.

Status Word for the Transparent 16 Profile

Status word of the Transparent 16 profile can be read from the object 2054h.

Bit	Name	Value	State/Description
0	READY	1	Drive is ready to receive the start command.
		0	Drive is not ready.
1	ENABLED	1	External run enable signal is active.
		0	External run enable signal is not active.
2	Reserved for ENABLED_TO_ROTATE		Not yet implemented.
3	RUNNING	1	Drive is modulating.
		0	Drive is not modulating.
4	ZERO_SPEED	1	Drive is at zero speed.
		0	Drive is not at zero speed.
5	ACCELERATING	1	Not yet implemented.
		0	Not yet implemented.
6	DECELERATING	1	Not yet implemented.
		0	Not yet implemented.
7	AT_SETPOINT	1	Drive is at setpoint.
		0	Drive is not at setpoint.
8	LIMIT	1	Drive operation is limited.
		0	Drive operation is not limited.
9	SUPERVISION	1	Actual value (speed, frequency or torque) is above a limit. Limit is set with parameters 46.31…46.33
		0	Actual value (speed, frequency or torque) is within limits.
10	REVERSE_REF	1	Not yet implemented.
		0	Not yet implemented.
11	REVERSE_ACT	1	Not yet implemented.
		0	Not yet implemented.

Bit	Name	Value	State/Description
12	PANEL_LOCAL	1	Panel/keypad (or PC tool) is in local control mode.
		0	Panel/keypad (or PC tool) is not in local control mode.
13	FIELDBUS_LOCAL	1	Fieldbus is in local control mode.
		0	Fieldbus is not in local control mode.
14	EXT2_ACT	1	External control location EXT2 is active.
		0	External control location EXT1 is active.
15	FAULT	1	Drive is faulted.
		0	Drive is not faulted.
		0	No warning/alarm

References for the Transparent 16 profile

The reference values can be written to the objects 2052h and 2053h. The references are scaled with the scaling value defined in *58.24 Transparent 16 scale*.

Actual values for the Transparent 16 profile

The actual values can be read from the objects 2055h and 2056h. The actual values are scaled with the scaling value defined in *58.24 Transparent 16 scale*.

Transparent 32 profile

Control Word for the Transparent 32 Profile

Control word of the Transparent 32 profile can be written to the object 2001h. The embedded fieldbus interface writes the fieldbus Control Word as is to the drive.

Bit	Name	Value	State/Description
0	STOP	1	Stop according to the Stop Mode parameter or the stop mode request bits (bits 7…9).
		0	(no op)
1	START	1	Start the drive.
		0	(no op)
2	REVERSE	1	Reverse direction of motor rotation.
		0	(no op)
3	Reserved		
4	RESET	0=>1	Fault reset if an active fault exists.
		0	(no op)
5	EXT2	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.

Bit	Name	Value	State/Description
6	RUN_DISABLE	1	Run disable. If the drive is set to receive the run enable signal from the fieldbus, this bit deactivates the signal.
		0	Run enable. If the drive is set to receive the run enable signal from the fieldbus, this bit activates the signal.
7	STOPMODE_RAMP	1	Normal ramp stop mode
		0	(no op) Default to parameter stop mode if bits 7…9 are all 0.
8	STOPMODE_EMERGENCY_RAMP	1	Emergency ramp stop mode.
		0	(no op) Default to parameter stop mode if bits 7…9 are all 0.
9	STOPMODE_COAST	1	Coast stop mode.
		0	(no op) Default to parameter stop mode if bits 7…9 are all 0.
10	Reserved for RAMP_PAIR _2		Not yet implemented.
11	RAMP_OUT_ZERO	1	Force Ramp Function Generator output to zero. Drive ramps to stop (current and DC voltage limits in force).
		0	Normal operation.
12	RAMP_HOLD	1	Halt ramping (Ramp Function Generator output held).
		0	Normal operation.
13	RAMP_IN_ZERO	1	Force Ramp Function Generator input to zero.
		0	Normal operation.
14	REQ_LOCAL_LOCK	1	Not yet implemented.
		0	Not yet implemented.
15	Reserved for TORQ_LIM_PAIR_2		Not yet implemented.
16	FB_LOCAL_CTL	1	Local mode for reference from the fieldbus is requested. Steal control from the active source.
		0	(no op)
17	FB_LOCAL_REF	1	Local mode for reference from the fieldbus is requested. Steal reference from the active source.
		0	(no op)
18	Reserved for RUN_DISABLE_1		Not yet implemented.
19	Reserved		
20	Reserved		
21	Reserved		

Bit	Name	Value	State/Description
22	USER_0		Writable control bits that can be combined with drive logic for application-specific functionality.
23	USER_1		
24	USER_2		
25	USER_3		
26... 31	Reserved		

Status Word for the Transparent 32 Profile

Status word of the Transparent 32 profile can be read from the object 2004h.

Bit	Name	Value	State/Description
0	READY	1	Drive is ready to receive the start command.
		0	Drive is not ready.
1	ENABLED	1	External run enable signal is active.
		0	External run enable signal is not active.
2	Reserved for ENABLED_TO_ROTATE		Not yet implemented.
3	RUNNING	1	Drive is modulating.
		0	Drive is not modulating.
4	ZERO_SPEED	1	Drive is at zero speed.
		0	Drive is not at zero speed.
5	ACCELERATING	1	Not yet implemented.
		0	Not yet implemented.
6	DECELERATING	1	Not yet implemented.
		0	Not yet implemented.
7	AT_SETPOINT	1	Drive is at setpoint.
		0	Drive is not at setpoint.
8	LIMIT	1	Drive operation is limited.
		0	Drive operation is not limited.
9	SUPERVISION	1	Actual value (speed, frequency or torque) is above a limit. Limit is set with parameters 46.31…46.33
		0	Actual value (speed, frequency or torque) is within limits.
10	REVERSE_REF	1	Not yet implemented.
		0	Not yet implemented.
11	REVERSE_ACT	1	Not yet implemented.
		0	Not yet implemented.
12	PANEL_LOCAL	1	Panel/keypad (or PC tool) is in local control mode.
		0	Panel/keypad (or PC tool) is not in local control mode.

Bit	Name	Value	State/Description
13	FIELDBUS_LOCAL	1	Fieldbus is in local control mode.
		0	Fieldbus is not in local control mode.
14	EXT2_ACT	1	External control location EXT2 is active.
		0	External control location EXT1 is active.
15	FAULT	1	Drive is faulted.
		0	Drive is not faulted.
16	ALARM	1	Warning/Alarm is active.
		0	No warning/alarm.
17	Reserved		
18	Reserved for DIRECTION_LOCK		Not yet implemented.
19...21	Reserved		
22	USER_0		Status bits that can be combined with drive logic for application-specific functionality.
23	USER_1		
24	USER_2		
25	USER_3		
26	REQ_CTL	1	Control is requested in this channel.
		0	Control is not requested in this channel.
27...31	Reserved		

References for the Transparent 32 profile

The reference values can be written to the objects 2002h and 2003h.

Actual values for the Transparent 32 profile

The actual values can be read from the objects 2005h and 2006h.

Object dictionary

The Object dictionary consists of objects. Each object within the dictionary is addressed using a 16-bit index (hexadecimal values 0000h-FFFFh). The object addresses are divided in this manual into three categories:

1. *Communication profile area (1000...1FFF)*

   Lists the communication related objects.

2. *Manufacturer specific profile area (2000...5FFF)*

   Lists the manufacturer specific objects.

3. *Standardized profile area (6000...9FFF)*

   Lists the CiA standard profile objects.

Communication profile area (1000...1FFF)

Index	Sub-index	Name	Type	Access	Description
1000h	0	Device Type	U32	RO	The device type specifies the kind of device. The lower 16 bits contain the device profile number and the upper 16 bits additional information depending on the profile.
1001h	0	Error Register	U8	RO	The error register is a field of 8 bits, each for a certain error type. If an error occurs the bit is set. Bit meaning 0 = generic error, always set on error 1 = current 2 = voltage 3 = temperature 4 = communication error (overrun, error state) 5 = device profile specific 6 = reserved 7 = manufacturer specific
1003h	0	Number of Errors	U8	RW	This object holds errors that have occurred on the device and have been signaled via Emergency Object. The most recent error is at sub-index 1. When a new error occurs, the previous errors move down the list. See *Fault tracing* on page *487* for details on the meaning of error codes. Writing 0 to sub index 0 deletes the entire error history. **Note:** Only sub-indices up to 1001h:0h (Number of Errors) can be read. E.g. if Number of Errors is 2, reading 1001h:2h is possible, but attempting to read 1001h:3h causes an SDO abort.
	1	Standard Error Field	U32	RO	
	2	Standard Error Field	U32	RO	
	3	Standard Error Field	U32	RO	
	4	Standard Error Field	U32	RO	
	5	Standard Error Field	U32	RO	
1005h	0	COB-ID Sync Message	U32	RW	
1008h	0	Manufacturer Device Name	Visible string	Const	Contains the device name.
1009h	0	Manufacturer Software Version	Visible string	RW	Contains the device software version.
100Ch	0	Guard Time	U6	RW	This entry contains the guard time in ms. The value 0 means, that the guard time is not used.

Index	Sub-index	Name	Type	Access	Description
100Dh	0	Life Time Factor	U8	RW	The life time factor multiplied with the guard time gives the life time for the device. If it is 0, it is not used.
1010h	0	Largest Subindex Supported	U8	RO	This entry supports saving of parameters in non-volatile memory. With read access the device provides information about its saving capabilities. Several parameter groups are distinguished. Sub index 1: all parameters Sub index 2: communication parameters (1000h…1FFFh) Sub index 3: application parameters (6000h…9FFFh) Sub index 4: request drive to perform parameter save function For saving the signature 'save' (65766173h) must be written.
	1	Save All Parameters	U32	RW	
	2	Save Communication parameters	U32	RW	
	3	Save Application parameters	U32	RW	
	4	Save Drive parameters	U32	RW	
1011h	0	Largest Subindex Supported	U8	RO	This entry supports restoring of default parameters. With read access the device provides information about its capabilities to restore these values. Several parameter groups are distinguished. Sub index 1: all parameters Sub index 2: communication parameters (1000h…1FFFh) Sub index 3: application parameters (6000h…9FFFh) Sub index 4: request drive to perform parameter restore function For restoring, the signature 'load' (64616F6Ch) must be written.
	1	Restore All Default Parameters	U32	RW	
	2	Restore Communication Default Parameters	U32	RW	
	3	Restore Application Default Parameters	U32	RW	
	4	Restore Drive Default Parameters	U32	RW	
1014h	0	COB-ID Emergency Message	U32	RW	COB-ID used for emergency message (Emergency Producer).

Index	Sub-index	Name	Type	Access	Description
1016h	0	Number Of Entries	U8	RO	The consumer heartbeat time defines the expected heartbeat cycle time and thus has to be higher than the corresponding producer heartbeat time configured on the device producing this heartbeat. The bits 31-24 of each sub-index have to be 0. The bits 23-16 contain the node-id. The lower 16 bits contain the heartbeat time
	1	Consumer Heartbeat Time	U32	RW	
1017h	0	Producer Heartbeat Time	U16	RW	The producer heartbeat time defines the cycle time of the heartbeat. If the time is 0 it is not used. The time has to be a multiple of 1 ms.
1018h	0	Number of Entries	U8	RO	This object contains general information about the device. Sub-Index 1 contains the vendor ID (B7h = ABB) Sub-Index 2 identifies the drive type. Sub-Index 3 contains the revision number. Bit 31-16 is the major revision number and Bit 15-0 the minor revision number. Sub-Index 4 contains a numerical representation of the drive's serial number.
	1	Vendor ID	U32	RO	
	2	Product Code	U32	RO	
	3	Module revision	U32	RO	
	4	Serial number	U32	RO	

Index	Sub-index	Name	Type	Access	Description
1400h	0	Number Of Entries	U8	RO	Contain the communication parameters of the PDOs the device is able to receive. Sub-index 0 contains the number of PDO-parameters implemented. Sub-index 1 describes the COB-ID for the PDO. If bit 31 is set the PDO is disabled. Sub-index 2 defines the transmission mode. Sub-index 3 is not used with RPDOs. Sub-index 5 defines a timeout for asynchronous PDOs.
	1	COB-ID	U32	RW	
	2	Transmission Type	U8	RW	
	3	Inhibit Time	U6	RW	
	5	Event Timer	U6	RW	
1405h	0	Number Of Entries	U8	RO	
	1	COB-ID	U32	RW	
	2	Transmission Type	U8	RW	
	3	Inhibit Time	U6	RW	
	5	Event Timer	U6	RW	
1414h	0	Number Of Entries	U8	RO	
	1	COB-ID	U32	RW	
	2	Transmission Type	U8	RW	
	3	Inhibit Time	U6	RW	
	5	Event Timer	U6	RW	

Index	Sub-index	Name	Type	Access	Description
1600h	0	Number Of Entries	U8	RW	Contain the mapping of data in PDOs to objects in the object dictionary. Sub-index 0 defines the number of objects mapped to the PDO. The other sub-indices each map one object to the PDO. Their structure is as follows: Index (top 16bits) Sub-index (8bits) Length in bits (bottom 8bits)
	1	PDO Mapping Entry 1	U32	RW	
	2	PDO Mapping Entry 2	U32	RW	
	3	PDO Mapping Entry 3	U32	RW	
	4	PDO Mapping Entry 4	U32	RW	
1605h	0	Number Of Entries	U8	RW	
	1	PDO Mapping Entry 1	U32	RW	
	2	PDO Mapping Entry 2	U32	RW	
	3	PDO Mapping Entry 3	U32	RW	
	4	PDO Mapping Entry 4	U32	RW	
1614h	0	Number Of Entries	U8	RW	
	1	PDO Mapping Entry 1	U32	RW	
	2	PDO Mapping Entry 2	U32	RW	
	3	PDO Mapping Entry 3	U32	RW	
	4	PDO Mapping Entry 4	U32	RW	

Index	Sub-index	Name	Type	Access	Description
1800h	0	Number Of Entries	U8	RO	Contain the communication parameters of the PDOs the device sends. Sub-index 0 contains the number of PDO-parameters implemented. Sub-index 1 describes the COB-ID for the PDO. If bit 31 is set the PDO is disabled. Sub-index 2 defines the transmission mode. Sub-index 3 defines inhibit time (10 = 1ms). Sub-index 5 defines a timeout for asynchronous PDOs.
	1	COB-ID	U32	RW	
	2	Transmission Type	U8	RW	
	3	Inhibit Time	U6	RW	
	5	Event Timer	U6	RW	
1805h	0	Number Of Entries	U8	RO	
	1	COB-ID	U32	RW	
	2	Transmission Type	U8	RW	
	3	Inhibit Time	U6	RW	
	5	Event Timer	U6	RW	
1814h	0	Number Of Entries	U8	RO	
	1	COB-ID	U32	RW	
	2	Transmission Type	U8	RW	
	3	Inhibit Time	U6	RW	
	5	Event Timer	U6	RW	

Index	Sub-index	Name	Type	Access	Description
1A00h	0	Number Of Entries	U8	RW	Contain the mapping of data in PDOs to objects in the object dictionary. Sub-index 0 defines the number of objects mapped to the PDO. The other sub-indices each map one object to the PDO. Their structure is as follows: Index (top 16bits) Sub-index (8bits) Length in bits (bottom 8bits)
	1	PDO Mapping Entry 1	U32	RW	
	2	PDO Mapping Entry 2	U32	RW	
	3	PDO Mapping Entry 3	U32	RW	
	4	PDO Mapping Entry 4	U32	RW	
1A05h	0	Number Of Entries	U8	RW	
	1	PDO Mapping Entry 1	U32	RW	
	2	PDO Mapping Entry 2	U32	RW	
	3	PDO Mapping Entry 3	U32	RW	
	4	PDO Mapping Entry 4	U32	RW	
1A14h	0	Number Of Entries	U8	RW	
	1	PDO Mapping Entry 1	U32	RW	
	2	PDO Mapping Entry 2	U32	RW	
	3	PDO Mapping Entry 3	U32	RW	
	4	PDO Mapping Entry 4	U32	RW	
2000h	0	Number Of Entries	U8	RO	
	3	REFERENCE 2	INT16	RWW	Transparent 16 and ABB Drives profile reference value 2 (alternative)
	6	ACTUAL VALUE 2	INT16	RO	Transparent 16 and ABB Drives profile actual value 2 (alternative)

Manufacturer specific profile area (2000...5FFF)

Index	Sub-index	Name	Type	Access	Description
2000h	0	Number Of Entries	U8	RO	
	3	REFERENCE 2	INT16	RWW	Transparent 16 and ABB Drives profile reference value 2 (alternative)
	6	ACTUAL VALUE 2	INT16	RO	Transparent 16 and ABB Drives profile actual value 2 (alternative)
2001h	0	T32 CW	U32	RWW	Transparent 32 profile command word
2002h	0	T32 Ref1	INT32	RWW	Transparent 32 profile
2003h	0	T32 Ref2	INT32	RWW	Transparent 32 profile reference value 1
2004h	0	T32 SW	U32	RO	Transparent 32 profile reference value 2
2005h	0	T32 Act1	INT32	RO	Transparent 32 profile actual value 1
2006h	0	T32 Act2	INT32	RO	Transparent 32 profile actual value 2
2051h	0	T16 CW	U6	RWW	Transparent 16 profile command word
2052h	0	T16 Ref1	INT16	RWW	Transparent 16 profile reference value 1
2053h	0	T16 Ref2	INT16	RWW	Transparent 16 profile reference value 2
2054h	0	T16 SW	U6	RO	Transparent 16 profile status word
2055h	0	T16 Act1	INT16	RO	Transparent 16 profile actual value 1
2056h	0	T16 Act2	INT16	RO	Transparent 16 profile actual value 2
2100h	0	Number Of Entries	U8	RO	Maximum sub-index in the object
	1		U6	RO	Alarm code 1
	2		U6	RO	Alarm code 2
	3		U6	RO	Alarm code 3
	4		U6	RO	Alarm code 4
	5		U6	RO	Alarm code 5
2101h	0	ABB CW	U6	RWW	ABB Drives profile command word
2102h	0	ABB Ref1	INT16	RWW	ABB Drives profile reference value 1
2103h	0	ABB Ref2	INT16	RWW	ABB Drives profile reference value 2
2104h	0	ABB SW	U6	RO	ABB Drives profile status word
2105h	0	ABB Act1	INT16	RO	ABB Drives profile actual value 1
2106h	0	ABB Act2	INT16	RO	ABB Drives profile actual value 2

Index	Sub-index	Name	Type	Access	Description
4001h - 4063h					The objects 4001h-4063h provide access to the drive parameters. Each object corresponds to a parameter group and each sub-index in the object corresponds to a single parameter in the group, e.g., 4001h.01 corresponds to parameter *01.01* and 400Ah.04 corresponds to parameter *10.04*.

Standardized profile area (6000...9FFF)

Index	Sub-index	Name	Type	Access	Description
603Fh	0	Error code	U6	RO	This object provides the error code of the last error occurred in the drive device.
6040h	0	Control Word	U6	RWW	See *CiA 402 profile* on page *556* and *ABB drives profile* on page *562* for details.
6041h	0	Status Word	U6	RO	
6042h	0	Vl Target Velocity	INT16	RWW	This object is the required velocity of the system in velocity mode. The value is multiplied by Vl Dimension Factor Numerator and divided by Vl Dimension Factor Denominator. If both of these are 1 (default), the velocity is given in rpm.
6043h	0	Vl Velocity Demand	INT16	RO	This object provides the velocity generated by the ramp function. It is an internal value of the drive. The value shall be given in the same unit as the Vl Target Velocity. Positive values indicate forward direction and negative values indicate reverse direction.
6044h	0	Vl Control Effort	INT16	RO	This object provides the actual velocity. The value shall be given in the same unit as the Vl Target Velocity. Positive values indicate forward direction and negative values indicate reverse direction.
6046h	0	Number of Entries	U8	RO	The values shall be given in rotations per minute (rpm) or in user-defined velocity unit if the Vl Dimension Factor object is not set to 1.
	1	Vl Velocity Min Amount	U32	RWW	Always zero.
	2	Vl Velocity Max Amount	U32	RWW	Mapped internally to the Vl Velocity Max Pos and Vl Velocity Max Neg values.

Index	Sub-index	Name	Type	Access	Description
6048h	0	Number of Entries	U8	RO	This object indicates the configured delta speed and delta time of the slope of the acceleration ramp: VI Velocity Acceleration = Delta Speed / Delta Time
	1	Delta Speed	U32	RWW	The value shall be given in rotations per minute (rpm) or in user-defined velocity unit if the VI Dimension Factor object is not set to 1.
	2	Delta Time	U6	RWW	Value shall be given in seconds.
6049h	0	Number of Entries	U8	RO	This object indicates the configured delta speed and delta time of the slope of the deceleration ramp: VI Velocity Deceleration = Delta Speed / Delta Time
	1	Delta Speed	U32	RWW	The value shall be given in rotations per minute (rpm) or in user-defined velocity unit if the VI Dimension Factor object is not set to 1.
	2	Delta Time	U6	RWW	Value shall be given in seconds.
604Ch	0	Highest sub-index supported	U8	Const	This object indicates the configured numerator and denominator of the VI Dimension Factor. The VI Dimension Factor serves to include gearing in calculation or serves to scale the frequencies or specific units of the user. It influences the VI Target Velocity, VI Velocity Demand, VI Velocity Actual Value as well as the velocity limit function and the ramp function.
	1	VI Dimension Factor Numerator	INT32	RW	Multiplier for VI velocity values. Shall not be 0.
	2	VI Dimension Factor Denominator	INT32	RW	Divider for VI velocity values. Shall not be 0.

Index	Sub-index	Name	Type	Access	Description
605Dh	0	Halt option code	INT16	RW	This object indicates what action is performed when the halt function is executed, i.e. when the halt bit in the Control word is set. The slow down ramp is the deceleration value of the used mode of operations. The following value definition is valid: 1 = slow down on slow down ramp and stay in OPERATION ENABLED 2 = slow down on quick stop ramp and stay in OPERATION ENABLED 3 = slow down on the current limit and stay in OPERATION ENABLED 4 = slow down on voltage limit and stay in OPERATION ENABLED
6060h	0	Mode of Operation	INT8	RW	The operational mode is selectable by this object. This object shows only the value of the requested operation mode, the actual operation mode of the PDS is reflected in the object 6061h. The following value definition is valid: 0 = no mode change / no mode assigned 1 = profile position mode (not supported) 2 = velocity mode 3 = profile velocity mode 4 = profile torque mode 5 = reserved 6 = homing mode (not supported) 7 = interpolated position mode (not supported) 8 = cyclic synchronous position mode (not supported) 9 = cyclic synchronous velocity mode 10 = cyclic synchronous torque mode

Index	Sub-index	Name	Type	Access	Description
6061h	0	Mode of Operation Display	INT8	RO	This object provides the actual operation mode. The following value definition is valid: 0 = no mode change / no mode assigned 1 = profile position mode (not supported) 2 = velocity mode 3 = profile velocity mode 4 = profile torque mode 5 = reserved 6 = homing mode (not supported) 7 = interpolated position mode (not supported) 8 = cyclic synchronous position mode (not supported) 9 = cyclic synchronous velocity mode 10 = cyclic synchronous torque mode
6069h	0	Velocity sensor actual value	INT32	RO	This object provides the value read from a velocity sensor.
606Bh	0	Velocity demand value	INT32	RO	This object provides the output value of the trajectory generator.
606Ch	0	Velocity actual value	INT32	RO	This object provides the actual velocity value derived either from the velocity sensor or the position sensor.
6071h	0	Target torque	INT16	RWW	This object indicates the input value for the torque controller in profile torque mode.
6072h	0	Max torque	U6	RWW	This object indicates the maximum permissible torque in the motor. 10 = 1%
6073h	0	Max current	U6	RWW	This object indicates the maximum permissible torque creating current in the motor. 10 = 1%
6077h	0	Torque actual value	INT16	RO	This object provides the actual value of the torque. It shall correspond to the instantaneous torque in the motor. 10 = 1%
6083h	0	Profile acceleration	U32	RWW	This object defines the commanded acceleration. This object is used in the profile velocity mode.

Index	Sub-index	Name	Type	Access	Description
6084h	0	Profile deceleration	U32	RWW	This object defines the deceleration. This object is used in the profile velocity mode.
6087h	0	Torque slope	U32	RW	This object indicates the rate of change of torque.
608Fh	0	Highest sub-index supported	U8	Const	This object indicates the configured encoder increments and number of motor revolutions. The position encoder resolution is calculated by the following formula: position encoder resolution = encoder increments / motor revolutions
	1	Encoder Increments	U32	RW	
	2	Motor Revolutions	U32	RW	
60C2h	0	Highest sub-index supported.	U8	Const	This object indicates the interpolation cycle time.
	1	Interpolation time period value	U8	RW	Value of the time.
	2	Interpolation time index	INT8	RW	Dimension index to the time value in sub-index 1
60FFh	0	Target velocity	INT32	RWW	This object indicates the configured target velocity.

Index	Sub-index	Name	Type	Access	Description
6402h	0	Motor type	U6	RO	This object indicates the type of motor attached to and driven by the drive device. The following value definition is valid: 0000h = non-standard motor 0001h = phase modulated DC motor 0002h = frequency controlled DC motor 0003h = PM synchronous motor 0004h = FC synchronous motor 0005h = switched reluctance motor 0006h = wound rotor induction motor 0007h = squirrel cage induction motor 0008h = stepper motor 0009h = micro-step stepper motor 0010h = sinusoidal PM BL motor 0011h = trapezoidal PM BL motor 0012h = AC synchronous reluctance sync 0013h = DC commutator PM 0014h = DC commutator wound field series 0015h = DC commutator wound field compound 7FFFh = no motor type assigned 8000h-FFFFh = manufacturer-specific

Index	Sub-index	Name	Type	Access	Description
6502h	0	Supported drive modes	U32	RO	This object provides information on the supported drive modes. This object is organized bit-wise. The bits have the following meaning: bit 0: profile position mode bit 1: velocity mode bit 2: profile velocity mode bit 3: profile torque mode bit 4: reserved bit 5: homing mode bit 6: interpolated position mode bit 7: cyclic synchronous position mode bit 8: cyclic synchronous velocity mode bit 9: cyclic synchronous torque mode bit 10-15: reserved bit 16-31: manufacturer-specific The bit values have the following meaning: bit value = 0: mode is not supported bit value = 1: mode is supported
6504h	0	Drive manufacturer	Visible string	Const	This object indicates the manufacturer: ABB Drives
6505h		http drive catalog address	Visible string	Const	This object indicates the assigned web address of the drive manufacturer: www.abb.com

CANopen status indicators

The status of CANopen communication can be determined from virtual LEDs which are displayed on the integrated panel. The two CANopen virtual LEDs, RUN and ERROR, can be found on Connection Status View of the integrated panel.

Both LEDs can be either ON or OFF. The following table defines the image shown for a LED that is ON and for a LED that is OFF.

LED	State
	Off

LED	State
	On

LED blinking descriptions.

Name	State	Description
ERROR	Off	No error
	Blinking	General configuration error
	Single flash	CANopen controller error counters have reached the warning limit (too many error frames).
	Double flash	A guard event or a receive heartbeat time-out has occurred.
	Quadruple flash	An expected PDO has not been received before the event-timer elapsed.
	On	The CAN controller is bus off.
RUN	Blinking	The device is in PRE-OPERATIONAL state.
	Single flash	The device is in STOPPED state.
	On	The device is in OPERATIONAL state.

10

Fieldbus control through a fieldbus adapter

Contents

System overview

For the following instrument:

- ACS380-04xC with fieldbus adapter connected (excluding BCAN-11 CANopen interface +K405)

The drive can be controlled by external devices over a communication network (fieldbus) through an optional fieldbus adapter module.

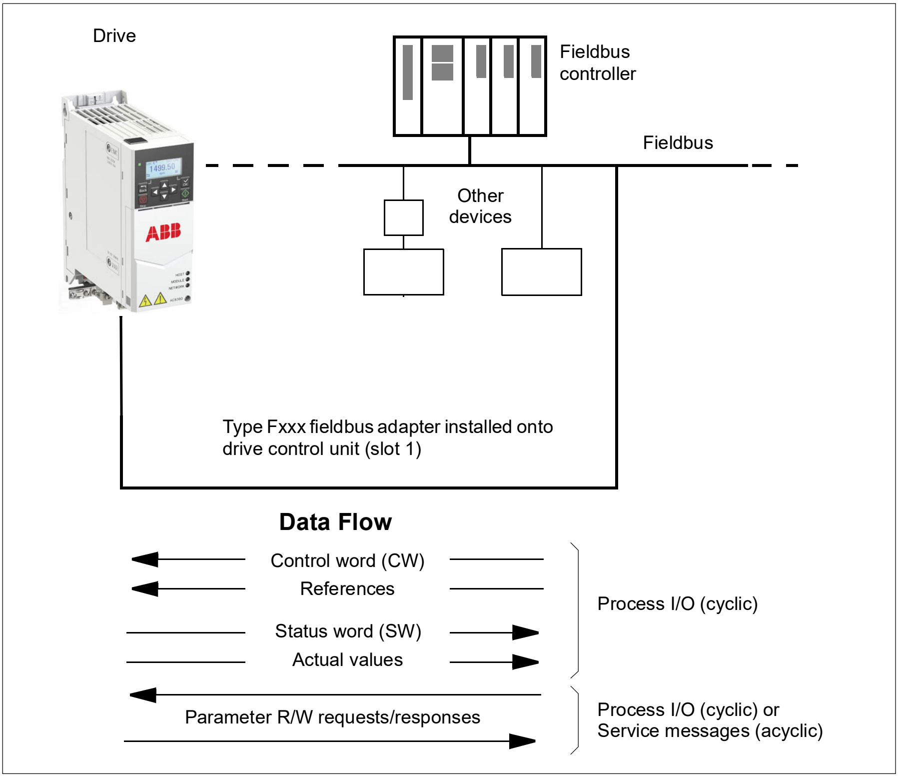
The drive can be connected to an external control system through an optional fieldbus adapter (“fieldbus adapter A” = FBA A) mounted onto the control unit of the drive. The drive can be configured to receive all of its control information through the fieldbus interface, or other available sources such as digital and analog inputs, depending on how control locations EXT1 and EXT2 are configured.

Fieldbus adapters are available as loose options for ACS380 base variants (ACS380-04xN-xxAx-x) or as built-in options for ACS380 configured variants (ACS380-04xC-xxAx-x types). For example following protocols are supported:

- PROFIBUS DP
- CANopen
- EtherNet/IP™
- EtherCAT™

When you use loose option, make sure that the adapter is compatible.

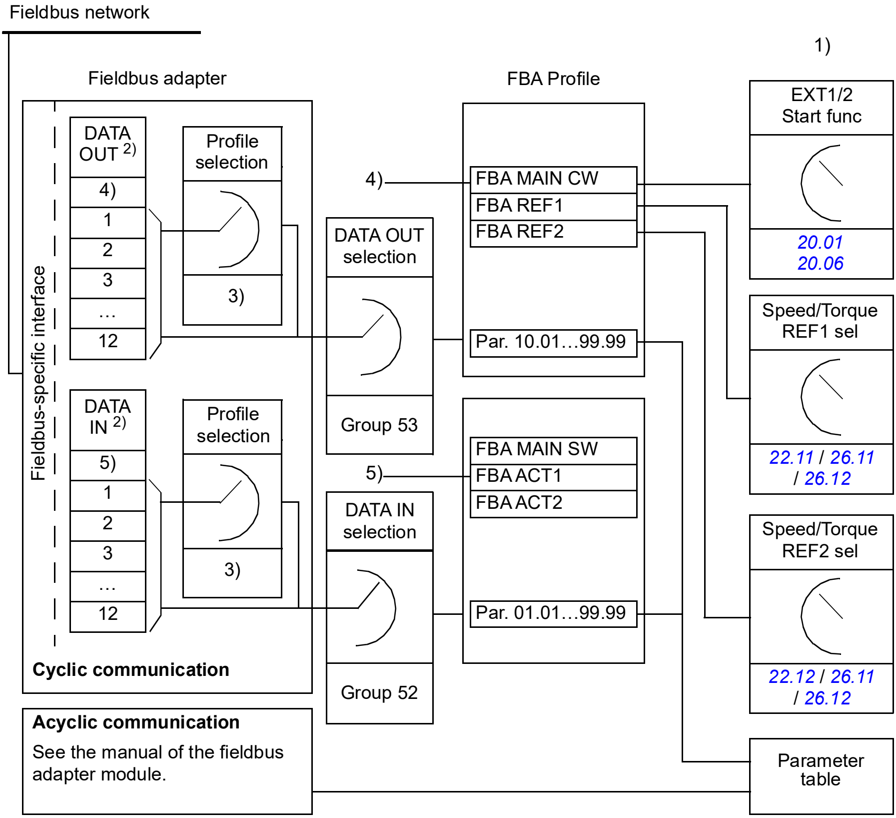
Note: The text and examples in this chapter describe the configuration of one fieldbus adapter (FBA A) by parameters *50.01*…*50.18* and parameter groups *51 FBA A settings*…*53 FBA A data out*.



Basics of the fieldbus control interface

The cyclic communication between a fieldbus system and the drive consists of 16- or 32-bit input and output data words. The drive is able to support a maximum of 12 data words (16 bits) in each direction.

Data transmitted from the drive to the fieldbus controller is defined by parameters *52.01 FBA A data in1* … *52.12 FBA A data in12*. The data transmitted from the fieldbus controller to the drive is defined by parameters *53.01 FBA A data out1* … *53.12 FBA A data out12*.



1) See also other parameters which can be controlled from fieldbus.
2) The maximum number of data words used is protocol-dependent.
3) Profile/instance selection parameters. Fieldbus module specific parameters. For more information, see the user's manual of the appropriate fieldbus adapter module.
4) With DeviceNet, the control part is transmitted directly.
5) With DeviceNet, the actual value part is transmitted directly.

Control word and Status word

The Control word is the principal means for controlling the drive from a fieldbus system. It is sent by the fieldbus master station to the drive through the adapter module. The drive switches between its states according to the bit-coded instructions in the Control word, and returns status information to the master in the Status word.

For the ABB Drives communication profile, the contents of the Control word and the Status word are detailed on pages *597* and *598* respectively. The drive states are presented in the state diagram (page *599*). For other fieldbus-specific communication profiles, see the manual of the fieldbus adapter.

When transparent16 or transparent32 profile is selected from the fieldbus group 51 profile parameter, the drive will implement the DCU profile in command and status words as well as reference and actual value scalings. See sections *Control Word for the DCU Profile* (page *533*) and *Status Word for the DCU Profile* (page *536*).

For more details on the Control word, go to page *597*, and on the Status word, got to page *598*. The drive states are presented in the state diagram on page *599*.

Debugging the network words

If parameter *50.12 FBA A debug mode* is set to *Fast*, the Control word received from the fieldbus is shown by parameter *50.13 FBA A control word*, and the Status word transmitted to the fieldbus network by *50.16 FBA A status word*. This “raw” data is very useful to determine if the fieldbus master is transmitting the correct data before handing control to the fieldbus network.

References

References are 16-bit words containing a sign bit and a 15-bit integer. A negative reference (indicating reversed direction of rotation) is formed by calculating the two's complement from the corresponding positive reference.

ABB drives can receive control information from multiple sources including analog and digital inputs, the drive control panel and a fieldbus adapter module. In order to have the drive controlled through the fieldbus, the module must be defined as the source for control information such as reference. This is done using the source selection parameters in groups *22 Speed reference selection*, *26 Torque reference chain* and *28 Frequency reference chain*.

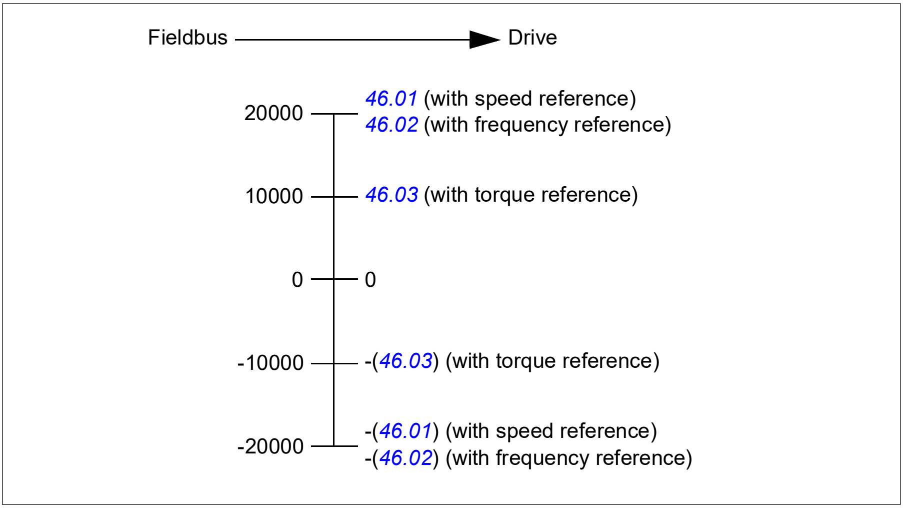
Debugging the network words

If parameter *50.12 FBA A debug mode* is set to *Fast*, the references received from the fieldbus are displayed by *50.14 FBA A reference 1* and *50.15 FBA A reference 2*.

Scaling of references

Note: The scalings described below are for the ABB Drives communication profile. Fieldbus-specific communication profiles may use different scalings. For more information, see the manual of the fieldbus adapter.

The references are scaled as defined by parameters *46.01…46.04*; which scaling is in use depends on the setting of *50.04 FBA A ref1 type* and *50.05 FBA A ref2 type*.



The scaled references are shown by parameters *03.05 FB A reference 1* and *03.06 FB A reference 2*.

Actual values

Actual values are 16-bit words containing information on the operation of the drive. The types of the monitored signals are selected by parameters *50.07 FBA A actual 1 type* and *50.08 FBA A actual 2 type*.

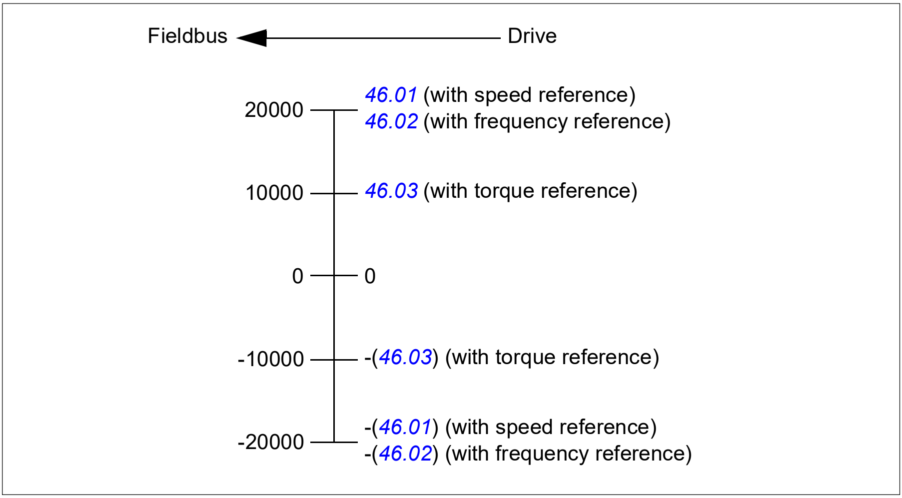
Debugging the network words

If parameter *50.12 FBA A debug mode* is set to *Fast* the actual values sent to the fieldbus are displayed by *50.17 FBA A actual value 1* and *50.18 FBA A actual value 2*.

Scaling of actual values

Note: The scalings described below are for the ABB Drives communication profile. Fieldbus-specific communication profiles may use different scalings. For more information, see the manual of the fieldbus adapter.

The actual values are scaled as defined by parameters *46.01…46.04*; which scaling is in use depends on the setting of parameters *50.07 FBA A actual 1 type* and *50.08 FBA A actual 2 type*.



Contents of the fieldbus Control word (ABB Drives profile)

The upper case boldface text refers to the states shown in the state diagram on page *599*.

Bit	Name	Value	State/Description
0	Off1 control	1	Proceed to **READY TO OPERATE**.
		0	Stop along currently active deceleration ramp. Proceed to **OFF1 ACTIVE**; proceed to **READY TO SWITCH ON** unless other interlocks (OFF2, OFF3) are active.
1	Off2 control	1	Continue operation (OFF2 inactive).
		0	Emergency OFF, coast to a stop. Proceed to **OFF2 ACTIVE**, proceed to **SWITCH-ON INHIBITED**.
2	Off3 control	1	Continue operation (OFF3 inactive).
		0	Emergency stop, stop within time defined by drive parameter. Proceed to **OFF3 ACTIVE**; proceed to **SWITCH-ON INHIBITED**. **WARNING:** Ensure motor and driven machine can be stopped using this stop mode.
3	Run	1	Proceed to **OPERATION ENABLED**. **Note:** Run enable signal must be active; see drive documentation. If the drive is set to receive the Run enable signal from the fieldbus, this bit activates the signal. See also parameter *06.18 Start inhibit status word* (page *143*).
		0	Inhibit operation. Proceed to **OPERATION INHIBITED**.
4	Ramp out zero	1	Normal operation. Proceed to **RAMP FUNCTION GENERATOR: OUTPUT ENABLED**.
		0	Force Ramp function generator output to zero. The drive will immediately decelerate to zero speed (observing the torque limits).
5	Ramp hold	1	Enable ramp function. Proceed to **RAMP FUNCTION GENERATOR: ACCELERATOR ENABLED**.
		0	Halt ramping (Ramp Function Generator output held).
6	Ramp in zero	1	Normal operation. Proceed to **OPERATING**. **Note:** This bit is effective only if the fieldbus interface is set as the source for this signal by drive parameters.
		0	Force Ramp function generator input to zero.
7	Reset	0=>1	Fault reset if an active fault exists. Proceed to **SWITCH-ON INHIBITED**. **Note:** This bit is effective only if the fieldbus interface is set as the source of the reset signal by drive parameters.
		0	Continue normal operation.
8	Inching 1	1	Accelerate to inching (jogging) setpoint 1. **Notes:** • Bits 4…6 must be 0. • See also section *Jogging* on page *71*.
		0	Inching (jogging) 1 disabled.
9	Inching 2	1	Accelerate to inching (jogging) setpoint 2. See notes at bit 8.
		0	Inching (jogging) 2 disabled.
10	Remote cmd	1	Fieldbus control enabled.
		0	Control word and reference not getting through to the drive, except for bits 0…2.

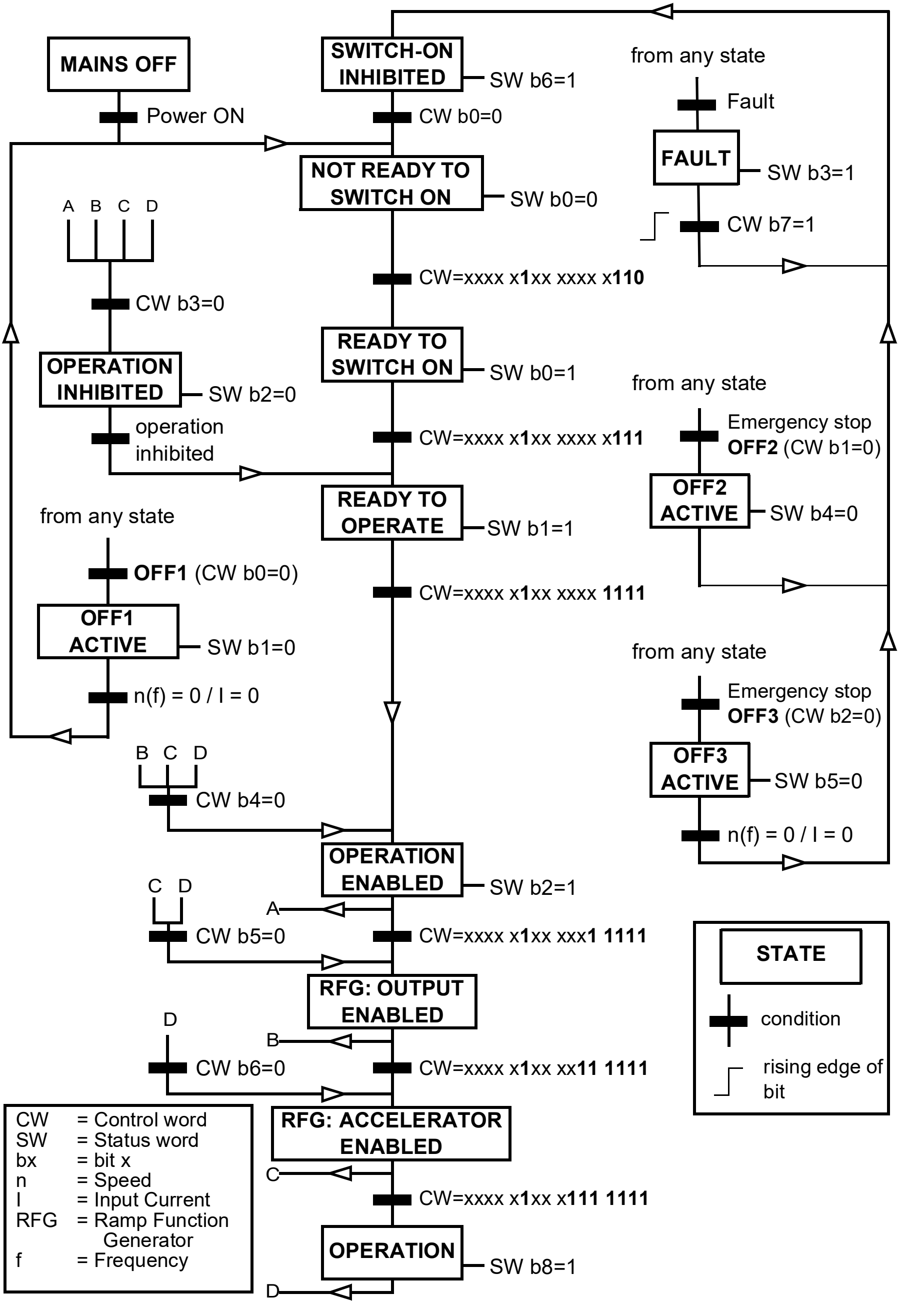
Bit	Name	Value	State/Description
11	Ext ctrl loc	1	Select External Control Location EXT2. Effective if control location is parameterized to be selected from fieldbus.
		0	Select External Control Location EXT1. Effective if control location is parameterized to be selected from fieldbus.
12	User bit 0	1	User configurable.
		0	
13	User bit 1	1	
		0	
14	User bit 2	1	
		0	
15	User bit 3	1	
		0	

Contents of the fieldbus Status word (ABB Drives profile)

The upper case boldface text refers to the states shown in the state diagram on page *599*.

Bit	Name	Value	State/Description
0	Ready to switch ON	1	**READY TO SWITCH ON**.
		0	**NOT READY TO SWITCH ON**.
1	Ready run	1	**READY TO OPERATE**.
		0	**OFF1 ACTIVE**.
2	Ready ref	1	**OPERATION ENABLED**.
		0	**OPERATION INHIBITED**. See also parameter *06.18 Start inhibit status word* (page *143*).
3	Tripped	1	**FAULT**.
		0	No fault.
4	Off 2 inactive	1	OFF2 inactive.
		0	**OFF2 ACTIVE**.
5	Off 3 inactive	1	OFF3 inactive.
		0	**OFF3 ACTIVE**.
6	Switch-on inhibited	1	**SWITCH-ON INHIBITED**.
		0	–
7	Warning	1	Warning active.
		0	No warning active.
8	At setpoint	1	**OPERATING**. Actual value equals reference = is within tolerance limits (see parameters *46.21*…*46.23*).
		0	Actual value differs from reference = is outside tolerance limits.
9	Remote	1	Drive control location: REMOTE (EXT1 or EXT2).
		0	Drive control location: LOCAL.
10	Above limit	-	See bit 10 of *06.17 Drive status word 2*.
11	User bit 0	-	See parameter *06.30 MSW bit 11 selection*.
12	User bit 1	-	See parameter *06.31 MSW bit 12 selection*.
13	User bit 2	-	See parameter *06.32 MSW bit 13 selection*.
14	User bit 3	-	See parameter *06.33 MSW bit 14 selection*.
15	Reserved		

The state diagram (valid for ABB drives profile only)



A control word sequence example is given below:

Start:

- 476h --> NOT READY TO SWITCH ON

If MSW bit 0 = 1 then

- 477h --> READY TO SWITCH ON (Stopped)
- 47Fh --> OPERATION (Running)

Stop:

- 477h = Stop according to *21.03 Stop mode*
- 47Eh = OFF1 ramp stop (**Note:** uninterpretable ramp stop)

Fault reset:

- Rising edge of MCW bit 7

Start after STO:

If *31.22 STO indication run/stop* is not Fault/Fault make sure that *06.18 Start inhibit status word*, bit 7 STO = 0 before giving a start command.

Automatic drive configuration for fieldbus control

The software automatically sets the relevant parameters when the fieldbus adapter module is connected to the drive. The preset settings apply to the CANopen, EtherCAT, PROFIBUS and PROFINET (default in the FENA-21-M module) protocols.

Warning! The drive needs to be unpowered for five (5) minutes before electrical installation.

To configure fieldbus communications:

1. Power up the drive.
2. The drive software recognizes the connected fieldbus adapter and automatically creates the basic configuration, if this was the first power-up with an adapter present..
3. If you need to change other parameters, you can set them manually.

If the relevant parameters are not automatically set, follow the instructions in section *Setting up the drive for fieldbus control manually* on page 606.

Automatic configuration is a minimum configuration, and you can change the parameters after it. There are certain parameters that you need to change, e.g. the station ID.

The fieldbus autosetting function is activated automatically after power boot if parameter *07.35* is set to 0. It also activates again if you change to another adapter and parameter *07.35* is 0.

Example: If you change to another adapter you need to configure parameter *07.35 Drive configuration* again. Select *0 Not initialized*, go to parameter *96.07* and save the parameter. Reboot the drive, and the drive starts again with the new configuration.

The fieldbus autosetting function is not activated automatically after fieldbus parameter changes, or after changing the fieldbus module.

When the fieldbus adapter is connected to the drive, the drive control program sets the applicable parameters. The preset settings apply to the CANopen, EtherCAT, PROFIBUS and PROFINET (the default in the FENA-21 module) protocols. If you have a BCAN-11 adapter, refer to the exceptions in the table.

Automatically changed parameters (all adapters)

Parameter	Setting (general)	Setting (BCAN-11)
20.01 Ext1 commands	Fieldbus A	Embedded fieldbus
20.03 Ext1 in1	Always off	Always off
20.04 Ext1 in2	Always off	Always off
22.11 Ext1 speed ref1	FB A ref1	EFB ref1
22.22 Constant speed sel1	Always off	Always off
22.23 Constant speed sel2	Always off	Always off
23.11 Ramp set selection	Acc/Dec time 1	Acc/Dec time 1
28.11 Ext1 frequency ref1	FB A ref1	EFB ref1
28.22 Constant frequency sel1	Always off	Always off
28.23 Constant frequency sel2	Always off	Always off
28.71 Freq ramp set sel	Acc/Dec time 1	Acc/Dec time 1
31.11 Fault reset selection	DI1	DI1
50.01 FBA A enable	Enable	Disable
50.02 FBA A comm loss func	Fault	No action

Specific fieldbus adapter parameters

Parameter	Setting
CANopen (FCAN-01)	
51.05 Profile	CiA 402
EtherCAT	
51.02 Profile	CiA 402
PROFIBUS	
51.02 Node address	3
51.05 Profile	ABB Drives
52.01 FBA A data in1	SW 16bit
52.02 FBA A data in2	Act1 16bit
53.01 FBA A data out1	CW 16bit
53.02 FBA A data out2	Ref1 16bit
PROFINET (default in FENA-21)	
51.02 Protocol/profile	11 = PNIO ABB Pro (PROFINET IO protocol: ABB Drives profile).
51.04 IP configuration	0 (Static IP)
52.01 Data In	4 (SW 16 bit (Status word (16 bit)))
52.02 Data In 2	5 (Act 1 16 bit)
53.01 Data Out 1	1 (CW 16 bit)
53.02 Data Out 2	2 (ref 1 16-bit)
Modbus TCP/IP	
51.02 Protocol / Profile	1 = MB/TCP T16. (Modbus/TCP: ABB Drives profile - Enhanced)

Parameter	Setting
Ethernet IP	
51.02 Protocol / Profile	EIP ABB Pro. (EtherNet/IP protocol: ABB Drives profile.)
CANopen (BCAN-11)	
58.01 Protocol enable	CANopen

Parameters set by module detection

The parameters set on module detection are shown in the tables below. These values are valid with the ABB Standard macro (*96.04*). Some values vary by macro selection. See also parameters *07.35* and *07.36*.

Option	20.01 Ext1 commands	20.03 Ext1 in1 source	20.04 Ext1 in2 source
BMIO-01	2 (In1 Start, In2 Dir)	2 (DI1)	3 (DI2)
BIO-01	2 (In1 Start, In2 Dir)	2 (DI1)	3 (DI2)
FECA-01	12 (Fieldbus A)	0	0
FCAN-01	12 (Fieldbus A)	0	0
FSCA-01	12 (Fieldbus A)	0	0
FEIP-21	12 (Fieldbus A)	0	0
FENA-21	12 (Fieldbus A)	0	0
FMBT-21	12 (Fieldbus A)	0	0
FPNO-21	12 (Fieldbus A)	0	0
FEPL-02	12 (Fieldbus A)	0	0
FDNA-01	12 (Fieldbus A)	0	0
FCNA-01	12 (Fieldbus A)	0	0
FPBA-01	12 (Fieldbus A)	0	0
FSPS-21	12 (Fieldbus A)	0	0
BCAN-11	14 (Embedded fieldbus)	0	0

Option	22.11 Ext1 speed ref1	22.22 Constant speed sel1	22.23 Constant speed sel2
BMIO-01	1 (AI1 scaled)	4 (DI3)	5 (DI4)
BIO-01	1 (AI1 scaled)	4 (DI3)	5 (DI4)
FECA-01	4 (FB A ref1)	0	0
FCAN-01	4 (FB A ref1)	0	0
FSCA-01	4 (FB A ref1)	0	0
FEIP-21	4 (FB A ref1)	0	0
FENA-21	4 (FB A ref1)	0	0
FMBT-21	4 (FB A ref1)	0	0
FPNO-21	4 (FB A ref1)	0	0
FEPL-02	4 (FB A ref1)	0	0
FDNA-01	4 (FB A ref1)	0	0
FCNA-01	4 (FB A ref1)	0	0

Option	22.11 Ext1 speed ref1	22.22 Constant speed sel1	22.23 Constant speed sel2
FPBA-01	4 (FB A ref1)	0	0
FSPS-21	4 (FB A ref1)	0	0
BCAN-11	8 (EFB ref 1)	0	0

Option	23.11 Ramp set selection	28.11 Ext1 frequency ref1	28.22 Constant frequency sel1	28.23 Constant frequency sel2
BMIO-01	10 (DIO1)	1 (AI1 scaled)	4 (DI3)	5 (DI4)
BIO-01	6 (DI5)	1 (AI1 scaled)	4 (DI3)	5 (DI4)
FECA-01	0	4 (FB A ref1)	0	0
FCAN-01	0	4 (FB A ref1)	0	0
FSCA-01	0	4 (FB A ref1)	0	0
FEIP-21	0	4 (FB A ref1)	0	0
FENA-21	0	4 (FB A ref1)	0	0
FMBT-21	0	4 (FB A ref1)	0	0
FPNO-21	0	4 (FB A ref1)	0	0
FEPL-02	0	4 (FB A ref1)	0	0
FDNA-01	0	4 (FB A ref1)	0	0
FCNA-01	0	4 (FB A ref1)	0	0
FPBA-01	0	4 (FB A ref1)	0	0
FSPS-21	0	4 (FB A ref1)	0	0
BCAN-11	0	8 (EFB ref 1)	0	0

Option	28.71 Freq ramp set selection	31.11 Fault reset selection
BMIO-01	10 (DIO1)	0
BIO-01	6 (DI5)	0
FECA-01	0	2 (DI1)
FCAN-01	0	2 (DI1)
FSCA-01	0	2 (DI1)
FEIP-21	0	2 (DI1)
FENA-21	0	2 (DI1)
FMBT-21	0	2 (DI1)
FPNO-21	0	2 (DI1)
FEPL-02	0	2 (DI1)
FDNA-01	0	2 (DI1)
FCNA-01	0	2 (DI1)
FPBA-01	0	2 (DI1)
FSPS-21	0	2 (DI1)
BCAN-11	0	2 (DI1)

Option	50.01 FBA A enable	50.02 FBA A comm loss func	51.02 FBA A Par2	51.04 FBA A Par4
BMIO-01	0	0	-	-
BIO-01	0	0	-	-
FECA-01	1 (Enable)	1 (Fault)	0	-
FCAN-01	1 (Enable)	1 (Fault)	-	-
FSCA-01	1 (Enable)	1 (Fault)	-	-
FEIP-21	1 (Enable)	1 (Fault)	100	0
FENA-21	1 (Enable)	1 (Fault)	11	0
FMBT-21	1 (Enable)	1 (Fault)	0	0
FPNO-21	1 (Enable)	1 (Fault)	11	0
FEPL-02	1 (Enable)	1 (Fault)	-	-
FDNA-01	1 (Enable)	1 (Fault)	-	-
FCNA-01	1 (Enable)	1 (Fault)	-	-
FPBA-01	1 (Enable)	1 (Fault)	-	-
FSPS-21	1 (Enable)	1 (Fault)	11	0
BCAN-11	0	0	-	-

Option	51.05 FBA A Par5	51.06 FBA A Par6	51.07 FBA A Par7	51.21 FBA A Par21	51.23 FBA A Par23	51.24 FBA A Par24
BMIO-01	-	-	-	-	-	-
BIO-01	-	-	-	-	-	-
FECA-01	-	-	-	-	-	-
FCAN-01	0	-	-	-	-	-
FSCA-01	-	10	1	-	-	-
FEIP-21	-	-	-	-	128	128
FENA-21	-	-	-	-	-	-
FMBT-21	-	-	-	1	-	-
FPNO-21	-	-	-	-	-	-
FEPL-02	-	-	-	-	-	-
FDNA-01	-	-	-	-	-	-
FCNA-01	-	-	-	-	-	-
FPBA-01	1	-	-	-	-	-
FSPS-21	-	-	-	-	-	-
BCAN-11	-	-	-	-	-	-

Option	52.01 FBA data in1	52.02 BA data in2	53.01 FBA data out1	53.02 FBA data out2	58.01 Protocol enable
BMIO-01	-	-	-	-	-
BIO-01	-	-	-	-	-
FECA-01	-	-	-	-	0
FCAN-01	-	-	-	-	0
FSCA-01	-	-	-	-	0

Option	52.01 FBA data in1	52.02 BA data in2	53.01 FBA data out1	53.02 FBA data out2	58.01 Protocol enable
FEIP-21	-	-	-	-	0
FENA-21	4	5	1	2	0
FMBT-21	-	-	-	-	0
FPNO-21	4	5	1	2	0
FEPL-02	-	-	-	-	0
FDNA-01	-	-	-	-	0
FCNA-01	-	-	-	-	0
FPBA-01	4	5	1	2	0
FSPS-21	4	5	1	2	0
BCAN-11	-	-	-	-	3 (CANopen)

Setting up the drive for fieldbus control manually

The fieldbus adapter module is typically pre-installed. The device automatically recognizes the module.

If the adapter is not pre-installed, you can install it mechanically and electrically.

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 above.
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 *Configure*.
11. Configure control locations EXT1 and EXT2 to allow control and reference signals to come from the fieldbus.

11

Control chain diagrams

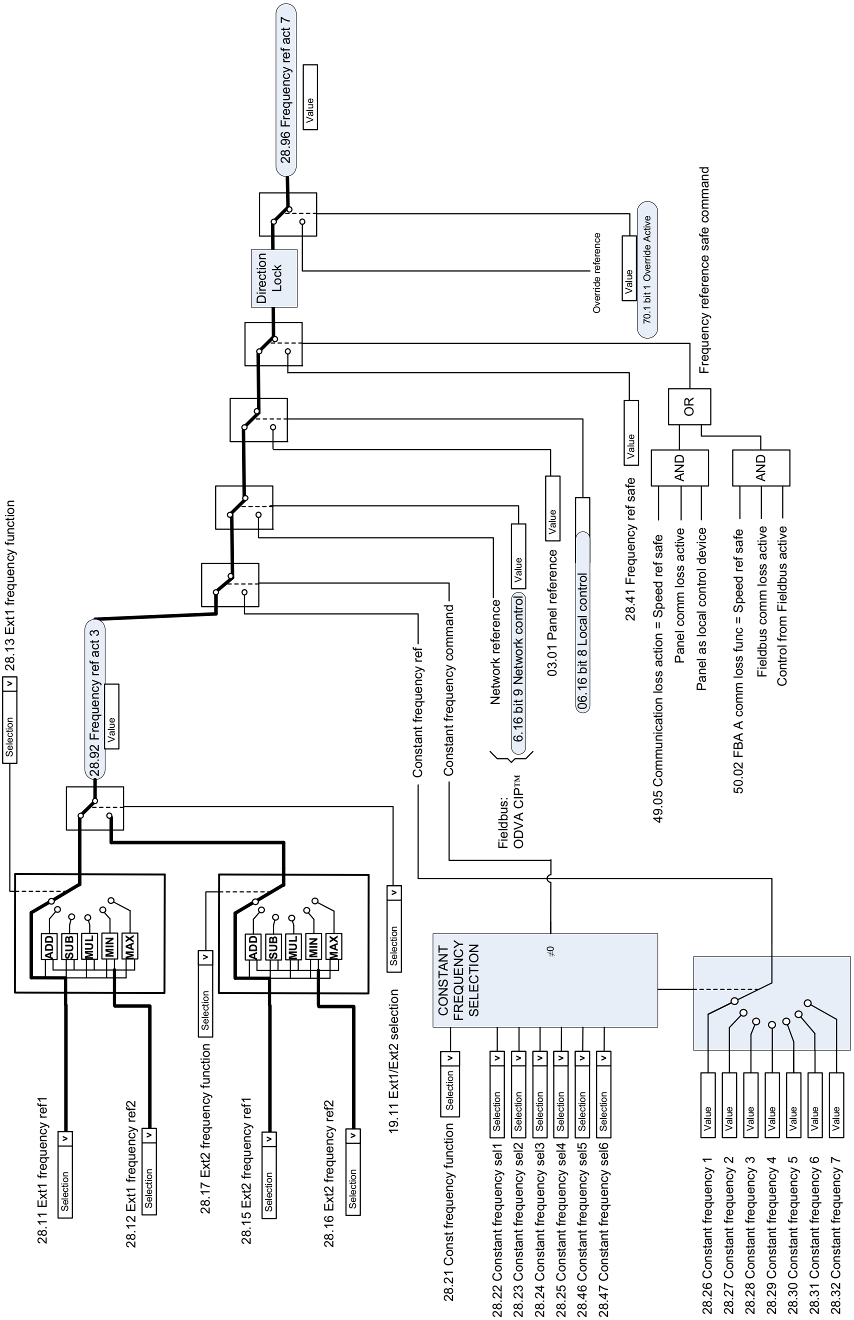
Contents of this chapter

This chapter presents the reference chains of the drive. The control chain diagrams can be used to trace how parameters interact and where parameters have an effect within the drive parameter system.

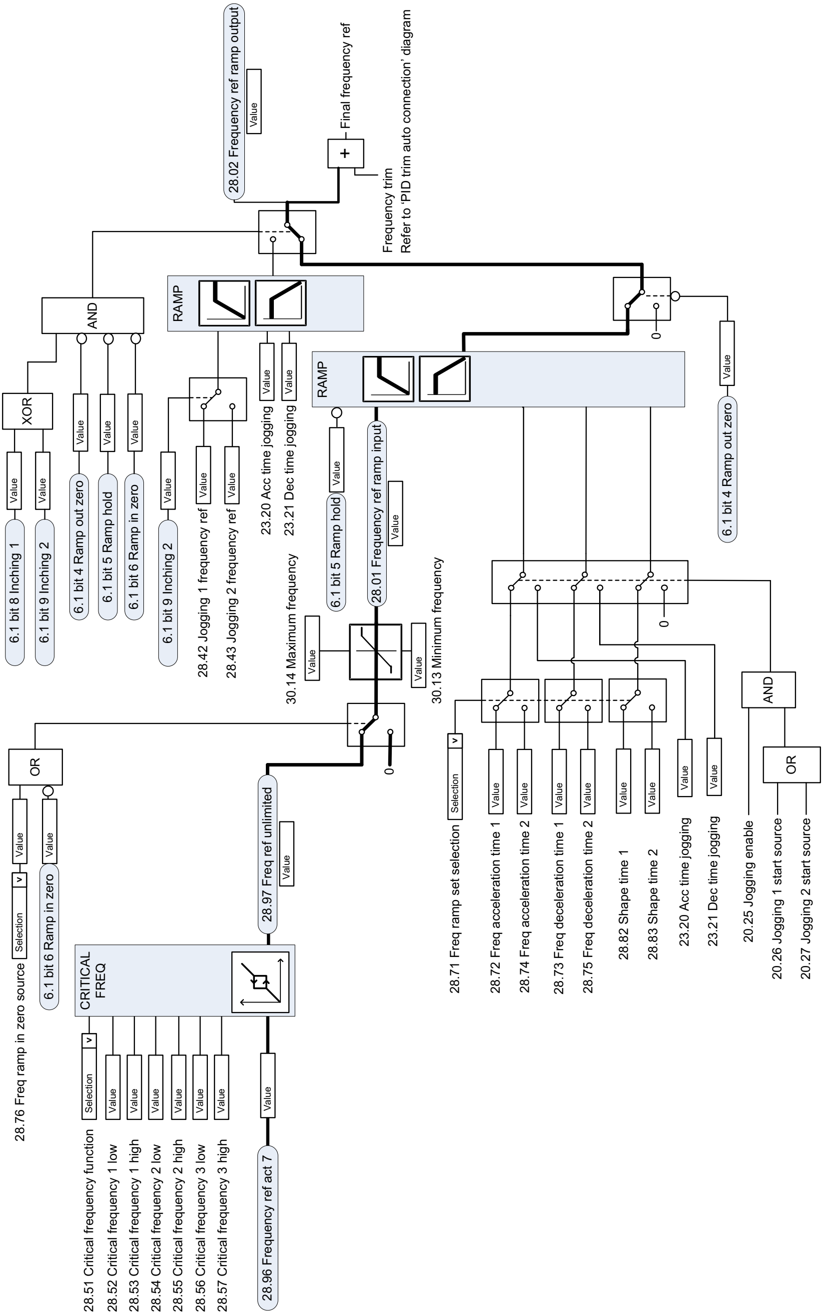
For a more general diagram, see section *Operating modes and motor control modes* on page *52*.

Note: The panel references in the diagrams refer to ACX-AP-x Assistant control panels and the Drive Composer PC tool.

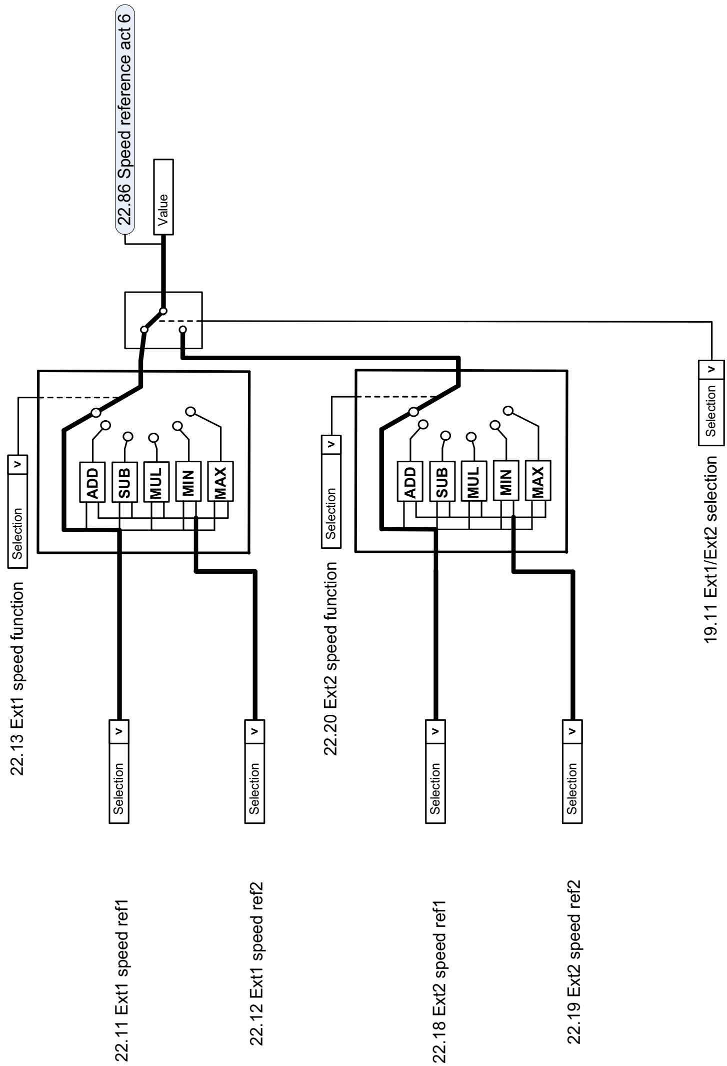
Frequency reference selection



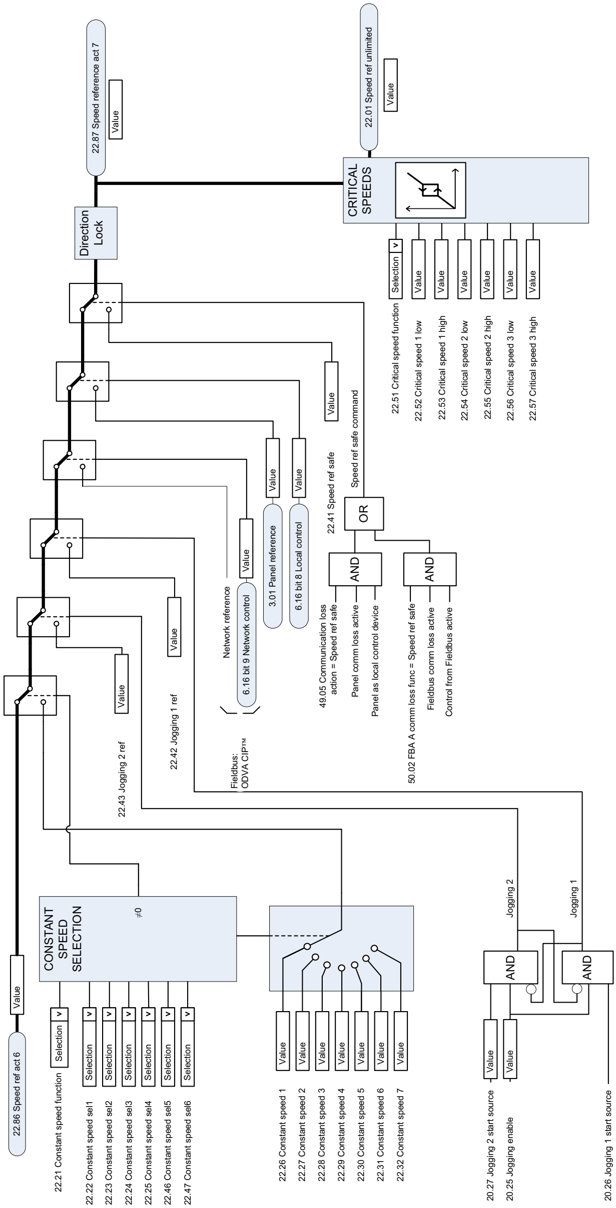
Frequency reference modification



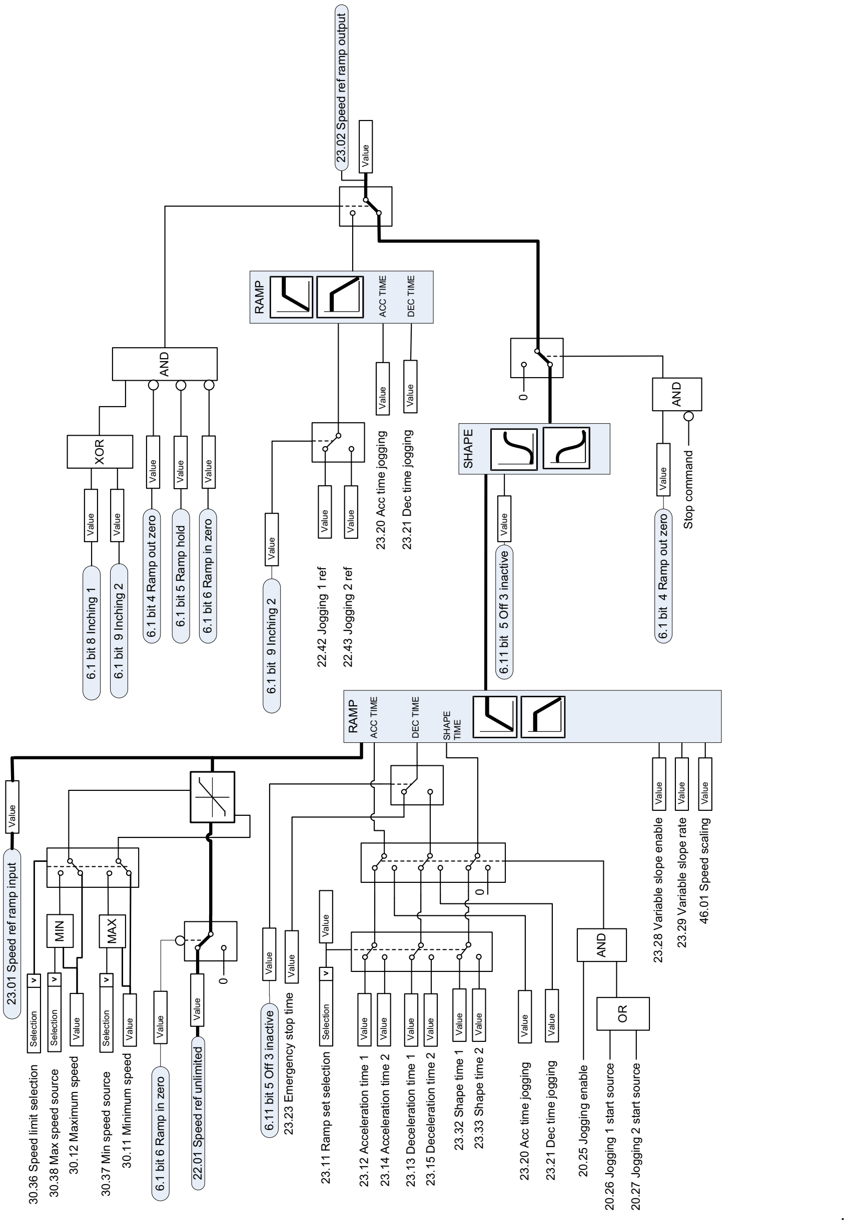
Speed reference source selection I



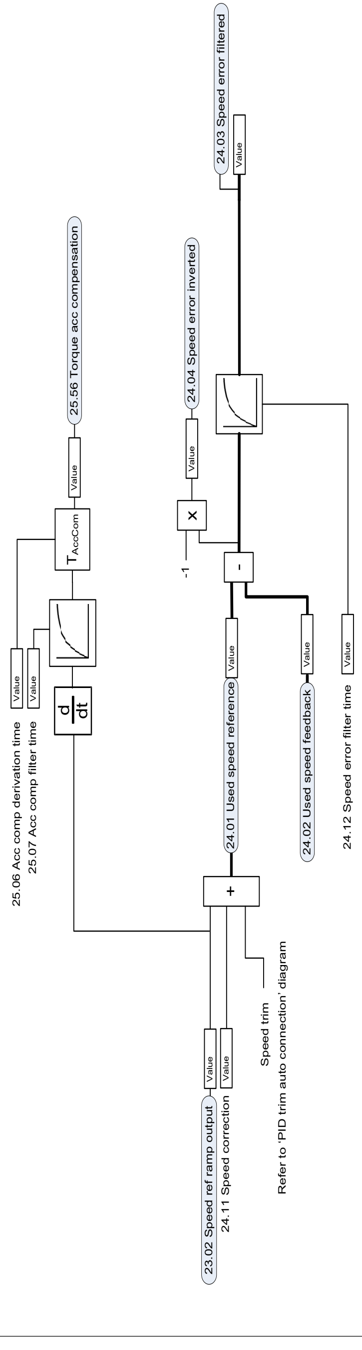
Speed reference source selection II



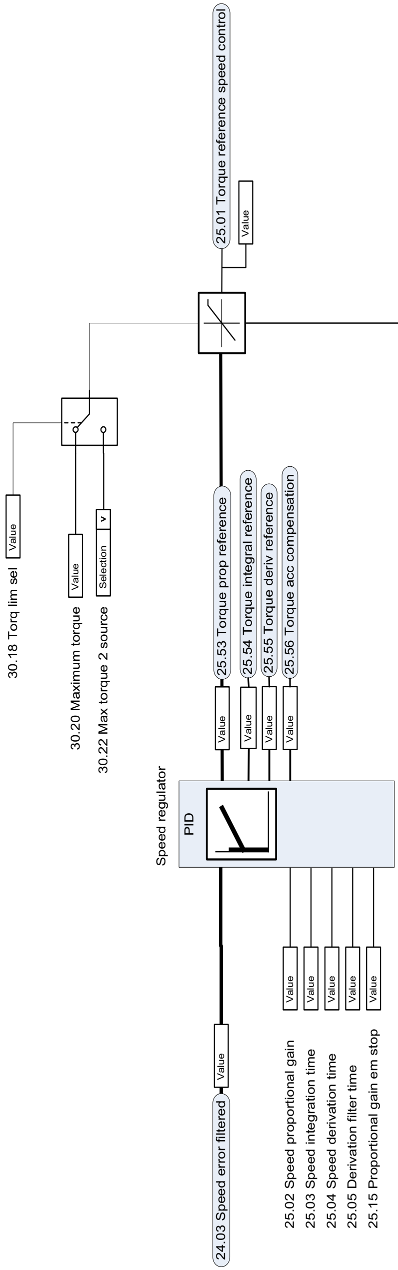
Speed reference ramping and shaping



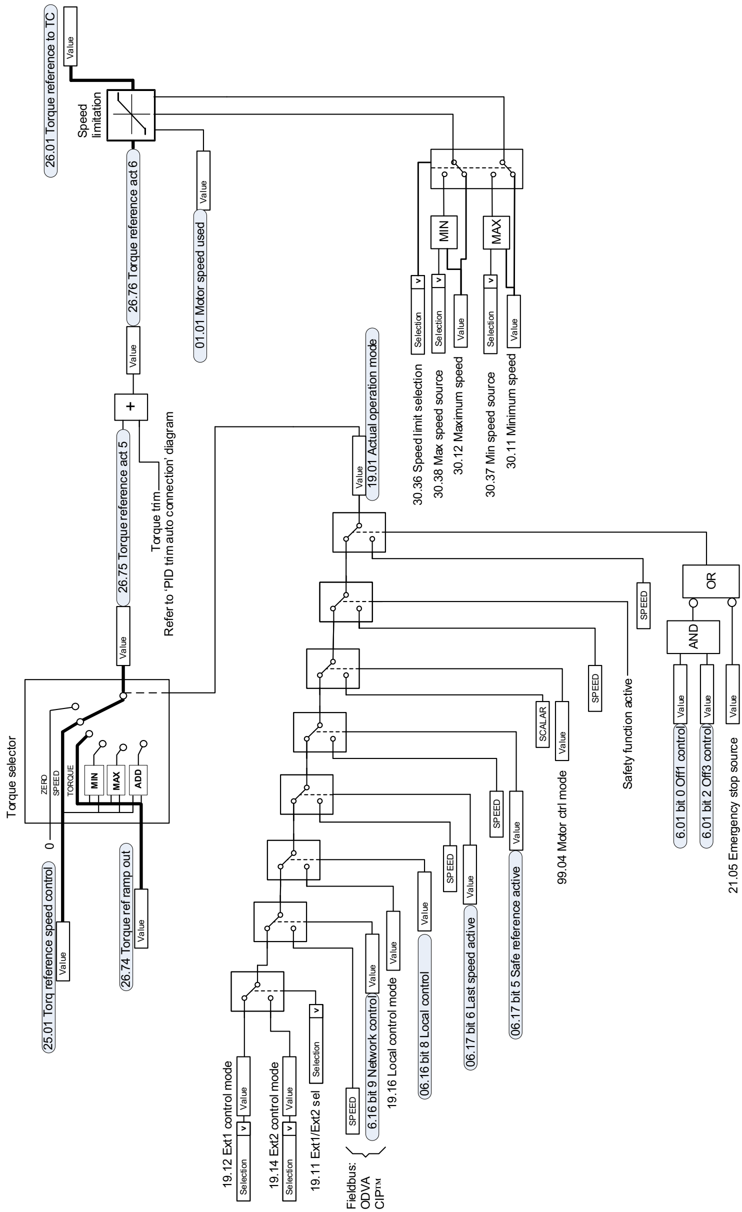
Speed error calculation



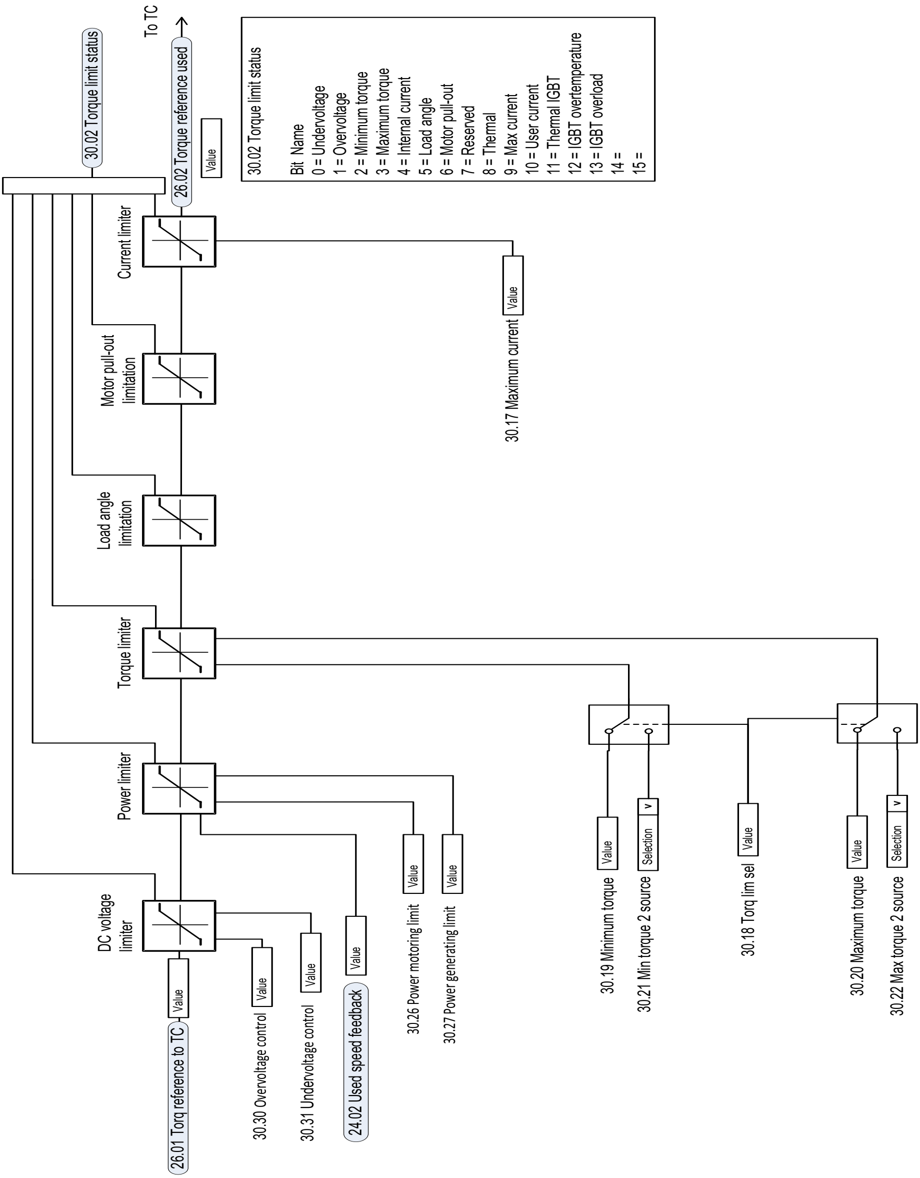
Speed controller



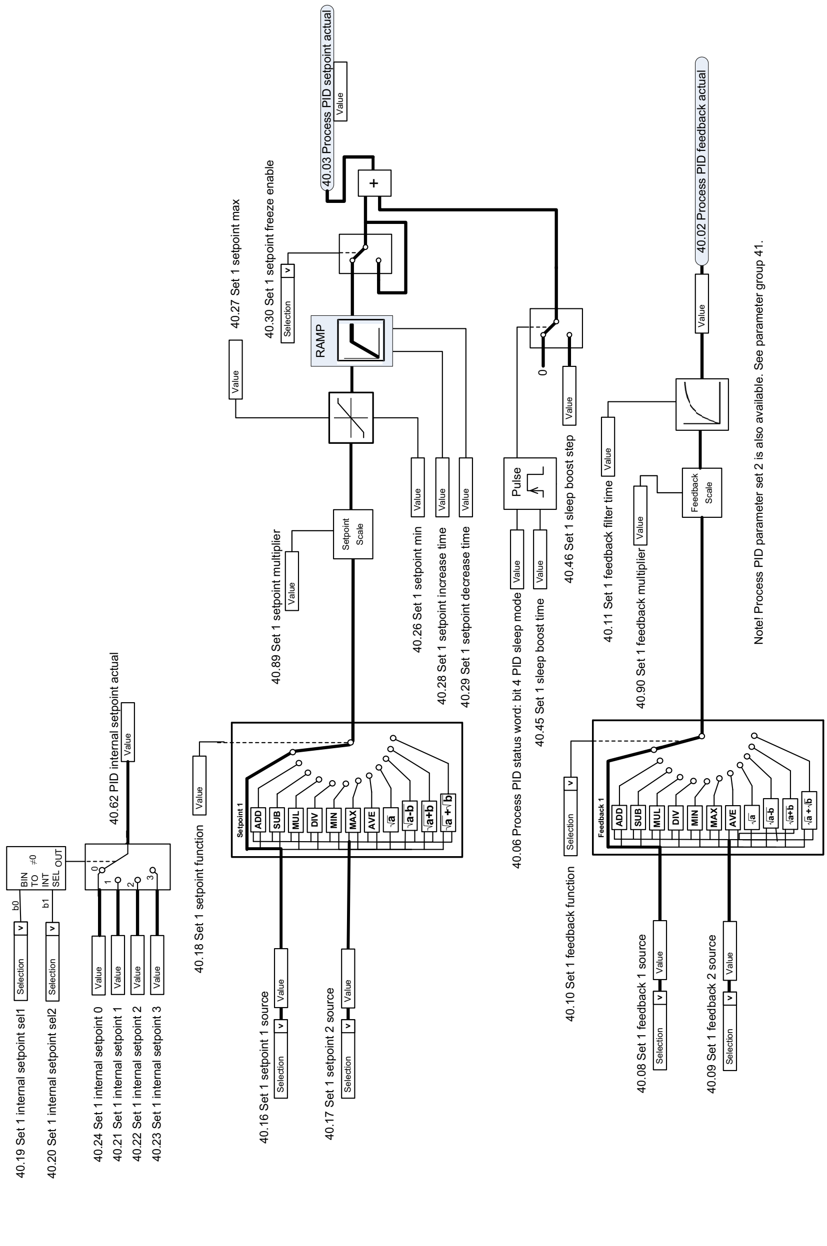
Reference selection for torque controller



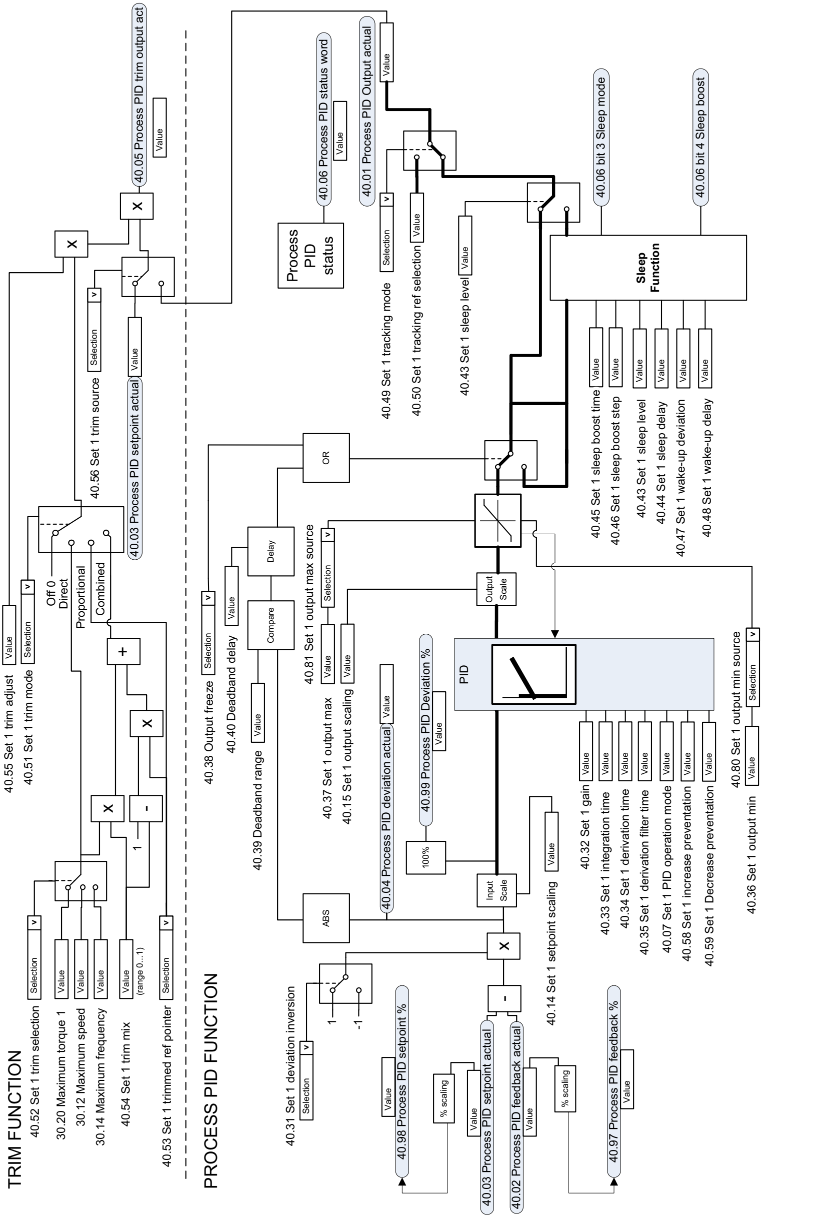
Torque limitation



Process PID setpoint and feedback source selection

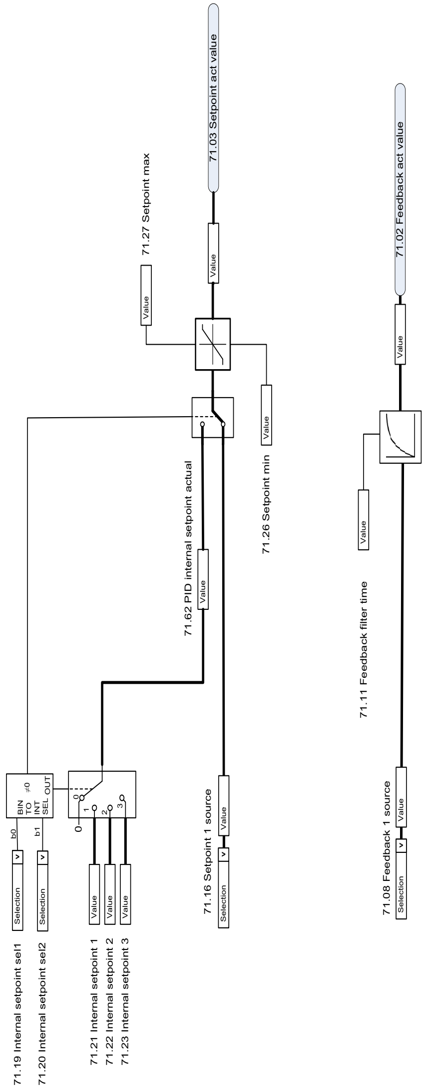


Process PID controller

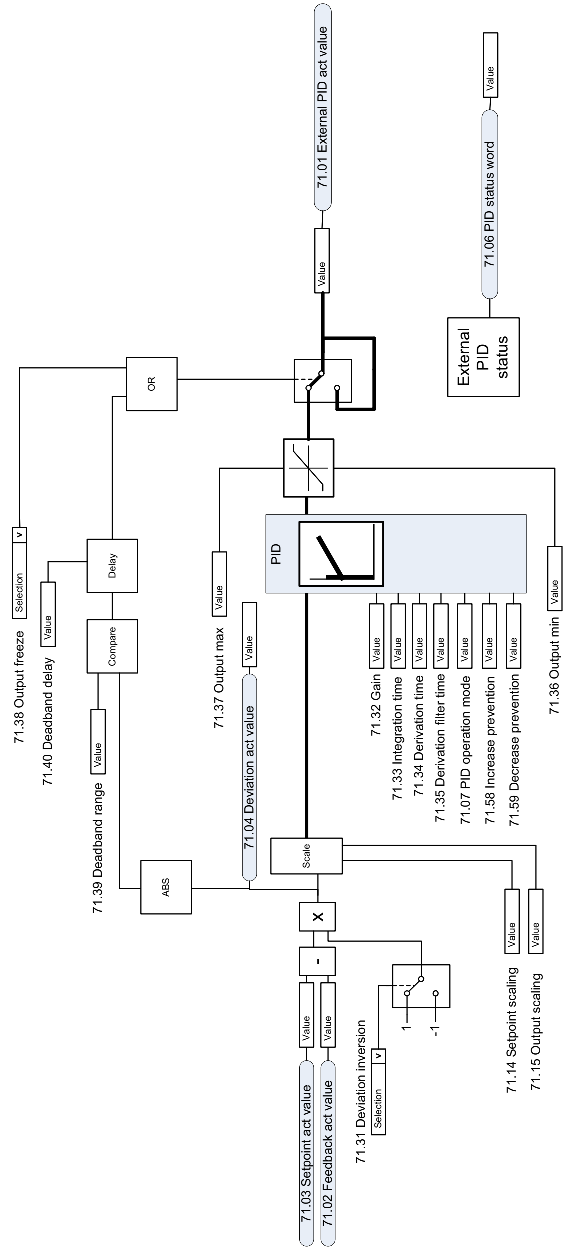


Note! Process PID parameter set 2 is also available. See parameter group 41.

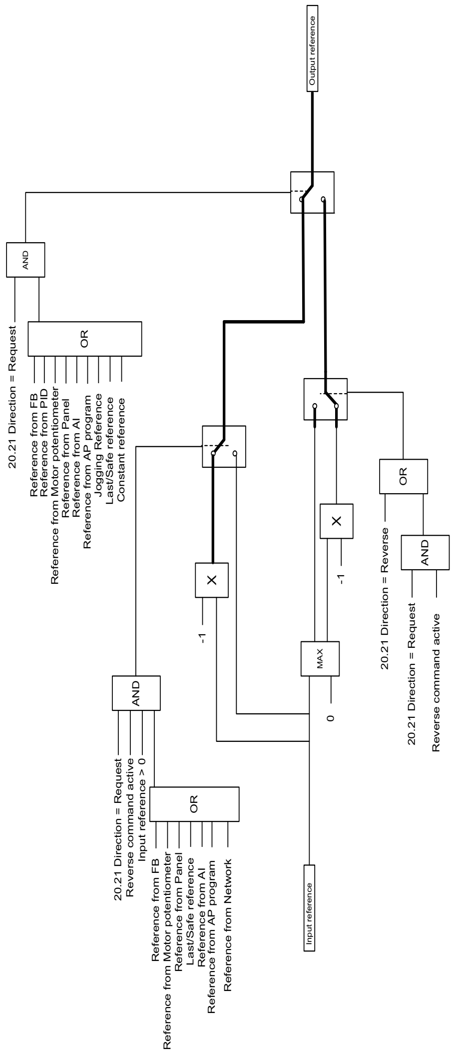
External PID setpoint and feedback source selection



External PID controller



Direction lock



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Appendix A - ACS380 in crane applications

This chapter describes the functions within the control program that are specific to the crane application, how to use them, and how to configure them to operate. If required, you can use these functions for other applications also.

Contents

Overview of the crane control program

The ACS380 drives can be used in cranes such as

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

These cranes require independent movements. Indoor EOT cranes and tower cranes have motions such as hoist, trolley and long travel. Outdoor tower cranes typically have motions such as hoist, trolley, and slew.

The start, stop and control signals can be analog, digital, or fieldbus-based from a programmable logic controller (PLC) or a manual control device such as joystick. For a typical crane control interface, see section *Control connections* on page *668*.

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

Quick 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 *628*)
- *Control through the I/O interface using the step reference logic/pendant control* (page *633*)
- *Control through the fieldbus interface using the fieldbus control word* (page *638*).

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

- *Configuring slowdown with two limits and stop limit logic* (page *643*)
- *Configuring speed feedback using a HTL/TTL pulse encoder* (page *642*)
- *Configuring Mechanical brake control* (page *647*).

Before the start-up, perform the following:

1. Make sure that the necessary IO connections are available. To configure necessary I/O connections, set the below parameters:

No.	Name	Value
11.09	*DIO2 configuration*	*Input*
22.22	*Constant speed sel1*	*Always off*
22.23	*Constant speed sel2*	*Always off*
23.11	*Ramp set selection*	*Acc/Dec time 1*

2. In scalar motor control or in trolley and long travel movements, disable torque proving and brake open torque. See *Configuring Mechanical brake control* on page *647*.

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 with a joystick.

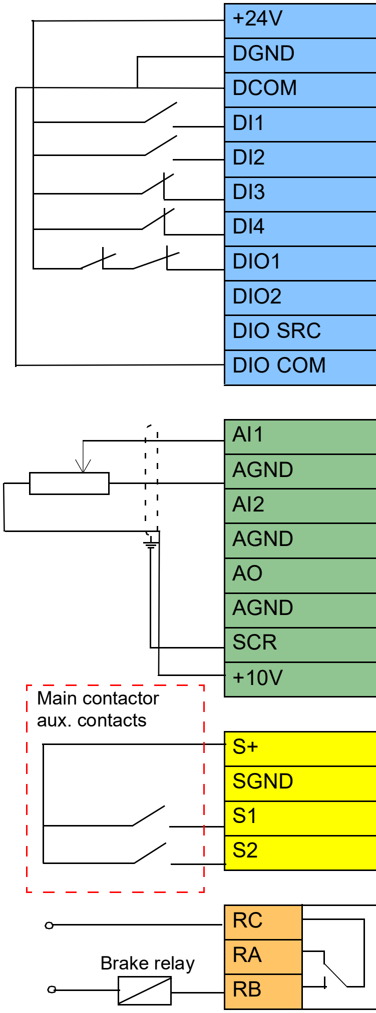
Safety	
⚠	**WARNING!** Obey all safety instructions for the drive. Only qualified electricians are allowed to start up the drive.
Preliminary actions	
☐	Make sure that you have completed the basic start-up sequence of the drive. See *Start-up, ID run and use* on page *23*. Make sure that the motor control method is selected as vector control (*99.04*).
☐	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.
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 as expected according to the command given by the default brake control signal interface (relay output RO1): • Open the brake temporarily by setting parameter *10.24 RO1 source* to *Energized*. Verify that the break opens. • Set parameter *10.24 RO1 source* to *Brake command* to use the default brake control signal interface.
Control signal settings	
☐	Select the signal sources for start and stop control. *20.01 Ext1 commands* = *In1 Start fwd; In2 Start rev* *20.02 Ext1 start trigger type* = *Edge* *20.03 Ext1 in1 source* = *DI1* *20.04 Ext1 in2 source* = *DI2*
☐	Select the signal source for speed reference 1. *22.11 Ext1 speed ref1* = *AI1 scaled* *22.13 Ext1 speed function* = *Abs (ref1)*
☐	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. *23.11 Ramp set selection* *23.12 Acceleration time 1* *23.13 Deceleration time 1* *23.14 Acceleration time 2* *23.15 Deceleration 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 control settings	
☐	Make sure that the brake control logic is activated. *44.06 Brake control enable* = *Selected* *10.24 RO1 source* = *Brake command*
☐	Define brake opening and closing delays. *44.08 Brake open delay* = eg. 1 s *44.13 Brake close delay* = eg. 1 s
☐	Select the source for the brake acknowledgment signal. *44.07 Brake acknowledge selection* = as per the application requirements (eg. *No acknowledge*)
☐	If you set up a hoist drive, set the parameters as below: *44.09 Brake open torque source* = *Brake open torque* *44.10 Brake open torque* = 30% (this value works as minimum value when *Brake torque memory* is selected) *44.202 Torque proving* = *Selected* *44.203 Torque proving reference* = 25.0 *44.204 Brake system check time* = 0.30 If you set up a trolley or long travel drive, set the parameters as below: *44.09 Brake open torque source* = *Zero* *44.10 Brake open torque* = 0% *44.202 Torque proving* = *Not selected* **Note:** These values are also recommended when you use scalar control mode (*99.04*) for the hoist drive.

Trial run	
☐	Do a trial run with no load.
☐	Make sure that the brake and safety circuits are working.
☐	Do a trial run with real load.

Control connections

The diagram shows the control connections for the joystick set-up described on page 628.



Terminals	Description
	Digital I/O connections
+24V	Aux. +24 V DC, max 200 mA
DGND	Aux. voltage output common
DCOM	Digital input common
DI1	Start forward
DI2	Start reverse
DI3	Stop limit 1 (forward)
DI4	Stop limit 2 (reverse)
DIO1	Slowdown
DIO2	Not configured
DIO SRC	Digital output auxiliary voltage
DIO COM	Digital input/output common
	Analog I/O
AI1	Speed / freq (0...10V)
AGND	Analog input circuit common
AI2	Not configured
AGND	Analog input circuit common
AO	Output frequency (0...20 mA)
AGND	Analog output circuit common
SCR	Signal cable shield (screen)
+10V	Ref. voltage +10 V DC
	Safe torque off (STO)
S+	Safe torque off. Connected at factory. Drive starts only if both circuits are closed. Status from *06.18 Start inhibit status word* (1 = STO active, circuits are open).
SGND	
S1	
S2	
	Relay output 1
RC	Brake command (*10.24 RO1 source* = *Brake command*)
RA	
RB	

Notes:

Terminal sizes: 0.14 mm² … 1.5 mm².

Tightening torque: 0.5 N·m (0.4 lbf·ft).

Terminals DGND, AGND and SGND are internally connected to same reference potential.

Input signals

- Start forward (DI1)
- Start reverse (DI2)
- Stop limit 1 (forward) (DI3)
- Stop limit 2 (reverse) (DI4)
- Slowdown (DIO1)

Output signals

- Speed / freq (0...10V) (AI1)
- Output frequency (0...20mA) (AO)
- Brake command (RO1)

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

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

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 *Start-up, ID run and use* on page *23*. Make sure that the motor control method is selected as vector control (*99.04*).
☐	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.
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 as expected according to the command given by the default brake control signal interface (relay output RO1): • Open the brake temporarily by setting parameter *10.24 RO1 source* to *Energized*. Verify that the brake opens. • Set parameter *10.24 RO1 source* to *Brake command* to use the default brake control signal interface.
Control signal settings	
☐	Select the signal sources for start and stop control. *20.01 Ext1 commands* = *In1 Start fwd; In2 Start rev* *20.02 Ext1 start trigger type* = *Edge* *20.03 Ext1 in1 source* = *DI1* *20.04 Ext1 in2 source* = *DI2*
☐	Define the step reference logic (4 steps). *22.21 Constant speed function* = Set speed step bit 2 = 1 (0b0100) *22.22 Constant speed sel1* = *DI3* *22.23 Constant speed sel2* = *DI4* *22.24 Constant speed sel3* = *DIO1* (*11.05 DIO1 configuration* = *Input*) *22.26 Constant speed 1* = 300.00 *22.27 Constant speed 2* = 600.00 *22.28 Constant speed 3* = 1000.00 *22.29 Constant speed 4* = 1500.00

☐	Set the required ramp times. *23.11 Ramp set selection* *23.12 Acceleration time 1* *23.13 Deceleration time 1* *23.14 Acceleration time 2* *23.15 Deceleration time 2*
☐	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 control settings	
☐	Make sure that the brake control logic is activated. *44.06 Brake control enable* = *Selected* *10.24 RO1 source* = *Brake command*
☐	Define brake opening and closing delays. *44.08 Brake open delay* = eg. 1 s *44.13 Brake close delay* = eg. 1 s
☐	Select the source for the brake acknowledgment signal. *44.07 Brake acknowledge selection* = as per the application requirements (eg. *No acknowledge*)
☐	If you set up a hoist drive, set the parameters as below: *44.09 Brake open torque source* = *Brake open torque* *44.10 Brake open torque* = 30% (this value works as minimum value when *Brake torque memory* is selected) *44.202 Torque proving* = *Selected* *44.203 Torque proving reference* = 25.0 *44.204 Brake system check time* = 0.30 If you set up a trolly or a long travel drive, set the parameters as below: *44.09 Brake open torque source* = *Zero* *44.10 Brake open torque* = 0% *44.202 Torque proving* = *Not selected* **Note:** These values are also recommended when you use scalar control mode (*99.04*) for the hoist drive.

Trial run	
☐	Do a trial run with no load.
☐	Make sure that the brake and safety circuits are working.
☐	Do a trial run with real load.

Control connections

The diagram shows the control connections for the step reference set-up described on page *678*.

Terminals	Description
	Digital I/O connections
+24V	Aux. +24 V DC, max 200 mA
DGND	Aux. voltage output common
DCOM	Digital input common
DI1	Start forward (Serial with stop limit 1)
DI2	Start reverse (Serial with stop limit 2)
DI3	Speed step sel 2
DI4	Speed step sel 3
DIO1	Speed step sel 4
DIO2	Not configured
DIO SRC	Digital output auxiliary voltage
DIO COM	Digital input/output common
	Analog I/O
AI1	Speed / freq.(0...10V)
AGND	Analog input circuit common
AI2	Not configured
AGND	Analog input circuit common
AO	Output frequency (0...20 mA)
AGND	Analog output circuit common
SCR	Signal cable shield (screen)
+10V	Ref. voltage +10 V DC
	Safe torque off (STO)
S+ SGND S1 S2	Safe torque off. Connected at factory. Drive starts only if both circuits are closed. Status from *06.18 Start inhibit status word* (1 = STO active, circuits are open), *20.212 Power on acknowledge*, and *20.12 Run enable 1 source*.
	Relay output 1
RC RA RB	Brake command (*10.24 RO1 source* = *Brake command*)

Notes:

Terminal sizes: 0.14 mm² … 1.5 mm².

Tightening torque: 0.5 N·m (0.4 lbf·ft).

Terminals DGND, AGND and SGND are internally connected to same reference potential.

Input signals

- Start forward (Serial with stop limit 1) (DI1)
- Start reverse (Serial with stop limit 2) (DI2)
- Speed step sel 2 (DI3)
- Speed step sel 3 (DI4)
- Speed step sel 4 (DIO1)

Output signals

- Speed / freq (0...10V) (AI1)
- Output frequency (0...20 mA) (AO)
- Brake command (RO1)

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 *Start-up, ID run and use* on page *23*. **Note:** While performing the start up procedures, make sure that the motor control method is selected as vector control (*99.04*).
☐	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.
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 as expected according to the command given by the default brake control signal interface (relay output RO1): • Open the brake temporarily by setting parameter *10.24 RO1 source* to *Energized*. Verify that the break opens. • Set parameter *10.24 RO1 source* to *Brake command* to use the default brake control signal interface.
Basic fieldbus adapter settings	
☐	See chapter *Automatic drive configuration for fieldbus control* on page *600*.
Control signal settings	
☐	Select the signal sources for start and stop control. *20.01 Ext1 commands* = *Fieldbus A* *20.02 Ext1 start trigger type* = *Level*
☐	Select the signal source for speed reference 1. *22.11 Ext1 speed ref1* = *FB A ref1*

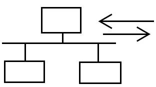
☐	Set the required ramp times. *23.11 Ramp set selection* *23.12 Acceleration time 1* *23.13 Deceleration time 1* *23.14 Acceleration time 2* *23.14 Deceleration time 2*
☐	Set the speed limits. *30.11 Minimum speed* *30.12 Maximum speed* *46.01 Speed scaling*
☐	Set the torque and current limits. *30.17 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 control settings	
☐	Make sure that the brake control logic is activated. *44.06 Brake control enable* = *Selected* *10.24 RO1 source* = *Brake command*
☐	Define brake opening and closing delays. *44.08 Brake open delay* = eg. 1 s *44.13 Brake close delay* = eg. 1 s
☐	Select the source for the brake acknowledgment signal. *44.07 Brake acknowledge selection* = as per the application requirements (eg. DI3 or No acknowledge)
☐	If you set up a hoist drive, set the parameters as below: *44.09 Brake open torque source* = *Brake open torque* *44.10 Brake open torque* = 30% (this value works as minimum value when *Brake torque memory* is selected) *44.202 Torque proving* = *Selected* *44.203 Torque proving reference* = 25.0 *44.204 Brake system check time* = 0.30 If you set up a trolley or long travel drive, set the parameters as below: *44.09 Brake open torque source* = *Zero* *44.10 Brake open torque* = 0% *44.202 Torque proving* = *Not selected* **Note:** These values are also recommended when you use scalar control mode (*99.04*) for the hoist drive.

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 connection for the fieldbus control set-up

The diagram below shows the control connections for the fieldbus control word set-up described on page *638*.

Terminals	Description
	Digital I/O connections
+24V	Aux. +24 V DC, max 200 mA
DGND	Aux. voltage output common
DCOM	Digital input common
DI1	Fault reset
DI2	Not configured
	Analog I/O
	Safe torque off (STO)
S+ SGND S1 S2	Safe torque off. Connected at factory. Drive starts only if both circuits are closed. Status from *06.18 Start inhibit status word* (1 = STO active, circuits are open),*20.212 Power on acknowledge* and *20.12 Run enable 1 source*.
	Relay output 1
RC RA RB	Brake command (*10.24 RO1 source* = *Brake command*)



DSUB9	CANopen	Fieldbus module connections
DSUB9	Profibus DP	+K457 FCAN-01-M CANopen
RJ45 X 2	EtherCAT	+K454 FPBA-01-M PROFIBUS DP
RJ45 X 2	Ethernet IP	+K469 FECA-01-M EtherCAT
RJ45 X 2	Profinet	+K475 FENA-21-M Ethernet/IP, PROFINET, Modbus TCP
RJ45 X 2	Modbus TCP	+K495 BCAN-11 CANopen interface
Terminal Block	CANopen	

Notes:

Terminal sizes: 0.14 mm² … 1.5 mm².

Tightening torque: 0.5 N·m (0.4 lbf·ft).

Terminals DGND, AGND and SGND are internally connected to same reference potential.

Input signals

- Fault reset (DI1)
- Control words and reference words through the fieldbus adapter module

Output signals

- Status words and status signals through the fieldbus adapter module
- Brake command (RO1)

Configuring speed feedback using a HTL/TTL pulse encoder

You can configure the speed feedback with a BTAC pulse encoder interface module (option +L535). This adds a digital pulse encoder interface to the drive and provides accurate speed or position (angle) feedback from the motor shaft.

Note: ABB product offering for cranes highlights safety and performance. You should use components that increases safety. For example, in hoist crane application drives, closed loop control (encoder or external supervision) must be used for safe speed supervision.

The figure below shows the ACS380 drive with BTAC module.

For information related to mechanical and electrical installation, see the hardware manual of the drive.

	Safety
☐	⚠ **WARNING!** Obey all safety instructions for the drive. Only qualified electricians are allowed to start up the drive.
	Parameter settings
☐	Power up the BTAC module and the drive (if external supply).
☐	Set the feedback selection. *90.41 Motor feedback selection* = *Encoder 1* *90.45 Motor feedback fault* = *Fault*
☐	Set the number of pulses according to encoder nameplate (*92.10 Pulses/revolution*).

☐	Set parameter *91.10 Encoder parameter refresh* to *Refresh*, to apply the new parameter settings. The parameter automatically changes to *Done* after application of the new settings. This must be performed whenever you change the encoder parameters.
Trial run	
☐	Temporarily set parameter *90.41* to *Estimate*. Perform a trial run. Observe encoder feedback from signal *90.10 Encoder 1 speed* and compare with *01.02 Motor speed estimated*. If the difference between values are not high, set *90.41 90.41* to *Encoder 1*.

Configuring slowdown with two limits and stop limit logic

Slowdown limit inputs

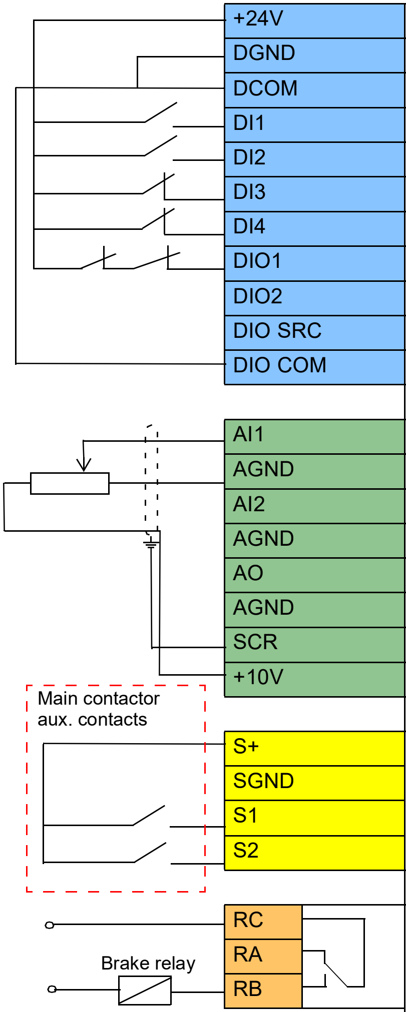
Safety	
☐	**WARNING!** Obey all safety instructions for the drive. Only qualified electricians are allowed to start up the drive.
Parameter settings	
☐	Enable limit control. *76.02 Enable limit to limit control* = *Selected*
☐	Set triggering type for signals. *76.03 Limit to limit trigger type* = *Level low*
☐	Select slowdown inputs. *76.05 Forward slow down limit* *76.07 Reverse slow down limit* Either select one incoming signal in both directions, or two inputs, one input for each direction. See section *Crane slowdown function* on page*664*.
☐	Select slowdown speed or frequency according to the selected reference. *76.08 Slow down speed* or *76.09 Slow down frequency*
Trial run	
☐	Test the connected inputs and outputs in the local control mode before the final trial run. **Note:** If digital input/output (DIO1 or DIO2) is in use, set correct configuration. *11.05 DIO1 configuration* =*Input* or *11.09 DIO2 configuration* = *Input*

Stop limit

Safety	
☐	⚠ **WARNING!** Obey all safety instructions for the drive. Only qualified electricians are allowed to start up the drive.
Parameter settings	
☐	Enable limit control. *76.02 Enable limit to limit control* = *Selected*
☐	Set triggering type for signals to be level. *76.03 Limit to limit trigger type* = *Level low*
☐	Select stop limit inputs *76.04 Forward stop limit* *76.06 Reverse stop limit*
☐	Select stop ramp mode. *76.11 Limit stop mode*
☐	If *76.11 Limit stop mode* = *Limit ramp stop mode*, enter required ramp time to stop. *76.12 Limit stop ramp time* = e.g 0.500 s
Trial run	
☐	Test the connected inputs and outputs in the local control mode before the final trial run. **Note:** Instead of stop limit logic, the switches can be connected serial with start orders

Control connection diagram

The diagram below shows the control connection example for the slowdown limit and stop limit function described on page *643*.



Terminals	Description
	Digital I/O connections
+24V	Aux. +24 V DC, max 200 mA
DGND	Aux. voltage output common
DCOM	Digital input common
DI1	Start forward
DI2	Start reverse
DI3	Stop limit 1 (forward)
DI4	Stop limit 2 (reverse)
DIO1	Slowdown
DIO2	Not configured
DIO SRC	Digital output auxiliary voltage
DIO COM	Digital input/output common
	Analog I/O
AI1	Speed / freq.(0...10V)
AGND	Analog input circuit common
AI2	Not configured
AGND	Analog input circuit common
AO	Output frequency (0...20 mA)
AGND	Analog output circuit common
SCR	Signal cable shield (screen)
+10V	Ref. voltage +10 V DC
	Safe torque off (STO)
S+ SGND S1 S2	Safe torque off. Connected at factory. Drive starts only if both circuits are closed. Status from *06.18 Start inhibit status word* (1 = STO active, circuits are open).
	Relay output 1
RC RA RB	Brake command (*10.24 RO1 source* = *Brake command*)

Notes:

Terminal sizes: 0.14 mm² … 1.5 mm².

Tightening torque: 0.5 N·m (0.4 lbf·ft).

Terminals DGND, AGND and SGND are internally connected to same reference potential.

Input signals

- Start forward (DI1)
- Start reverse (DI2)
- Stop limit 1 (forward) (DI3)
- Stop limit 2 (reverse) (DI4)
- Slowdown (DIO1)

Output signals

- Speed/freq(0...10V) (AI1)
- Output frequency (0...20 mA) (AO)
- Brake command (RO1)

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*
☐	Select the source for the brake acknowledgment signal. *44.07 Brake acknowledge selection* = as per the application requirements (eg. DI3 or No acknowledge)
☐	Define the brake open and close delay. *44.08 Brake open delay* = eg. 1 s *44.13 Brake close delay* = eg. 1 s **Notes:** • Close delay time can be longer than the mechanical delay time provided by the mechanical brake manufacturer. • Longer delay time can cause small roll back, and short delay time can cause wear of the brake pads.
☐	Select the source for the brake opening torque. At first, select the following: *44.09 Brake open torque source* = *Brake open torque* *44.10 Brake open torque* = 30% **Notes:** • The break opening torque is meant for hoisting application only, and is not necessary to use it with trolley and long travel movement applications. If used for trolley or long travel movement applications, set the value of both parameters as 0%. • In scalar motor control or in trolley and long travel movements, disable Torque proving and Brake open torque. Select the following: *44.09 Brake open torque source* = *Zero* *44.10 Brake open torque* = 0% *44.202 Torque proving* = *Not selected* *44.203 Torque proving reference* = 0%
☐	Set the brake close level. *44.14 Brake close level* = 30 rpm or 60 rpm When an encoder is used, the value needs to be set as 10-30 rpm else set the value as 60 rpm.
☐	Set break fault function to fault. *44.17 Brake fault function* = *Fault*

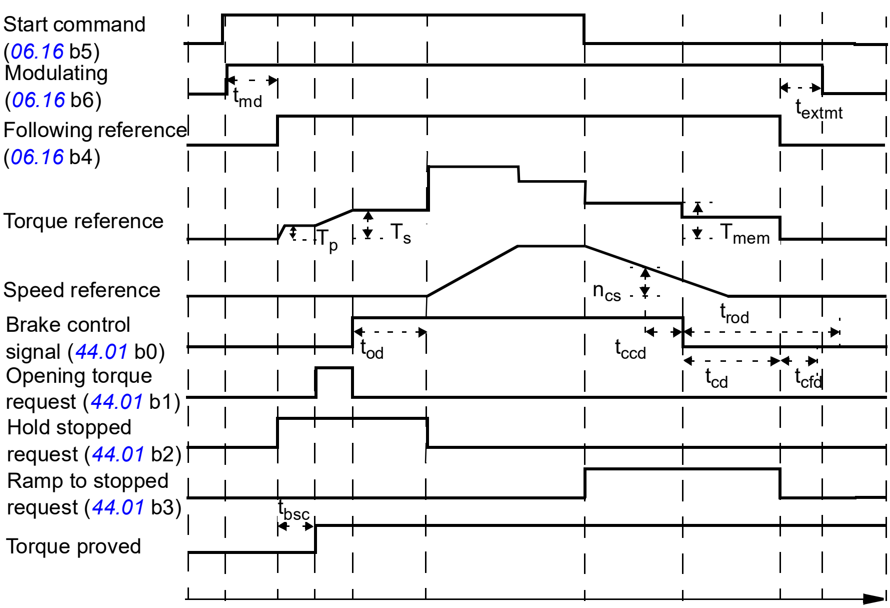
☐	For hoist drives, set the parameters as below: *44.202 Torque proving* = *Selected* *44.203 Torque proving reference* = 30%
☐	Set the extended runtime to keep the drive modulating after the brake is closed. This magnetizes the drive before the next start and enables faster response to the control commands. *44.211 Extended runtime*
☐	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	
☐	Tune the brake control parameters during final testing and when you monitor the actual speed and torque. This helps 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.

Crane mechanical brake control

In addition to the existing mechanical brake control function (see page *98*), the crane mechanical brake control function consists of brake system check (see page *650*) and extended run time (see page *655*) functions.

The *Crane brake control timing diagram* below shows an example of a close-open-close sequence and illustrates the operation of the crane brake control function.

Crane brake control timing diagram



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 open delay*)
n_{cs}	Brake close speed (parameter *44.14 Brake close level*)
t_{ccd}	Brake close command delay (parameter *44.15 Brake close level delay*)
t_{cd}	Brake close delay (parameter *44.13 Brake close delay*)
t_{cfd}	Brake close fault delay (parameter *44.18 Brake fault delay*)
t_{rod}	Brake reopen delay (parameter *44.16 Brake reopen delay*)
t_{bscd}	Brake system check time (parameter *44.204 Brake system check time*)
t_{extmt}	Extended run time (parameter *44.211 Extended runtime*)

Note: In case of any fault, the brake closes immediately. By default, the brake control uses relay output RO1.

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.

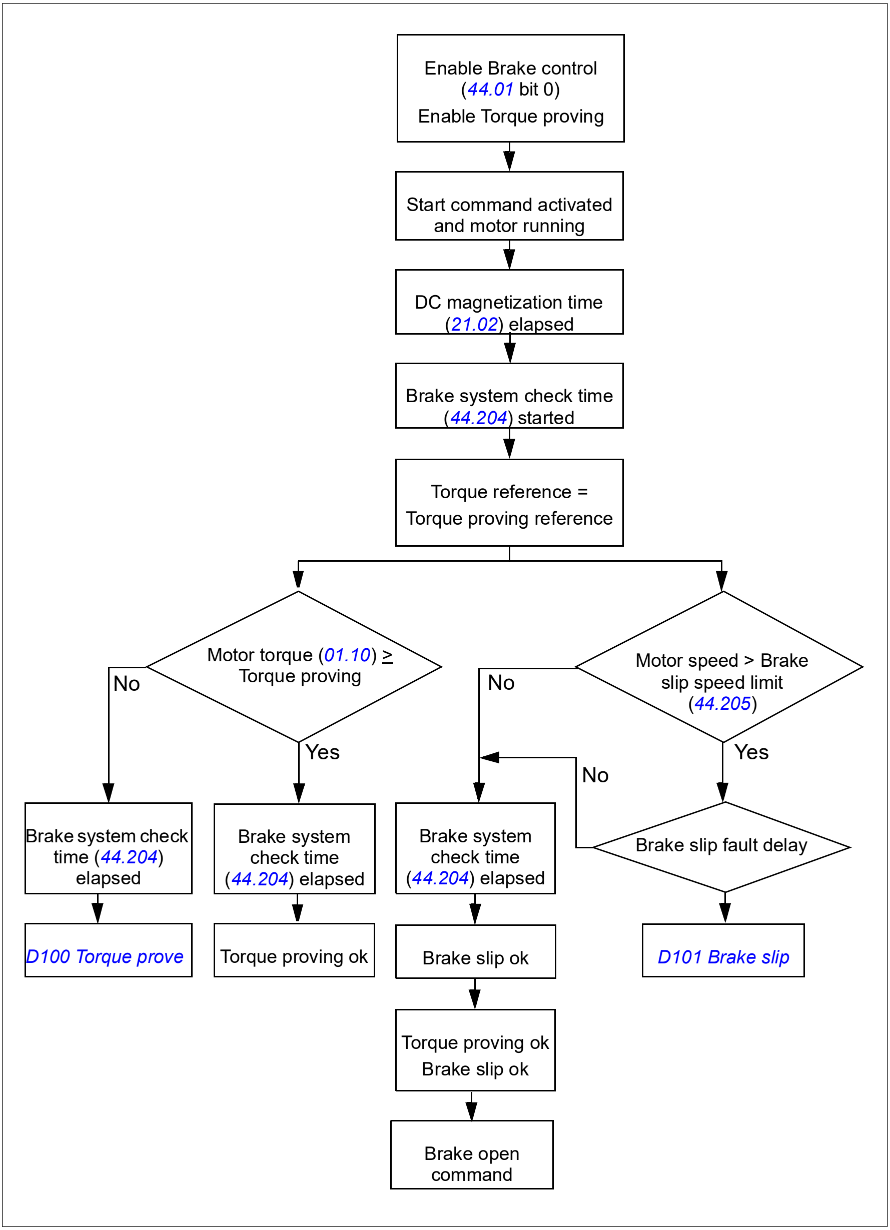
For more detailed information on the tests, see sections:

- *Brake system checks – Torque proving* on page *652*
- *Brake system checks – Brake slip* on page *653*.

Note: In scalar motor control or in trolley and long travel movements, disable Torque proving and Brake open torque. Select the following:

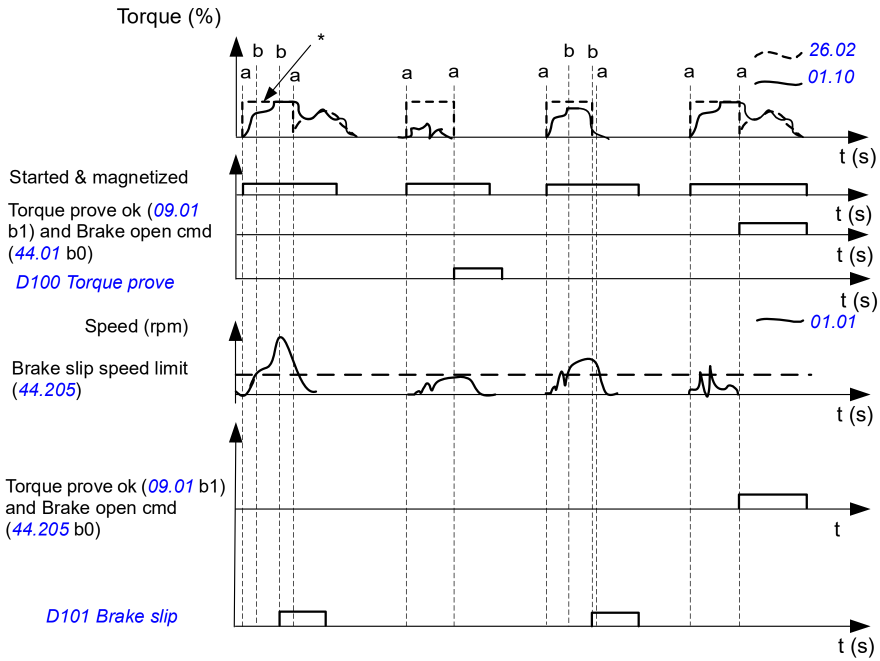
- *44.09 Brake open torque source* = Zero
- *44.10 Brake open torque*= 0%
- *44.202Torque proving* = *Not selected*

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 uses encoder feedback.

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.

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

See also the *Timing diagram* on page *652*.

Settings and diagnostics

- Parameters: *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 performs Torque proving with the brake closed. If the motor actual speed exceeds 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, *Timing diagram* on page *652*.

Note: In scalar motor control or in trolley and long travel movements, disable Torque proving and Brake open torque. Select the following:

- *44.09 Brake open torque source* = *Zero*
- *44.10Brake open torque*= 0%
- *44.202Torque proving* = *Not selected*

Settings and diagnostics

- 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*

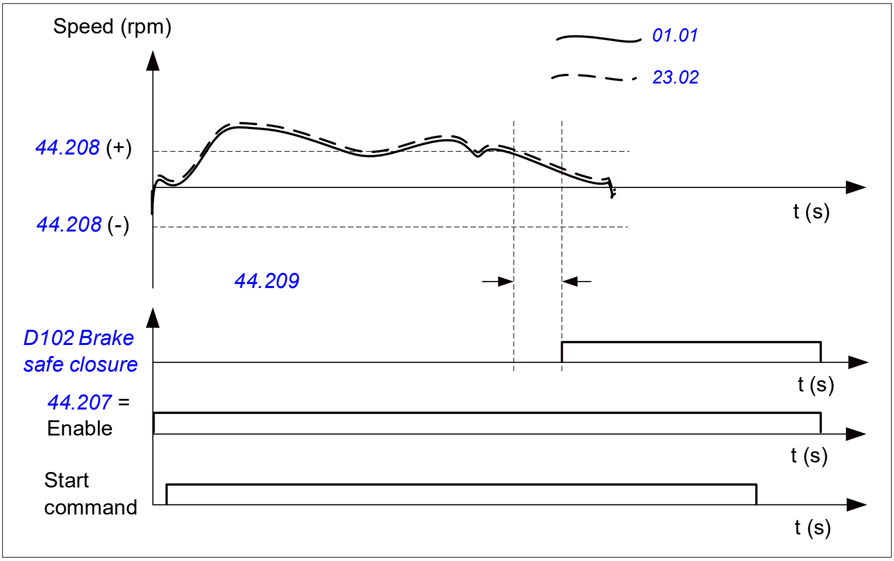
Brake safe closure

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

The below diagram shows the operation of the *Brake safe closure* fault.



Settings and diagnostics

- 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. After the brake closes and the brake close delay time elapses, the extended run time function keeps the motor magnetized for a defined time period. 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 *78*) and torque proving (page *652*).

The function activates when the following parameters are set:

- *44.06 Brake control enable* = *Selected*
- *44.211 Extended runtime* > 0.
- *44.212 Extended runtime sw* (Bit 0) = 1. After the brake closes, this modulates the drive for the defined time in parameter *44.211 Extended runtime*.

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

Refer the *Crane brake control timing diagram* (page *649*), to see the operation of the Extended run time function.

Notes:

- The Extended run time function is available only in vector control mode (see page *52*) when the drive is in Remote mode and only when parameter *21.03 Stop mode* is set as *Ramp*.
- If you enable Post magnetization function at the same time, post magnetization function executes first, and when post magnetization time elapses, the extended runtime should be set for the remaining time if extended runtime is longer than post magnetization time.

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

Settings and diagnostics

- Parameters: *44.211 Extended runtime*
- Signals: *44.01 Brake control status*, *44.212 Extended runtime sw*
- Warnings: -
- 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 (*76.33*)
- one for checking the speed deviation during a constant speed (*76.32*).

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 (*90.01*) and the ramped and shaped speed reference (*24.01*) is greater than the steady state deviation level for longer than a delay (*76.34*)

  or

- the motor is accelerating or decelerating, and the difference between the motor actual speed (*90.01*) and the ramped and shaped speed reference (*24.01*) is greater than the ramping state deviation level for longer than a delay (*76.34*).

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

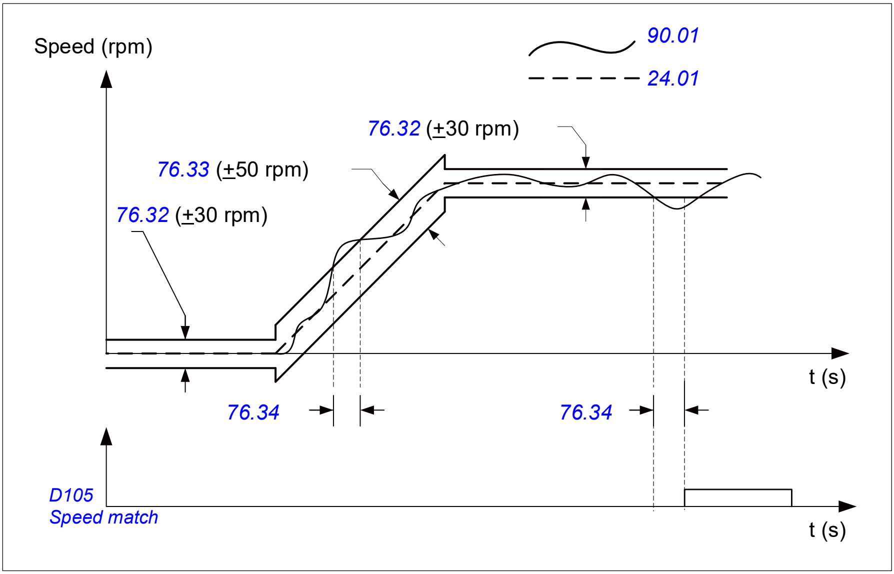
- the difference between the motor actual speed (*90.01*) and the speed reference is greater than the steady state deviation level for longer than a delay (*76.34*)

  and

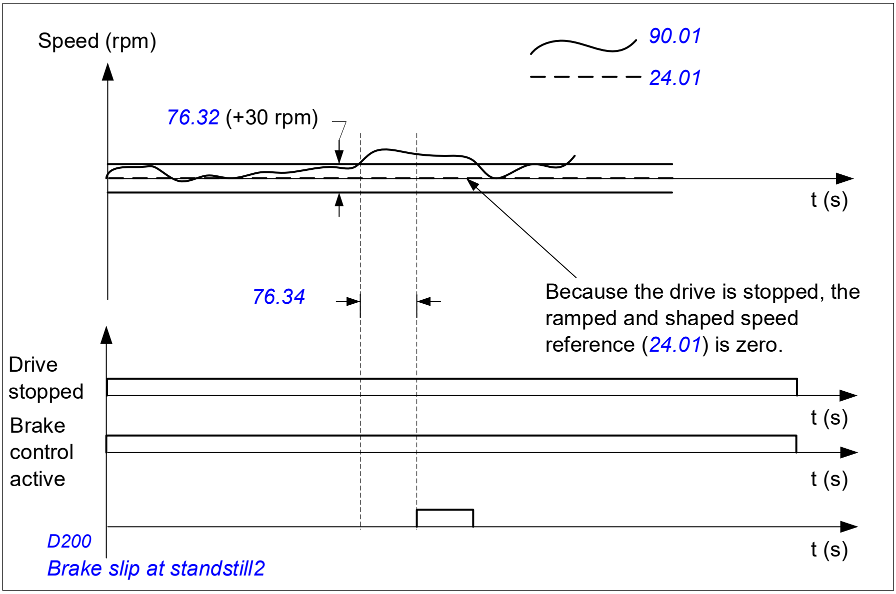
- the brake control is active and the brake is closed.

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 and diagnostics

- Parameters: *76.31 Motor speed match*
- Signals: *09.01 Crane SW1*, *09.03 Crane FW1*
- Warnings: *D200 Brake slip at standstill2*
- Faults: *D105 Speed match*

Crane warning masking

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

Parameter: *31.205 Crane warning masking*

Settings and diagnostics

- Signals: *09.01 Crane SW1*
- Warnings: -
- Faults: -

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.

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 and diagnostics

- Parameters: *30.203 Deadband forward*, *30.204 Deadband reverse*
- Signals: *09.06 Crane speed reference*, *09.16 Crane frequency reference*
- 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.

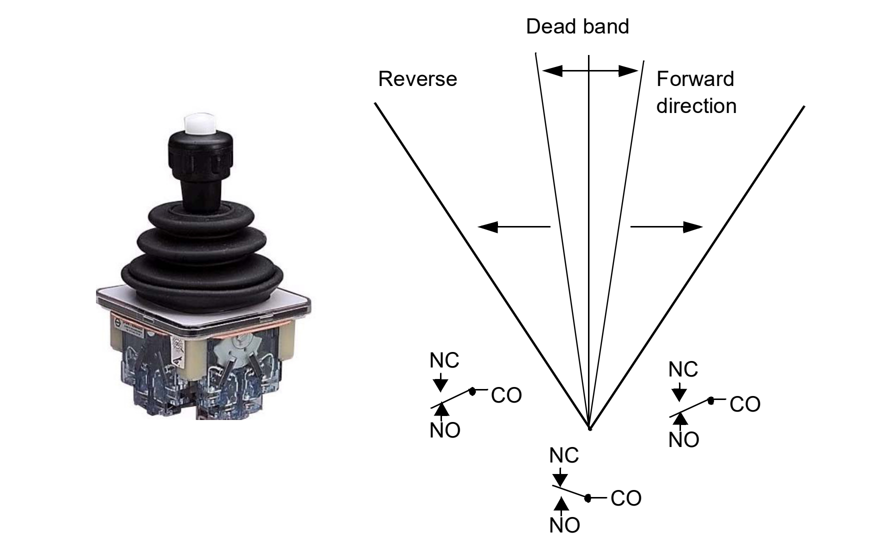
The function includes the following features:

- *Joystick zero position interlocking* (page *659*)
- *Joystick reference interlocking* (page *660*)

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.

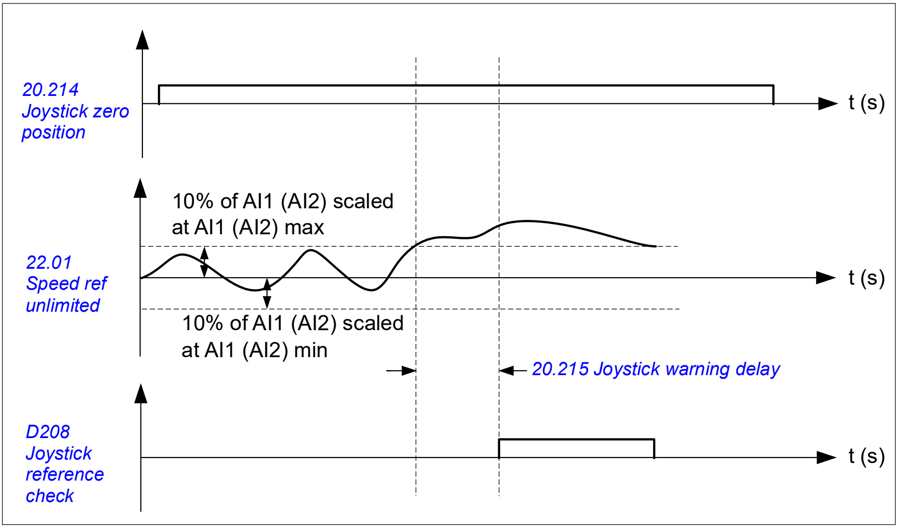


Joystick reference interlocking

You can use this function to check the analog reference that comes 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.



Settings and diagnostics

- Parameters: *20.214 Joystick zero position*, *20.215 Joystick warning delay*
- Signals: *09.01 Crane SW1*
- Warnings: *D208 Joystick reference check*, *D209 Joystick zero position*
- Faults: -

Crane stop limit function

The crane stop limit function stops the crane movement safely when it reaches the end position. You can use the stop limit function in both horizontal (long travel trolley) and vertical (hoist) movement.

The stop limit function has two stop limits:

1. Forward stop limit (*76.04*) – for forward (positive) direction.
2. Reverse stop limit (*76.06*) – for reverse (negative) direction.

For forward and reverse stop limit, the input is wired to the forward and reverse limit switch respectively.

If one of the two limits is active, the function activates a stop command and stops the movement according to the stop mode selection (*76.11*). The two limits are independent of each other.

For both forward and reverse limit, the active and inactive conditions are applicable as follows:

- The limits are active when the limit input to the drive is False (0), i.e. when the normally-closed limit switch is open.
- The limits are inactive when the limit input to the drive is True (1), i.e. the normally-closed limit switch is closed. This condition is valid when the crane movement has not reached the limit.

The following steps describe the forward stop limit operation in the forward lifting (positive) direction. The same can be applied for reverse stop limit in the reverse lowering (negative) direction:

- If the forward stop limit is activated while the drive is running in the forward (up) direction, the function stops the motor according to the selected stop mode (*76.11*)
  - If limit ramp stop mode is selected (*76.11*), the drive decelerates according to the defined limit ramp stop time (*76.12*)
  - If limit normal stop mode is selected (*76.11*), the drive stops according to the selected stop mode (*21.03*).
- When the forward stop limit is active, the drive generates a warning *D205 Forward stop limit*.
- You can run the motor only in the reverse direction when the forward stop limit is active.

Typically, for the crane stop limit function, the parameters are set as follows:

No.	Name	Value
76.01	*Limit to limit control status*	(Actual status of limit control)
76.02	*Enable limit to limit control*	*Selected*
76.03	*Limit to limit trigger type*	*Level low*

No.	Name	Value
76.04	*Forward stop limit*	*DI3* (sample value)
76.05	*Forward slow down limit*	*Selected*
76.06	*Reverse stop limit*	*DI4* (sample value)
76.07	*Reverse slow down limit*	*Selected*
76.11	*Limit stop mode*	*Limit ramp stop mode*
76.12	*Limit stop ramp time*	0.5 s (sample value)

Settings and diagnostics

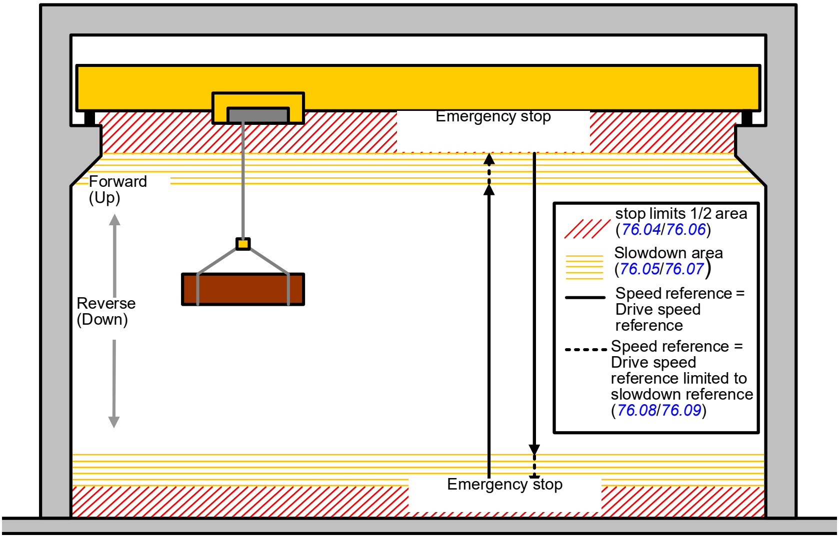
- Parameters: *76.01 Limit to limit control status*, *76.02 Enable limit to limit control*,*76.03 Limit to limit trigger type*, *76.04 Forward stop limit*, *76.06 Reverse stop limit*, *76.11 Limit stop mode*,*76.12 Limit stop ramp time*
- Signals: *09.01 Crane SW1*, *09.03 Crane FW1*
- Warnings: *D205 Forward stop limit*, *D206 Reverse stop limit*
- Faults: *D108 Stop limits I/O error*

Crane slowdown function

The slowdown function limits the forward and reverse movements of the load between two points.

The function supports monitoring of the slowdown sensors in the movement area and reduces the speed accordingly. The system installer must install the sensors and connect them to the drive.

You can use the crane slowdown function in both horizontal (long travel and trolley) and vertical (hoist) movements of the crane.



The crane slowdown function uses Limit to limit trigger type Level low (*76.03*) and has two modes:

1. Slowdown with two limit inputs.
2. Slowdown with direction.

Slowdown with two limit inputs

The two limit inputs of slowdown function are (see figure above):

1. Forward slowdown limit (*76.05*) – for forward (positive) direction.
2. Reverse slowdown limit (*76.07*) – for reverse (negative) direction.

For both forward and reverse limit, the active and inactive conditions are applicable as follows:

- The limits are active when the limit input to the drive is False (0), i.e. when the normally-closed limit switch is open.
- The limits are inactive when the limit input to the drive is True (1), i.e. the normally-closed limit switch is closed. This condition is applicable for the normal operation of the crane.

Slowdown with direction

The control program activates this mode when you have the same signal source in the parameters *76.05 Forward slow down limit* and *76.07 Reverse slow down limit* and any of these source signals is set to False (0).

On activation of slowdown with direction, the function limits the speed reference to the slowdown reference limit (*76.08*/*76.09*) in the direction of motion at the time of 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 you activate the slowdown command after the drive stops, the function allows only slow speed in both directions. The function also limits the speed reference in both directions if you activate the slowdown command when the drive powers up.

Typically, for the crane slowdown function, parameters are set as follows:

No.	Name	Value
76.01	*Limit to limit control status*	(Actual status of limit control)
76.02	*Enable limit to limit control*	*Selected*
76.03	*Limit to limit trigger type*	*Level low*
76.05	*Forward slow down limit*	*DIO1*
76.07	*Reverse slow down limit*	*DIO1*
76.08	*Slow down speed*	300 rpm
76.09	*Slow down frequency*	0.00 Hz

Settings and diagnostics

- Parameters: *76.01 Limit to limit control status*, *76.02 Enable limit to limit control*,*76.03 Limit to limit trigger type*, *76.05 Forward slow down limit*, *76.07 Reverse slow down limit*, *76.08 Slow down speed*, *76.09 Slow down frequency*
- Signals: *09.01 Crane SW1*, *09.03 Crane FW1*
- Warnings: *D201 Forward slow down limit*, *D202 Reverse slow down limit*
- Faults: -

For the control connection diagram, see *Configuring slowdown with two limits and stop limit logic* on page *643*.

Fast stop

The Fast stop function stops the drive immediately, even if the drive is at high speed. For example, the function can be used 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 fast stop mode activates when the fast stop input changes to false (0). The drive stops the motor according to the selected fast stop mode (*20.211*) and displays warning *D20A Fast stop*. The function reverts to normal operation once the fast stop input is changed to 1 (true).

The function has three modes:

- **Ramping and mechanical braking** – 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** – 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** – the function forces the mechanical brake to close.

Typically, for the crane fast stop feature, parameters are set as follows:

No.	Name	Value
20.210	*Fast stop input*	*DIO2*
20.211	*Fast stop mode*	*Ramp*
23.206	*Fast stop deceleration time*	0.5 s

Settings and diagnostics

- 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: -

Power on acknowledgment

The Power on acknowledgment function makes sure 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.

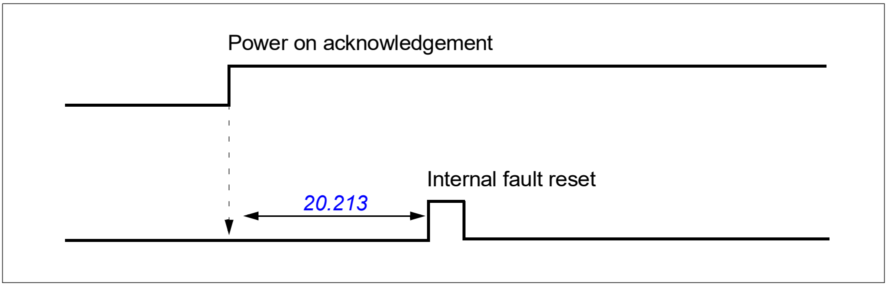
The source to Power on acknowledgment signal (*20.212*) can be from the following sources:

- From the Safe torque off (STO), parameter *06.18 Start inhibit status word*, bit 7 inverted.
  or
- Digital input. For example parameter *20.212 Power on acknowledge*, *DIO2*.

If the drive trips on a fault, and you activate the Power on acknowledgment signal (a rising edge), the drive generates an internal fault reset after a time delay (*20.213*).

If the Power on acknowledgment circuit is open (*20.212* = False), then the drive shows the warning *D20B Power on acknowledge*.

Timing diagram



Typically, for the crane power acknowledgment feature, parameters are set as follows:

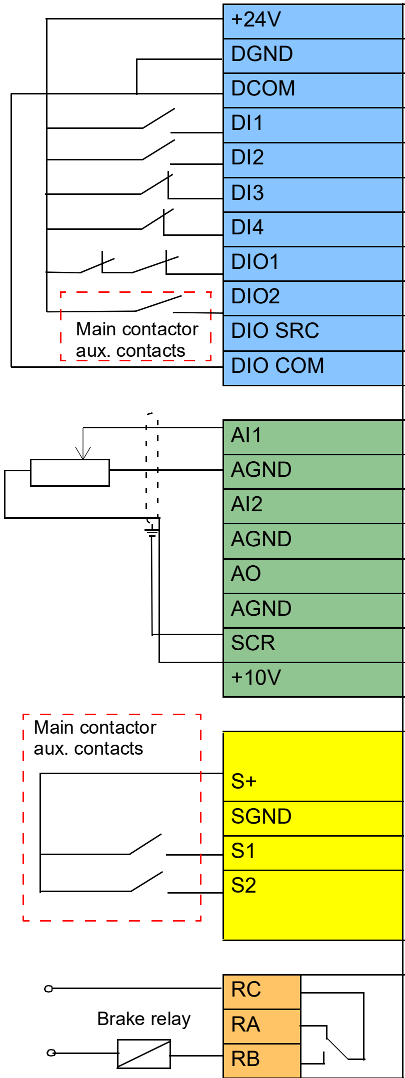
No.	**Name**	**Value**
20.12	*Run enable 1 source*	value of parameter *06.18* bit 7. (if run enabled is used)
20.212	*Power on acknowledge*	value of parameter *06.18* bit 7.
20.213	*Power on ackn reset delay*	500 ms

Settings and diagnostics

- Parameters: *20.212 Power on acknowledge*, *20.213 Power on ackn reset delay*
- Signals: *09.01 Crane SW1*
- Warnings: *D20B Power on acknowledge*
- Faults: -

Control connections

The diagram below shows control connection diagram to enable the power acknowledge feature (through STO or DIO2) with external 24V supply.



Terminals	Description	
	Digital I/O connections	BTAC
+24V	Aux. +24 V DC, max 200 mA	X103
DGND	Aux. voltage output common	
DCOM	Digital input common	VIN
DI1	Start forward	VOUT
DI2	Start reverse	
DI3	Stop limit 1 (forward)	GND
DI4	Stop limit 2 (reverse)	
DIO1	Slowdown	
DIO2	Power acknowledge	
DIO SRC	Digital output auxiliary voltage	
DIO COM	Digital input/output common	
	Analog I/O	
AI1	Speed / freq (0...10V)	
AGND	Analog input circuit common	
AI2	Not configured	
AGND	Analog input circuit common	
AO	Output frequency (0...20 mA)	
AGND	Analog output circuit common	
SCR	Signal cable shield (screen)	
+10V	Ref. voltage +10 V DC	
	Safe torque off (STO)	
S+ SGND S1 S2	Safe torque off. Connected at factory. Drive starts only if both circuits are closed. Status from *06.18 Start inhibit status word* (1 = STO active, circuits are open)	
	Relay output 1	
RC RA RB	Brake command (*10.24 RO1 source* = *Brake command*)	

Notes

Terminal sizes: 0.14 mm²…1.5 mm².

Tightening torque: 0.5 Nm (0.4 lbf·ft).

Terminals DGND, AGND and SGND are internally connected to same reference potential.

Input signals:

- Start forward (DI1)
- Start reverse (DI2)
- Stop limit 1 (forward) (DI3)
- Stop limit 2 (reverse) (DI4)
- Slowdown (DIO1)
- Power acknowledge (DIO2)

Output signals:

- Speed / freq (0...10V) (AI1)
- Output frequency (0...20mA) (AO)
- Brake command

Speed reference handling

The crane speed reference can be provided through any of the following sources:

- Joystick connected through digital and analog I/O
- PLC device connected to a fieldbus
- Pendant control connected to digital inputs or the step references
- Crane motor potentiometer.

Unipolar joysticks

Unipolar joysticks give the speed reference value with analog signal 0…10 V where 0 V is -maximum speed, 5 V is zero speed, and +10 V is +maximum speed. The direction commands are specified with two digital inputs. For example, digital input DI1 can be used for Start forward and DI2 for Start reverse.

Typically, for unipolar joysticks, parameters are set as follows:

No.	Name	Value
12.17	*AI1 min*	0.000
12.18	*AI1 max*	10.000
12.19	*AI1 scaled at AI1 min*	-1500
12.20	*AI1 scaled at AI1 max*	1500
22.11	*Ext1 speed ref1*	*AI1 scaled*
22.13	*Ext1 speed function*	*Abs (ref1)*

Settings and diagnostics

- Parameters: *12.17 AI1 min*, *12.18 AI1 max*, *12.19 AI1 scaled at AI1 min*, *12.20 AI1 scaled at AI1 max*, *22.11 Ext1 speed ref1*, *22.13 Ext1 speed function*
- Signals: -
- Warnings: -
- Faults: -

For the control connection diagram, see *Control through the I/O interface using a joystick* on page *628*.

Parabolic speed reference

In general, joystick movements cause a linear change to the speed reference: a 50% change in position gives a 50% speed reference.

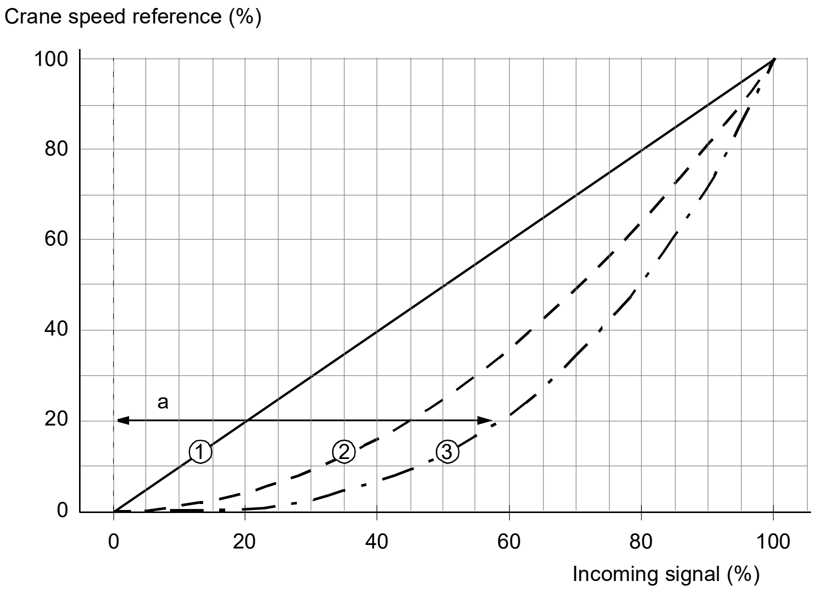
Often, accurate load handling is needed in lower speed areas. For example, when the end-user needs to position the load manually, or when the lack of space causes limitations. In such situations, the end-user can control joystick movements more accurately with a parabolic speed reference instead of a linear reference.

The Parabolic speed reference function (par. *22.211*) changes the interrelationship of the incoming signal (joystick movement) and the speed reference according to a mathematical function. The mathematical functions available are X2 (*Parabolic 1*), X3 (*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 and diagnostics

- Parameters: *22.211 Speed reference shape*
- Signals: *09.06 Crane speed reference*
- Warnings: -
- Faults: -

Step reference speed selection/Pendant control

In step reference, you can select speed between four step reference speeds. A pendant controller is commonly used with the step reference logic.

The figure below shows a pendant controller.

To activate a pendant control/step control, set parameter *22.21 Constant speed function*, bit 2 to 1. The polarity of the references depends on the direction in which the end-user gives the start command using digital inputs (*20.03* and *20.04*)

The table below shows how the control program determines which step reference speed is used. To activate the subsequent speed step, the previous speed step must be retained.

22.21 Constant speed function	***22.22 Constant speed sel1***	***22.23 Constant speed sel2***	***22.24 Constant speed sel3***	**Used reference**
1	0	0	0	*22.26 Constant speed 1*
1	1	0	0	*22.27 Constant speed 2*
1	1	1	0	*22.28 Constant speed 3*
1	1	1	1	*22.29 Constant speed 4*
1	0	1	1	*22.26 Constant speed 1*
1	1	0	1	*22.27 Constant speed 2*
1	0	0	1	*22.26 Constant speed 1*
1	0	1	0	*22.26 Constant speed 1*

Typically, for the step reference logic, parameters are set as follows:

No.	**Name**	**Value**
22.21	*Constant speed function*	0b0100 (Bit 2 = 1)
22.22	*Constant speed sel1*	*DI3*
22.23	*Constant speed sel2*	*DI4*
22.24	*Constant speed sel3*	*Always off*

No.	Name	Value
22.26	*Constant speed 1*	300.00
22.27	*Constant speed 2*	750
22.28	*Constant speed 3*	1500
22.29	*Constant speed 4*	1500

Settings and diagnostics

- Parameters: *22.21 Constant speed function*, *22.22 Constant speed sel1*, *22.23 Constant speed sel2*, *22.24 Constant speed sel3*, *22.26 Constant speed 1*, *22.27 Constant speed 2*, *22.28 Constant speed 3*, *22.29 Constant speed 4*
- Signals: -
- Warnings: -
- Faults: -

Crane motor potentiometer

The crane motor potentiometer function can be used in retrofit cases with older controllers. For example, a pendant controller with push-buttons for start forward, start reverse, and increase speed (three buttons). The function is used instead of the normal motor potentiometer which contains separate incoming signals for increasing and decreasing the reference. These signals are not effective when the drive is stopped.

To activate crane potentiometer, use parameter *22.220 Crane motpot enable*.

Forward direction

You can increase the motor potentiometer reference (*22.230*) with any of these two methods:

- Activating the forward command: When you activate the forward command, the motor potentiometer reference (*22.230*) increases to the crane motor potentiometer minimum speed (*22.224*).

  or
- Activating the crane motor potentiometer acceleration command (*22.223*) together with forward command: This increases the motor potentiometer reference (*22.230*).

When you activate a forward command,

- when the motor potentiometer reference (*22.230*) is less than the crane motor potentiometer minimum speed (*22.224*), the crane accelerates to the crane motor potentiometer minimum speed (*22.224*).
- when the motor potentiometer reference (*22.230*) is higher than the crane motor potentiometer minimum speed (*22.224*) and the crane travels in forward direction the speed reference remains at the last speed before the forward command.
- when the motor potentiometer reference (*22.230*) is higher than the crane motor potentiometer minimum speed (*22.224*) and the crane travels in reverse direction, the crane decelerates to zero speed, changes direction and then accelerates to the crane motor potentiometer minimum speed (*22.224*).

Notes:

1. When you release the acceleration command (*22.223*), the motor potentiometer reference (*22.230*) remains in the last reached level. To accelerate further, you need to activate the acceleration command (*22.223*) again.
2. When you release the forward command, the motor potentiometer reference (*22.230*) decreases to zero as per the deceleration time (*23.202*).

Reverse direction

You can increase the motor potentiometer reference (*22.230*) to the reverse direction with any of these two methods:

- Activating the reverse command: The motor potentiometer reference (*22.230*) increases to the crane motor potentiometer minimum speed (*22.224*).

  or
- Activating the crane motor potentiometer acceleration command (*22.223*) together with the reverse command: This increases the motor potentiometer reference (*22.230*).

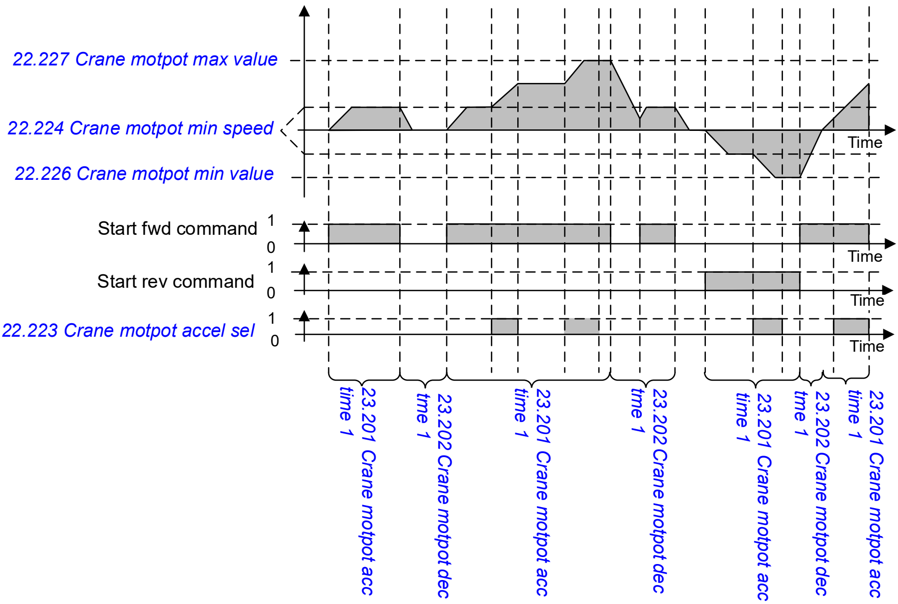
When you activate a reverse command,

- when the motor potentiometer reference (*22.230*) is less than the crane motor potentiometer minimum speed (*22.224*), the crane accelerates to the crane motor potentiometer minimum speed (*22.224*).
- when the motor potentiometer reference (*22.230*) is higher than the crane motor potentiometer minimum speed (*22.224*) and the crane travels in reverse direction the speed reference remains at the last speed before the reverse command.
- when the motor potentiometer reference (*22.230*) is higher than the crane motor potentiometer minimum speed (*22.224*) and the crane travels in the forward direction, the crane decelerates to zero speed, changes direction and then accelerates to the crane motor potentiometer minimum speed (*22.224*).

Notes:

1. When you release the acceleration command (*22.223*), the motor potentiometer reference (*22.230*) remains in the last reached level. To accelerate further, you need to activate the acceleration command (*22.223*) again.
2. When you release the reverse command immediately, the motor potentiometer reference (*22.230*) decreases to zero as per the deceleration time (*23.202*). On activating the acceleration command again (*22.223*), the motor potentiometer reference (*22.230*) remains in the last reached level.

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



Typically, for the motor potentiometer function, parameters are set as follows:

No.	Name	Value
22.11	*Ext1 speed ref1*	*MotPot Crane*
22.220	*Crane motpot enable*	*Selected*
22.223	*Crane motpot accel sel*	*DIO2*
22.224	*Crane motpot min speed*	300.00
22.226	*Crane motpot min value*	-1500.00
22.227	*Crane motpot max value*	1500.00
23.201	*Crane motpot acc time 1*	4.0 (*visible only if parameter 22.220 Crane motpot enable is set to Selected*)
23.202	*Crane motpot dec tme 1*	4.0 (*visible only if parameter 22.220 Crane motpot enable is set to Selected*)

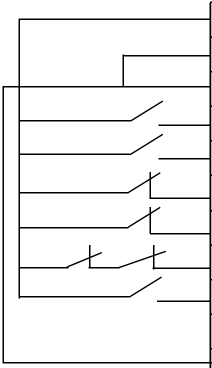
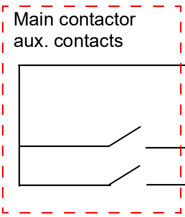
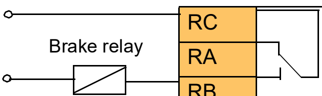
The start forward and start reverse commands are defined in parameter group *20 Start/stop/direction*.

Settings and diagnostics

- Parameters: *22.11 Ext1 speed ref1*, *28.11 Ext1 frequency ref1*, *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 motpot acc time 1*, *23.202 Crane motpot dec tme 1*, group *20 Start/stop/direction*
- Signals: - *22.230 Crane motpot ref act*, *22.225 Crane motpot sw*
- Warnings: -
- Faults: -

Control connections

The diagram below shows the I/O control connection diagram for the crane motor potentiometer.

Terminals		Description
		Digital I/O connections
	+24V	Aux. +24 V DC, max 200 mA
	DGND	Aux. voltage output common
	DCOM	Digital input common
	DI1	Start forward
	DI2	Start reverse
	DI3	Stop limit 1 (forward)
	DI4	Stop limit 2 (reverse)
	DIO1	Slowdown
	DIO2	Accelerate (*22.223*)
	DIO SRC	Digital output auxiliary voltage
	DIO COM	Digital input/output common
		Analog I/O
	AI1	Not configured
	AGND	Analog input circuit common
	AI2	Not configured
	AGND	Analog input circuit common
	AO	Output frequency (0...20 mA)
	AGND	Analog output circuit common
	SCR	Signal cable shield (screen)
	+10V	Ref. voltage +10 V DC
		Safe torque off (STO)
	S+	Safe torque off. Connected at factory. Drive starts only if both circuits are closed.
	SGND	
	S1	Status from *06.18 Start inhibit status word* (1 = STO active, circuits are open), *20.212 Power on acknowledge*, and *20.12 Run enable 1 source*.
	S2	
		Relay output 1
	RC	Brake command (*10.24 RO1 source* = *Brake command*)
	RA	
	RB	

Notes:

Terminal sizes: 0.14 mm^2 … 1.5 mm^2.

Tightening torque: 0.5 N·m (0.4 lbf·ft).

Terminals DGND, AGND and SGND are internally connected to same reference potential.

Input signals:

- Start forward (DI1)
- Start reverse (DI2)
- Stop limit 1 (forward) (DI3)
- Stop limit 2 (reverse) (DI4)
- Slowdown (DIO1)
- Accelerate (DIO2)

Output signals:

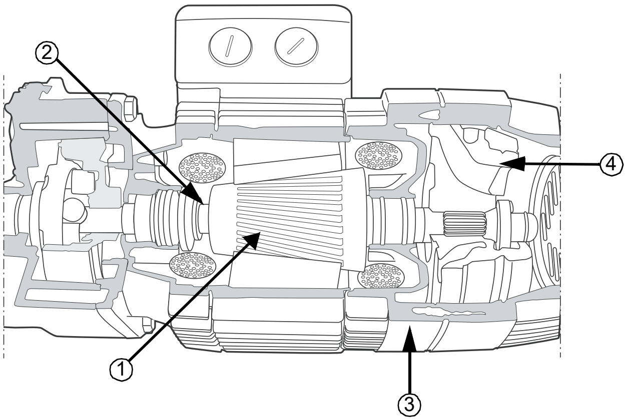
- Output frequency (AO)
- Brake command

76.25

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

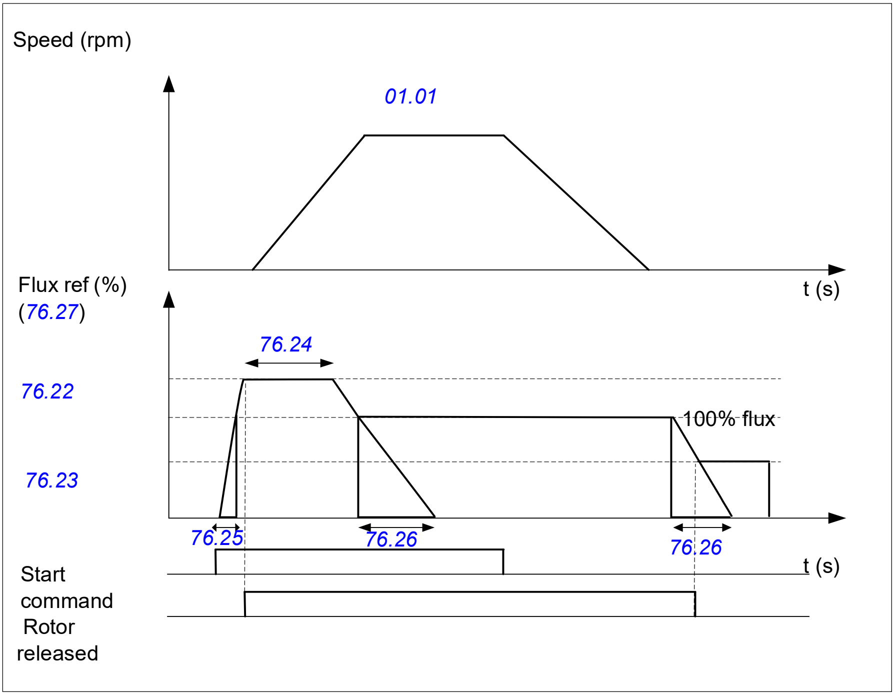
When the Conical motor control function is enabled and the start command is given, the motor flux ramps up over the normal level (100%) to the start flux level (*76.22*) during a flux ramp-up time (*76.25*). The ramp-up time makes sure that the brake opens faster and there is minimal roll-back that can cause a load dip. The start flux level is kept as the reference for a hold time (*76.24*) 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 (*76.26*).

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 (*76.23*) 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.

Timing diagram

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



Settings and diagnostics

- Parameters: *76.21*...*76.26*
- Signals: *09.01 Crane SW1*, *76.27 Flux reference*
- Warnings: -
- Faults: *D10A Brake not selected*

Further information

Product and service inquiries

Address any inquiries about the product to your local ABB representative, quoting the type designation and serial number of the unit in question. A listing of ABB sales, support and service contacts can be found by navigating to new.abb.com/channel-partners/search.

Product training

For information on ABB product training, navigate to new.abb.com/service/training.

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