ABB DRIVES FOR HVAC

ACH531 HVAC control program

Firmware manual

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ACH531
HVAC control program

Firmware manual

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3AXD50000810710 Rev A
EN
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Introduction to the manual

Contents of this chapter

The chapter describes applicability, target audience and purpose of this manual. It also describes the contents of this manual and refers to a list of related manuals for more information.

Applicability

The manual applies to the ACH531 HVAC control program (version 2.15).

To check the firmware version of the control program in use, see parameter *07.05 Firmware version* on the control panel.

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 and notes** before changing parameter values. These warnings and notes are included in the parameter descriptions presented in chapter *Parameters* on page *123*.

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. Special US instructions for installations in the United States are given.

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Purpose of the manual

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

Contents of this manual

This manual consists of the following chapters:

- *Introduction to the manual* (this chapter) describes applicability, target audience, purpose and contents of this manual. At the end, it lists terms and abbreviations.
- *Start-up, ID run and use* (page *21*) describes how to start up the drive as well as how to start, change the direction of the motor rotation and adjust the motor speed through the I/O interface.
- *Control panel* (page *25*) contains instructions for removing and reinstalling the assistant control panel and briefly describes its display, keys, key shortcuts and home view displays.
- *Application macros* (page *37*) contains the connection diagram of the HVAC default configuration together with a connection diagram. The predefined default configuration will save the user time when configuring the drive.
- *Program features* (page *53*) describes program features with lists of related user settings, actual signals, and fault and warning messages
- *Parameters* (page *123*) lists the warning and fault messages with possible causes and remedies.) describes the parameters used to program the drive.
- *Additional parameter data* (page *375*) contains further information on the parameters.
- *Fault tracing* (page *411*) lists the warning and fault messages with possible causes and remedies.
- *Modbus RTU control through the embedded fieldbus interface (EFB)* (page *163*) describes the communication to and from a fieldbus network using the drive embedded fieldbus interface with the Modbus RTU protocol.
- *BACnet MS/TP control through the embedded fieldbus interface (EFB)* (page *471*) describes the communication to and from a fieldbus network using the drive embedded fieldbus interface with the BACnet MS/TP protocol.
- *Fieldbus control through a fieldbus adapter* (page *219*) describes the communication to and from a fieldbus network using an optional fieldbus adapter module.
- *Control chain diagrams* (page *517*) describes the parameter structure within the drive.
- *Further information* (inside of the back cover, page *535*) describes how to make product and service inquiries, get information on product training, provide feedback on ABB Drives manuals and find documents on the Internet.

Related documents

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.

Drive manuals and guides	Code (English)
Drive/converter/inverter safety instructions	*3AXD50000037978*
ACH531 HVAC control program firmware manual	*3AXD50000810710*
ACH531-01 (0.75 to 75 kW, 1 to 100 hp) hardware manual	*3AXD50000815319*
ACH531-01 quick installation and start-up guide for frames R1 to R5	*3AXD50000815333*
ACH531-01 quick installation and start-up guide for frames R6	*3AXD50000816613*
ACS-BP-S basic control panel user's manual	*3AXD50000032527*

Option manuals and guides	
BACnet Protocol Implementation Conformance Statement (PICS)	*3AXD10000387059*
CDPI-01 communication adapter module user's manual	*3AXD50000009929*
CPTC-02 ATEX-certified thermistor protection module, Ex II (2) GD (+L537+Q971) user's manual	*3AXD50000030058*
FBIP-21 BACnet/IP adapter module user's manual	*3AXD50000028468*
FCAN-01 CANopen adapter module user's manual	*3AFE68615500*
FCNA-01 ControlNet adapter module user's manual	*3AUA0000141650*
FDNA-01 DeviceNet™ adapter module user's manual	*3AFE68573360*
FECA-01 EtherCAT adapter module user's manual	*3AUA0000068940*
FEIP-21 Ethernet/IP adapter module user’s manual	*3AXD50000158621*
FENA-01/-11/-21 Ethernet adapter module user's manual	*3AUA0000093568*
FEPL-02 Ethernet POWERLINK adapter module user's manual	*3AUA0000123527*
FLON-01 LONWORKS® adapter module user’s manual	*3AUA0000041017*
FMBA-01 Modbus adapter module user’s manual	*3AFE68586704*
FMBT-21 Modbus/TCP adapter module user’s manual	*3AXD50000158607*
FPBA-01 PROFIBUS DP adapter module user's manual	*3AFE68573271*
FPNO-21 PROFINET adapter module user’s manual	*3AXD50000158614*
FSCA-01 RS-485 adapter module user's manual	*3AUA0000109533*

Tool and maintenance manuals and guides	
Drive Composer PC tool user's manual	*3AUA0000094606*
Converter module capacitor reforming instructions	*3BFE64059629*
NETA-21 remote monitoring tool user's manual	*3AUA0000096939*
NETA-21 remote monitoring tool installation and start-up guide	*3AUA0000096881*

The codes below open online listings of the manuals applicable to the products.

ACH531 manuals

Categorization by frame (size)

The ACH531 is manufactured in several frames (frame sizes), which are denoted as RN, where N is an integer. Some information which only concern certain frames are marked with the symbol of the frame (RN).

The frame is marked on the type designation label attached to the drive, see chapter *Operation principle and hardware description*, section *Type designation label* in the *Hardware manual* of the drive.

Terms and abbreviations

Term/abbreviation	Explanation
ACx-AP-x	Assistant control panel, advanced operator keypad for communication with the drive. The ACH531 supports the Hand-Off-Auto control panels ACH-AP-H and ACH-AP-W (with a Bluetooth interface).
AI	Analog input; interface for analog input signals
AO	Analog output; interface for analog output signals
BACnet™	BACnet™ is a registered trademark of American Society of Heating, Refrigerating and Air-Conditioning Engineers (ASHRAE).
BAS	Building automation system
BMS	Building management system
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 *Brake chopper* in the *Hardware manual* of the drive.
Control board	Circuit board in which the control program runs.
CAIO-01	CAIO-01 optional bipolar analog input and unipolar analog output extension module
CCA-01	Cold configuration adapter
CDPI-01	Communication adapter module
CHDI-01	Optional 115/230 V digital input extension module
CMOD-01	Optional multifunction extension module (external 24 V AC/DC and digital I/O extension)
CMOD-02	Optional multifunction extension module (external 24 V AC/DC and isolated PTC interface)
CPTC-02	Optional multifunction extension module (external 24 V and ATEX certified PTC interface)
CRC	Cyclic redundancy check.
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
DPMP-01	Mounting platform for ACx-AP control panel (flange mounting)
DPMP-02/03	Mounting platform for ACx-AP control panel (surface mounting)
Drive	Frequency converter for controlling AC motors
EFB	Embedded fieldbus
FBA	Fieldbus adapter

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Term/abbreviation	Explanation
FBIP-21	Optional BACnet/IP adapter module
FCAN-01	Optional CANopen adapter module
FCNA-01	ControlNet adapter module
FDNA-01	Optional DeviceNet adapter module
FECA-01	Optional EtherCAT adapter module
FEIP-21	Optional Ethernet/IP adapter module
FENA-21	Optional Ethernet adapter module for EtherNet/IP, Modbus TCP and PROFINET IO protocols
FEPL-02	Optional Ethernet POWERLINK adapter module
FLON-01	LONWORKS® adapter module
FMBA-01	Optional Modbus RTU adapter module
FMBT-21	Optional Modbus/TCP adapter module
FPBA-01	Optional PROFIBUS DP adapter module
FPNO-21	Optional PROFINET adapter module
Frame (size)	Refers to drive physical size, for example, R1 and R2. The type designation label attached to the drive shows the frame of the drive, see chapter *Operation principle and hardware description,* section *Type designation label* in the *Hardware manual* of the drive.
FSCA-01	Optional RSA-485 adapter module
FW Part 1	ACH531 standard control program firmware manual, Part 1 (3AXD50000209811 [English]). This printed manual includes all chapters except *Parameters* and *Additional parameter data*. The abbreviation is used in FW Part 2 to refer to items in FW Part 1.
FW Part 2	ACH531 standard control program firmware manual, Part 2 Parameters (3AXD50000209828 [English]). This printed manual includes chapters *Parameters* and *Additional parameter data*. The abbreviation is used in FW Part 1 to refer to items in FW Part 2.
ID run	Motor identification run. During the identification run, the drive will identify the characteristics of the motor for optimum motor control.
IGBT	Insulated gate bipolar transistor
Intermediate circuit	See *DC link*.
Inverter	Converts direct current and voltage to alternating current and voltage.
I/O	Input/Output
LONWORKS®	LONWORKS® (local operating network) is a networking platform specifically created to address the needs of control applications.
LSW	Least significant word
NETA-21	Remote monitoring tool

Term/abbreviation	Explanation
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]) • *FEIP-21 Ethernet/IP adapter module user's manual* (3AXD50000158621 [English]).
Parameter	User-adjustable operation instruction to the drive, or signal measured or calculated by the drive
PFC	Single pump and fan control. One drive controls multiple pumps or fans with motors.
PID controller	Proportional-integral-derivative controller, also known as closed loop controller. Drive speed control is based on PID algorithm.
PLC	Programmable logic controller
PROFIBUS, PROFIBUS DP, PROFINET IO	Registered trademarks of PI - PROFIBUS & PROFINET International
PTC	Positive temperature coefficient, thermistor whose resistance is dependent on temperature.
R1, R2 … R6	*Frame (size)*
RO	Relay output; interface for a digital output signal. Implemented with a relay.
Rectifier	Converts alternating current and voltage to direct current and voltage.
SPFC	Soft pump and fan control. One drive controls multiple pumps or fans with motors.
STO	Safe torque off. See chapter *The Safe torque off function* in the *Hardware manual* of the drive.

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.

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Start-up, ID run and use

Contents

Note: In this chapter the drive uses an basic panel to perform the start-up, ID run, and other actions. You can also perform these functions using a drive composer PC tool.

Start up the drive

1. Select the unit (international or US) and press OK.

   The drive recognizes the connected adapter and sets the correct settings. This may take a few seconds depending on the adapter.

2. In the *Motor data* view, set the motor type:

   AsynM: Asynchronous motor

   PMSM: Permanent magnet motor, or

3. 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.

4. Set the nominal motor values:
   - Nominal power
   - Nominal current
   - Nominal voltage
   - Nominal frequency
   - Nominal speed
   - Nominal torque (optional)
   - Nominal cosphi
5. Examine the direction of the motor.
   If it is necessary, set the motor direction with the **Phase order** setting or with the phase order of the motor cable.
6. In the *Motor control* view, set the start and stop mode.
7. 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*.
8. 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 *362*.
9. In the *Application macros* view, select the applicable macro.
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

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* and
- parameter *99.04 Motor control mode* selection is *Vector*.

In most applications there is no need to perform a separate ID run. Select the ID run for demanding motor control connections. For example:

- permanent magnet motor (PMSM) is used
- 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 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*.

ID run steps

Warning! Make sure it is safe to run the procedure.

1. Open the *Main* menu.
2. Select the *Parameters* submenu.
3. Select *All parameters*.
4. Select *99 Motor data* and press OK.
5. 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.

6. Press Start to start the ID run.

   Do not to 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*.

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Control panel

Applicability

This manual is applicable with the ACS-BP-S basic control panel, the panel software Version GPBPS 1.40.0.0 or later.

The images and instructions are based on the use of the basic control panel with an ACH531 drive equipped with the Standard control program. Note that there may be differences if you use the basic control panel with other equipments or program versions.

Safety

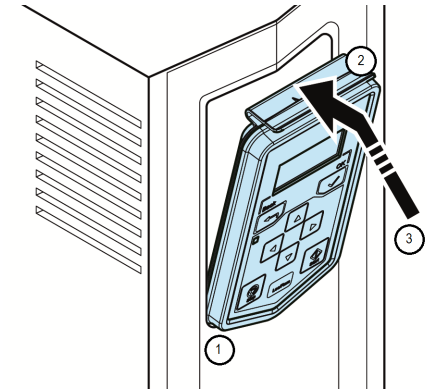
See the appropriate drive hardware manual.

Related manuals

See the appropriate drive manual. All manuals are available in pdf format at www.abb.com/drives/documents).

Attach and remove the control panel

You can attach the control panel directly to the drive, or use a separate mounting kit.



To attach the control panel to a drive:

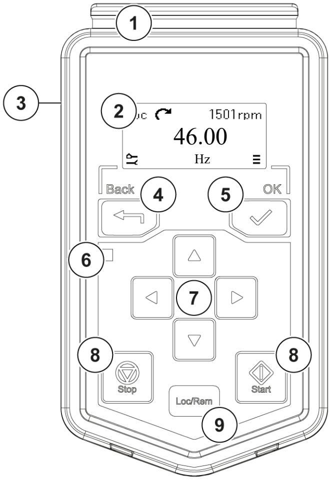
1. Place the bottom end of the control panel into the slot in the drive.
2. Press the control panel lock clip down.
3. Push the control panel into place.

To remove the control panel:

Press the control panel clip down and pull the panel out.

Start up and use

To start up the drive, you need to set the motor data, motor control, connection macro and drive parameters. See ACH531 firmware manual (3AXD50000728282 [EN]) for start-up details.

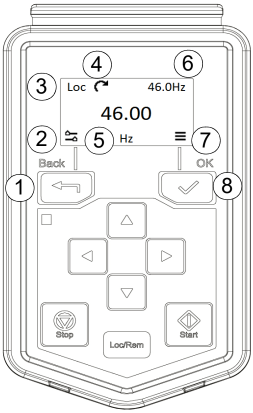


1. Clip - press down to remove the panel.
2. Display - shows the selected settings and menus.
3. RJ-45 connector slot on the back of the panel.
4. Back button - return to previous menu.
5. **OK** button - select settings and open submenu.
6. Status leds - green and red colors indicate the state and potential problems.
7. Arrow buttons - move in the menus.
8. **Start** and **Stop** buttons - start and stop the operation.
9. **Loc/Rem** button - switch to local or remote control mode.

Display

"Options" menu

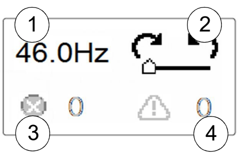
1. The return button: opens the Options menu.
2. Options menu.
3. Control mode.
4. Rotation direction: forward or reverse.
5. Frequency: Active
6. Frequency: Reference



"Main" menu.

7. Main menu.
8. **OK** button: opens the Main menu.

The options menu

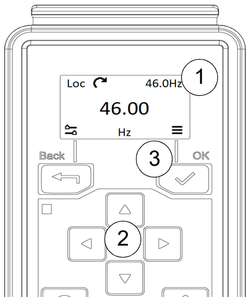


1. Frequency setting
2. Rotation direction - forward or reverse
3. Active faults
4. Active warnings

Start and stop the drive

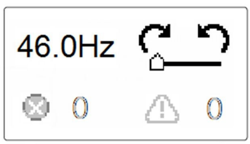
To start the drive, press the **Start** button on the basic control panel. To stop the drive, press the **Stop** button on the basic control panel.

Change the rotation direction

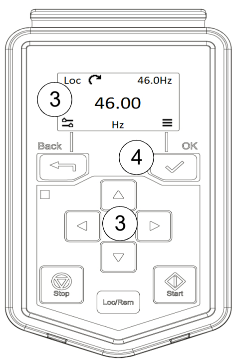


1. In *Options* menu .
2. Move to the rotation direction item with the arrow buttons.
3. Press the **OK** button to change the rotation direction.

Set the frequency reference

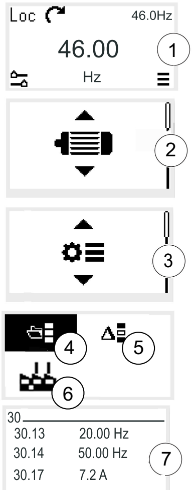


1. In the *Options* menu , move to the frequency reference item with the arrow buttons.
2. Press the **OK** button to open the item.



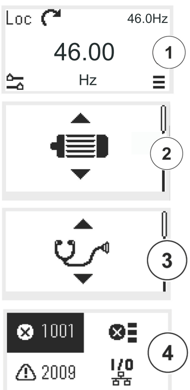
3. Press the arrow buttons to set the frequency.
4. Press the **OK** button to confirm the change.

Set the drive parameters



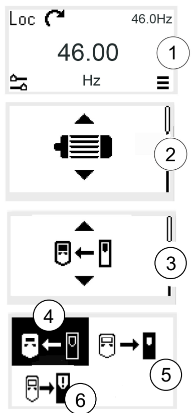
1. Select Main menu from *Home view* ☰ .
2. The Main menu opens.
3. Scroll up or down in the menu to the Parameters submenu, and press the **OK** button.
4. Select the complete parameters list, *or*
5. Select the modified parameters list with the arrow button and press the **OK** button.
6. Select the restore the factory default settings with the arrow button and press the **OK** button.
7. The parameters are shown in respective groups. The first two digits of the parameter name represent the parameter group. For example, parameters starting with 30 are in the Limits parameters group.

Open Diagnostics



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

Backup



1. Select Main menu from *Home* view ☰ .
2. The Main menu opens.
3. Scroll the menu to the Backup submenu and press the **OK** button.
4. Select to back up from the drive to the panel, *or*
5. Select to completely restore from the panel to the drive. A progress view is shown during the backup.
6. Select partlyrestore from the panel to the drive. A progress view is shown during the backup.

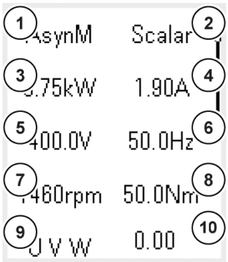
Main menu ☰

1. Motor data - motor parameters
2. Motor control - motor curve settings
3. Control macros - I/O and fielddbus presettings
4. Diagnostics - faults, warnings, fault log and connection status
5. Energy efficiency - energy savings
6. Backup and reset
7. Parameters

Submenus

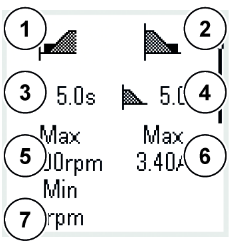
The Main menu items have a submenu where you can change settings and set actions. Some submenus also have menus and/or option lists. The content of the submenus depend on the drive type.

Motor Data



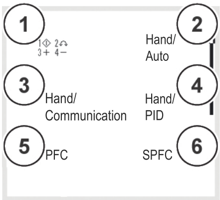
1. Asynchronous motor
2. Scalar
3. Nominal Power
4. Nominal Current
5. Nominal Voltage
6. Nominal frequency
7. Nominal speed
8. Nominal torque
9. Phase order - U V W, U W V
10. Power factor

Motor control



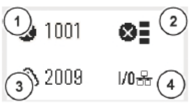
1. Start mode - Auto, Scan
2. Stop mode - Coast, DC hold, Ramp
3. Acceleration time - Automatic, Flying start
4. Deceleration time
5. Maximum allowed speed
6. Maximum allowed current
7. Minimum allowed speed

Connection macro



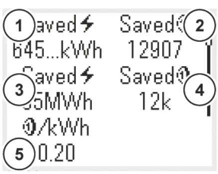
1. Motor potentiometer
2. Hand/Auto
3. Hand / communication
4. Hand / PID
5. PFC
6. SPFC

Diagnose

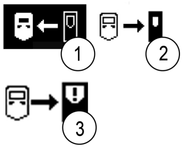
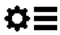
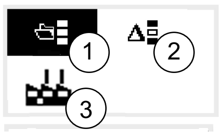


1. Present Fault - the fault code is displayed
2. Fault History - list of latest fault codes (newest first)
3. Present warnings - the warning code is shown
4. I/O status - I/O settings

Energy Efficiency



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

Backup  	1. Backup from the drive to the control panel. 2. Completely restore the back up from the panel to the drive. A progress view is shown during the backup. 3. Select partlyrestore from the panel to the drive. A progress view is shown during the backup.
Parameters  	1. Complete parameter list - Groups menu with complete parameters and parameter levels 2. Modified parameters list - non-default value. 3. Restore the factory default settings.

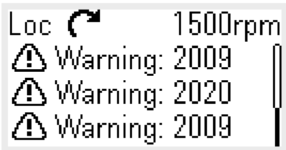
Fault and warning

A fault message

The display shows warnings and faults messages if a problem has been detected. A fault message needs your immediate attention.

1. Identify and eliminate the cause.
2. For detailed information please refer to the Firmware manual.
3. Press *Reset* in the *Fault*.

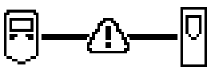
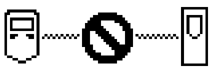
Warning messages



To view the warning messages:

1. Open the *Main* menu.
2. Select *Diagnostics*.
3. Scroll down the list if there are multiple warnings.

Drive and panel communication failure

	There is a general communication failure, e.g., the drive does not respond to the panel commands.
	The drive and panel are not compatible, e.g., the drive does not support the basic panel.

Status light

Continuous green		The drive is running normally.
Green, blinking		There is an active warning in the drive.
Red, continuous		There is an active fault in the drive.

4

Application macros

What this chapter contains

This chapter describes the intended use, operation and default control connections of the application macros. At the end of chapter there are tables showing those parameter default values (not the same for all macros).

Get an Overview

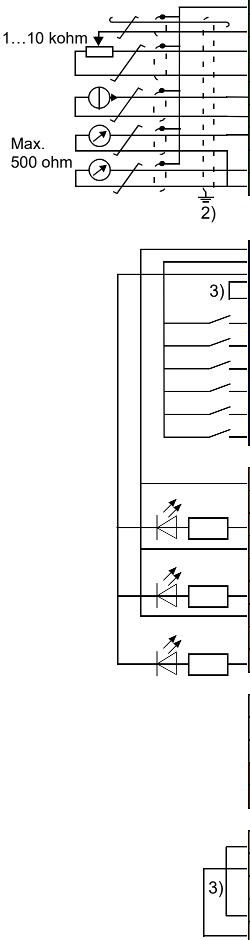
Control macros are sets of default parameter values suitable for a certain control configuration. When starting up the drive, the user typically selects the best-suited control macro as a starting point, then makes any necessary changes to tailor the settings to their purpose. This usually results in a much lower number of user edits compared to the traditional way of programming a drive.

Use parameter *96.04 Macro select* (Page *344*).

Hand/Auto macro

This macro can be used when switching between two external control devices is needed. Both external control device have their own control and reference signals. One signal is used to switch between these two. To enable the macro, set the value of parameter *96.04 Macro select* to *Hand/Auto*.

Default control connections for the Hand/Auto macro



XI	Reference power and analog inputs and outputs	
1	SCR	Signal cable shield (screen)
2	AI1	**Hand frequency reference (hand):** 0…10 V [1]
3	AGND	Analog input circuit common
4	+10V	+10 V DC Reference voltage
5	AI2	**Auto frequency reference (auto):**4…20 mA[1]
6	AGND	Analog input circuit common
7	AO1	**Output frequency:** 4…20 mA [1]
8	AO2	**Motor current:** 4…20 mA
9	AGND	Analog input circuit common
X2 and X3	Aux. voltage output and programmable digital inputs	
10	+24V	Auxiliary voltage output +24 V DC, max. 250 mA
11	DGND	Aux. voltage output common
12	DCOM	Digital input common
13	DI1	**Hand Stop (0) / Start (1)**
14	DI2	**Fault Reset**
15	DI3	**Hand control (0) / Auto control (1)**
16	DI4	Not used
17	DI5	Not used
18	DI6	**Auto Stop (0) / Start (1)**
X6, X7,	**X8** relay output	
19	RO1C	**Ready run** 250 V AC / 30 V DC 2 A
20	RO1A	
21	RO1B	
22	RO2C	**Running** 250 V AC / 30 V DC 2 A
23	RO2A	
24	RO2B	
25	RO3C	**Fault (-1)** 250 V AC / 30 V DC 2 A
26	RO3A	
27	RO3B	
X5	Embedded fieldbus	
29	B+	Embedded Modbus RTU (EIA-485).
30	A-	
31	DGND	
S100	TERM	Termination resistors switch
S200	BIAS	Bias resistors switch
X4	Safe torque off	
34	OUT1	Safe torque off. Factory connection. Both circuits must be closed for the drive to start. see safety torque cancellation function in the drive firmware manual
35	OUT2	
36	SGND	
37	IN1	
38	IN2	
X10	24 V AC/DC	(Only for frames size R6)
40	24 V AC/DC- in	24V AC/DC input to power up the control unit when the main supply is disconnected
41	24 V AC/DC+ in	

Terminal size:

R1…R6: 0.14…1.5 mm^2(All terminals)

Tightening torque: 0.5…0.6 N·m (0.4 lbf·ft)

Notes:

[1] The analog types of AI1, AI2 and AO1 are selected as voltage or current respectively by parameters 12.15, 12.25 and 13.15.

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

[3] Connected with jumpers at the factory.

Input signals

- Control location (Hand / Auto) selection (DI3)
- Hand - frequency reference (AI1)
- Hand - start / stop selection (DI1)
- Auto - frequency reference (AI2)
- Auto - start / stop selection (DI6)
- Fault reset (DI2)

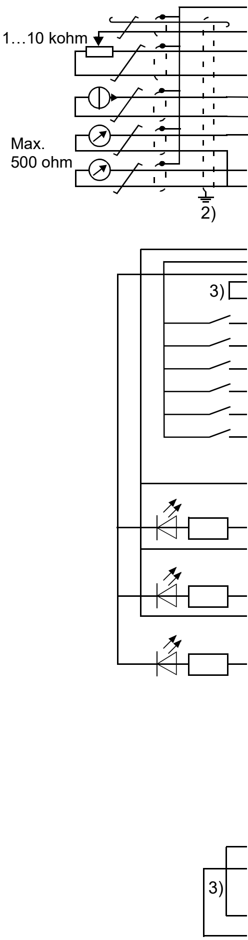
Output signals

- Analog output AO1: output frequency
- Analog output AO2: motor current
- Relay output 1: ready run
- Relay output 2: running
- Relay output 3: fault (-1)

Hand/Comm macro

This macro can be used when switching between two external control devices is needed. Both external control device have their own control and reference signals. One signal is used to switch between these two. To enable the macro, set the value of parameter *96.04 Macro select* to *Hand/Comm*.

Default control connections for the Hand/Comm macro



XI		Reference power and analog inputs and outputs
1	SCR	Signal cable shield (screen)
2	AI1	**Hand frequency reference (hand):** 0…10 V [1)]
3	AGND	Analog input circuit common
4	+10V	+10 V DC Reference voltage
5	AI2	Not used
6	AGND	Analog input circuit common
7	AO1	**Output frequency:** 4…20 mA [1)]
8	AO2	**Motor current:** 4…20 mA
9	AGND	Analog input circuit common
X2 and X3		Aux. voltage output and programmable digital inputs
10	+24V	Auxiliary voltage output +24 V DC, max. 250 mA
11	DGND	Aux. voltage output common
12	DCOM	Digital input common
13	DI1	**Hand Stop (0) / Start (1)**
14	DI2	**Fault Reset**
15	DI3	**Hand control (0) / Comm control (1)**
16	DI4	Not used
17	DI5	Not used
18	DI6	Not used
X6, X7,		**X8** relay output
19	RO1C	**Ready run** 250 V AC / 30 V DC 2 A
20	RO1A	
21	RO1B	
22	RO2C	**Running** 250 V AC / 30 V DC 2 A
23	RO2A	
24	RO2B	
25	RO3C	**Fault (-1)** 250 V AC / 30 V DC 2 A
26	RO3A	
27	RO3B	
X5		Embedded fieldbus
29	B+	Embedded Modbus RTU (EIA-485).
30	A-	
31	DGND	
S100	TERM	Termination resistors switch
S200	BIAS	Bias resistors switch
X4		Safe torque off
34	OUT1	Safe torque off. Factory connection. Both circuits must be closed for the drive to start. see safety torque cancellation function in the drive firmware manual
35	OUT2	
36	SGND	
37	IN1	
38	IN2	
X10	24 V AC/DC	(Only for frames size R6)
40	24 V AC/DC- in	24V AC/DC input to power up the control unit when the main supply is disconnected
41	24 V AC/DC+ in	

Terminal size:

R1…R6: 0.14…1.5 mm^2(All terminals)

Tightening torque: 0.5…0.6 N·m (0.4 lbf·ft)

Notes:

1) The analog types of AI1 and AO1 are selected as voltage or current respectively by parameters 12.15 and 13.15.

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

3) Connected with jumpers at the factory.

Input signals

- Control location (Hand / Auto) selection (DI3)
- Hand - frequency reference (AI1)
- Hand - start / stop selection (DI1)
- Comm - frequency reference (Modbus RTU)
- Comm - start / stop selection (Modbus RTU)
- Fault reset (DI2)

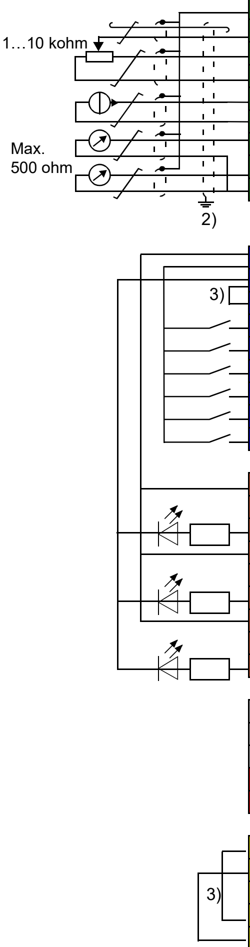
Output signals

- Analog output AO1: output frequency
- Analog output AO2: motor current
- Relay output 1: ready run
- Relay output 2: running
- Relay output 3: fault (-1)

Hand/PID macro

This macro controls the drive with the built-in process PID controller. In addition this macro has a second control location for the direct frequency control mode, and one of the devices uses Modbus-RTU communication to connect with the drive. To enable the macro, set the value of parameter *96.04 Macro select* to *Hand/PID*.

Default control connections for the Hand/PID macro



XI	Reference power and analog inputs and outputs	
1	SCR	Signal cable shield (screen)
2	AI1	**Hand frequency reference:** 0…10 V 1)
3	AGND	Analog input circuit common
4	+10V	+10 V DC Reference voltage
5	AI2	**PID pressure feedback:** 4…20 mA 1) 4)
6	AGND	Analog input circuit common
7	AO1	**Output frequency:** 4…20 mA 1)
8	AO2	**Motor current:** 4…20 mA
9	AGND	Analog input circuit common
X2 and X3	Aux. voltage output and programmable digital inputs	
10	+24V	Auxiliary voltage output +24 V DC, max. 250 mA
11	DGND	Aux. voltage output common
12	DCOM	Digital input common
13	DI1	**Hand Stop (0) / Start (1)**
14	DI2	**Fault Reset**
15	DI3	**Hand control (0) / PID control (1)**
16	DI4	Not used
17	DI5	Not used
18	DI6	**PID Stop (0) / Start (1)**
X6, X7,	**X8** relay output	
19	RO1C	**Ready run** 250 V AC / 30 V DC 2 A
20	RO1A	
21	RO1B	
22	RO2C	**Running** 250 V AC / 30 V DC 2 A
23	RO2A	
24	RO2B	
25	RO3C	**Fault (-1)** 250 V AC / 30 V DC 2 A
26	RO3A	
27	RO3B	
X5	Embedded fieldbus	
29	B+	Embedded Modbus RTU (EIA-485).
30	A-	
31	DGND	
S100	TERM	Termination resistors switch
S200	BIAS	Bias resistors switch
X4	Safe torque off	
34	OUT1	Safe torque off. Factory connection. Both circuits must be closed for the drive to start. see safety torque cancellation function in the drive firmware manual
35	OUT2	
36	SGND	
37	IN1	
38	IN2	
X10	24 V AC/DC	(Only for frames size R6)
40	24 V AC/DC- in	24V AC/DC input to power up the control unit when the main supply is disconnected
41	24 V AC/DC+ in	

Terminal size:

R1…R6: 0.14…1.5 mm^2(All terminals)

Tightening torque: 0.5…0.6 N·m (0.4 lbf·ft)

Notes:

[1] The analog types of AI1, AI2 and AO1 are selected as voltage or current respectively by parameters 12.15, 12.25 and 13.15.

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

[3] Connected with jumpers at the factory.

[4] 4... 20mA electrical signal corresponds to the sensor from zero to the maximum value, unit: MPa. The default pressure sensor range is 0... 1.6Mpa. If other ranges of pressure sensors are used, it is only necessary to set the scale maximum value of 12.30 AI2 to the maximum range of the corresponding sensor value.

Input signals

- Control location (Hand / PID) selection (DI3)
- Hand - frequency reference (AI1)
- Hand - start / stop selection (DI1)
- PID - pressure reference (Control panel)
- PID - pressure feedback (AI2)
- PID - start / stop selection (DI6)
- Fault reset (DI2)

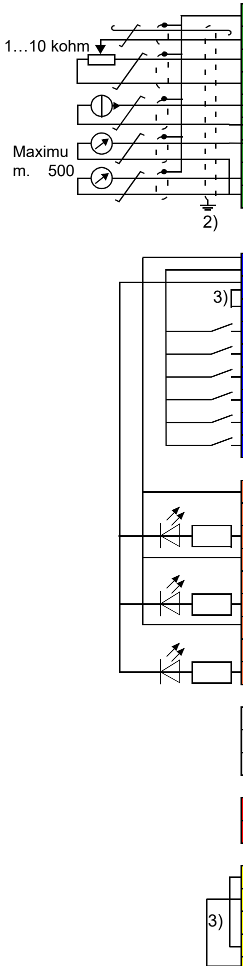
Output signals

- Analog output AO1: output frequency
- Analog output AO2: motor current
- Relay output 1: ready run
- Relay output 2: running
- Relay output 3: fault (-1)

PFC macro

Control multiple pumps by drive relay output. Activate PFC macro by selecting basic setting menu, or activate the macro by setting parameter *96.04 Macro select* to *PFC*.
PFC function is valid only when the external 2 is selected.

PFC macro default control connections



XI	Reference power and analog inputs and outputs	
1	SCR	Signal cable shield (screen)
2	AI1	**Hand frequency reference**: 0…10 V 1)
3	AGND	Analog input circuit common
4	+10V	+10 V DC Reference voltage
5	AI2	**PFC pressure feedback**: 4…20 mA 1) 4)
6	AGND	Analog input circuit common
7	AO1	**Output frequency:** 4…20 mA 1)
8	AO2	**Motor current:** 4…20 mA
9	AGND	Analog input circuit common
X2 & X3	Aux. voltage output and programmable digital inputs	
10	+24V	Auxiliary voltage output +24 V DC, max. 250 mA
11	DGND	Aux. voltage output common
12	DCOM	Digital input common
13	DI1	**Hand Stop (0) / Start (1)**
14	DI2	**Fault Reset**
15	DI3	**Hand control (0) / PFC control (1)**
16	DI4	**Motor 1 interlock**
17	DI5	**Motor 2 interlock**
18	DI6	**PFC Stop (0) / Start (1)**
X6, X7, X8	Relay output	
19	RO1C	**Fault (-1)** 250 V AC / 30 V DC 2 A
20	RO1A	
21	RO1B	
22	RO2C	**PFC1 (pump 1)** 5) 250 V AC / 30 V DC 2 A
23	RO2A	
24	RO2B	
25	RO3C	**PFC2 (pump 2)** 5) 250 V AC / 30 V DC 2 A
26	RO3A	
27	RO3B	
X5	Embedded fieldbus	
29	B+	Embedded Modbus RTU (EIA-485).
30	A-	
31	DGND	
(frames size R3~R6)		
S100	TERM	Termination resistors switch
S200	BIAS	Bias resistors switch
X4	Safe torque off	
34	OUT1	Safe torque off. Factory connection. Both circuits must be closed, before starting drive. See chapter Safe torque off in drive hardware manual.
35	OUT2	
36	SGND	
37	IN1	
38	IN2	
X10	24 V AC/DC	(Only for frames size R6)
40	24 V AC/DC- in	24V AC/DC input to power up the control unit when the main supply is disconnected
41	24 V AC/DC+ in	

Terminal size:

R1…R6: 0.14…1.5 mm^2(All terminals)

Tightening torque: 0.5…0.6 N·m (0.4 lbf·ft)

Notes:

1) The analog types of AI1, AI2 and AO1 are selected as voltage or current respectively by parameters 12.15, 12.25 and 13.15.

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

3) Connect jumper in factory.

4) 4... 20mA electrical signal corresponds to the sensor from zero to the maximum value, unit: MPa. The default pressure sensor range is 0... 1.6 Mpa. If other ranges of pressure sensors are used, it is only necessary to set the scale maximum value of 12.30 AI2 to the maximum range of the corresponding sensor value.

5) PFC1 connects the control circuit of the first pump, and PFC2 connects the control circuit of the second pump.

Input signals

- Control location (Hand / PFC) selection (DI3)
- Hand - frequency reference (AI1)
- Hand - start / stop selection (DI1)
- PFC - pressure reference (Control panel)
- PFC - pressure feedback (AI2)
- PFC - start / stop selection (DI6)
- PFC - pump1 interlock selection (DI4)
- PFC - pump2 interlock selection (DI5)
- Fault reset (DI2)

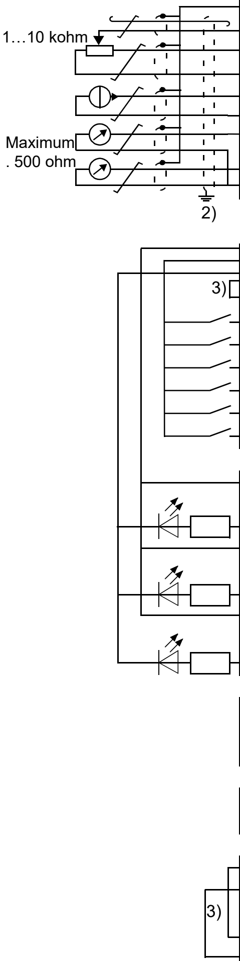
Output signals

- Analog output AO1: output frequency
- Analog output AO2: motor current
- Relay output 1: ready run
- Relay output 2: PFC2
- Relay output 3: fault (-1)

SPFC macro

Control multiple pumps and fans by drive relay output. Activate SPFC macro by selecting basic setting menu, or activate the macro by setting parameter *96.04 Macro select* to *SPFC*. **SPFC function is valid only when EXT 2 is selected.**

SPFC macro default control connections



XI	Reference power and analog inputs and outputs	
1	SCR	Signal cable shield (screen)
2	AI1	**Hand frequency reference**: 0…10 V 1)
3	AGND	Analog input circuit common
4	+10V	+10 V DC Reference voltage
5	AI2	**SPFC pressure feedback**: 4…20 mA 1) 4)
6	AGND	Analog input circuit common
7	AO1	**Output frequency:** 4…20 mA 1)
8	AO2	**Motor current:** 4…20 mA
9	AGND	Analog input circuit common
X2 & X3	Aux. voltage output and programmable digital inputs	
10	+24V	Auxiliary voltage output +24 V DC, max. 250 mA
11	DGND	Aux. voltage output common
12	DCOM	Digital input common
13	DI1	**Hand Stop (0) / Start (1)**
14	DI2	**Fault Reset**
15	DI3	**Hand control (0) / SPFC control (1)**
16	DI4	**Motor 1 interlock**
17	DI5	**Motor 2 interlock**
18	DI6	**SPFC Stop (0) / Start (1)**
X6, X7, X8	Relay output	
19	RO1C	**Fault (-1)** 250 V AC / 30 V DC 2 A
20	RO1A	
21	RO1B	
22	RO2C	**PFC1 (#1 motor)** 5) 250 V AC / 30 V DC 2 A
23	RO2A	
24	RO2B	
25	RO3C	**PFC2 (#2 motor)** 5) 250 V AC / 30 V DC 2 A
26	RO3A	
27	RO3B	
X5	Embedded fieldbus	
29	B+	Embedded Modbus RTU (EIA-485).
30	A-	
31	DGND	
(frames size R3~R6)		
S100	TERM	Termination resistors switch
S200	BIAS	Bias resistors switch
X4	Safe torque off	
34	OUT1	Safe torque off. Factory connection. Both circuits must be closed, before starting drive. See chapter Safe torque off in drive hardware manual.
35	OUT2	
36	SGND	
37	IN1	
38	IN2	
X10	24 V AC/DC	(Only for frames size R6)
40	24 V AC/DC- in	24V AC/DC input to power up the control unit when the main supply is disconnected
41	24 V AC/DC+ in	

Terminal size:

R1…R6: 0.14…1.5 mm^2(All terminals)

Tightening torque: 0.5…0.6 N·m (0.4 lbf·ft)

Notes:

1) The analog types of AI1, AI2 and AO1 are selected as voltage or current respectively by parameters 12.15, 12.25 and 13.15.

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

3) Connect jumper in factory.

4) 4... 20mA electrical signal corresponds to the sensor from zero to the maximum value, unit: MPa. The default pressure sensor range is 0... 1.6 Mpa. If other ranges of pressure sensors are used, it is only necessary to set the scale maximum value of 12.30 AI2 to the maximum range of the corresponding sensor value.

5) PFC1 connects the control circuit of the first pump, and PFC2 connects the control circuit of the second pump.

Input signals

- Control location (Hand / SPFC) selection (DI3)
- Hand - frequency reference (AI1)
- Hand - start / stop selection (DI1)
- SPFC - pressure reference (Control panel)
- SPFC - pressure feedback (AI2)
- SPFC - start / stop selection (DI6)
- SPFC - pump1 interlock selection (DI4)
- SPFC - pump2 interlock selection (DI5)
- Fault reset (DI2)

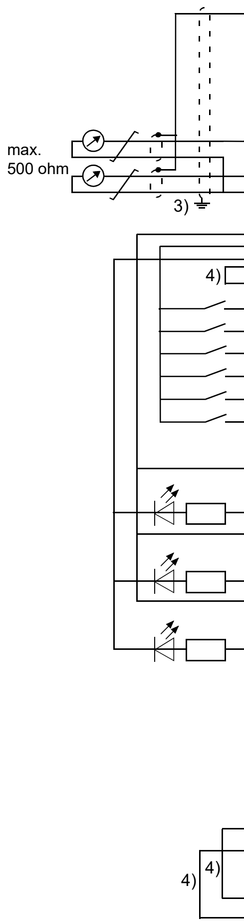
Output signals

- Analog output AO1: output frequency
- Analog output AO2: motor current
- Relay output 1: PFC1
- Relay output 2: PFC2
- Relay output 3: 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.To enable the macro, select it in the **Primary settings** menu or set parameter *96.04 Macro select* to *Motor potentiometer*.

Default control connections for the Motor potentiometer macro



Terminal	Name	Description
XI	Reference voltage and analog inputs and outputs	
1	SCR	Signal cable shield (screen)
2	AI1	Not configured[5]
3	AGND	Analog input circuit common
4	+10V	Reference voltage 10 V DC
5	AI2	Not configured[5]
6	AGND	Analog input circuit common
7	AO1	**Output frequency:** 0…20 mA[5]
8	AO2	**Motor current:** 0…20 mA
9	AGND	Analog output circuit common
X2 & X3	Aux. voltage output and programmable digital inputs	
10	+24V	Auxiliary voltage output +24 V DC, max. 250 mA
11	DGND	Auxiliary voltage output common
12	DCOM	Digital input common for all
13	DI1	**Hand Start(1)/Stop(0)**
14	DI2	Not configured
15	DI3	**Reference up**[1]
16	DI4	**Reference down**[1]
17	DI5	Not configured
18	DI6	**Fault reset (1)**
X6, X7, X8	Relay outputs	
19	RO1C	**Ready run** 250 V AC / 30 V DC 2 A
20	RO1A	
21	RO1B	
22	RO2C	**Running** 250 V AC / 30 V DC 2 A
23	RO2A	
24	RO2B	
25	RO3C	**Fault (-1)** 250 V AC / 30 V DC 2 A
26	RO3A	
27	RO3B	
X5	Embedded fieldbus	
29	B+	Embedded Modbus RTU (EIA-485). See chapter *Modbus RTU control through the embedded fieldbus interface (EFB)* on page *163*.
30	A-	
31	DGND	
S4	TERM	Serial data link termination switch
S5	BIAS	Serial data link bias resistors switch
X4	Safe torque off	
34	OUT1	Safe torque off. Factory connection. Both circuits must be closed for the drive to start. See chapter *The Safe torque off function* in the *Hardware manual* of the drive.
35	OUT2	
36	SGND	
37	IN1	
38	IN2	
X10	24 V AC/DC	
40	24 V AC/DC+ in	R6 only: Ext. 24V AC/DC input to power up the control unit when the main supply is disconnected.
41	24 V AC/DC- in	

See the notes on the next page.

Terminal size:

R1…R6: 0.14…1.5 mm^2(All terminals)

Tightening torque: 0.5…0.6 N·m (0.4 lbf·ft)

Notes:

1) 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 *28.26 Constant frequency 1*.
In vector control: See parameter *22.26 Constant speed 1*.

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

4) Connected with jumpers at the factory.

5) Select voltage or current for inputs AI1 and AI2 and output AO1 with parameters 12.15, 12.25 and 13.15, respectively.

Input signals

- Hand Start/Stop selection (DI1)
- Reference up (DI3)
- Reference down (DI4)
- Fault reset (DI6)

Output signals

- Analog output AO1: Output frequency
- Analog output AO2: Motor current
- Relay output 1: ready run
- Relay output 2: running
- Relay output 3: fault (-1)

Parameter default values for different macros

The *Parameters* chapter (page *123*) gives the default values for all parameters of Hand/Auto macro (factory macro). The default values of other macros are different. The table below lists the default values of these parameters for each macro.

96.04	**Macro select**	**27= Hand/Auto macro**	**28= Hand/Comm macro**	**29= Hand/PID macro**	**30= PFC macro**	**31 = SPFC macro**	**13 = Motor potentiometer macro**
10.24	RO1 source	2 = Ready run	2 = Ready run	2 = Ready run	15 = Fault (-1)	15 = Fault (-1)	2 = Ready run
10.27	RO2 source	7 = Running	7 = Running	7 = Ready run	45 = PFC1	45 = PFC1	7 = Running
10.30	RO3 source	15 = Fault (-1)	15 = Fault (-1)	15 = Fault (-1)	46 = PFC2	46 = PFC2	15 = Fault (-1)
12.20	AI1 scaled at AI1 max	50.0	50.0	50.0	50.0	50.0	50.0
12.30	AI2 scaled at AI2 max	50.0	50.0	1.6	1.6	1.6	50.0
13.19	AO1 out at AO1 src min	4.000	4.000	4.000	4.000	4.000	0.000
19.11	Ext1/Ext2 selection	5 = DI3	5 = DI3	5 = DI3	5 = DI3	5 = DI3	0 = EXT1
20.01	Ext1 commands	1 = In1 start-up	1 = In1 start-up	1 = In1 start-up	1 = In1 start-up	1 = In1 start-up	1 = In1 start-up
20.03	Ext1 in1 source	2 = DI1	2 = DI1	2 = DI1	2 = DI1	2 = DI1	2 = DI1
20.06	Ext2 commands	1 = In1 start-up	14=Embedded fieldbus	1 = In1 start-up	1 = In1 start-up	1 = In1 start-up	0 = Not selected
20.08	Ext2 in1 source	7 = DI6	7 = DI6	7 = DI6	7 = DI6	7 = DI6	0 = Always off
21.03	Stop mode	0 = Coast	0 = Coast	0 = Coast	0 = Coast	0 = Coast	0 = Coast
28.11	Ext1 frequency	1 = AI1 scaled	1 = AI1scaled	1 = AI1scaled	1 = AI1scaled	1 = AI1scaled	15 =Motor potentiometer
28.15	Ext2 frequency	2 = AI2 scaled	8 = EFB ref1	16 = PID	16 = PID	16 = PID	0 = Zero
28.22	Constant frequency	0 = Always off	0 = Always off	0 = Always off	0 = Always off	0 = Always off	0 = Always off
28.23	Constant frequency	0 = Always off	0 = Always off	0 = Always off	0 = Always off	0 = Always off	0 = Always off
30.13	Minimum frequency	20.00	20.00	20.00	20.00	20.00	0.00
31.11	Fault reset selection	3 = DI2	3 = DI2	3 = DI2	3 = DI2	3 = DI2	7 = DI6
31.22	STO indication	3 = Warning/ Warning	3 = Warning/ Warning	3 = Warning/ Warning	3 = Warning/ Warning	3 = Warning/ Warning	3 = Warning/ Warning
31.24	Stall function	2 = Fault	2 = Fault	2 = Fault	2 = Fault	2 = Fault	2 = Fault
31.25	Stall current limit	110.0 %	110.0 %	110.0 %	110.0 %	110.0 %	110.0 %

96.04	**Macro select**	**27= Hand/Auto macro**	**28= Hand/Comm macro**	**29= Hand/PID macro**	**30= PFC macro**	**31 = SPFC macro**	**13 = Motor potentiometer macro**
40.07	Process PID operation	0 = Off	0 = Off	1 = On	1 = On	1 = On	0 = Off

96.04	**Macro select**	**27= Hand/Auto macro**	**28= Hand/Comm macro**	**29= Hand/PID macro**	**30= PFC macro**	**31 = SPFC macro**	**32 = Motor potentiometer macro**
40.08	Set 1 feedback 1	2 = AI2 scaled	2 = AI2 scaled	2 = AI2 scaled	2 = AI2 scaled	2 = AI2 scaled	2 = AI2 scaled
40.16	Set 1 setpoint 1 source	0 = Not selected	0 = Not selected	14 = Control panel (ref copied)	14 = Control panel (ref copied)	14 = Control panel (ref copied)	0 = Not selected
40.17	Set 1 setpoint 2 source	0 = Not selected	0 = Not selected	0 = Not selected	0 = Not selected	0 = Not selected	0 = Not selected
40.19	Set 1 internal setpoint sel1	1 = Selected	1 = Selected	1 = Selected	1 = Selected	1 = Selected	1 = Selected
40.20	Set 1 internal setpoint sel2	0 = Not selected	0 = Not selected	0 = Not selected	0 = Not selected	0 = Not selected	0 = Not selected
40.32	Set 1 gain	2.00	2.00	2.00	2.00	2.00	2.00
40.33	Set 1 integration	15.0	15.0	15.0	15.0	15.0	15.0
40.44	Set 1 sleep delay	60.0	60.0	300	300	300	60.0
40.45	Set 1 sleep boost time	0.0	0.0	120	120	120	0.0
40.46	Set 1 sleep boost step	0.0	0.0	0.1	0.1	0.1	0.0
40.47	Set 1 wake-up deviation	0.00	0.00	0.10	0.10	0.10	0.0
40.48	Set 1 wake-up delay	0.50	0.50	60	60	60	0.50
45.11	Energy optimizer	1 = Enable	1 = Enable	1 = Enable	1 = Enable	1 = Enable	1 = Enable
49.19	Basic panel home view 1	3 = Output frequency	3 = Output frequency	3 = Output frequency	3 = Output frequency	3 = Output frequency	3 = Output frequency
49.20	Basic panel home view 2	4 = Motor current	4 = Motor current	4 = Motor current	4 = Motor current	4 = Motor current	4 = Motor current
49.21	Basic panel home view 3	14 = Freq ref used	14 = Freq ref used	14 = Freq ref used	14 = Freq ref used	14 = Freq ref used	14 = Freq ref used
49.219	Basic panel home view 4	3 = Output frequency	3 = Output frequency	17 = Process PID	17 = Process PID	17 = Process PID	17 = Output frequency
49.220	Basic panel home view 5	4 = Motor current	4 = Motor current	4 =Motor current	4 =Motor current	4 =Motor current	4 =Motor current
49.221	Basic panel home view 6	14 = Freq ref used	14 = Freq ref used	18 = Process PID	18 =Process PID setpoint	18 =Process PID setpoint	18 = Freq ref used
50.02	FBA A comm loss func	1 = Fault	1 = Fault	1 = Fault	1 = Fault	1 = Fault	1 = Fault

96.04	Macro select	27= Hand/Auto macro	28= Hand/Comm macro	29= Hand/PID macro	30= PFC macro	31 = SPFC macro	32 = Motor potentiometer macro
58.01	Protocol enable	0 = None	0 = None	0 = None	0 = None	0 = None	1 = Modbus RTU
76.21	Multipump configuration	0 = Off	0 = Off	0 = Off	2 = PFC	3 = SPFC	0 = Off
76.26	Min number of motors	1	1	1	1	1	1
76.27	Max number of motors	1	1	1	2	2	1
76.55	Start delay	10	10	10	30	30	10
76.56	Stop delay	10	10	10	15	15	10
76.60	PFC ramp acceleration	1	1	1	20	20	1
76.61	PFC ramp deceleration	1	1	1	20	20	1
76.71	PFC Autochange	1	1	1	120	120	1
76.72	Maximum wear	10	10	10	12	12	10
76.74	Autochange auxiliary PFC	1 = Aux motors only	1 = Aux motors only	1 = Aux motors only	0 = All motors	0 = All motors	1 = Aux motors only
76.81	PFC 1 interlock	1 = Available.	1 =Available. PFC motor	1 = Available.	5 = DI4	5 = DI4	1 =Available. PFC motor
76.82	PFC 2 interlock	1 = Available.	1 = Available.	1 = Available.	6 = DI5	6 = DI5	1 =Available. PFC motor

5

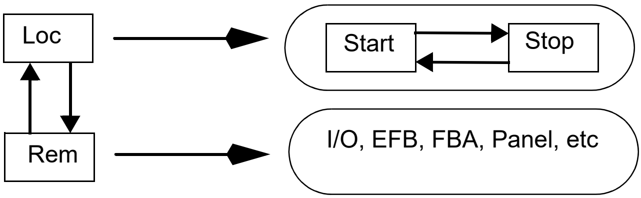
Program features

What this chapter contains

This chapter describes some of the more important functions within the control program, how to use them and how to program them to operate. It also explains the control locations and operating modes.

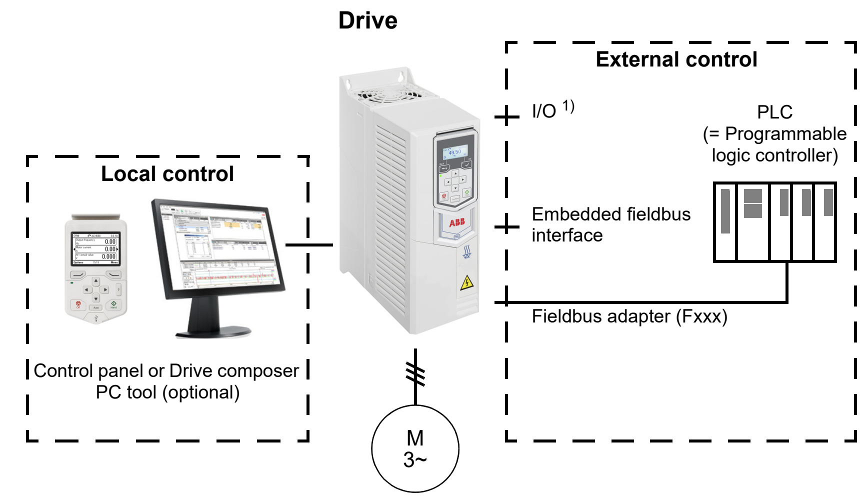
Local control vs. external control

The ACH531 has two main control locations: external and local. The control position is selected by the **Loc / Rem** key on the control panel or in the PC tool.



The control location can also be selected in the PC tool.

Note: If fault *7081 Control panel loss* is active and the drive is powered up at the same time, the mode would be changed from **Loc** to **Rem**.



1) Extra inputs/outputs can be added by installing an optional I/O extension module (CMOD-01, CMOD-02, CAIO-01, CHDI-01 or CPTC-02) in drive slot.

5

Local control

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

- the control panel keypad
- a PC equipped with Drive composer PC tool.

Speed control mode is available in vector motor control mode; frequency mode is available when scalar motor control mode is used.

Local control is mainly used during commissioning and maintenance. The control panel always overrides the external control signal sources when used in local control. Changing the control location to local can be prevented by parameter *19.18 HAND/OFF disable source*.

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

External control

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

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

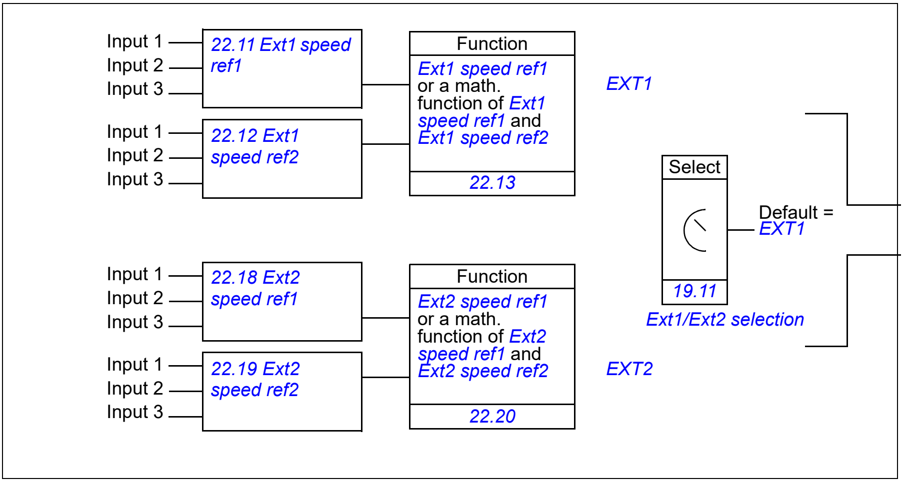
Two external control locations, EXT1 and EXT2, are available. The user can select the sources of the start and stop commands separately for each location by setting parameters *20.01 Ext1 commands*…*20.10 Ext2 in3 source*. The operating mode can be selected separately for each location, which enables quick switching between different operating modes, for example, speed and process PID control. Selection between EXT1 and EXT2 is done via any binary source such as a digital input or fieldbus control word (parameter *19.11 Ext1/Ext2 selection*). The source of reference is selectable for each operating mode separately.

Communication fail functionality

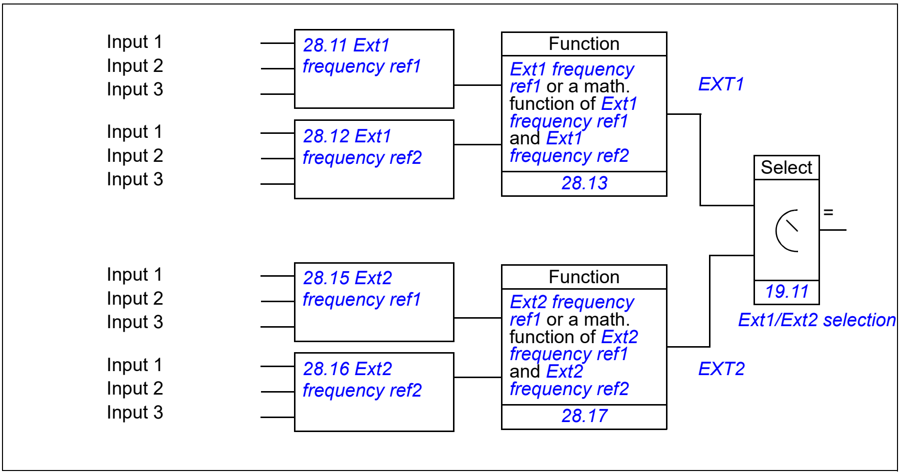
The communication fail functionality ensures continuous process without interruptions. If there is a communication loss, the drive automatically changes the control location from EXT1 to EXT2. This enables process to be controlled, for example, with the drive PID controller. When the original control location recovers, the drive automatically switches control back to the communication network (EXT1).

5

Block diagram: EXT1/EXT2 selection for speed control



Block diagram: EXT1/EXT2 selection for frequency control

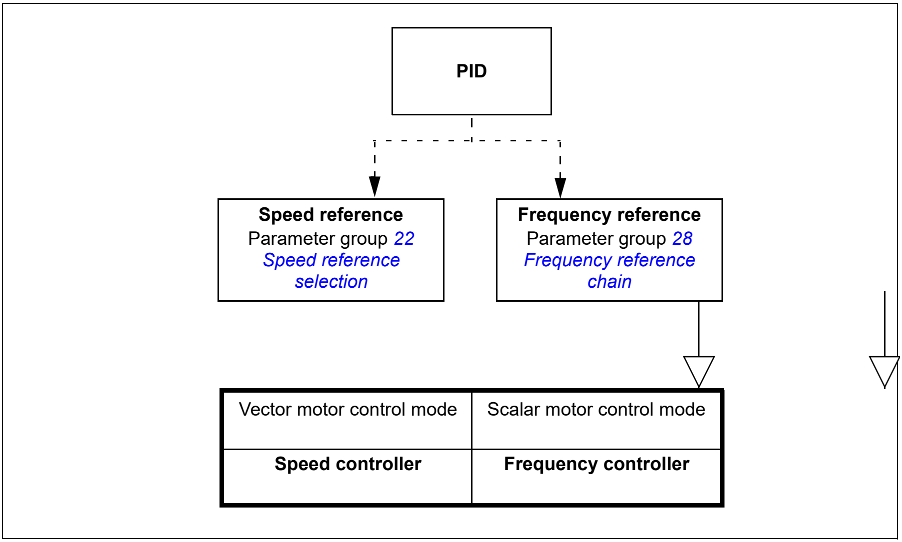


Settings

- Parameters *19.11 Ext1/Ext2 selection* (page *175*); *20.01 Ext1 commands*…*20.10 Ext2 in3 source* (page *176*).
- Parameters *22.11 Ext1 speed ref1*…*22.20 Ext2 speed function* (page *196*)
- Parameters *28.11 Ext1 frequency ref1*…*28.17 Ext2 frequency function* (page *216*).

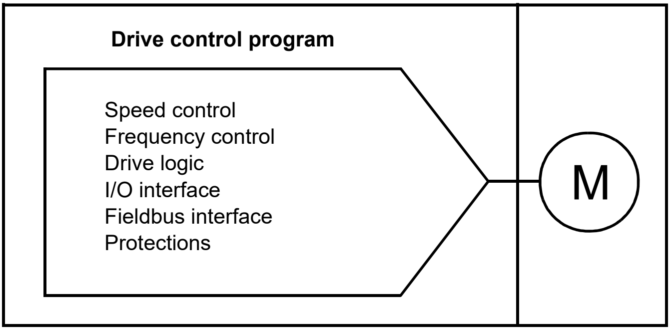
Operating modes of the drive

The drive can operate in several operating modes with different types of reference. The mode is selectable for each control location (Local, EXT1 and EXT2) in parameter group *19 Operation mode*. An overview of the different reference types and control chains is shown below.



Drive configuration and programming

The drive control program performs the main control functions, including speed and frequency control, drive logic (start/stop), I/O, feedback, communication and protection functions. Control program functions are configured and programmed with parameters.



Configuring via default configurations

Default configurations are predefined I/O configurations. See chapter *Application macros* (page *37*).

Configuring via parameters

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

- the control panel, as described in chapter *Control panel* (see page *25*)
- the Drive composer PC tool, as described in *Drive composer user's manual* (3AUA0000094606 [English]), or
- the fieldbus interface, as described in chapters *Modbus RTU control through the embedded fieldbus interface (EFB)* (see page *163*) and *Fieldbus control through a fieldbus adapter* (see page *219*).

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*.

Control interfaces

Programmable analog inputs

The control unit has two programmable analog inputs. Each of the inputs can be independently set as a voltage (0/2…10 V) or current (0/4…20 mA) input with parameters. Each input can be filtered, inverted and scaled.

Settings

- Parameter group *12 Standard AI* (page *155*).

Programmable analog outputs

The control unit has two current (0…20 mA) analog outputs. Analog output 1 can be set as a voltage (0/2…10 V) or current (0/4…20 mA) output with a parameter. Analog output 2 always uses current. Each output can be filtered, inverted and scaled.

Settings

- Parameter group *13 Standard AO* (page *160*).

Programmable digital inputs and outputs

The control unit has six digital inputs.

Digital input DI5 can be used as a frequency input.

Settings

- Parameter groups *10 Standard DI, RO* (page *145*) and *11 Standard DIO, FI, FO* (page *154*).

Programmable frequency input and output

Digital input DI5 can be configured as a frequency input.

Settings

- Parameter groups *10 Standard DI, RO* (page *145*) and *11 Standard DIO, FI, FO* (page *154*).

Programmable relay outputs

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

Settings

- Parameter group *10 Standard DI, RO* (page *145*).

Programmable I/O extensions

Inputs and outputs can be added by using a CMOD-01 or CMOD-02 multifunction extension module, a CHDI-01 115/230 V digital input extension module, or a CAIO-01 analog input and output extension module. The module is mounted on option slot 2 of the control unit.

The table below shows the number of I/O on the control unit as well as optional CMOD-01, CMOD-02, CHDI-01, and CAIO-01 modules.

Location	Digital inputs (DI)	Digital outputs (DO)	Analog inputs (AI)	Analog outputs (AO)	Relay outputs (RO)
Control unit	6	-	2	2	3
CMOD-01	-	1	-	-	2
CMOD-02	-	-	-	-	1 (non-configurable)
CHDI-01	6 (115/230 V)	-	-	-	2
CAIO-01	-	-	3	2	-

The I/O extension module can be activated and configured using parameter group 15.

The CMOD-02 offers, in addition to the relay output (non-configurable), a +24VDC/AC input and a thermistor input.

CAIO-01 analog inputs are bipolar whereas analog outputs are unipolar.

Notes:

- The configuration parameter group 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. To connect to an input, choose the setting *Other* in the source selector parameter, then specify the appropriate value parameter (and bit, for digital signals) in group 15.
- With the CHDI, you can use up to six additional digital inputs. The CHDI does in no way affect the fixed digital inputs on the control board.
- With any extension IO module connected/selected in parameter *15.01 Extension module type*, only the corresponding module parameters will be visible in group 15.

Settings

15 I/O extension module (page *166*)

Fieldbus control

The drive can be connected to several different automation systems through its fieldbus interfaces. See chapters *Modbus RTU control through the embedded fieldbus interface (EFB)* (page *163*) and *Fieldbus control through a fieldbus adapter* (page *219*).

Settings

Parameter groups *50 Fieldbus adapter (FBA)* (page 308), *51 FBA A settings* (page 313), *52 FBA A data in* (page 314), and *53 FBA A data out* (page 315) and *58 Embedded fieldbus* (page 315).

Pump and fan control features

Note: ABB recommends reading the pump manufacturer's instructions for optimal performance.

Single pump and fan control (PFC/SPFC)

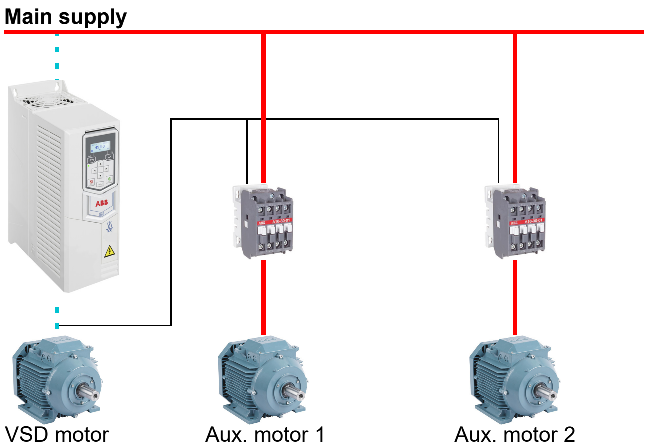
The Single pump and fan control (PFC) is used in pump or fan systems consisting of one drive and multiple pumps or fans. The drive controls the speed of one of the pumps/fans and in addition connects (and disconnects) the other pumps/fans directly to the supply network through contactors.

The PFC control logic switches auxiliary motors on and off as required by the capacity changes of the process. In a pump application, for example, the drive controls the motor of the first pump, varying the motor speed to control the output of the pump. This pump is the speed regulated pump. When the demand (represented by the process PID reference) exceeds the capacity of the first pump (a user defined speed/frequency limit), the PFC logic automatically starts an auxiliary pump. The logic also reduces the speed of the first pump, controlled by the drive, to account for the addition to the total system output by the auxiliary pump. Then, as before, the PID controller adjusts the speed/frequency of the first pump in such a way that the system output meets the process needs. If the demand continues to increase, the PFC logic adds further auxiliary pumps, in a similar manner as just described.

As the demand drops, making the speed of the first pump fall below a minimum limit (user defined as a speed/frequency limit), the PFC logic automatically stops an auxiliary pump. The PFC logic also increases the speed of the drive controlled pump to account for the missing output of the stopped auxiliary pump.

The Single pump and fan control (PFC) is supported in external control location EXT2 only.

Example: Three-pump constant pressure water supply application



Pump 1 is connected to **VSD motor** (drive controlled motor).
Pump 2 is connected to **auxiliary motor 1**.
Pump 3 is connected to **auxiliary motor 2**.

Flow consumption vs. pump status			
Consumption	Pump 1	Pump 2	Pump 3
Low	**VSD**	**Off**	**Off**
↓	**VSD**	**DOL**	**Off**
High	**VSD**	**DOL**	**DOL**
↓	**VSD**	**DOL**	**Off**
Low	**VSD**	**Off**	**Off**

VSD = Controlled by drive, tuning the output speed according to PID control.
DOL = Direct On Line. Pump is running at fixed motor nominal speed.
Off = Off-line. Pump stops.

Soft pump and fan control (SPFC)

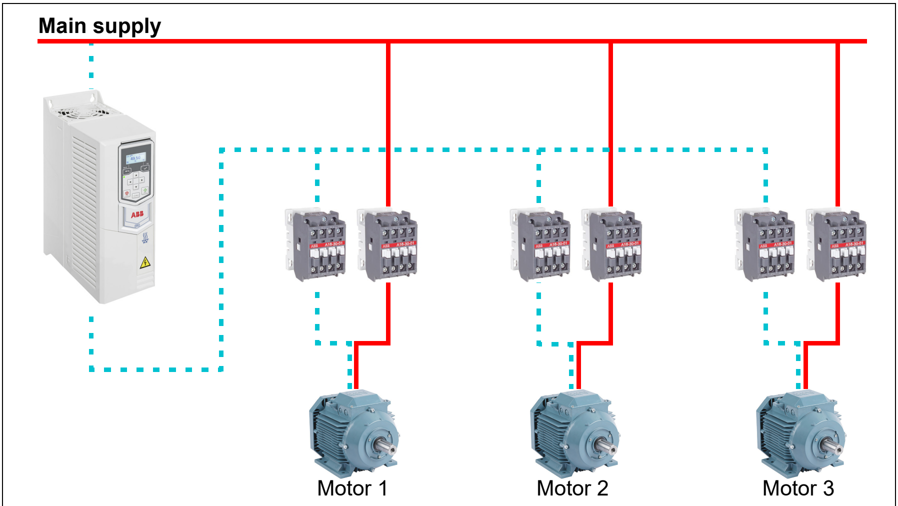
The Soft pump and fan control (SPFC) logic is a variant of the PFC logic for pump and fan alternation applications where lower pressure peaks are desirable when a new auxiliary motor is to be started. The SPFC logic is an easy way to implement soft starting of direct on line (auxiliary) motors.

The main difference between traditional PFC and SPFC logic is how the SPFC logic connects auxiliary motors on-line. When the criteria for starting a new motor is fulfilled (see above) the SPFC logic disconnects the drive controlled motor from the drive and immediately connects that motor to the supply network in a flying start, that is, while the motor is still coasting. The drive then connects to the next pump/fan unit to be started and starts controlling the speed of that one, while the previously controlled unit is now connected directly on line through a contactor.

Further (auxiliary) motors are started in a similar manner. The motor stopping routine is the same as for the normal PFC routine.

In some cases SPFC makes it possible to soften the start-up current while connecting auxiliary motors on-line. Lower pressure peaks on the pipelines and pumps may be achieved as a result.

Example: Three-pump constant pressure water supply application



Pump 1 is connected to **Motor 1**.
Pump 2 is connected to **Motor 2**.
Pump 3 is connected to **Motor 3**.

Flow consumption and pump status			
Consumption	Pump 1	Pump 2	Pump 3
Low	**VSD**	**Off**	**Off**
↓	**DOL**	**VSD**	**Off**
High	**DOL**	**DOL**	**VSD**
↓	**DOL**	**Off**	**VSD**
Low	**Off**	**Off**	**VSD**
↓	**VSD**	**Off**	**DOL**
High	**DOL**	**VSD**	**DOL**
↓	**DOL**	**VSD**	**Off**
Low	**Off**	**VSD**	**Off**
↓	**VSD**	**DOL**	**Off**
High	**DOL**	**DOL**	**VSD**

VSD = Controlled by drive, tuning the output speed according to PID control.
DOL = Direct On Line. Pump is running at fixed motor nominal speed.
Off = Off-line. Pump stops.

Autochange

Automatic rotation of the start order, or Autochange functionality, serves two main purposes in many PFC type setups. One is to keep the run times of the pumps/fans equal over time to even their wear. The other is to prevent any pump/fan from standing still for too long, which would clog up the unit. In some cases it is desirable to rotate the start order only when all units are stopped, for example, to minimize the impact on the process.

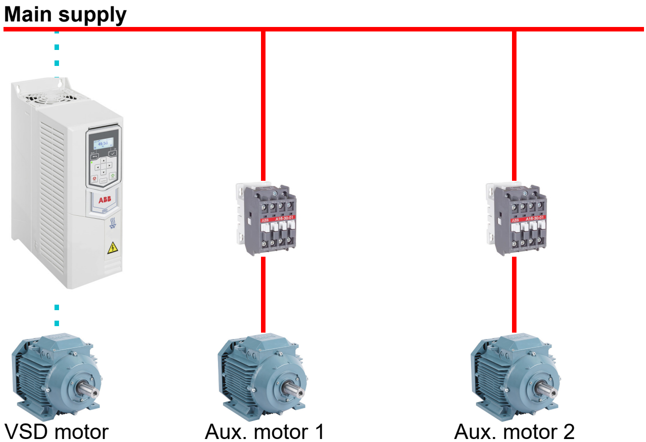
The Autochange can also be triggered by the Timed function (see page 70).

There are three modes of autochange according to what kind of PFC and SPFC together with auxiliary circuit are implemented.

1. Autochange PFC with auxiliary motors only

Example: Three-pump constant pressure water supply application.

Two pumps fulfill the flow consumption for long term running, and the third pump is reserved for shifting. In this mode, only two auxiliary motors, pump 2 and pump 3, shift working.



Pump 1 is connected to **VSD motor** (drive controlled motor).
Pump 2 is connected to **auxiliary motor 1**.
Pump 3 is connected to **auxiliary motor 2**.

Flow consumption and pump status			
Consumption	Pump 1	Pump 2	Pump 3
Low	**VSD**	**Off**	**Off**
Normal	**VSD**	**DOL**	**Off**
↓	**VSD**	**Off**	**DOL**
↓	**VSD**	**DOL**	**Off**
Normal	**VSD**	**Off**	**DOL**

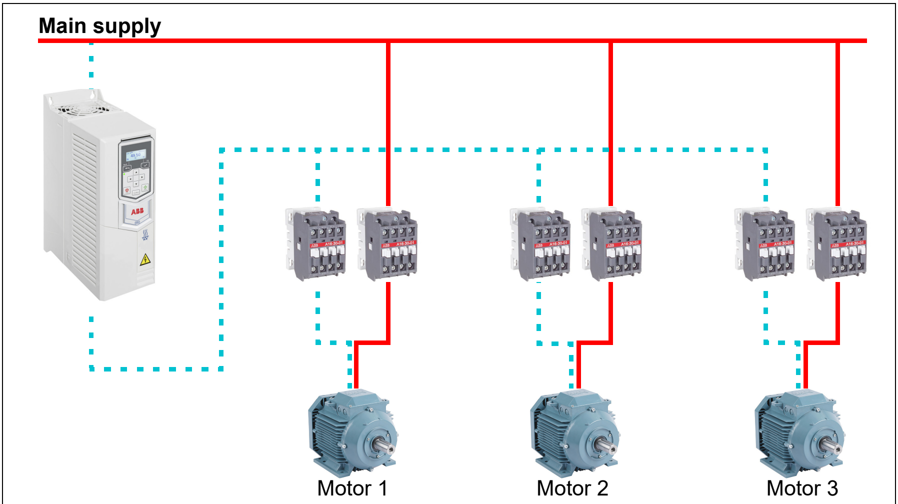
VSD = Controlled by drive, tuning the output speed according to PID control.
DOL = Direct On Line. Pump is running at fixed motor nominal speed.
Off = Off-line. Pump stops.

2. Autochange PFC with all motors

Example: Three-pump constant pressure water supply application

Two pumps fulfill the flow consumption for long term running, and the third pump is reserved for shifting. Because all motors will be shifted for autochange routine, special auxiliary circuit is needed, which is the same as for the SPFC system.

In this mode, the VSD motor will move to the next pump one by one, but the auxiliary motor will always be put on-line in DOL mode. However, three pumps are shifted overall.



Pump 1 is connected to **Motor 1**.
Pump 2 is connected to **Motor 2**.
Pump 3 is connected to **Motor 3**.

Flow consumption and pump status			
Consumption	Pump 1	Pump 2	Pump 3
Low	**VSD**	**Off**	**Off**
Normal	**VSD**	**DOL**	**Off**
↓	**Off**	**VSD**	**DOL**
↓	**DOL**	**Off**	**VSD**
Normal	**VSD**	**DOL**	**Off**

VSD = Controlled by drive, tuning the output speed according to PID control.
DOL = Direct On Line. Pump is running at fixed motor nominal speed.
Off = Off-line. Pump stops.

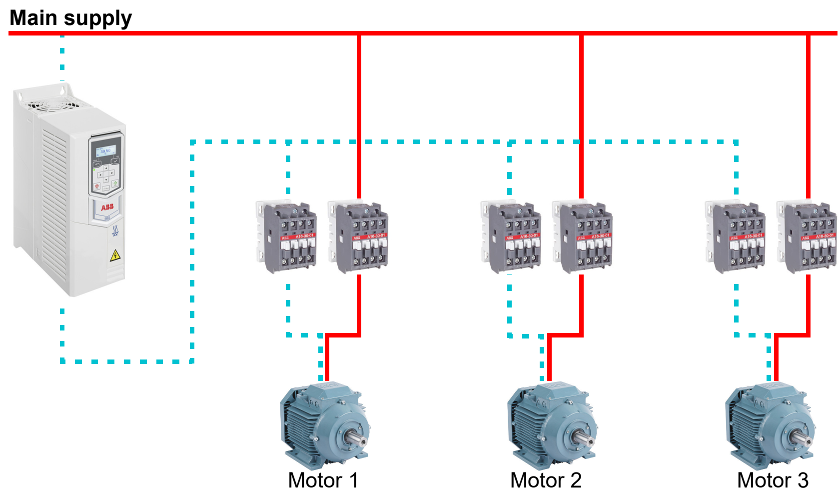
3. Autochange with SPFC

Auxiliary motor is meaningless in SPFC. So it does not matter if you select All motors or Aux motor only.

Example: Three-pump constant pressure water supply application

Two pumps fulfills the flow consumption for long term running, and the third pump is reserved for shifting.

SPFC system supports autochange naturally. No extra component is needed as long as SPFC is already working there. In this mode, all the pumps are always started by the drive as they are in SPFC normal operation.



Pump 1 is connected to **Motor 1**.
Pump 2 is connected to **Motor 2**.
Pump 3 is connected to **Motor 3**.

Flow consumption and pump status			
Consumption	Pump 1	Pump 2	Pump 3
Low	**VSD**	**Off**	**Off**
Normal	**DOL**	**VSD**	**Off**
↓	**Off**	**DOL**	**VSD**
↓	**VSD**	**Off**	**DOL**
Normal	**DOL**	**VSD**	**Off**

VSD = Controlled by drive, tuning the output speed according to PID control.
DOL = Direct On Line. Pump is running at fixed motor nominal speed.
Off = Off-line. Pump stops.

Interlock

There is an option to define interlock signals for each motor in the PFC system. When the interlock signal of a motor is available, the motor participates in the PFC starting sequence. If the signal is Interlocked, the motor is excluded. This feature can be used for informing the PFC logic that a motor is not available (for example, due to maintenance or manual direct-on-line starting).

Settings

- Parameter group *10 Standard DI, RO* (page *145*)
- Parameter group *40 Process PID set 1* (page *279*)
- Parameter groups *76 Multipump configuration* (page *331*) and *77 Multipump maintenance and monitoring* (page *340*).

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.

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

Settings

- Parameters *31.12*…*31.16* (page *237*).

External events

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 geneNominal. The contents of the messages can be edited on the control panel.

Settings

- Parameters *31.01*…*31.10* (page *234*).

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

- Parameter groups *22 Speed reference selection* (page *195*) and *28 Frequency reference chain* (page *215*).

Critical speeds/frequencies

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

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

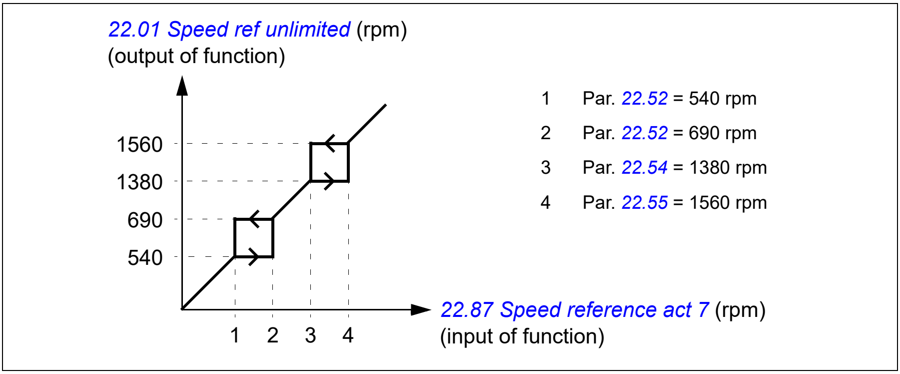
When the drive is limiting the allowed output speeds/frequencies, it limits to the absolutely lowest critical speed (critical speed low or critical frequency low) when accelerating from standstill, unless the speed reference is over the upper critical speed/ frequency limit.

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

Example for critical speeds:

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

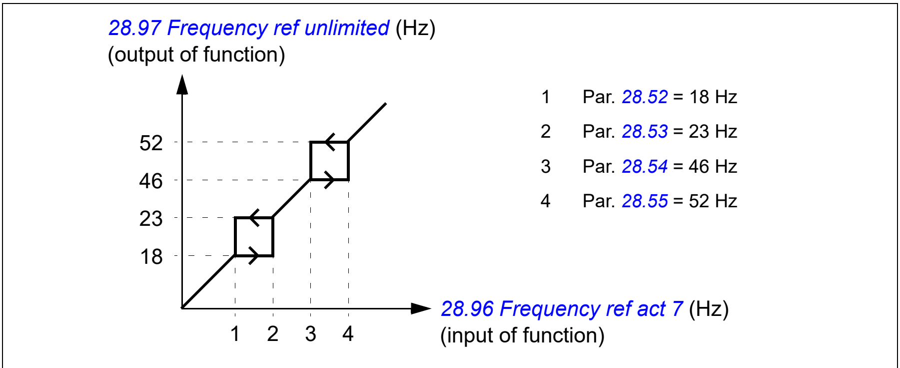
- enable the critical speeds function by turning on bit 0 of parameter *22.51 Critical speed function*, and
- set the critical speed ranges as in the figure below.



Example for critical frequencies:

A fan has vibrations in the range of 18…23 Hz and 46…52 Hz. To make the drive avoid these frequency ranges,

- enable the critical frequencies function by turning on bit 0 of parameter *28.51 Critical frequency function*, and
- set the critical frequency ranges as in the figure below.



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Settings

- Critical speeds: parameters *22.51*…*22.57* (page *202*)
- Critical frequencies: parameters *28.51*…*28.57* (page *222*).

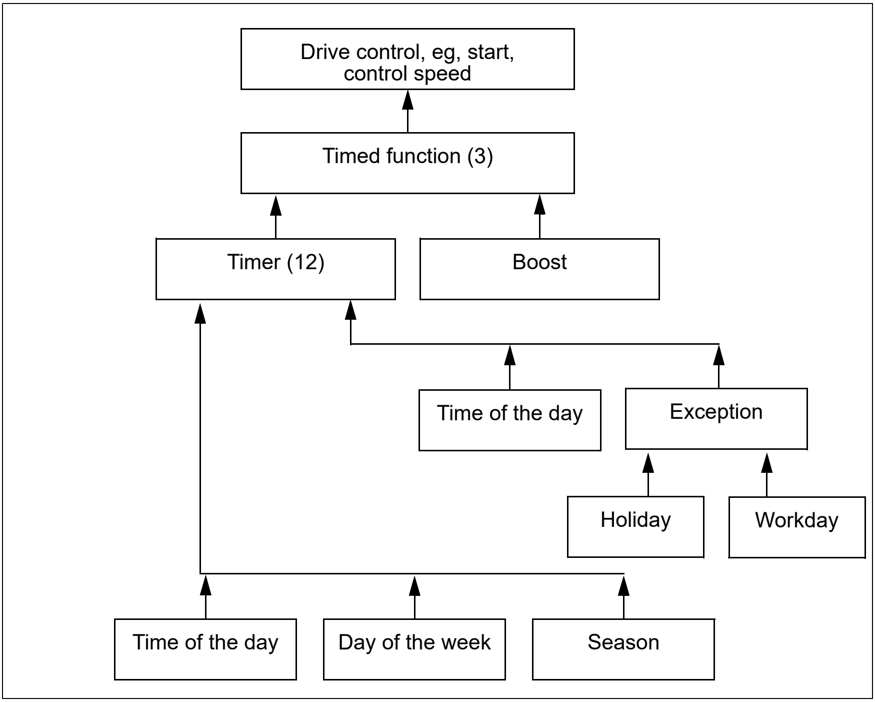
Timed functions

The base entity of the timed functions is called a timer. A timer can be active based on time of the day, day of the week and season of the year. In addition to these time related parameters, the timer activation can be influenced by so called days of exception (configurable as holiday or workday). For example, 25.12. (Dec 25th) can be defined as holiday in many countries. A timer can be set to be active or inactive during the days of exception.

Several timers can be connected to a timed function with the OR function. Thus if any of the timers connected to a timed function is active, the timed function is also active. The timed function is then in turn controlling normal drive functions like starting the drive, choosing the right speed or right setpoint for the PID loop controller.

In many cases where a fan, pump or other equipment is controlled with a timed function, it is often required that there is a possibility to override the time program for a short while. The overriding functionality is called boost. The boost is directly affecting selected timed function(s) and switches it (them) on for a predefined time. The boost mode is typically activated through a digital input and its operation time is set in parameters.

A diagram illustrating the relations of the timed functions entities is shown below.



Settings

- Parameter group *34 Timed functions* (page *253*).

Ramps

Overview

Ramps refer to acceleration and deceleration times. The ramps function adjusts the rate of how fast or slow a drive changes the motor speed with respect to the commanded speed. Ramps should be configured based on the specific application requirements.

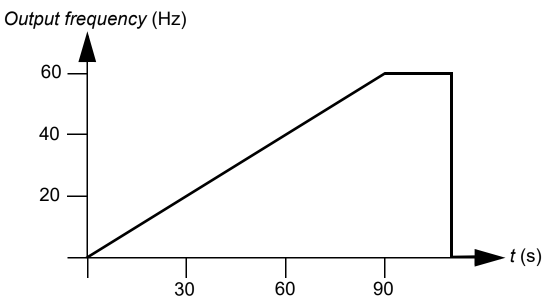
Functionality

Acceleration ramps are recommended for all applications. The acceleration ramp is the amount of time required for the drive to ramp up the motor from 0 Hz to the ramp time target frequency setting.

The deceleration ramp is the amount of time required for the drive to ramp down from the ramp time target frequency to 0 Hz. The most typical settings of ramp time target frequency are 50 Hz outside of North America and 60 Hz for North America. Note that the ramps function is always active during operation and not just used for starting and stopping modes.

In fan applications, the stop mode is typically set to coast, which causes the drive to ignore the deceleration ramp while stopping. In this scenario, the drive will no longer be controlling the speed of the motor once the run command is removed. The figure below shows a ramp curve for 90-second acceleration and no deceleration.

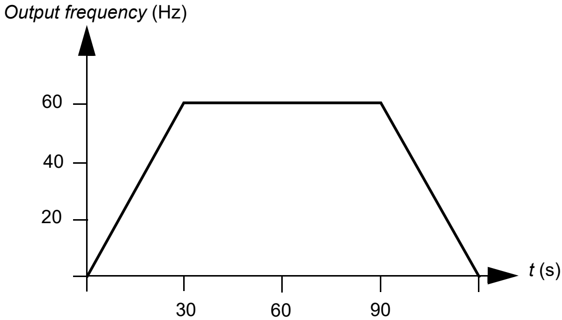
21.03 Stop mode: *Coast*



90-second acceleration and no deceleration ramp curve

In pump applications, the stop mode is typically set to ramp and the deceleration ramp is used while stopping. Ramping a pump motor to a stop helps prevent issues such as water hammer and assist in closing the check valve. The figure below shows a ramp curve for 30-second acceleration and deceleration.

21.03 Stop mode: *Ramp*



30-second acceleration and deceleration ramp curve

If the acceleration time is too short, the drive may trip out on overcurrent. If the deceleration ramp is set to stop too quickly, the drive may trip out on overvoltage. These scenarios are unlikely in most applications due to the internal current and voltage limiting features built into the drive. However, the desired ramps times will not be achieved in such circumstances.

Each application and motor is unique. As a general guideline for HVAC pumps and fans, ramp times are often set between 30 and 90 seconds. Typically a larger drive/motor has a longer ramp time. However, certain applications or pump types require a much faster or slower ramp time.

The drive also supports the ability to have two ramp sets. This feature is most commonly used in situations where a fast acceleration time is needed to a certain speed, and then a slower acceleration time is needed above that speed.

Settings

- Speed reference ramping: Parameters *23.11*…*23.15* and *46.01* (pages *206* and *302*)
- Frequency reference ramping: Parameters *28.71*…*28.75* and *46.02* (pages *223* and *303*)
- Floating point control (Motor potentiometer): Parameter *22.75* (page *204*)
- Emergency stop (“Off3” mode): Parameter *23.23 Emergency stop time* (page *207*).

Application examples

Referring to *Parameter groups 76 Multipump configuration (page 331) and 77 Multipump maintenance and monitoring (page 340).* (page *68*) and *Parameter groups 76 Multipump configuration (page 331) and 77 Multipump maintenance and monitoring (page 340).* (page *68*), the drive is programmed to have the drive ramp the motor to a stop to prevent water hammer. All of the fan application examples are set up to coast to stop.

In the case of the fan application examples, it is not necessary to control the fan while stopping because the resistive forces are not great enough to cause damage to any part in the system. The fan will slowly come to a stop due to the air resistance and friction in the system. If a drive receives a new run command while the fan is still slowing, the drive can catch the spinning motor and ramp the fan to the reference speed.

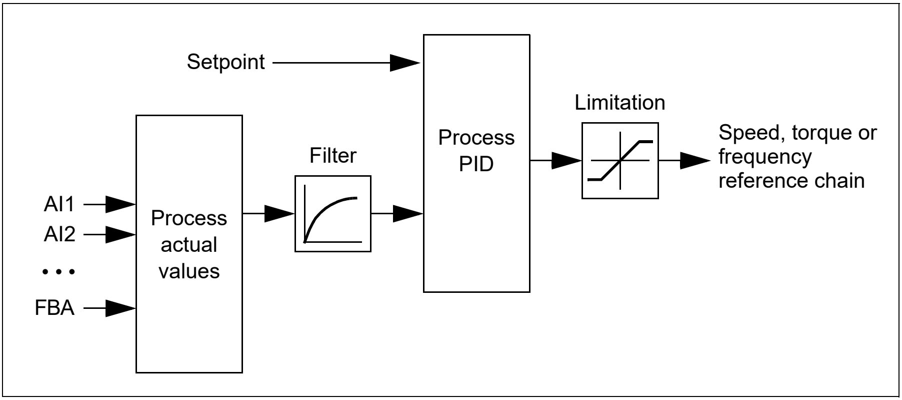
In the pump application examples, the fluid in the pipes can create enough force on the pump to cause the pump to come to a stop very quickly after the drive stops controlling the motor. This sudden stop will cause a pressure surge in the pipes, often known as water hammer. Water hammer problems include noise and vibration, but can also cause major problems like pipe collapse. By using the drive to control the slowdown of the pump over a longer period of time, the pressure change is not sudden and the water hammer issue is eliminated.

Process PID control

There are two built-in process PID controllers (PID set 1 and PID set 2) in the drive. The controller can be used to control process variables 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. For more detailed block diagrams, see pages *527* and *529*.



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*.

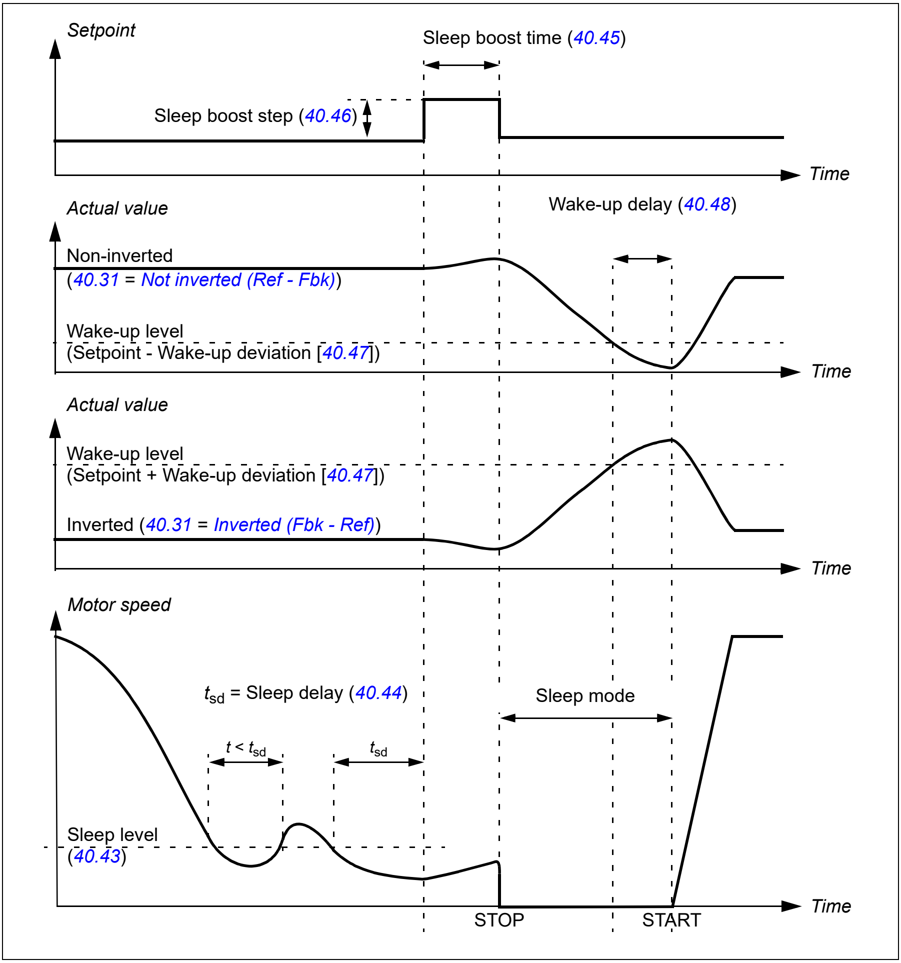
Note: Process PID control is only available in external control location EXT2; see section *Local control vs. external control* (page *53*).

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.



Tracking

In tracking mode, the PID block output is set directly to the value of parameter *40.50* (or *41.50*) *Set 1 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

- Parameter groups *40 Process PID set 1* (page *279*) and *41 Process PID set 2* (page *295*).

Limits

Limits overview

The drive has multiple limits that can be set to prevent the drive from causing damage to the motor or the mechanical system. Limits can be applied to the minimum and maximum frequency, speed, or torque and the maximum current. Frequency limits are used in scalar motor control mode, while speed limits are used in vector motor control mode.

Setting a minimum speed/frequency may be used to prevent a pump or motor from overheating. Running a certain pump or motor type at too slow a speed will decrease its ability to cool itself. Also, certain gearbox style cooling towers require a minimum speed setting to provide proper lubrication of the gearbox. Equipment that runs warmer, or lacks proper lubrication, will likely have a shorter lifespan. Consult the equipment manufacturer for minimum speed/frequency settings.

Setting a maximum speed/frequency may be used to prevent excessive mechanical stress. Mechanical stress at levels above the equipment's design will likely shorten the lifespan of the equipment. Consult the equipment manufacturer to determine the maximum safe speed/frequency.

The maximum current setting will prevent steady-state operation above a specific current operation. Note that this setting is unrelated to the motor overload protection, which is configured based on actual motor current information entered into the drive.

Settings

- Parameter group *30 Limits*.

Application examples

Referring to *Parameter groups 76 Multipump configuration (page 331) and 77 Multipump maintenance and monitoring (page 340).* (page *68*) and *Parameter groups 76 Multipump configuration (page 331) and 77 Multipump maintenance and monitoring (page 340).* (page *68*), the minimum frequency is set based on limitations on the lubrication requirements of the fan's gearbox. In this case, the limit is based on information provided by the equipment manufacturer.

Override

Overview

The Override mode, a flexible way to configure a critical response, is typically used in fan applications that require a special operating mode to assist with fire and smoke control. The Override mode can also be used in a variety of different applications besides life safety control.

Note: The following section details the operation of Override for a stand-alone drive in scalar mode. See section *Scalar motor control* (page *88*).

Activating the Override mode

When Override is activated, the drive follows the programmed functionality defined in the parameter group *70 Override*, using the settings defined in the *70.02 Override enable*. The Override mode is activated through an assigned digital input in the drive, which you select in the *70.03 Override activation source*. The digital input also acts as the start command for the drive in Override mode.

Select Normal or Critical Override mode in *70.02 Override enable*. Normal follows the programmed number of fault resets while in Override mode. Critical allows for infinite number of fault resets. Disabled indicates that Override is not being used.

It is important that the system will operate as programmed when the Override mode is triggered.

When Override is deactivated, the drive returns to the original programmed mode of operation. Note that if the drive was in the Hand mode before Override was selected, the drive returns to the Off mode after Override is deactivated.

Reference for Override frequency

You can configure the drive to run in seven different Override mode types by selecting the reference for Override frequency in the *70.04 Override reference source*.

- **Constant frequencies** allows you to select multiple, constant frequencies based on multiple digital inputs.
- **AI1 directly** or **AI2 directly** is the speed reference in the Override mode.
- **Override frequency** commands the drive frequency to a single preprogrammed value.
- **Floating point** uses two defined digital inputs to increase or decrease the drive frequency. Initial values can be configured, as well as, minimum and maximum values and ramp times.
- **Force stop** stops the drive following the defined stop mode.
- **PID, set1** controls the drive frequency using the output value of the process PID controller for PID parameter set 1.

Override mode features

When placed into the Override mode, the drive shows the following features and behaviors.

- Once in Override, the drive ignores all fieldbus communication commands for start/stop and speed reference.
- In the Override mode the drive ignores all commands from the control panel: for example, Hand/Off/Auto requests and any parameters changes that would affect override are ignored. If a DriveWare tool is connected via the USB port, it will be ignored.
- Activating the Override mode also initiates a start command. There is no need for a secondary start command while in the Override mode.
- The run permissive signal and the signal source for the start interlock(s) that will be followed during the Override mode can be set up from the *70.10 Override enables selection*.
- When Override is enabled, the drive ignores all inputs with the exception of the override activation/deactivation input, the digital inputs selecting the constant frequency, or frequencies, and the safeties selected to be effective in the Override mode.
- When the Override mode is active, the drive displays warning code: AFFE.
- The monitoring of parameters by fieldbus communication is still available during the Override mode. Pass through I/O points (analog outputs, relays outputs and digital inputs that are controlled through a fieldbus) will operate normally and pass data through the drive.
- Faults are grouped into high priority faults and low priority faults. High priority faults are displayed and they will stop the drive. See parameter group *70 Override* (page *323*) for fault handling. The following is a list of the high priority faults:

2310 Overcurrent	*5090 STO hardware failure*
2330 Earth leakage	*5091 Safe torque off*
2340 Short circuit	*7122 Motor overload*
3210 DC link overvoltage	*FA81 Safe torque off 1*
4981 External temperature 1	*FA82 Safe torque off 2*
4982 External temperature 2	

- Unless listed above, all other faults are low priority faults. Active low priority faults are reset when the drive enters the Override mode. Low priority faults are ignored when the drive is in the Override mode.
- You can select whether or not to use autoreset for critical faults (*70.20 Override fault handling*) or require a manual reset from the control panel or designated digital input.
- The number of high priority fault reset attempts is affected by the Override mode. You can select: **Disabled, Normal, or Critical.** Disabled indicates that Override is

not being used. Normal follows the programmed number of fault resets. Critical allows for an infinite number of fault resets.

Note: Using Critical Override might void the warranty if the function is not used correctly.

- The Override configuration is able to be locked through the drive's access level security. See parameter group *96 System* (page *344*) for pass code and access level settings.
- The AI supervision function still operates for any Override modes that utilize an analog input. Thus if an analog input signal is lost, the drive will operate based on parameter group *12 Standard AI* (page *155*) configuration.
- If Safe Torque Off (STO) is triggered while the drive is in the Override mode, the drive exits override and follows the programming for STO alarm and fault configuration. A fault code is displayed to let the operator know the drive is in an STO condition. When STO is disabled, the drive does not go back into override operation.

Settings

- Parameter group *70 Override* (page *323*)
- Parameter group *12 Standard AI* (page *155*)
- Parameter group *96 System* (page *344*).

Interlocks

Overview

Interlocks provide a way to prevent the drive from running when an input is not satisfied. The interlock feature of the drive is often used to wire safeties back to the drive. ABB does not recommend wiring interlocks in series with each other, unless there are more than four interlocks. Wiring interlocks separately allows for faster system troubleshooting, as the drive provides quick identification on which individual interlock is no longer satisfied. Monitoring the status of each interlock is available over fieldbus communications.

Interlocks typically are wired to the drive’s digital inputs (DI), DI1 through DI6. Certain fieldbus communications can also be used to control interlocks, although typically not recommended for most applications.

Configuration

You can configure interlocks via parameter group *20 Start/stop/direction* in the **Parameters** menu.

Interlocks are configurable for normally open or normally closed functionality.

- For example, selecting an interlock for DI4 high indicates that digital input 4 must be closed, or logic 1, to allow the drive to run. A setting of DI4 low indicates the digital input must be open, or logic 0, to allow the drive to run. If the interlock is not in a logic state that will allow the drive to run, the interlock is unsatisfied. If the interlock is in a logic state that will allow the drive to run, the interlock is satisfied.

An unsatisfied interlock is indicated on the drive control panel display via a flashing green LED light, and a flashing warning on the display. You can set up the drive to indicate an unsatisfied interlock in one of two methods. This setting applies to all the interlocks.

- Indicate a warning, whenever an interlock is unsatisfied, regardless of a run command.
- Indicate a warning, whenever an interlock is unsatisfied and a run command is present.

You can configure the drive for either coast or ramp to a stop, when the interlock changes to an unsatisfied state.

Wiring connections

Interlocks function in both Auto and Hand control modes. ABB recommends that the system interlocks are wired directly to the drive, and not to an external building automation system (BAS) controller.

Failure to wire the interlock(s) directly to the drive can inadvertently allow Hand mode operation, when an interlock is not satisfied.

Functionality

The drive allows predefined descriptive text and label text (free text) to be independently associated with each of the four different interlocks. The control panel display will display that specific text when the interlock becomes unsatisfied.

Settings and diagnostics

- Parameter *20.41 Start interlock 1* (page *184*)
- Warnings *AFEE Start interlock 1*, *AFEF Start interlock 2*, *AFF0 Start interlock 3*, *AFF1 Start interlock 4* and *AFF3 Start interlock forced warning*

Application examples of interlocks

The following are application examples of interlocks that can be connected to the drive. The drive has predefined text available for all of these examples.

1. **Overpressure.** This interlock is typically used with air handlers for air duct protection. This interlock stops operation when the measured pressure exceeds a threshold, to prevent damage to ductwork. For integration examples, see *Parameter groups 76 Multipump configuration (page 331) and 77 Multipump maintenance and monitoring (page 340).* (page *68*) and *Parameter groups 76 Multipump configuration (page 331) and 77 Multipump maintenance and monitoring (page 340).* (page *68*).
2. **Motor disconnect open.** This interlock is used in a variety of applications that have a disconnect switch between the drive and motor, to indicate the disconnect switch has been opened. This interlock prevents the drive from attempting to operate a motor while the disconnect switch is open. Note that without this interlock wired to the drive, under certain operating conditions, the motor will attempt to draw a high amount of inrush current once the disconnect switch is closed. This high amount of current may cause the drive to fault to protect itself.
3. **Vibration trip.** This interlock is typically used with cooling towers for vibration protection. This interlock stops operation when the measured vibration exceeds a threshold, to prevent damage to the tower.

   A vibration switch that is connected to the drive digital input setup as an interlock should be a latching style vibration switch. A latching style vibration switch requires manual reset to allow the drive to run the motor again. If the vibration switch is an auto reset style, the drive digital input should be setup as an external event to fault the drive.

   For integration examples, see *Parameter groups 76 Multipump configuration (page 331) and 77 Multipump maintenance and monitoring (page 340).* (page *68*) and *Parameter groups 76 Multipump configuration (page 331) and 77 Multipump maintenance and monitoring (page 340).* (page *68*).
4. **Smoke alarm.** This interlock is typically used with air handlers to stop the propagation of smoke through air ducts. This interlock stops operation when the measured smoke exceeds a threshold, to limit the amount of smoke spread

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through the system. For an integration example, see *Parameter groups 76 Multipump configuration (page 331) and 77 Multipump maintenance and monitoring (page 340).* (page 68).

5. **Freezestat.** This interlock is typically used with air handlers for coil protection. This interlock stops operation when the measured temperature is below a threshold, to prevent freezing and subsequent coil damage. For an integration example, see *Parameter groups 76 Multipump configuration (page 331) and 77 Multipump maintenance and monitoring (page 340).* (page 68).
6. **Firestat.** This interlock is typically used with air handlers. This interlock stops operation when the measured temperature is above a threshold, possibly indicating a fire in the building.
7. **Low suction or Low pressure.** This interlock is typically used with pumps for pump protection. This interlock stops operation when the measured pressure on the suction side of the pump is below a threshold, to prevent pump damage from having it run dry.
8. **Access door.** This interlock is used in a variety of applications that have an access door. This interlock stops operation when the access door is opened. Note that an interlock is not an acceptable alternative to following proper safety procedures.
9. **Auxiliary open.** This interlock text is a generic term used in a variety of applications that have auxiliary contacts that need to stop drive operation. This interlock stops operation when the auxiliary has been opened.
10. **Pressure relief.** This interlock is used in applications that have a pressure relief method, such as a pressure relief valve, that also has an interlock tied to this relief method. This interlock stops operation when pressure exceeds a threshold and pressure is being mechanically relieved.
11. **Start interlock 1, Start interlock 2, Start interlock 3, and Start interlock 4.** This interlock text is a generic term used in a variety of applications that have interlocks. This interlock stops operation when the interlock has been opened or closed depending on the setup. ABB recommends using the predefined Descriptive text and/or custom Label text whenever possible, as this will simplify any future interlock troubleshooting needs.
12. **Label text.** Provides up to 35 characters of free/custom text describing the interlock. This text will appear on the drive control panel when the interlock is no longer satisfied. This text can be used to better describe the interlock itself or its physical location. This text can also be used to enter a phone number for the local support of that equipment. Note that the Label text option is separate from the predefined text, thus the two can be used in conjunction with each other. For example, the predefined text can be selected for Overpressure, while the Label text may state “Reset switch located in control panel.”

Run permissives

Overview

The run permissive function provides a way to prevent the drive from outputting to a motor when an input is not satisfied. This function is used to support applications that require the drive to first trigger an external event before the drive starts to ramp the motor. Run permissive is often used in conjunction with an end-switch wired back to the drive. This end-switch could be part of a damper or valve control scheme. Monitoring the status of the run permissive is available over fieldbus communications.

Run permissive is different from start interlock:

- A run permissive makes the drive enter a run state but does not provide an output to the motor.
- An unsatisfied run permissive input will only indicate a warning on the control panel display if a start command is also provided. No warning will be provided if the start command is not present. Start interlock is configurable to acknowledge, or ignore, the start command status when determining if a warning must be indicated.

The run permissive is typically wired to one of the drive’s digital inputs (DI), DI1 through DI6. DI2 is most commonly used. Certain fieldbus communications can also be used to control run permissive, although typically not recommended for most applications.

Configuration

You can configure run permissive via parameter group *20 Start/stop/direction* in the **Parameters** menu. Run permissive is configurable for normally open or normally closed functionality.

Wiring connections

The run permissive functions in both Auto and Hand control modes. ABB recommends that any system permissive is wired directly to the drive and not to an external building automation system (BAS) controller.

Failure to wire the permissive directly to the drive can inadvertently allow Hand mode operation when a permissive is not satisfied.

Functionality

The drive allows predefined Descriptive text, and Label text (free text), to be associated with the Run permissive. The control panel will display that specific text when the permissive becomes unsatisfied.

Run permissive features include the following:

- With no run command issued and run permissive not satisfied, no warning is displayed.
- With a start command issued and run permissive not satisfied, the drive displays a warning that the run permissive is missing, the status LED will flash green, and the control panel's direction arrow is dashed and rotating. The drive remains in running mode, but does not output to the motor until run permissive is satisfied.
- During normal operation of the motor, if run permissive changes state, the drive will coast to stop and display a warning that run permissive is keeping the drive from outputting to the motor.
- Relay settings that are not affected by run permissive input not being satisfied include: Ready run, Enabled, Started, Running, and Damper control. Relay settings that are affected by run permissive include: Warning and Fault/Warning.

Settings and diagnostics

- Parameter *20.40 Run permissive* (page *183*)
- Warnings *AFED Run permissive* and *AFF2 Run permissive forced warning*.

Application example 1: Damper end switch

The run permissive function is used in damper control to monitor the damper status through the damper end switch. Sequence of operation:

1. Drive receives start command, either via Hand or Auto source.
2. Drive verifies safeties are satisfied and end switch has not yet been satisfied.
3. Drive activates a relay output that was programmed to Damper control. This relay allows power to the actuator.
4. Once the damper end switch closes, run permissive is satisfied and the drive outputs to the motor.

See the figure on page *150* and *Parameter groups 76 Multipump configuration (page 331) and 77 Multipump maintenance and monitoring (page 340).* (page *68*).

Application example 2: Valve opening

The Run permissive function is used in valve control to prevent the pump from running until the valve is opened. Sequence of operation:

1. Drive receives start command, either via Hand or Auto source.
2. Drive verifies safeties are satisfied and valve position has not yet been satisfied.
3. Drive activates a relay output that was programmed to Valve opening (could have also been programmed to Started or Running). This relay allows power to the actuator.
4. Once the valve is opened, run permissive is satisfied and the drive outputs to the motor.

Motor control

Frequency control mode

The motor follows a frequency reference given to the drive. Frequency control is available in both local and external control. 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 *215*.

Scalar motor control

Scalar motor control is the default motor control method. In scalar control mode, the drive is controlled with a frequency reference. However, the excellent performance of vector control is not achieved in scalar control.

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

- If the exact nominal motor values are not available or the drive needs to run different motor after the commissioning phase
- If a short commissioning time is needed or no ID run is wanted
- In multimotor systems: 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
- If the drive is used without a motor connected (for example, for test purposes)
- If the drive is equipped with a sine filter.

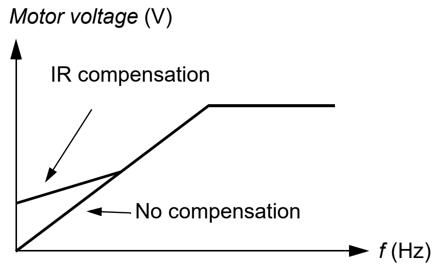
In scalar control, some standard features are not available.

See also section *Operating modes of the drive* (page *57*).

IR compensation for scalar motor control

R 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, such as positive displacement pumps, that require a high break-away torque.

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



Settings

- Parameters *97.13 IR compensation* (page *357*), *97.94 IR comp max frequency* (page *358*) and *99.04 Motor control mode* (page *361*)
- Parameter group *28 Frequency reference chain* (page *215*).

Speed control mode

The motor follows a speed reference given to the drive. This mode can be used with estimated speed used as feedback.

Speed control mode is available in both local and external control. 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 *195*.

Vector motor control

Vector control is the motor control mode that is intended for applications where high control accuracy is needed. It offers better control over whole speed range, in particular in applications where slow speed with high torque is needed. It requires an identification run at startup. Vector control cannot be used in all applications, for example, when sine filters are being used or there are multiple motors connected to single drive.

The switching of the output semiconductors is controlled to achieve the required stator flux and motor torque. The reference value for the torque controller comes from the speed controller.

Stator flux is calculated by integrating the motor voltage in vector space. Rotor flux can be calculated from stator flux and the motor model. Motor torque is produced by controlling current 90 degrees from the rotor flux. By utilizing the identified motor model, the rotor flux estimate is improved. Actual motor shaft speed is not needed for the motor control.

Settings

- Parameters *99.04 Motor control mode* (page *361*) and *99.13 ID run requested* (page *363*), *99.13 ID run requested* (page *363*)

Motor types

The drive supports asynchronous AC induction, permanent magnet (PM).

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 and the motor and motor cable resistance are measured to allow the motor model to be created. This identification method is suitable for most applications.

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

Settings

- Parameter *99.13 ID run requested* (page *363*).

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 Nominal torque of the motor throughout the frequency range

In squared mode (default), 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. Thus using squared mode saves energy.

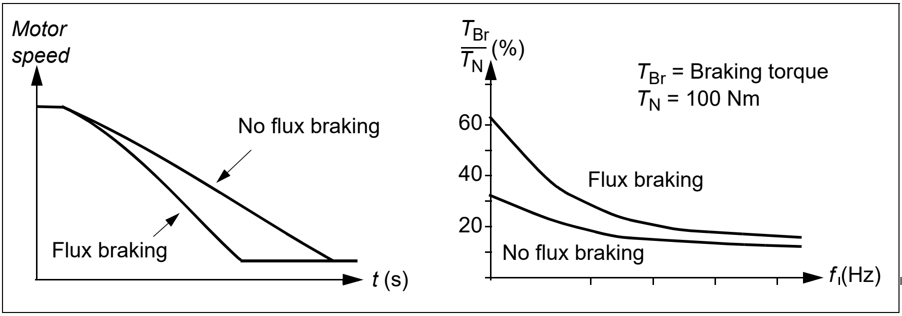
The *U*/f function cannot be used with energy optimization; if parameter *45.11 Energy optimizer* is set to *Enable*, parameter *97.20 U/F ratio* is ignored.

Settings

- Parameter *97.20 U/F ratio* (page *358*).

Flux braking

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



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

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

Two braking power levels are available:

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

WARNING: The motor needs to be Nominal to absorb the thermal energy geneNominal by flux braking.

Settings

- Parameter *97.05 Flux braking* (page *355*).

5

Start methods – DC magnetization

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

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 on 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 the STO circuit is closed or not triggered open.
- The heating function requires that the drive is not faulted.
- The heating function is allowed even if Run permissive signal is missing.
- The heating function is allowed even if one or more Start interlock signals are missing.
- Pre-heating uses DC hold to produce current.

Settings

- Parameters *21.14 Pre-heating input source*, *21.15 Pre-heating time delay* and *21.16 Pre-heating current* (page *190*).

Pre-magnetization

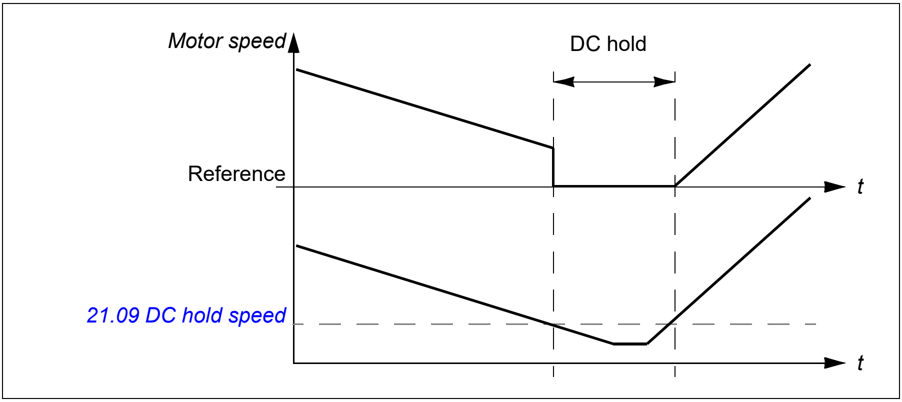
Pre-magnetization refers to DC magnetization of the motor before start. Depending on the selected start mode (*21.01 Start mode* or *21.19 Scalar start mode*), pre-magnetization can be applied to guarantee the highest possible breakaway torque, up to 200% of the nominal torque of the motor. By adjusting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

Settings

- Parameters *21.01 Start mode*, *21.19 Scalar start mode*, *21.02 Magnetization time*.

DC hold

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



Settings

- Parameters *21.08 DC current control* and *21.09 DC hold speed*.

DC brake

This function enables DC injection braking after modulation has stopped for a certain period (*21.11 Post magnetization time*). DC injection braking can be used to quickly stop the motor without using a mechanical brake. DC brake is activated by parameter *21.08 DC current control*. The DC braking current is set by parameter *21.10 DC current reference*.

Post-magnetization

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

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

Settings

- Parameters *21.03 Stop mode* (page *187*), *21.08 DC current control* and *21.11 Post magnetization time*.

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.

5

For derating, see chapter *Technical data*, section *Switching frequency derating* in 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, for example, with EMC C1 filters (see the *Hardware manual* of the drive), 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 8 kHz and the minimum switching frequency is set to the smallest available value, 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 toleNominal when the full output current is needed.

Settings

- Parameters *97.01 Switching frequency reference* and *97.02 Minimum switching frequency* (page *341*).

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.

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

Insulation

WARNING! IEC 60664 requires 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.

To fulfil this requirement, connect a thermistor to the drive's control terminals using any of these alternatives:

- Separate the thermistor from live parts of the motor with double reinforced insulation.
- Protect all circuits connected to the drive's digital and analog inputs. Protect against contact, and insulate from other low voltage circuits with basic insulation (Nominal for the same voltage level as the drive's main circuit).
- Use an external thermistor relay. The relay insulation must be Nominal for the same voltage level as the drive's main circuit.

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.

See section *Insulation* on page *95*.

For the wiring of the sensor, see *AI1 and AI2 as Pt100, Pt1000, Ni1000, KTY83 and KTY84 sensor inputs* on page *98*.

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.

See section *Insulation* on page *95*.

For the wiring of the sensor, see *AI1 and AI2 as Pt100, Pt1000, Ni1000, KTY83 and KTY84 sensor inputs* on page *98*.

Temperature monitoring using Ni1000 sensors

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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. Resistance at 100 degrees Celsius is 1618 ohm, and the rate of change is 6180 ppm / degrees Celsius. The temperature measurement function reads the voltage through the analog input and converts it into degrees Celsius.

See section *Insulation* on page *95*.

For the wiring of the sensor, see section *AI1 and AI2 as Pt100, Pt1000, Ni1000, KTY83 and KTY84 sensor inputs* on page *98*.

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 *97* show typical KTY84 sensor resistance values as a function of the motor operating temperature.

See section *Insulation* on page *95*.

For the wiring of the sensor, see section *AI1 and AI2 as Pt100, Pt1000, Ni1000, KTY83 and KTY84 sensor inputs* on page *98*.

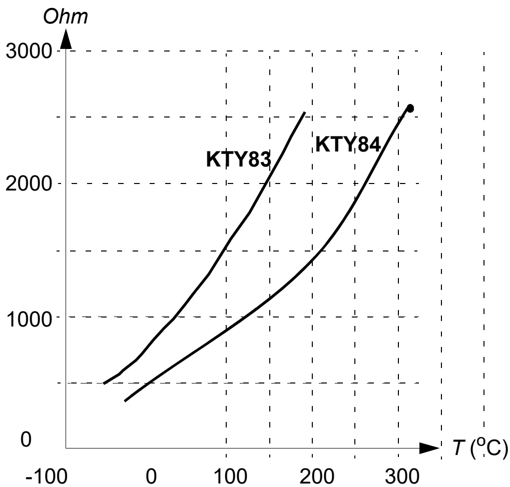
Temperature monitoring using KTY83 sensors

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



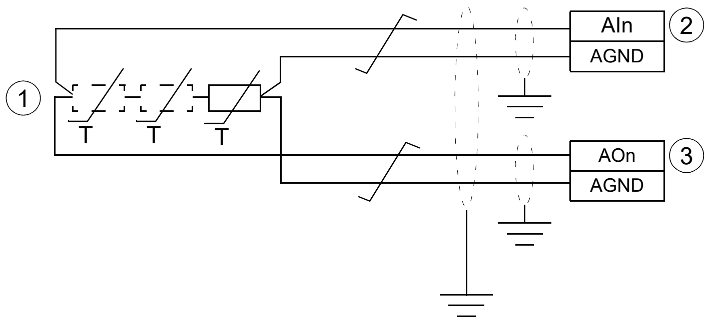
It is possible to adjust the motor temperature supervision limits and select how the drive reacts when overtemperature is detected.

See section *Insulation* on page *95*.

For the wiring of the sensor, see section *AI1 and AI2 as Pt100, Pt1000, Ni1000, KTY83 and KTY84 sensor inputs* on page *98*.

AI1 and AI2 as Pt100, Pt1000, Ni1000, KTY83 and KTY84 sensor inputs

One, two or three Pt100 sensors; one, two or three Pt1000 sensors; or one Ni1000, KTY83 or KTY84 sensor for motor temperature measurement can be connected between an analog input and output as shown below. Do not connect both ends of the cable shields directly to ground. If a capacitor cannot be used at one end, leave that end of the shield unconnected.



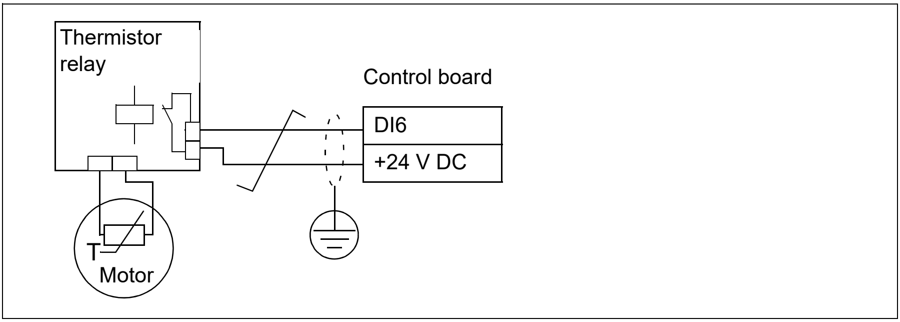
1	1…3 × (Pt100 or Pt1000) or 1 × (Ni1000 or KTY83 or KTY84)
2	Select the input type to voltage for analog input AI1 or AI2 with parameters. Set the appropriate analog input unit to V (volt) in parameter group *12 Standard AI*.
3	Select the excitation mode in parameter group *13 Standard AO*.

WARNING! As the inputs pictured above are not insulated according to IEC 60664, the connection of the motor temperature sensor requires double or reinforced insulation between motor live parts and the sensor. If the assembly does not fulfill the requirement, the I/O board terminals must be protected against contact and must not be connected to other equipment or the temperature sensor must be isolated from the I/O terminals.

Temperature monitoring using thermistor relays

A normally closed or a normally open thermistor relay can be connected to digital input DI6.

See section *Insulation* on page *95*.



Settings

- Parameter group *35 Motor thermal protection* (page *261*).

5

Motor overload protection

This section describes motor overload protection without using motor thermal protection model, either with estimated or measured temperature. For protection with the motor thermal protection model, see section *Motor thermal protection* on page *94*.

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*.

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

Parameters *35.51 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*.

5

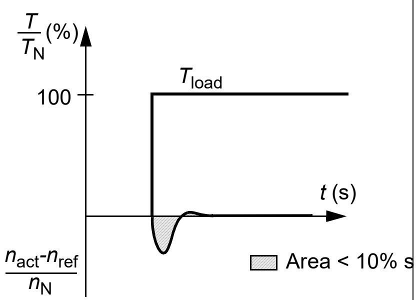
Settings

- Parameters common to motor thermal protection and motor overload protection: *35.51 Motor load curve* (page *271*), *35.52 Zero speed load* (page *271*) and *35.53 Break point* (page *271*).
- Parameters specific to motor overload protection: *35.05 Motor overload level* (page *262*), *35.56 Motor overload action* (page *273*) and *35.57 Motor overload class* (page *273*).

Speed control performance figures

The table below shows typical performance figures for speed control.

Speed control	Performance
Static accuracy	20% of motor nominal slip
Dynamic accuracy	< 10% s with 100% torque step (with default speed controller tuning)
Dynamic accuracy with tuned speed controller	< 2% s with 100% torque step



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

Floating point control (Motor potentiometer)

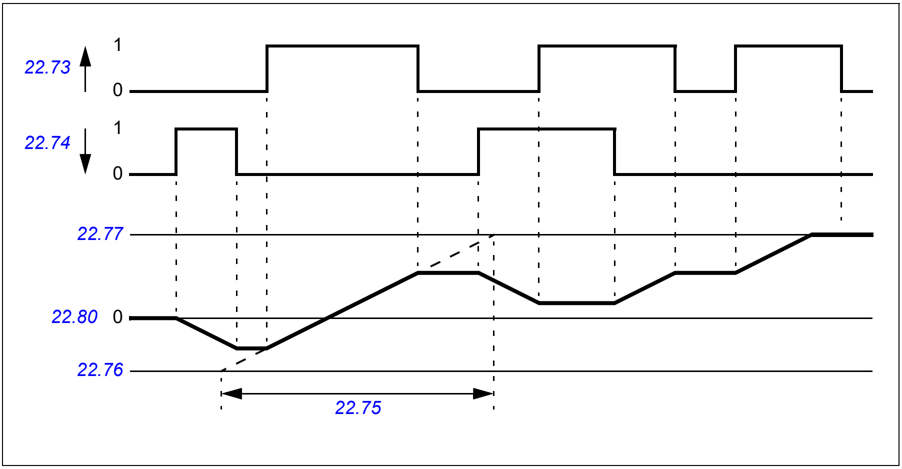
The Floating point control (parameters are named Motor potentiometer, however) is, in effect, a counter whose value can be adjusted up and down using two digital signals selected by parameters *22.73 Motor potentiometer up source* and *22.74 Motor potentiometer down source*.

When the Floating point control is enabled by *22.71 Motor potentiometer function*, the counter assumes the value set by *22.72 Motor potentiometer initial value*. Depending on the mode selected in *22.71*, the counter value is either retained or reset over a power cycle.

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

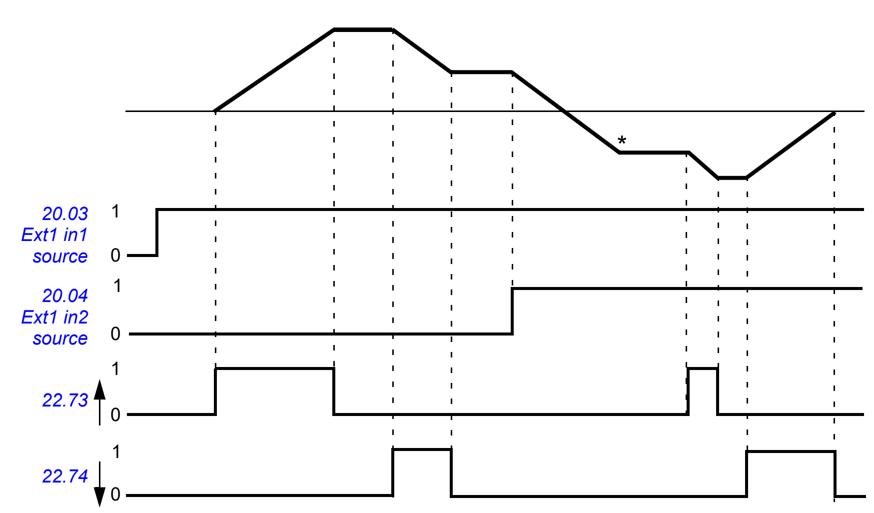
The output of the Floating point control counter is shown by *22.80 Motor potentiometer ref act*, which can directly be set as the reference source in the main selector parameters, or used as an input by other source selector parameters, both in scalar and vector control.

The following example shows the behavior of the Floating point control counter value.



Parameters *22.73 Motor potentiometer up source* and *22.74 Motor potentiometer down source* control speed or frequency from zero to maximum speed or frequency.

The running direction can be changed with parameter *20.04 Ext1 in2 source*. See the following example.



* Output speed or frequency has reached the reference value.

Settings

- Parameters *22.71 Motor potentiometer function*…*22.80 22.80 Motor potentiometer ref act* (page *203*).

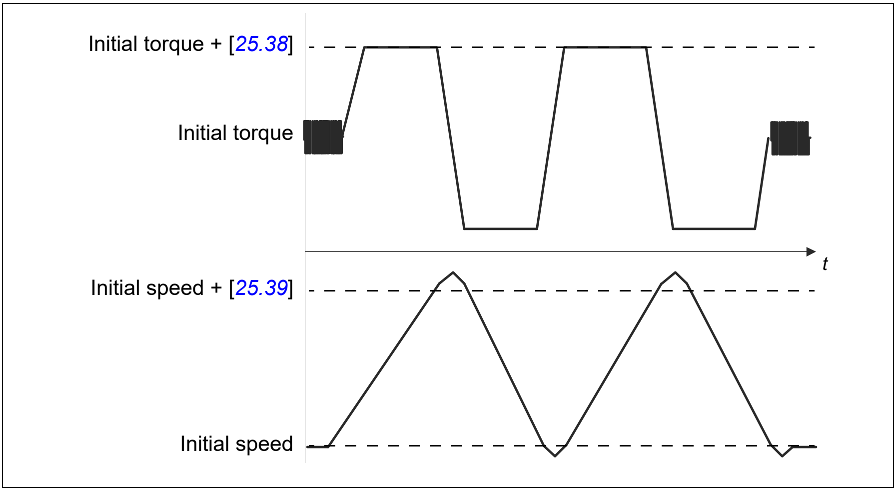
Speed controller autotune

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 Auto tune repeat times*. 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 parameter *25.38 Auto tune torque step*, unless limited by the maximum torque limit (parameter group *30 Limits*) or the nominal motor torque (*99 Motor data*). The calculated maximum speed during the routine is the initial speed (ie.speed when the routine is activated) + the value of parameter *25.39 Auto tune speed step*, unless limited by parameter *30.12 Maximum speed* or *99.09 Motor nominal speed*.

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



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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

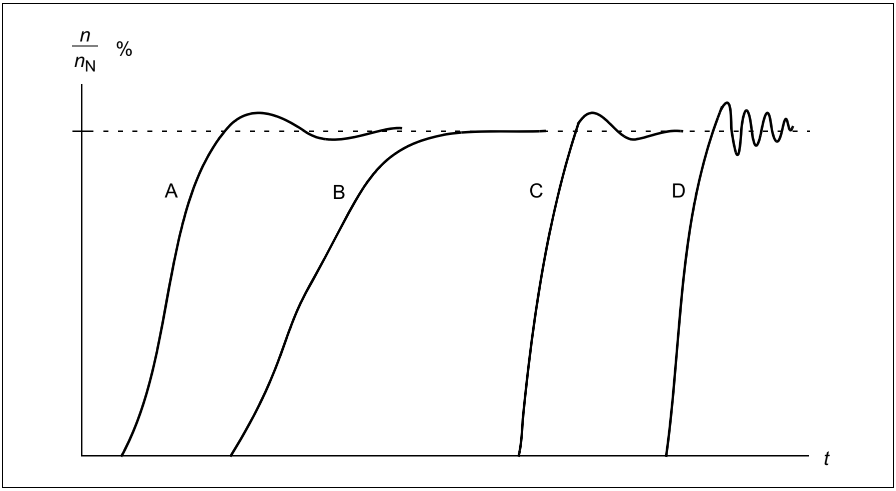
The prerequisites for performing the autotune routine are the following:

- The motor identification run (ID run) has been successfully completed
- Speed and torque limits (parameter group *30 Limits*) have been set
- The speed feedback has been monitored for noise, vibrations and other disturbances caused by the mechanics of the system, and speed error filtering (*24 Speed reference conditioning*) and zero speed (parameters *21.06* and *21.07*) have been set to eliminate these disturbances.
- The drive has been started and is running in speed control mode.

After these conditions have been fulfilled, autotuning can be activated by parameter *25.33 Speed controller auto tune* (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 Auto tune control preset*. 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

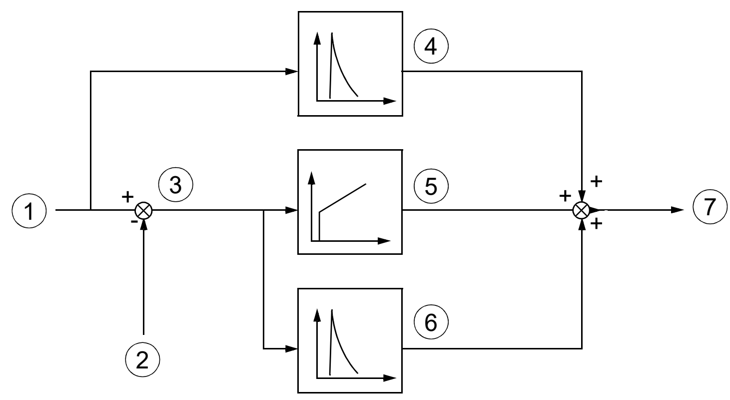
Autotune results

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)
- *25.37 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.



1	Speed reference
2	Actual speed
3	Error value
4	Derivative acceleration compensation
5	Proportional, integral
6	Derivative
7	Torque reference

Warning indications

A warning message, *AF90 Speed controller autotuning*, will be generated if the autotune routine does not complete successfully. See chapter *Fault tracing* on page *411* for further information.

Settings

- Parameters *25.33 Speed controller auto tune*…*25.40 Auto tune repeat times*

Event: *AF90 Speed controller autotuning*.

DC voltage control

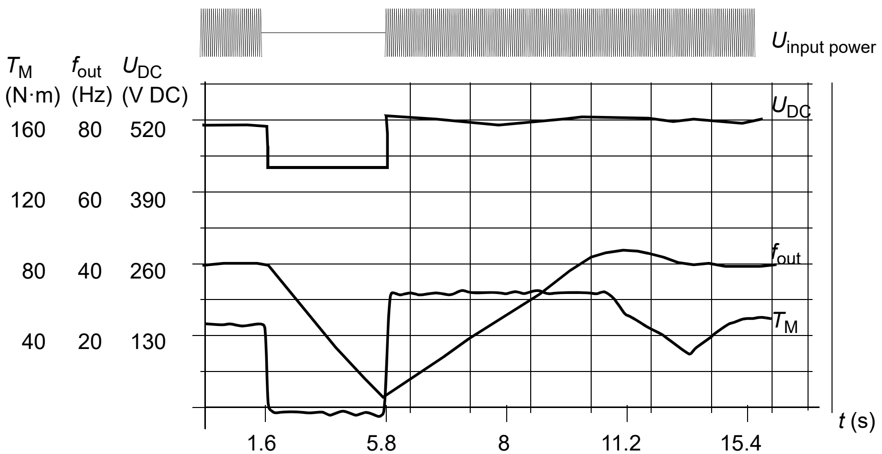
Overvoltage control

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 (for example, 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 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 a successful restart:

- The undervoltage fault is suppressed (but a warning is geneNominal).
- 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*.

If parameter *21.34 Force auto restart* is set to *Enable*, the drive never trips on the undervoltage fault and the start signal is on forever. When the DC voltage is restored, the normal operation continues.

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

Voltage control and trip limits

The control and trip limits of the intermediate DC voltage regulator are relative to the supply voltage as well as drive/inverter type. The DC voltage (U_{DC}) is approximately 1.41 times the line-to-line supply voltage, and is displayed by parameter *01.11 DC voltage*.

The system calculates the necessary drive DC limits from parameters *95.01 Supply* *voltage* and *95.02 Adaptive voltage limits*).

DC voltage levels for drive types -01

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

Adaptive voltage limit enabled by parameter *95.02 Adaptive voltage limits*

DC voltage level [V] See *95.01 Supply voltage*.	**95.01 Supply voltage**		
	AC supply voltage range [V] 380…415	**AC supply voltage range [V] 440…480**	**Automatic / Not selected**
Overvoltage fault limit	842	842	842
Overvoltage control limit	779	779	779
Internal brake chopper start limit	779	779	779
Internal brake chopper stop limit	759	759	759
Overvoltage warning limit	745	745	745
Undervoltage warning limit	0.85×1.41×par *95.03* value	0.85×1.41×par *95.03* value	0.85×1.41×par *95.03* value
Undervoltage control limit	0.78×1.41×par *95.03* value	0.78×1.41×par *95.03* value	0.78×1.41×par *95.03* value
Charging relay closing limit / charging deactivation	0.78×1.41×par *95.03* value	0.78×1.41×par *95.03* value	0.78×1.41×par *95.03* value
Charging relay opening limit / charging activation	0.73×1.41×par *95.03* value	0.73×1.41 ×par *95.03* value	0.73×1.41 ×par *95.03* value
DC voltage at upper bound of supply voltage range (U_{DCmax})	560	648	(variable)
DC voltage at lower bound of supply voltage range (U_{DCmin})	513	594	(variable)
Standby limit [3)]	0.73×1.41×par *95.03* value	0.3×1.41×par *95.03* value	0.73×1.41×par *95.03* value

Note: Parameter *95.03 Estimated AC supply voltage* is the estimated AC supply voltage while powering up the drive and it will not be continuously updated during run time.

5

Adaptive voltage limit disabled by parameter *95.02 Adaptive voltage limits*

DC voltage level [V] See *95.01 Supply voltage*.	**95.01 Supply Voltage**			
	AC supply voltage range [V AC] 380…415	**AC supply voltage range [V AC] 440…480**	**Automatic / Not selected**	
			if *95.03* < 456 V AC	**if *95.03* > 456 V AC**
Overvoltage fault limit	842	842	842	842
Overvoltage control limit	779	779	779	779
Internal brake chopper start limit	779	779	779	779
Internal brake chopper stop limit	759	759	759	759
Overvoltage warning limit	745	745	745	745
Undervoltage warning limit	0.85×1.35×380 = 436	0.85×1.35×440 = 504	0.85×1.35×380 = 436	0.85×1.35×440 = 505
Undervoltage control limit	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	0.78×1.35×380 = 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	0.73×1.35x380 = 374	0.73×1.35x440 = 433	0.73×1.35x380 = 374	0.73×1.35x440 = 433
DC voltage at upper bound of supply voltage range (U_{DCmax})	560	648	(variable)	(variable)
DC voltage at lower bound of supply voltage range (U_{DCmin})	513	594	(variable)	(variable)
Standby limit	0.73×1.35×380 = 374	0.73×1.35×440 = 433	0.73×1.35×380 = 374	0.73×1.35×440 = 433
Undervoltage fault limit [1)]	0.73×1.35×380 = 374	0.73×1.35×440 = 433	0.73×1.35×380 = 374	0.73×1.35×440 = 433

[1)] See section *Triggering the undervoltage fault* on page *110*.

Triggering the undervoltage warning

The undervoltage warning *A3A2* is triggered if one of below conditions is active:

- If the DC link voltage goes below the undervoltage warning limit when the drive is not modulating.
- If the DC link voltage goes below the standby limit when the drive is modulating, and auto restart is enabled (that is, parameter *21.18 Auto restart time* > 0.0 s). 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 drive control board 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.

5

Triggering the undervoltage fault

The undervoltage fault *3220* 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 and auto restart is not enabled (that is, parameter *21.18 Auto restart time*= 0.0 s).
- If the DC link voltage goes below the undervoltage trip limit and auto restart is enabled (that is, parameter *21.18 Auto restart time* > 0.0 s), 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

- Parameters *01.11 DC voltage* (page *127*), *30.30 Overvoltage control* (page *232*), *30.31 Undervoltage control* (page *233*), *95.01 Supply voltage* (page *341*) and *95.02 Adaptive voltage limits* (page *341*).
- Warning *A3A2 DC link undervoltage* (page *415*) and fault *3220 DC link undervoltage* (page *428*).

5

Supervisory

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 geneNominal.

The supervised signal is low-pass filtered.

Settings

- Parameter group *32 Supervision* (page *245*).

Application example 1: Dirty filter

The supervisory function can be used to indicate a dirty filter. Since pressure drop across the air filter increases as the filter becomes dirty, a transducer can be installed that measures the differential pressure across the filter. The transducer output signal is an analog value that is fed back to an analog input on the drive. The supervisory function in the drive is configured to monitor the analog value.

For example, the user wants to be notified when an air handler filter needs to be replaced. Starting with a published value for the drop across a clean filter, a value is established that corresponds to a dirty filter scenario. The drive is then configured to monitor the transducer’s analog output signal. This includes a supervision level to indicate when a threshold for a dirty filter has been exceeded. To use this status, a drive relay output can be used instead of a separate relay to indicate the filter status.

This information may also be monitored over fieldbus communications, such as BACnet.

The benefit of using the drive to accomplish this function is to eliminate the need for one analog (transducer) input on the controller, thereby resulting in reduced cost of the building automation controller for the air handler.

Application example 2: High current

The supervisory function can be used to monitor motor current for increasing or excessive loading. This increase in loading may be due to mechanical failure/wear. A single “high current” threshold may be used with the supervisory function. Alternately, parameter group *37 User load curve* (page *276*) can be used to detect this scenario throughout the entire speed range, as shown under *User load curve* (page *111*).

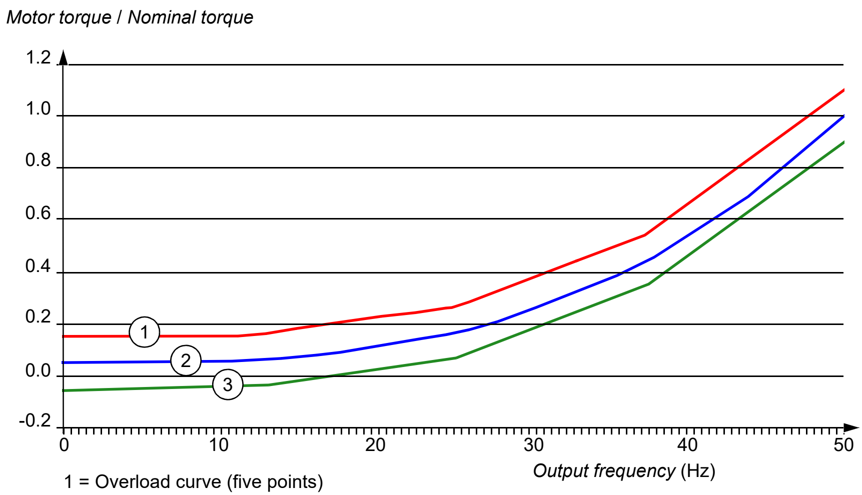
For example, a fan bearing is beginning to fail due to lack of lubrication. The bearing surfaces are beginning to bind, causing the motor current draw to exceed its normal level. The supervisory function indicates the load is drawing higher current than normal. As a result, service personnel can investigate the problem. The goal is to find the problem before a catastrophic failure occurs.

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 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

- Parameter group *37 User load curve* (page *276*).

Application example: Proof of flow

The user load curve function can be used to indicate proof of flow. Proof of flow is most commonly used for indicating a broken belt on a belt-driven fan. This drive function eliminates the need and cost for an external current-sensing relay and is more reliable. External current-sensing relays depend on the difference in motor current draw between a full-speed, no-load condition (broken belt) and a slow speed with load. This difference is minimal since the motor’s magnetizing current makes up the vast majority of the motor’s current consumption, which is unrelated to load. The drive’s user load curve is adjustable and ideal for variable speed, variable torque, proof-of-flow applications.

For example, during commissioning of the fan, the motor torque is recorded with the belt installed and the fan operating at 50% speed. The drive control panel is capable of displaying the motor torque. See parameter *01.10 Motor torque* (page *127*). Using this value as a reference point, a low torque threshold is determined to indicate a broken belt indication. This technique verifies that not only the drive is running the motor, but that the motor is also loaded by the application. A time delay value is available and configurable to allow for system variables. A relay output can be configured for the user load curve (proof of flow) status.

Energy efficiency

Energy optimization

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. Energy optimization is enabled by default.

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

Settings

- Parameter *45.11 Energy optimizer* (page 300).

Energy saving calculators

This feature consists of the following functionalities:

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

The amount of energy that has passed through the drive (in either direction) is counted and shown as full GWh, MWh and kWh. The cumulative energy is also shown as full kWh. All these counters are resettable.

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

- Parameter group *45 Energy efficiency* (page *298*)
- Parameters *01.50 Current hour kWh*, *01.51 Previous hour kWh*, *01.52 Current day kWh* and *01.53 Previous day kWh* (on page *128*)
- Parameters *01.55 Inverter GWh counter (resettable)*, *01.56 Inverter MWh counter (resettable)*, *01.57 Inverter kWh counter (resettable)* and *01.58 Cumulative inverter energy (resettable)* (on page *129*).

Load analyzer

Peak value logger

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

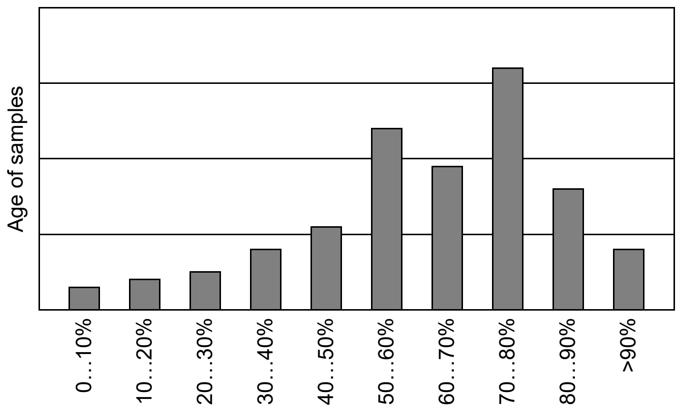
Amplitude loggers

The control program has two amplitude loggers.

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

5

You can view this graphically with the assistant control 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}), which is listed 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

- Parameter group *36 Load analyzer* (page *273*).

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 possible to use digital inputs to switch between user parameter sets.

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

- forced I/O values such as parameters *10.03 DI force selection* and *10.04 DI forced data*
- I/O extension module settings (group 15)
- data storage parameters (group 47)
- fieldbus communication enable parameter (*50.01 FBA A enable*)
- other fieldbus communication settings (groups 51…53 and 58)
- some hardware settings in group *95 HW configuration* (for example parameter *95.01 Supply voltage*)
- user set selection parameters *96.11*…*96.13*.

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

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

Switching between sets is only possible with the drive stopped.

Settings

- Parameters *96.10*…*96.13* (page *347*).

System 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 *105*.

DC undervoltage

See section *Undervoltage control (power loss ride-through)* on page *106*.

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 geneNominal.

Short circuit

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

Programmable protection functions

Motor phase loss detection (parameter *31.19*)

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

Supply phase loss detection (parameter *31.21*)

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

Safe torque off detection (parameter *31.22*)

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

Swapped supply and motor cabling (parameter *31.23*)

The drive can detect if the supply and motor cables have accidentally been swapped (for example, if the supply is connected to the motor connection of the drive). The parameter selects if a fault is geneNominal or not.

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

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

Overspeed protection (parameter *31.30*…*31.31*)

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 (parameter *49.05*)

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

AI supervision (parameters *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. This can be due to broken I/O wiring or sensor.

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

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

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

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 geneNominal through fieldbus (parameter *06.01 Main control word*, bits 0…2).

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

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

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

Notes:

- The installer of the equipment is responsible for installing the emergency stop devices and all additional devices needed for the emergency stop function to fulfill the required emergency stop categories. For more information, contact your local ABB representative.
- After an emergency stop signal is detected, the emergency stop function cannot be canceled even though the signal is canceled.
- If the minimum (or maximum) torque limit is set to 0%, the emergency stop function may not be able to stop the drive.
- While the ramp-down of the motor speed is in progress due to emergency stop with mode Off1, a sudden activation of Override mode will cause the motor to immediately ramp to the override speed selection.

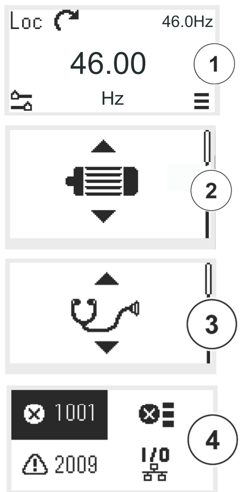
Settings

- Parameters *21.04 Emergency stop mode* (page *187*), *21.05 Emergency stop source* (page *187*), *23.23 Emergency stop time* (page *207*), *31.32 Emergency ramp supervision* (page *243*) and *31.33 Emergency ramp supervision delay* (page *244*).

Diagnostics

Diagnostics menu

The **Diagnostics** menu provides quick information about active faults, warnings and inhibits in the drive and how to fix and reset them. It also helps you to find out why the drive is not starting, stopping or running at the desired speed.



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

Miscellaneous

Backup and restore

You can make backups of the settings manually to the assistant control panel. The assistant control 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 control panel or with the Drive composer PC tool.

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 with parameter *96.07 Parameter save manually*.

Automatic backup

The assistant control panel has a dedicated space for one automatic backup. An automatic backup is created two hours after the last parameter change. After completing the backup, the control 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 with parameter *96.07 Parameter save manually*.

Restore

The backups are shown on the control panel. Automatic backups are marked with icon and manual backups with . To restore a backup, select it and press . In the following display you can view backup contents and restore all parameters or select a subset to be restored.

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

Settings

- Parameter *96.07 Parameter save manually* (page *345*).

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

- Parameter group *47 Data storage* (page *305*).

Parameter checksum calculation

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

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

The parameters included in the checksum A calculation are user editable parameters in parameter groups 10…13, 15, 19…25, 28, 30…32, 34…37, 40…41, 43, 45…46, 70…74, 76, 80, 94…99.

The set of parameters for checksum B does not include

- fieldbus settings
- motor data settings
- energy data settings.

The parameters included in the checksum B calculation are user editable parameters in parameter groups 10…13, 15, 19…25, 28, 30…32, 34, 35…37, 40…41, 43, 46, 70…74, 76, 80, 94…97.

Settings

- Parameters *96.54*…*96.69*, *96.71*…*96.72* (page *350*).

User lock

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

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

- 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.
- Enter a new pass code into *96.100 Change user pass code*. Always use eight digits; if using Drive composer PC tool, finish with Enter.
- Confirm the new pass code in *96.101 Confirm user pass code*.

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

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

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

Settings

- Parameters *96.02* (page *344*) and *96.100*…*96.102* (page *352*).

Sine filter support

With a sine filter connected to the output of the drive, the drive must use scalar motor control mode, and limit the switching and output frequencies to

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

When using ABB sine filters (available separately), this is done automatically when you switch bit 1 of *95.15 Special HW settings* on.

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

Settings

- Parameter *95.15 Special HW settings* (page *341*).

6

Parameters

What this chapter contains

The chapter describes the parameters, including actual signals, of the control program. At the end of the chapter, on page 381, there is a separate list of the parameters whose default values are different between 50 Hz and 60 Hz supply frequency settings.

Terms and abbreviations

Term	Definition
Actual signal	Type of *parameter* that is the result of a measurement or calculation by the drive, or contains status information. Most actual signals are read-only, but some (especially counter-type actual signals) can be reset.
Def	(In the following table, shown on the same row as the parameter name) The default value of a *parameter* when used in the default configuration. For information on other macro-specific parameter values, see chapter *Application macros*.
FbEq16	(In the following table, shown on the same row as the parameter range, or for each selection) 16-bit fieldbus equivalent: The scaling between the value shown on the control panel and the integer used in communication when a 16-bit value is selected for transmission to an external system. A dash (-) indicates that the parameter is not accessible in 16-bit format. The corresponding 32-bit scalings are listed in chapter *Additional parameter data* (page *375*). **Note:** Any scaled value that exceeds 32767 will be clamped at 32767 when reading with a 16 bit system.
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. Choosing “Other” displays a parameter list in which the user can specify the source parameter and bit.
Parameter	Either a user-adjustable operating instruction for the drive, or an *actual signal*.
p.u.	Per unit
[parameter number]	Value of the parameter

Summary of parameter groups

Parameter listing

No.	Name/Value	Description	Def/FbEq16
01 Actual values		Basic signals for monitoring the drive. All parameters in this group are read-only unless otherwise noted. **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*	Estimated motor speed. 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*
01.02	*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 %*	Motor speed in percent of the synchronous motor speed.	-
	-1000.00…1000.00%	Motor speed.	10 = 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 A	Motor current.	See par. *46.05*
01.08	*Motor current % of motor nom*	Motor current (drive output current) in percent of the nominal motor current.	-
	0.0…1000.0%	Motor current.	1 = 1%
01.09	*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 DC link voltage.	-
	0.00…2000.00 V	DC link voltage.	10 = 1 V
01.13	*Output voltage*	Calculated motor voltage in V AC.	-
	0…2000 V	Motor voltage.	1 = 1 V

No.	Name/Value	Description	Def/FbEq16
01.14	*Output power*	Drive output power. The unit is selected by parameter *96.16 Unit selection*. A filter time constant for this signal can be defined by parameter *46.14 Filter time power*.	-
	-32768.00… 32767.00 kW	Output power.	See par. *46.04*
01.15	*Output power % of motor nom*	Output power in percent of the nominal motor power.	-
	-300.00… 300.00%	Output power.	10 = 1%
01.17	*Motor shaft power*	Estimated mechanical power at motor shaft.	-
	-32768.00… 32767.00 kW or hp	Motor shaft power.	1 = 1 unit
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
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 reference in percent of nominal flux of motor.	-
	0…200%	Flux reference.	1 = 1%
01.30	*Nominal torque scale*	Torque that corresponds to 100% of nominal motor torque. The unit is selected by parameter *96.16 Unit selection*. **Note:** This value is copied from parameter *99.12 Motor nominal torque* if entered. Otherwise the value is calculated from other motor data.	-
	0.000…4000000 N·m or lb·ft	Nominal torque.	1 = 100 unit
01.31	*Ambient temperature*	Ambient temperature of the drive. Only for drive frames R6 or larger.	-
	40.0…120.0 °C or °F	Temperature.	1 = 1 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. If the power is cycled, after the drive is again up and running, the parameter value is set to the value it had before the power cycle.	-
	0.00…1000000.00 kWh	Energy.	-

No.	Name/Value	Description	Def/FbEq16
01.51	*Previous hour kWh*	Previous hour energy consumption. The value *01.50 Current hour kWh* is stored here when its values has been cumulated for 60 minutes. If the power is cycled, after the drive is again up and running, the parameter value is set to the value it had before the power cycle.	-
	0.00…1000000.00 kWh	Energy.	-
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. If the power is cycled, after the drive is again up and running, the parameter value is set to the value it had before the power cycle.	-
	0.00… 1000000.00 kWh	Energy.	-
01.53	*Previous day kWh*	Previous day energy consumption. The value *01.52 Current day kWh* is stored here when its value has been cumulated for 24 hours. If the power is cycled, after the drive is again up and running, the parameter value is set to the value it had before the power cycle.	-
	0.00… 1000000.00 kWh	Energy.	-
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 or by pressing the Reset softkey for 3 seconds. 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 or by pressing the Reset softkey for 3 seconds. 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 or by pressing the Reset softkey for 3 seconds. Resetting any of parameters *01.55…01.58* resets all of them.	-
	0…1000 kWh	Energy in kWh.	10 = 1 kWh

No.	Name/Value	Description	Def/FbEq16
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 or by pressing the Reset softkey for 3 seconds. 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 parameter *01.01 Motor speed used*.	-
	0.00… 30000.00 rpm	Estimated motor speed.	See par. *46.01*
01.62	*Abs motor speed %*	Absolute value of parameter *01.03 Motor speed %*.	-
	0.00… 1000.00%	Estimated motor speed.	10 = 1%
01.63	*Abs output frequency*	Absolute value of parameter *01.06 Output frequency*.	-
	0.00…500.00 Hz	Estimated output frequency.	See par. *46.02*
01.64	*Abs motor torque*	Absolute value of parameter *01.10 Motor torque*.	-
	0.0…1600.0%	Motor torque.	See par. *46.03*
01.65	*Abs output power*	Absolute value of parameter *01.14 Output power*.	-
	0.00… 32767.00 kW	Output power.	1 = 1 kW
01.66	*Abs output power % motor nom*	Absolute value of parameter *01.15 Output power % of motor nom*.	-
	0.00… 300.00%	Output power.	10 = 1%
01.68	*Abs motor shaft power*	Absolute value of parameter *01.17 Motor shaft power*.	-
	0.00… 32767.00 kW or hp	Motor shaft power.	1 = 1 unit

No.	Name/Value	Description	Def/FbEq16
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*	Reference 1 given from the control panel or PC tool.	-
	-100000.00… 100000.00	Control panel or PC tool reference.	1 = 10
03.02	*Panel reference remote*	Reference 2 given from the control panel or PC tool.	-
	-100000.00… 100000.00	Control panel or PC tool reference.	1 = 10
03.05	*FB A reference 1*	Reference 1 received through fieldbus adapter A. See also chapter *Fieldbus control through a fieldbus adapter*.	-
	-100000.00… 100000.00	Reference 1 from fieldbus adapter A.	1 = 10

No.	Name/Value	Description	Def/FbEq16
03.06	*FB A reference 2*	Reference 2 received through fieldbus adapter A.	-
	-100000.00… 100000.00	Reference 2 from fieldbus adapter A.	1 = 10
03.09	*EFB reference 1*	Scaled reference 1 received through the embedded fieldbus interface.	-
	-30000.00… 30000.00	Scaled reference 1 received through the embedded fieldbus interface.	1 = 10
03.10	*EFB reference 2*	Scaled reference 2 received through the embedded fieldbus interface.	-
	-30000.00… 30000.00	Scaled reference 2 received through the embedded fieldbus interface.	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. Fault and event logs can be cleared with parameter *96.51 Clear fault and event logger*.	
04.01	*Tripping fault*	Code of the 1st active fault (the fault that caused the current trip).	-
	0000h…FFFFh	1st active fault.	1 = 1
04.02	*Active fault 2*	Code of the 2nd active fault.	-
	0000h…FFFFh	2nd active fault.	1 = 1
04.03	*Active fault 3*	Code of the 3rd active fault.	-
	0000h…FFFFh	3rd active fault.	1 = 1
04.06	*Active warning 1*	Code of the 1st active warning.	-
	0000h…FFFFh	1st active warning.	1 = 1
04.07	*Active warning 2*	Code of the 2nd active warning.	-
	0000h…FFFFh	2nd active warning.	1 = 1
04.08	*Active warning 3*	Code of the 3rd active warning.	-
	0000h…FFFFh	3rd active warning.	1 = 1
04.11	*Latest fault*	Code of the 1st stored (non-active) fault.	-
	0000h…FFFFh	1st stored fault.	1 = 1
04.12	*2nd latest fault*	Code of the 2nd stored (non-active) fault.	-
	0000h…FFFFh	2nd stored fault.	1 = 1
04.13	*3rd latest fault*	Code of the 3rd stored (non-active) fault.	-
	0000h…FFFFh	3rd stored fault.	1 = 1
04.16	*Latest warning*	Code of the 1st stored (non-active) warning.	-
	0000h…FFFFh	1st stored warning.	1 = 1
04.17	*2nd latest warning*	Code of the 2nd stored (non-active) warning.	-
	0000h…FFFFh	2nd stored warning.	1 = 1
04.18	*3rd latest warning*	Code of the 3rd stored (non-active) warning.	-
	0000h…FFFFh	3rd stored warning.	1 = 1

No.	Name/Value	Description	Def/FbEq16
04.40	*Event word 1*	User-defined event word. This word collects the status of the events (warnings, faults or pure events) selected by parameters *04.41*…*04.71*. 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	Def/FbEq16
	0000h…FFFFh	User-defined event word.	1 = 1
04.41	*Event word 1 bit 0 code*	Selects the hexadecimal code of an event (warning, fault or pure event) whose status is shown as bit 0 of *04.40 Event word 1*. The event codes are listed in chapter *Fault tracing* (page *411*).	2310h
	0000h…FFFFh	Default fault 2310 Overcurrent.	1 = 1
04.43	*Event word 1 bit 1 code*	Selects the hexadecimal code of an event (warning, fault or pure event) whose status is shown as bit 1 of *04.40 Event word 1*. The events are listed in chapter *Fault tracing* (page *411*).	3210h
	0000h…FFFFh	Default fault 3210 DC link overvoltage.	1 = 1
04.45	Event word 1 bit 2 code	Default fault 4310 Excess temperature.	4310h
04.47	Event word 1 bit 3 code	Default fault 2340 Short circuit.	2340h
04.49	Event word 1 bit 4 code	No default fault	0000h
04.51	Event word 1 bit 5 code	Default fault 3220 DC link undervoltage.	3220h
04.53	Event word 1 bit 6 code	Default fault 80A0 AI supervision.	80A0h
04.55	Event word 1 bit 7 code	No default fault.	0000h
04.57	Event word 1 bit 8 code	Default fault 7122 Motor overload.	7122h
04.59	Event word 1 bit 9 code	Default fault 7081 Control panel loss.	7081h
04.61	Event word 1 bit 10 code	Default fault FF61 ID run.	FF61h
04.63	Event word 1 bit 11 code	Default fault 7121 Motor stall.	7121h
04.65	Event word 1 bit 12 code	Default fault 4110 Control board temperature.	4110h
04.67	Event word 1 bit 13 code	Default fault 9081 External fault 1.	9081h
04.69	Event word 1 bit 14 code	Default fault 9082 External fault 2.	9082h

No.	Name/Value	Description	Def/FbEq16
04.71	*Event word 1 bit 15 code*	Selects the hexadecimal code of an event (warning, fault or pure event) whose status is shown as bit 15 of *04.40 Event word 1*. The events are listed in chapter *Fault tracing* (page *411*). Default fault 2330 Earth leakage.	2330h
	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*	On-time counter. The counter runs when the drive is powered.	-
	0…65535 d	On-time counter.	1 = 1 d
05.02	*Run-time counter*	Motor run-time counter in full days. The counter runs when the inverter modulates.	-
	0…65535 d	Motor run-time counter.	1 = 1 d
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.	-
	0.0… 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 pressing the Reset softkey for 3 seconds.	-
	0…65535 d	Cooling fan run-time counter.	1 = 1 d
05.10	*Control board temperature*	Measured temperature of the control board.	-
	-100… 300 °C or °F	Control board temperature in degrees Celsius or Fahrenheit.	1 = 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%	Drive temperature in percent.	1 = 1%

No.	Name/Value	Description	Def/FbEq16
05.20	*Diagnostic word 1*	Diagnostic word 1. For possible causes and remedies, see chapter *Fault tracing*.	-

Bit	Name	Value
0	Any warning or fault	1 = Yes = Drive has generated a warning or tripped on a fault. 0 = None active = No warning or fault active.
1	Any warning	1 = Yes = Drive has generated a warning. 0 = None active = No warning active.
2	Any fault	1 = Yes = Drive has tripped on a fault. 0 = None active = No fault active.
3	Reserved	
4	Overcurrent flt	Yes = Drive has tripped on fault *2310 Overcurrent*.
5	Reserved	
6	DC overvoltage	Yes = Drive has tripped on fault *3210 DC link overvoltage*.
7	DC undervoltage	Yes = Drive has tripped on fault *3220 DC link undervoltage*.
8	Reserved	
9	Device overtemp flt	Yes = Drive has tripped on fault *4310 Excess temperature*.
10…15	Reserved	

No.	Name/Value	Description	Def/FbEq16
	0000h…FFFFh	Diagnostic word 1.	1 = 1
05.21	*Diagnostic word 2*	Diagnostic word 2. For possible causes and remedies, see chapter *Fault tracing*.	-

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

No.	Name/Value	Description	Def/FbEq16
	0000h…FFFFh	Diagnostic word 2.	1 = 1
05.22	*Diagnostic word 3*	Diagnostic word 3	-

Bit	Name	Value
0…8	Reserved	
9	kWh pulse	Yes = kWh pulse is active.
10	Reserved	
11	Fan command	On = Drive fan is rotating above idle speed.
12…15	Reserved	

No.	Name/Value	Description	Def/FbEq16
	0000h…FFFFh	Diagnostic word 3.	1 = 1
05.80	*Motor speed at fault*	Copy of parameter *01.01 Motor speed used* at the occurrence of the latest fault. Parameters *05.80*…*05.89* are shown for each fault in the fault log.	-
	-30000.00…30000.00 rpm	Estimated motor speed.	1 = 1 rpm

No.	Name/Value	Description	Def/FbEq16
05.81	*Output frequency at fault*	Copy of parameter *01.06 Output frequency* at the occurrence of the latest fault.	-
	-500.00…500.00 Hz	Estimated output frequency.	1 = 1 Hz
05.82	*DC voltage at fault*	Copy of parameter *01.11 DC voltage* at the occurrence of the latest fault.	-
	0.00…2000.00 V	DC link voltage.	10 = 1 V
05.83	*Motor current at fault*	Copy of parameter *01.07 Motor current* at the occurrence of the latest fault.	-
	0.00…30000.00 A	Motor current.	1 = 1 A
05.84	*Motor torque at fault*	Copy of parameter *01.10 Motor torque* at the occurrence of the latest fault.	-
	-1600.0…1600.0%	Motor torque.	1 = 1 %
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*	Copy of parameter *10.02 DI delayed status* at the occurrence of the latest fault.	-
	0000h…FFFFh	Delayed status for digital inputs.	1 = 1
05.87	*Inverter temperature at fault*	Copy of parameter *05.11 Inverter temperature* at the occurrence of the latest fault.	-
	-40…160 °C	Drive temperature in °C.	1 = 1
05.88	*Reference used at fault*	Copy of parameter *28.01 Frequency ref ramp input* (in scalar control mode) or *23.01 Speed ref ramp input* (in speed control mode) at the occurrence of the latest fault.	-
	-500.00… 500.00 Hz or -30000.00… 30000.00 rpm	Frequency or speed reference.	1 = 1
05.89	*HVAC status word at fault*	Copy of parameter *06.22 HVAC status word* at the occurrence of the latest fault.	-
	0000h…FFFFh	ACH531 specific status word.	1 = 1

No.	Name/Value	Description	Def/FbEq16
06 Control and status words		Drive control and status words.	
06.01	*Main control word*	The main control word of the drive. This parameter shows the control signals as received from the selected sources (such as digital inputs, the fieldbus interfaces and the application program). For the control word bit descriptions see page *226*. The related status word and state diagram are presented on pages *227* and *228* respectively. This parameter is read-only. **Note:** When using fieldbus control, this parameter value is not the same as the Control word value that the drive receives from the PLC. For the exact value, see *50.12 FBA A debug mode*.	-
	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	Reserved
9	Reserved
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	Def/FbEq16
06.11	*Main status word*	Main status word of the drive. For the status word bit descriptions see page *227*. The related control word and state diagram are presented on pages *226* and *228* respectively. This parameter is read-only. **Note:** When using fieldbus control, this parameter value is not the same as the Status word value that the drive sends to the PLC. For the exact value, see *50.12 FBA A debug mode*.	-

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*

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

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

Bit	Name	Description
0	Enabled	1 = If start interlock signals (par. *20.41*…*20.44*) are all 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 *19*).
10	Ext1 active	1 = Control location EXT1 active
11	Ext2 active	1 = Control location EXT2 active
12	Reserved	
13	Start request	1 = If Start requested. 0 = When Run permissive signal (see par. *20.40*) is 0.
14	Running	1 = Drive is controlling speed or frequency, in PID sleep or pre-magnetization.
15	Reserved	

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

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

Bit	Name	Description
0	Identification run done	1 = Motor identification (ID) run has been performed
1	Magnetized	1 = The motor has been magnetized
2	Reserved	
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	Reserved	
10	Above limit	1 = Actual speed or frequency equals or exceeds limit (defined by parameters *46.31*…*46.32*). Valid in both directions of rotation.
11…12	Reserved	
13	Start delay active	1 = Start delay (par. *21.22*) active
14…15	Reserved	

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

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

No.	Name/Value	Description	Def/FbEq16
	0000h…FFFFh	Start inhibit status word.	1 = 1
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…6	Reserved	
7	Any constant speed request	1 = A constant speed or frequency has been selected; see par. *06.20*
8…15	Reserved	

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

No.	Name/Value	Description	Def/FbEq16
06.20	*Constant speed status word*	Constant speed/frequency status word. Indicates which constant speed or frequency is active (if any). See also parameter *06.19 Speed control status word*, bit 7, and section *Constant speeds/frequencies* (page *120*). This parameter is read-only.	-

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

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

Bit	Name	Description
0	DC hold active	1 = DC hold is active
1	Post-magnetizing active	1 = Post-magnetizing is active
2	Motor pre-heating active	1 = Motor pre-heating is active
3	PM smooth start active	1 = PM smooth start active
5	DC brake active	1 = DC brake active
4, 6…15	Reserved	

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

No.	Name/Value	Description	Def/FbEq16
06.22	*HVAC status word*	HVAC specific status word.This parameter is read-only.	-

Bit	Name	Description
0	Hand mode	0 = Drive is not operated from the control panel in the Hand mode; 1 = Drive is operated from the control panel in the Hand mode.
1	Off mode	0 = Drive is not in the Off mode; 1 = Drive is in the Off mode.
2	Auto mode	0 = Drive is not in the Auto mode; 1 = Drive is in the Auto mode.
3	Override	0 = Drive is not in the Override mode; 1 = Drive is in the Override mode.
4	Pre-heating	0 = Motor pre-heating is not active; 1 = Motor pre-heating is active.
5	Damper control	0 = Damper control is not active; 1 = Damper control is active.
6	Reserved	
7	Run permissive	0 = Run permissive is not present, drive is not allowed to run; 1 = Run permissive is present, drive is allowed to run.
8	Start interlock 1	0 = Start interlock 1 is not present, drive is not allowed to start; 1 = Start interlock 1 is present, drive is allowed to start.
9	Start interlock 2	0 = Start interlock 2 is not present, drive is not allowed to start; 1 = Start interlock 2 is present, drive is allowed to start.
10	Start interlock 3	0 = Start interlock 3 is not present, drive is not allowed to start; 1 = Start interlock 3 is present, drive is allowed to start.
11	Start interlock 4	0 = Start interlock 4 is not present, drive is not allowed to start; 1 = Start interlock 4 is present, drive is allowed to start.
12	All start interlocks	0 = One or more of Start interlock 1, Start interlock 2, Start interlock 3 or Start interlock 4 is not present, drive is not allowed to start; 1 = Start interlock 1 and Start interlock 2 and Start interlock 3 and Start interlock 4 are all present, drive is allowed to start.
13…15	Reserved	

No.	Name/Value	Description	Def/FbEq16
	0000h…FFFFh		1 = 1
06.29	*MSW bit 10 selection*	Selects a binary source whose status is transmitted as bit 10 (User bit 0) of *06.11 Main status word*.	*Above limit*
	False	0.	0
	True	1.	1
	Above limit	Bit 10 of *06.17 Drive status word 2* (see page *139*).	2
	Other [bit]	Source selection (see *Terms and abbreviations* on page *124*).	-
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* (see page *137*).	2
	Other [bit]	Source selection (see *Terms and abbreviations* on page *124*).	-
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*.	*Run permissive*
	False	0.	0
	True	1.	1
	Reserved	1.	2

No.	Name/Value	Description	Def/FbEq16
	Run permissive	Bit 5 of *06.18 Start inhibit status word* status word (see page *140*).	3
	Other [bit]	Source selection (see *Terms and abbreviations* on page *124*).	-
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* on page *124*).	-
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* on page *124*).	-

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. (Rating ID in brackets.)	1 = 1
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.	-
07.10	*Language file set*	The language file set (language package) in use, see parameter *96.01 Language*. The language file set value is written to this parameter after the first start-up, and it is available in this parameter through power-ups.	-
	Not known	No language file set in use.	0
	Global	Global language file set in use.	1
	European	European language file set in use.	2
	Asian	Asian language file set in use.	3
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*	Not applicable.	-
07.31	*AP sequence state*	Not applicable.	

No.	Name/Value	Description	Def/FbEq16
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 information on automatic setting of parameters after detecting a module, see section *Automatic drive configuration for fieldbus control* on page *234*.	0000h

Bit	Name	Description
0	Not initialized	1 = Drive configuration has not been initialized
1	Base unit	1 = Drive has not detected any modules.
2	Reserved	
3	FENA-21	1 = FENA-21 Two-port Ethernet adapter module included
4	FECA-01	1 = FECA-01 EtherCAT adapter module included
5	FPBA-01	1 = FPBA-01 PROFIBUS DP adapter module included
6	FCAN-01	1 = FCAN-01 CANopen adapter module included
7…9	Reserved	
10	FSCA-01	1 = FSCA-01 Modbus/RTU adapter module included
11	FEIP-21	1 = FEIP-21 Two-port EtherNet/IP adapter module included
12	FMBT-21	1 = FMBT-21 Two-port Modbus/TCP adapter module included
13	FBIP-21	1 = FBIP-21 BACnet/IP (2-port) adapter module included
14	FBNO-21	1 = FPNO-21 Two-port PROFINET IO adapter module included
15	FEPL-02	1 = FEPL-02 Ethernet POWERLINK adapter module included

No.	Name/Value	Description	Def/FbEq16
	0000h…FFFFh	Drive configuration.	1 = 1
07.36	*Drive configuration 2*	Shows the detected module configuration. See parameter *07.35 Drive configuration*.	0000h

Bit	Name	Description
0	FLON-01	1 = FLON-01 LonWorks® adapter module include
1	FDNA-01	1 = FDNA-01 DeviceNet™ adapter module include
2	FCNA-01	1 = FCNA-01 ControlNet™ adapter module include
3	CMOD-01	1 = CMOD-01 External 24 V AC/DC and digital I/O extension module included
4	CMOD-02	1 = CMOD-02 External 24 V AC/DC and isolated PTC interface extension module included
5	CPTC-02	1 = CPTC-02 ATEX certified PTC interface and external 24 V extension module included
6	CHDI-01	1 = CHDI-01 115/230 V digital input extension module included
7	FSPS-21	1 = FSPS-21 adapter module included
8…15	Reserved	

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

No.	Name/Value	Description	Def/FbEq16
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	Name	Description
0	DI1	1 = Digital input 1 is ON.
1	DI2	1 = Digital input 2 is ON.
2	DI3	1 = Digital input 3 is ON.
3	DI4	1 = Digital input 4 is ON.
4	DI5	1 = Digital input 5 is ON.
5	DI6	1 = Digital input 6 is ON.
6…15	Reserved	

No.	Name/Value	Description	Def/FbEq16
	0000h…FFFFh	Status of digital inputs.	1 = 1
10.02	*DI delayed status*	Displays the delayed status of digital inputs DI1…DI6. Bits 0…5 reflect the delayed status of DI1…DI6. **Example:** 0000000000010011b = DI5, DI2 and DI1 are on, DI3, DI4 and DI6 are off. This word is updated only after a 2 ms activation/deactivation delay. When the value of a digital input changes, it must remain the same in two consecutive samples, that is for 2 ms, for the new value to be accepted. This parameter is read-only.	-
	0000h…FFFFh	Delayed status for digital inputs.	1 = 1

No.	Name/Value	Description	Def/FbEq16
10.03	*DI force selection*	The electrical statuses of the digital inputs can be overridden, for example, testing purposes. 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

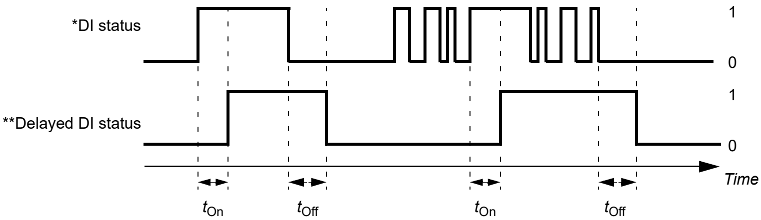
Bit	Name	Value
0	DI1	1 = Force DI1 to value of bit 0 of parameter *10.04 DI forced data*. (0 = Normal mode)
1	DI2	1 = Force DI2 to value of bit 1 of parameter *10.04 DI forced data*. (0 = Normal mode)
2	DI3	1 = Force DI3 to value of bit 2 of parameter *10.04 DI forced data*. (0 = Normal mode)
3	DI4	1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

No.	Name/Value	Description	Def/FbEq16
	0000h…FFFFh	Override selection for digital inputs.	1 = 1
10.04	*DI forced data*	Allows the data value of a forced digital input to be changed from 0 to 1. It is only possible to force an input that has been selected in parameter *10.03 DI force selection*. Bit 0 is the forced value for DI1; bit 5 is the forced value for the DI6.	0000h

Bit	Name	Value
0	DI1	1 = Force the value of this bit to D1, if so defined in parameter *10.03 DI force selection*.
1	DI2	1 = Force the value of this bit to D3, if so defined in parameter *10.03 DI force selection*.
2	DI3	1 = Force the value of this bit to D3, if so defined in parameter *10.03 DI force selection*.
3	DI4	1 = Force the value of this bit to D4, if so defined in parameter *10.03 DI force selection*.
4	DI5	1 = Force the value of this bit to D5, if so defined in parameter *10.03 DI force selection*.
5	DI6	1 = Force the value of this bit to D6, if so defined in parameter *10.03 DI force selection*.
6…15	Reserved	

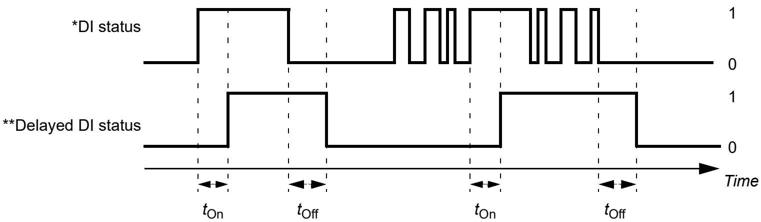
No.	Name/Value	Description	Def/FbEq16
	0000h…FFFFh	Forced values of digital inputs.	1 = 1

No.	Name/Value	Description	Def/FbEq16
10.05	*DI1 ON delay*	Defines the activation delay for digital input DI1.	0.00 s



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

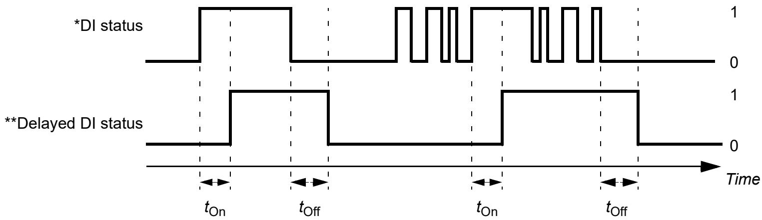
No.	Name/Value	Description	Def/FbEq16
	0.00 … 3000.00 s	Activation delay for DI1.	10 = 1 s
10.06	*DI1 OFF delay*	Defines the deactivation delay for digital input DI1. See parameter *10.05 DI1 ON delay*.	0.00 s
	0.00 … 3000.00 s	Deactivation delay for DI1.	10 = 1 s
10.07	*DI2 ON delay*	Defines the activation delay for digital input DI2.	0.00 s



t_{On} = *10.07 DI2 ON delay*
t_{Off} = *10.08 DI2 OFF delay*
*Electrical status of digital input. Indicated by *10.01 DI status*.
**Indicated by *10.02 DI delayed status*.

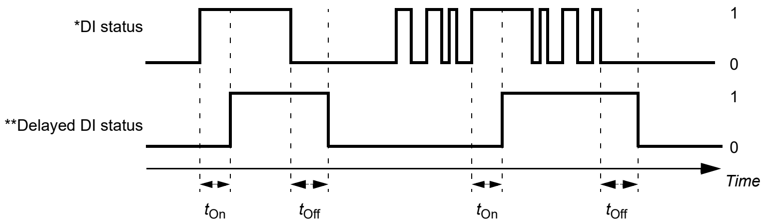
No.	Name/Value	Description	Def/FbEq16
	0.00 … 3000.00 s	Activation delay for DI2.	10 = 1 s
10.08	*DI2 OFF delay*	Defines the deactivation delay for digital input DI2. See parameter *10.07 DI2 ON delay*.	0.00 s
	0.00 … 3000.00 s	Deactivation delay for DI2.	10 = 1 s

No.	Name/Value	Description	Def/FbEq16
10.09	*DI3 ON delay*	Defines the activation delay for digital input DI3.	0.00 s



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

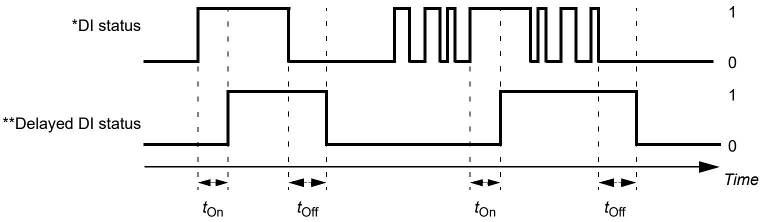
No.	Name/Value	Description	Def/FbEq16
	0.00 … 3000.00 s	Activation delay for DI3.	10 = 1 s
10.10	*DI3 OFF delay*	Defines the deactivation delay for digital input DI3. See parameter *10.09 DI3 ON delay*.	0.00 s
	0.00 … 3000.00 s	Deactivation delay for DI3.	10 = 1 s
10.11	*DI4 ON delay*	Defines the activation delay for digital input DI4.	0.00 s



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

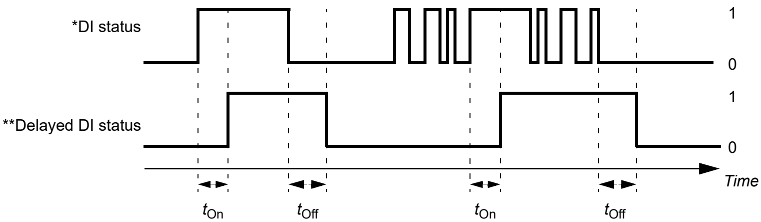
No.	Name/Value	Description	Def/FbEq16
	0.00 … 3000.00 s	Activation delay for DI4.	10 = 1 s
10.12	*DI4 OFF delay*	Defines the deactivation delay for digital input DI4. See parameter *10.11 DI4 ON delay*.	0.00 s
	0.00 … 3000.00 s	Deactivation delay for DI4.	10 = 1 s

No.	Name/Value	Description	Def/FbEq16
10.13	*DI5 ON delay*	Defines the activation delay for digital input DI5.	0.00 s



t_{On} = *10.13 DI5 ON delay*
t_{Off} = *10.14 DI5 OFF delay*
*Electrical status of digital input. Indicated by *10.01 DI status*.
**Indicated by *10.02 DI delayed status*.

No.	Name/Value	Description	Def/FbEq16
	0.00 … 3000.00 s	Activation delay for DI5.	10 = 1 s
10.14	*DI5 OFF delay*	Defines the deactivation delay for digital input DI5. See parameter *10.13 DI5 ON delay*.	0.00 s
	0.00 … 3000.00 s	Deactivation delay for DI5.	10 = 1 s
10.15	*DI6 ON delay*	Defines the activation delay for digital input DI6.	0.00 s



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

No.	Name/Value	Description	Def/FbEq16
	0.00 … 3000.00 s	Activation delay for DI6.	10 = 1 s
10.16	*DI6 OFF delay*	Defines the deactivation delay for digital input DI6. See parameter *10.15 DI6 ON delay*.	0.00 s
	0.00 … 3000.00 s	Deactivation delay for DI6.	10 = 1 s
10.21	*RO status*	Status of relay outputs RO3…RO1.	-

Bit	Value
0	1 = RO1 is energized.
1	1 = RO2 is energized.
2	1 = RO3 is energized.
3…15	Reserved

No.	Name/Value	Description	Def/FbEq16
	0000h…FFFFh	Status of relay outputs.	1 = 1

No.	Name/Value	Description	Def/FbEq16
10.22	*RO force selection*	The signals connected to the relay outputs can be overridden for, for example, 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 RO2 to value of bit 1 of parameter *10.23 RO forced data*. (0 = Normal mode)
2	1 = Force RO3 to value of bit 2 of parameter *10.23 RO forced data*. (0 = Normal mode)
3…15	Reserved

No.	Name/Value	Description	Def/FbEq16
	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.	0000h

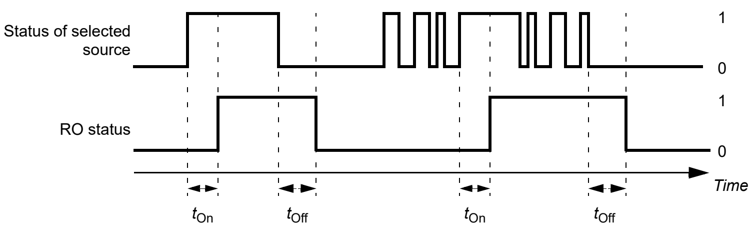
Bit	Value
0	1 = Force the value of this bit to RO1, if so defined in parameter *10.22 RO force selection*.
1	1 = Force the value of this bit to RO2, if so defined in parameter *10.22 RO force selection*.
2	1 = Force the value of this bit to RO3, if so defined in parameter *10.22 RO force selection*.
3…15	Reserved

No.	Name/Value	Description	Def/FbEq16
	0000h…FFFFh	Forced RO values.	1 = 1
10.24	*RO1 source*	Selects a drive signal to be connected to relay output RO1.	*Ready run*
	Not energized	Output is not energized.	0
	Energized	Output is energized.	1
	Ready run	Bit 1 of *06.11 Main status word* (see page *137*).	2
	Enabled	Bit 0 of *06.16 Drive status word 1* (see page *138*).	4
	Started	Bit 5 of *06.16 Drive status word 1* (see page *138*).	5
	Magnetized	Bit 1 of *06.17 Drive status word 2* (see page *139*).	6
	Running	Bit 6 of *06.16 Drive status word 1* (see page *138*).	7
	Ready ref	Bit 2 of *06.11 Main status word* (see page *137*).	8
	At setpoint	Bit 8 of *06.11 Main status word* (see page *137*).	9
	Reverse	Bit 2 of *06.19 Speed control status word* (see page *140*).	10
	Zero speed	Bit 0 of *06.19 Speed control status word* (see page *140*).	11
	Above limit	Bit 10 of *06.17 Drive status word 2* (see page *139*).	12
	Warning	Bit 7 of *06.11 Main status word* (see page *137*).	13
	Fault	Bit 3 of *06.11 Main status word* (see page *137*).	14
	Fault (-1)	Inverted bit 3 of *06.11 Main status word* (see page *137*).	15

6

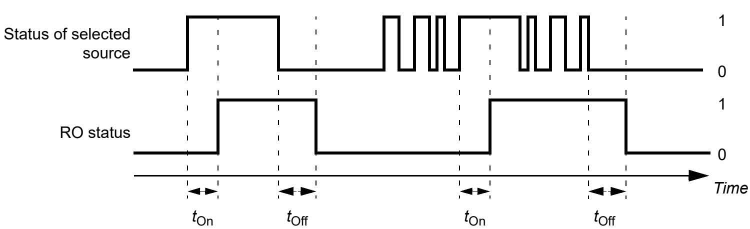
No.	Name/Value	Description	Def/FbEq16
	Fault/Warning	Bit 3 of *06.11 Main status word* OR bit 7 of *06.11 Main status word* (see page *137*).	16
	Overcurrent	Fault *2310 Overcurrent* has occurred.	17
	Overvoltage	Fault *3210 DC link overvoltage* has occurred.	18
	Drive temp	Fault *2381 IGBT overload*, *4110 Control board temperature*, *4210 IGBT overtemperature*, *4290 Cooling*, *42F1 IGBT temperature*, *4310 Excess temperature* or *4380 Excess temperature difference* has occurred.	19
	Undervoltage	Fault *3220 DC link undervoltage* has occurred.	20
	Motor temp	Fault *4981 External temperature 1* or *4982 External temperature 2* has occurred.	21
	Reserved		22
	Ext2 active	Bit 11 of *06.16 Drive status word 1* (see page *138*).	23
	Remote control	Bit 9 of *06.11 Main status word* (see page *137*).	24
	Reserved		25…26
	Timed function 1	Bit 0 of *34.01 Timed functions status* (see page *267*).	27
	Timed function 2	Bit 1 of *34.01 Timed functions status* (see page *267*).	28
	Timed function 3	Bit 2 of *34.01 Timed functions status* (see page *267*).	29
	Reserved		30…32
	Supervision 1	Bit 0 of *32.01 Supervision status* (see page *259*).	33
	Supervision 2	Bit 1 of *32.01 Supervision status* (see page *259*).	34
	Supervision 3	Bit 2 of *32.01 Supervision status* (see page *259*).	35
	Reserved		36…38
	Start delay	Bit 13 of *06.17 Drive status word 2* (see page *139*).	39
	RO/DIO control word bit0	Bit 0 of *10.99 RO/DIO control word* (see page *153*).	40
	RO/DIO control word bit1	Bit 1 of *10.99 RO/DIO control word* (see page *153*).	41
	RO/DIO control word bit2	Bit 2 of *10.99 RO/DIO control word* (see page *153*).	42
	Reserved		43…44
	PFC1	Bit 0 of *76.01 PFC status* (see page *345*).	45
	PFC2	Bit 1 of *76.01 PFC status* (see page *345*).	46
	PFC3	Bit 2 of *76.01 PFC status* (see page *345*).	47
	PFC4	Bit 3 of *76.01 PFC status* (see page *345*).	48
	PFC5	Bit 4 of *76.01 PFC status* (see page *345*).	49
	PFC6	Bit 5 of *76.01 PFC status* (see page *345*).	50
	Reserved		51…52
	Event word 1	Event word 1 = 1 if any bit of *04.40 Event word 1* (see page *132*) is 1, that is, if any warning, fault or pure event that has been defined with parameters *04.41*…*04.71* is on.	53
	Run permissive	Bit 7 of *06.22 HVAC status word*.	55
	Start interlock 1	Bit 8 of *06.22 HVAC status word*.	56
	Start interlock 2	Bit 9 of *06.22 HVAC status word*.	57

No.	Name/Value	Description	Def/FbEq16
	Start interlock 3	Bit 10 of *06.22 HVAC status word*.	58
	Start interlock 4	Bit 11 of *06.22 HVAC status word*.	59
	All start interlocks	Bit 12 of *06.22 HVAC status word*.	60
	User load curve	Bit 3 (Outside load limit) of *37.01 ULC output status word* (see page *290*).	61
	RO/DIO control word	For *10.24 RO1 source*: Bit 0 (RO1) of *10.99 RO/DIO control word* (see page *153*). For *10.27 RO2 source*: Bit 1 (RO2) of *10.99 RO/DIO control word* (see page *153*). For *10.30 RO3 source*: Bit 2 (RO3) of *10.99 RO/DIO control word* (see page *153*).	62
	Other [bit]	Source selection (see *Terms and abbreviations* on page *124*).	-
10.25	*RO1 ON delay*	Defines the activation delay for relay output RO1.	0.0 s



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

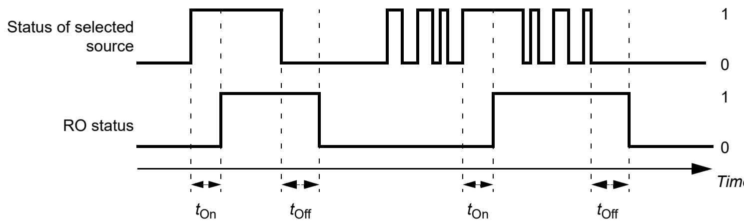
No.	Name/Value	Description	Def/FbEq16
	0.0 … 3000.0 s	Activation delay for RO1.	10 = 1 s
10.26	*RO1 OFF delay*	Defines the deactivation delay for relay output RO1. See parameter *10.25 RO1 ON delay*.	0.0 s
	0.0 … 3000.0 s	Deactivation delay for RO1.	10 = 1 s
10.27	*RO2 source*	Selects a drive signal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



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

No.	Name/Value	Description	Def/FbEq16
	0.0 … 3000.0 s	Activation delay for RO2.	10 = 1 s
10.29	*RO2 OFF delay*	Defines the deactivation delay for relay output RO2. See parameter *10.28 RO2 ON delay*.	0.0 s
	0.0 … 3000.0 s	Deactivation delay for RO2.	10 = 1 s

No.	Name/Value	Description	Def/FbEq16
10.30	*RO3 source*	Selects a drive signal to be connected to relay output RO3. For the available selections, see parameter *10.24 RO1 source*.	*Fault (-1)*
10.31	*RO3 ON delay*	Defines the activation delay for relay output RO3.	0.0 s



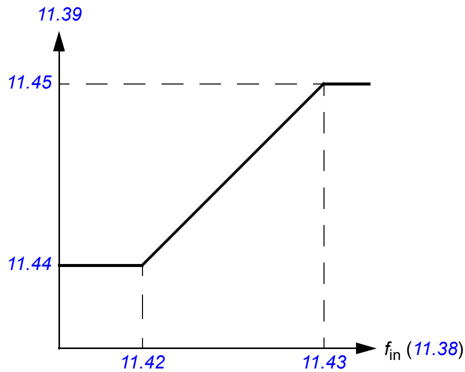
t_{On} = *10.31 RO3 ON delay*
t_{Off} = *10.32 RO3 OFF delay*

No.	Name/Value	Description	Def/FbEq16
	0.0 … 3000.0 s	Activation delay for RO3.	10 = 1 s
10.32	*RO3 OFF delay*	Defines the deactivation delay for relay output RO3. See parameter *10.31 RO3 ON delay*.	0.0 s
	0.0 … 3000.0 s	Deactivation delay for RO3.	10 = 1 s
10.99	*RO/DIO control word*	Storage parameter for controlling the relay outputs, for example, 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 bit for relay output RO1. See parameter *10.24*.
1	RO2	Source bit for relay output RO2. See parameter *10.27*.
2	RO3	Source bit for relay output RO3. See parameter *10.30*.
3	RO4	Source bit for extension module relay output RO4. See parameter *15.07*.
4	RO5	Source bit for extension module relay output RO4. See parameter *15.10*.
5…7	Reserved	
8	DIO1	Source bit for digital output DO1 with a CMOD-01 extension module. See parameter *15.23*.
9…15	Reserved	

No.	Name/Value	Description	Def/FbEq16
	0000h…FFFFh	RO/DIO control word.	1 = 1
10.101	*RO1 toggle counter*	Displays the number of times relay output RO1 has changed states. Can be reset from the control panel by pressing the Reset softkey for 3 seconds.	5
	0…4294967000	State change count.	1 = 1

No.	Name/Value	Description	Def/FbEq16
10.102	RO2 toggle counter	Displays the number of times relay output RO2 has changed states. Can be reset from the control panel by pressing the Reset softkey for 3 seconds.	0
	0…4294967000	State change count.	1 = 1
10.103	RO3 toggle counter	Displays the number of times relay output RO3 has changed states. Can be reset from the control panel by pressing the Reset softkey for 3 seconds.	5
	0…4294967000	State change count.	1 = 1

11 Standard DIO, FI, FO		Configuration of the frequency input.	
11.21	DI5 configuration	Selects how digital input 5 is used.	Digital input
	Digital input	DI5 is used as a digital input.	0
	Frequency input	DI5 is used as a frequency input.	1
11.38	Freq in 1 actual value	Displays the value of frequency input 1 (via DI5 when it is used as a frequency input) before scaling. See parameter 11.42 Freq in 1 min. This parameter is read-only.	-
	0 … 16000 Hz	Unscaled value of frequency input 1 (DI5).	1 = 1 Hz
11.39	Freq in 1 scaled value	Displays the value of frequency input 1 (via DI5 when it is used as a frequency input) after scaling. See parameter 11.42 Freq in 1 min. This parameter is read-only.	-
	-32768.000… 32767.000	Scaled value of frequency input 1 (DI5).	1 = 1
11.42	Freq in 1 min	Defines the minimum for the frequency actually arriving at frequency input 1 (DI5) when it is used as a frequency input). The incoming frequency signal (11.38 Freq in 1 actual value) is scaled into an internal signal (11.39 Freq in 1 scaled value) by parameters 11.42…11.45 as follows:  	0 Hz
	0 … 16000 Hz	Minimum frequency of frequency input 1 (DI5).	1 = 1 Hz

No.	Name/Value	Description	Def/FbEq16
11.43	*Freq in 1 max*	Defines the maximum for the frequency actually arriving at frequency input 1 (DI5) when it is used as a frequency input). See parameter *11.42 Freq in 1 min*.	16000 Hz
	0 … 16000 Hz	Maximum frequency for frequency input 1 (DI5).	1 = 1 Hz
11.44	*Freq in 1 at scaled min*	Defines the value that is required to correspond internally to the minimum input frequency defined by parameter *11.42 Freq in 1 min*. See diagram at parameter *11.42 Freq in 1 min*.	0.000
	-32768.000… 32767.000	Value corresponding to minimum of frequency input 1.	1 = 1
11.45	*Freq in 1 at scaled max*	Defines the value that is required to correspond internally to the maximum input frequency defined by parameter *11.43 Freq in 1 max*. See diagram at parameter *11.42 Freq in 1 min*.	1500.000; 1800.000 (*95.20* b0)
	-32768.000… 32767.000	Value corresponding to maximum of frequency input 1.	1 = 1

12 Standard AI		Configuration of standard analog inputs.	
12.02	*AI force selection*	The true readings of the analog inputs can be overridden, for example, for 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. **Notes:** • AI filter times (parameters *12.16 AI1 filter time* and *12.26 AI2 filter time*) have no effect on forced AI values (parameters *12.13 AI1 forced value* and *12.23 AI2 forced value*). • Boot and power cycle reset the force selections (parameters *12.02* and *12.03*).	0000h

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

	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 fault *80A0 AI supervision*.	1
	Warning	Drive generates warning *A8A0 AI supervision*.	2
	Last speed	Drive generates 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	Def/FbEq16
	Speed ref safe	Drive generates 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

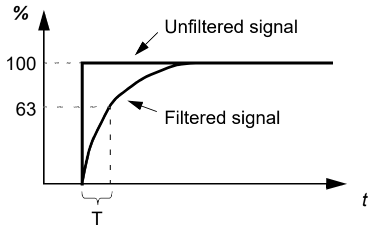
Bit	Name	Description
0	AI1 < MIN	1 = Minimum limit supervision of AI1 active.
1	AI1 > MAX	1 = Maximum limit supervision of AI1 active.
2	AI2 < MIN	1 = Minimum limit supervision of AI2 active.
3	AI2 > MAX	1 = Maximum limit supervision of AI2 active.
4…15	Reserved	

No.	Name/Value	Description	Def/FbEq16
	0000h…FFFFh	Activation of analog input supervision.	1 = 1
12.05	*AI supervision force*	Activates analog input supervision separately for each control location (see section *Local control vs. external control* on page *53*). The parameter is primarily intended for analog input supervision when the input is connected to the application program and not selected as a control source by drive parameters.	0000 0000b

Bit	Name	Description
0	AI1 Ext1	1 = AI1 supervision active when EXT1 is being used.
1	AI1 Ext2	1 = AI1 supervision active when EXT2 is being used.
2	AI1 Local	1 = AI1 supervision active when local control is being used.
3	Reserved	
4	AI2 Ext1	1 = AI2 supervision active when EXT1 is being used.
5	AI2 Ext2	1 = AI2 supervision active when EXT2 is being used.
6	AI2 Local	1 = AI2 supervision active when local control is being used.
7…15	Reserved	

No.	Name/Value	Description	Def/FbEq16
	0000 0000b … 0111 0111b	Analog input supervision selection.	1 = 1
12.11	*AI1 actual value*	Displays the value of analog input AI1 in mA or V (depending on whether the input is set to current or voltage by a hardware setting). This parameter is read-only.	-
	0.000…22.000 mA or 0.000…11.000 V	Value of analog input AI1.	1000 = 1 unit
12.12	*AI1 scaled value*	Displays the value of analog input AI1 after scaling. See parameters *12.19 AI1 scaled at AI1 min* and *12.20 AI1 scaled at AI1 max*. This parameter is read-only.	-
	-32768.000… 32767.000	Scaled value of analog input AI1.	1 = 1

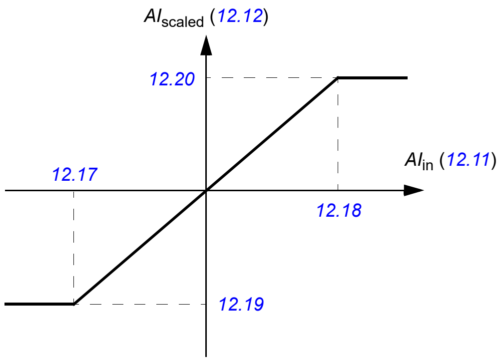
<table>
<tr><th>No.</th><th>Name/Value</th><th>Description</th><th>Def/FbEq16</th></tr>
<tr><td>12.13</td><td>AI1 forced value</td><td>Forced value that can be used instead of the true reading of the input. See parameter 12.02 AI force selection.</td><td>0.000 V</td></tr>
<tr><td></td><td>0.000…22.000 mA or 0.000…11.000 V</td><td>Forced value of analog input AI1.</td><td>1000 = 1 unit</td></tr>
<tr><td>12.15</td><td>AI1 unit selection</td><td>Selects the unit for readings and settings related to analog input AI1.</td><td>V</td></tr>
<tr><td></td><td>V</td><td>Volts.</td><td>2</td></tr>
<tr><td></td><td>mA</td><td>Milliamperes.</td><td>10</td></tr>
<tr><td>12.16</td><td>AI1 filter time</td><td>Defines the filter time constant for analog input AI1.

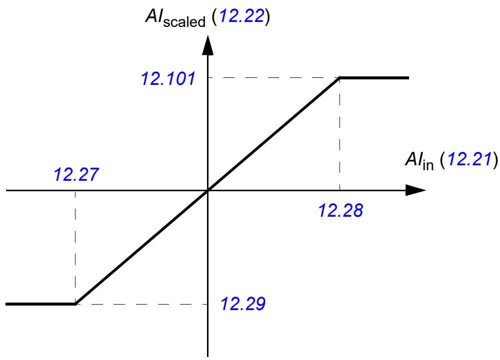


$O = I \times (1 - e^{-t/T})$

I = filter input (step)
O = filter output
t = time
T = filter time constant

Note: The signal is also filtered due to the signal interface hardware (approximately 0.25 ms time constant). This cannot be changed by any parameter.</td><td>0.100 s</td></tr>
<tr><td></td><td>0.000…30.000 s</td><td>Filter time constant.</td><td>1000 = 1 s</td></tr>
<tr><td>12.17</td><td>AI1 min</td><td>Defines the minimum site value for analog input AI1.
Set the value actually sent to the drive when the analog signal from plant is wound to its minimum setting.
See also parameter 12.19 AI1 scaled at AI1 min.</td><td>4.000 mA or 0.000 V</td></tr>
<tr><td></td><td>0.000…22.000 mA or 0.000…11.000 V</td><td>Minimum value of AI1.</td><td>1000 = 1 unit</td></tr>
<tr><td>12.18</td><td>AI1 max</td><td>Defines the maximum site value for analog input AI1.
Set the value actually sent to the drive when the analog signal from plant is wound to its maximum setting.
See also parameter 12.19 AI1 scaled at AI1 min.</td><td>20.000 mA or 10.000 V</td></tr>
<tr><td></td><td>0.000…22.000 mA or 0.000…11.000 V</td><td>Maximum value of AI1.</td><td>1000 = 1 unit</td></tr>
</table>

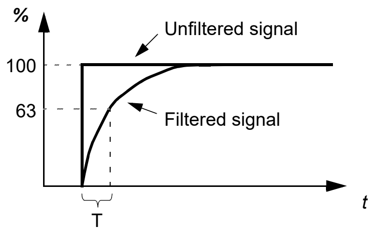
No.	Name/Value	Description	Def/FbEq16
12.19	*AI1 scaled at AI1 min*	Defines the real internal value that corresponds to the minimum analog input AI1 value defined by parameter *12.17 AI1 min*. (Changing the polarity settings of *12.19* and *12.20* can effectively invert the analog input.) 	0.000
	-32768.000…32767.000	Real value corresponding to minimum AI1 value.	1 = 1
12.20	*AI1 scaled at AI1 max*	Defines the real internal value that corresponds to the maximum analog input AI1 value defined by parameter *12.18 AI1 max*. See the drawing at parameter *12.19 AI1 scaled at AI1 min*.	50.000; 60.000 (*95.20* b0)
	-32768.000…32767.000	Real value corresponding to maximum AI1 value.	1 = 1
12.21	*AI2 actual value*	Displays the value of analog input AI2 in mA or V (depending on whether the input is set to current or voltage by a hardware setting). This parameter is read-only.	-
	0.000…22.000 mA or 0.000…11.000 V	Value of analog input AI2.	1000 = 1 unit
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 selection*.	0.000 V
	0.000…22.000 mA or 0.000…11.000 V	Forced value of analog input AI2.	1000 = 1 unit
12.25	*AI2 unit selection*	Selects the unit for readings and settings related to analog input AI2.	*mA*
	V	Volts.	2
	mA	Milliamperes.	10
12.26	*AI2 filter time*	Defines the filter time constant for analog input AI2. See parameter *12.16 AI1 filter time*.	0.100 s
	0.000…30.000 s	Filter time constant.	1000 = 1 s

No.	Name/Value	Description	Def/FbEq16
12.27	*AI2 min*	Defines the minimum site value for analog input AI2. Set the value actually sent to the drive when the analog signal from plant is wound to its minimum setting.	4.000 mA
	0.000…22.000 mA or 0.000…11.000 V	Minimum value of AI2.	1000 = 1 unit
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
	0.000…22.000 mA or 0.000…11.000 V	Maximum value of AI2.	1000 = 1 unit
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 AI2 scaling (*12.28 AI2 max* - *12.27 AI2 min*).	-
	0.00…100.00%	AI2 value.	100 = 1%

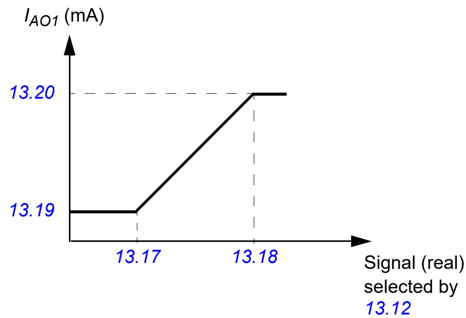
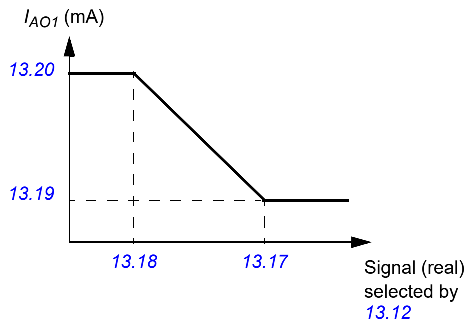
No.	Name/Value	Description	Def/FbEq16
13 Standard AO		Configuration of standard analog outputs.	
13.02	AO force selection	The source signals of the analog outputs can be overridden, for example, for testing purposes. A forced value parameter is provided for each analog output, and its value is applied 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	Name	Value
0	AO1	1 = Force AO1 to value of parameter 13.13 AO1 forced value. (0 = Normal mode)
1	AO2	1 = Force AO2 to value of parameter 13.23 AO2 forced value. (0 = Normal mode)
2…15	Reserved	

No.	Name/Value	Description	Def/FbEq16
	0000h…FFFFh	Forced values selector for analog outputs AO1 and AO2.	1 = 1
13.11	AO1 actual value	Displays the value of AO1 in mA or V. This parameter is read-only.	-
	0.000…22.000 mA or 0.000…11.000 V	Value of AO1.	1000 = 1 unit
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 (page 127).	1
	Reserved		2
	Output frequency	01.06 Output frequency (page 127).	3
	Motor current	01.07 Motor current (page 127).	4
	Motor current % of motor nominal	01.08 Motor current % of motor nom (page 127).	5
	Motor torque	01.10 Motor torque (page 127).	6
	DC voltage	01.11 DC voltage (page 127).	7
	Output power	01.14 Output power (page 128).	8
	Reserved		9
	Speed ref ramp in	23.01 Speed ref ramp input (page 219).	10
	Speed ref ramp out	23.02 Speed ref ramp output (page 219).	11
	Speed ref used	24.01 Used speed reference (page 223).	12
	Reserved		13
	Freq ref used	28.02 Frequency ref ramp output (page 230).	14
	Reserved		15
	Process PID out	40.01 Process PID output actual (page 293).	16
	Reserved		17…19
	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 Programmable protection functions (page 117).	20

No.	Name/Value	Description	Def/FbEq16
	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 *Programmable protection functions* (page *117*).	21
	Reserved		21…25
	Abs motor speed used	*01.61 Abs motor speed used* (page *130*).	26
	Abs motor speed %	*01.62 Abs motor speed %* (page *130*).	27
	Abs output frequency	*01.63 Abs output frequency* (page *130*).	28
	Reserved		29
	Abs motor torque	*01.64 Abs motor torque* (page *130*).	30
	Abs output power	*01.65 Abs output power* (page *130*).	31
	Abs motor shaft power	*01.68 Abs motor shaft power* (page *130*).	32
	External PID1 out	*71.01 External PID act value* (page *343*).	33
	AO1 data storage	*13.91 AO1 data storage* (page *166*).	37
	AO2 data storage	*13.92 AO2 data storage* (page *166*).	38
	Other	Source selection (see *Terms and abbreviations* on page *124*).	-
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 V
	0.000…22.000 mA / 0.000…11.000 V	Forced value for AO1.	1000 = 1 unit
13.15	*AO1 unit selection*	Selects the unit for readings and settings related to analog input AO1.	*V*
	V	Volts.	2
	mA	Milliamperes.	10
13.16	*AO1 filter time*	Defines the filtering time constant for analog output AO1.  $O = I \times (1 - e^{-t/T})$ I = filter input (step) O = filter output *t* = time T = filter time constant	0.100 s
	0.000 … 30.000 s	Filter time constant.	1000 = 1 s

6

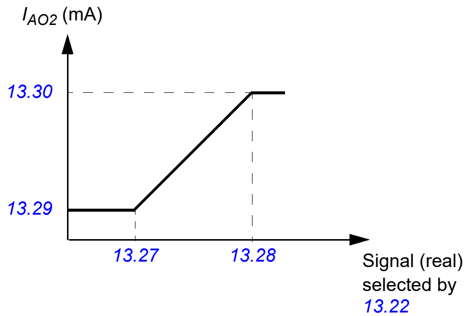
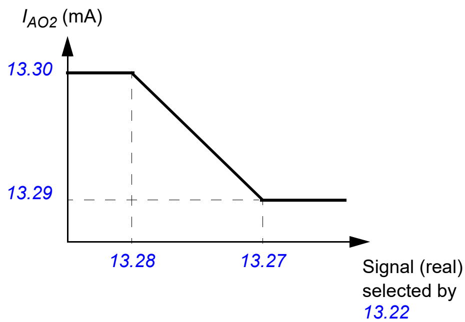
No.	Name/Value	Description	Def/FbEq16
13.17	*AO1 source min*	Defines the real minimum value of the signal (selected by parameter *13.12 AO1 source*) that corresponds to the minimum required AO1 output value (defined by parameter *13.19 AO1 out at AO1 src min*).  Programming *13.17* as the maximum value and *13.18* as the minimum value inverts the output.  	0.0

No.	Name/Value	Description	Def/FbEq16
	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 nominal	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	Def/FbEq16
	-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; 60.0 (95.20 b0)
	-32768.0…32767.0	Real signal value corresponding to maximum AO1 output value.	1 = 1
13.19	AO1 out at AO1 src min	Defines the minimum output value for analog output AO1. See also drawing at parameter 13.17 AO1 source min.	4.000 V
	0.000…22.000 mA / 0.000…11.000 V	Minimum AO1 output value.	1000 = 1 unit

No.	Name/Value	Description	Def/FbEq16
13.20	*AO1 out at AO1 src max*	Defines the maximum output value for analog output AO1. See also drawing at parameter *13.17 AO1 source min*.	10.000 V
	0.000…22.000 mA / 0.000…11.000 V	Maximum AO1 output value.	1000 = 1 unit
13.21	*AO2 actual value*	Displays the value of AO2 in mA. This parameter is read-only.	-
	0.000 … 22.000 mA	Value of AO2.	1000 = 1 mA
13.22	*AO2 source*	Selects a signal to be connected to analog output AO2. Alternatively, sets the output to excitation mode to feed a constant current to a temperature sensor. For the selections, see parameter *13.12 AO1 source*.	*Motor current*
13.23	*AO2 forced value*	Forced value that can be used instead of the selected output signal. See parameter *13.02 AO force selection*.	0.000 mA
	0.000 … 22.000 mA	Forced value for AO2.	1000 = 1 mA
13.26	*AO2 filter time*	Defines the filtering time constant for analog output AO2. See parameter *13.16 AO1 filter time*.	0.100 s
	0.000 … 30.000 s	Filter time constant.	1000 = 1 s

No.	Name/Value	Description	Def/FbEq16
13.27	*AO2 source min*	Defines the real minimum value of the signal (selected by parameter *13.22 AO2 source*) that corresponds to the minimum required AO2 output value (defined by parameter *13.29 AO2 out at AO2 src min*). See parameter *13.17 AO1 source min* about the AO automatic scaling.  Programming *13.27* as the maximum value and *13.28* as the minimum value inverts the output.  	0.0
	-32768.0…32767.0	Real signal value corresponding to minimum AO2 output value.	1 = 1
13.28	*AO2 source max*	Defines the real maximum value of the signal (selected by parameter *13.22 AO2 source*) that corresponds to the maximum required AO2 output value (defined by parameter *13.30 AO2 out at AO2 src max*). See parameter *13.27 AO2 source min*. See parameter *13.17 AO1 source min* about the AO automatic scaling.	30000.0
	-32768.0…32767.0	Real signal value corresponding to maximum AO2 output value.	1 = 1
13.29	*AO2 out at AO2 src min*	Defines the minimum output value for analog output AO2. See also drawing at parameter *13.27 AO2 source min*.	4.000 mA
	0.000 … 22.000 mA	Minimum AO2 output value.	1000 = 1 mA

No.	Name/Value	Description	Def/FbEq16
13.30	*AO2 out at AO2 src max*	Defines the maximum output value for analog output AO2. See also drawing at parameter *13.27 AO2 source min*.	20.000 mA
	0.000 … 22.000 mA	Maximum AO2 output value.	1000 = 1 mA
13.91	*AO1 data storage*	Storage parameter for controlling analog output AO1, for example, through the embedded fieldbus interface. 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*…*58.114*) to *AO1 data storage*.	0.00
	-327.68…327.67	Storage parameter for AO1.	100 = 1
13.92	*AO2 data storage*	Storage parameter for controlling analog output AO2, for example, through the embedded fieldbus interface. In parameter *13.22 AO2 source*, select *AO2 data storage*. Then set this parameter as the target of the incoming value data. With the embedded fieldbus interface, simply set the target selection parameter of that particular data (*58.101*…*58.114*) to *AO2 data storage*.	0.00
	-327.68…327.67	Storage parameter for AO2.	100 = 1

15 I/O extension module		Configuration of the I/O extension module installed in slot 2. See also section *Programmable I/O extensions* (page *59*). **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.	*CMOD-01*
	None	Inactive.	0
	CMOD-01	CMOD-01 multifunction extension module (external 24 V AC/DC and digital I/O).	1
	CMOD-02	CMOD-02 multifunction extension module (external 24 V AC/DC and isolated PTC interface).	2
	CHDI-01	CHDI-01115/230 V digital input extension module.	3
	CPTC-02	CPTC-02 extension module (external 24 V and ATEX certified PTC interface).	4
	CAIO-01	CAIO-01 optional bipolar analog input and unipolar analog output extension module.	8
15.02	*Detected extension module*	I/O extension module detected on the drive.	*CMOD-01*
	None	Inactive.	0
	CMOD-01	CMOD-01 multifunction extension module (external 24 V AC/DC and digital I/O).	1
	CMOD-02	CMOD-02 multifunction extension module (external 24 V AC/DC and isolated PTC interface).	2
	CHDI-01	CHDI-01115/230 V digital input extension module.	3

No.	Name/Value	Description	Def/FbEq16
	CPTC-02	CPTC-02 extension module (external 24 V and ATEX certified PTC interface).	4
	CAIO-01	CAIO-01 optional bipolar analog input and unipolar analog output extension module.	8
15.04	*RO/DO status*	Displays the status of the relay outputs RO4 and RO7 and digital output DO1 on the extension module. Bits 0…3 indicates the status of RO4…RO7; bit 5 indicates the status of DO1. **Example:** 100101b = RO4 and R07 are on, RO5 and R6 are off and DO1 is on. This parameter is read-only.	-

Bit	Name	Description
0	RO4	1 = Relay output 4 is ON.
1	RO5	1 = Relay output 5 is ON
2...4	Reserved	
5	DO1	1 = Digital output 1 is ON.
6…15	Reserved	

No.	Name/Value	Description	Def/FbEq16
	0000h…FFFFh	Status of relay/digital outputs.	1 = 1
15.05	*RO/DO force selection*	The electrical statuses of the relay/digital outputs can be overridden, for example, for testing purposes. A bit in parameter *15.06 RO/DO forced data* is provided for each relay or digital 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	Name	Value
0	RO4	1 = Force RO4 to value of bit 0 of parameter *15.06 RO/DO forced data*. (0 = Normal mode)
1	RO5	1 = Force RO5 to value of bit 1 of parameter *15.06 RO/DO forced data*. (0 = Normal mode)
2...4	Reserved	
5	DO1	1 = Force DO1 to value of bit 5 of parameter *15.06 RO/DO forced data*. (0 = Normal mode)
6…15	Reserved	

No.	Name/Value	Description	Def/FbEq16
	0000h…FFFFh	Override selection for relay/digital outputs.	1 = 1

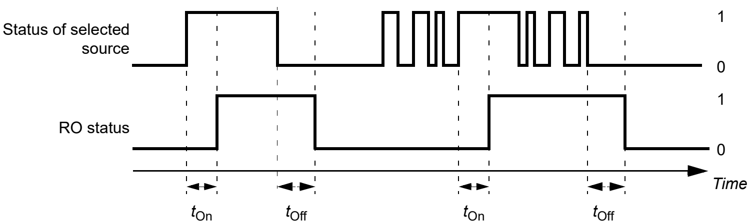
No.	Name/Value	Description	Def/FbEq16
15.06	RO/DO forced data	Allows the data value of a forced relay or digital output to be changed from 0 to 1. It is only possible to force an output that has been selected in parameter 15.05 RO/DO force selection. Bits 0…1 are the forced values for RO4…RO5; bit 5 is the forced value for DO1.	0000h

Bit	Name	Description
0	RO4	1 = Force the value of this bit to RO4, if so defined in parameter 15.05 RO/DO force selection.
1	RO5	1 = Force the value of this bit to RO5, if so defined in parameter 15.05 RO/DO force selection.
2...4	Reserved	
5	DO1	1 = Force the value of this bit to DO1 if so defined in parameter 15.05 RO/DO force selection.
6…15	Reserved	

No.	Name/Value	Description	Def/FbEq16
	0000h…FFFFh	Forced values of relay/digital 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 (see page 137).	2
	Reserved		3
	Enabled	Bit 0 of 06.16 Drive status word 1 (see page 138).	4
	Started	Bit 5 of 06.16 Drive status word 1 (see page 138).	5
	Magnetized	Bit 1 of 06.17 Drive status word 2 (see page 139).	6
	Running	Bit 6 of 06.16 Drive status word 1 (see page 138).	7
	Ready ref	Bit 2 of 06.11 Main status word (see page 137).	8
	At setpoint	Bit 8 of 06.11 Main status word (see page 137).	9
	Reverse	Bit 2 of 06.19 Speed control status word (see page 140).	10
	Zero speed	Bit 0 of 06.19 Speed control status word (see page 140).	11
	Above limit	Bit 10 of 06.17 Drive status word 2 (see page 139).	12
	Warning	Bit 7 of 06.11 Main status word (see page 137).	13
	Fault	Bit 3 of 06.11 Main status word (see page 137).	14
	Fault (-1)	Inverted bit 3 of 06.11 Main status word (see page 137).	15
	Fault/Warning	Bit 3 of 06.11 Main status word OR bit 7 of 06.11 Main status word (see page 137).	16
	Overcurrent	Fault 2310 Overcurrent has occurred.	17
	Overvoltage	Fault 3210 DC link overvoltage has occurred.	18
	Drive temp	Fault 2381 IGBT overload, 4110 Control board temperature, 4210 IGBT overtemperature, 4290 Cooling, 42F1 IGBT temperature, 4310 Excess temperature or 4380 Excess temperature difference has occurred.	19
	Undervoltage	Fault 3220 DC link undervoltage has occurred.	20
	Motor temp	Fault 4981 External temperature 1 or 4982 External temperature 2 has occurred.	21

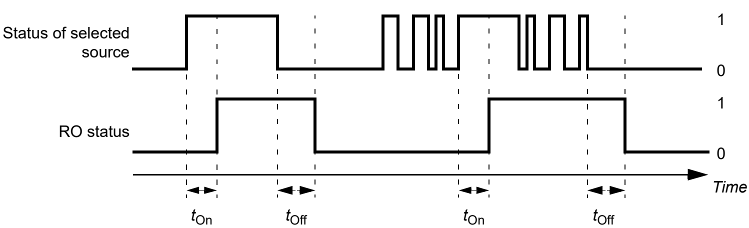
No.	Name/Value	Description	Def/FbEq16
	Reserved		22
	Ext2 active	Bit 11 of *06.16 Drive status word 1* (see page *138*).	23
	Remote control	Bit 9 of *06.11 Main status word* (see page *137*).	24
	Reserved		25…26
	Timed function 1	Bit 0 of *34.01 Timed functions status* (see page *267*).	27
	Timed function 2	Bit 1 of *34.01 Timed functions status* (see page *267*).	28
	Timed function 3	Bit 2 of *34.01 Timed functions status* (see page *267*).	29
	Reserved		30…32
	Supervision 1	Bit 0 of *32.01 Supervision status* (see page *259*).	33
	Supervision 2	Bit 1 of *32.01 Supervision status* (see page *259*).	34
	Supervision 3	Bit 2 of *32.01 Supervision status* (see page *259*).	35
	Reserved		36…38
	Start delay	Bit 13 of *06.17 Drive status word 2* (see page *139*).	39
	RO/DIO control word bit0	Bit 0 of *10.99 RO/DIO control word* (see page *153*).	40
	RO/DIO control word bit1	Bit 1 of *10.99 RO/DIO control word* (see page *153*).	41
	RO/DIO control word bit2	Bit 2 of *10.99 RO/DIO control word* (see page *153*).	42
	Reserved		43…44
	PFC1	Bit 0 of *76.01 PFC status* (see page *345*).	45
	PFC2	Bit 1 of *76.01 PFC status* (see page *345*).	46
	PFC3	Bit 2 of *76.01 PFC status* (see page *345*).	47
	PFC4	Bit 3 of *76.01 PFC status* (see page *345*).	48
	PFC5	Bit 4 of *76.01 PFC status* (see page *345*).	49
	PFC6	Bit 5 of *76.01 PFC status* (see page *345*).	50
	Reserved		51…52
	Event word 1	Event word 1 = 1 if any bit of *04.40 Event word 1* (see page *132*) is 1, that is, if any warning, fault or pure event that has been defined with parameters *04.41*…*04.71* is on.	53
	Run permissive	Bit 7 of *06.22 HVAC status word*.	55
	Start interlock 1	Bit 8 of *06.22 HVAC status word*.	56
	Start interlock 2	Bit 9 of *06.22 HVAC status word*.	57
	Start interlock 3	Bit 10 of *06.22 HVAC status word*.	58
	Start interlock 4	Bit 11 of *06.22 HVAC status word*.	59
	All start interlocks	Bit 12 of *06.22 HVAC status word*.	60
	User load curve	Bit 3 (Outside load limit) of *37.01 ULC output status word* (see page *290*).	61

No.	Name/Value	Description	Def/FbEq16
	RO/DIO control word	For *15.07 RO4 source*: Bit 3 (RO4) of *10.99 RO/DIO control word* (see page *153*). For *15.10 RO5 source*: Bit 4 (RO5) of *10.99 RO/DIO control word* (see page *153*). For *15.10 RO6 source*: Bit 5 (RO6) of *10.99 RO/DIO control word* (see page *153*). For *15.16 RO7 source*: Bit 6 (RO7) of *10.99 RO/DIO control word* (see page *153*).	62
	Other [bit]	Source selection (see *Terms and abbreviations* on page *124*).	-
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 RO4 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. For the available selections, see parameter *15.07 RO4 source*.	*Not energized*
15.11	*RO5 ON delay*	Defines the activation delay for relay output RO5.	0.0 s

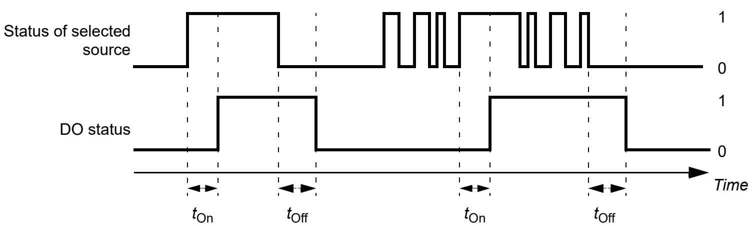


t_{On} = *15.11 RO5 ON delay*
t_{Off} = *15.12 RO5 OFF delay*

	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 = s
15.22	*DO1 configuration*	Selects how DO1 is used.	*Digital output*
	Digital output	DO1 is used as a digital output.	0
	Frequency output	DO1 is used as a frequency output.	2

No.	Name/Value	Description	Def/FbEq16
15.23	*DO1 source*	Selects a drive signal to be connected to digital output DO1 when *15.22 DO1 configuration* is set to *Digital output*.	*Not energized*
	Not energized	Output is not energized.	0
	Energized	Output is energized.	1
	Ready run	Bit 1 of *06.11 Main status word* (see page *137*).	2
	Reserved		3
	Enabled	Bit 0 of *06.16 Drive status word 1* (see page *138*).	4
	Started	Bit 5 of *06.16 Drive status word 1* (see page *138*).	5
	Magnetized	Bit 1 of *06.17 Drive status word 2* (see page *139*).	6
	Running	Bit 6 of *06.16 Drive status word 1* (see page *138*).	7
	Ready ref	Bit 2 of *06.11 Main status word* (see page *137*).	8
	At setpoint	Bit 8 of *06.11 Main status word* (see page *137*).	9
	Reverse	Bit 2 of *06.19 Speed control status word* (see page *140*).	10
	Zero speed	Bit 0 of *06.19 Speed control status word* (see page *140*).	11
	Above limit	Bit 10 of *06.17 Drive status word 2* (see page *139*).	12
	Warning	Bit 7 of *06.11 Main status word* (see page *137*).	13
	Fault	Bit 3 of *06.11 Main status word* (see page *137*).	14
	Fault (-1)	Inverted bit 3 of *06.11 Main status word* (see page *137*).	15
	Fault/Warning	Bit 3 of *06.11 Main status word* OR bit 7 of *06.11 Main status word* (see page *137*).	16
	Overcurrent	Fault *2310 Overcurrent* has occurred.	17
	Overvoltage	Fault *3210 DC link overvoltage* has occurred.	18
	Drive temp	Fault *2381 IGBT overload*, *4110 Control board temperature*, *4210 IGBT overtemperature*, *4290 Cooling*, *42F1 IGBT temperature*, *4310 Excess temperature* or *4380 Excess temperature difference* has occurred.	19
	Undervoltage	Fault *3220 DC link undervoltage* has occurred.	20
	Motor temp	Fault *4981 External temperature 1* or *4982 External temperature 2* has occurred.	21
	Reserved		22
	Ext2 active	Bit 11 of *06.16 Drive status word 1* (see page *138*).	23
	Remote control	Bit 9 of *06.11 Main status word* (see page *137*).	24
	Reserved		25…26
	Timed function 1	Bit 0 of *34.01 Timed functions status* (see page *267*).	27
	Timed function 2	Bit 1 of *34.01 Timed functions status* (see page *267*).	28
	Timed function 3	Bit 2 of *34.01 Timed functions status* (see page *267*).	29
	Reserved		30…32
	Supervision 1	Bit 0 of *32.01 Supervision status* (see page *259*).	33
	Supervision 2	Bit 1 of *32.01 Supervision status* (see page *259*).	34
	Supervision 3	Bit 2 of *32.01 Supervision status* (see page *259*).	35
	Reserved		36…38
	Start delay	Bit 13 of *06.17 Drive status word 2* (see page *139*).	39

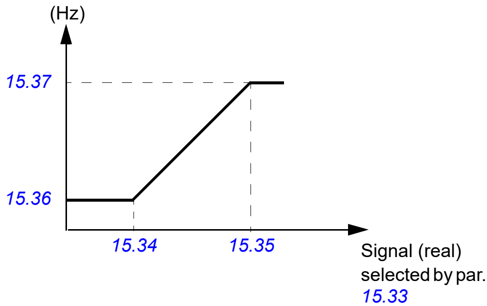
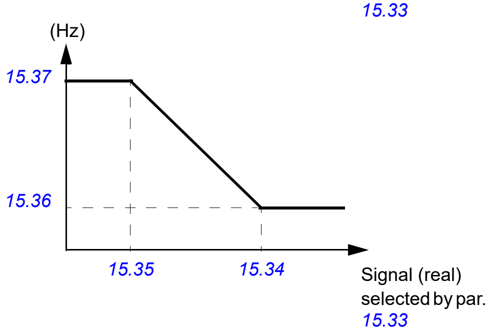
No.	Name/Value	Description	Def/FbEq16
	RO/DIO control word bit0	Bit 0 of *10.99 RO/DIO control word* (see page *153*).	40
	RO/DIO control word bit1	Bit 1 of *10.99 RO/DIO control word* (see page *153*).	41
	RO/DIO control word bit2	Bit 2 of *10.99 RO/DIO control word* (see page *153*).	42
	PFC1	Bit 0 of *76.01 PFC status* (see page *345*).	45
	PFC2	Bit 1 of *76.01 PFC status* (see page *345*).	46
	PFC3	Bit 2 of *76.01 PFC status* (see page *345*).	47
	PFC4	Bit 3 of *76.01 PFC status* (see page *345*).	48
	PFC5	Bit 4 of *76.01 PFC status* (see page *345*).	49
	PFC6	Bit 5 of *76.01 PFC status* (see page *345*).	50
	Reserved		51…52
	Event word 1	Event word 1 = 1 if any bit of *04.40 Event word 1* (see page *132*) is 1, that is, if any warning, fault or pure event that has been defined with parameters *04.41*…*04.71* is on.	53
	Run permissive	Bit 7 of *06.22 HVAC status word*.	55
	Start interlock 1	Bit 8 of *06.22 HVAC status word*.	56
	Start interlock 2	Bit 9 of *06.22 HVAC status word*.	57
	Start interlock 3	Bit 10 of *06.22 HVAC status word*.	58
	Start interlock 4	Bit 11 of *06.22 HVAC status word*.	59
	All start interlocks	Bit 12 of *06.22 HVAC status word*.	60
	User load curve	Bit 3 (Outside load limit) of *37.01 ULC output status word* (see page *290*).	61
	RO/DIO control word	Bit 8 (DIO1) of *10.99 RO/DIO control word* (see page *153*).	62
	Other [bit]	Source selection (see *Terms and abbreviations* on page *124*).	-
15.24	*DO1 ON delay*	Defines the activation delay for digital output DO1 when *15.22 DO1 configuration* is set to *Digital output*.	0.0 s



t_{On} = *15.24 DO1 ON delay*
t_{Off} = *15.25 DO1 OFF delay*

No.	Name/Value	Description	Def/FbEq16
	0.0 … 3000.0 s	Activation delay for DO1.	1 = 1 s
15.25	*DO1 OFF delay*	Defines the deactivation delay for relay output DO1 when *15.22 DO1 configuration* is set to *Digital output*. See parameter *15.24 DO1 ON delay*.	0.0 s
	0.0 … 3000.0 s	Deactivation delay for DO1.	1 =1 s

No.	Name/Value	Description	Def/FbEq16
15.32	*Freq out 1 actual value*	Displays the value of frequency output 1 at digital output DO1 when *15.22 DO1 configuration* is set to *Frequency output*. This parameter is read-only.	-
	0 … 16000 Hz	Value of frequency output 1.	1 = 1 Hz
15.33	*Freq out 1 source*	Selects a signal to be connected to digital output DO1 when *15.22 DO1 configuration* is set to *Frequency output*. Alternatively, sets the output to excitation mode to feed a constant current to a temperature sensor.	*Motor speed used*
	Not selected	None.	0
	Motor speed used	*01.01 Motor speed used* (page *127*).	1
	Output frequency	*01.06 Output frequency* (page *127*).	3
	Motor current	*01.07 Motor current* (page *127*).	4
	Motor torque	*01.10 Motor torque* (page *127*).	6
	DC voltage	*01.11 DC voltage* (page *127*).	7
	Output power	*01.14 Output power* (page *128*).	8
	Speed ref ramp in	*23.01 Speed ref ramp input* (page *219*).	10
	Speed ref ramp out	*23.02 Speed ref ramp output* (page *219*).	11
	Speed ref used	*24.01 Used speed reference* (page *223*).	12
	Reserved		13
	Freq ref used	*28.02 Frequency ref ramp output* (page *230*).	14
	Reserved		15
	Process PID out	*40.01 Process PID output actual* (page *293*).	16
	Other	Source selection (see *Terms and abbreviations* on page *124*).	-

No.	Name/Value	Description	Def/FbEq16
15.34	*Freq out 1 src min*	Defines the real value of the signal (selected by parameter *15.33 Freq out 1 source*) that corresponds to the minimum value of frequency output 1 (defined by parameter *15.36 Freq out 1 at src min*). This applies when *15.22 DO1 configuration* is set to *Frequency output*.  	0.000
	-32768.000… 32767.000	Real signal value corresponding to minimum value of frequency output 1.	1 = 1
15.35	*Freq out 1 src max*	Defines the real value of the signal (selected by parameter *15.33 Freq out 1 source*) that corresponds to the maximum value of frequency output 1 (defined by parameter *15.37 Freq out 1 at src max*). This applies when *15.22 DO1 configuration* is set to *Frequency output*. See parameter *15.34 Freq out 1 src min*.	1500.000; 1800.000 (*95.20* b0)
	-32768.000… 32767.000	Real signal value corresponding to maximum value of frequency output 1.	1 = 1
15.36	*Freq out 1 at src min*	Defines the minimum output value of frequency output 1 when *15.22 DO1 configuration* is set to *Frequency output*. See also drawing at parameter *15.34 Freq out 1 src min*.	0 Hz
	0 … 16000 Hz	Minimum frequency output 1 value.	1 = 1 Hz
15.37	*Freq out 1 at src max*	Defines the maximum value of frequency output 1 when *15.22 DO1 configuration* is set to *Frequency output*. See also drawing at parameter *15.34 Freq out 1 src min*.	16000 Hz
	0 … 16000 Hz	Maximum value of frequency output 1.	1 = 1 Hz

No.	Name/Value	Description	Def/FbEq16
15.40	*AI force selection*	The true readings of the analog inputs can be overridden for example for 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 *15.56 AI3 filter time*, *15.66 AI4 filter time* and *15.76 AI5 filter time*) have no effect on forced AI values (parameters *15.54 AI3 forced value*, *15.64 AI4 forced value* and *15.74 AI5 forced value*). **Note**: Boot and power cycle reset the force selections (parameter *15.40*). **Note**: This parameter is visible when CAIO-01 is selected in parameter *15.01*.	0b000

Bit	Name	Value
0…1	-	Reserved
2	AI3	1 = Force AI3 to value of parameter *15.54 AI3 forced value*.
3	AI4	1 = Force AI4 to value of parameter *15.64 AI4 forced value*.
4	AI5	1 = Force AI5 to value of parameter *15.74 AI5 forced value*.
5…15	-	Reserved

No.	Name/Value	Description	Def/FbEq16
	00000h…0FFFFh	Bitmask	1 = 1
15.41	*AI supervision function*	Selects how the drive reacts when an analog input signal moves out of the minimum and/or maximum limits specified for the input. The inputs and the limits to be observed are selected by parameter *15.42 AI supervision selection*. **Note**: This parameter is visible when CAIO-01 is selected in parameter *15.01*.	0000h
	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. **WARNING**! Make sure that it is safe to continue.	3
	Speed ref safe	Drive generates a warning (*A8A0 AI supervision*) and sets the speed to the speed defined by parameter *22.41 Speed ref safe* (or *28.41 Frequency ref safe* when frequency reference is being used). **WARNING**! Make sure that it is safe to continue	4
15.42	*AI supervision selection*	Specifies the analog input limits to be supervised. See parameter *15.43 AI supervision function*. **Note**: This parameter is visible when CAIO-01 is selected in parameter *15.01*.	0000h

No.	Name/Value	Description	Def/FbEq16

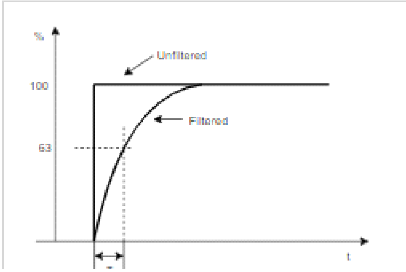
Bit	Name	Value
0	AI3<MIN	1 = Minimum limit supervision of AI3 active.
1	AI3>MAX	1 = Maximum limit supervision of AI3 active.
2	AI4<MIN	1 = Minimum limit supervision of AI4 active.
3	AI4>MAX	1 = Maximum limit supervision of AI4 active.
4	AI5<MIN	1 = Minimum limit supervision of AI5 active.
5	AI5>MAX	1 = Maximum limit supervision of AI5 active.
6…15	-	Reserved

No.	Name/Value	Description	Def/FbEq16
	00000h…0FFFFh	Bitmask	1 = 1
15.43	*AI supervision force selection*	Activates/deactivate the Analog Input supervision for each control location (EXT1, EXT2, Local). By deactivating any bit user can mask the fault/warning for selected control location. **Note**: This parameter is visible when CAIO-01 is selected in parameter *15.01*.	0b 0111 0111 0111

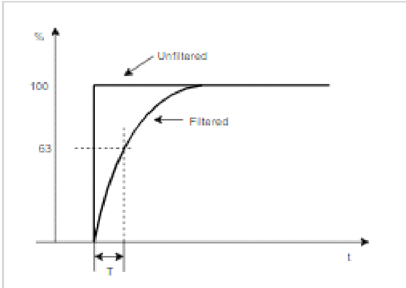
Bit	Name	Value
0	AI3 Ext1	1 = AI3 supervision is active when EXT1 control is being used.
1	AI3 Ext2	1 = AI3 supervision is active when EXT2 control is being used.
2	AI3 Local	1 = AI3 supervision is active when local control is being used.
3	-	Reserved
4	AI4 Ext1	1 = AI4 supervision is active when EXT1 control is being used.
5	AI4 Ext2	1 = AI4 supervision is active when EXT2 control is being used.
6	AI4 Local	1 = AI4 supervision is active when local control is being used.
7	-	Reserved
8	AI5 Ext1	1 = AI5 supervision is active when EXT1 control is being used.
9	AI5 Ext2	1 = AI5 supervision is active when EXT2 control is being used.
10	AI5 Local	1 = AI5 supervision is active when local control is being used.

No.	Name/Value	Description	Def/FbEq16
	00000h…0FFFFh	Bitmask	1 = 1
15.44	*AI dead band*	AI dead band value in percentage of the respective AI max value and applicable for AI3, AI4 and AI5, i.e. Extension AI only. (Currently available only with the CAIO-01 module). AI max value is 10V and 20mA in voltage and current mode, respectively. This value affects separately the positive and negative sides of AI values around the zero value. 10% of AI dead band value is internally added in firmware as AI dead band hysteresis near the calculated AI dead band value. **Note**: This parameter is visible when CAIO-01 is selected in parameter *15.01*.	0.00
	0.00…100.00 %	Dead band percentage value.	1 = 1
15.45	*AO force selection*	The 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. **Note**: This parameter is visible when CAIO-01 is selected in parameter *15.01*.	0000h

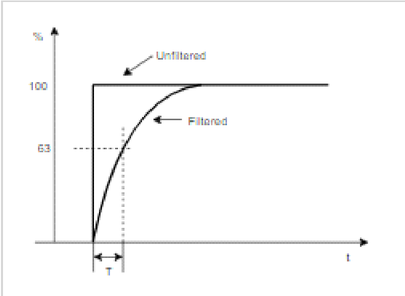
<table>
<tr><th>No.</th><th>Name/Value</th><th>Description</th><th>Def/FbEq16</th></tr>
<tr><td colspan="4">
<table>
<tr><th>Bit</th><th>Name</th><th>Value</th></tr>
<tr><td>0…1</td><td>-</td><td>Reserved</td></tr>
<tr><td>2</td><td>AO3</td><td>1 = Force AO3 to value of parameter 15.83 AO3 forced value. (0 = Normal mode).</td></tr>
<tr><td>3</td><td>AO4</td><td>1 = Force AO4 to value of parameter 15.93 AO4 forced value. (0 = Normal mode).</td></tr>
<tr><td>4…15</td><td>-</td><td>Reserved</td></tr>
</table>
</td></tr>
<tr><td></td><td>00000h…0FFFFh</td><td>Bitmask</td><td>1 = 1</td></tr>
<tr><td>15.51</td><td>AI3 actual value</td><td>Displays the value of analog input AI3 in mA or V mode (depending on whether the input is set to current or voltage in 15.55 AI3 unit selection).
This parameter is read-only.
Note: This parameter is visible when CAIO-01 is selected in parameter 15.01.</td><td>-</td></tr>
<tr><td></td><td>-11.000…11.000V / -22.000…22.000A</td><td>Actual AI3 value</td><td>1000 = 1 V/A</td></tr>
<tr><td>15.52</td><td>AI3 scaled value</td><td>Displays the value of analog input AI3 after scaling. See parameters 15.59 AI3 scaled at AI3 min and 15.60 AI3 scaled at AI3 max.
This parameter is read-only.
Note: This parameter is visible when CAIO-01 is selected in parameter 15.01.</td><td>-</td></tr>
<tr><td></td><td>-32768…32767</td><td>Scaled AI3 value</td><td>1 = 1</td></tr>
<tr><td>15.53</td><td>AI3 percent value</td><td>Value of analog input AI3 in percent of AI3 scaling. Where -110% = -11V or -22mA and 110% = 11V or 22mA.
Note: This parameter is visible when CAIO-01 is selected in parameter 15.01.</td><td></td></tr>
<tr><td></td><td></td><td></td><td></td></tr>
<tr><td>15.54</td><td>AI3 forced value</td><td>Forced value that can be used instead of the true reading of the input. See parameter 15.40 AI force selection.
Note: This parameter is visible when CAIO-01 is selected in parameter 15.01.</td><td></td></tr>
<tr><td></td><td></td><td></td><td></td></tr>
<tr><td>15.55</td><td>AI3 unit selection</td><td>Selects the unit for readings and settings related to analog input AI3.
Note: This parameter is visible when CAIO-01 is selected in parameter 15.01.</td><td>V</td></tr>
<tr><td></td><td>V</td><td>Volts</td><td>2</td></tr>
<tr><td></td><td>mA</td><td>Milliamperes</td><td>10</td></tr>
</table>

No.	Name/Value	Description	Def/FbEq16
15.56	*AI3 filter time*	Defines the filter time constant for analog input AI3.  O = I × (1 - e-t/T) I = filter input (step) O = filter output t = time T = filter time constant **Note**: The signal is also filtered due to the signal interface hardware (approximately 0.22 ms time constant). This cannot be changed by any parameter. **Note**: This parameter is visible when CAIO-01 is selected in parameter *15.01*.	0.100
	-0.000…30.000 s	Filter time constant	1000 = 1 s
15.57	*AI3 min*	Defines the minimum value for analog input AI3. Set the value actually sent to the drive when the analog signal is wound to its minimum setting. See also parameter *15.59 AI3 scaled at AI3 min*. **Note**: This parameter is visible when CAIO-01 is selected in parameter *15.01*.	0.000 V
	-11.000…11.000V / -22.000…22.000A	Minimum value	1000 = 1 V/mA
15.58	*AI3 max*	Defines the maximum value for analog input AI3. Set the value actually sent to the drive when the analog signal is wound to its maximum setting. See also parameter *15.60 AI3 scaled at AI3 max*. **Note**: This parameter is visible when CAIO-01 is selected in parameter *15.01*.	10.000V
	-11.000…11.000V / -22.000…22.000A	Maximum value	1000 = 1 V/mA
15.59	*AI3 scaled at AI3 min*	Defines the real internal value that corresponds to the minimum analog input AI3 value defined by parameter *15.57 AI3 min*. (Changing the polarity settings of *15.59* and *15.60* can effectively invert the analog input.) **Note**: This parameter is visible when CAIO-01 is selected in parameter *15.01*.	0.000
	-32768…32767	Real internal value	1 = 1
15.60	*AI3 scaled at AI3 max*	Defines the real internal value that corresponds to the maximum analog input AI3 value defined by parameter *15.58 AI3 scaled at AI3 max*. **Note**: This parameter is visible when CAIO-01 is selected in parameter *15.01*.	50.000
	-32768…32767	Real internal value	1 = 1

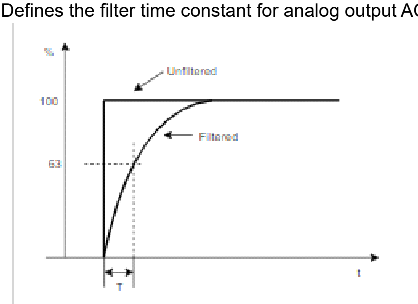
No.	Name/Value	Description	Def/FbEq16
15.61	*AI4 actual value*	Displays the value of analog input AI4 in mA or V mode (depending on whether the input is set to current or voltage in parameter *15.65 AI4 unit selection*). This parameter is read-only. **Note**: This parameter is visible when CAIO-01 is selected in parameter *15.01*.	-
	-11.000…11.000V / -22.000…22.000A	Value of analog input	1 = 1
15.62	*AI4 scaled value*	Displays the value of analog input AI4 after scaling. See parameters *15.69 AI4 scaled at AI4 min* and *15.70 AI4 scaled at AI4 max*. This parameter is read-only. **Note**: This parameter is visible when CAIO-01 is selected in parameter *15.01*.	-
	-32768…32767	Value of analog input	1 = 1
15.63	*AI4 percent value*	Value of analog input AI4 in percent of AI4 scaling. Where -110% = -11 V or -22 mA and 110% = 11 V or 22 mA. **Note**: This parameter is visible when CAIO-01 is selected in parameter *15.01*.	-
	0…110	Value of analog input	1 = 1
15.64	*AI4 forced value*	Forced value that can be used instead of the true reading of the input. See parameter *15.40 AI force selection*. **Note**: This parameter is visible when CAIO-01 is selected in parameter *15.01*.	-
	-11.000…11.000V / -22.000…22.000A	Forced value	1 = 1
15.65	*AI4 unit selection*	Selects the unit for readings and settings related to analog input AI4. **Note**: This parameter is visible when CAIO-01 is selected in parameter *15.01*.	V
	V	Volts	2
	mA	Milliamperes	10

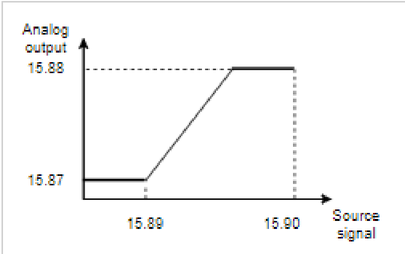
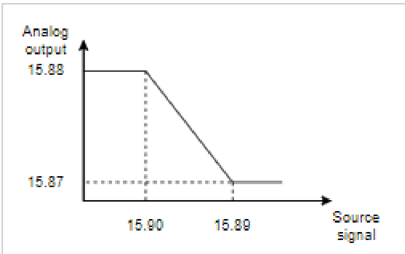
No.	Name/Value	Description	Def/FbEq16
15.66	*AI4 filter time*	Defines the filter time constant for analog input AI4.  $O = I \times (1 - e^{-t/T})$ I = filter input (step) O = filter output t = time T = filter time constant **Note**: The signal is also filtered due to the signal interface hardware (approximately 0.22 ms time constant). This cannot be changed by any parameter. **Note**: This parameter is visible when CAIO-01 is selected in parameter *15.01*.	0.100
	0.000…30.000 s	Filter time constant	1000 = 1 s
15.67	*AI4 min*	Defines the minimum value for analog input AI4. Set the value actually sent to the drive when the analog signal is wound to its minimum setting. See also parameter *15.69 AI4 scaled at AI4 min*. **Note**: This parameter is visible when CAIO-01 is selected in parameter *15.01*.	0.000 V
	-11.000…11.000V / -22.000…22.000A	Minimum value for AI4	1 = 1
15.68	*AI4 max*	Defines the maximum value for analog input AI4. Set the value actually sent to the drive when the analog signal is wound to its maximum setting. See also parameter *15.70 AI4 scaled at AI4 max*. **Note**: This parameter is visible when CAIO-01 is selected in parameter *15.01*.	10.000 V
	-11.000…11.000V / -22.000…22.000A	Maximum value for AI4	1 = 1
15.69	*AI4 scaled at AI4 min*	Defines the real internal value that corresponds to the minimum analog input AI4 value defined by parameter *15.67 AI4 min*. (Changing the polarity settings of parameters *15.69* and *15.70* can effectively invert the analog input.) **Note**: This parameter is visible when CAIO-01 is selected in parameter *15.01*.	0.000
	-32768…32767	Real internal value of the minimum AI4 value	1 = 1
15.70	*AI4 scaled at AI4 max*	Defines the real internal value that corresponds to the maximum analog input AI4 value defined by parameter *15.68 AI4 max*. **Note**: This parameter is visible when CAIO-01 is selected in parameter *15.01*.	50.000
	-32768…32767	Real internal value of the maximum AI4 value	1 = 1

No.	Name/Value	Description	Def/FbEq16
15.71	*AI5 actual value*	Displays the value of analog input AI5 in mA or V mode (depending on whether the input is set to current or voltage in parameter *15.75 AI5 unit selection*). This parameter is read-only. **Note**: This parameter is visible when CAIO-01 is selected in parameter *15.01*.	-
	-11.000…11.000V / -22.000…22.000A	Value of AI5	1 = 1
15.72	*AI5 scaled value*	Displays the value of analog input AI5 after scaling. See parameters *15.79 AI5 scaled at AI5 min* and *15.80 AI5 scaled at AI5 max*. This parameter is read-only. **Note**: This parameter is visible when CAIO-01 is selected in parameter *15.01*.	-
	-32768…32767	Value of AI5 after scaling	1 = 1
15.73	*AI5 percent value*	Value of analog input AI5 in percent of AI5 scaling. Where -110% = -11 V or -22 mA and 110% = 11 V or 22 mA. **Note**: This parameter is visible when CAIO-01 is selected in parameter *15.01*.	-
	0…110	Value of AI5 in percent of AI5 scaling	1 = 1
15.74	*AI5 forced value*	Forced value that can be used instead of the true reading of the input. See parameter 15.40 AI force selection. **Note**: This parameter is visible when CAIO-01 is selected in parameter *15.01*.	-
	-11.000…11.000V / -22.000…22.000A	Forced value	1 = 1
15.75	*AI5 unit selection*	Selects the unit for readings and settings related to analog input AI5. **Note**: This parameter is visible when CAIO-01 is selected in parameter *15.01*.	V
	V	Volts	2
	mA	Milliamperes	10

No.	Name/Value	Description	Def/FbEq16
15.76	*AI5 filter time*	Defines the filter time constant for analog input AI5.  O = I × (1 - e-t/T) I = filter input (step) O = filter output t = time T = filter time constant **Note**: The signal is also filtered due to the signal interface hardware (approximately 0.22 ms time constant). This cannot be changed by any parameter. **Note**: This parameter is visible when CAIO-01 is selected in parameter *15.01*.	0.100
	0.000…30.000 s	Filter time constant for AI5	1000 = 1 s
15.77	*AI5 min*	Defines the minimum value for analog input AI5. Set the value actually sent to the drive when the analog signal is wound to its minimum setting. See also parameter *15.79 AI5 scaled at AI5 min*. **Note**: This parameter is visible when CAIO-01 is selected in parameter *15.01*.	0.000 V
	-11.000…11.000V / -22.000…22.000A	Minimum value for AI5	1 = 1
15.78	*AI5 max*	Defines the maximum value for analog input AI5. Set the value actually sent to the drive when the analog signal is wound to its maximum setting. See also parameter *15.80 AI5 scaled at AI5 max*. **Note**: This parameter is visible when CAIO-01 is selected in parameter *15.01*.	10.000 V
	-11.000…11.000V / -22.000…22.000A	Maximum value for AI5	1 = 1
15.79	*AI5 scaled at AI5 min*	Defines the real internal value that corresponds to the minimum analog input AI5 value defined by parameter *15.77 AI5 min*. (Changing the polarity settings of *15.79* and *15.80* can effectively invert the analog input.) **Note**: This parameter is visible when CAIO-01 is selected in parameter *15.01*.	0.000
	-32768…32767	Real internal value of the minimum AI5 value	1000 = 1
15.80	*AI5 scaled at AI5 max*	Defines the real internal value that corresponds to the maximum analog input AI5 value defined by parameter *15.78 AI5 max*. **Note**: This parameter is visible when CAIO-01 is selected in parameter *15.01*.	50.000
	-32768…32767	Real internal value of the maximum AI5 value	1000 = 1

No.	Name/Value	Description	Def/FbEq16
15.81	*AO3 actual value*	Displays the value of AO3 in mA or V. This parameter is read-only. **Note**: This parameter is visible when CAIO-01 is selected in parameter *15.01*.	-
	-11.000…11.000V / -22.000…22.000A	Value of AO3	1 = 1
15.82	*AO3 source*	Selects a signal to be connected to analog output AO3. **Note**: The following selection list depends on the parameters available in the product. If a parameter is not available in the product, then the corresponding list item is also not available/not supported. **Note**: This parameter is visible when CAIO-01 is selected in parameter *15.01*.	-
	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 as % 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
	Frequency 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, *35.11 Temperature 1 source*	20
	Temp sensor 2 excitation	The output is used to feed an excitation current to the temperature sensor 2, *35.21 Temperature 2 source*	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
	External PID2 out	*72.01 External PID act value*	34
	External PID3 out	*73.01 External PID act value*	35
	External PID4 out	*74.01 External PID act value*	36
	AO1 data storage	*13.91 AO1 data storage*	37
	AO2 data storage	*13.92 AO2 data storage*	38

No.	Name/Value	Description	Def/FbEq16
	Other	Different source selection	-
15.83	*AO3 forced value*	Forced value that can be used instead of the selected output signal. See parameter *15.45 AO force selection*. **Note**: This parameter is visible when CAIO-01 is selected in parameter *15.01*.	-
	0.000…11.000 V / 0.000…22.000mA	Forced value	1000 = 1
15.84	*AO3 data storage*	Storage parameter for controlling analog output AO3 for example through the embedded fieldbus interface. In parameter *15.82 AO3 source*, select the AO3 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*…*58.114*) to AO3 data storage. **Note**: This parameter is visible when CAIO-01 is selected in parameter *15.01*.	0.00
	-327.68…327.67	Storage parameter for controlling AO3	100 = 1
15.85	*AO3 unit selection*	Selects the unit for readings and settings related to analog input AO3. **Note**: This parameter is visible when CAIO-01 is selected in parameter *15.01*.	mA
	V	Volts	2
	mA	Milliamperes	10
15.86	*AO3 filter time*	Defines the filter time constant for analog output AO3.  O = I × (1 - e-t/T) I = filter input (step) O = filter output t = time T = filter time constant **Note**: The signal is also filtered due to the signal interface hardware. This cannot be changed by any parameter. **Note**: This parameter is visible when CAIO-01 is selected in parameter *15.01*.	0.100
	0.000…30.000 s	Filter time constant for AO3	1000 = 1 s

No.	Name/Value	Description	Def/FbEq16
15.87	*AO3 source min*	Defines the real minimum value of the signal (selected by parameter *15.82 AO3 source*) that corresponds to the minimum required AO3 output value (defined by parameter *15.89 AO3 out at AO3 source min*).  Programming *15.87* as the maximum value and *15.88* as the minimum value inverts the output as shown below.  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. See parameter *13.17* for more details. **Note**: This parameter is visible when CAIO-01 is selected in parameter *15.01*.	-32768.0
	-32768.0…32767.0	Real minimum value of the AO3 signal	10 = 1
15.88	*AO3 source max*	Defines the real maximum value of the signal (selected by parameter *15.82 AO3 source*) that corresponds to the maximum required AO3 output value (defined by parameter *15.90 AO3 out at AO3 source max*). See parameter *15.87 AO3 source min*. **Note**: This parameter is visible when CAIO-01 is selected in parameter *15.01*.	32767.0
	-32768.0…32767.0	Real maximum value of the AO3 signal	10 = 1
15.89	*AO3 out at AO3 source min*	Defines the minimum output value for analog output AO3. See also the drawing at parameter *15.87 AO3 source min*. **Note**: This parameter is visible when CAIO-01 is selected in parameter *15.01*.	0.000
	0.000…11.000 V / 0.000…22.000 mA	Minimum output value of AO3	1000 = 1
15.90	*AO3 out at AO3 source max*	Defines the maximum output value for analog output AO3. See also the drawing at parameter *15.87 AO3 source min*. **Note**: This parameter is visible when CAIO-01 is selected in parameter *15.01*.	20.000

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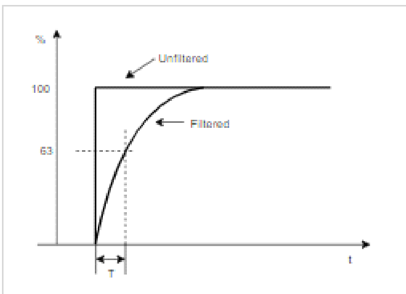
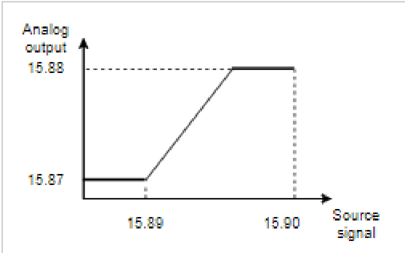
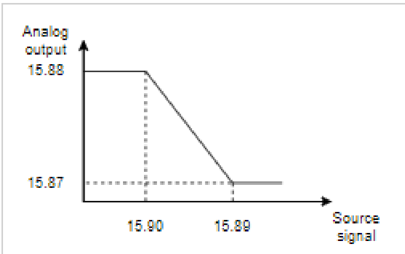
No.	Name/Value	Description	Def/FbEq16
	0.000…11.000 V / 0.000…22.000 mA	Maximum output value of AO3	1000 = 1
15.91	*AO4 actual value*	Displays the value of AO4 in mA or V. This parameter is read-only. **Note**: This parameter is visible when CAIO-01 is selected in parameter *15.01*.	-
	0.000…11.000 V / 0.000…22.000 mA	Value of AO4	1000 = 1
15.92	*AO4 source*	Selects a signal to be connected to analog output AO4. **Note**: The following selection list depends on the parameters available in the product. If a parameter is not available in the product, then the corresponding list item is also not available/not supported. **Note**: This parameter is visible when CAIO-01 is selected in parameter *15.01*.	-
	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 as % 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
	Frequency 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, *35.11 Temperature 1 source*	20
	Temp sensor 2 excitation	The output is used to feed an excitation current to the temperature sensor 2, *35.21 Temperature 2 source*	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
	External PID2 out	*72.01 External PID act value*	34
	External PID3 out	*73.01 External PID act value*	35
	External PID4 out	*74.01 External PID act value*	36

No.	Name/Value	Description	Def/FbEq16
	AO1 data storage	*13.91 AO1 data storage*	37
	AO2 data storage	*13.92 AO2 data storage*	38
	Other	Different source selection	-
15.93	*AO4 forced value*	Forced value that can be used instead of the selected output signal. See parameter *15.45 AO force selection*. **Note**: This parameter is visible when CAIO-01 is selected in parameter *15.01*.	-
	0.000…11.000 V / 0.000…22.000 mA	Forced value	1000 = 1
15.94	*AO4 data storage*	Storage parameter for controlling analog output AO4 for example through the embedded fieldbus interface. In parameter *15.92 AO4 source*, select the AO4 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*…*58.114*) to AO4 data storage. **Note**: This parameter is visible when CAIO-01 is selected in parameter *15.01*.	0.00
	-327.68…327.67	Storage parameter for controlling AO4	100 = 1
15.95	*AO4 unit selection*	Selects the unit for readings and settings related to analog input AO4. **Note**: This parameter is visible when CAIO-01 is selected in parameter *15.01*.	mA
	V	Volts	2
	mA	Milliamperes	10
15.96	*AO4 filter time*	Defines the filter time constant for analog output AO4.  O = I × (1 - e-t/T) I = filter input (step) O = filter output t = time T = filter time constant **Note**: The signal is also filtered due to the signal interface hardware. This cannot be changed by any parameter. **Note**: This parameter is visible when CAIO-01 is selected in parameter *15.01*.	0.100
	0.000…30.000 s	Filter time constant for AO4	1000 = 1 s

No.	Name/Value	Description	Def/FbEq16
15.97	*AO4 source min*	Defines the real minimum value of the signal (selected by parameter *15.92 AO4 source*) that corresponds to the minimum required AO4 output value (defined by parameter *15.99 AO4 out at AO4 source min*).  Programming *15.97* as the maximum value and *15.98* as the minimum value inverts the output as shown below.  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. See parameter *13.17* for more details. **Note**: This parameter is visible when CAIO-01 is selected in parameter *15.01*.	-32768.0
	-32768.0…32767.0	Real minimum value of the AO4 signal	10 = 1
15.98	*AO4 source max*	Defines the real maximum value of the signal (selected by parameter *15.92 AO4 source*) that corresponds to the maximum required AO4 output value (defined by parameter *15.100 AO4 out at AO4 source max*). See parameter *15.97 AO4 source min*. **Note**: This parameter is visible when CAIO-01 is selected in parameter *15.01*.	32767.0
	-32768.0…32767.0	Real maximum value of the AO4 signal	10 = 1
15.99	*AO4 out at AO4 source min*	Defines the minimum output value for analog output AO4. See also drawing at parameter *15.97 AO4 source min*. **Note**: This parameter is visible when CAIO-01 is selected in parameter *15.01*.	0.000
	0.000…11.000 V / 0.000…22.000 mA	Minimum output value for AO4	1000 = 1
15.100	*AO4 out at AO4 source max*	Defines the maximum output value for analog output AO4. See also drawing at parameter *15.97 AO4 source min*. **Note**: This parameter is visible when CAIO-01 is selected in parameter *15.01*.	20.000

No.	Name/Value	Description	Def/FbEq16
	0.000…11.000 V / 0.000…22.000 mA	Maximum output value for AO4	1000 = 1

19 Operation mode		Selection of local and external control location sources and operating modes. See also section *Operating modes of the drive* (page *57*).	
19.01	*Actual operation mode*	Displays the operating mode currently used. See parameter *19.11*. This parameter is read-only.	-
	Zero	None.	1
	Speed	Speed control (in vector motor control mode).	2
	Reserved		3…9
	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	*DI3*
	EXT1	EXT1 (permanently selected).	0
	EXT2	EXT2 (permanently selected).	1
	FBA A MCW bit 11	Control word bit 11 received through fieldbus interface A.	2
	DI1	Digital input DI1 (*10.02 DI delayed status*, bit 0).	3
	DI2	Digital input DI2 (*10.02 DI delayed status*, bit 1).	4
	DI3	Digital input DI3 (*10.02 DI delayed status*, bit 2).	5
	DI4	Digital input DI4 (*10.02 DI delayed status*, bit 3).	6
	DI5	Digital input DI5 (*10.02 DI delayed status*, bit 4).	7
	DI6	Digital input DI6 (*10.02 DI delayed status*, bit 5).	8
	Reserved		9…18
	Timed function 1	Bit 0 of *34.01 Timed functions status* (see page *267*).	19
	Timed function 2	Bit 1 of *34.01 Timed functions status* (see page *267*).	20
	Timed function 3	Bit 2 of *34.01 Timed functions status* (see page *267*).	21
	Reserved		22…24
	Supervision 1	Bit 0 of *32.01 Supervision status* (see page *259*).	25
	Supervision 2	Bit 1 of *32.01 Supervision status* (see page *259*).	26
	Supervision 3	Bit 2 of *32.01 Supervision status* (see page *259*).	27
	Reserved		28…31
	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.	34
	Other [bit]	Source selection (see *Terms and abbreviations* on page *124*).	-

<table>
<tr><th>No.</th><th>Name/Value</th><th>Description</th><th>Def/FbEq16</th></tr>
<tr><td>19.18</td><td>HAND/OFF disable source</td><td>Selects the source for Hand/Off disable.
1 = Hand and/or Off buttons are disabled on the control panel and in Drive composer PC tool. Parameter 19.19 HAND/OFF disable action specifies which buttons are disabled or enabled.
If the HAND/OFF disable is activated while the drive is in the Hand mode, the mode will be automatically switched to Off and the motor stops, and the user must start the motor again.</td><td>Not used</td></tr>
<tr><td></td><td>Not used</td><td>0 = Hand and/or Off buttons are enabled and operational.</td><td>0</td></tr>
<tr><td></td><td>Active</td><td>1 = Hand and/or Off buttons are disabled and not operational.</td><td>1</td></tr>
<tr><td></td><td>DI1</td><td>Digital input DI1 (10.02 DI delayed status, bit 0).</td><td>2</td></tr>
<tr><td></td><td>DI2</td><td>Digital input DI2 (10.02 DI delayed status, bit 1).</td><td>3</td></tr>
<tr><td></td><td>DI3</td><td>Digital input DI3 (10.02 DI delayed status, bit 2).</td><td>4</td></tr>
<tr><td></td><td>DI4</td><td>Digital input DI4 (10.02 DI delayed status, bit 3).</td><td>5</td></tr>
<tr><td></td><td>DI5</td><td>Digital input DI5 (10.02 DI delayed status, bit 4).</td><td>6</td></tr>
<tr><td></td><td>DI6</td><td>Digital input DI6 (10.02 DI delayed status, bit 5).</td><td>7</td></tr>
<tr><td></td><td>Comms</td><td>DCU profile control word bit 14 received through the embedded fieldbus interface. If a fieldbus adapter that supports transparent mode profiles is used, DCU control word bit 14 through the transparent mode profile is used.</td><td>8</td></tr>
<tr><td></td><td>Other [bit]</td><td>Source selection (see Terms and abbreviations on page 124).</td><td>-</td></tr>
<tr><td>19.19</td><td>HAND/OFF disable action</td><td>Selects which buttons are disabled on the control panel and in the Drive composer PC tool when parameter 19.18 HAND/OFF disable source is disabled.</td><td>HAND</td></tr>
<tr><td></td><td>HAND</td><td>Hand button disabled.</td><td>0</td></tr>
<tr><td></td><td>OFF and HAND</td><td>Both Off and Hand buttons disabled.</td><td>1</td></tr>
<tr><td></td><td>OFF when Auto</td><td>Off button is disabled when the drive is in the Auto mode. Off button is again enabled after the Hand button has been pressed.</td><td>2</td></tr>
</table>

<table>
<tr><td colspan="2">20 Start/stop/direction</td><td>Start/stop/direction and run/start enable signal source selection; positive/negative reference enable signal source selection.
For information on control locations, see section Local control vs. external control (page 53).</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 parameter 20.21 for the determination of the actual direction. See also parameters 20.02…20.05.</td><td>In1 Start</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>
</table>

<table>
<tr><th>No.</th><th>Name/Value</th><th>Description</th><th>Def/FbEq16</th></tr>
<tr><td></td><td>In1 Start; In2 Dir</td><td>The source selected by 20.03 Ext1 in1 source is the start signal; the source selected by 20.04 Ext1 in2 source determines the direction. The state transitions of the source bits are interpreted as follows:
<table>
<tr><th>State of source 1 (20.03)</th><th>State of source 2 (20.04)</th><th>Command</th></tr>
<tr><td>0</td><td>Any</td><td>Stop</td></tr>
<tr><td rowspan="2">0 -> 1 (20.02 = Edge)
1 (20.02 = Level)</td><td>0</td><td>Start forward</td></tr>
<tr><td>1</td><td>Start reverse</td></tr>
</table></td><td>2</td></tr>
<tr><td></td><td>In1 Start fwd; In2 Start rev</td><td>The source selected by 20.03 Ext1 in1 source is the forward start signal; the source selected by 20.04 Ext1 in2 source is the reverse start signal. The state transitions of the source bits are interpreted as follows:
<table>
<tr><th>State of source 1 (20.03)</th><th>State of source 2 (20.04)</th><th>Command</th></tr>
<tr><td>0</td><td>0</td><td>Stop</td></tr>
<tr><td>0 -> 1 (20.02 = Edge)
1 (20.02 = Level)</td><td>0</td><td>Start forward</td></tr>
<tr><td>0</td><td>0 -> 1 (20.02 = Edge)
1 (20.02 = Level)</td><td>Start reverse</td></tr>
<tr><td>1</td><td>1</td><td>Stop</td></tr>
</table></td><td>3</td></tr>
<tr><td></td><td>In1P Start; In2 Stop</td><td>The sources of the start and stop commands are selected by parameters 20.03 Ext1 in1 source and 20.04 Ext1 in2 source. The state transitions of the source bits are interpreted as follows:
<table>
<tr><th>State of source 1 (20.03)</th><th>State of source 2 (20.04)</th><th>Command</th></tr>
<tr><td>0 -> 1</td><td>1</td><td>Start</td></tr>
<tr><td>Any</td><td>0</td><td>Stop</td></tr>
</table>
Notes:

Run permissive and Start interlock signals can be put ON before or after the start pulse has been given.
Parameter 20.02 Ext1 start trigger type has an effect only at startup of the drive with this setting. If the start input is ON and 20.02 = Level (1) when the drive is powered up, the motor will start.
</td><td>4</td></tr>
</table>

<table>
<tr><th>No.</th><th>Name/Value</th><th>Description</th><th>Def/FbEq16</th></tr>
<tr><td></td><td>In1P Start; In2 Stop; In3 Dir</td><td>The sources of the start and stop commands are selected by parameters 20.03 Ext1 in1 source and 20.04 Ext1 in2 source. The source selected by 20.05 Ext1 in3 source determines the direction. The state transitions of the source bits are interpreted as follows:
<table>
<tr><th>State of source 1 (20.03)</th><th>State of source 2 (20.04)</th><th>State of source 3 (20.05)</th><th>Command</th></tr>
<tr><td>0 -> 1</td><td>1</td><td>0</td><td>Start forward</td></tr>
<tr><td>0 -> 1</td><td>1</td><td>1</td><td>Start reverse</td></tr>
<tr><td>Any</td><td>0</td><td>Any</td><td>Stop</td></tr>
</table>
Notes:

Run permissive and Start interlock signals can be put ON before or after the start pulse has been given.
Parameter 20.02 Ext1 start trigger type has an effect only at startup of the drive with this setting. If the start input is ON and 20.02 = Level (1) when the drive is powered up, the motor will start.
</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 stop. 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>
Notes:

Run permissive and Start interlock signals can be put ON before or after the start pulse has been given.
Parameter 20.02 Ext1 start trigger type has no effect with this setting.
</td><td>6</td></tr>
<tr><td></td><td>Reserved</td><td></td><td>7…10</td></tr>
<tr><td></td><td>Control panel</td><td>The start and stop commands are taken from the control panel (or PC connected to the control panel connector).</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: Set also 20.02 Ext1 start trigger type to Level.</td><td>12</td></tr>
<tr><td></td><td>Reserved</td><td></td><td>13</td></tr>
<tr><td></td><td>Embedded fieldbus</td><td>The start and stop commands are taken from the embedded fieldbus interface.
Note: Set also 20.02 Ext1 start trigger type to Level.</td><td>14</td></tr>
<tr><td>20.02</td><td>Ext1 start trigger type</td><td>Defines whether the start signal for external control location EXT1 is edge-triggered or level-triggered.
Note: If a pulse type start signal is selected, this parameter is only effective at drive startup. See the descriptions of the selections of parameter 20.01 Ext1 commands.</td><td>Level</td></tr>
<tr><td></td><td>Edge</td><td>The start signal is edge-triggered.</td><td>0</td></tr>
</table>

<table>
<tr><th>No.</th><th>Name/Value</th><th>Description</th><th>Def/FbEq16</th></tr>
<tr><td></td><td>Level</td><td>The start signal is level-triggered.</td><td>1</td></tr>
<tr><td>20.03</td><td>Ext1 in1 source</td><td>Selects source 1 for parameter 20.01 Ext1 commands.</td><td>DI1</td></tr>
<tr><td></td><td>Always off</td><td>0.</td><td>0</td></tr>
<tr><td></td><td>Always on</td><td>1.</td><td>1</td></tr>
<tr><td></td><td>DI1</td><td>Digital input DI1 (10.02 DI delayed status, bit 0).</td><td>2</td></tr>
<tr><td></td><td>DI2</td><td>Digital input DI2 (10.02 DI delayed status, bit 1).</td><td>3</td></tr>
<tr><td></td><td>DI3</td><td>Digital input DI3 (10.02 DI delayed status, bit 2).</td><td>4</td></tr>
<tr><td></td><td>DI4</td><td>Digital input DI4 (10.02 DI delayed status, bit 3).</td><td>5</td></tr>
<tr><td></td><td>DI5</td><td>Digital input DI5 (10.02 DI delayed status, bit 4).</td><td>6</td></tr>
<tr><td></td><td>DI6</td><td>Digital input DI6 (10.02 DI delayed status, bit 5).</td><td>7</td></tr>
<tr><td></td><td>Reserved</td><td></td><td>8…17</td></tr>
<tr><td></td><td>Timed function 1</td><td>Bit 0 of 34.01 Timed functions status (see page 267).</td><td>18</td></tr>
<tr><td></td><td>Timed function 2</td><td>Bit 1 of 34.01 Timed functions status (see page 267).</td><td>19</td></tr>
<tr><td></td><td>Timed function 3</td><td>Bit 2 of 34.01 Timed functions status (see page 267).</td><td>20</td></tr>
<tr><td></td><td>Reserved</td><td></td><td>21…23</td></tr>
<tr><td></td><td>Supervision 1</td><td>Bit 0 of 32.01 Supervision status (see page 259).</td><td>24</td></tr>
<tr><td></td><td>Supervision 2</td><td>Bit 1 of 32.01 Supervision status (see page 259).</td><td>25</td></tr>
<tr><td></td><td>Supervision 3</td><td>Bit 2 of 32.01 Supervision status (see page 259).</td><td>26</td></tr>
<tr><td></td><td>Reserved</td><td></td><td>27…39</td></tr>
<tr><td></td><td>Constant speed</td><td>Bit 7 of 06.19 Speed control status word (see page 140).</td><td>40</td></tr>
<tr><td></td><td>Other [bit]</td><td>Source selection (see Terms and abbreviations on page 124).</td><td>-</td></tr>
<tr><td>20.04</td><td>Ext1 in2 source</td><td>Selects source 2 for parameter 20.01 Ext1 commands.
For the available selections, see parameter 20.03 Ext1 in1 source.</td><td>Always off</td></tr>
<tr><td>20.05</td><td>Ext1 in3 source</td><td>Selects source 3 for parameter 20.01 Ext1 commands.
For the available selections, see parameter 20.03 Ext1 in1 source.</td><td>Always off</td></tr>
<tr><td>20.06</td><td>Ext2 commands</td><td>Selects the source of start, stop and direction commands for external control location 2 (EXT2).
See parameter 20.21 for the determination of the actual direction. See also parameters 20.07…20.10.</td><td>In1 Start</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>
</table>

<table>
<tr><th>No.</th><th>Name/Value</th><th>Description</th><th>Def/FbEq16</th></tr>
<tr><td></td><td>In1 Start; In2 Dir</td><td>The source selected by 20.08 Ext2 in1 source is the start signal; the source selected by 20.09 Ext2 in2 source determines the direction. The state transitions of the source bits are interpreted as follows:
<table>
<tr><th>State of source 1 (20.08)</th><th>State of source 2 (20.09)</th><th>Command</th></tr>
<tr><td>0</td><td>Any</td><td>Stop</td></tr>
<tr><td rowspan="2">0 -> 1 (20.07 = Edge)
1 (20.07 = Level)</td><td>0</td><td>Start forward</td></tr>
<tr><td>1</td><td>Start reverse</td></tr>
</table></td><td>2</td></tr>
<tr><td></td><td>In1 Start fwd; In2 Start rev</td><td>The source selected by 20.08 Ext2 in1 source is the forward start signal; the source selected by 20.09 Ext2 in2 source is the reverse start signal. The state transitions of the source bits are interpreted as follows:
<table>
<tr><th>State of source 1 (20.08)</th><th>State of source 2 (20.09)</th><th>Command</th></tr>
<tr><td>0</td><td>0</td><td>Stop</td></tr>
<tr><td>0 -> 1 (20.07 = Edge)
1 (20.07 = Level)</td><td>0</td><td>Start forward</td></tr>
<tr><td>0</td><td>0 -> 1 (20.07 = Edge)
1 (20.07 = Level)</td><td>Start reverse</td></tr>
<tr><td>1</td><td>1</td><td>Stop</td></tr>
</table></td><td>3</td></tr>
<tr><td></td><td>In1P Start; In2 Stop</td><td>The sources of the start and stop commands are selected by parameters 20.08 Ext2 in1 source and 20.09 Ext2 in2 source. The state transitions of the source bits are interpreted as follows:
<table>
<tr><th>State of source 1 (20.08)</th><th>State of source 2 (20.09)</th><th>Command</th></tr>
<tr><td>0 -> 1</td><td>1</td><td>Start</td></tr>
<tr><td>Any</td><td>0</td><td>Stop</td></tr>
</table>
Notes:

Run permissive and Start interlock signals can be put ON before or after the start pulse has been given.
Parameter 20.07 Ext2 start trigger type has an effect only at startup of the drive with this setting. If the start input is ON and 20.07 = Level (1) when the drive is powered up, the motor will start.
</td><td>4</td></tr>
</table>

<table>
<tr><th>No.</th><th>Name/Value</th><th>Description</th><th>Def/FbEq16</th></tr>
<tr><td></td><td>In1P Start; In2 Stop; In3 Dir</td><td>The sources of the start and stop commands are selected by parameters 20.08 Ext2 in1 source and 20.09 Ext2 in2 source. The source selected by 20.10 Ext2 in3 source determines the direction. The state transitions of the source bits are interpreted as follows:
<table>
<tr><th>State of source 1 (20.08)</th><th>State of source 2 (20.09)</th><th>State of source 3 (20.10)</th><th>Command</th></tr>
<tr><td>0 -> 1</td><td>1</td><td>0</td><td>Start forward</td></tr>
<tr><td>0 -> 1</td><td>1</td><td>1</td><td>Start reverse</td></tr>
<tr><td>Any</td><td>0</td><td>Any</td><td>Stop</td></tr>
</table>
Notes:
• Run permissive and Start interlock signals can be put ON before or after the start pulse has been given.
• Parameter 20.07 Ext2 start trigger type has an effect only at startup of the drive with this setting. If the start input is ON and 20.07 = Level (1) when the drive is powered up, the motor will start.</td><td>5</td></tr>
<tr><td></td><td>In1P Start fwd; In2P Start rev; In3 Stop</td><td>The sources of the start and stop commands are selected by parameters 20.08 Ext2 in1 source, 20.09 Ext2 in2 source and 20.10 Ext2 in3 source. The 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>
Notes:
• Run permissive and Start interlock signals can be put ON before or after the start pulse has been given.
• Parameter 20.07 Ext2 start trigger type has no effect with this setting.</td><td>6</td></tr>
<tr><td></td><td>Reserved</td><td></td><td>7…10</td></tr>
<tr><td></td><td>Control panel</td><td>The start and stop commands are taken from the control panel (or PC connected to the control panel connector).</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: Set also 20.07 Ext2 start trigger type to Level.</td><td>12</td></tr>
<tr><td></td><td>Reserved</td><td></td><td>13</td></tr>
<tr><td></td><td>Embedded fieldbus</td><td>The start and stop commands are taken from the embedded fieldbus interface.
Note: Set also 20.07 Ext2 start trigger type to Level.</td><td>14</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: If a pulse type start signal is selected, this parameter is only effective at drive startup. 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>
</table>

No.	Name/Value	Description	Def/FbEq16
	Level	The start signal is level-triggered.	1
20.08	*Ext2 in1 source*	Selects source 1 for parameter *20.06 Ext2 commands*. For the available selections, see parameter *20.03 Ext1 in1 source*.	*DI6*
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*
20.21	*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 Ext1 commands* or *20.06 Ext2 commands*). See control chain diagram *Direction lock* (page *532*)	*Forward*

	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, Floating point control (Motor potentiometer), PID, Safe speed, Last or Panel reference, reference used as is. • If reference from the network, reference used as is.	Reverse, but • If reference from Constant or PID, reference used as is. • If reference from the network, Panel, Analog input, Floating point control (Motor potentiometer), Safe speed or Last reference, reference multiplied by -1.	Forward

No.	Name/Value	Description	Def/FbEq16
	Request	In external control the direction is selected by a direction command (parameter *20.01 Ext1 commands* or *20.06 Ext2 commands*). If the reference comes from Constant (constant speeds/frequencies), Floating point control (Motor potentiometer), PID, Speed ref safe, Last speed reference 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
	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

No.	Name/Value	Description	Def/FbEq16
	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
20.30	*Enable signal warning function*	Selects enable signal warnings to be suppressed. This parameter can be used to prevent these warnings from flooding the event log. Whenever a bit of this parameter is set to 1, the corresponding warning is suppressed.	0000h

Bit	Name	Description
0	Run permissive	1 = Warning *AFED Run permissive* is suppressed.
1	Start interlocks	1 = Following warnings are suppressed: • *AFEE Start interlock 1* • *AFEF Start interlock 2* • *AFF0 Start interlock 3* • *AFF1 Start interlock 4*
3…15	Reserved	

No.	Name/Value	Description	Def/FbEq16
	0000h…FFFFh	Word for disabling enable signal warnings.	1 = 1
20.40	*Run permissive*	Selects the source of the Run permissive signal. Value 0 of the source deactivates the Run permissive and prevents running. Value 1 of the source activates the Run permissive and permits running.	*Not used*
	Not used	0.	0
	Not used	1.	1
	DI1	Digital input DI1 (*10.02 DI delayed status*, bit 0).	2
	DI2	Digital input DI2 (*10.02 DI delayed status*, bit 1).	3
	DI3	Digital input DI3 (*10.02 DI delayed status*, bit 2).	4
	DI4	Digital input DI4 (*10.02 DI delayed status*, bit 3).	5
	DI5	Digital input DI5 (*10.02 DI delayed status*, bit 4).	6
	DI6	Digital input DI6 (*10.02 DI delayed status*, bit 5).	7
	-DI1	Digital input DI1 (*10.02 DI delayed status*, bit 0).	8
	-DI2	Digital input DI2 (*10.02 DI delayed status*, bit 1).	9
	-DI3	Digital input DI3 (*10.02 DI delayed status*, bit 2).	10
	-DI4	Digital input DI4 (*10.02 DI delayed status*, bit 3).	11
	-DI5	Digital input DI5 (*10.02 DI delayed status*, bit 4).	12
	-DI6	Digital input DI6 (*10.02 DI delayed status*, bit 5).	13
	Fieldbus adapter	Control word bit 3 received through the fieldbus interface.	14
	Embedded fieldbus	ABB Drives profile: Control word bit 3 received through the embedded fieldbus interface DCU profile: Inverse of control word bit 6 received through the embedded fieldbus interface.	15
	Other [bit]	Source selection (see *Terms and abbreviations* on page *124*).	-

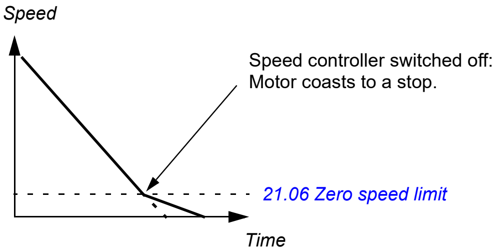
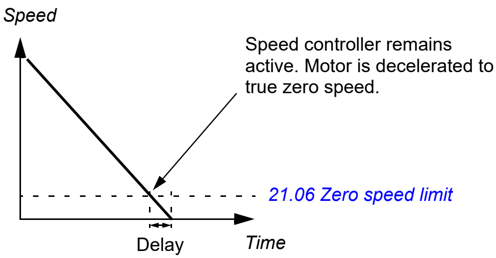
No.	Name/Value	Description	Def/FbEq16
20.41	*Start interlock 1*	Selects the source of the Start interlock 1 signal. Value 0 of the source deactivates the Start interlock 1 signal and inhibits starting. Value 1 of the source activates the Start interlock 1 signal and allows starting.	*Not used*
	Not used	0.	0
	Not used	1.	1
	DI1	Digital input DI1 (*10.02 DI delayed status*, bit 0).	2
	DI2	Digital input DI2 (*10.02 DI delayed status*, bit 1).	3
	DI3	Digital input DI3 (*10.02 DI delayed status*, bit 2).	4
	DI4	Digital input DI4 (*10.02 DI delayed status*, bit 3).	5
	DI5	Digital input DI5 (*10.02 DI delayed status*, bit 4).	6
	DI6	Digital input DI6 (*10.02 DI delayed status*, bit 5).	7
	-DI1	Digital input DI1 (*10.02 DI delayed status*, bit 0).	8
	-DI2	Digital input DI2 (*10.02 DI delayed status*, bit 1).	9
	-DI3	Digital input DI3 (*10.02 DI delayed status*, bit 2).	10
	-DI4	Digital input DI4 (*10.02 DI delayed status*, bit 3).	11
	-DI5	Digital input DI5 (*10.02 DI delayed status*, bit 4).	12
	-DI6	Digital input DI6 (*10.02 DI delayed status*, bit 5).	13
	Fieldbus adapter	This selection cannot be used to control Start interlock with ABB drives profile from the fieldbus adapter. Use *Other [bit]* and map to control word user bits. This selection is only available for *20.41 Start interlock 1* and *20.42 Start interlock 2*.	14
	Embedded fieldbus	Start interlock 1: DCU profile: Inverse of control word bit 18 received through the embedded fieldbus interface. Start interlock 2: Inverse of bit 19. This selection is only available for *20.41 Start interlock 1* and *20.42 Start interlock 2*.	15
	Other [bit]	Source selection (see *Terms and abbreviations* on page *124*).	-
20.42	*Start interlock 2*	Selects the source of the Start interlock 2 signal. For the selections, see parameter *20.41 Start interlock 1*.	*Not used*
20.43	*Start interlock 3*	Selects the source of the Start interlock 3 signal. Start interlock 3 is not supported over the Fieldbus adapter or Embedded fieldbus. For the other selections than 14 and 15, see parameter *20.41 Start interlock 1*.	*Not used*
20.44	*Start interlock 4*	Selects the source of the Start interlock 4 signal. Start interlock 4 is not supported over the Fieldbus adapter or Embedded fieldbus. For the other selections than 14 and 15, see parameter *20.41 Start interlock 1*.	*Not used*
20.45	*Start interlock stop mode*	Follows motor stop mode selection, see parameter *21.03 Stop mode*.	*Not used*
	Not used	Not in use.	0
	Coast	The motor coasts to a stop.	1
	Ramp	Stop along the active deceleration ramp.	2

No.	Name/Value	Description	Def/FbEq16
20.46	*Run permissive text*	Alternative alarm texts for the run permissive. There is also label text (free text) for the run permissive. The control panel display will display the text when the run permissive becomes unsatisfied. You edit the label text in **Menu > Primary settings > Start, stop, reference > Interlocks/Permissives > Label text**.	*Run permissive*
	Run permissive		0
	Damper end switch		1
	Valve opening		2
	Pre-lube cycle		3
	Interlock open		5
20.47	*Start interlock 1 text*	Alternative alarm texts for the start interlock 1. There is also label text (free text) for each start interlock. The control panel display will display that specific text when the interlock becomes unsatisfied. You edit the label text in **Menu > Primary settings > Start, stop, reference > Interlocks/Permissives > Label text**.	*Start interlock 1*
	Start interlock 1		0
	Vibration switch		1
	Firestat		2
	Freezestat		3
	Overpressure		4
	Vibration trip		5
	Smoke alarm		6
	Auxiliary open		7
	Low suction		8
	Low pressure		9
	Access door		10
	Pressure relief		11
	Motor disconnect open		12
	High static		13
	Safety option		14
	Interlock open		15
20.48	*Start interlock 2 text*	Alternative alarm texts for the start interlock 2. See parameter *20.47 Start interlock 1 text*.	*Start interlock 2*
	Start interlock 2	For other selections, see parameter *20.47 Start interlock 1 text*.	0
20.49	*Start interlock 3 text*	Alternative alarm texts for the start interlock 3. See parameter *20.47 Start interlock 1 text*.	*Start interlock 3*
	Start interlock 3	For other selections, see parameter *20.47 Start interlock 1 text*.	0
20.50	*Start interlock 4 text*	Alternative alarm texts for the start interlock 4. See parameter *20.47 Start interlock 1 text*.	*Start interlock 4*
	Start interlock 4	For other selections, see parameter *20.47 Start interlock 1 text*.	0

No.	Name/Value	Description	Def/FbEq16
20.51	*Start interlock condition*	Selects the condition for start interlock function. This parameter determines if the start command is needed before start interlock warnings are displayed.	*Start command ignored*
	Start command ignored	Start interlock warnings are displayed if the interlocks are missing.	0
	Start command required	Start command must be present before the start interlock warnings are displayed if the interlocks are missing.	1
21 Start/stop mode		Start and stop modes; emergency stop mode and signal source selection; DC magnetization settings.	
21.01	*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 *Start methods – DC magnetization* (page *92*).	*Automatic*
	Fast	The drive pre-magnetizes the motor before start. The pre-magnetizing time is determined automatically, being typically 200 ms to 2 s depending on motor size. This mode should be selected if a high break-away torque is required.	0
	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 (for example, if the motor start must be synchronized with the release of a mechanical brake). This setting also guarantees the highest possible break-away torque when the pre-magnetizing time is set long enough. **WARNING!** The drive will start after the set magnetizing time has passed even if motor magnetization is not completed. In applications where a full break-away torque is essential, ensure that the constant magnetizing time is long enough to allow generation of full magnetization and torque.	1
	Automatic	Automatic start guarantees optimal motor start in most cases. It includes the flying start function (starting into a rotating motor) and the automatic restart function. The drive motor control program identifies the flux as well as the mechanical state of the motor and starts the motor instantly under all conditions.	2

<table>
<tr><th>No.</th><th>Name/Value</th><th>Description</th><th>Def/FbEq16</th></tr>
<tr><td>21.02</td><td>Magnetization time</td><td>Defines the pre-magnetization time when
• parameter 21.01 Start mode is set to 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>Coast</td></tr>
<tr><td></td><td>Coast</td><td>Stop by switching off the output semiconductors of the drive. The motor coasts to a stop.
WARNING! If a mechanical brake is used, ensure it is safe to stop the drive by coasting.</td><td>0</td></tr>
<tr><td></td><td>Ramp</td><td>Stop along the active deceleration ramp. See parameter group 23 Speed reference ramp on page 219 or 28 Frequency reference chain on page 229.</td><td>1</td></tr>
<tr><td></td><td>Torque limit</td><td>Stop according to torque limits (parameters 30.19 and 30.20). This mode is only possible in vector motor control mode.</td><td>2</td></tr>
<tr><td>21.04</td><td>Emergency stop mode</td><td>Selects the way the motor is stopped when an emergency stop command is received.
The source of the emergency stop signal is selected by parameter 21.05 Emergency stop source.</td><td>Ramp stop (Off1)</td></tr>
<tr><td></td><td>Ramp stop (Off1)</td><td>With the drive running:
• 1 = Normal operation.
• 0 = Normal stop along the standard deceleration ramp defined for the particular reference type. 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.</td><td>0</td></tr>
</table>

No.	Name/Value	Description	Def/FbEq16
	Coast stop (Off2)	With the drive running: • 1 = Normal operation. • 0 = Stop by coasting. The drive can be restarted by restoring the start interlock signal and switching the start signal from 0 to 1. With the drive stopped: • 1 = Starting allowed. • 0 = Starting not allowed.	1
	Eme ramp stop (Off3)	With the drive running: • 1 = Normal operation • 0 = Stop by ramping along emergency stop ramp defined by parameter *23.23 Emergency stop time*. After the drive has stopped, it can be restarted by removing the emergency stop signal and switching the start signal from 0 to 1. With the drive stopped: • 1 = Starting allowed • 0 = Starting not allowed	2
21.05	*Emergency stop source*	Selects the source of the emergency stop signal. The stop mode is selected by parameter *21.04 Emergency stop mode*. 0 = Emergency stop active 1 = Normal operation **Note:** This parameter cannot be changed while the drive is running.	*Inactive (true)*
	Active (false)	0.	0
	Inactive (true)	1.	1
	Reserved		2
	DI1	Digital input DI1 (*10.02 DI delayed status*, bit 0).	3
	DI2	Digital input DI2 (*10.02 DI delayed status*, bit 1).	4
	DI3	Digital input DI3 (*10.02 DI delayed status*, bit 2).	5
	DI4	Digital input DI4 (*10.02 DI delayed status*, bit 3).	6
	DI5	Digital input DI5 (*10.02 DI delayed status*, bit 4).	7
	DI6	Digital input DI6 (*10.02 DI delayed status*, bit 5).	8
	Other [bit]	Source selection (see *Terms and abbreviations* on page *124*).	-
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	Def/FbEq16
21.07	*Zero speed delay*	Defines the delay for the zero speed delay function. The function is useful in applications where a smooth and quick restarting is essential. During the delay, the drive knows the rotor position accurately. <u>Without zero speed delay</u>: The drive receives a stop command and decelerates along a ramp. When actual motor speed falls below the value of parameter *21.06 Zero speed limit*, inverter modulation is stopped and the motor coasts to a standstill.  <u>With zero speed delay</u>: The drive receives a stop command and decelerates along a ramp. When actual motor speed falls below the value of parameter *21.06 Zero speed limit*, the zero speed delay function activates. During the delay the function keeps the speed controller live: the inverter modulates, motor is magnetized and the drive is ready for a quick restart.  	0 ms
	0…30000 ms	Zero speed delay.	1 = 1 ms

No.	Name/Value	Description	Def/FbEq16
21.08	*DC current control*	Activates/deactivates the DC hold and post-magnetization functions. See section *Start methods – DC magnetization* (page *92*). **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.	0000b

Bit	Name	Value
0	DC hold	1 = Enable DC hold. See section *DC hold* (page *93*) **Note:** The DC hold function has no effect if the start signal is switched off.
1	Post magnetization	1 = Enable post-magnetization. See section *Settings* (page *93*). **Note:** Post-magnetization is only available when ramping is the selected stop mode (see parameter *21.03 Stop mode*).
2	DC brake	1 = Enables DC injection braking after modulation has stopped. **Notes:** • To enable DC brake, parameter *21.03 Stop mode* has to be set to *Coast*. • DC braking current can be set with parameter *21.10 DC current reference*. • DC braking time can be set with parameter *21.11 Post magnetization time*.
3…15	Reserved	

No.	Name/Value	Description	Def/FbEq16
	0000h…0011h	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* (page *93*).	5.00 rpm
	0.00…1000.00 rpm	DC hold speed.	See par. *46.01*
21.10	*DC current reference*	Defines the DC hold current in percent of the motor nominal current. See parameter *21.08 DC current control*, and section *Start methods – DC magnetization* (page *92*). 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
21.14	*Pre-heating input source*	Selects the source for controlling 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.	*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

No.	Name/Value	Description	Def/FbEq16
	DI2	Digital input DI2 (*10.02 DI delayed status*, bit 1).	3
	DI3	Digital input DI3 (*10.02 DI delayed status*, bit 2).	4
	DI4	Digital input DI4 (*10.02 DI delayed status*, bit 3).	5
	DI5	Digital input DI5 (*10.02 DI delayed status*, bit 4).	6
	DI6	Digital input DI6 (*10.02 DI delayed status*, bit 5).	7
	Supervision 1	Bit 0 of *32.01 Supervision status* (see page *259*).	8
	Supervision 2	Bit 1 of *32.01 Supervision status* (see page *259*).	9
	Supervision 3	Bit 2 of *32.01 Supervision status* (see page *259*).	10
	Timed function 1	Bit 0 of *34.01 Timed functions status* (see page *267*).	11
	Timed function 2	Bit 1 of *34.01 Timed functions status* (see page *267*).	12
	Timed function 3	Bit 2 of *34.01 Timed functions status* (see page *267*).	13
	MCW user bit 0	Bit 12 of *06.01 Main control word* (see page *136*).	16
	MCW user bit 1	Bit 13 of *06.01 Main control word* (see page *136*).	17
	MCW user bit 2	Bit 14 of *06.01 Main control word* (see page *136*).	18
	MCW user bit 3	Bit 15 of *06.01 Main control word* (see page *136*).	19
	Other [bit]	Source selection (see *Terms and abbreviations* on page *124*).	-
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%
21.18	*Auto restart time*	The motor can be automatically started after a short supply power failure using the automatic restart function. See section *Automatic restart* (page *107*) When this parameter is set to 0.0 seconds, automatic restarting is disabled. Otherwise, the parameter defines the maximum duration of the power failure after which restarting is attempted. Note that this time also includes the DC precharging delay. See also parameter *21.34 Force auto restart*. This parameter has effect only if parameter *95.04 Control board supply* is set to *External 24V*. ⚠ **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 restarting disabled.	0
	0.1…10.0 s	Maximum power failure duration.	10 = 1 s

No.	Name/Value	Description	Def/FbEq16
21.19	*Scalar start mode*	Selects the motor start function for the scalar motor control mode, ie, when *99.04 Motor control mode* is set to *Scalar*. **Notes**: • The start function for the vector motor control mode is selected by parameter *21.01 Start mode*. • With permanent magnet motors, *Automatic* start mode must be used. • This parameter cannot be changed while the drive is running. See also section *Start methods – DC magnetization* (page *92*).	*Automatic*
	Normal	Immediate start from zero speed.	0
	Const time	The drive pre-magnetizes the motor before start. The pre-magnetizing time is defined by parameter *21.02 Magnetization time*. This mode should be selected if constant pre-magnetizing time is required (for example, 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 pre-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	The drive pre-magnetizes the motor before the start. The pre-magnetizing time is defined by parameter *21.02 Magnetization time*. Torque boost is applied at start. Torque boost is stopped when output frequency exceeds 40% of nominal frequency or when it is equal to the reference value. See parameter *21.26 Torque boost current*. This mode should selected if a high break-away torque is required. **Note:** This mode cannot be used to start into a rotating motor. **WARNING!** The drive will start after the set pre-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.	3
	Automatic+boost	Automatic start with torque boost. Automatic start is performed first and the motor is magnetized. If the speed is found to be zero, torque boost is applied.	4

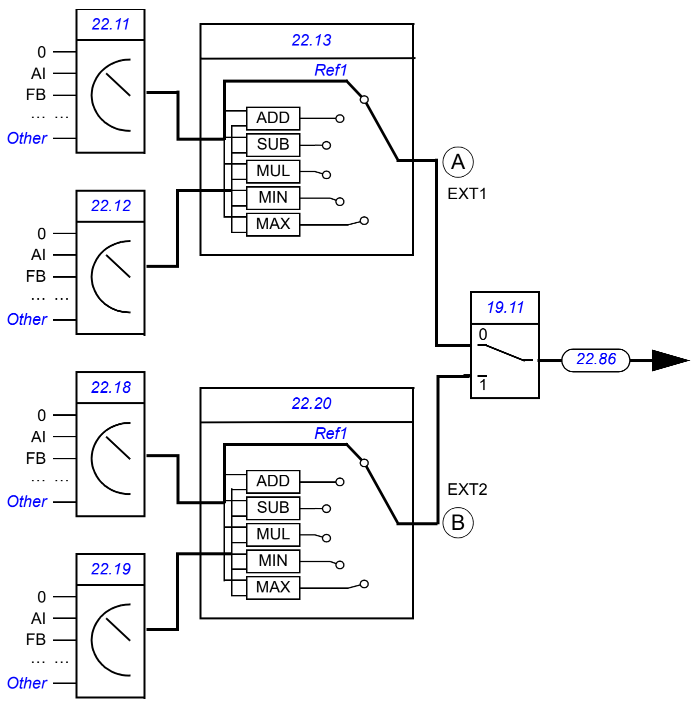
No.	Name/Value	Description	Def/FbEq16
	Flying start	The drive automatically selects the correct output frequency to start a rotating motor. If the motor is already rotating, drive will start smoothly at the current frequency. – The mode will start the motor with vector control and switch to scalar control 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	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 motor is in scalar frequency mode. See parameter *21.08 DC current control*, and section *DC hold* (page *93*).	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
21.23	*Smooth start*	Selects the forced current vector rotation mode at low speeds. When the smooth start mode is selected, the rate of acceleration is limited by the acceleration and deceleration ramp times. If the process driven by the permanent magnet synchronous motor has high inertia, slow ramp times are recommended. Can be used for permanent magnet synchronous motors only.	*Disabled*
	Disabled	Disabled.	0
	Enabled always	Enabled always.	1
	Start only	Enabled when starting the motor.	2
21.24	*Smooth start current*	Current used in the current vector rotation at low speeds. Increase the smooth start current if the application requires motor shaft swinging needs to be minimized. Note that accurate torque control is not possible in the current vector rotation mode. Can be used for permanent magnet synchronous motors only.	50.0%
	10.0…200.0%	Value in percent of the nominal motor current.	1 = 1%
21.25	*Smooth start speed*	Output frequency up to which the current vector rotation is used. See parameter *21.19 Scalar start mode*. Can be used for permanent magnet synchronous motors only.	10.0%
	2.0…100.0%	Value as a percentage of the nominal motor frequency.	1 = 1%

No.	Name/Value	Description	Def/FbEq16
21.26	*Torque boost current*	Defines the maximum supplied current to motor when (*21.19 Scalar start mode* is set to *Torque boost* (see page *206*). Parameter value is in percent of the motor nominal current. Nominal value of the parameter is 100.0%. Torque boost is only applied at start, ending when output frequency exceeds 40% of nominal frequency or when output frequency is equal to reference. Can be used in scalar mode only.	100.0%
	15.0…300.0%	Value in percent of the nominal motor current.	1 = 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*), then torque boost time is set at 40% of frequency acceleration time.	20 s
	0.0...60.0 s	Nominal motor time.	1 = 1 s
21.30	*Speed compensated stop mode*	Selects the method used to stop the drive. Speed compensated stop is active only if • the operation mode is not torque, and • parameter *21.03 Stop mode* is *Ramp*.	*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 comp 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%

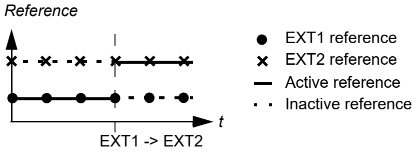
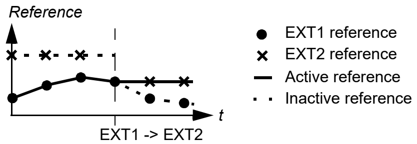
No.	Name/Value	Description	Def/FbEq16
21.34	*Force auto restart*	Forces automatic restart. The parameter is applicable only if parameter *95.04 Control board supply* is set to *External 24V*.	*Enable*
	Disable	Force auto restart disabled. Parameter *21.18 Auto restart time* is in effect if its value 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
21.35	*Preheating power*	Defines the power used to heat the motor.	0.00 kW
	0.00 … 10.00 kW	Preheating power.	100 = 1 kW
21.36	*Preheating unit*	Defines if preheating is specified as current or power.	*Current*
	Current	Preheating specified as current.	0
	Power	Preheating specified as power.	1

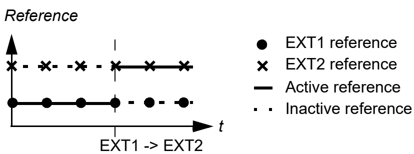
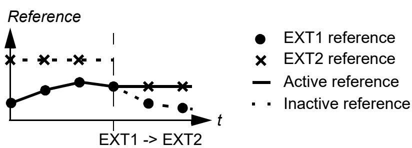
22 Speed reference selection		Speed reference selection; Floating point control (Motor potentiometer) settings. See control chain diagrams *Speed reference source selection I* (page *520*)…*Speed controller* (page *525*).	
22.01	*Speed ref unlimited*	Displays the output of the speed reference selection block. See control chain diagram *Speed reference source selection II* on page *521*. This parameter is read-only.	-
	-30000.00… 30000.00 rpm	Value of the selected speed reference.	See par. *46.01*

No.	Name/Value	Description	Def/FbEq16
22.11	*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).	*AI1 scaled*



	Zero	None.	0
	AI1 scaled	*12.12 AI1 scaled value* (see page *156*).	1
	AI2 scaled	*12.22 AI2 scaled value* (see page *158*).	2
	Reserved		3
	FB A ref1	*03.05 FB A reference 1* (see page *130*).	4
	FB A ref2	*03.06 FB A reference 2* (see page *131*).	5
	Reserved		6…7
	EFB ref1	*03.09 EFB reference 1* (see page *131*).	8
	EFB ref2	*03.10 EFB reference 2* (see page *131*).	9
	Reserved		10…14

No.	Name/Value	Description	Def/FbEq16
	Motor potentiometer	*22.80 Motor potentiometer ref act* (output of the Floating point control (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 DI5 is used as a frequency input).	17
	Control panel (ref saved)	Control panel reference (*03.01 Panel reference*, see page *130*) saved by the control system for the location where the control returns is used as the reference. 	18
	Control panel (ref copied)	Control panel reference (*03.01 Panel reference*, see page *130*) 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
	Other	Source selection (see *Terms and abbreviations* on page *124*).	-
22.12	*Ext1 speed ref2*	Selects EXT1 speed reference source 2. For the selections, and a diagram of reference source selection, see parameter *22.11 Ext1 speed ref1*.	*Zero*
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

No.	Name/Value	Description	Def/FbEq16
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* (see page *156*).	1
	AI2 scaled	*12.22 AI2 scaled value* (see page *158*).	2
	Reserved		3
	FB A ref1	*03.05 FB A reference 1* (see page *130*).	4
	FB A ref2	*03.06 FB A reference 2* (see page *131*).	5
	Reserved		6…7
	EFB ref1	*03.09 EFB reference 1* (see page *131*).	8
	EFB ref2	*03.10 EFB reference 2* (see page *131*).	9
	Reserved		10…14
	Motor potentiometer	*22.80 Motor potentiometer ref act* (output of the Floating point control (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 DI5 is used as a frequency input).	17
	Control panel (ref saved)	Control panel reference (*03.01 Panel reference*, see page *130*) saved by the control system for the location where the control returns is used as the reference. 	18
	Control panel (ref copied)	Control panel reference (*03.01 Panel reference*, see page *130*) 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
	Other	Source selection (see *Terms and abbreviations* on page *124*).	-
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*

No.	Name/Value	Description	Def/FbEq16
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
	Min (ref1, ref2)	The smaller of the reference sources is used as speed reference 1.	4
	Max (ref1, ref2)	The greater of the reference sources is used as speed reference 1.	5
22.21	*Constant speed function*	Determines how constant speeds are selected, and whether the rotation direction signal is considered or not when applying a constant speed.	000b

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 speed is determined by the sign of the constant speed setting (parameters *22.26*…*22.32*).
2…15	Reserved	

	0000h…FFFFh	Constant speed configuration word.	1 = 1

No.	Name/Value	Description	Def/FbEq16
22.22	*Constant speed sel1*	When bit 0 of parameter *22.21 Constant speed function* is 0 (Separate), selects a source that activates constant speed 1. When bit 0 of parameter *22.21 Constant speed function* is 1 (Packed), this parameter and parameters *22.23 Constant speed sel2* and *22.24 Constant speed sel3* select three sources whose states activate constant speeds as follows:	*DI3*

Source defined by par. *22.22*	Source defined by par. *22.23*	Source defined by par. *22.24*	Constant speed active
0	0	0	None
1	0	0	Constant speed 1
0	1	0	Constant speed 2
1	1	0	Constant speed 3
0	0	1	Constant speed 4
1	0	1	Constant speed 5
0	1	1	Constant speed 6
1	1	1	Constant speed 7

No.	Name/Value	Description	Def/FbEq16
	Always off	0.	0
	Always 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
	DI5	Digital input DI5 (*10.02 DI delayed status*, bit 4).	6
	DI6	Digital input DI6 (*10.02 DI delayed status*, bit 5).	7
	Reserved		8…17
	Timed function 1	Bit 0 of *34.01 Timed functions status* (see page *267*).	18
	Timed function 2	Bit 1 of *34.01 Timed functions status* (see page *267*).	19
	Timed function 3	Bit 2 of *34.01 Timed functions status* (see page *267*).	20
	Reserved		21…23
	Supervision 1	Bit 0 of *32.01 Supervision status* (see page *259*).	24
	Supervision 2	Bit 1 of *32.01 Supervision status* (see page *259*).	25
	Supervision 3	Bit 2 of *32.01 Supervision status* (see page *259*).	26
	Other [bit]	Source selection (see *Terms and abbreviations* on page *124*).	-
22.23	*Constant speed sel2*	When bit 0 of parameter *22.21 Constant speed function* is 0 (Separate), selects a source that activates constant speed 2. When bit 0 of parameter *22.21 Constant speed function* is 1 (Packed), this parameter and parameters *22.22 Constant speed sel1* and *22.24 Constant speed sel3* select three sources that are used to activate constant speeds. See table at parameter *22.22 Constant speed sel1*. For the selections, see parameter *22.22 Constant speed sel1*.	*Always off*

No.	Name/Value	Description	Def/FbEq16
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*
22.25	*Constant speed sel4*	When bit 0 of parameter *22.21 Constant speed function* is 0 (Separate), selects a source that activates constant speed 4. 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; 360.00 rpm (*95.20* b0)
	-30000.00… 30000.00 rpm	Constant speed 1.	See par. *46.01*
22.27	*Constant speed 2*	Defines constant speed 2.	600.00 rpm; 720.00 rpm (*95.20* b0)
	-30000.00… 30000.00 rpm	Constant speed 2.	See par. *46.01*
22.28	*Constant speed 3*	Defines constant speed 3.	900.00 rpm; 1080.00 rpm (*95.20* b0)
	-30000.00… 30000.00 rpm	Constant speed 3.	See par. *46.01*
22.29	*Constant speed 4*	Defines constant speed 4.	1200.00 rpm; 1440.00 rpm (*95.20* b0)
	-30000.00… 30000.00 rpm	Constant speed 4.	See par. *46.01*
22.30	*Constant speed 5*	Defines constant speed 5.	1500.00 rpm; 1800.00 rpm (*95.20* b0)
	-30000.00… 30000.00 rpm	Constant speed 5.	See par. *46.01*
22.31	*Constant speed 6*	Defines constant speed 6.	2400.00 rpm; 2880.00 rpm (*95.20* b0)
	-30000.00… 30000.00 rpm	Constant speed 6.	See par. *46.01*
22.32	*Constant speed 7*	Defines constant speed 7.	3000.00 rpm; 3600.00 rpm (*95.20* b0)
	-30000.00… 30000.00 rpm	Constant speed 7.	See par. *46.01*

No.	Name/Value	Description	Def/FbEq16
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*
22.46	*Constant speed sel5*	When bit 0 of parameter *22.21 Constant speed function* is 0 (Separate), selects a source that activates constant speed 5. For the selections, see parameter *22.22 Constant speed sel1*.	*Always off*
22.47	*Constant speed sel6*	When bit 0 of parameter *22.21 Constant speed function* is 0 (Separate), selects a source that activates constant speed 6. For the selections, see parameter *22.22 Constant speed sel1*.	*Always off*
22.51	*Critical speed function*	Enables/disables the critical speeds function. Also determines whether the specified ranges are effective in both rotating directions or not. See also section *Critical speeds/frequencies* (page *69*).	0000b

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

No.	Name/Value	Description	Def/FbEq16
	0000h…FFFFh	Critical speeds configuration word.	1 = 1
22.52	*Critical speed 1 low*	Defines the low limit for critical speed range 1. **Note:** This value must be less than or equal to the value of *22.53 Critical speed 1 high*.	0.00 rpm
	-30000.00… 30000.00 rpm	Low limit for critical speed 1.	See par. *46.01*
22.53	*Critical speed 1 high*	Defines the high limit for critical speed range 1. **Note:** This value must be greater than or equal to the value of *22.52 Critical speed 1 low*.	0.00 rpm
	-30000.00… 30000.00 rpm	High limit for critical speed 1.	See par. *46.01*
22.54	*Critical speed 2 low*	Defines the low limit for critical speed range 2. **Note:** This value must be less than or equal to the value of *22.55 Critical speed 2 high*.	0.00 rpm
	-30000.00… 30000.00 rpm	Low limit for critical speed 2.	See par. *46.01*
22.55	*Critical speed 2 high*	Defines the high limit for critical speed range 2. **Note:** This value must be greater than or equal to the value of *22.54 Critical speed 2 low*.	0.00 rpm
	-30000.00… 30000.00 rpm	High limit for critical speed 2.	See par. *46.01*

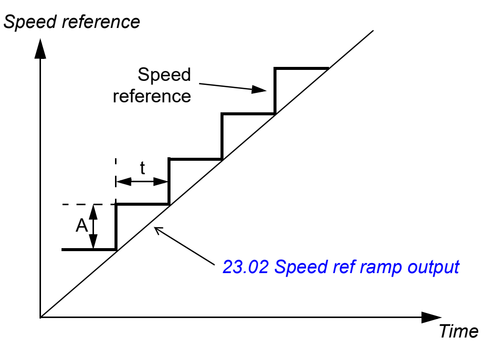
No.	Name/Value	Description	Def/FbEq16
22.56	*Critical speed 3 low*	Defines the low limit for critical speed range 3. **Note:** This value must be less than or equal to the value of *22.57 Critical speed 3 high*.	0.00 rpm
	-30000.00… 30000.00 rpm	Low limit for critical speed 3.	See par. *46.01*
22.57	*Critical speed 3 high*	Defines the high limit for critical speed range 3. **Note:** This value must be greater than or equal to the value of *22.56 Critical speed 3 low*.	0.00 rpm
	-30000.00… 30000.00 rpm	High limit for critical speed 3.	See par. *46.01*
22.70	*Motor potentiometer reference enable*	Activates and selects the mode of the Floating point control (Motor potentiometer).	*Selected*
	Not selected	Motor potentiometer Up/Down sources(*22.73* and *22.74*) are disabled.	0
	Selected	Motor potentiometer Up/Down sources(*22.73* and *22.74*) are enabled.	1
	While running	Motor potentiometer reference enable follows bit 4 'Following reference' of 06.16 Drive status word 1.	2
	Other		
22.71	*Motor potentiometer function*	Activates and selects the mode of the Floating point control (Motor potentiometer).	*Disabled*
	Disabled	Floating point control (Motor potentiometer) is disabled and the Floating point control (Motor potentiometer) counter value set to 0.	0
	Enabled (init at stop /power-up)	When enabled, the Floating point control (Motor potentiometer) counter first adopts the value defined by parameter *22.72 Motor potentiometer initial value*. The value can then be adjusted from the up and down sources defined by parameters *22.73 Motor potentiometer up source* and *22.74 Motor potentiometer down source*. A stop or a power cycle will reset the counter to the initial value (*22.72*).	1
	Enabled (resume always)	As *Enabled (init at stop /power-up)*, but the Floating point control (Motor potentiometer) counter is retained over a power cycle.	2
	Enabled (init to actual)	Whenever another reference source is selected, the value of the Floating point control (Motor potentiometer) counter follows that reference. After the source of reference returns to the Floating point control (Motor potentiometer) counter, 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 Floating point control (Motor potentiometer) counter. See the selections of parameter *22.71 Motor potentiometer function*.	0.00
	-32768.00… 32767.00	Initial value for the counter.	1 = 1

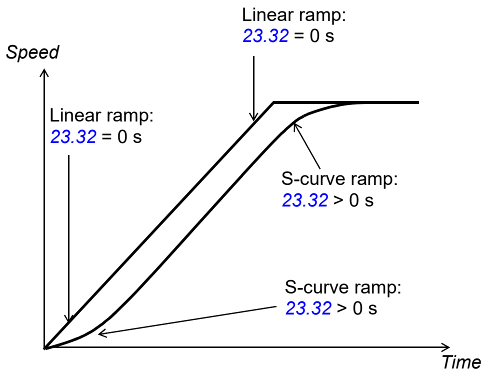
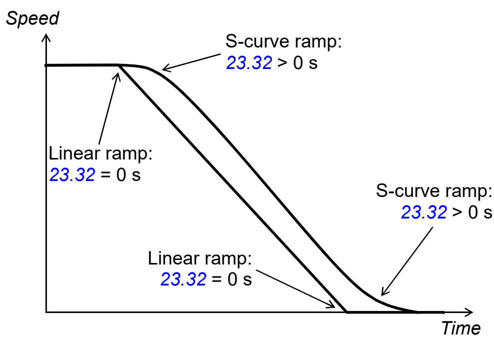
No.	Name/Value	Description	Def/FbEq16
22.73	*Motor potentiometer up source*	Selects the source of Floating point control (Motor potentiometer) counter up signal. 0 = No change 1 = Increase Floating point control (Motor potentiometer) counter value. (If both the up and down sources are on, the potentiometer value will not change.) **Note:** Floating point control (Motor potentiometer) function up/down source control speed or frequency from zero to maximum speed or frequency. The running direction can be changed with parameter *20.04 Ext1 in2 source*. See the figure in section *Floating point control (Motor potentiometer)* on page *101*.	*Not used*
	Not used	0.	0
	Not used	1.	1
	DI1	Digital input DI1 (*10.02 DI delayed status*, bit 0).	2
	DI2	Digital input DI2 (*10.02 DI delayed status*, bit 1).	3
	DI3	Digital input DI3 (*10.02 DI delayed status*, bit 2).	4
	DI4	Digital input DI4 (*10.02 DI delayed status*, bit 3).	5
	DI5	Digital input DI5 (*10.02 DI delayed status*, bit 4).	6
	DI6	Digital input DI6 (*10.02 DI delayed status*, bit 5).	7
	Reserved		8…17
	Timed function 1	Bit 0 of *34.01 Timed functions status* (see page *267*).	18
	Timed function 2	Bit 1 of *34.01 Timed functions status* (see page *267*).	19
	Timed function 3	Bit 2 of *34.01 Timed functions status* (see page *267*).	20
	Reserved		21…23
	Supervision 1	Bit 0 of *32.01 Supervision status* (see page *259*).	24
	Supervision 2	Bit 1 of *32.01 Supervision status* (see page *259*).	25
	Supervision 3	Bit 2 of *32.01 Supervision status* (see page *259*).	26
	Other [bit]	Source selection (see *Terms and abbreviations* on page *124*).	-
22.74	*Motor potentiometer down source*	Selects the source of Floating point control (Motor potentiometer) counter down signal. 0 = No change 1 = Decrease Floating point control (Motor potentiometer) counter value. (If both the up and down sources are on, the counter value will not change.) **Note:** Floating point control (Motor potentiometer) function up/down source control speed or frequency from zero to maximum speed or frequency. The running direction can be changed with parameter *20.04 Ext1 in2 source*. See the figure in section *Floating point control (Motor potentiometer)* on page *101*. For the selections, see parameter *22.73 Motor potentiometer up source*.	*Not used*
22.75	*Motor potentiometer ramp time*	Defines the change rate of the Floating point control (Motor potentiometer) counter. This parameter specifies the time required for the Floating point control (Motor potentiometer) to change from minimum (*22.76*) to maximum (*22.77*). The same change rate applies in both directions.	40.0 s
	0.0…3600.0 s	Counter change time.	1 = 1 s

No.	Name/Value	Description	Def/FbEq16
22.76	*Motor potentiometer min value*	Defines the minimum value of the Floating point control (Motor potentiometer) counter. **Note:** If vector control mode is used, value of this parameter must be changed.	-50.00
	-32768.00… 32767.00	Counter minimum.	1 = 1
22.77	*Motor potentiometer max value*	Defines the maximum value of the Floating point control (Motor potentiometer) counter. **Note:** If vector control mode is used, value of this parameter must be changed.	50.00
	-32768.00… 32767.00	Counter maximum.	1 = 1
22.80	*Motor potentiometer ref act*	The output of the Floating point control (Motor potentiometer) function. (The meter is configured using parameters *22.71*…*22.74*.) This parameter is read-only.	-
	-32768.00… 32767.00	Value of the Floating point control (Motor potentiometer) counter.	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 control chain diagram *Speed reference source selection I* on page *520*. This parameter is read-only.	-
	-30000.00… 30000.00 rpm	Speed reference after additive 2.	See par. *46.01*
22.87	*Speed reference act 7*	Displays the value of speed reference before application of critical speeds. See the control chain diagram on page *521*. The value is received from *22.86 Speed reference act 6* unless overridden by • any constant speed • *network control* reference (see page *19*) • control panel reference • safe speed reference. This parameter is read-only.	-
	-30000.00… 30000.00 rpm	Speed reference before application of critical speeds.	See par. *46.01*

23 Speed reference ramp		Speed reference ramp settings (programming of the acceleration and deceleration rates for the drive). See control chain diagram *Speed reference ramping and shaping* on page *522*.	
23.01	*Speed ref ramp input*	Displays the used speed reference (in rpm) before it enters the ramping and shaping functions. See control chain diagram *Speed reference ramping and shaping* on page *522*. 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 control chain diagram *Speed reference ramping and shaping* on page *522*. This parameter is read-only.	-
	-30000.00… 30000.00 rpm	Speed reference after ramping and shaping.	See par. *46.01*

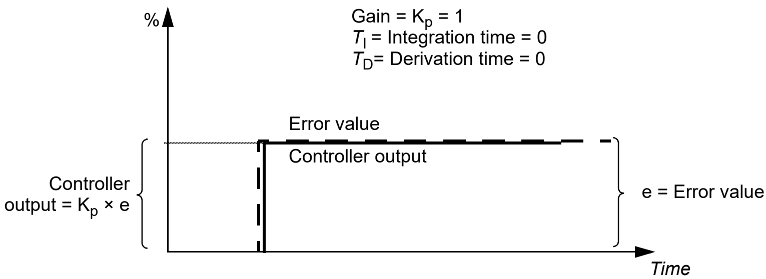
No.	Name/Value	Description	Def/FbEq16
23.11	*Ramp set selection*	Selects the source that switches between the two sets of acceleration/deceleration ramp times defined by parameters *23.12*…*23.15*. 0 = Acceleration time 1 and deceleration time 1 are active 1 = Acceleration time 2 and deceleration time 2 are active	*Acc/Dec time 1*
	Acc/Dec time 1	0.	0
	Acc/Dec time 2	1.	1
	DI1	Digital input DI1 (*10.02 DI delayed status*, bit 0).	2
	DI2	Digital input DI2 (*10.02 DI delayed status*, bit 1).	3
	DI3	Digital input DI3 (*10.02 DI delayed status*, bit 2).	4
	DI4	Digital input DI4 (*10.02 DI delayed status*, bit 3).	5
	DI5	Digital input DI5 (*10.02 DI delayed status*, bit 4).	6
	DI6	Digital input DI6 (*10.02 DI delayed status*, bit 5).	7
	Reserved		8…17
	FBA A	For Transparent16 and Transparent32 profiles only. DCU control word bit 10 received through the fieldbus adapter.	18
	Reserved		19
	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* on page *124*).	-
23.12	*Acceleration time 1*	Defines acceleration time 1 as the time required for the speed to change from zero to the speed defined by parameter *46.01 Speed scaling* (**not** to parameter *30.12 Maximum speed*). If the speed reference increases faster than the set acceleration rate, the motor speed will follow the acceleration rate. If the speed reference increases slower than the set acceleration rate, the motor speed will follow the reference. If the acceleration time is set too short, the drive will automatically prolong the acceleration in order not to exceed the drive torque limits.	20.000 s
	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.	20.000 s
	0.000…1800.000 s	Deceleration time 1.	10 = 1 s

No.	Name/Value	Description	Def/FbEq16
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
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
23.28	*Variable slope enable*	Activates the variable slope function, which controls the slope of the speed ramp during a speed reference change. This allows for a constantly variable ramp rate to be generated, instead of just the standard two ramps normally available. If the update interval of the signal from an external control system and the variable slope rate (*23.29 Variable slope rate*) are equal, speed reference (*23.02 Speed ref ramp output*) is a straight line.  t = update interval of signal from an external control system A = speed reference change during t This function is only active in external control.	*Off*
	Off	Variable slope disabled.	0
	On	Variable slope enabled (not available in local control).	1

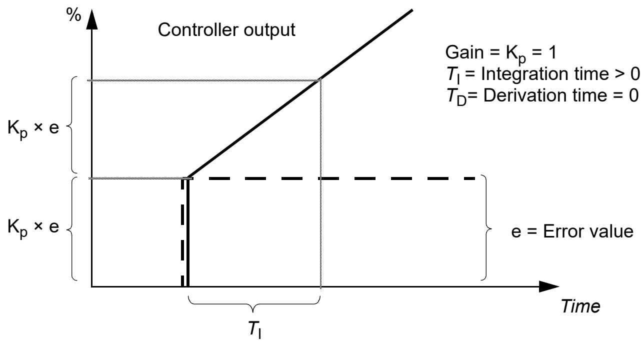
No.	Name/Value	Description	Def/FbEq16
23.29	*Variable slope rate*	Defines the rate of the speed reference change when variable slope is enabled by parameter *23.28 Variable slope enable*. For the best result, enter the reference update interval into this parameter.	50 ms
	2…30000 ms	Variable slope rate.	1 = 1 ms
23.32	*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

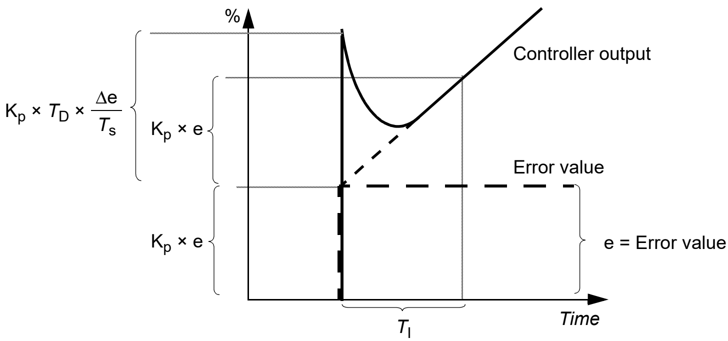
No.	Name/Value	Description	Def/FbEq16
24 Speed reference conditioning		Speed error calculation; speed error window control configuration; speed error step. See control chain diagram *Speed error calculation* on page *523*.	
24.01	*Used speed reference*	Displays the ramped and corrected speed reference (before speed error calculation). See control chain diagram *Speed error calculation* on page *523*. 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 control chain diagram *Speed error calculation* on page *523*. 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 control chain diagram *Speed error calculation* on page *523*. This parameter is read-only.	-
	-30000.00… 30000.00 rpm	Filtered speed error.	See par. *46.01*
24.04	*Speed error inverted*	Displays the inverted (unfiltered) speed error. See control chain diagram *Speed error calculation* on page *523*. 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 control chain diagram *Speed error calculation* on page *523*.	0.00 rpm
	-10000.00… 10000.00 rpm	Speed reference correction.	See par. *46.01*
24.12	*Speed error filter time*	Defines the time constant of the speed error low-pass filter. If the used speed reference changes rapidly, the possible interferences in the speed measurement can be filtered with the speed error filter. Reducing the ripple with this filter may cause speed controller tuning problems. A long filter time constant and fast acceleration time contradict one another. A very long filter time results in unstable control.	0 ms
	0…10000 ms	Speed error filtering time constant. 0 = filtering disabled.	1 = 1 ms
25 Speed control		Speed controller settings. See control chain diagram *Speed error calculation* on page *523*.	
25.01	*Torque reference speed control*	Displays the speed controller output that is transferred to the torque controller. See control chain diagram *Speed error calculation* on page *523*. This parameter is read-only.	-
	-1600.0…1600.0%	Limited speed controller output torque.	See par. *46.03*

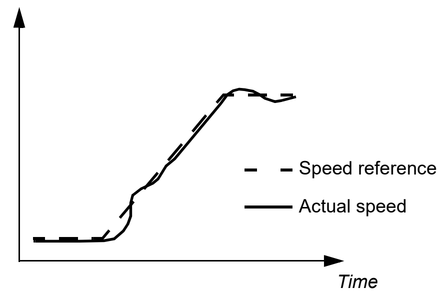
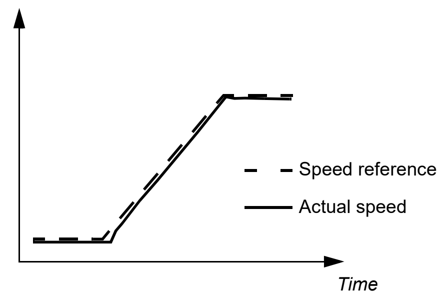
No.	Name/Value	Description	Def/FbEq16
25.02	*Speed proportional gain*	Defines the proportional gain (K_p) of the speed controller. Too high a gain may cause speed oscillation. The figure below shows the speed controller output after an error step when the error remains constant.	5.00



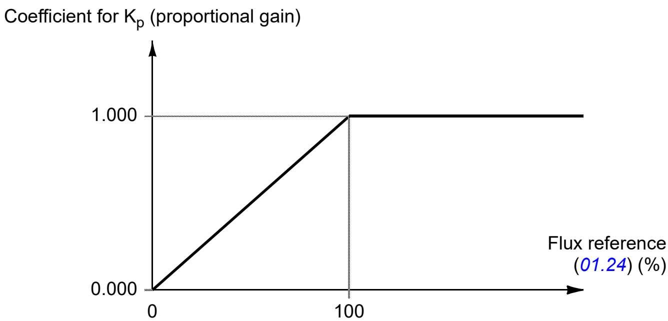
		If gain is set to 1, a 10% change in error value (reference - actual value) causes the speed controller output to change by 10%, ie, the output value is input × gain.	
	0.00…250.00	Proportional gain for speed controller.	100 = 1

No.	Name/Value	Description	Def/FbEq16
25.03	*Speed integration time*	Defines the integration time of the speed controller. The integration time defines the rate at which the controller output changes when the error value is constant and the proportional gain of the speed controller is 1. The shorter the integration time, the faster the continuous error value is corrected. 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. 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	Def/FbEq16
25.04	*Speed derivation time*	Defines the derivation time of the speed controller. Derivative action boosts the controller output if the error value changes. The longer the derivation time, the more the speed controller output is boosted during the change. If the derivation time is set to zero, the controller works as a PI controller, otherwise as a PID controller. The derivation makes the control more responsive for disturbances. For simple applications, 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.  Gain = K_p = 1 T_I = Integration time > 0 T_D= Derivation time > 0 T_s= Sample time period = 250 µs Δe = Error value change between two samples	0.000 s
	0.000…10.000 s	Derivation time for speed controller.	1000 = 1 s
25.05	*Derivation filter time*	Defines the derivation filter time constant. See parameter *25.04 Speed derivation time*.	8 ms
	0…10000 ms	Derivation filter time constant.	1 = 1 ms

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

No.	Name/Value	Description	Def/FbEq16
25.30	*Flux adaption enable*	Enables/disables speed controller adaptation based on motor flux reference (*01.24 Flux actual %*). The proportional gain of the speed controller is multiplied by a coefficient of 0…1 between 0…100% flux reference respectively. See also the block diagram on page *525*.	*Enable*



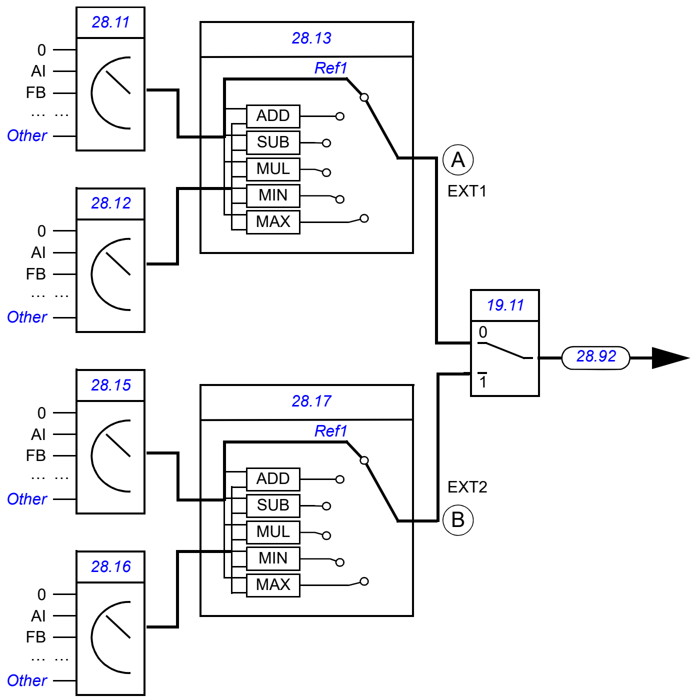
No.	Name/Value	Description	Def/FbEq16
	Disable	Speed controller adaptation based on flux reference disabled.	0
	Enable	Speed controller adaptation based on flux reference enabled.	1
25.33	*Speed controller auto tune*	Activates (or selects a source that activates) the speed controller auto tune function. See section *Before activating the autotune routine* on page *103*.	*Off*
	Off	Not activated.	0
	On	Activated.	1
25.34	*Auto tune 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 s
	0.00 … 1000.00 s	Mechanical time constant.	10 = 1 s
25.38	*Auto tune 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%	Torque step.	100 = 1%

No.	Name/Value	Description	Def/FbEq16
25.39	*Auto tune 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%	Speed step.	100 = 1%
25.40	*Auto tune 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	5
	0 … 10	Number of steps for auto tune.	1 = 1
25.53	*Torque prop reference*	Displays the output of the proportional (P) part of the speed controller. See control chain diagram *Speed error calculation* on page *523*. 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 control chain diagram *Speed error calculation* on page *523*. 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 control chain diagram *Speed error calculation* on page *523*. 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 control chain diagram *Speed error calculation* on page *523*. This parameter is read-only.	-
	-30000.0… 30000.0%	Output of acceleration compensation function.	See par. *46.03*

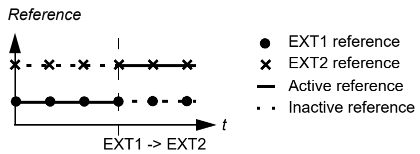
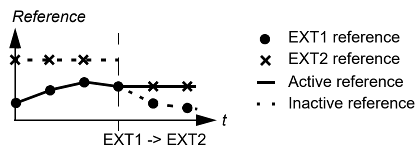
28 Frequency reference chain		Settings for the frequency reference chain. See the control chain diagrams on pages *518* and *519*.	
28.01	*Frequency ref ramp input*	Displays the used frequency reference before ramping. See the control chain diagrams *Frequency reference selection* on page *518* and *Frequency reference modification* on page *519*. This parameter is read-only.	-
	-500.00…500.00 Hz	Frequency reference before ramping.	See par. *46.02*

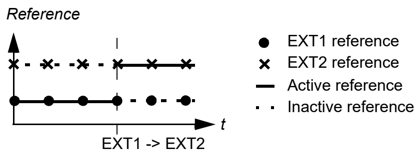
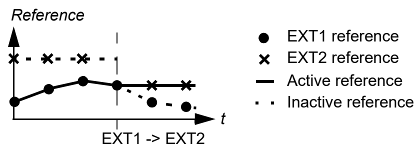
6

No.	Name/Value	Description	Def/FbEq16
28.02	*Frequency ref ramp output*	Displays the final frequency reference (after selection, limitation and ramping). See control chain diagram on page *518*. This parameter is read-only.	-
	-500.00…500.00 Hz	Final frequency reference.	See par. *46.02*
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).	*AI1 scaled*



	Zero	None.	0
	AI1 scaled	*12.12 AI1 scaled value* (see page *156*).	1
	AI2 scaled	*12.22 AI2 scaled value* (see page *158*).	2
	Reserved		3
	FB A ref1	*03.05 FB A reference 1* (see page *130*).	4
	FB A ref2	*03.06 FB A reference 2* (see page *131*).	5

No.	Name/Value	Description	Def/FbEq16
	Reserved		6…7
	EFB ref1	*03.09 EFB reference 1* (see page *131*).	8
	EFB ref2	*03.10 EFB reference 2* (see page *131*).	9
	Reserved		10…14
	Motor potentiometer	*22.80 Motor potentiometer ref act* (output of the Floating point control (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 DI5 is used as a frequency input).	17
	Control panel (ref saved)	Control panel reference (*03.01 Panel reference*, see page *130*) saved by the control system for the location where the control returns is used as the reference. 	18
	Control panel (ref copied)	Control panel reference (*03.01 Panel reference*, see page *130*) 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
	Other	Source selection (see *Terms and abbreviations* on page *124*).	-
28.12	*Ext1 frequency ref2*	Selects EXT1 frequency reference source 2. For the selections, and a diagram of reference source selection, see parameter *28.11 Ext1 frequency ref1*.	*Zero*
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

No.	Name/Value	Description	Def/FbEq16
	Max (ref1, ref2)	The greater of the reference sources is used as frequency reference 1.	5
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 *156*).	1
	AI2 scaled	*12.22 AI2 scaled value* (see page *158*).	2
	Reserved		3
	FB A ref1	*03.05 FB A reference 1* (see page *130*).	4
	FB A ref2	*03.06 FB A reference 2* (see page *131*).	5
	Reserved		6…7
	EFB ref1	*03.09 EFB reference 1* (see page *131*).	8
	EFB ref2	*03.10 EFB reference 2* (see page *131*).	9
	Reserved		10…14
	Motor potentiometer	*22.80 Motor potentiometer ref act* (output of the Floating point control (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 DI5 is used as a frequency input).	17
	Control panel (ref saved)	Control panel reference (*03.01 Panel reference*, see page *130*) saved by the control system for the location where the control returns is used as the reference.  	18
	Control panel (ref copied)	Control panel reference (*03.01 Panel reference*, see page *130*) 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
	Other	Source selection (see *Terms and abbreviations* on page *124*).	-
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*

No.	Name/Value	Description	Def/FbEq16
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
	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
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.	000b

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 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 speed is determined by the sign of the constant speed setting (parameters *22.26*…*22.32*).
2…15	Reserved	

	0000h…FFFFh	Constant frequency configuration word.	1 = 1

No.	Name/Value	Description	Def/FbEq16
28.22	*Constant frequency sel1*	When bit 0 of parameter *28.21 Constant frequency function* is 0 (Separate), selects a source that activates constant frequency 1. When bit 0 of parameter *28.21 Constant frequency function* is 1 (Packed), this parameter and parameters *28.23 Constant frequency sel2* and *28.24 Constant frequency sel3* select three sources whose states activate constant frequencies as follows:	*Always off*

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	Def/FbEq16
	Always off	0.	0
	Always 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
	DI5	Digital input DI5 (*10.02 DI delayed status*, bit 4).	6
	DI6	Digital input DI6 (*10.02 DI delayed status*, bit 5).	7
	Reserved		8…17
	Timed function 1	Bit 0 of *34.01 Timed functions status* (see page *267*).	18
	Timed function 2	Bit 1 of *34.01 Timed functions status* (see page *267*).	19
	Timed function 3	Bit 2 of *34.01 Timed functions status* (see page *267*).	20
	Reserved		21…23
	Supervision 1	Bit 0 of *32.01 Supervision status* (see page *259*).	24
	Supervision 2	Bit 1 of *32.01 Supervision status* (see page *259*).	25
	Supervision 3	Bit 2 of *32.01 Supervision status* (see page *259*).	26
	Other [bit]	Source selection (see *Terms and abbreviations* on page *124*).	-
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*.	*Always off*

No.	Name/Value	Description	Def/FbEq16
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*
28.25	*Constant frequency sel4*	When bit 0 of parameter *28.21 Constant frequency function* is 0 (Separate), selects a source that activates constant frequency 4. 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; 6.00 Hz (*95.20* b0)
	-500.00…500.00 Hz	Constant frequency 1.	See par. *46.02*
28.27	*Constant frequency 2*	Defines constant frequency 2.	10.00 Hz; 12.00 Hz (*95.20* b0)
	-500.00…500.00 Hz	Constant frequency 2.	See par. *46.02*
28.28	*Constant frequency 3*	Defines constant frequency 3.	15.00 Hz; 18.00 Hz (*95.20* b0)
	-500.00…500.00 Hz	Constant frequency 3.	See par. *46.02*
28.29	*Constant frequency 4*	Defines constant frequency 4.	20.00 Hz; 24.00 Hz (*95.20* b0)
	-500.00…500.00 Hz	Constant frequency 4.	See par. *46.02*
28.30	*Constant frequency 5*	Defines constant frequency 5.	25.00 Hz; 30.00 Hz (*95.20* b0)
	-500.00…500.00 Hz	Constant frequency 5.	See par. *46.02*
28.31	*Constant frequency 6*	Defines constant frequency 6.	40.00 Hz; 48.00 Hz (*95.20* b0)
	-500.00…500.00 Hz	Constant frequency 6.	See par. *46.02*
28.32	*Constant frequency 7*	Defines constant frequency 7.	50.00 Hz; 60.00 Hz (*95.20* b0)
	-500.00…500.00 Hz	Constant frequency 7.	See par. *46.02*

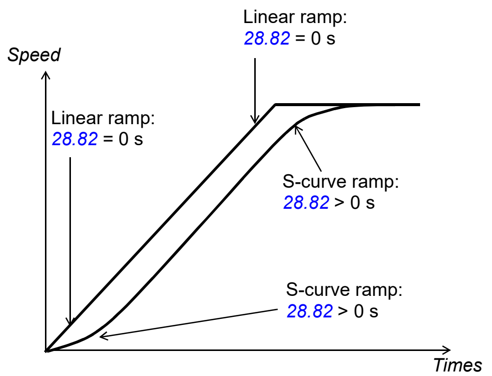
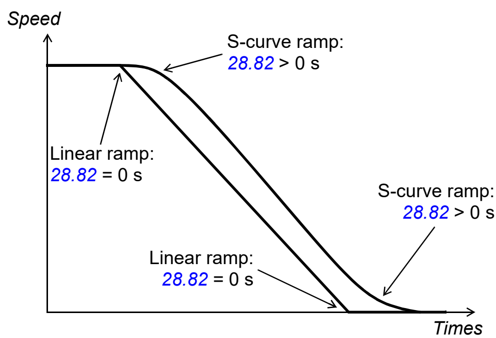
No.	Name/Value	Description	Def/FbEq16
28.41	*Frequency ref safe*	Defines a safe frequency reference value that is used with supervision functions such as • *12.03 AI supervision function* • *49.05 Communication loss action* • *50.02 FBA A comm loss func.*	0.00 Hz
	-500.00…500.00 Hz	Safe frequency reference.	See par. *46.02*
28.46	*Constant frequency sel5*	When bit 0 of parameter *28.21 Constant frequency function* is 0 (Separate), selects a source that activates constant frequency 4. For the selections, see parameter *28.22 Constant frequency sel1*.	*Always off*
28.47	*Constant frequency sel6*	When bit 0 of parameter *28.21 Constant frequency function* is 0 (Separate), selects a source that activates constant frequency 4. For the selections, see parameter *28.22 Constant frequency sel1*.	*Always off*
28.51	*Critical frequency function*	Enables/disables the critical frequencies function. Also determines whether the specified ranges are effective in both rotating directions or not. See also section *Critical speeds/frequencies* (page *69*).	0000b

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.

No.	Name/Value	Description	Def/FbEq16
	0000h…FFFFh	Critical frequencies configuration word.	1 = 1
28.52	*Critical frequency 1 low*	Defines the low limit for critical frequency 1. **Note:** This value must be less than or equal to the value of *28.53 Critical frequency 1 high*.	0.00 Hz
	-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*

No.	Name/Value	Description	Def/FbEq16
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	*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
	DI2	Digital input DI2 (*10.02 DI delayed status*, bit 1).	3
	DI3	Digital input DI3 (*10.02 DI delayed status*, bit 2).	4
	DI4	Digital input DI4 (*10.02 DI delayed status*, bit 3).	5
	DI5	Digital input DI5 (*10.02 DI delayed status*, bit 4).	6
	DI6	Digital input DI6 (*10.02 DI delayed status*, bit 5).	7
	Reserved		8…17
	FBA A	For Transparent16 and Transparent32 profiles only. DCU control word bit 10 received through the fieldbus adapter.	18
	Reserved		19
	EFB DCU CW bit 0	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* on page *124*).	-
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.	30.000 s
	0.000…1800.000 s	Acceleration time 1.	10 = 1 s

No.	Name/Value	Description	Def/FbEq16
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.	30.000 s
	0.000…1800.000 s	Deceleration time 1.	10 = 1 s
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
	DI5	Digital input DI5 (*10.02 DI delayed status*, bit 4).	6
	DI6	Digital input DI6 (*10.02 DI delayed status*, bit 5).	7
	Other [bit]	Source selection (see *Terms and abbreviations* on page *124*).	-

No.	Name/Value	Description	Def/FbEq16
28.82	*Acc/Dec curve 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:** 	0.100 s
	0.100…1800.000 s	Ramp shape at start and end of acceleration and deceleration.	10 = 1s
28.83	*Acc/Dec curve time 2*	Defines the shape of the acceleration and deceleration ramps used with the set 2. See parameter *28.82 Acc/Dec curve time 1*.	0.100 s
	0.100…1800.000 s	Ramp shape at start and end of acceleration and deceleration.	10 = 1s

6

No.	Name/Value	Description	Def/FbEq16
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 control chain diagram *Frequency reference selection* on page *518*. This parameter is read-only.	-
	-500.00…500.00 Hz 0.100…1800.000 s	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 control chain diagram *Frequency reference selection* on page *518*. This parameter is read-only.	-
	-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 control chain diagram *Frequency reference modification* on page *519*. This parameter is read-only.	-
	-500.00…500.00 Hz	Frequency reference before ramping and limiting.	See par. *46.02*
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 *30.20 Maximum torque 1*, *30.26 Power motoring limit* or *30.27 Power generating limit*.
4	Torq ref min	1 = Torque reference is being limited by *30.19 Minimum torque 1*, *30.26 Power motoring limit* or *30.27 Power generating limit*.
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	

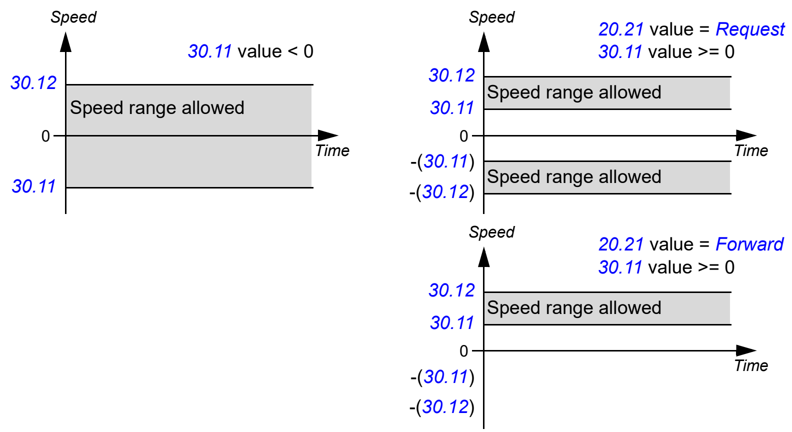
	0000h…FFFFh	Limit word 1.	1 = 1

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

Bit	Name	Description
0	Undervoltage	*1 = Intermediate DC circuit undervoltage
1	Overvoltage	*1 = Intermediate DC circuit overvoltage
2	Minimum torque	*1 = Torque is being limited by *30.19 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 estimated IGBT temperature
13	IGBT overload	*1 = Output current is being limited because of IGBT junction to case temperature
14…15	Reserved	
*Only one out of bits 0…3, and one out of bits 9…11 can be on simultaneously. The bit typically indicates the limit that is exceeded first.		

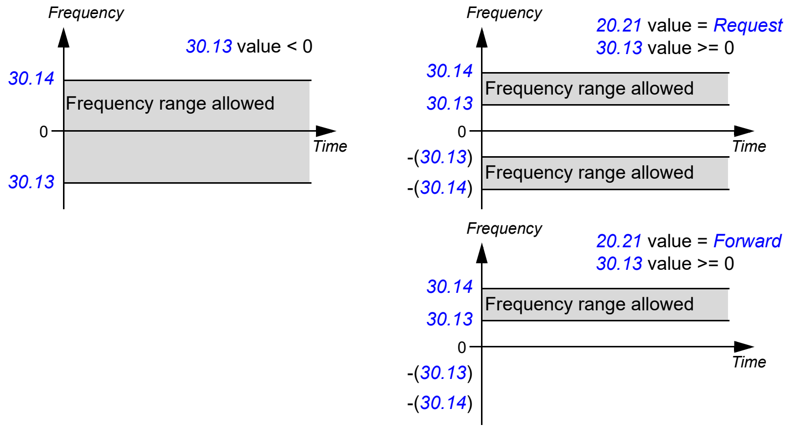
No.	Name/Value	Description	Def/FbEq16
	0000h…FFFFh	Torque limitation status word.	1 = 1

No.	Name/Value	Description	Def/FbEq16
30.11	*Minimum speed*	Defines together with *30.12 Maximum speed* the 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 absolute value of *30.12 Maximum speed*. ⚠ **WARNING!** In speed control mode only. In frequency control mode, use frequency limits (*30.13* and *30.14*).	0.00 rpm



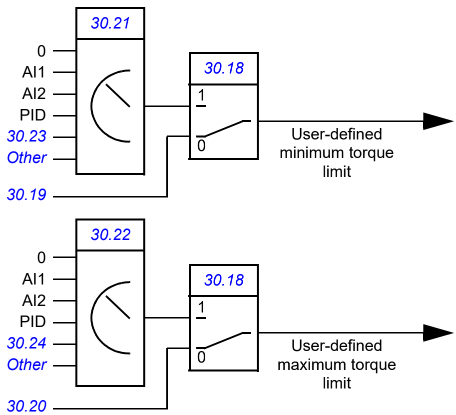
No.	Name/Value	Description	Def/FbEq16
	-30000.00… 30000.00 rpm	Minimum allowed speed.	See par. *46.01*
30.12	*Maximum speed*	Defines together with *30.11 Minimum speed* the allowed speed range. See parameter *30.11 Minimum speed*. **Note:** This parameter does not affect the speed acceleration and deceleration ramp times. See parameter *46.01 Speed scaling*.	1500.00 rpm; 1800.00 rpm (*95.20* b0)
	-30000.00… 30000.00 rpm	Maximum speed.	See par. *46.01*

No.	Name/Value	Description	Def/FbEq16
30.13	*Minimum frequency*	Defines together with *30.14 Maximum frequency* the allowed frequency range. See the figure. A positive or zero minimum frequency value defines two ranges, one positive and one negative. ⚠ **WARNING!** The absolute value of *30.13 Minimum frequency* must not be higher than the absolute value of *30.14 Maximum frequency*. ⚠ **WARNING!** in frequency control mode only.	0.00 Hz



No.	Name/Value	Description	Def/FbEq16
	-500.00…500.00 Hz	Minimum frequency.	See par. *46.02*
30.14	*Maximum frequency*	Defines together with *30.13 Minimum frequency* the allowed frequency range. See parameter *30.13 Minimum frequency*. **Note:** This parameter does not affect the frequency acceleration and deceleration ramp times. See parameter *46.02 Frequency scaling*.	50.00 Hz; 60.00 Hz (*95.20* b0)
	-500.00…500.00 Hz	Maximum frequency.	See par. *46.02*
30.17	*Maximum current*	Defines the maximum allowed motor current. This depends on the drive type; it is automatically determined on the basis of the rating. The system sets the default value to 90% of the rated current so you can increase the parameter value by 10% if needed (not valid for ACH531-01-12A7-4 drive type).	0.00 A
	0.00…30000.00 A	Maximum motor current.	1 = 1 A

No.	Name/Value	Description	Def/FbEq16
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).	*Torque limit set 1*

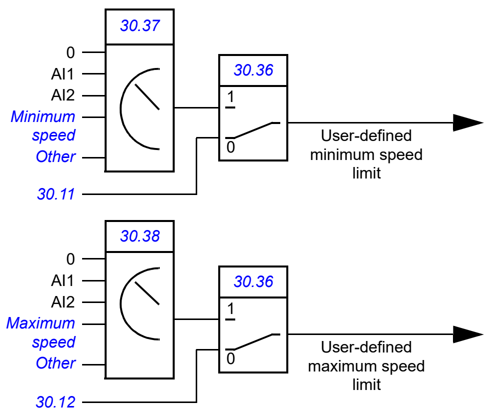


Note: In addition to the user-defined limits, torque may be limited for other reasons (such as power limitation). See block diagram *Torque limitation* on page *526*.

	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
	DI5	Digital input DI5 (*10.02 DI delayed status*, bit 4).	6
	DI6	Digital input DI6 (*10.02 DI delayed status*, bit 5).	7
	Reserved		8…10
	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* on page *124*).	-

No.	Name/Value	Description	Def/FbEq16
30.19	*Minimum torque 1*	Defines a minimum torque limit for the drive (in percent of nominal motor torque). See diagram at parameter *30.18 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*. **Note:** If your application, like a pump or a fan, requires that the motor must rotate in one direction only, use speed/ frequency limit (*30.11 Minimum speed*/*30.13 Minimum frequency*), or direction limit (*20.21 Direction*) to achieve this. Do not set parameter *30.19 Minimum torque 1* or *30.27 Power generating limit* to 0%, as the drive is then not able to stop correctly.	-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 *156*).	1
	AI2 scaled	*12.22 AI2 scaled value* (see page *158*).	2
	Reserved		3…14
	PID	*40.01 Process PID output actual* (output of the process PID controller).	15
	Minimum torque 2	*30.23 Minimum torque 2*.	16
	Other	Source selection (see *Terms and abbreviations* on page *124*).	-
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 *156*).	1
	AI2 scaled	*12.22 AI2 scaled value* (see page *158*).	2
	Reserved		3…14

No.	Name/Value	Description	Def/FbEq16
	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* on page *124*).	-
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*
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. **Note:** If your application, like a pump or a fan, requires that the motor must rotate in one direction only, use speed/frequency limit (*30.11 Minimum speed*/*30.13 Minimum frequency*), or direction limit (*20.21 Direction*) to achieve this. Do not set parameter *30.19 Minimum torque 1* or *30.27 Power generating limit* to 0%, as the drive is then not able to stop correctly.	-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

No.	Name/Value	Description	Def/FbEq16
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
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 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

No.	Name/Value	Description	Def/FbEq16
	Selected	Adjustable speed limits are enabled. (Minimum speed limit defined by *30.37 Minimum speed source* and maximum speed limit defined by *30.38 Maximum speed source* are active).	1
	Ext1 active	Adjustable speed limits are enabled if EXT1 is active.	2
	Ext2 active	Adjustable speed limits are enabled if EXT2 is active.	3
	Reserved		4
	DI1	Digital input DI1 (*10.02 DI delayed status*, bit 0).	5
	DI2	Digital input DI2 (*10.02 DI delayed status*, bit 1).	6
	DI3	Digital input DI3 (*10.02 DI delayed status*, bit 2).	7
	DI4	Digital input DI4 (*10.02 DI delayed status*, bit 3).	8
	DI5	Digital input DI5 (*10.02 DI delayed status*, bit 4).	9
	DI6	Digital input DI6 (*10.02 DI delayed status*, bit 5).	10
	Reserved		11
	Other [bit]	Source selection (see *Terms and abbreviations* on page *124*).	-
30.37	*Minimum speed source*	Defines the source of a minimum speed limit for the drive when the source is selected by *30.36 Speed limit selection*. **Note:** 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* (see page *156*).	1
	AI2 scaled	*12.22 AI2 scaled value* (see page *158*).	2
	Reserved		3…10
	Minimum speed	*30.11 Minimum speed*.	11
	Other	Source selection (see *Terms and abbreviations* on page *124*).	-
30.38	*Maximum speed source*	Defines the source of a maximum speed limit for the drive when the source is selected by *30.36 Speed limit selection*. **Note:** 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* (see page *156*).	1
	AI2 scaled	*12.22 AI2 scaled value* (see page *158*).	2
	Reserved		3…11
	Maximum speed	*30.12 Maximum speed*.	12
	Other	Source selection (see *Terms and abbreviations* on page *124*).	-

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
	Reserved		2

No.	Name/Value	Description	Def/FbEq16
	DI1	Digital input DI1 (*10.02 DI delayed status*, bit 0).	3
	DI2	Digital input DI2 (*10.02 DI delayed status*, bit 1).	4
	DI3	Digital input DI3 (*10.02 DI delayed status*, bit 2).	5
	DI4	Digital input DI4 (*10.02 DI delayed status*, bit 3).	6
	DI5	Digital input DI5 (*10.02 DI delayed status*, bit 4).	7
	DI6	Digital input DI6 (*10.02 DI delayed status*, bit 5).	8
	Other [bit]	Source selection (see *Terms and abbreviations* on page *124*).	-
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*
	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)*
31.08	*External event 4 type*	Selects the type of external event 4.	*Fault*
	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

No.	Name/Value	Description	Def/FbEq16
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 **Notes:** • When the start and stop command is through digital inputs (parameter *20.01 Ext1 commands* or *20.06 Ext2 commands*) or from local control, and you want to use fault reset from the fieldbus, selection *FBA A MCW bit 7* or *EFB MCW bit 7* can be used. • Whenever the drive is in external control through fieldbus (start and stop command and reference are received through fieldbus), the fault can be reset from the fieldbus regardless of the selection of this parameter.	*DI2*
	Not used	0.	0
	Not used	1.	1
	DI1	Digital input DI1 (*10.02 DI delayed status*, bit 0).	2
	DI2	Digital input DI2 (*10.02 DI delayed status*, bit 1).	3
	DI3	Digital input DI3 (*10.02 DI delayed status*, bit 2).	4
	DI4	Digital input DI4 (*10.02 DI delayed status*, bit 3).	5
	DI5	Digital input DI5 (*10.02 DI delayed status*, bit 4).	6
	DI6	Digital input DI6 (*10.02 DI delayed status*, bit 5).	7
	Reserved		8…17
	Timed function 1	Bit 0 of *34.01 Timed functions status* (see page *267*).	18
	Timed function 2	Bit 1 of *34.01 Timed functions status* (see page *267*).	19
	Timed function 3	Bit 2 of *34.01 Timed functions status* (see page *267*).	20
	Reserved		21…23
	Supervision 1	Bit 0 of *32.01 Supervision status* (see page *259*).	24
	Supervision 2	Bit 1 of *32.01 Supervision status* (see page *259*).	25
	Supervision 3	Bit 2 of *32.01 Supervision status* (see page *259*).	26
	Reserved		27…29
	FBA A MCW bit 7	Control word bit 7 received through fieldbus interface A.	30
	Reserved		31
	EFB MCW bit 7	Control word bit 7 received through the embedded fieldbus interface.	32
	Other [bit]	Source selection (see *Terms and abbreviations* on page *124*).	-

No.	Name/Value	Description	Def/FbEq16
31.12	*Autoreset selection*	Selects faults that are automatically reset. The parameter is a 16-bit word with each bit corresponding to a fault type. Whenever a bit is set to 1, the corresponding fault is automatically reset. **Note:** Infinite reset trials are executed if parameter *70.02 Override enable* is set to value *On, critical*. **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:	000Ch

Bit	Fault
0	Overcurrent
1	Overvoltage
2	Undervoltage
3	AI supervision fault
4	Reserved
5	Over frequency
6	EarthFarult
7	Shortcircuit
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*)

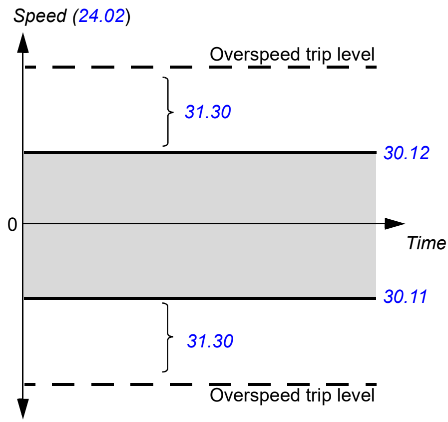
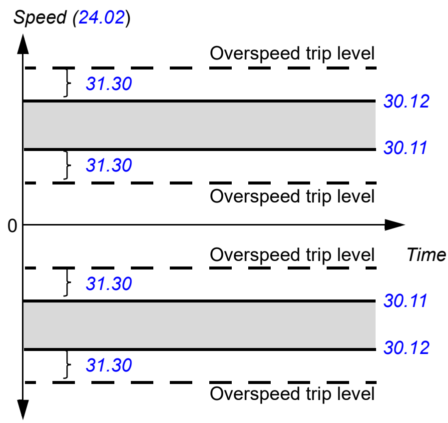
No.	Name/Value	Description	Def/FbEq16
	0000h…FFFFh	Automatic reset configuration word.	1 = 1
31.13	*Selectable fault*	Defines the fault that can be automatically reset using parameter *31.12 Autoreset selection*, bit 10. Faults are listed in chapter *Fault tracing* (page *414*).	0000h
	0000h…FFFFh	Fault code.	1 = 1
31.14	*Number of trials*	Defines the maximum number of automatic resets that the drive is allowed to attempt within the time specified by *31.15 Total trials time*. If the fault persists, subsequent reset attempts will be made at intervals defined by *31.16 Delay time*. The faults to be automatically reset are defined by *31.12 Autoreset selection*.	5
	0…5	Number of automatic resets.	1 = 1
31.15	*Total trials time*	Defines a time window for automatic fault resets. The maximum number of attempts made during any period of this length is defined by *31.14 Number of trials*. **Note:** If the fault condition remains and cannot be reset, each reset attempt will generate an event and start a new time window. In practice, if the specified number of resets (*31.14*) at specified intervals (*31.16*) take longer than the value of *31.15*, the drive will continue to attempt resetting the fault until the cause is eventually removed.	30.0 s
	1.0…600.0 s	Time for automatic resets.	10 = 1 s

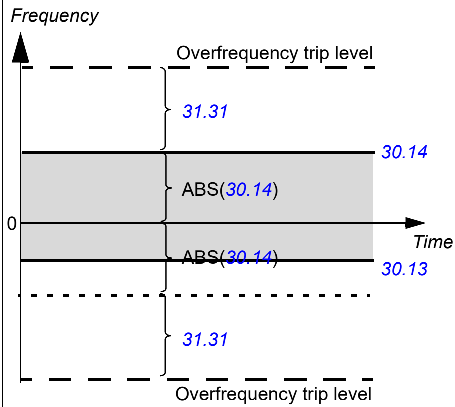
No.	Name/Value	Description	Def/FbEq16
31.16	*Delay time*	Defines the time that the drive will wait after a fault before attempting an automatic reset. See parameter *31.12 Autoreset selection*.	5.0 s
	0.0…120.0 s	Autoreset delay.	10 = 1 s
31.19	*Motor phase loss*	Selects how the drive reacts when a motor phase loss is detected. In scalar motor control mode: • The supervision activates above 10% of the motor nominal frequency. If any of the phase currents stays very small for a certain time limit, the output phase loss fault is given. • If the motor nominal current is below 1/6 of the drive nominal current or there is no motor connected, ABB recommends to disable the motor output phase loss function.	*Fault*
	No action	No action taken.	0
	Fault	Drive trips on fault *3381 Output phase loss*.	1
31.20	*Earth fault*	Selects how the drive reacts when an earth fault or current unbalance is detected in the motor or the motor cable. See also section *Earth (Ground) fault detection (parameter31.20)* (page *118*).	*Fault*
	No action	No action taken.	0
	Warning	The drive generates an *A2B3 Earth leakage* warning.	1
	Fault	The drive trips on fault *2330 Earth leakage*.	2
31.21	*Supply phase loss*	Selects how the drive reacts when a supply phase loss is detected.	*Fault*
	No action	No action taken.	0
	Fault	Drive trips on fault *3130 Input phase loss*.	1

<table>
<tr><th>No.</th><th>Name/Value</th><th>Description</th><th>Def/FbEq16</th></tr>
<tr><td>31.22</td><td>STO indication run/stop</td><td>Selects which indications are given when one or both Safe torque off (STO) signals are switched off or lost. The indications also depend on whether the drive is running or stopped when this occurs.
The tables at each selection below show the indications generated with that particular setting.
Notes:
• This parameter does not affect the operation of the STO function itself. The STO function will operate regardless of the setting of this parameter: a running drive will stop upon removal of one or both STO signals, and will not start until both STO signals are restored and all faults reset.
• The loss of only one STO signal always generates a fault as it is interpreted as a malfunction.
• With the CPTC-02 ATEX-certified thermistor protection module, follow the instructions given in the CPTC-02 ATEX-certified thermistor protection module, Ex II (2) GD (+L537+Q971) user's manual (3AXD50000030058 [English]).
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>Faults 5091 Safe torque off
and
FA81 Safe torque off 1</td></tr>
<tr><td>1</td><td>0</td><td>Faults 5091 Safe torque off
and
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>
<tr><td></td><td>Fault/Warning</td><td>
<table>
<tr><th colspan="2">Inputs</th><th colspan="2">Indication</th></tr>
<tr><th>IN1</th><th>IN2</th><th>Running</th><th>Stopped</th></tr>
<tr><td>0</td><td>0</td><td>Fault 5091 Safe torque off</td><td>Warning A5A0 Safe torque off</td></tr>
<tr><td>0</td><td>1</td><td>Faults 5091 Safe torque off and FA81 Safe torque off 1</td><td>Warning A5A0 Safe torque off and fault FA81 Safe torque off 1</td></tr>
<tr><td>1</td><td>0</td><td>Faults 5091 Safe torque off and FA82 Safe torque off 2</td><td>Warning A5A0 Safe torque off and 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>
</table>

<table>
<tr><th>No.</th><th>Name/Value</th><th>Description</th><th>Def/FbEq16</th></tr>
<tr><td></td><td>Fault/Event</td><td>
<table>
<tr><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 STO event</td></tr>
<tr><td>0</td><td>1</td><td>Faults 5091 Safe torque off and FA81 Safe torque off 1</td><td>Event B5A0 STO event and fault FA81 Safe torque off 1</td></tr>
<tr><td>1</td><td>0</td><td>Faults 5091 Safe torque off and FA82 Safe torque off 2</td><td>Event B5A0 STO event and 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>Warning A5A0 Safe torque off and fault FA81 Safe torque off 1</td></tr>
<tr><td>1</td><td>0</td><td>Warning A5A0 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>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 STO event</td></tr>
<tr><td>0</td><td>1</td><td>Event B5A0 STO event and fault FA81 Safe torque off 1</td></tr>
<tr><td>1</td><td>0</td><td>Event B5A0 STO event 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>
<tr><td>31.23</td><td>Wiring or earth fault</td><td>Selects how the drive reacts to incorrect input power and motor cable connection (ie. input power cable is connected to drive motor connection).</td><td>Fault</td></tr>
<tr><td></td><td>No action</td><td>No action taken.</td><td>0</td></tr>
<tr><td></td><td>Fault</td><td>Drive trips on fault 3181 Wiring or earth fault.</td><td>1</td></tr>
</table>

No.	Name/Value	Description	Def/FbEq16
31.24	*Stall function*	Selects how the drive reacts to a motor stall condition. A stall condition is defined as follows: • The drive exceeds the stall current limit (*31.25 Stall current limit*), and • the output frequency is below the level set by parameter *31.27 Stall frequency limit* or the motor speed is below the level set by parameter *31.26 Stall speed limit*, and • the conditions above have been true longer than the time set by parameter *31.28 Stall time*.	*No action*
	No action	None (stall supervision disabled).	0
	Warning	Drive generates warning *A780 Motor stall*.	1
	Fault	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*.	110.0%
	0.0…1600.0%	Stall current limit.	10 = 1%
31.26	*Stall speed limit*	Stall speed limit in rpm. See parameter *31.24 Stall function*.	150.00 rpm; 180.00 rpm (*95.20* b0)
	0.00…10000.00 rpm	Stall speed limit.	See par. *46.01*
31.27	*Stall frequency limit*	Stall frequency limit. See parameter *31.24 Stall function*. **Note:** Setting the limit below 10 Hz is not recommended.	15.00 Hz; 18.00 Hz (*95.20* b0)
	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.	1 = 1 s

No.	Name/Value	Description	Def/FbEq16
31.30	*Overspeed trip margin*	Defines, together with *30.11 Minimum speed* and *30.12 Maximum speed*, the maximum allowed speed of the motor (overspeed protection). If 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	Def/FbEq16
31.31	*Frequency trip margin*	Defines, together with *30.13 Minimum frequency* and *30.14 Maximum frequency*, the maximum allowed frequency of the motor (overfrequency protection). The absolute value of this overfrequency trip level is calculated by adding the value of this parameter to the higher of the absolute values of *30.13 Minimum frequency* and *30.14 Maximum frequency*. If the output frequency (*01.06 Output frequency*) exceeds the overfrequency trip level (ie. the absolute value of the output frequency exceeds the absolute value of the overfrequency trip level), the drive trips on fault *73F0 Overfrequency*. **WARNING!** This function only supervises the frequency in scalar motor control mode. 	15.00 Hz
	0.00…10000.00 Hz	Overfrequency trip margin.	1 = 1 Hz
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 fault *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.	

No.	Name/Value	Description	Def/FbEq16
31.33	*Emergency ramp supervision delay*	If parameter *31.32 Emergency ramp supervision* is set to 0%, this parameter defines the maximum time an emergency stop (mode Off1 or Off3) is allowed to take. If the motor has not stopped when the time elapses, the drive trips on fault *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
31.35	*Main fan fault function*	Selects how the drive reacts when a main cooling fan speed problem is detected. For frame sizes R6 or larger only. An event is triggered according to the value of this parameter (fault, warning or no action) • if the rotation speed signal from the fan is lower than the measured fan maximum speed (determined during the fan ID run) • if the measured fan maximum speed is lower than the predefined minimum value.	*Fault*
	Fault	Drive trips on fault *5080 Fan*	0
	Warning	Drive generates warning *A581 Fan*.	1
	No action	No action taken.	2
31.36	*Aux fan fault function*	Selects how the drive reacts when an auxiliary fan problem is detected. Certain drive types (especially those protected to IP55) have an auxiliary fan built into the front cover as standard. if it is necessary to operate the drive without the front cover (for example, during commissioning), you can set the parameter to value *No action* within two minutes from power-up to temporarily suppress the fault or warning. Return the value to *Fault* or *Warning* afterwards. On frame sizes R1…R5, the auxiliary fan is attached to connector X10 and on frame sizes R6 and larger to connector X16.	*Fault*
	Fault	The drive trips on fault *5081 Auxiliary fan broken*. The fault is suppressed for two minutes after power-up.	0
	Warning	The drive generates warning *A582 Auxiliary fan missing*. The warning is suppressed for two minutes after power-up.	1
	No action	No action taken.	2

No.	Name/Value	Description	Def/FbEq16
31.40	*Disable warning messages*	Selects 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 suppressed.	0000h

Bit	Name	Description
0	Reserved	
1	DC link undervoltage	1 = Warning *A3A2 DC link undervoltage* is suppressed.
2…4	Reserved	
5	Emergency stop off2	1 = Warning *AFE1 Emergency stop (off2)* is suppressed.
4	Emergency stop off1, off3	1 = Warning *AFE2 Emergency stop (off1 or off3)* is suppressed.
7…15	Reserved	

No.	Name/Value	Description	Def/FbEq16
	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 a stop.	0
	Emergency ramp	The drive follows the ramp specified for an emergency stop in parameter *23.23 Emergency stop time*.	1
32 Supervision		Configuration of signal supervision functions 1…6. Six values can be chosen to be monitored; a warning or fault is generated whenever predefined limits are exceeded. See also section *Diagnostics menu* (page *120*).	
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*.	0000b

Bit	Name	Description
0	Supervision 1 active	1 = Signal selected by *32.07* is outside its limits.
1	Supervision 2 active	1 = Signal selected by *32.17* is outside its limits.
2	Supervision 3 active	1 = Signal selected by *32.27* is outside its limits.
3	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 *32.27* is outside its limits.
6…15	Reserved	

No.	Name/Value	Description	Def/FbEq16
	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 falls below its lower limit.	1
	High	Action is taken whenever the signal rises above its upper limit.	2

No.	Name/Value	Description	Def/FbEq16
	Abs low	Action is taken whenever the absolute value of the signal falls below its (absolute) lower limit.	3
	Abs high	Action is taken whenever the absolute value of the signal rises above its (absolute) upper limit.	4
	Both	Action is taken whenever the signal falls below its low limit or rises above its high limit.	5
	Abs both	Action is taken whenever the absolute value of the signal falls below its (absolute) low limit or rises above its (absolute) high limit.	6
	Hysteresis	Action is taken whenever the signal rises above the value defined by the upper limit + 0.5 · hysteresis. The action is deactivated when the signal falls below the value defined by the lower limit - 0.5 · hysteresis.	7
	Low falling	Action is taken whenever the absolute value of the signal falls below its (absolute) lower limit.	8
	High rising	Action is taken whenever the absolute value of the signal rises above its (absolute) upper limit.	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	Drive generates warning *A8B0 ABB Signal supervision 1*.	1
	Fault	Drive trips on fault *80B0 Signal supervision 1*.	2
	Fault if running	If running, the drive trips on fault *80B0 Signal supervision 1*.	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* (page *127*).	1
	Reserved		2
	Frequency	*01.06 Output frequency* (page *127*).	3
	Current	*01.07 Motor current* (page *127*).	4
	Reserved		5
	Torque	*01.10 Motor torque* (page *127*).	6
	DC voltage	*01.11 DC voltage* (page *127*).	7
	Output power	*01.14 Output power* (page *128*).	8
	AI1	*12.11 AI1 actual value* (page *156*).	9
	AI2	*12.21 AI2 actual value* (page *158*).	10
	Reserved		11…17
	Speed ref ramp in	*23.01 Speed ref ramp input* (page *219*).	18
	Speed ref ramp out	*23.02 Speed ref ramp output* (page *219*).	19
	Speed ref used	*24.01 Used speed reference* (page *223*).	20
	Reserved		21
	Freq ref used	*28.02 Frequency ref ramp output* (page *230*).	22

No.	Name/Value	Description	Def/FbEq16
	Inverter temperature	*05.11 Inverter temperature* (page *133*).	23
	Process PID output	*40.01 Process PID output actual* (page *293*).	24
	Process PID feedback	*40.02 Process PID feedback actual* (page *294*).	25
	Process PID setpoint	*40.03 Process PID setpoint actual* (page *294*).	26
	Process PID deviation	*40.04 Process PID deviation actual* (page *294*).	27
	Other	Source selection (see *Terms and abbreviations* on page *124*).	-
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
	-21474836.00… 21474836.00	Low limit.	
32.10	*Supervision 1 high*	Defines the upper limit for signal supervision 1.	0.00
	-21474836.00… 21474836.00	Upper limit.	
32.11	*Supervision 1 hysteresis*	Defines the hysteresis for the signal monitored by signal supervision 1. This parameter applies to all selections for parameter *32.05 Supervision 1 function*, not just selection Hysteresis (7). Action is taken whenever the signal rises above the value defined by the upper limit + 0.5 · hysteresis. The action is deactivated when the signal falls below the value defined by the lower limit - 0.5 · hysteresis.	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 falls below its lower limit.	1
	High	Action is taken whenever the signal rises above its upper limit.	2
	Abs low	Action is taken whenever the absolute value of the signal falls below its (absolute) lower limit.	3
	Abs high	Action is taken whenever the absolute value of the signal rises above its (absolute) upper limit.	4
	Both	Action is taken whenever the signal falls below its low limit or rises above its high limit.	5
	Abs both	Action is taken whenever the absolute value of the signal falls below its (absolute) low limit or rises above its (absolute) high limit.	6
	Hysteresis	Action is taken whenever the signal rises above the value defined by the upper limit + 0.5 · hysteresis. The action is deactivated when the signal falls below the value defined by the lower limit - 0.5 · hysteresis.	7

No.	Name/Value	Description	Def/FbEq16
	Low falling	Action is taken whenever the absolute value of the signal falls below its (absolute) lower limit.	8
	High rising	Action is taken whenever the absolute value of the signal rises above its (absolute) upper limit.	9
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	Drive generates warning *A8B1 ABB Signal supervision 2*.	1
	Fault	Drive trips on fault *80B1 Signal supervision 2*.	2
	Fault if running	If running, the drive trips on fault *80B1 Signal supervision 2*.	3
32.17	*Supervision 2 signal*	Selects the signal to be monitored by signal supervision function 2. For the available selections, see parameter *32.07 Supervision 1 signal*.	*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
	-21474836.00… 21474836.00	Low limit.	
32.20	*Supervision 2 high*	Defines the upper limit for signal supervision 2.	0.00
	-21474836.00… 21474836.00	Upper limit.	
32.21	*Supervision 2 hysteresis*	Defines the hysteresis for the signal monitored by signal supervision 2. This parameter applies to all selections for parameter *32.15 Supervision 2 function*, not just selection Hysteresis (7). Action is taken whenever the signal rises above the value defined by the upper limit + 0.5 · hysteresis. The action is deactivated when the signal falls below the value defined by the lower limit - 0.5 · hysteresis.	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 falls below its lower limit.	1
	High	Action is taken whenever the signal rises above its upper limit.	2
	Abs low	Action is taken whenever the absolute value of the signal falls below its (absolute) lower limit.	3
	Abs high	Action is taken whenever the absolute value of the signal rises above its (absolute) upper limit.	4
	Both	Action is taken whenever the signal falls below its low limit or rises above its high limit.	5

No.	Name/Value	Description	Def/FbEq16
	Abs both	Action is taken whenever the absolute value of the signal falls below its (absolute) low limit or rises above its (absolute) high limit.	6
	Hysteresis	Action is taken whenever the signal rises above the value defined by the upper limit + 0.5 · hysteresis. The action is deactivated when the signal falls below the value defined by the lower limit - 0.5 · hysteresis.	7
	Low falling	Action is taken whenever the absolute value of the signal falls below its (absolute) lower limit.	8
	High rising	Action is taken whenever the absolute value of the signal rises above its (absolute) upper limit.	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	Drive generates warning *A8B2 ABB Signal supervision 3*.	1
	Fault	Drive trips on fault *80B2 Signal supervision 3*.	2
	Fault if running	If running, the drive trips on fault *80B2 Signal supervision 3*.	3
32.27	*Supervision 3 signal*	Selects the signal to be monitored by signal supervision function 3. For the available selections, see parameter *32.07 Supervision 1 signal*.	*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
	-21474836.00… 21474836.00	Low limit.	
32.30	*Supervision 3 high*	Defines the upper limit for signal supervision 3.	0.00
	-21474836.00… 21474836.00	Upper limit.	
32.31	*Supervision 3 hysteresis*	Defines the hysteresis for the signal monitored by signal supervision 3. This parameter applies to all selections for parameter *32.25 Supervision 3 function*, not just selection Hysteresis (7). Action is taken whenever the signal rises above the value defined by the upper limit + 0.5 · hysteresis. The action is deactivated when the signal falls below the value defined by the lower limit - 0.5 · hysteresis.	0.00
	0.00…100000.00	Hysteresis.	
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 falls below its lower limit.	1

No.	Name/Value	Description	Def/FbEq16
	High	Action is taken whenever the signal rises above its upper limit.	2
	Abs low	Action is taken whenever the absolute value of the signal falls below its (absolute) lower limit.	3
	Abs high	Action is taken whenever the absolute value of the signal rises above its (absolute) upper limit.	4
	Both	Action is taken whenever the signal falls below its low limit or rises above its high limit.	5
	Abs both	Action is taken whenever the absolute value of the signal falls below its (absolute) low limit or rises above its (absolute) high limit.	6
	Hysteresis	Action is taken whenever the signal rises above the value defined by the upper limit + 0.5 · hysteresis. The action is deactivated when the signal falls below the value defined by the lower limit - 0.5 · hysteresis.	7
	Low falling	Action is taken whenever the absolute value of the signal falls below its (absolute) lower limit.	8
	High rising	Action is taken whenever the absolute value of the signal rises above its (absolute) upper limit.	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	Drive generates warning *A8B3 ABB Signal supervision 4*.	1
	Fault	Drive trips on fault *80B3 Signal supervision 4*.	2
	Fault if running	If running, the drive trips on fault *80B3 Signal supervision 4*.	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
	-21474836.00… 21474836.00	Low limit.	
32.40	*Supervision 4 high*	Defines the upper limit for signal supervision 4.	0.00
	-21474836.00… 21474836.00	Upper limit.	
32.41	*Supervision 4 hysteresis*	Defines the hysteresis for the signal monitored by signal supervision 4. This parameter applies to all selections for parameter *32.35 Supervision 4 function*, not just selection Hysteresis (7). Action is taken whenever the signal rises above the value defined by the upper limit + 0.5 · hysteresis. The action is deactivated when the signal falls below the value defined by the lower limit - 0.5 · hysteresis.	0.00
	0.00…100000.00	Hysteresis.	

No.	Name/Value	Description	Def/FbEq16
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 falls below its lower limit.	1
	High	Action is taken whenever the signal rises above its upper limit.	2
	Abs low	Action is taken whenever the absolute value of the signal falls below its (absolute) lower limit.	3
	Abs high	Action is taken whenever the absolute value of the signal rises above its (absolute) upper limit.	4
	Both	Action is taken whenever the signal falls below its low limit or rises above its high limit.	5
	Abs both	Action is taken whenever the absolute value of the signal falls below its (absolute) low limit or rises above its (absolute) high limit.	6
	Hysteresis	Action is taken whenever the signal rises above the value defined by the upper limit + 0.5 · hysteresis. The action is deactivated when the signal falls below the value defined by the lower limit - 0.5 · hysteresis.	7
	Low falling	Action is taken whenever the absolute value of the signal falls below its (absolute) lower limit.	8
	High rising	Action is taken whenever the absolute value of the signal rises above its (absolute) upper limit.	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	Drive generates warning *A8B4 ABB Signal supervision 5*.	1
	Fault	Drive trips on fault *80B4 Signal supervision 5*.	2
	Fault if running	If running, the drive trips on fault *80B4 Signal supervision 5*.	3
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
	-21474836.00… 21474836.00	Low limit.	
32.50	*Supervision 5 high*	Defines the upper limit for signal supervision 5.	0.00
	-21474836.00… 21474836.00	Upper limit.	

6

No.	Name/Value	Description	Def/FbEq16
32.51	*Supervision 5 hysteresis*	Defines the hysteresis for the signal monitored by signal supervision 5. This parameter applies to all selections for parameter *32.45 Supervision 5 function*, not just selection Hysteresis (7). Action is taken whenever the signal rises above the value defined by the upper limit + 0.5 · hysteresis. The action is deactivated when the signal falls below the value defined by the lower limit - 0.5 · 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 falls below its lower limit.	1
	High	Action is taken whenever the signal rises above its upper limit.	2
	Abs low	Action is taken whenever the absolute value of the signal falls below its (absolute) lower limit.	3
	Abs high	Action is taken whenever the absolute value of the signal rises above its (absolute) upper limit.	4
	Both	Action is taken whenever the signal falls below its low limit or rises above its high limit.	5
	Abs both	Action is taken whenever the absolute value of the signal falls below its (absolute) low limit or rises above its (absolute) high limit.	6
	Hysteresis	Action is taken whenever the signal rises above the value defined by the upper limit + 0.5 · hysteresis. The action is deactivated when the signal falls below the value defined by the lower limit - 0.5 · hysteresis.	7
	Low falling	Action is taken whenever the absolute value of the signal falls below its (absolute) lower limit.	8
	High rising	Action is taken whenever the absolute value of the signal rises above its (absolute) upper limit.	9
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	Drive generates warning *A8B5 ABB Signal supervision 6*.	1
	Fault	Drive trips on fault *80B5 Signal supervision 6*.	2
	Fault if running	If running, the drive trips on fault *80B5 Signal supervision 6*.	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

No.	Name/Value	Description	Def/FbEq16
32.59	*Supervision 6 low*	Defines the lower limit for signal supervision 6.	0.00
	-21474836.00… 21474836.00	Low limit.	
32.60	*Supervision 6 high*	Defines the upper limit for signal supervision 6.	0.00
	-21474836.00… 21474836.00	Upper limit.	
32.61	*Supervision 6 hysteresis*	Defines the hysteresis for the signal monitored by signal supervision 6. This parameter applies to all selections for parameter *32.55 Supervision 6 function*, not just selection Hysteresis (7). Action is taken whenever the signal rises above the value defined by the upper limit + 0.5 · hysteresis. The action is deactivated when the signal falls below the value defined by the lower limit - 0.5 · hysteresis.	0.00
	0.00…100000.00	Hysteresis.	
34 Timed functions		Configuration of the timed functions. See section *Timed functions* on page *70*.	
34.01	*Timed functions status*	Status of the combined timers. The status of a combined timer is the logical OR of all timers connected to it. This parameter is read-only.	-
	0000h…FFFFh	Status of combined timers 1…3.	1 = 1
34.02	*Timer status*	Status of timers 1…12. This parameter is read-only.	-
	0000h…FFFFh	Timer status.	1 = 1

34.01 bits:

Bit	Name	Description
0	Timed function 1	1 = Active.
1	Timed function 2	1 = Active.
2	Timed function 3	1 = Active.
3…15	Reserved	

34.02 bits:

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	Def/FbEq16
34.04	*Season/exception day status*	Status of seasons 1…4, exception weekday 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	Season 1	1 = Active.
1	Season 2	1 = Active.
2	Season 3	1 = Active.
3	Season 4	1 = Active.
4…9	Reserved	
10	Exception workday	1 = Active.
11	Exception holiday	1 = Active.
12…15	Reserved	

No.	Name/Value	Description	Def/FbEq16
	0000h…FFFFh	Status of the seasons and exception weekday and holiday.	1 = 1
34.10	*Timed functions enable*	Selects the source for the timed functions enable signal. 0 = Disabled. 1 = Enabled.	*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
	DI5	Digital input DI5 (*10.02 DI delayed status*, bit 4).	6
	DI6	Digital input DI6 (*10.02 DI delayed status*, bit 5).	7
	Other [bit]	Source selection (see *Terms and abbreviations* on page *124*).	-

No.	Name/Value	Description	Def/FbEq16
34.11	*Timer 1 configuration*	Defines when timer 1 is active.	0000 0111 1000 0000b

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. The timer follows only weekday and season settings (bits 0…10 in the timer configuration) and the start time and duration of the timer (see *34.12* and *34.13*). Exception day settings, parameters *34.70*…*34.90*, do not have any effect on this timer. 1 = Exception days are enabled. The timer is active during the weekdays and seasons defined with bits 0…10 and the times defined by *34.12* and *34.13*. In addition, the timer is active during the exception days defined with bit 12, bit 13 and parameters *34.70*…*34.90*. If bit 12 and bit 13 are both zero, the timer is inactive during the exception days.
12	Holidays	This bit has no effect unless bit 11 = 1 (Exceptions days are enabled). When bits 11 and 12 are both 1, the timer is active during the weekdays and seasons defined with bits 0…10 and times defined by parameters *34.12* and *34.13*. In addition, the timer is active when the ongoing day is defined as Exception day Holiday by parameters *34.70*…*34.90* and the current time matches with the time range defined by *34.12* and *34.13*. During Exception days, weekday and season bits are ignored.
13	Workdays	This bit has no effect unless bit 11 = 1 (Exceptions enabled). When bits 11 and 13 are both 1, the Timer is active during the weekdays and seasons defined with bits 0…10 and the times defined by parameters *34.12* and *34.13*. In addition, the timer is active when the ongoing day is defined as Exception day Workday by parameters *34.70*…*34.90* and the current time matches with the time range defined by *34.12* and *34.13*. During Exception days, weekday and season bits are ignored.
14…15	Reserved	

No.	Name/Value	Description	Def/FbEq16
	Examples of how the timer configuration defines when the Timer is active are shown below.		

Bits of parameter *34.11 Timer 1 configuration*

Monday	Tuesday	Wednesday	Thursday	Friday	Saturday	Sunday	Season1	Season2	Season3	Season4	Exceptions	Holidays	Workdays	
1	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	0	0	0	**Example 1:** Timer is active during the times of the day defined by other parameters every Weekday and every Season. Exception day settings (*34.70*…*34.90*) do not have any effect on the Timer.
1	**1**	**1**	**1**	**1**	0	0	1	1	1	1	0	0	0	**Example 2:** Timer is active during the times of the day defined by other parameters from Mon to Fri, every Season. Exception day settings (*34.70*…*34.90*) do not have any effect on the Timer.
1	1	1	1	1	0	0	0	0	**1**	0	0	0	0	**Example 3:** Timer is active during the times of the day defined by other parameters from Mon to Fri, only during Season 3 (can be configured as, eg, summer). Exception day settings (*34.70*…*34.90*) do not have any effect on the Timer.
1	1	1	1	1	0	0	1	1	1	1	**1**	**1**	0	**Example 4:** Timer is active during the times of the day defined by other parameters from Mon to Fri, every Season. In addition, the Timer is active every Exception day Holidays, regardless what is the day or season.
1	0	1	0	1	0	1	1	1	0	0	**1**	0	**1**	**Example 5:** Timer is active during the times of the day defined by other parameters on Mon, Wed, Fri and Sun, during Season1 and Season 2. In addition, the Timer is active every Exception day Workdays, regardless what is the day or season.
1	1	1	1	1	1	1	1	1	1	1	**1**	**0**	**0**	**Example 6:** Timer is active during the times of the day defined by other parameters every Weekday and every Season. The Timer is inactive during all Exception days.

No.	Name/Value	Description	Def/FbEq16
	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. For example, 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.	

No.	Name/Value	Description	Def/FbEq16
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
	00 00:00…07 00:00	Timer duration.	1 = 1 min
34.14	*Timer 2 configuration*	See *34.11 Timer 1 configuration*.	0000 0111 1000 0000b
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*.	0000 0111 1000 0000b
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*.	0000 0111 1000 0000b
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*.	0000 0111 1000 0000b
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*.	0000 0111 1000 0000b
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*.	0000 0111 1000 0000b
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*.	0000 0111 1000 0000b
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*.	0000 0111 1000 0000b
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*.	0000 0111 1000 0000b
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

No.	Name/Value	Description	Def/FbEq16
34.41	*Timer 11 configuration*	See *34.11 Timer 1 configuration*.	0000 0111 1000 0000b
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*.	0000 0111 1000 0000b
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.	1 = 1

No.	Name/Value	Description	Def/FbEq16
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).	0000 0000 0000 0000b

Bit	Name	Description
0	Exception 1	0 = Workday. 1 = Holiday
1	Exception 2	0 = Workday. 1 = Holiday
2	Exception 3	0 = Workday. 1 = Holiday
3	Exception 4	0 = Workday. 1 = Holiday
4	Exception 5	0 = Workday. 1 = Holiday
5	Exception 6	0 = Workday. 1 = Holiday
6	Exception 7	0 = Workday. 1 = Holiday
7	Exception 8	0 = Workday. 1 = Holiday
8	Exception 9	0 = Workday. 1 = Holiday
9	Exception 10	0 = Workday. 1 = Holiday
10	Exception 11	0 = Workday. 1 = Holiday
11	Exception 12	0 = Workday. 1 = Holiday
12	Exception 13	0 = Workday. 1 = Holiday
13	Exception 14	0 = Workday. 1 = Holiday
14	Exception 15	0 = Workday. 1 = Holiday
15	Exception 16	0 = Workday. 1 = Holiday

	0000h…FFFFh	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 d
	0…60 d	Length of exception period 1.	1 = 1 d
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 d
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 d
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
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

No.	Name/Value	Description	Def/FbEq16
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 combined timer 1. 0 = Not connected. 1 = Connected. See *34.01 Timed functions status*.	0000 0000 0000 0000b

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	Def/FbEq16
	0000h…FFFFh	Timers connected to combined timer 1.	1 = 1
34.101	*Timed function 2*	Defines which timers are connected to combined timer 2. See *34.01 Timed functions status*.	0000 0000 0000 0000b
34.102	*Timed function 3*	Defines which timers are connected to combined timer 3. See *34.01 Timed functions status*.	0000 0000 0000 0000b
34.110	*Boost time function*	Defines which combined timers (that is, timers that are connected to the combined timers) are activated with the extra time function.	0000 0000 0000 0000b

Bit	Name	Description
0	Timed function 1	0 = Inactive. 1 = Active.
1	Timed function 2	0 = Inactive. 1 = Active.
2	Timed function 3	0 = Inactive. 1 = Active.
3…15	Reserved	

No.	Name/Value	Description	Def/FbEq16
	0000h…FFFFh	Combined timers including the extra timer.	1 = 1

No.	Name/Value	Description	Def/FbEq16
34.111	*Boost time activation source*	Selects the source of extra 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
	DI5	Digital input DI5 (*10.02 DI delayed status*, bit 4).	6
	DI6	Digital input DI6 (*10.02 DI delayed status*, bit 5).	7
	Other [bit]	Source selection (see *Terms and abbreviations* on page *124*).	-
34.112	*Boost time duration*	Defines the time inside which the extra time is deactivated after extra time activation signal is switched off. **Example:** If parameter *34.111 Boost time activation source* is set to *DI1* and *34.112 Boost time duration* is set to 00 01:30, the extra time is active for 1 hour and 30 minutes after digital input DI is deactivated.	00 00:00
	00 00:00…07 00:00	Extra time duration.	1 = 1 min

35 Motor thermal protection		Motor thermal protection settings such as temperature measurement configuration, load curve definition and motor fan control configuration; motor overload protection. See also section *Programmable protection functions* (page *117*).	
35.01	*Motor estimated temperature*	Displays the motor temperature as estimated by the internal motor thermal protection model (see parameters *35.50*…*35.55*). The unit is selected by parameter *96.16 Unit selection*. This parameter is read-only.	-
	-60…1000 °C or -76…1832 °F	Estimated motor temperature.	1 = 1 unit

No.	Name/Value	Description	Def/FbEq16
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*. **Notes:** • With a PTC sensor, the value shown is not a valid measurement. Either 0 ohm (normal temperature) or the value of parameter *35.12 Temperature 1 fault limit* (excessive temperature) is shown. • With a PTC sensor connected to DI6, the unit is ohms. • If the measured temperature source selection (*35.11*) is PTC analog I/O, 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 if 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*). This parameter is read-only.	-
	-60…5000 °C or -76…9032 °F, or 0...5000 ohm or [*35.12*] ohm or [*35.14*] ohm	Measured temperature 2.	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*. **Notes:** • With a PTC sensor, the value shown is not a valid measurement. Either 0 ohm (normal temperature) or the value of parameter *35.22 Temperature 2 fault limit* (excessive temperature) is shown. • With a PTC sensor connected to DI6, the unit is ohms. • If the measured temperature source selection (*35.21*) is PTC analog I/O, 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 if 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*). This parameter is read-only.	-
	-60…5000 °C or -76…9032 °F or 0...5000 ohm or [*35.22*] ohm or [*35.24*] ohm	Measured temperature 2.	1 = 1 unit
35.05	*Motor overload level*	Motor overload level as a percent of the motor overload fault limit. See section *Motor overload protection* (page *99*). 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.	-

No.	Name/Value	Description	Def/FbEq16
35.11	*Temperature 1 source*	Selects the source from which measured temperature 1 is read. Usually this source is from a sensor connected to the motor controlled by the drive, but it could be used to measure and monitor a temperature from other parts of the process as long as a suitable sensor is used as per the selection list.	*Estimated temperature*
	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 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.	2
	Reserved		3…4
	1 × Pt100 analog I/O	Pt100 sensor connected to a standard analog input selected by parameter *35.14 Temperature 1 AI source* and an analog output. The following settings are required: • Set the hardware jumper or switch related to the analog input to ***U*** (voltage). Any change must be validated by a control unit reboot. • Set the appropriate analog input unit selection parameter in group *12 Standard AI* to *V* (volt). • In parameter group *13 Standard AO*, set the source selection parameter of the analog output to *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 × Pt100 analog I/O	As selection *1 × Pt100 analog I/O*, but with two sensors connected in series. Using multiple sensors improves measurement accuracy significantly.	6
	3 × Pt100 analog I/O	As selection *1 × Pt100 analog I/O*, but with three sensors connected in series. Using multiple sensors improves measurement accuracy significantly.	7

No.	Name/Value	Description	Def/FbEq16
	PTC DI6	PTC sensor is connected to DI6. **Note:** With a PTC sensor, the value shown is not a valid measurement. Either 0 ohm (normal temperature) or the value of parameter *35.22 Temperature 2 fault limit* (excessive temperature) is shown.	8
	Reserved		9…10
	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 *96.16*.	11
	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	Def/FbEq16
	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
	Reserved		17…18
	PTC extension module	PTC is connected to the CMOD-02 multifunction extension module, which is installed in drive slot 2. See chapter *Optional I/O extension modules, section CMOD-02 multifunction extension module (external 24 V AC/DC and isolated PTC interface)* in the *Hardware manual* of the drive).	19
	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*. 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 *35.02*. The parameter name and unit still refer to temperature.	20
	Therm(0)	PTC sensor or a normally closed thermistor relay connected to digital input DI6. The motor is overheated when the digital input is 0.	21
	Therm(1)	Normally open thermistor relay connected to digital input DI6. The motor is overheated when the digital input is 1.	22
	Reserved		23
35.12	*Temperature 1 fault limit*	Defines the fault limit for temperature supervision function 1. When measured temperature 1 exceeds the limit, the drive trips on fault *4981 External temperature 1*. The unit is selected by parameter *96.16 Unit selection*. **Notes:** • With a PTC sensor, the unit is ohms. • With a PTC sensor, changing the value of this parameter has no effect on fault generation. When PTC is over the triggering threshold of the CMOD-02 (see the *Hardware manual*), the drive trips on the fault and when PTC has decreased below recovery threshold of the CMOD-02 (see the *Hardware manual*), the fault can be reset manually.	130 °C or 266 °F or 4500 ohm
	-60…5000 °C or -76…9032 °F or 0…5000 ohm	Fault limit for temperature monitoring function 1.	1 = 1 unit

No.	Name/Value	Description	Def/FbEq16
35.13	*Temperature 1 warning limit*	Defines the warning limit for temperature supervision function 1. When measured temperature 1 exceeds the limit, warning *A491 External temperature 1* is generated. The unit is selected by parameter *96.16 Unit selection*. **Notes:** • With a PTC sensor, the unit is ohms. • With a PTC sensor, changing the value of this parameter has no effect on warning generation. When PTC is over the triggering threshold of the CMOD-02 (see the *Hardware manual*), the drive trips on the fault and when PTC has decreased below recovery threshold of the CMOD-02 (see the *Hardware manual*), the fault can be reset manually.	110 °C or 230 °F or 4000 ohm
	-60…5000 °C or -76…9032 °F or 0…5000 ohm	Warning limit for temperature monitoring function 1.	1 = 1 unit
35.14	*Temperature 1 AI source*	Specifies the analog input when the setting of *35.11 Temperature 1 source* requires measurement through an analog input. **Note:** If parameter *35.11 Temperature 1 source* is set to *Direct temperature*, use selection *Other* here, and point to *12.12 AI1 scaled value*.	*Not selected*
	Not selected	None.	0
	AI1 actual value	Analog input AI1 on the control unit.	1
	AI2 actual value	Analog input AI2 on the control unit.	2
	Other	Source selection (see *Terms and abbreviations* on page *124*).	-
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 temperature*
	Disabled	None. Temperature monitoring function 2 is disabled.	0
	Estimated temperature	Estimated motor temperature (see parameter *35.01 Motor estimated temperature*). The temperature is estimated from an internal drive calculation. It is important to set up the ambient temperature of the motor in *35.50 Motor ambient temperature*.	1

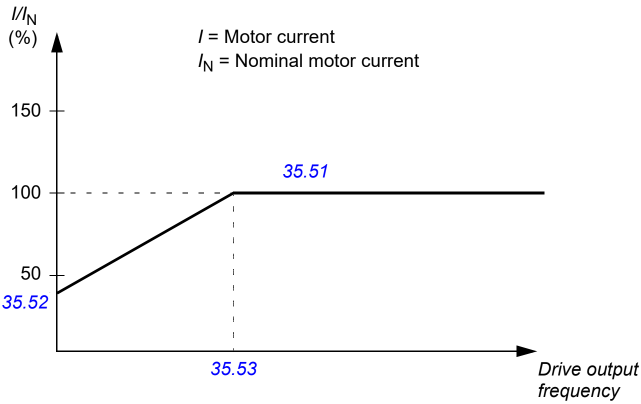
No.	Name/Value	Description	Def/FbEq16
	KTY84 analog I/O	KTY84 sensor connected to the analog input selected by parameter *35.24 Temperature 2 AI source* and an analog output. The following settings are required: • Set the hardware jumper or switch related to the analog input to ***U*** (voltage). Any 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
	Reserved		3…4
	1 × Pt100 analog I/O	Pt100 sensor connected to a standard analog input selected by parameter *35.24 Temperature 2 AI source* and an analog output. The 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.	5
	2 × Pt100 analog I/O	As selection *1 × Pt100 analog I/O*, but with two sensors connected in series. Using multiple sensors improves measurement accuracy significantly.	6
	3 × Pt100 analog I/O	As selection *1 × Pt100 analog I/O*, but with three sensors connected in series. Using multiple sensors improves measurement accuracy significantly.	7
	PTC DI6	PTC sensor is connected to DI6. **Note:** With a PTC sensor, the value shown is not a valid measurement. Either 0 ohm (normal temperature) or the value of parameter *35.22 Temperature 2 fault limit* (excessive temperature) is shown.	8
	Reserved		9…10
	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 *96.16*.	11

No.	Name/Value	Description	Def/FbEq16
	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 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.	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 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
	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 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.	16

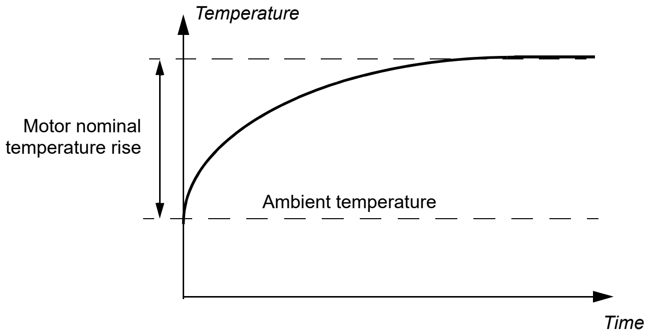
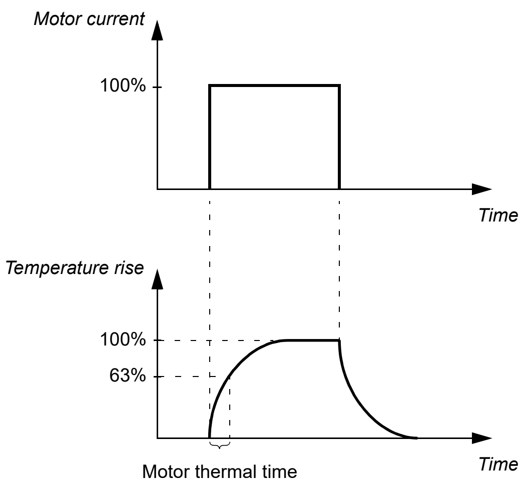
No.	Name/Value	Description	Def/FbEq16
	Reserved		17…18
	PTC extension module	PTC is connected to the CMOD-02 multifunction extension module, which is installed in drive slot 2. See chapter *Optional I/O extension modules, section CMOD-02 multifunction extension module (external 24 V AC/DC and isolated PTC interface)* in the *Hardware manual* of the drive).	19
	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
	Therm(0)	PTC sensor or a normally closed thermistor relay connected to digital input DI6. The motor is overheated when the digital input is 0.	21
	Therm(1)	Normally open thermistor relay connected to digital input DI6. The motor is overheated when the digital input is 1.	22
35.22	*Temperature 2 fault limit*	Defines the fault limit for temperature supervision function 2. When measured temperature 1 exceeds the limit, the drive trips on fault *4982 External temperature 2*. The unit is selected by parameter *96.16 Unit selection*. **Notes:** • With a PTC sensor, the unit is ohms. • With a PTC sensor, changing the value of this parameter has no effect on warning generation. When PTC is over the triggering threshold of the CMOD-02 (see the *Hardware manual*), the drive trips on the fault and when PTC has decreased below recovery threshold of the CMOD-02 (see the *Hardware manual*), the fault can be reset manually.	130 °C or 266 °F or 4500 ohm
	-60…5000 °C or -76…9032 °F or 0…5000 ohm	Fault limit for temperature monitoring function 2.	1 = 1 unit
35.23	*Temperature 2 warning limit*	Defines the warning limit for temperature supervision function 2. When measured temperature 1 exceeds the limit, warning *A492 External temperature 2* is generated. The unit is selected by parameter *96.16 Unit selection*. **Notes:** • With a PTC sensor, the unit is ohms. • With a PTC sensor, changing the value of this parameter has no effect on fault generation. When PTC is over the triggering threshold of the CMOD-02 (see the *Hardware manual*), the drive trips on the fault and when PTC has decreased below recovery threshold of the CMOD-02 (see the *Hardware manual*), the fault can be reset manually.	110 °C or 230 °F or 4000 ohm
	-60…5000 °C or -76…9032 °F or 0…500 0 ohm	Warning limit for temperature monitoring function 2.	1 = 1 unit

No.	Name/Value	Description	Def/FbEq16
35.24	*Temperature 2 AI source*	Specifies the analog input when the setting of *35.11 Temperature 1 source* requires measurement through an analog input.	*Not selected*
	Not selected	None.	0
	AI1 actual value	Analog input AI1 on the control unit.	1
	AI2 actual value	Analog input AI2 on the control unit.	2
	Other	Source selection (see *Terms and abbreviations* on page *124*).	-
35.31	*Safe motor temperature enable*	Activates or deactivates the Safe motor temperature (SMT) fault indication *4991 Safe motor temperature*. Automatically activated when the CPTC-02 ATEX-certified thermistor protection module is connected to the drive.	*Off*
	Off	Activated.	0
	On	Deactivated.	1
35.50	*Motor ambient temperature*	Defines the ambient temperature of the motor for the motor thermal protection model. The unit is selected by parameter *96.16 Unit selection*. The motor thermal protection model estimates the motor temperature on the basis of parameters *35.50*…*35.55*. The motor temperature increases if it operates in the region above the load curve, and decreases if it operates in the region below the load curve. **WARNING!** The model cannot protect the motor if the motor does not cool properly because of dust, dirt, etc.	20 °C or 68 °F
	-60…100 °C or -76 … 212 °F	Ambient temperature.	1 = 1 unit

No.	Name/Value	Description	Def/FbEq16
35.51	*Motor load curve*	Defines the maximum thermal load of the motor. If the load is above the curve, the motor can be overheated. 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%



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

<table>
<tr><th>No.</th><th>Name/Value</th><th>Description</th><th>Def/FbEq16</th></tr>
<tr><td>35.54</td><td>Motor nominal temperature rise</td><td>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.</td><td>80 °C or 176 °F</td></tr>
<tr><td colspan="4">
</td></tr>
<tr><td></td><td>0…300 °C or 32…572 °F</td><td>Temperature rise.</td><td>1 = 1 unit</td></tr>
<tr><td>35.55</td><td>Motor thermal time constant</td><td>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.
For thermal protection according to UL requirements for NEMA class motors, use the rule of thumb: Motor thermal time equals 35 times t6, where t6 (in seconds) is specified by the motor manufacturer as the time that the motor can safely operate at six time its rated current.</td><td>256 s</td></tr>
<tr><td colspan="4">
</td></tr>
<tr><td></td><td>100…10000 s</td><td>Motor thermal time constant.</td><td>1 = 1 s</td></tr>
</table>

No.	Name/Value	Description	Def/FbEq16
35.56	*Motor overload action*	Selects the action taken when the system detects the motor overload specified by parameter *35.57*. See section *Motor overload protection* (page *99*).	*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 Motor overload level* reaches value 88.0%.	1
	Warning and fault	Drive generates warning *A783 Motor overload* when the motor is overloaded to the warning level, that is, parameter *35.05 Motor overload level* reaches value 88.0%. Drive trips on fault *7122 Motor overload* when the motor is overloaded to the fault level, that is, parameter *35.05 Motor overload level* reaches value 100.0%.	2
35.57	*Motor overload class*	Defines the motor overload class to be used. The class of protection is specified by the user as the time for tripping at 7.2 times (IEC 60947-4-1) or 6 times (NEMA ICS) the tripping level current. See section *Motor overload protection* (page *99*).	*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 logger is also reset whenever the signal source is changed. The date and time of the last reset are stored into parameters *36.16* and *36.17* respectively.	*Output power*
	Not selected	None (peak value logger disabled).	0
	Motor speed used	*01.01 Motor speed used* (page *127*).	1
	Reserved		2
	Output frequency	*01.06 Output frequency* (page *127*).	3
	Motor current	*01.07 Motor current* (page *127*).	4
	Reserved		5
	Motor torque	*01.10 Motor torque* (page *127*).	6
	DC voltage	*01.11 DC voltage* (page *127*).	7
	Output power	*01.14 Output power* (page *128*).	8
	Reserved		9
	Speed ref ramp in	*23.01 Speed ref ramp input* (page *219*).	10
	Speed ref ramp out	*23.02 Speed ref ramp output* (page *219*).	11
	Speed ref used	*24.01 Used speed reference* (page *223*).	12

No.	Name/Value	Description	Def/FbEq16
	Reserved		13
	Freq ref used	28.02 Frequency ref ramp output (page 230).	14
	Reserved		15
	Process PID out	40.01 Process PID output actual (page 293).	16
	Other	Source selection (see Terms and abbreviations on page 124).	-
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 logger is also reset whenever the signal source or scaling is changed. The date and time of the last reset are stored into parameters 36.50 and 36.51 respectively. For the selections, see parameter 36.01 PVL signal source.	Motor torque
36.07	AL2 signal scaling	Defines the signal value that corresponds to 100% amplitude.	100.00
	0.00…32767.00	Signal value corresponding to 100%.	1 = 1
36.09	Reset loggers	Resets the peak value logger and/or amplitude logger 2. (Amplitude logger 1 cannot be reset.)	Done
	Done	Reset completed or not requested (normal operation).	0
	All	Reset both the peak value logger and amplitude logger 2.	1
	PVL	Reset the peak value logger.	2
	AL2	Reset amplitude logger 2.	3
36.10	PVL peak value	Peak value recorded by the peak value logger.	0.00
	-32768.00… 32767.00	Peak value.	1 = 1
36.11	PVL peak date	The date on which the peak value was recorded.	01.01.1980
	-	Peak occurrence date.	-
36.12	PVL peak time	The time at which the peak value was recorded.	00:00:05
	-	Peak occurrence time.	-
36.13	PVL current at peak	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	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	Motor speed at the moment the peak value was recorded.	0.00 rpm
	-30000.00… 30000.00 rpm	Motor speed at peak.	See par. 46.01

No.	Name/Value	Description	Def/FbEq16
36.16	*PVL reset date*	The date on which the peak value logger was last reset.	01.01.1980
	-	Last reset date of the peak value logger.	
36.17	*PVL reset time*	The time at which the peak value logger was last reset.	00:00:05
	-	Last reset time of the peak value logger.	
36.20	*AL1 0 to 10%*	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* of the drive.	0.00%
	0.00…100.00%	Amplitude logger 1 samples between 0 and 10%.	1 = 1%
36.21	*AL1 10 to 20%*	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%*	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%*	Percentage of samples recorded by amplitude logger 1 that fall between 30 and 40%.	0.00%
	0.00…100.00%	Amplitude logger 1 samples between 30 and 40%.	1 = 1%
36.24	*AL1 40 to 50%*	Percentage of samples recorded by amplitude logger 1 that fall between 40 and 50%.	0.00%
	0.00…100.00%	Amplitude logger 1 samples between 40 and 50%.	1 = 1%
36.25	*AL1 50 to 60%*	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%

No.	Name/Value	Description	Def/FbEq16
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%
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
	-	Last reset date of amplitude logger 2.	
36.51	AL2 reset time	The time at which amplitude logger 2 was last reset.	00:00:05
	-	Last reset time of amplitude logger 2.	

37 User load curve		Settings for user load curve. See also section User load curve (page 120).	
37.01	ULC output status word	Displays the status of the monitored signal. 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.	-

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 % (page 127).	1

No.	Name/Value	Description	Def/FbEq16
	Motor current %	*01.08 Motor current % of motor nom* (page *127*).	2
	Motor torque %	*01.10 Motor torque* (page *127*).	3
	Output power % of motor nominal	*01.15 Output power % of motor nom* (page *128*).	4
	Output power % of drive nominal	Output power % of drive nominal.	5
	Other	Source selection (see *Terms and abbreviations* on page *124*).	-
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 action taken.	0
	Warning	Drive generates warning *A8BE ULC overload warning*.	1
	Fault	Drive trips on fault *8002 ULC overload fault*.	2
	Warning/Fault	Drive generates warning *A8BE ULC overload warning* if the signal stays continuously above the overload curve for half of the time defined by parameter *37.41 ULC overload timer*. Drive trips on fault *8002 ULC overload fault* if the signal stays continuously above the overload curve for a time defined by parameter *37.41 ULC overload timer*.	3
37.04	*ULC underload actions*	Selects how the drive reacts if the absolute value of the monitored signal stays continuously above the overload curve for longer than the value of *37.42 ULC underload timer*.	*Disabled*
	Disabled	No action taken.	0
	Warning	Drive generates warning *A8BF ULC underload warning*.	1
	Fault	Drive trips on fault *8001 ULC underload fault*.	2
	Warning/Fault	Drive generates warning *A8BF ULC underload warning* if the signal stays continuously below the underload curve for half of the time defined by parameter *37.41 ULC overload timer*. Drive trips on fault *8001 ULC underload fault* if the signal stays continuously above the underload curve for a time defined by parameter *37.42 ULC underload timer*.	3
37.11	*ULC speed table point 1*	Defines the first of the five speed points on the X-axis of the user load curve. 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

No.	Name/Value	Description	Def/FbEq16
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
37.16	*ULC frequency table point 1*	Defines the first of the five frequency points on the X-axis of the user load curve. 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
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*…*37.20 ULC frequency table point 5*) define the underload (lower) curve. Each point of the underload curve must have a lower value than the corresponding overload point.	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%

No.	Name/Value	Description	Def/FbEq16
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 speed table point 5* or *37.15 ULC speed table point 5*…*37.20 ULC frequency table point 5*) define the overload (higher) curve. Each point of the overload curve must have a higher value than the corresponding underload point.	300.0%
	-1600.0…1600.0%	Overload point.	1 = 1%
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	Overload timer.	1 = 1 s
37.42	*ULC underload timer*	Defines the time for which the monitored signal must continuously stay below the underload curve before the drive takes the action selected by *37.04 ULC underload actions*.	20.0 s
	0.0…10000.0 s	Underload timer	1 = 1 s

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 control chain diagrams *PID setpoint compensation* on page *527* and *Direction lock* on page *532*. To set the PID customer unit, select **Menu > Primary settings > PID > Unit** on the control panel.	
40.01	*Process PID output actual*	Displays the output of the process PID controller. See control chain diagram *Process PID controller* on page *529*. This parameter is read-only.	-
	-200000.00…200000.00	Process PID controller output.	1 = 1

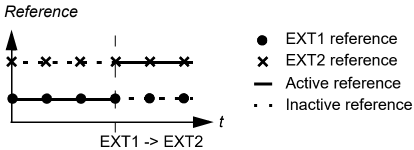
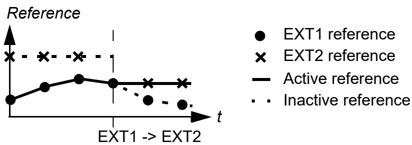
No.	Name/Value	Description	Def/FbEq16
40.02	*Process PID feedback actual*	Displays the value of process feedback after source selection, mathematical function (parameter *40.10 Set 1 feedback function*), and filtering. See control chain diagram *PID setpoint compensation* on page *527*. This parameter is read-only.	-
	-200000.00…200000.00 PID unit 1	Process feedback.	1 = 1 PID unit 1
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 control chain diagram *PID setpoint compensation* on page *527*. This parameter is read-only.	-
	-200000…200000 PID unit 1	Setpoint for process PID controller.	1 = 1 PID unit 1
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 control chain diagram *Process PID controller* on page *529*. This parameter is read-only.	-
	-200000.00…200000.00 PID unit 1	PID deviation.	1 = 1 PID unit 1
40.06	*Process PID status word*	Displays status information on process PID control. This parameter is read-only.	-

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	Reserved	
6	Tracking mode	1 = Tracking function active.
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 = Feedback value is in the deadband range (*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 par. *40.16*…*40.23*).
13…15	Reserved	

No.	Name/Value	Description	Def/FbEq16
	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 control vs. external control* (page *53*).	*Off*
	Off	Process PID control inactive.	0
	On	Process PID control active.	1

No.	Name/Value	Description	Def/FbEq16
	On when drive running	Process PID control is active when the drive is running.	2
40.08	*Set 1 feedback 1 source*	Selects the primary source of process feedback. See control chain diagram *PID setpoint compensation* on page *527*.	*AI2 scaled*
	Not selected	None.	0
	AI1 scaled	*12.12 AI1 scaled value* (see page *156*).	1
	AI2 scaled	*12.22 AI2 scaled value* (see page *158*).	2
	Freq in scaled	*11.39 Freq in 1 scaled value* (see page *154*).	3
	Reserved		4…7
	AI1 percent	*12.101 AI1 percent value* (see page *159*).	8
	AI2 percent	*12.102 AI2 percent value* (see page *159*).	9
	Feedback data storage	*40.91 Feedback data storage* (see page *309*). (Selection not available for parameter *71.08 Feedback 1 source*.)	10
	Other	Source selection (see *Terms and abbreviations* on page *124*).	-
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*. The result of the function (for any selection) is multiplied by parameter *40.90 Set 1 feedback multiplier*. (That is why in selections 12 and 13, the multiplier k is constant 1.)	*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
	k*sqrt(In1)	Square root of source 1. (k = 1)	12
	k*sqrt(In1-In2)	Square root of (source 1 - source 2). (k = 1)	13
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

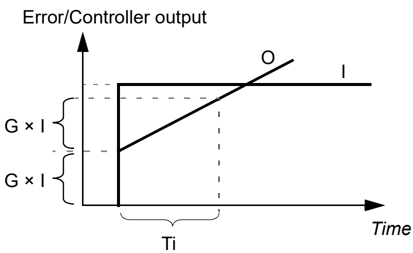
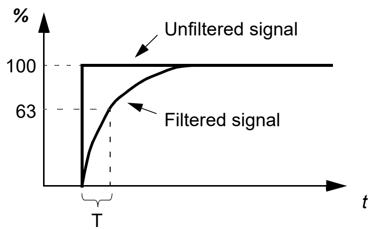
<table>
<tr><th>No.</th><th>Name/Value</th><th>Description</th><th>Def/FbEq16</th></tr>
<tr><td>40.14</td><td>Set 1 setpoint scaling</td><td>Defines, together with parameter 40.15 Set 1 output scaling, a general scaling factor for the process PID control chain.
If the parameter is set to zero, automatic setpoint scaling is activated, where suitable setpoint scale is calculated according to selected setpoint source. Actual setpoint scale is shown in parameter 40.61 Setpoint scaling actual.
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.</td><td>0.00</td></tr>
<tr><td></td><td>-200000.00…
200000.00</td><td>Process setpoint base.</td><td>1 = 1</td></tr>
<tr><td>40.15</td><td>Set 1 output scaling</td><td>See parameter 40.14 Set 1 setpoint scaling.
If the parameter is set to zero, scaling is automatic:
<table><tr><th>Operation mode
(see par. 19.01)</th><th>Scaling</th></tr><tr><td>Speed control</td><td>46.01 Speed scaling</td></tr><tr><td>Frequency control</td><td>46.02 Frequency scaling</td></tr></table></td><td>0.00</td></tr>
<tr><td></td><td>-200000.00…
200000.00</td><td>Process PID controller output base.</td><td>1 = 1</td></tr>
<tr><td>40.16</td><td>Set 1 setpoint 1 source</td><td>Selects the primary source of process PID setpoint. See the control chain diagram on page 527.</td><td>Internal setpoint</td></tr>
<tr><td></td><td>Not selected</td><td>None.</td><td>0</td></tr>
<tr><td></td><td>Reserved</td><td></td><td>1</td></tr>
<tr><td></td><td>Internal setpoint</td><td>Internal setpoint. See parameter 40.19 Set 1 internal setpoint sel1.</td><td>2</td></tr>
<tr><td></td><td>AI1 scaled</td><td>12.12 AI1 scaled value (see page 156).</td><td>3</td></tr>
<tr><td></td><td>AI2 scaled</td><td>12.22 AI2 scaled value (see page 158).</td><td>4</td></tr>
<tr><td></td><td>Reserved</td><td></td><td>5…7</td></tr>
<tr><td></td><td>Motor potentiometer</td><td>22.80 Motor potentiometer ref act (output of the Floating point control (Motor potentiometer)).</td><td>8</td></tr>
<tr><td></td><td>Reserved</td><td></td><td>9</td></tr>
<tr><td></td><td>Freq in scaled</td><td>11.39 Freq in 1 scaled value (see page 154).</td><td>10</td></tr>
<tr><td></td><td>AI1 percent</td><td>12.101 AI1 percent value (see page 159)</td><td>11</td></tr>
<tr><td></td><td>AI2 percent</td><td>12.102 AI2 percent value (see page 159)</td><td>12</td></tr>
</table>

No.	Name/Value	Description	Def/FbEq16
	Control panel (ref saved)	Control panel reference (*03.01 Panel reference*, see page *130*) saved by the control system for the location where the control returns is used as the reference. (Selection not available for parameter *71.16 Setpoint 1 source*.) 	13
	Control panel (ref copied)	Control panel reference (*03.01 Panel reference*, see page *130*) 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* (see page *130*).	15
	FB A ref2	*03.06 FB A reference 2* (see page *131*).	16
	Reserved		17…18
	EFB ref1	*03.09 EFB reference 1* (see page *131*).	19
	EFB ref2	*03.10 EFB reference 2* (see page *131*).	20
	Reserved		21…23
	Setpoint data storage	*40.92 Setpoint data storage* (see page *309*). (Selection not available for parameter *71.16 Setpoint 1 source*.)	24
	Compensated setpoint	*40.70 Compensated setpoint* (see page *306*).	25
	Other	Source selection (see *Terms and abbreviations* on page *124*).	-
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*. The result of the function (for any selection) is multiplied by parameter *40.89 Set 1 setpoint multiplier*. (That is why in selections 12 and 13, the multiplier k is constant 1.)	*In1*
	In1	Source 1.	0
	In1+In2	Sum of sources 1 and 2.	1
	In1-In2	Source 2 subtracted from source 1.	2

No.	Name/Value	Description	Def/FbEq16
	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
	k*sqrt(In1)	Square root of source 1. (k = 1)	12
	k*sqrt(In1-In2)	Square root of (source 1 - source 2). (k = 1)	13
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*…*40.24*. **Note:** Parameters *40.16 Set 1 setpoint 1 source* and *40.17 Set 1 setpoint 2 source* must be set to *Internal setpoint*. **Source defined by par. *40.19*** / **Source defined by par. *40.20*** / **Setpoint preset active** 0 / 0 / 0 (par. ***40.24***) 1 / 0 / 1 (par. ***40.21***) 0 / 1 / 2 (par. ***40.22***) 1 / 1 / 3 (par. ***40.23***)	*Not selected*
	Not selected	0.	0
	Selected	1.	1
	DI1	Digital input DI1 (*10.02 DI delayed status*, bit 0).	2
	DI2	Digital input DI2 (*10.02 DI delayed status*, bit 1).	3
	DI3	Digital input DI3 (*10.02 DI delayed status*, bit 2).	4
	DI4	Digital input DI4 (*10.02 DI delayed status*, bit 3).	5
	DI5	Digital input DI5 (*10.02 DI delayed status*, bit 4).	6
	DI6	Digital input DI6 (*10.02 DI delayed status*, bit 5).	7
	Reserved		8…17
	Timed function 1	Bit 0 of *34.01 Timed functions status* (see page *267*).	18
	Timed function 2	Bit 1 of *34.01 Timed functions status* (see page *267*).	19
	Timed function 3	Bit 2 of *34.01 Timed functions status* (see page *267*).	20
	Supervision 1	Bit 0 of *32.01 Supervision status* (see page *259*).	21
	Supervision 2	Bit 1 of *32.01 Supervision status* (see page *259*).	22
	Supervision 3	Bit 2 of *32.01 Supervision status* (see page *259*).	23
	Other [bit]	Source selection (see *Terms and abbreviations* on page *124*).	-
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

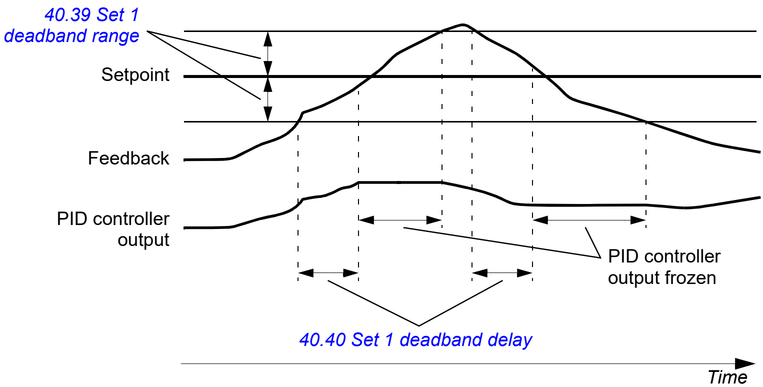
No.	Name/Value	Description	Def/FbEq16
	Selected	1.	1
	DI1	Digital input DI1 (*10.02 DI delayed status*, bit 0).	2
	DI2	Digital input DI2 (*10.02 DI delayed status*, bit 1).	3
	DI3	Digital input DI3 (*10.02 DI delayed status*, bit 2).	4
	DI4	Digital input DI4 (*10.02 DI delayed status*, bit 3).	5
	DI5	Digital input DI5 (*10.02 DI delayed status*, bit 4).	6
	DI6	Digital input DI6 (*10.02 DI delayed status*, bit 5).	7
	Reserved		8…17
	Timed function 1	Bit 0 of *34.01 Timed functions status* (see page *267*).	18
	Timed function 2	Bit 1 of *34.01 Timed functions status* (see page *267*).	19
	Timed function 3	Bit 2 of *34.01 Timed functions status* (see page *267*).	20
	Supervision 1	Bit 0 of *32.01 Supervision status* (see page *259*).	21
	Supervision 2	Bit 1 of *32.01 Supervision status* (see page *259*).	22
	Supervision 3	Bit 2 of *32.01 Supervision status* (see page *259*).	23
	Other [bit]	Source selection (see *Terms and abbreviations* on page *124*).	-
40.21	*Set 1 internal setpoint 1*	Internal process setpoint 1. See parameter *40.19 Set 1 internal setpoint sel1*.	0.00 PID unit 1
	-200000.00… 200000.00 PID unit 1	Internal process setpoint 1.	1 = 1 PID unit 1
40.22	*Set 1 internal setpoint 2*	Internal process setpoint 2. See parameter *40.19 Set 1 internal setpoint sel1*.	0.00 PID unit 1
	-200000.00… 200000.00 PID unit 1	Internal process setpoint 2.	1 = 1 PID unit 1
40.23	*Set 1 internal setpoint 3*	Internal process setpoint 3. See parameter *40.19 Set 1 internal setpoint sel1*.	0.00 PID unit 1
	-200000.00… 200000.00 PID unit 1	Internal process setpoint 3.	1 = 1 PID unit 1
40.24	*Set 1 internal setpoint 0*	Internal process setpoint 0. See parameter *40.19 Set 1 internal setpoint sel1*.	0.00 PID unit 1
	-200000.00… 200000.00 PID unit 1	Internal process setpoint 0.	1 = 1 PID unit 1
40.26	*Set 1 setpoint min*	Defines a minimum limit for the process PID controller setpoint.	0.00 PID unit 1
	-200000.00… 200000.00 PID unit 1	Minimum limit for process PID controller setpoint.	1 = 1 PID unit 1
40.27	*Set 1 setpoint max*	Defines a maximum limit for the process PID controller setpoint.	200000.00 PID unit 1
	-200000.00… 200000.00 PID unit 1	Maximum limit for process PID controller setpoint.	1 = 1 PID unit 1

No.	Name/Value	Description	Def/FbEq16
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
	DI5	Digital input DI5 (*10.02 DI delayed status*, bit 4).	6
	DI6	Digital input DI6 (*10.02 DI delayed status*, bit 5).	7
	Reserved		8…17
	Timed function 1	Bit 0 of *34.01 Timed functions status* (see page *267*).	18
	Timed function 2	Bit 1 of *34.01 Timed functions status* (see page *267*).	19
	Timed function 3	Bit 2 of *34.01 Timed functions status* (see page *267*).	20
	Supervision 1	Bit 0 of *32.01 Supervision status* (see page *259*).	21
	Supervision 2	Bit 1 of *32.01 Supervision status* (see page *259*).	22
	Supervision 3	Bit 2 of *32.01 Supervision status* (see page *259*).	23
	Other [bit]	Source selection (see *Terms and abbreviations* on page *124*).	-
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 *75*).	*Not inverted (Ref - Fbk)*
	Not inverted (Ref - Fbk)	0.	0
	Inverted (Fbk - Ref)	1.	1
	Other [bit]	Source selection (see *Terms and abbreviations* on page *124*).	-
40.32	*Set 1 gain*	Defines the gain for the process PID controller. See parameter *40.33 Set 1 integration time.*	2.00
	0.01…100.00	Gain for PID controller.	100 = 1

No.	Name/Value	Description	Def/FbEq16
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 Ti = integration time **Note:** Setting this value to 0 disables the “I” part, turning the PID controller into a PD controller.	15.0 s
	0.0…9999.0 s	Integration time.	1 = 1 s
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 T = filter time constant	0.0 s
	0.0…10.0 s	Filter time constant.	10 = 1 s

No.	Name/Value	Description	Def/FbEq16
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
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
	DI5	Digital input DI5 (*10.02 DI delayed status*, bit 4).	6
	DI6	Digital input DI6 (*10.02 DI delayed status*, bit 5).	7
	Reserved		8…17
	Timed function 1	Bit 0 of *34.01 Timed functions status* (see page *267*).	18
	Timed function 2	Bit 1 of *34.01 Timed functions status* (see page *267*).	19
	Timed function 3	Bit 2 of *34.01 Timed functions status* (see page *267*).	20
	Supervision 1	Bit 0 of *32.01 Supervision status* (see page *259*).	21
	Supervision 2	Bit 1 of *32.01 Supervision status* (see page *259*).	22
	Supervision 3	Bit 2 of *32.01 Supervision status* (see page *259*).	23
	Other [bit]	Source selection (see *Terms and abbreviations* on page *124*).	-

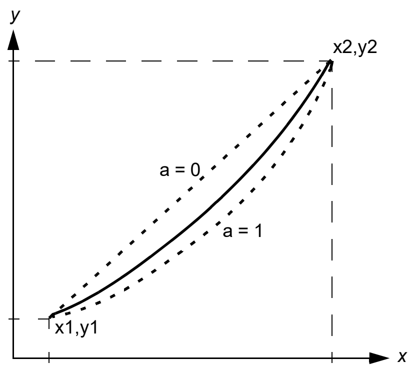
No.	Name/Value	Description	Def/FbEq16
40.39	*Set 1 deadband range*	Defines a deadband around the setpoint. Whenever process feedback enters the deadband, a delay timer starts. If the feedback remains within the deadband longer than the delay (*40.40 Set 1 deadband delay*), the PID controller output is frozen. Normal operation resumes after the feedback value leaves the deadband.	0.0 bar



No.	Name/Value	Description	Def/FbEq16
	0.0…200000.0	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 PID output (parameter *40.01 Process PID output actual*) to the value of this parameter. If PID output 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
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.	0.0 PID unit 1
	0.0…200000.0 PID unit 1	Sleep boost step.	1 = 1 PID unit 1

No.	Name/Value	Description	Def/FbEq16
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 unit 1
	-200000.00…200000.00 PID unit 1	Wake-up level (as deviation between process setpoint and feedback).	1 = 1 PID unit 1
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 *77*). 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
	DI5	Digital input DI5 (*10.02 DI delayed status*, bit 4).	6
	DI6	Digital input DI6 (*10.02 DI delayed status*, bit 5).	7
	Reserved		8…17
	Timed function 1	Bit 0 of *34.01 Timed functions status* (see page *267*).	18
	Timed function 2	Bit 1 of *34.01 Timed functions status* (see page *267*).	19
	Timed function 3	Bit 2 of *34.01 Timed functions status* (see page *267*).	20
	Supervision 1	Bit 0 of *32.01 Supervision status* (see page *259*).	21
	Supervision 2	Bit 1 of *32.01 Supervision status* (see page *259*).	22
	Supervision 3	Bit 2 of *32.01 Supervision status* (see page *259*).	23
	Other [bit]	Source selection (see *Terms and abbreviations* on page *124*).	-
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* (see page *156*).	1
	AI2 scaled	*12.22 AI2 scaled value* (see page *158*).	2
	FB A ref1	*03.05 FB A reference 1* (see page *130*).	3
	FB A ref2	*03.06 FB A reference 2* (see page *131*).	4
	Other	Source selection (see *Terms and abbreviations* on page *124*).	-

No.	Name/Value	Description	Def/FbEq16
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.	*PID set 1*
	PID set 1	0. Process PID parameter set 1 in use.	0
	PID set 2	1. Process PID parameter set 2 in use.	1
	DI1	Digital input DI1 (*10.02 DI delayed status*, bit 0).	2
	DI2	Digital input DI2 (*10.02 DI delayed status*, bit 1).	3
	DI3	Digital input DI3 (*10.02 DI delayed status*, bit 2).	4
	DI4	Digital input DI4 (*10.02 DI delayed status*, bit 3).	5
	DI5	Digital input DI5 (*10.02 DI delayed status*, bit 4).	6
	DI6	Digital input DI6 (*10.02 DI delayed status*, bit 5).	7
	Reserved		8…17
	Timed function 1	Bit 0 of *34.01 Timed functions status* (see page *267*).	18
	Timed function 2	Bit 1 of *34.01 Timed functions status* (see page *267*).	19
	Timed function 3	Bit 2 of *34.01 Timed functions status* (see page *267*).	20
	Supervision 1	Bit 0 of *32.01 Supervision status* (see page *259*).	21
	Supervision 2	Bit 1 of *32.01 Supervision status* (see page *259*).	22
	Supervision 3	Bit 2 of *32.01 Supervision status* (see page *259*).	23
	Other [bit]	Source selection (see *Terms and abbreviations* on page *124*).	-
40.58	*Set 1 increase prevention*	Prevention of PID integration term increase for PID set 1.	*No*
	No	Increase prevention not in use.	0
	Limiting	The PID integration term is not increased if the maximum value for the PID output is reached. 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*	Prevention of PID integration term decrease for PID set 1.	*No*
	No	Decrease prevention not in use.	0
	Limiting	The PID integration term is not decreased if the minimum value for the PID output is reached. 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 a source that enables/disables process PID control. See also parameter *40.07 Process PID operation mode*. 0 = Process PID control disabled. 1 = Process PID control enabled.	*On*
	Off	0.	0
	On	1.	1
	Follow Ext1/Ext2 selection	Process PID control is disabled when external control location EXT1 is active, and enabled 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

No.	Name/Value	Description	Def/FbEq16
	DI3	Digital input DI3 (*10.02 DI delayed status*, bit 2).	5
	DI4	Digital input DI4 (*10.02 DI delayed status*, bit 3).	6
	DI5	Digital input DI5 (*10.02 DI delayed status*, bit 4).	7
	DI6	Digital input DI6 (*10.02 DI delayed status*, bit 5).	8
	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*.	100.00
	-200000.00…200000.00	Scaling.	1 = 1
40.62	*PID internal setpoint actual*	Displays the value of the internal setpoint. See control chain diagram *PID setpoint compensation* on page *527*. This parameter is read-only.	-
	-200000.00…200000.00 PID unit 1	Process PID internal setpoint.	1 = 1 PID unit 1
40.70	*Compensated setpoint*	Compensated setpoint determined for the input specified by parameter *40.71 Set 1 compensation input source*. The determination of the compensated setpoint is based on the curve specified by points (x1, y1), (x2, y2) and the non-linearity of the curve specified with parameters *40.71*…*40.76*. The compensated setpoint curve will be a mixture of a straight line between the points and a squared line between the points:  *x* = value from *40.71 Set 1 compensation input source* *y* = *40.70 Compensated setpoint* *a* = *40.76 Set 1 compensation non-linearity* Compensated setpoint curve = a ∗ squared function + (1 - a) ∗ linear function	-
	-21474836.48…21474835.20 PID unit 1	Compensated setpoint value.	1 = 1 PID unit 1
40.71	*Set 1 compensation input source*	Selects the source for set 1 compensation input.	*Not selected*
	Not selected	None.	0
	Reserved		1

No.	Name/Value	Description	Def/FbEq16
	Internal setpoint	Internal setpoint. See parameter *40.19 Set 1 internal setpoint sel1*.	2
	AI1 scaled	*12.12 AI1 scaled value* (see page *156*).	3
	AI2 scaled	*12.22 AI2 scaled value* (see page *158*).	4
	Reserved		5…7
	Motor potentiometer	*22.80 Motor potentiometer ref act* (output of the Floating point control (Motor potentiometer)).	8
	Reserved		9
	Freq in scaled	*11.39 Freq in 1 scaled value* (see page *154*).	10
	AI1 percent	*12.101 AI1 percent value* (see page *159*).	11
	AI2 percent	*12.102 AI2 percent value* (see page *159*).	12
	Reserved		13…14
	FB A ref1	*03.05 FB A reference 1* (see page *130*).	15
	FB A ref2	*03.06 FB A reference 2* (see page *131*).	16
	Reserved		17…18
	EFB ref1	*03.09 EFB reference 1* (see page *131*).	19
	EFB ref2	*03.10 EFB reference 2* (see page *131*).	20
	Reserved		21…23
	Setpoint data storage	*40.92 Setpoint data storage* (see page *309*).	24
	Other	Source selection (see *Terms and abbreviations* on page *124*).	-
40.72	*Set 1 compensation input 1*	Point x1 on the setpoint compensation curve, see parameter *40.71 Compensated setpoint*.	0.00
	-200000.00… 200000.00	Setpoint value.	1 = 1
40.73	*Set 1 compensated output 1*	Point y1 (= the compensated output of parameter *40.72 Set 1 compensation input 1*) on the setpoint compensation curve, see parameter *40.70 Compensated setpoint*.	0.00 PID unit 1
	-200000.00… 200000.00 PID unit 1	Compensated setpoint value.	1 = 1 PID unit 1
40.74	*Set 1 compensation input 2*	Point x2 on the setpoint compensation curve, see parameter *40.71 Compensated setpoint*.	0.00
	-200000.00… 200000.00	Setpoint value.	1 = 1
40.75	*Set 1 compensated output 2*	Point y2 (= the compensated output of parameter *40.74 Set 1 compensation input 2*) on the setpoint compensation curve, see parameter *40.70 Compensated setpoint*.	0.00 PID unit 1
	-200000.00… 200000.00 PID unit 1	Compensated setpoint value.	1 = 1 PID unit 1
40.76	*Set 1 compensation non-linearity*	Describes the non-linearity of the setpoint compensation curve, see parameter *40.70 Compensated setpoint*.	0%
	0…100%	Percentage.	1 = 1%

No.	Name/Value	Description	Def/FbEq16
40.79	*Set 1 units*	Unit used for PID set 1.	*User text*
	User text	User editable text. User text default is “PID unit 1”.	0
	%	Percent.	4
	bar	Bar.	74
	kPa	Kilo pascal.	75
	Pa	Pascal.	77
	psi	Pound per square inch.	76
	CFM	Cubic feet per minute.	26
	inH$_2$O	Inch of water.	58
	°C	Degree Celsius.	150
	°F	Degree Fahrenheit.	151
	mbar	Millibar.	44
	m^3/h	Cubic meter per hour.	78
	dm^3/h	Cubic decimeter per hour.	21
	l/s	Liter per second.	79
	l/min	Liter per minute.	37
	l/h	Liter per hour.	38
	m^3/s	Cubic meter per second.	88
	m^3/min	Cubic meter per minute.	40
	km^3/h	Cubic kilometer per minute.	131
	gal/s	Gallon 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	Cubic kilo feet per minute.	126
	inWC	Inch of water.	65
	gpm	Gallon per minute.	80
	gal/min	Gallon per minute.	48
	in wg	Inch water gauge.	59
	MPa	Megapascal.	94
	ftWC	Feet of water.	125
40.80	*Set 1 PID output min source*	Selects the source for set 1 PID output minimum.	*Set1 output min*
	None	Not selected.	0
	Set1 output min	*40.36 Set 1 output min*.	1
	Other [bit]	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	Not selected.	0
	Set1 output max	*40.37 Set 1 output max*.	1

6

No.	Name/Value	Description	Def/FbEq16
	Other [bit]	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
40.91	*Feedback data storage*	Storage parameter for receiving a process feedback value, for example, 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 data 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, for example, 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 control chain diagrams *PID setpoint compensation* and *Direction lock* on pages *527* and *532*, respectively.	
41.08	*Set 2 feedback 1 source*	See parameter *40.08 Set 1 feedback 1 source*.	*AI2 percent*
41.09	*Set 2 feedback 2 source*	See parameter *40.09 Set 1 feedback 2 source*.	*Not selected*

No.	Name/Value	Description	Def/FbEq16
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*.	0.00
41.15	*Set 2 output scaling*	See parameter *40.15 Set 1 output scaling*.	0.00
41.16	*Set 2 setpoint 1 source*	See parameter *40.16 Set 1 setpoint 1 source*.	*Internal setpoint*
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 unit 1
41.22	*Set 2 internal setpoint 2*	See parameter *40.22 Set 1 internal setpoint 2*.	0.00 PID unit 1
41.23	*Set 2 internal setpoint 3*	See parameter *40.23 Set 1 internal setpoint 3*.	0.00 PID unit 1
41.24	*Set 2 internal setpoint 0*	See parameter *40.24 Set 1 internal setpoint 0*.	0.00 PID unit 1
41.26	*Set 2 setpoint min*	See parameter *40.26 Set 1 setpoint min*.	0.00 PID unit 1
41.27	*Set 2 setpoint max*	See parameter *40.27 Set 1 setpoint max*.	200000.00 PID unit 1
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
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*

No.	Name/Value	Description	Def/FbEq16
41.39	*Set 2 deadband range*	See parameter *40.39 Set 1 deadband range*.	0.0 bar
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*.	0.0 PID unit 1
41.47	*Set 2 wake-up deviation*	See parameter *40.47 Set 1 wake-up deviation*.	0.00 PID unit 1
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*
41.58	*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*
41.71	*Set 2 compensation input source*	See parameter *40.71 Set 1 compensation input source*.	*Not selected*
41.72	*Set 2 compensation input 1*	See parameter *40.72 Set 1 compensation input 1*.	0.00
41.73	*Set 2 compensated output 1*	See parameter *40.73 Set 1 compensated output 1*.	0.00 PID unit 1
41.74	*Set 2 compensation input 2*	See parameter *40.74 Set 1 compensation input 2*.	0.00
41.75	*Set 2 compensated output 2*	See parameter *40.75 Set 1 compensated output 2*.	0.00 PID unit 1
41.76	*Set 2 compensation non-linearity*	See parameter *40.76 Set 1 compensation non-linearity*.	0%
41.79	*Set 2 units*	See parameter *40.79 Set 1 units*.	*bar*
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
	Other [bit]	Source selection (see *Terms and abbreviations* on page *124*).	-
41.81	*Set 2 PID output max source*	Selects the source for set 2 PID output maximum.	*Set2 output max*
	None	None.	0

No.	Name/Value	Description	Def/FbEq16
	Set2 output max	*41.37 Set 2 output max*.	1
	Other [bit]	Source selection (see *Terms and abbreviations* on page *124*).	-
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
45 Energy efficiency		Settings for the energy saving calculators as well as peak and energy loggers. See also section *Diagnostics menu* (page *120*).	
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
45.04	*Saved energy*	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. This parameter is read-only (see parameter *45.21 Energy calculations reset*).	-
	0.0…214748368.0 kWh	Energy savings in kWh.	1 = 1 kWh

No.	Name/Value	Description	Def/FbEq16
45.05	*Saved money x1000*	Monetary savings in thousands compared to direct-on-line motor connection. This parameter is incremented when *45.06 Saved money* rolls over. If you have not set the currency during the first start-up, you can specify it in **Main menu > Primary settings > Clock, region display > Units > Currency**. This parameter is read-only (see parameter *45.21 Energy calculations reset*).	-
	0…4294967295 thousands (unit x 1000)	Monetary savings in thousands of units.	
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. If you have not set the currency during the first start-up, you can specify it in **Main menu > Primary settings > Clock, region display > Units > Currency**. 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*). If you have not set the currency during the first start-up, you can specify it in **Main menu > Primary settings > Clock, region display > Units > Currency**. This parameter is read-only (see parameter *45.21 Energy calculations reset*).	-
	0.00… 21474830.0 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
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

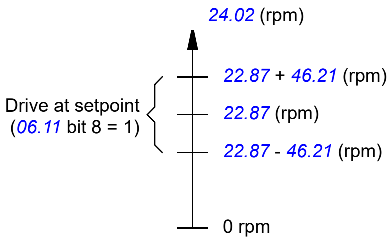
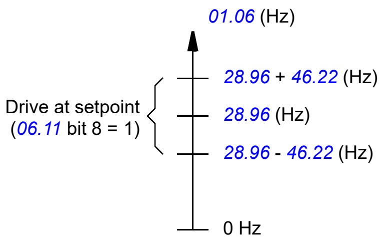
No.	Name/Value	Description	Def/FbEq16
45.10	*Total saved CO2*	Reduction in CO_2 emissions in metric tons compared to direct-on-line motor connection. This value is calculated by multiplying the saved energy in MWh by the value of parameter *45.18 CO2 conversion factor* (by default, 0.5 metric tons/MWh). This parameter is read-only (see parameter *45.21 Energy calculations reset*).	-
	0.0…214748304.0 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 and a synchronous reluctance motor, energy optimization is always enabled regardless of this parameter.	*Enable*
	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. If you have not set the currency during the first start-up, you can specify it in **Main menu > Primary settings > Clock, region display > Units > Currency**. **Note:** Tariffs are read only at the instant of selection, and are not applied retroactively.	0.100 units
	0.000…4294966.296 units	Energy tariff 1.	
45.13	*Energy tariff 2*	Defines energy tariff 2 (price of energy per kWh). See parameter *45.12 Energy tariff 1*.	0.200 units
	0.000…4294966.296 units	Energy tariff 2.	
45.14	*Tariff selection*	Selects (or defines a source that selects) which pre-defined energy tariff is used. 0 = *45.12 Energy tariff 1*. 1 = *45.13 Energy tariff 2*.	*Energy tariff 1*
	Energy tariff 1	0.	0
	Energy tariff 2	1.	1
	DI1	Digital input DI1 (*10.02 DI delayed status*, bit 0).	2
	DI2	Digital input DI2 (*10.02 DI delayed status*, bit 1).	3
	DI3	Digital input DI3 (*10.02 DI delayed status*, bit 2).	4
	DI4	Digital input DI4 (*10.02 DI delayed status*, bit 3).	5
	DI5	Digital input DI5 (*10.02 DI delayed status*, bit 4).	6
	DI6	Digital input DI6 (*10.02 DI delayed status*, bit 5).	7
	Other [bit]	Source selection (see *Terms and abbreviations* on page *124*).	-

No.	Name/Value	Description	Def/FbEq16
45.18	*CO2 conversion factor*	Defines a factor for conversion of saved energy into CO_2 emissions (kg/kWh or tn/MWh).	0.500 tn/MWh (metric ton)
	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.	0.75 kW
	0.00…10000000.00 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
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

No.	Name/Value	Description	Def/FbEq16
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
	-30000.00… 30000.00 kWh	Peak power value.	10 = 1 kW
45.32	*Monthly peak power date*	Date of the peak power during the present month.	1.1.1980
		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.	1 = 100 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		1 = 100 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, for example, in fieldbus communication.	1500.00 rpm; 1800.00 rpm (*95.20* b0)
	0.10…30000.00 rpm	Acceleration/deceleration terminal/initial speed.	1 = 1 rpm

No.	Name/Value	Description	Def/FbEq16
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, for example, in fieldbus communication.	50.00 Hz; 60.00 Hz (*95.20* b0)
	0.10…1000.00 Hz	Acceleration/deceleration terminal/initial frequency.	10 = 1 Hz
46.03	*Torque scaling*	Defines the 16-bit scaling of torque parameters. The value of this parameter (in percent of nominal motor torque) corresponds to 10000, for example, in 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, for example, in fieldbus communication. The unit is selected by parameter *96.16 Unit selection*. For 32-bit scaling see parameter *46.43 Power decimals*.	1000.00 unit
	0.10…30000.00 kW or 0.10…40214.48 hp	Power corresponding to 10000 on fieldbus.	1 = 1 unit
46.05	*Current scaling*	Defines the 16-bit scaling of current parameters. The value of this parameter corresponds to 10000, for example, in fieldbus communication. For 32-bit scaling see parameter *46.44 Current decimals*.	10000 A
	0…30000 A	Current corresponding to 10000 on fieldbus.	1 = 1 A
46.06	*Speed ref zero scaling*	Defines a speed corresponding to a zero reference received from fieldbus (either the embedded fieldbus interface, or interface FBA A). For example, with a setting of 500, the fieldbus reference range of 0…20000 would correspond to a speed of 500…[*46.01*] rpm. **Note:** This parameter is effective only with the ABB Drives communication profile.	0.00 rpm
	0.00…30000.00 rpm	Speed corresponding to minimum fieldbus reference.	1 = 1 rpm
46.07	*Frequency ref zero scaling*	Defines a frequency corresponding to a zero reference received from fieldbus (either the embedded fieldbus interface, or interface FBA). For example, with a setting of 30, the fieldbus reference range of 0…20000 would correspond to a speed of 30…[*46.02*] Hz. **Note:** This parameter is effective only with the ABB Drives communication profile.	0.00 Hz
	0.00…1000.00 Hz	Frequency corresponding to minimum fieldbus reference.	10 = 1 Hz
46.11	*Filter time motor speed*	Defines a filter time for signals *01.01 Motor speed used* 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

No.	Name/Value	Description	Def/FbEq16
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*
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*
46.31	*Above speed limit*	Defines the trigger level for “above limit” indication in speed control. When actual speed exceeds the limit, bit 10 of *06.17 Drive status word 2* is set. This is also indicated by bit 10 in *06.11 Main status word*.	1500.00 rpm; 1800.00 rpm (*95.20* b0)
	0.00…30000.00 rpm	“Above limit” indication trigger level for speed control.	See par. *46.01*

No.	Name/Value	Description	Def/FbEq16
46.32	Above frequency limit	Defines the trigger level for “above limit” indication in frequency control. When actual frequency exceeds the limit, bit 10 of 06.17 Drive status word 2 is set. This is also indicated by bit 10 in 06.11 Main status word.	50.00 Hz; 60.00 Hz (95.20 b0)
	0.00…1000.00 Hz	“Above limit” indication trigger level for frequency control.	See par. 46.02
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 decimals shown for parameter 99.10 Motor nominal power on the control panel and Drive composer PC tool. It also defines 32-bit scaling of power 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 Power scaling.	2
	0…3	Number of decimals.	1 = 1
46.44	Current decimals	Defines the number of decimals shown for parameter 99.06 Motor nominal current on the control panel and Drive composer PC tool. It also defines 32-bit scaling of current 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 Current scaling.	1
	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 121).	
47.01	Data storage 1 real32	Data storage parameter 1.	0.000
	-2147483.000… 2147483.000	32-bit data.	
47.02	Data storage 2 real32	Data storage parameter 2.	0.000
	-2147483.000… 2147483.000	32-bit data.	
47.03	Data storage 3 real32	Data storage parameter 3.	0.000
	-2147483.000… 2147483.000	32-bit data.	
47.04	Data storage 4 real32	Data storage parameter 4.	0.000
	-2147483.000… 2147483.000	32-bit data.	

No.	Name/Value	Description	Def/FbEq16
47.11	*Data storage 1 int32*	Data storage parameter 9.	0
	-2147483648…2147483647	32-bit data.	
47.12	*Data storage 2 int32*	Data storage parameter 10.	0
	-2147483648…2147483647	32-bit data.	
47.13	*Data storage 3 int32*	Data storage parameter 11.	0
	-2147483648…2147483647	32-bit data.	
47.14	*Data storage 4 int32*	Data storage parameter 12.	0
	-2147483648…2147483647	32-bit data.	
47.21	*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

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	Control panel/PC tool communication timeout.	10 = 1 s

No.	Name/Value	Description	Def/FbEq16
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 fault *7081 Control panel loss*.	1
	Last speed	Drive generates warning *A7EE Panel loss* 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 warning *A7EE Panel loss* 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
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).	*Output frequency*
	Auto	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 *35 Motor thermal protection* (page *275*).	20
	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

No.	Name/Value	Description	Def/FbEq16
	Abs output power	*01.66 Abs output power % motor nom*	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		
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.	*Motor current*
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.	*Freq ref used*
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*.	*Output frequency*
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*.	*Motor current*
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*.	*Freq ref used*

50 Fieldbus adapter (FBA)		Fieldbus communication configuration. See also chapter *Fieldbus control through a fieldbus adapter* (page *219*).	
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*.	*No action*
	No action	No action taken.	0
	Fault	Drive trips on fault *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	Drive generates warning *A7C1 FBA A communication* and freezes the speed to the level the drive was operating at. This only occurs if control is expected from the fieldbus. The speed is determined on the basis of actual speed using 850 ms low-pass filtering. ⚠ **WARNING!** Make sure that it is safe to continue operation in case of a communication break.	2

No.	Name/Value	Description	Def/FbEq16
	Speed ref safe	Drive generates warning *A7C1 FBA A communication* and sets the speed to the value defined by parameter *22.41 Speed ref safe* (when speed reference is being used) or *28.41 Frequency ref safe* (when frequency reference is being used). This only occurs if control is expected from the fieldbus. **WARNING!** Make sure that it is safe to continue operation in case of a communication break.	3
	Fault always	Drive trips on fault *7510 FBA A communication*. This occurs even though no control is expected from the fieldbus.	4
	Warning	Drive generates warning *A7C1 FBA A communication*. This only occurs if control is expected from the fieldbus. **WARNING!** Make sure that it is safe to continue operation in case of a communication break.	5
50.03	*FBA A comm loss t out*	Defines the time delay before the action defined by parameter *50.02 FBA A comm loss func* is taken. Time count starts when the communication link fails to update the message. **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.	10 = 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: **Operation mode** (see par. *19.01*) → **Reference 1 type** Speed control → *Speed* Frequency control → *Frequency*	0
	Transparent	No scaling is applied (the 16-bit scaling is 1 = 1 unit). **Note:** All decimal information is lost, for example, 1.23 = 1.	1
	General	Generic reference with a 16-bit 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

<table>
<tr><th>No.</th><th>Name/Value</th><th>Description</th><th>Def/FbEq16</th></tr>
<tr><td>50.05</td><td>FBA A ref2 type</td><td>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.</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 2 type</th></tr><tr><td>Speed control</td><td>Speed</td></tr><tr><td>Frequency control</td><td>Frequency</td></tr></table>
Select Speed (selection 4) or Frequency (selection 5) manually.</td><td>0</td></tr>
<tr><td></td><td>Transparent</td><td>No scaling is applied (the 16-bit scaling is 1 = 1 unit).
Note: All decimal information is lost, for example, 1.23 = 1.</td><td>1</td></tr>
<tr><td></td><td>General</td><td>Generic reference with a 16-bit scaling of 100 = 1 (that is, integer and two decimals).
Note: All data after two decimals is lost, for example, 1.234 = 123.</td><td>2</td></tr>
<tr><td></td><td>Torque</td><td>The scaling is defined by parameter 46.03 Torque scaling.</td><td>3</td></tr>
<tr><td></td><td>Speed</td><td>The scaling is defined by parameter 46.01 Speed scaling.</td><td>4</td></tr>
<tr><td></td><td>Frequency</td><td>The scaling is defined by parameter 46.02 Frequency scaling.</td><td>5</td></tr>
<tr><td>50.06</td><td>FBA A SW sel</td><td>Selects the source of the Status word to be sent to the fieldbus network through fieldbus adapter A.</td><td>Auto</td></tr>
<tr><td></td><td>Auto</td><td>Source of the Status word is chosen automatically.</td><td>0</td></tr>
<tr><td></td><td>Transparent mode</td><td>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.</td><td>1</td></tr>
<tr><td>50.07</td><td>FBA A actual 1 type</td><td>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.</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>Actual value 1 type</th></tr><tr><td>Speed 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>The value selected by parameter 50.10 FBA A act1 transparent source is sent as actual value 1. No scaling is applied (the 16-bit scaling is 1 = 1 unit).
Note: All decimal information is lost, for example, 1.23 = 1.</td><td>1</td></tr>
<tr><td></td><td>General</td><td>The value selected by parameter 50.10 FBA A act1 transparent source is sent as actual value 1 with a 16-bit scaling of 100 = 1 unit (that is, integer and two decimals).
Note: All data after two decimals is lost, for example, 1.234 = 123.</td><td>2</td></tr>
<tr><td></td><td>Torque</td><td>The scaling is defined by parameter 46.03 Torque scaling.</td><td>3</td></tr>
</table>

<table>
<tr><th>No.</th><th>Name/Value</th><th>Description</th><th>Def/FbEq16</th></tr>
<tr><td></td><td>Speed</td><td>01.01 Motor speed used is sent as actual value 1. The 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. The scaling is defined by parameter 46.02 Frequency scaling.</td><td>5</td></tr>
<tr><td>50.08</td><td>FBA A actual 2 type</td><td>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.</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>Actual value 2 type</th></tr>
<tr><td>Speed control</td><td>Speed</td></tr>
<tr><td>Frequency control</td><td>Frequency</td></tr>
</table>
Select Speed (selection 4) or Frequency (selection 5) manually.</td><td>0</td></tr>
<tr><td></td><td>Transparent</td><td>The value selected by parameter 50.10 FBA A act1 transparent source is sent as actual value 1. No scaling is applied (the 16-bit scaling is 1 = 1 unit).
Note: All decimal information is lost, for example, 1.23 = 1.</td><td>1</td></tr>
<tr><td></td><td>General</td><td>The value selected by parameter 50.10 FBA A act1 transparent source is sent as actual value 1 with a 16-bit scaling of 100 = 1 unit (that is, integer and two decimals).
Note: All data after two decimals is lost, for example, 1.234 = 123.</td><td>2</td></tr>
<tr><td></td><td>Torque</td><td>01.10 Motor torque is sent as actual value 1. The 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. The 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. The scaling is defined by parameter 46.02 Frequency scaling.</td><td>5</td></tr>
<tr><td>50.09</td><td>FBA A SW transparent source</td><td>Selects the source of the fieldbus status word when parameter 50.06 FBA A SW sel is set to Transparent mode.</td><td>Not selected</td></tr>
<tr><td></td><td>Not selected</td><td>No source selected.</td><td>-</td></tr>
<tr><td></td><td>Other</td><td>Source selection (see Terms and abbreviations on page 124).</td><td>-</td></tr>
<tr><td>50.10</td><td>FBA A act1 transparent source</td><td>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.</td><td>Not selected</td></tr>
<tr><td></td><td>Not selected</td><td>No source selected.</td><td>-</td></tr>
<tr><td></td><td>Other</td><td>Source selection (see Terms and abbreviations on page 124).</td><td>-</td></tr>
<tr><td>50.11</td><td>FBA A act2 transparent source</td><td>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.</td><td>Not selected</td></tr>
<tr><td></td><td>Not selected</td><td>No source selected.</td><td>-</td></tr>
<tr><td></td><td>Other</td><td>Source selection (see Terms and abbreviations on page 124).</td><td>-</td></tr>
</table>

No.	Name/Value	Description	Def/FbEq16
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.	-
50.17	*FBA A actual value 1*	Displays raw (unmodified) actual value ACT1 sent by fieldbus adapter A to the master (PLC) if debugging is enabled by parameter *50.12 FBA A debug mode*. This parameter is read-only.	-
	-2147483648… 2147483647	Raw ACT1 sent by fieldbus adapter A to master.	
50.18	*FBA A actual value 2*	Displays raw (unmodified) actual value ACT2 sent by fieldbus adapter A to the master (PLC) if debugging is enabled by parameter *50.12 FBA A debug mode*. This parameter is read-only.	-
	-2147483648… 2147483647	Raw ACT2 sent by fieldbus adapter A to master.	

No.	Name/Value	Description	Def/FbEq16
51 FBA A settings		Fieldbus adapter A configuration.	
51.01	*FBA A type*	Displays the type of the connected fieldbus adapter module. **0** = None. Module is not found or is not properly connected, or is disabled by parameter *50.01 FBA A enable*. **1** = PROFIBUS-DP **32** = CANopen **37** = DeviceNet **128** = Ethernet **132** = PROFInet IO **135** = EtherCAT **136** = ETH Pwrlink (Ethernet Powerlink) **485** = RS-485 comm **101** = ControlNet **47808** = BACnet/IP **2222 =** Ethernet/IP **502 =** Modbus/TCP 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
	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
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

No.	Name/Value	Description	Def/FbEq16
	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.	-
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
	Reserved		7…10
	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
	Reserved		17…23
	SW2 16bit	Status Word 2 (16 bits)	24

No.	Name/Value	Description	Def/FbEq16
	Other	Source selection (see *Terms and abbreviations* on page *124*).	-
…	…	…	…
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
	Reserved		7…10
	CW 32bit	Control Word (32 bits)	11
	Ref1 32bit	Reference REF1 (32 bits)	12
	Ref2 32bit	Reference REF2 (32 bits)	13
	Reserved		14…20
	CW2 16bit	Control Word 2 (16 bits)	21
	Other	Source selection (see *Terms and abbreviations* on page *124*).	-
…	…	…	…
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 also chapter *Modbus RTU control through the embedded fieldbus interface (EFB)* (page *163*).	
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
	BACnet MSTP	Embedded fieldbus interface is enabled and uses the BACnet MS/TP protocol.	2
	Reserved		3…4
	N2	Embedded fieldbus interface is enabled and uses the N2 protocol.	5
	Reserved		6
	GPI	Generic Protocol 1. Contact ABB technical support for details.	7
58.02	*Protocol ID*	Displays the protocol ID and revision. First 4 bits specify the protocol ID and last 12 bits specify the revision. This parameter is read-only.	-
		Protocol ID and revision.	

No.	Name/Value	Description	Def/FbEq16
58.03	Node address	Defines the node address of the drive on the fieldbus link. Values 1…247 are allowable. Also called Station ID, MAC Address or Device Address. 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).	1
	0…255	Node address (values 1…247 are allowed).	1 = 1
58.04	Baud rate	Selects the transfer rate of the fieldbus link. When using selection Autodetect, the parity setting of the bus must be known and configured in parameter 58.05 Parity. When parameter 58.04 Baud rate is set to Autodetect, the EFB settings must be refreshed with parameter 58.06. The bus is monitored for a period of time and the detected baud rate is set as the value of this parameter. 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).	Modbus RTU: 19.2 kbps BACnet MS/TP: Autodetect N2: 9.6 kbps
	Autodetect	Baud rate detected automatically.	0
	4.8 kbps	4.8 kbit/s.	1
	9.6 kbps	9.6 kbit/s.	2
	19.2 kbps	19.2 kbit/s.	3
	38.4 kbps	38.4 kbit/s.	4
	57.6 kbps	57.6 kbit/s.	5
	76.8 kbps	76.8 kbit/s.	6
	115.2 kbps	115.2 kbit/s.	7
58.05	Parity	Modbus RTU, N2 only: 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:** For BACnet MS/TP, the BACnet standard defines the parity as 8 NONE 1.	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 (parameters 58.01…58.05, 58.14…58.17, 58.25, 58.28…58.34) 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.	2

No.	Name/Value	Description	Def/FbEq16
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).	-

Bit	Name	Description
0	Init failed	1 = EFB initialization failed
1	Addr config err	1 = Node address not allowed by protocol
2	Silent mode	1 = Drive not allowed to transmit
		0 = Drive allowed to transmit
3	Autobauding	1 = Automatic detection of baud rate is in use (see parameter *58.04*)
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	Reserved	
13	Protocol 1	1 = Duplicate ID detected on the network. Used for BACnet.
14	Reserved	
15	Internal error	1 = Internal error occurred. Contact your local ABB representative.

No.	Name/Value	Description	Def/FbEq16
	0000h…FFFFh	EFB communication status.	1 = 1
58.08	*Received packets*	Displays a count of valid packets addressed to the drive. During normal operation, this number increases constantly. Can be reset from the control panel by pressing the Reset softkey for 3 seconds.	-
	0…4294967295	Number of received packets addressed to the drive.	
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 pressing the Reset softkey for 3 seconds.	-
	0…4294967295	Number of transmitted packets.	
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 pressing the Reset softkey for 3 seconds.	-
	0…4294967295	Number of all received packets.	

No.	Name/Value	Description	Def/FbEq16
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 pressing the Reset softkey for 3 seconds.	-
	0…4294967295	Number of UART errors.	
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 pressing the Reset softkey for 3 seconds.	-
	0…4294967295	Number of CRC errors.	
58.13	*Token counter*	BACnet MS/TP only: Contains a count of the number of times this device has received the token. Used for diagnostic purposes.	0
	0…4294967295	Counter.	1 = 1
58.14	*Communication loss action*	Selects how the drive reacts to an EFB communication break. Changes to this parameter take effect after the control unit is rebooted or the new settings validated by parameter *58.06 Communication control* (*Refresh settings*). See also parameters *58.15 Communication loss mode* and *58.16 Communication loss time*.	*No action*
	No action	No action taken (monitoring disabled).	0
	Fault	Drive monitors communication loss when start/stop is expected from the EFB on the currently active control location. The drive trips on fault *6681 EFB comm loss* if control in the currently active control location is expected from the EFB or reference is coming from the EFB, and the communication is lost.	1
	Last speed	Drive generates warning *A7CE EFB comm loss* 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 if control or reference 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 warning *A7CE EFB comm loss* 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 if control or reference 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 continuously monitors for communication loss. Drive trips on fault *6681 EFB comm loss*. This happens even though the drive is in a control location where the EFB start/stop or reference is not used.	4
	Warning	Drive generates warning *A7CE EFB comm loss*. 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

No.	Name/Value	Description	Def/FbEq16
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*.	*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
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*. **Note:** There is a 30-second boot-up delay immediately after power-up.	30.0 s
	0.0…6000.0 s	EFB communication timeout.	1 = 1
58.17	*Transmit delay*	<u>Modbus RTU, N2 only:</u> 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*).	0 ms
	0…65535 ms	Minimum response delay.	1 = 1
58.18	*EFB control word*	<u>Modbus RTU, BACnet MS/TP only:</u> Displays the raw (unmodified) control word sent by the Modbus controller to the drive. For debugging purposes. This parameter is read-only.	-
	00000000h… FFFFFFFFh	Control word sent by Modbus controller to the drive.	1 = 1
58.19	*EFB status word*	<u>Modbus RTU, BACnet MS/TP only:</u> Displays the raw (unmodified) status word for debugging purposes. This parameter is read-only.	-
	00000000h… FFFFFFFFh	Status word sent by the drive to the Modbus controller.	1 = 1
58.25	*Control profile*	<u>Modbus RTU only:</u> Defines the communication profile used by the Modbus 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*). See section *About the control profiles* on page *172*. **Note**: If you want to use the ABB drives limited profile, set parameter *96.79 Legacy control profile* accordingly (supported in firmware revisions 2.15 or later).	*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

No.	Name/Value	Description	Def/FbEq16
58.26	*EFB ref1 type*	Modbus RTU only: Selects the type and scaling of reference 1 received through the embedded fieldbus interface. The scaled reference is displayed by *03.09 EFB reference 1*.	*Speed or frequency*
	Speed or frequency	Type and scaling is chosen automatically according to the currently active operation mode as follows. **Operation mode** (see par. *19.01*) / **Reference 1 type**: Speed control – *Speed* Frequency control – *Frequency*	0
	Transparent	No scaling is applied.	1
	General	Generic reference without a specific unit. Scaling: 1 = 100.	2
	Torque	Torque reference. The scaling is defined by parameter *46.03 Torque scaling*.	3
	Speed	Speed reference. The scaling is defined by parameter *46.01 Speed scaling*.	4
	Frequency	Frequency reference. The scaling is defined by parameter *46.02 Frequency scaling*.	5
58.27	*EFB ref2 type*	Modbus RTU only: 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*.	*Speed or frequency*
58.28	*EFB act1 type*	Modbus RTU only: Selects the type of actual value 1.	*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*) / **Actual 1 type**: Speed control – *Speed* Frequency control – *Frequency*	0
	Transparent	No scaling is applied.	1
	General	Generic reference without a specific unit. Scaling: 1 = 100.	2
	Torque	Scaling is defined by parameter *46.03 Torque scaling*.	3
	Speed	Scaling is defined by parameter *46.01 Speed scaling*.	4
	Frequency	Scaling is defined by parameter *46.02 Frequency scaling*.	5
58.29	*EFB act2 type*	Modbus RTU only: Selects the type of actual value 2. For the selections, see parameter *58.28 EFB act1 type*.	*Transparent*
58.30	*EFB status word transparent source*	N2 only: 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* on page *124*).	-
58.31	*EFB act1 transparent source*	Modbus RTU only: 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* on page *124*).	-

No.	Name/Value	Description	Def/FbEq16
58.32	*EFB act2 transparent source*	Modbus RTU, N2 only: Selects the source of actual value 2 when parameter *58.29 EFB act2 type* is set to *Transparent*.	*Not selected*
	Not selected	None.	0
	Other	Source selection (see *Terms and abbreviations* on page *124*).	-
58.33	*Addressing mode*	Modbus RTU only: 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*).	*Mode 0*
	Mode 0	16-bit values (groups 1…99, indexes 1…99): Register address = 400000 + 100 × parameter group + parameter index. For example, parameter 22.80 would be mapped to register 400000 + 2200 + 80 = 402280. 32-bit values (groups 1…99, indexes 1…99): 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	16-bit values (groups 1…255, indexes 1…255): Register address = 400000 + 256 × parameter group + parameter index. For example, parameter 22.80 would be mapped to register 400000 + 5632 + 80 = 405712.	1
	Mode 2	32-bit values (groups 1…127, indexes 1…255): Register address = 400000 + 512 × parameter group + 2 × parameter index. For example, parameter 22.80 would be mapped to register 400000 + 11264 + 160 = 411424.	2
58.34	*Word order*	Modbus RTU only: 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*).	*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
58.40	*Device object ID*	BACnet MS/TP only: The Device object ID must be unique across all BACnet devices in the building network. Valid values are in range 0…4194303. The default Device object ID (4194303) indicates that the Device object ID is uninitialized per the BACnet specification and it must be set to a unique value in the valid 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*).	4194303
	0…4194303	ID.	

No.	Name/Value	Description	Def/FbEq16
58.101	Data I/O 1	Modbus RTU, BACnet MS/TP only: 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
	None	No mapping, register is always zero.	0
	CW 16bit	*ABB Drives* profile: 16-bit ABB drives 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
	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 aha(16 bits).	6
	Reserved		7…10
	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
	Reserved		17…20
	CW2 16bit	*ABB Drives* profile: not used; *DCU Profile*: upper 16 bits of the DCU control word.	21
	SW2 16bit	*ABB Drives* profile: not used / always zero; *DCU Profile*: upper 16 bits of the DCU status word.	24
	Reserved		25…30
	RO/DIO control word	Parameter *10.99 RO/DIO control word*.	31
	AO1 data storage	Parameter *13.91 AO1 data storage*.	32
	AO2 data storage	Parameter *13.92 AO2 data storage*.	33
	Reserved		34…39
	Feedback data storage	Parameter *40.91 Feedback data storage*.	40
	Setpoint data storage	Parameter *40.92 Setpoint data storage*.	41
	Other	Source selection (see *Terms and abbreviations* on page *124*).	-
58.102	Data I/O 2	Modbus RTU, BACnet MS/TP only: 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

No.	Name/Value	Description	Def/FbEq16
58.103	*Data I/O 3*	Modbus RTU, BACnet MS/TP only: 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*.	*Pointer -> 40.92*
58.104	*Data I/O 4*	Modbus RTU, BACnet MS/TP only: Defines the address in the drive which the Modbus master accesses when it reads from or writes to register address 400004. For the selections, see parameter *58.101 Data I/O 1*.	*SW 16bit*
58.105	*Data I/O 5*	Modbus RTU, BACnet MS/TP only: 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*.	*Pointer -> 01.06*
58.106	*Data I/O 6*	Modbus RTU, BACnet MS/TP only: 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*.	*Pointer -> 01.07*
58.107	*Data I/O 7*	Modbus RTU, BACnet MS/TP only: Parameter selector for Modbus register address 400007. For the selections, see parameter *58.101 Data I/O 1*.	*None*
…	…	…	…
58.114	*Data I/O 14*	Modbus RTU, BACnet MS/TP only: Parameter selector for Modbus register address 400014. For the selections, see parameter *58.101 Data I/O 1*.	*None*
70 Override		Enabling/disabling of the Override function, Override activation signal and Override speed/frequency. See control chain diagram *Override* on page *533*.	
70.01	*Override status*	Shows the override status. This parameter is read-only.	-

Bit	Name	Description
0	Override enabled	0 = Override is disabled; 1 = Override is enabled.
1	Override active	0 = Override is inactive; 1 = Drive is active.
2	Override direction is forward	0 = Override direction is not forward; 1 = Override direction is forward.
3	Override direction is reverse	0 = Override direction is not reverse; 1 = Override direction is reverse.
4	Override stop mode is active	0 = Override stop mode is not active; 1 = Override stop mode is active.
5…6	Reserved	
7	Run permissive	0 = Prevents running; 1 = Permits running.
8	Start interlock 1	0 = Prevents starting; 1 = Permits starting.
9	Start interlock 2	0 = Prevents starting; 1 = Permits starting.
10	Start interlock 3	0 = Prevents starting; 1 = Permits starting.
11	Start interlock 4	0 = Prevents starting; 1 = Permits starting.
12…15	Reserved	

No.	Name/Value	Description	Def/FbEq16
70.02	*Override enable*	Enables the Override function.	*Off*
	Off	Override disabled.	0
	On	Override enabled.	1

No.	Name/Value	Description	Def/FbEq16
	On, critical	Allows for an infinite number of fault resets. To be able use this selection, first set parameter *70.20 Override fault handling* to value *Autoreset*. **Note**: Using Critical Override might void the warranty if the function is not used correctly.	2
70.03	*Override activation source*	Selects the source of the Override activation. Value 0 of the source deactivates the Override. Value 1 of the source activates the Override.	*Not used*
	Not used	0.	0
	DI1	Digital input DI1 (*10.02 DI delayed status*, bit 0).	1
	DI2	Digital input DI2 (*10.02 DI delayed status*, bit 1).	2
	DI3	Digital input DI3 (*10.02 DI delayed status*, bit 2).	3
	DI4	Digital input DI4 (*10.02 DI delayed status*, bit 3).	4
	DI5	Digital input DI5 (*10.02 DI delayed status*, bit 4).	5
	DI6	Digital input DI6 (*10.02 DI delayed status*, bit 5).	6
	-DI1	Digital input DI1 (*10.02 DI delayed status*, bit 0).	7
	-DI2	Digital input DI2 (*10.02 DI delayed status*, bit 1).	8
	-DI3	Digital input DI3 (*10.02 DI delayed status*, bit 2).	9
	-DI4	Digital input DI4 (*10.02 DI delayed status*, bit 3).	10
	-DI5	Digital input DI5 (*10.02 DI delayed status*, bit 4).	11
	-DI6	Digital input DI6 (*10.02 DI delayed status*, bit 5).	12
	Constant speed	Bit 7 of *06.19 Speed control status word* (see page *140*).	13
	Other [bit]	Source selection (see *Terms and abbreviations* on page *124*).	-
70.04	*Override reference source*	Selects the source for the speed used in the Override mode.	*Override speed/freq*
	Constant speed	Constant speed used as the reference.	0
	AI1	*12.12 AI1 scaled value* (page *156*).	1
	AI2	*12.22 AI2 scaled value* (page *158*).	2
	Override speed/freq	Parameter *70.06 Override frequency* or *70.07 Override speed* is used as the reference.	3
	Motor potentiometer	*22.80 Motor potentiometer ref act* (output of the Floating point control (Motor potentiometer)).	4
	Stop	The output of the drive is shut off and the motor no longer runs. Override is displayed on the control panel but the motor does not run. Drive follows the specified stop type.	5
	Process PID set 1	*40.01 Process PID output actual* (page *293*).	6
70.05	*Override direction*	Selects the source of the motor direction used in the Override mode.	*Forward*
	Forward	Direction is forward.	0
	Reverse	Direction is reverse.	1
	DI1	Digital input DI1 (*10.02 DI delayed status*, bit 0).	2
	DI2	Digital input DI2 (*10.02 DI delayed status*, bit 1).	3
	DI3	Digital input DI3 (*10.02 DI delayed status*, bit 2).	4
	DI4	Digital input DI4 (*10.02 DI delayed status*, bit 3).	5
	DI5	Digital input DI5 (*10.02 DI delayed status*, bit 4).	6

No.	Name/Value	Description	Def/FbEq16
	DI6	Digital input DI6 (*10.02 DI delayed status*, bit 5).	7
	-DI1	Digital input DI1 (*10.02 DI delayed status*, bit 0).	8
	-DI2	Digital input DI2 (*10.02 DI delayed status*, bit 1).	9
	-DI3	Digital input DI3 (*10.02 DI delayed status*, bit 2).	10
	-DI4	Digital input DI4 (*10.02 DI delayed status*, bit 3).	11
	-DI5	Digital input DI5 (*10.02 DI delayed status*, bit 4).	12
	-DI6	Digital input DI6 (*10.02 DI delayed status*, bit 5).	13
	Other [bit]	Source selection (see *Terms and abbreviations* on page *124*).	-
70.06	*Override frequency*	Defines the frequency used as reference in the Override mode if *70.04 Override reference source* is set to *Override speed/freq* and the drive is in frequency mode.	0.0 Hz
	-500.0…500.0 Hz	Override frequency.	1 = 1 Hz
70.07	*Override speed*	Defines the speed used in as reference the Override mode if *70.04 Override reference source* is set to *Override speed/freq* and the drive is in speed mode.	0.0 rpm
	30000.0… 30000.0 rpm	Override speed.	1 = rpm

No.	Name/Value	Description	Def/FbEq16
70.10	*Override enables selection*	Selects which start interlock and run permissive input signals configured in the drive parameters will not allow the Override function to run the motor or will stop running the motor. The drive remains in Override mode nevertheless.	00000b

Bit	Name	Description
0	Run permissive	1 = The Override is not allowed to run the motor or the motor will be stopped, if the source defined by parameter *20.40 Run permissive* is 0.
1	Start interlock 1	1 = The Override is not allowed to start the motor or the motor will be stopped, if the source defined by parameter *20.41 Start interlock 1* is 0.
2	Start interlock 2	1 = The Override is not allowed to start the motor or the motor will be stopped, if the source defined by parameter *20.42 Start interlock 2* is 0.
3	Start interlock 3	1 = The Override is not allowed to start the motor or the motor will be stopped, if the source defined by parameter *20.43 Start interlock 3* is 0.
4	Start interlock 4	1 = The Override is not allowed to start the motor or the motor will be stopped, if the source defined by parameter *20.44 Start interlock 4* is 0.
5…15	Reserved	

70.20	*Override fault handling*	Faults are grouped into high priority faults and low priority faults. The following faults are high priority, and they are displayed and they will stop the drive: *2310 Overcurrent*, *2330 Earth leakage*, *2340 Short circuit*, *3210 DC link overvoltage*, *4991 Safe motor temperature*, *5089 SMT circuit malfunction*, *5090 STO hardware failure*, *5091 Safe torque off*, *FA81 Safe torque off 1*, *FA82 Safe torque off 2*. Other faults are low priority faults. Active low priority faults are reset when the drive enters Override mode. Low priority faults are ignored when the drive is in Override mode.	*Fault on high priority*
	Fault on high priority	Fault on high priority faults. The fault must be reset from the control panel or from a digital input.	0
	Autoreset	Fault on high priority faults (except STO related faults) with automatic fault reset and run. See the list of high priority faults above. See parameter *70.21 Override auto reset trials*.	1
70.21	*Override auto reset trials*	Defines the number of automatic fault resets the drive performs during Override operation. When the parameter is set to 0, reset trials are made continuously during the Override operation. A value of 1…5 defines a specific number of automatic reset trials.	5
	0…5	Number of automatic reset trials.	1 = 1
70.22	*Override auto reset time*	Defines the time the drive will wait after a fault before attempting an automatic fault reset.	5.0 s
	5.0…120.0 s	Auto reset delay time.	10 = 1 s
70.40	*Override log 1 start date*	Displays the start date of the last Override activation.	01.01.1980
		Start date.	

No.	Name/Value	Description	Def/FbEq16
70.41	*Override log 1 start time*	Displays the start time of the last Override activation.	00:00:00
		Start time.	
70.42	*Override log 1 end date*	Displays the end date of the last Override situation. If the drive is in Override mode, the parameter shows the current date.	01.01.1980
		End date.	
70.43	*Override log 1 end time*	Displays the end time of the last Override situation. If the drive is in Override mode, the parameter shows the current time.	00:00:00
		End time.	
70.44	*Override log 1 fault 1*	Displays the last fault, if any, that occurred during the last operation of Override.	0
		Fault description.	
70.45	*Override log 1 fault 2*	Displays the second last fault, if any, that occurred during the last operation of Override.	0
		Fault description.	
70.46	*Override log 1 fault 3*	Displays the third last fault, if any, that occurred during the last operation of Override.	0
		Fault description.	
70.47	*Override log 1 warning 1*	Displays the last warning, if any, that occurred during the last operation of Override.	0
		Warning description.	
70.48	*Override log 1 warning 2*	Displays the second last warning, if any, that occurred during the last operation of Override.	0
		Warning description.	
70.49	*Override log 1 warning 3*	Displays the third last warning, if any, that occurred during the last operation of Override.	0
		Warning description.	
70.50	*Override log 2 start date*	Displays the start date of the second last Override activation.	01.01.1980
		Start date.	
70.51	*Override log 2 start time*	Displays the start time of the second last Override activation.	00:00:00
		Start time.	
70.52	*Override log 2 end date*	Displays the end date of the second last Override situation.	01.01.1980
		End date.	
70.53	*Override log 2 end time*	Displays the end time of the second last Override situation.	00:00:00
		End time.	
70.54	*Override log 2 fault 1*	Displays the last fault, if any, that occurred during the second last operation of Override.	0
		Fault description.	
70.55	*Override log 2 fault 2*	Displays the second last fault, if any, that occurred during the second last operation of Override.	0
		Fault description.	

No.	Name/Value	Description	Def/FbEq16
70.56	*Override log 2 fault 3*	Displays the third last fault, if any, that occurred during the second last operation of Override.	0
		Fault description.	
70.57	*Override log 2 warning 1*	Displays the last warning, if any, that occurred during the second last operation of Override.	0
		Warning description.	
70.58	*Override log 2 warning 2*	Displays the second last warning, if any, that occurred during second the last operation of Override.	0
		Warning description.	
70.59	*Override log 2 warning 3*	Displays the third last warning, if any, that occurred during the second last operation of Override.	0
		Warning description.	
70.60	*Override log 3 start date*	Displays the start date of the third last Override activation.	01.01.1980
		Start date.	
70.61	*Override log 3 end date*	Displays the start time of the third last Override activation.	00:00:00
		Start time.	
70.62	*Override log 3 end time*	Displays the end date of the third last Override situation.	01.01.1980
		End date.	
70.63	*Override log 3 end time*	Displays the end time of the third last Override situation.	00:00:00
		End time.	
70.64	*Override log 3 fault 1*	Displays the last fault, if any, that occurred during the third last operation of Override.	0
		Fault description.	
70.65	*Override log 3 fault 2*	Displays the second last fault, if any, that occurred during the third last operation of Override	0
		Fault description.	
70.66	*Override log 3 fault 3*	Displays the third last fault, if any, that occurred during the third last operation of Override.	0
		Fault description.	
70.67	*Override log 3 warning 1*	Displays the last warning, if any, that occurred during the third last operation of Override.	0
		Warning description.	
70.68	*Override log 3 warning 2*	Displays the second last warning, if any, that occurred during third the last operation of Override.	0
		Warning description.	
70.69	*Override log 3 warning 3*	Displays the third last warning, if any, that occurred during the third last operation of Override.	0
		Warning description.	

No.	Name/Value	Description	Def/FbEq16
71 External PID1		Configuration of external PID. See control chain diagrams *External PID setpoint and feedback source selection*, and *External PID controller* on pages *530* and *531*, respectively.	
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. *71.37*.
8	Output limit low	1 = PID output is being limited by par. *71.36*.
9	Deadband active	1 = Deadband is active.
10…11	Reserved	
12	Internal setpoint active	1 = Internal setpoint active (see par. *71.16*…*71.23*)
13…15	Reserved	

No.	Name/Value	Description	Def/FbEq16
	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
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.	100.00
	-200000.00… 200000.0	Process setpoint base.	1 = 1
71.15	*Output scaling*	See parameter *71.14 Setpoint scaling*.	100.00

No.	Name/Value	Description	Def/FbEq16
	-200000.00… 200000.0	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%
71.22	*Internal setpoint 2*	See parameter *40.22 Set 1 internal setpoint 2*.	0.00%
71.23	*Internal setpoint 3*	See parameter *40.23 Set 1 internal setpoint 3*.	0.00%
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
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*	See parameter *40.58 Set 1 increase prevention*.	*No*
71.59	*Decrease prevention*	See parameter *40.59 Set 1 decrease prevention*.	*No*
71.62	*Internal setpoint actual*	See parameter *40.62 PID internal setpoint actual*.	0.00%
71.79	*External PID units*	See parameter *40.79 Set 1 units*.	*%*

No.	Name/Value	Description	Def/FbEq16
76 Multipump configuration		PFC (Pump and fan control), multipump and autochange configuration parameters. See sections *Single pump and fan control (PFC/SPFC)* on page *61, Parameter groups 76 Multipump configuration (page 331) and 77 Multipump maintenance and monitoring (page 340).* on page *68 and Note: ABB recommends reading the pump manufacturer's instructions for optimal performance.* on page *61*. **Note:** Parameters are dynamically hidden based on selection of pumping mode (*76.21 Multipump configuration*) and number of motors (*76.25 Number of motors*).	
76.01	*PFC status*	Displays the running/stopped status of the PFC motors. PFC1, PFC2, PFC3, PFC4, PFC5 and PFC6 always correspond to the 1st…6th motor of the PFC system. If *76.74 Autochange auxiliary PFC* auxiliary PFC is set to *Aux motors only*, PFC1 represents the motor connected to the drive and PFC2 the first auxiliary motor (the 2nd motor of the system). If *76.74* is set to *All motors*, PFC1 is the first motor, PFC2 the 2nd. The drive can be connected to any of these motors depending on the Autochange functionality.	-

Bit	Name	Value
0	PFC 1 running	0 = Stop, 1 = Start
1	PFC 2 running	0 = Stop, 1 = Start
2	PFC 3 running	0 = Stop, 1 = Start
3	PFC 4 running	0 = Stop, 1 = Start
4	PFC 5 running	0 = Stop, 1 = Start
5	PFC 6 running	0 = Stop, 1 = Start
6…15	Reserved	

No.	Name/Value	Description	Def/FbEq16
	0000h…FFFFh	Status of the PFC relay outputs.	1 = 1
76.02	*Multipump system status*	Displays the status of the multipump system in text format. Provides a quick PFC system overview, for example, if the parameter is added to the Home view on the control panel.	*PFC disabled*
	PFC disabled	PFC (Pump and fan control) is disabled.	0
	PFC enabled (not started)	PFC is enabled but not started.	1
	SPFC enabled (not started)	SPFC (Soft pump and fan control) is enabled but not started.	2
	MPFC enabled	Reserved.	3
	Running with VSD	The drive is controlling one pump/fan motor, no auxiliary motors are used.	100
	Running with VSD + 1 Aux	One auxiliary motor has been taken in use.	101
	Running with VSD + 2 Aux	Two auxiliary motor have been taken in use.	102
	Running with VSD + 3 Aux	Three auxiliary motor have been taken in use.	103
	Starting Aux1	Auxiliary motor 1 is being started.	200
	Starting Aux2	Auxiliary motor 2 is being started.	201
	Starting Aux3	Auxiliary motor 3 is being started.	202

No.	Name/Value	Description	Def/FbEq16
	Stopping Aux1	Auxiliary motor 1 is being stopped.	300
	Stopping Aux2	Auxiliary motor 2 is being stopped.	301
	Stopping Aux3	Auxiliary motor 3 is being stopped.	302
	Autochange active	Autochange, that is, automatic rotation of the start order is active.	400
	No auxiliary motors available to be started	No auxiliary motors are available to be started, for example, all are already running, or a motor in not available due to maintenance.	500
	Regulator bypass active	Direct-on-line pumps are automatically started and stopped.	600
	MPFC connection ok	Reserved.	700
	PID sleep	PID sleep is in use, and the pump can be stopped in during low demand.	800
	PID sleep boost	PID sleep with extended sleep time is in use, and the pump can be stopped in during low demand.	801
	Invalid configuration	PFC configuration is invalid.	4
	PFC inactive (local control)	PFC is inactive because the drive is in local control.	5
	PFC inactive (invalid operation mode)	PFC is inactive because of an invalid operation mode.	6
	Drive motor interlocked	The motor connected to the drive is interlocked (not available). Warning *D503 VSD controlled PFC motor interlocked* (page *425*) is generated.	7
	All motors interlocked	All motors are interlocked (not available). Warning *D502 All motors interlocked* (page *425*) is generated.	8
	PFC inactive (ext1 active)	PFC is inactive because external control location EXT1 is in use. PFC is supported in EXT2 only.	9
	Interlocked	Pump is interlocked.	701
	Standby	Drive is in standby mode.	703
	Master	Drive is master, running.	704
	Master (limited)	Drive is master, one or more pumps are offline or inhibited.	705
	Follower	Drive is follower.	706
	Follower (limited)	Drive is follower, one or more pumps are offline or inhibited.	707
	Follower (starting)	Drive is follower, starting.	708
	Master (stop delay)	Drive is master, waiting until stop delay time has passed.	709
	Master (start delay)	Drive is master, waiting until start delay time has passed.	710
	Master (wait start ack)	Waiting for master pump.	711
	Master (starting follower)	Drive is master, follower is starting.	712
	Master (wait switch ack)	Waiting for master pump.	713
	Master (stopping follower)	Drive is master, follower is stopping.	714

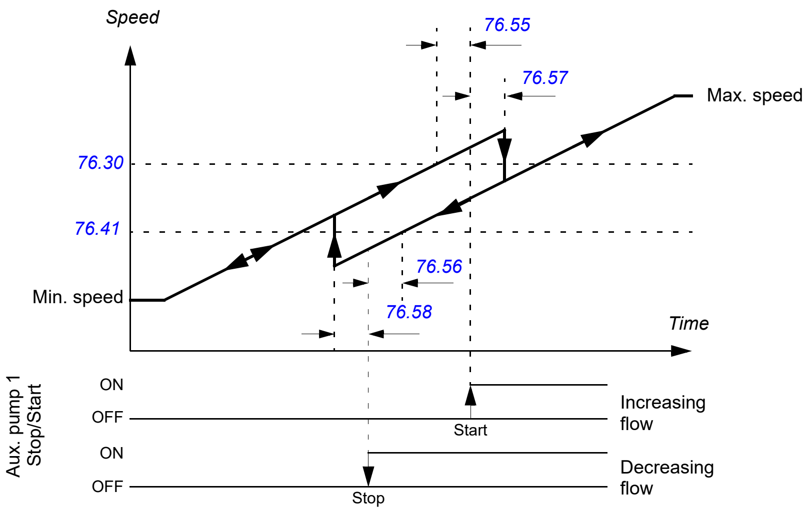
No.	Name/Value	Description	Def/FbEq16
	Master (offline)	Drive is master, offline.	715
	Not ready (node error)	Duplicate node(s) with same ID detected.	716
	Follower (stopping)	Pump is a follower and stopping	717
	Not ready (Off mode)	Drive is in Off mode.	718
	Not ready (Hand mode)	Drive is in Hand mode.	719
	Not ready (Hand mode (EXT1))	EXT1 selected as external control source.	720
	Standby (offline)	Drive is in standby mode, no remote pumps are connected	721
	Master (autochange)	Drive is master, master is changing.	722
	Master (PID sleep)	Drive is master, PID is sleeping.	723
	Synchronizing settings	Synchronizing settings.	725
	Master (sleep)	Level control, No pumps are running, pump is the next master.	726
	Not ready	No nodes defined.	727
	Master (decaking)	Drive is master, decaking.	728
	Not ready (pumping mode)	Node settings mismatch.	729
	Not ready (level conflict)	Conflict in pump start or stop levels. One possible reason for this can be if parameter *30.13 Minimum frequency* is higher than parameter *76.41 Stop point 1*.	730
76.11	*Pump/fan status 1*	Shows the status of pump or fan 1.	-

Bit	Name	Value
0	Ready	0 = False, 1 = True
1	CRC mismatch	0 = False, 1 = True
2	Running	0 = False, 1 = True
3…4	Reserved	
5	In PFC control	0 = False, 1 = True
6	Reserved	
7	Master enable	0 = False, 1 = True
8	Active master	0 = False, 1 = True
9…10	Reserved	
11	Interlocked	0 = False, 1 = True
12	Local mode	0 = False, 1 = True
13	Reserved	
14	Drive start active	0 = False, 1 = True
15	Max stationary time elapsed	0 = False, 1 = True

	0000h…FFFFh	Status of pump or fan 1.	1 = 1

No.	Name/Value	Description	Def/FbEq16
76.12	*Pump/fan status 2*	See parameter *76.11 Pump/fan status 1*.	-
76.13	*Pump/fan status 3*	See parameter *76.11 Pump/fan status 1*.	-
76.14	*Pump/fan status 4*	See parameter *76.11 Pump/fan status 1*.	-
76.15	*Pump/fan status 5*	See parameter *76.11 Pump/fan status 1*.	-
76.16	*Pump/fan status 6*	See parameter *76.11 Pump/fan status 1*.	-
76.21	*Multipump configuration*	Selects the multi-pump/fan mode.	*Off*
	Off	Disabled.	0
	PFC	PFC enabled. One pump at a time is controlled by the drive. The remaining pumps are direct-on-line pumps that are started and stopped by the drive logic. The frequency (group *28 Frequency reference chain*) / speed (group *22 Speed reference selection*) reference must be defined as PID for the PFC functionality to work properly. See *Single pump and fan control (PFC/SPFC)* on page *61*.	2
	SPFC	SPFC enabled. See section *Soft pump and fan control (SPFC)* on page *62*.	3
76.25	*Number of motors*	Total number of motors used in the application, including the motor connected directly to the drive.	1
	1…8	Number of motors. For PFC 1…6.	1 = 1
76.26	*Min number of motors allowed*	Minimum number of motors running simultaneously.	1
	0…8	Minimum number of motors. For PFC 0…6.	1 = 1
76.27	*Max number of motors allowed*	Maximum number of motors running simultaneously.	1
	1…8	Maximum number of motors. For PFC 1…6.	1 = 1

No.	Name/Value	Description	Def/FbEq16
76.30	*Start point 1*	Defines the start speed or frequency (Hz/rpm) for the first auxiliary motor. As the motor speed or frequency exceeds the limit defined by this parameter, a new auxiliary motor is started. To avoid nuisance starts of the second auxiliary motor, the speed of the variable speed motor should be higher than the start speed for the duration defined by parameter *76.55 Start delay*. If the speed decreases below the start speed, the auxiliary motor is not started. To maintain the process conditions during the start of the second auxiliary motor, a speed hold on time can be defined with parameter *76.57 PFC speed hold on*. Certain pump types do not produce significant flow with low frequencies. The speed hold on time can be used to compensate the time needed to accelerate the second auxiliary motor to a speed where it produces flow. The start of the second auxiliary motor is not aborted if the speed of the first auxiliary motor decreases	Vector: 1300 rpm; Scalar 48 Hz; 58 Hz (*95.20* b0)



No.	Name/Value	Description	Def/FbEq16
	0.00…32767.00 rpm/Hz	Speed/frequency	1 = 1 unit
76.31	*Start point 2*	Defines the start speed or frequency (Hz/rpm) for the second auxiliary motor. See parameter *76.31 Start point 1*.	Vector: 1300 rpm; Scalar 48 Hz; 58 Hz (*95.20* b0)
76.32	*Start point 3*	Defines the start speed or frequency (Hz/rpm) for the third auxiliary motor. See parameter *76.31 Start point 1*.	Vector: 1300 rpm; Scalar 48 Hz; 58 Hz (*95.20* b0)

No.	Name/Value	Description	Def/FbEq16
76.33	*Start point 4*	Defines the start speed or frequency (Hz/rpm) for the fourth follower pump/auxiliary motor. See parameter *76.30 Start point 1*.	Vector: 1300 rpm; Scalar 48 Hz; 58 Hz (*95.20* b0)
76.34	*Start point 5*	Defines the start speed or frequency (Hz/rpm) for the fifth follower pump/auxiliary motor. See parameter *76.30 Start point 1*.	Vector: 1300 rpm; Scalar 48 Hz; 58 Hz (*95.20* b0)
76.41	*Stop point 1*	Defines the stop speed or frequency (Hz/rpm) for the first auxiliary motor. When the speed or frequency of the motor connected directly to the drive falls below this value and one auxiliary motor is running, the stop delay defined by parameter *76.56 Stop delay* is started. If the speed is still at the same level or lower when the stop delay elapses, the first auxiliary motor stops. The running speed of the drive is increased by [*Start point 1* - *Stop point 1*] after the auxiliary motor stops.	Vector: 800 rpm; Scalar 25 Hz; 30 Hz (*95.20* b0)
	0.00…32767.00 rpm/Hz	Speed/frequency	1 = 1 unit
76.42	*Stop point 2*	Defines the stop speed or frequency (Hz/rpm) for the second auxiliary motor. See parameter *76.41 Stop point 1*.	Vector: 800 rpm; Scalar 25 Hz; 30 Hz (*95.20* b0)
76.43	*Stop point 3*	Defines the stop speed or frequency (Hz/rpm) for the third auxiliary motor. See parameter *76.41 Stop point 1*.	Vector: 800 rpm; Scalar 25 Hz; 30 Hz (*95.20* b0)
76.44	*Stop point 4*	Defines the stop speed or frequency (Hz/rpm) for the fourth follower pump/auxiliary motor. See parameter *76.41 Stop point 1*.	Vector: 800 rpm; Scalar 25 Hz; 30 Hz (*95.20* b0)
76.45	*Stop point 5*	Defines the stop speed or frequency (Hz/rpm) for the fifth follower pump/auxiliary motor. See parameter *76.41 Stop point 1*.	Vector: 800 rpm; Scalar 25 Hz; 30 Hz (*95.20* b0)
76.55	*Start delay*	Defines the delay time for starting the auxiliary motors. See parameter *76.31 Start point 1*.	10.00 s
	0.00…12600.00 s	Time delay.	1 = 1 s
76.56	*Stop delay*	Defines the delay time for starting the auxiliary motors. See parameter *76.31 Stop point 1*.	10.00 s
	0.00…12600.00 s	Time delay.	1 = 1 s

6

No.	Name/Value	Description	Def/FbEq16
76.57	*PFC speed hold on*	Hold time for auxiliary motor switch-on. See parameter *76.31 Start point 1*.	0.00 s
	0.00…1000.00 s	Time.	1 = 1 s
76.58	*PFC speed hold off*	Hold time for auxiliary motor switch-off. See parameter *76.31 Stop point 1*.	0.00 s
	0.00…1000.00 s	Time.	1 = 1 s
76.59	*PFC contactor delay*	Start delay for the motor that is directly controlled by the drive. This does not affect the starting of the auxiliary motors. **WARNING!** There must always be a delay set if the motors are equipped with star-delta starters. The delay must be set longer than the time setting of the starter. After the motor is switched on by the relay output of the drive, there must be enough time for the star-delta starter to first switch to star and then back to delta before the motor is connected to the drive.	0.50 s
	0.20…600.00 s	Time delay.	1 = 1 s
76.60	*PFC ramp acceleration time*	Defines the acceleration time for the drive motor speed compensation, when an auxiliary motor is stopped. This ramp time is also used for the drive motor to accelerate after an autochange has occurred. The parameter sets the ramp-up time as seconds from zero to maximum frequency (not from the previous reference to the new reference).	1.00 s
	0.00…1800.00 s	Time.	1 = 1 s
76.61	*PFC ramp deceleration time*	Defines the deceleration time for the drive motor speed compensation, when an auxiliary motor is started. This ramp time is also used for the drive motor to decelerate after an autochange has occurred. The parameter sets the ramp-up time as seconds from maximum to zero frequency (not from the previous reference to the new reference).	1.00 s
	0.00…1800.00 s	Time.	1 = 1 s
76.70	*PFC Autochange*	Defines the way the autochange is triggered. In all cases except *Even wear*, the start order is moved one step forward each time the autochange occurs. If the start order initially is 1-2-3-4, after the first autochange the order will be 2-3-4-1, etc. For *Even wear*, the start order will be determined so that the running times of all motors remain within the defined limit. **Note:** Autochange only occurs when the speed of the drive is below the speed defined by parameter *76.73 Autochange level*. See also section *Autochange* on page *64*	*Not selected* (for PFC)
	Not selected	Autochange disabled.	0
	Selected	Rising edge starts the autochange if autochange conditions are met.	1
	DI1	Autochange triggered by the rising edge of digital input DI1 (*10.02 DI delayed status*, bit 0).	2
	DI2	Autochange triggered by the rising edge of digital input DI2 (*10.02 DI delayed status*, bit 1).	3
	DI3	Autochange triggered by the rising edge of digital input DI3 (*10.02 DI delayed status*, bit 2).	4

No.	Name/Value	Description	Def/FbEq16
	DI4	Autochange triggered by the rising edge of digital input DI4 (*10.02 DI delayed status*, bit 3).	5
	DI5	Autochange triggered by the rising edge of digital input DI5 (*10.02 DI delayed status*, bit 4).	6
	DI6	Autochange triggered by the rising edge of digital input DI6 (*10.02 DI delayed status*, bit 5).	7
	Timed function 1	Autochange triggered by timed function 1 (bit 0 of *34.01 Timed functions status* (see page *267*)).	8
	Timed function 2	Autochange triggered by timed function 2 (bit 1 of *34.01 Timed functions status* (see page *267*)).	9
	Timed function 3	Autochange triggered by timed function 3 (bit 2 of *34.01 Timed functions status* (see page *267*)).	10
	Fixed interval	Autochange is done when the interval determined in the parameter *76.71 PFC Autochange interval* has elapsed.	11
	All stop	Autochange is done when all the motors are stopped. The PID sleep feature (parameters *40.43 Set 1 sleep level* … *40.48 Set 1 wake-up delay*) must be used for the drive to stop when the process demand is low.	12
	Even wear	The running time of the motors are balanced by the drive. When the difference in running time between the motors with the least and most running hours exceeds the time defined by parameter *76.72 Maximum wear imbalance*, the autochange occurs. The running hours of the motors can be found in group *77 Multipump maintenance and monitoring*.	13
	Other [bit]	Source selection (see *Terms and abbreviations* on page *124*).	-
76.71	*PFC Autochange interval*	Specifies the interval that is used in setting *Fixed interval* of parameter *76.70 PFC Autochange*.	1.00 h
	0.00…42949672.95 h	Time.	1 = 1 h
76.72	*Maximum wear imbalance*	Specifies the maximum wear imbalance, or difference in running times between any motor, used by the *Even wear* setting of parameter *76.70 PFC Autochange*.	10.00 h
	0.00…1000000.00 h	Time.	1 = 1 h
76.73	*Autochange level*	Upper speed limit for the Autochange to occur. The Autochange occurs when: • the condition defined in *76.70 PFC Autochange* is fulfilled and, • the speed of the drive motor *01.03 Motor speed %* is below the speed limit defined in this parameter. **Note:** When the value is selected as 0%, this speed limit check is disabled.	100.0%
	0.0…300.0%	Speed/frequency in percentage of the nominal speed or frequency of the drive motor.	1 = 1%
76.74	*Autochange auxiliary PFC*	Selects whether only auxiliary motors or all motors are included in the Autochange function.	*Aux motors only*

No.	Name/Value	Description	Def/FbEq16
	All motors	All motors, including the one connected to the drive participates in the autochange. The Autochange logic will connect the drive to each of the motors according to setting of parameter *76.70 PFC Autochange*. **Note:** The first motor (PFC1) also requires the appropriate hardware contactor connections and PFC1 must be defined in one of the relay output source parameters.	0
	Aux motors only	Only auxiliary (direct-on-line) motors are affected by the autochange function. **Note:** PFC1 refers to the motor that is fixed to the drive and must not be selected in any of the relay output source parameters. Only the starting order of the auxiliary motors will be rotated.	1
76.81	*PFC 1 interlock*	Defines if the PFC motor 1 can be started. An interlocked PFC motor cannot be started. 0 = Interlocked (not available) 1 = Available.	*Available. PFC motor is available*
	Interlocked. PFC motor is not in use	PFC motor is interlocked and not available.	0
	Available. PFC motor is available	PFC motor is available.	1
	DI1	Digital input DI1 (*10.02 DI delayed status*, bit 0).	2
	DI2	Digital input DI2 (*10.02 DI delayed status*, bit 1).	3
	DI3	Digital input DI3 (*10.02 DI delayed status*, bit 2).	4
	DI4	Digital input DI4 (*10.02 DI delayed status*, bit 3).	5
	DI5	Digital input DI5 (*10.02 DI delayed status*, bit 4).	6
	DI6	Digital input DI6 (*10.02 DI delayed status*, bit 5).	7
	Timed function 1	Bit 0 of *34.01 Timed functions status* (see page *267*).	8
	Timed function 2	Bit 1 of *34.01 Timed functions status* (see page *267*).	9
	Timed function 3	Bit 2 of *34.01 Timed functions status* (see page *267*).	10
	Other [bit]	Source selection (see *Terms and abbreviations* on page *124*).	-
76.82	*PFC 2 interlock*	See parameter *76.81 PFC 1 interlock*.	*Available. PFC motor is available*
76.83	*PFC 3 interlock*	See parameter *76.81 PFC 1 interlock*.	*Available. PFC motor is available*
76.84	*PFC 4 interlock*	See parameter *76.81 PFC 1 interlock*.	*Available. PFC motor is available*
76.85	*PFC 5 interlock*	See parameter *76.81 PFC 1 interlock*.	*Available. PFC motor is available*
76.86	*PFC 6 interlock*	See parameter *76.81 PFC 1 interlock*.	*Available. PFC motor is available*
76.95	*Regulator bypass control*	Defines if direct-on-line pumps are automatically started and stopped. This setting can be used in applications with a low number of sensors and low accuracy requirements.	*Disable*

No.	Name/Value	Description	Def/FbEq16
	Disable	Automatic starting and stopping is disabled.	0
	Enable	Automatic starting and stopping is enabled.	1
	Other [bit]	Source selection (see *Terms and abbreviations* on page *124*).	-
77 Multipump maintenance and monitoring		PFC (Pump and fan control) and multipump maintenance and monitoring parameters	
77.10	*PFC runtime change*	Enables the reset, or arbitrary setting, of *77.11 Pump/fan 1 running time*.	*Done*
	Done	The parameter automatically reverts back to this value.	0
	Set any PFC run time	Enables the setting of *77.11 Pump/fan 1 running time*.	1
	Reset PFC1 run time	Resets parameter *77.11 Pump/fan 1 running time*.	2
	Reset PFC2 run time	Resets parameter *77.12 Pump/fan 2 running time*.	3
	Reset PFC3 run time	Resets parameter *77.13 Pump/fan 3 running time*.	4
	Reset PFC4 run time	Resets parameter *77.14 Pump/fan 4 running time*.	4
	Reset PFC5 run time	Resets parameter *77.15 Pump/fan 5 running time*	
	Reset PFC6 run time	Resets parameter *77.16 Pump/fan 6 running time*.	7
77.11	*Pump/fan 1 running time*	Running time counter of pump/fan 1. Can be set or reset by parameter *77.10 PFC runtime change*.	0.00 h
	0.00… 42949672.95 h	Time	1 = 1 h
77.12	*Pump/fan 2 running time*	See parameter *77.11 Pump/fan 1 running time*.	0.00 h
77.13	*Pump/fan 3 running time*	See parameter *77.11 Pump/fan 1 running time*.	0.00 h
77.14	*Pump/fan 4 running time*	See parameter *77.11 Pump/fan 1 running time*.	0.00 h
77.15	*Pump/fan 5 running time*	See parameter *77.11 Pump/fan 1 running time*.	0.00 h
77.16	*Pump/fan 6 running time*	See parameter *77.11 Pump/fan 1 running time*.	0.00 h

No.	Name/Value	Description	Def/FbEq16
95 HW configuration		Various hardware-related settings.	
95.01	*Supply voltage*	Selects the supply voltage range. This parameter is used by the drive to determine the nominal voltage of the supply network. The parameter also affects the current ratings and the DC voltage control functions (trip and brake chopper activation limits) of the drive. **WARNING!** An incorrect setting may cause the motor to rush uncontrollably, or the brake chopper or resistor to overload. **Note:** The selections shown depend on the hardware of the drive. If only one voltage range is valid for the drive in question, it is selected by default.	*Automatic / not selected*
	Automatic / not selected	No voltage range selected. The drive will not start modulating before a range is selected, unless parameter *95.02 Adaptive voltage limits* is set to *Enable*, in which case the drive estimates the supply voltage itself.	0
	380…415 V	380…415 V	1
	440…480 V	440…480 V	2
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. Estimation is done every time the drive is powered up and is based on the rise speed of voltage level of the DC bus while the drive charges the DC bus.	-
	0…65535 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

No.	Name/Value	Description	Def/FbEq16
95.15	*Special HW settings*	Contains hardware-related settings that can be enabled and disabled by toggling the specific bits. **Notes:** • The installation of the hardware specified by this parameter may require derating of drive output, or impose other limitations. See (ATEX) the *Hardware manual* of the drive. • With the CPTC-02 ATEX-certified thermistor protection module, follow the instructions given in the *CPTC-02 ATEX-certified thermistor protection module, Ex II (2) GD (+L537+Q971) user's manual* (3AXD50000030058 [English]).	0000h

Bit	Name	Information
0	EX motor	1 = The driven motor is an Ex (ATEX) motor provided by ABB for potentially explosive atmospheres. This sets the required minimum switching frequency for ABB Ex (ATEX) motors. **Notes:** • For non-ABB Ex (ATEX) motors, use parameters *97.01* and *97.02* to define the correct minimum switching frequency. • If you have a multimotor system, contact your local ABB representative.
1	ABB Sine filter	1 = An ABB sine filter is connected to the output of the drive.
2…15	Reserved	

	0000h…FFFFh	Hardware options configuration word.	1 = 1
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	See section *Differences in the default values between 50 Hz and 60 Hz supply frequency settings* on page *381*. 0 = 50 Hz. 1 = 60 Hz.
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	Output contactor	1 = Output contactor present. Affects *10.24*.
15	Reserved	*1 = IGBT supply unit control by inverter unit active. Makes several parameters visible in groups *01*, *05*, *06*, *07*, *30*, *31*, and *96*.

*See section *Parameter groups 50 Fieldbus adapter (FBA) (page 308), 51 FBA A settings (page 313), 52 FBA A data in (page 314), and 53 FBA A data out (page 315) and 58 Embedded fieldbus (page 315).* (page *61*).

	0000h…FFFFh	Hardware options configuration word.	1 = 1

No.	Name/Value	Description	Def/FbEq16
95.21	*HW options word 2*	Specifies more hardware-related options that require differentiated parameter defaults. See parameter *95.20 HW options word 1*. ⚠ **WARNING!** After switching any bits in this word, recheck the values of the affected parameters.	-

Bit	Name	Information
0…4	Reserved	
5	Bypass present	1 = Bypass is used.
6	Cabinet drive	0 = Inactive, 1 = Active. Only for drive frames R6 or larger.
7	Cabinet fan	0 = Inactive, 1 = Active. Only for drive frames R6 or larger.
8	Legacy bypass present	1 = Legacy bypass is used.
9	ACS510 EFB default	1 = ACS510 EFB default is used.
10…15	Reserved	

No.	Name/Value	Description	Def/FbEq16
	0000b…0101b	Hardware options configuration word 2.	1 = 1
95.26	*Motor disconnect detection*	Detects if motor is disconnected and shows a warning of disconnected motor. When this parameter is enabled, the drive will do the following: 1. The drive detects if the motor is disconnected from the drive (all three phases). 2. When a motor disconnection is detected, the drive will stay running and waits for the motor to be connected again. The drive shows warning *A784 Motor disconnect* on the control panel. 3. When motor connection is again detected, the motor returns back to the last active reference before the disconnection was detected. 4. The warning message disappears from the panel. **Note:** This feature is only available in scalar control mode. This parameter does not affect vector control mode behavior.	*Disable*
	Disable	Detecting of disconnecting motor disabled.	0
	Enable	Detecting of disconnecting motor enabled.	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

<table>
<tr><th>No.</th><th>Name/Value</th><th>Description</th><th>Def/FbEq16</th></tr>
<tr><td colspan="2">96 System</td><td>Language selection; access levels; macro selection; parameter save and restore; control unit reboot; user parameter sets; unit selection; parameter checksum calculation; user lock.</td><td></td></tr>
<tr><td>96.01</td><td>Language</td><td>Selects the language of the parameter interface and other displayed information when viewed on the control panel.

Drive supports multiple languages. The languages are divided in three firmware packages: Global, European and Asian.
The default package is Global package that supports languages marked with X and G. European delta supports languages marked with X and E. Asian delta supports languages marked with X and A.

<table>
<tr><th>Language</th><th>Global package</th><th>European</th><th>Asian</th></tr>
<tr><td>English</td><td>X</td><td>X</td><td>X</td></tr>
<tr><td>Chinese (Simplified)</td><td>X</td><td></td><td>X</td></tr>
<tr><td colspan="4">X = Common language, available in all packages</td></tr>
</table>

The drives include the language package corresponding to the order's geographical location. No plus code or other actions are needed.</td><td>English</td></tr>
<tr><td></td><td>Not selected</td><td>None.</td><td>0</td></tr>
<tr><td></td><td>English</td><td>English. Included in all packages.</td><td>1033</td></tr>
<tr><td></td><td>Chinese (Simplified, PRC)</td><td>Simplified Chinese. Included in Global and Asian packages.</td><td>2052</td></tr>
<tr><td>96.02</td><td>Pass code</td><td>Pass codes can be entered into this parameter to activate further access levels (see parameter 96.03 Access level status) or to configure the user lock.
Entering “358” toggles the parameter lock, which prevents the changing of all other parameters through the control panel or the Drive composer PC tool.
Entering the user pass code (by default, “10000000”) enables parameters 96.100…96.102, which can be used to define a new user pass code and to select the actions that are to be prevented.
Entering an invalid pass code will close the user lock if open, ie, hide parameters 96.100…96.102. After entering the code, check that the parameters are in fact hidden. If they are not, enter another (random) pass code.
Note: You must change the default user pass code to maintain a high level of cybersecurity. <u>Store the code in a safe place – ABB CANNOT UNLOCK THE DRIVE ONCE YOU CHANGE THE PASS CODE.</u>
See also section User lock (page 122).</td><td></td></tr>
<tr><td></td><td>0…99999999</td><td>Pass code.</td><td>-</td></tr>
</table>

No.	Name/Value	Description	Def/FbEq16
96.03	*Access level status*	Shows which access levels have been activated by pass codes entered into parameter *96.02 Pass code*.	0001b

Bit	Name
0	End user
1	Service
2	Advanced programmer
3…9	Reserved
10	Override parameter lock
11	OEM access level 1
12	OEM access level 2
13	OEM access level 3
14	Parameter lock
15	Reserved

No.	Name/Value	Description	Def/FbEq16
	0000h…FFFFh	Active access levels.	1 = 1
96.04	*Macro select*	Selects the control macro. See chapter *Application macros* (page *37*) for more information. After a selection is made, the parameter reverts automatically to *Done*.	*Done*
	Done	Macro selection complete; normal operation.	0
	Motor potentiometer	Motor potentiometer (see page *48*).	1
	Hand/Auto	Hand/Auto (see page *38*).	2
	Hand/Comm	Hand/Comm (see page *40*).	3
	Hand/PID	Hand/PID (see page *48*).	4
	PFC	PFC (see page *44*).	5
	SPFC	SPFC (see page *46*).	6
96.05	*Macro active*	Shows which control macro is currently selected. See chapter *Application macros* (page *37*) for more information. To change the macro, use parameter *96.04 Macro select*.	*Hand/Auto*
	Motor potentiometer	Motor potentiometer (see page *48*).	1
	Hand/Auto	Hand/Auto (see page *38*).	2
	Hand/Comm	Hand/Comm (see page *40*).	3
	Hand/PID	Hand/PID (see page *48*).	4
	PFC	PFC (see page *44*).	5
	SPFC	SPFC (see page *46*).	6
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

No.	Name/Value	Description	Def/FbEq16
	Restore defaults	Restores all editable parameter values to default values, except • motor data and ID run results • I/O extension module settings • end user texts, such as customized warnings and faults • control panel/PC communication settings • fieldbus adapter settings • control macro selection and the parameter defaults implemented by it • parameter *95.01 Supply voltage* • differentiated defaults implemented by parameters *95.20 HW options word 1* and *95.21 HW options word 2* • user lock configuration parameters *96.100…96.102*.	8
	Clear all	Restores all editable parameter values to default values, except • end user texts, such as customized warnings and faults • control panel/PC communication settings • parameter *95.01 Supply voltage* • differentiated defaults implemented by parameters *95.20 HW options word 1* and *95.21 HW options word 2* • user lock configuration parameters *96.100…96.102*. • group *49 Panel port communication* parameters.	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 back to show the values of the default parameters defined by the control macro in use	512
	Reset end user texts	Restores all end user texts to default values, including the contact info, customized fault and warning texts, PID unit and currency unit. **Note:** PID unit is reset only if it is user editable text, that is, parameter *40.79 Set 1 units* is set to *User text*.	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 • differentiated defaults implemented by parameters *95.20 HW options word 1* and *95.21 HW options word 2*.	34560
96.07	*Parameter save manually*	Saves the valid parameter values to the permanent memory on the drive control unit 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

No.	Name/Value	Description	Def/FbEq16
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.	*No action*
	No action	1 = No action.	0
	Reboot	1 = Reboot the control unit.	1
96.10	*User set status*	Shows the status of the user parameter sets. This parameter is read-only. See also section *Data storage parameters* (page *121*).	-
	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
	Reserved		8…19
	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. See section *User parameter sets* (page *116*). The set that was in use before powering down the drive is in use after the next power-up. **Notes:** • Hardware configuration settings, such as I/O extension module and fieldbus configuration parameters (groups 14…16, 47, 51…58 and 92…93, and parameter *50.01 FBA A enable*), and forced input/output values (such as *10.03 DI force selection* and *10.04 DI forced data*) are not included in user parameter sets. • Parameter changes made after loading a set are not automatically stored – they must be saved using this parameter. • If no sets have been saved, attempting to load a set will create all sets from the currently active parameter settings. • Switching between sets is only possible with the drive stopped.	*No action*
	No action	Load or save operation complete; normal operation.	0
	User set I/O mode	Load user parameter set using parameters *96.12 User set I/O mode in1* and *96.13 User set I/O mode in2*.	1
	Load set 1	Load user parameter set 1.	2
	Load set 2	Load user parameter set 2.	3

<table>
<tr><th>No.</th><th>Name/Value</th><th>Description</th><th>Def/FbEq16</th></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>Reserved</td><td></td><td>6…17</td></tr>
<tr><td></td><td>Save to set 1</td><td>Save user parameter set 1.</td><td>18</td></tr>
<tr><td></td><td>Save to set 2</td><td>Save user parameter set 2.</td><td>19</td></tr>
<tr><td></td><td>Save to set 3</td><td>Save user parameter set 3.</td><td>20</td></tr>
<tr><td></td><td>Save to set 4</td><td>Save user parameter set 4.</td><td>21</td></tr>
<tr><td>96.12</td><td>User set I/O mode in1</td><td>When parameter 96.11 User set save/load is set to User set I/O mode, selects the user parameter set together with parameter 96.13 User set I/O mode in2 as follows:
<table>
<tr><th>Status of source defined by par. 96.12</th><th>Status of source defined by par. 96.13</th><th>User parameter set selected</th></tr>
<tr><td>0</td><td>0</td><td>Set 1</td></tr>
<tr><td>1</td><td>0</td><td>Set 2</td></tr>
<tr><td>0</td><td>1</td><td>Set 3</td></tr>
<tr><td>1</td><td>1</td><td>Set 4</td></tr>
</table></td><td>Not selected</td></tr>
<tr><td></td><td>Not selected</td><td>0.</td><td>0</td></tr>
<tr><td></td><td>Selected</td><td>1.</td><td>1</td></tr>
<tr><td></td><td>DI1</td><td>Digital input DI1 (10.02 DI delayed status, bit 0).</td><td>2</td></tr>
<tr><td></td><td>DI2</td><td>Digital input DI2 (10.02 DI delayed status, bit 1).</td><td>3</td></tr>
<tr><td></td><td>DI3</td><td>Digital input DI3 (10.02 DI delayed status, bit 2).</td><td>4</td></tr>
<tr><td></td><td>DI4</td><td>Digital input DI4 (10.02 DI delayed status, bit 3).</td><td>5</td></tr>
<tr><td></td><td>DI5</td><td>Digital input DI5 (10.02 DI delayed status, bit 4).</td><td>6</td></tr>
<tr><td></td><td>DI6</td><td>Digital input DI6 (10.02 DI delayed status, bit 5).</td><td>7</td></tr>
<tr><td></td><td>Reserved</td><td></td><td>8…17</td></tr>
<tr><td></td><td>Timed function 1</td><td>Bit 0 of 34.01 Timed functions status (see page 267).</td><td>18</td></tr>
<tr><td></td><td>Timed function 2</td><td>Bit 1 of 34.01 Timed functions status (see page 267).</td><td>19</td></tr>
<tr><td></td><td>Timed function 3</td><td>Bit 2 of 34.01 Timed functions status (see page 267).</td><td>20</td></tr>
<tr><td></td><td>Reserved</td><td></td><td>21…23</td></tr>
<tr><td></td><td>Supervision 1</td><td>Bit 0 of 32.01 Supervision status (see page 259).</td><td>24</td></tr>
<tr><td></td><td>Supervision 2</td><td>Bit 1 of 32.01 Supervision status (see page 259).</td><td>25</td></tr>
<tr><td></td><td>Supervision 3</td><td>Bit 2 of 32.01 Supervision status (see page 259).</td><td>26</td></tr>
<tr><td></td><td>Other [bit]</td><td>Source selection (see Terms and abbreviations on page 124).</td><td>-</td></tr>
<tr><td>96.13</td><td>User set I/O mode in2</td><td>See parameter 96.12 User set I/O mode in1.</td><td>Not selected</td></tr>
</table>

No.	Name/Value	Description	Def/FbEq16
96.16	*Unit selection*	Selects the unit of parameters indicating power, temperature and torque. **Bit** / **Name** / **Information**: 0 – Power unit – 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	0000b
	0000h…FFFFh	Unit selection word.	1 = 1
96.20	*Time sync primary source*	Defines the first priority external source for synchronization of the drive's time and date.	*Panel link*
	Internal	No external source selected.	0
	Reserved		1…2
	Fieldbus A	FENA/FPNO can get the time from SNTP server and set it as time for the drive.	3
	Reserved		4…5
	Embedded FB	EFB BACnet MS/ TP Timesync service can be used for setting the time for the drive.	6
	Reserved		7
	Panel link	You can set the time using the control panel, or a PC tool connected to the panel link.	8
	Ethernet tool link	You can set the time manually using DCP over Ethernet. The time can be set in the same way when you do it with USB and panel.	9
96.24	*Full days since 1st Jan 1980*	Number of full days passed since beginning of the year 1980. This parameter, together with *96.25 Time in minutes within 24 h* and *96.26 Time in ms within one minute* makes it possible to set the date and time in the drive via the parameter interface from a fieldbus or application program. This may be necessary if the fieldbus protocol does not support time synchronization.	-
	1…59999	Days since beginning of 1980.	1 = 1
96.25	*Time in minutes within 24 h*	Number of full minutes passed since midnight. For example, the value 860 corresponds to 2:20 pm. See parameter *96.24 Full days since 1st Jan 1980*.	0 min
	1…1439	Minutes since midnight.	1 = 1
96.26	*Time in ms within one minute*	Number of milliseconds passed since last minute. See parameter *96.24 Full days since 1st Jan 1980*.	0 ms
	0…59999	Number of milliseconds since last minute.	1 = 1
96.39	*Event configuration*	Enables/disables power-up logging. When enabled, an event (*B5A2 Power up*) is logged by the drive upon each power-up.	*Enable*

No.	Name/Value	Description	Def/FbEq16
		<table><tr><th>Bit</th><th>Name</th></tr><tr><td>0</td><td>0 = Power applied</td></tr><tr><td>1</td><td>1 = Hand mode selected</td></tr><tr><td>2</td><td>2 = Off mode selected</td></tr><tr><td>3</td><td>3 = Auto mode selected</td></tr><tr><td>4</td><td>4 = Auto start command</td></tr><tr><td>5</td><td>5 = Auto stop command</td></tr><tr><td>6</td><td>6 = Modulating started</td></tr><tr><td>7</td><td>7 = Modulating stopped</td></tr></table>	
	Disable	Power-up event logging disabled.	0
	Enable	Power-up event logging enabled.	1
96.51	*Clear fault and event logger*	Clears all events from the drive's fault and event logs. See section *Warning/fault history* on page *412*.	*Done*
	Done	0 = No action	0
	Reset	1 = Clear the loggers.	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	Drive generates an event log entry *B686 Checksum mismatch*.	1
	Warning	Drive generates warning *A686 Checksum mismatch*.	2
	Warning and prevent start	Drive generates warning *A686 Checksum mismatch*. Starting the drive is prevented.	3
	Fault	Drive trips on fault *6200 Checksum mismatch*.	4

No.	Name/Value	Description	Def/FbEq16
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*.	0000h

Bit	Name	Description
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	Def/FbEq16
	0000h…FFFFh	Checksum control word.	1 = 1
96.68	*Actual checksum A*	Displays the actual parameter configuration checksum. Checksum A calculation does not include • fieldbus settings. The parameters included in the calculation are user editable parameters in parameter groups 10…13, 15, 19…25, 28, 30…32, 34…37, 40…41, 43, 45…46, 70…74, 76, 80, 94…99. See also section *Parameter checksum calculation* (page *122*).	-
	00000000h… FFFFFFFFh	Actual checksum.	-
96.69	*Actual checksum B*	Displays the actual parameter configuration checksum B. Checksum B calculation does not include • fieldbus settings • motor data settings • energy data settings. The parameters included in the calculation are user editable parameters in parameter groups 10…13, 15, 19…25, 28, 30…32, 34, 35…37, 40…41, 43, 46, 70…74, 76, 80, 94…97. See also section *Parameter checksum calculation* (page *122*).	-
	00000000h… FFFFFFFFh	Actual checksum.	-

No.	Name/Value	Description	Def/FbEq16
96.70	*Disable adaptive program*	Not applicable.	
96.71	*Approved checksum A*	Approved (reference) checksum A.	0h
	00000000h… FFFFFFFFh	Approved checksum A.	-
96.72	*Approved checksum B*	Approved (reference) checksum B.	0h
	00000000h… FFFFFFFFh	Approved checksum B.	-
96.78	*Legacy Modbus mapping*	Enables a Modbus user to access a select set of parameters using legacy register numbering. See the supported parameters in section *Parameters supported by Modbus legacy compatibility* on page *383*.	*Disable*
	Disable	Using legacy register numbering disabled.	0
	Enable	Using legacy register numbering enabled. This selection sets parameter *58.33 Addressing mode* to *Mode 0*. Only 16-bit addressing is used, and only 16-bit data is used for reading and writing. 16-bit values (groups 1…99, indexes 1…99): Register address = 40000 + 100 × parameter group + parameter index. For example, parameter 22.80 would be mapped to register 40000 + 2200 + 80 = 42280.	1
96.79	*Legacy control profile*	Enables using a legacy control profile. Currently only EFB supports legacy profiles.	*Not selected*
	Not selected	EFB: Control profile selected with *58.25 Control profile* used.	0
	DCU	Legacy DCU profile used.	1
	ABB drives	ABB drives profile used.	2
	ABB drives limited	Legacy ABB drives limited profile used.	3
96.100	*Change user pass code*	*(Visible when user lock is open)* To change the current user pass code, enter a new code into this parameter as well as *96.101 Confirm user pass code*. A warning will be active until the new pass code is confirmed. To cancel changing the pass code, close the user lock without confirming. To close the lock, enter an invalid pass code in parameter *96.02 Pass code*, activate parameter *96.08 Control board boot*, or cycle the power. See also section *Parameter checksum calculation* (page *122*).	10000000
	10000000… 99999999	New user pass code.	-
96.101	*Confirm user pass code*	*(Visible when user lock is open)* Confirms the new user pass code entered in *96.100 Change user pass code*.	
	10000000… 99999999	Confirmation of new user pass code.	-

No.	Name/Value	Description	Def/FbEq16
96.102	*User lock functionality*	*(Visible when user lock is open)* Selects the actions or functionalities to be prevented by the user lock. Parameter *96.03 Access level status* shows which access are selected. **Notes:** • The changes made take effect only when the user lock is closed. See parameter *96.02 Pass code*. • We recommend you select all the actions and functionalities unless otherwise required by the application.	0000h

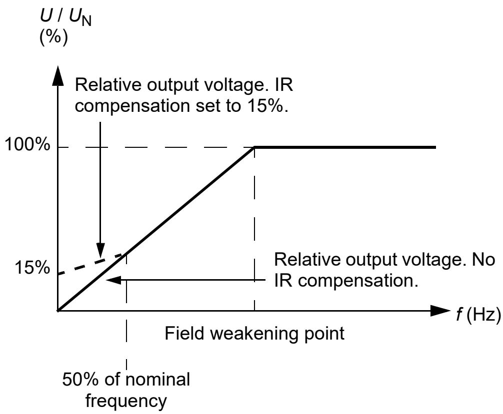
Bit	Name	Information
0	Disable ABB access levels	1 = ABB access levels (service, advanced programmer, etc.; see *96.03*) disabled
1	Freeze parameter lock state	1 = Changing the parameter lock state prevented, ie, pass code 358 has no effect
2	Disable file download	1 = Loading of files to drive prevented. This applies to • firmware upgrades • parameter restore • loading an adaptive program • changing home view of control panel • editing drive texts • editing the favorite parameters list on control panel • configuration settings made through control panel such as time/date formats and enabling/disabling clock display.
3	Reserved	
4	Disable backups	0 = Backups are enabled. 1 = Backups are disabled.
5	Override lock	1 = Override locked. Group *70 Override* parameters and reference or control chain parameters that have been selected to be used for override are write protected.
6	Reserved	
7	Disable panel Bluetooth	1 = Bluetooth disabled on ACH-AP-W control panel. If the drive is part of a panel bus, Bluetooth is disabled on all control panels.
8…10	Reserved	
11	Disable OEM access level 1	1 = OEM access level 1 disabled
12	Disable OEM access level 2	1 = OEM access level 2 disabled
13	Disable OEM access level 3	1 = OEM access level 3 disabled
14…15	Reserved	

	0000h…FFFFh	Selection of actions to be prevented by user lock.	1 = 1

No.	Name/Value	Description	Def/FbEq16
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 stays below the thermal limit. See section *Switching frequency* on page *94*. Higher switching frequency results in lower acoustic motor noise. Lower switching frequency generates less switching losses and reduce EMC emissions. **Notes:** • If you have a multimotor system, contact your local ABB representative. • With the CPTC-02 ATEX-certified thermistor protection module, follow the instructions given in the *CPTC-02 ATEX-certified thermistor protection module, Ex II (2) GD (+L537+Q971) user's manual* (3AXD50000030058 [English]). • With an ABB EX motor, follow the instructions given in the ABB EX motor documentation.	*4 kHz*
	2 kHz	2 kHz.	2
	4 kHz	4 kHz.	4
	8 kHz	8 kHz.	8
	12 kHz	12 kHz.	12
97.02	*Minimum switching frequency*	Lowest switching frequency value that is allowed. Depends on the frame size. When drive is reaching the thermal limit, it will automatically start to reduce the switching frequency until the minimum allowed value is reached. Once the minimum has been reached, the drive will automatically start limiting the output current to keep the temperature below the thermal limit. Inverter temperature is shown by parameter *05.11 Inverter temperature*. **Notes:** • With the CPTC-02 ATEX-certified thermistor protection module, follow the instructions given in the *CPTC-02 ATEX-certified thermistor protection module, Ex II (2) GD (+L537+Q971) user's manual* (3AXD50000030058 [English]). • With an ABB EX motor, follow the instructions given in the ABB EX motor documentation.	*2 kHz*
	1.5 kHz	1.5 kHz. Not for all frame sizes.	1
	2 kHz	2 kHz.	2
	4 kHz	4 kHz.	4
	8 kHz	8 kHz.	8
	12 kHz	12 kHz.	12

No.	Name/Value	Description	Def/FbEq16
97.03	*Slip gain*	Defines the slip gain which is used to improve the estimated motor slip. 100% means full slip gain; 0% means no slip gain. The default value is 100%. Other values can be used if a static speed error is detected despite having the setting at full slip gain. **Example** (with nominal load and nominal slip of 40 rpm): A 1000 rpm constant speed reference is given to the drive. Despite having full slip gain (= 100%), a manual tachometer measurement from the motor axis gives a speed value of 998 rpm. The static speed error is 1000 rpm - 998 rpm = 2 rpm. To compensate the error, the slip gain should be increased to 105% (2 rpm / 40 rpm = 5%).	100%
	0…200%	Slip gain.	1 = 1%
97.04	*Voltage reserve*	Defines the minimum allowed voltage reserve. When the voltage reserve has decreased to the set value, the drive enters the field weakening area. **Note:** This is an expert level parameter and should not be adjusted without appropriate skill. If the intermediate circuit DC voltage U_{dc} = 550 V and the voltage reserve is 5%, the RMS value of the maximum output voltage in steady-state operation is 0.95 × 550 V / sqrt(2) = 369 V The dynamic performance of the motor control in the field weakening area can be improved by increasing the voltage reserve value, but the drive enters the field weakening area earlier.	-2%
	-4…50%	Voltage reserve.	1 = 1%
97.05	*Flux braking*	Defines the level of flux braking power. (Other stopping and braking modes can be configured in parameter group *21 Start/stop mode*). **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
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%

No.	Name/Value	Description	Def/FbEq16
97.10	*Signal injection*	Enables the anti-cogging function: a high-frequency alternating signal is injected to the motor in the low speed region to improve the stability of torque control. This removes the “cogging” that can sometimes be seen as the rotor passes the motor magnetic poles. Anti-cogging can be enabled with different amplitude levels. **Notes:** • This is an expert level parameter and should not be adjusted without appropriate skill. • Use as low a level as possible that gives satisfactory performance. • Signal injection cannot be applied to asynchronous motors. • For ACH531-01 frames R6…R9.	*Disabled*
	Disabled	Anti-cogging disabled.	0
	Enabled (5%)	Anti-cogging enabled with amplitude level of 5%.	1
	Enabled (10%)	Anti-cogging enabled with amplitude level of 10%.	2
	Enabled (15%)	Anti-cogging enabled with amplitude level of 15%.	3
	Enabled (20%)	Anti-cogging enabled with amplitude level of 20%.	4
97.11	*TR tuning*	Rotor time constant tuning. This parameter can be used to improve torque accuracy in closed-loop control of an induction motor. Normally, the motor identification run provides sufficient torque accuracy, but manual fine-tuning can be applied in exceptionally demanding applications to achieve optimal performance. **Note:** This is an expert level parameter and should not be adjusted without appropriate skill.	100%
	25…400%	Rotor time constant tuning.	1 = 1%

<table>
<tr><th>No.</th><th>Name/Value</th><th>Description</th><th>Def/FbEq16</th></tr>
<tr><td>97.13</td><td>IR compensation</td><td>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.


Typical IR compensation values are shown below.
<table><tr><th colspan="6">3-phase U_N = 400 V (380…415 V) drives</th></tr><tr><td>P_N (kW)</td><td>3</td><td>7.5</td><td>15</td><td>37</td><td>132</td></tr><tr><td>IR compensation (%)</td><td>2.3</td><td>1.7</td><td>1.3</td><td>1.1</td><td>0.6</td></tr></table>
See also section IR compensation for scalar motor control on page 88.</td><td>0</td></tr>
<tr><td></td><td>0.00…50.00%</td><td>Voltage boost at zero speed in percent of nominal motor voltage.</td><td>1 = 1%</td></tr>
<tr><td>97.15</td><td>Motor model temperature adaptation</td><td>Enables the motor model temperature adaptation. Estimated motor temperature can be used to adapt temperature dependent parameters (for example, resistances) of motor model.</td><td>Disabled</td></tr>
<tr><td></td><td>Disabled</td><td>Temperature adaptation disabled.</td><td>0</td></tr>
<tr><td></td><td>Estimated temperature</td><td>Temperature adaptation with motor temperature estimate (parameter 35.01 Motor estimated temperature).</td><td>1</td></tr>
<tr><td>97.16</td><td>Stator temperature factor</td><td>Tunes the motor temperature dependence of stator parameters (stator resistance).</td><td>50%</td></tr>
<tr><td></td><td>0…200%</td><td>Tuning factor.</td><td>1 = 1%</td></tr>
<tr><td>97.17</td><td>Rotor temperature factor</td><td>Tunes the motor temperature dependence of rotor parameters (eg. rotor resistance).</td><td>100%</td></tr>
<tr><td></td><td>0…200%</td><td>Tuning factor.</td><td>1 = 1%</td></tr>
</table>

6

No.	Name/Value	Description	Def/FbEq16
97.20	*U/F ratio*	Selects the form for the *U/f* (voltage to frequency) ratio below field weakening point. For scalar control only. **Notes:** • The U/f function cannot be used with energy optimization; if *45.11 Energy optimizer* is set to *Enable*, parameter *97.20 U/F ratio* is ignored. • With the CPTC-02 ATEX-certified thermistor protection module, follow the instructions given in the *CPTC-02 ATEX-certified thermistor protection module, Ex II (2) GD (+L537+Q971) user's manual* (3AXD50000030058 [English]).	*Squared*
	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
97.48	*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
	Enabled max	DC bus voltage stabilizer enabled, maximum stabilization.	800
97.49	*Slip gain for scalar*	Sets gain for slip compensation in percent when the 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. **Note:** This parameter is only effective in scalar motor control mode (parameter *99.04 Motor control mode* is set to *Scalar*).	0%
	0…200%	0% = No slip compensation. 0…200% = Increasing slip compensation. 100% means full slip compensation according to parameter *99.08 Motor nominal frequency* and *99.09 Motor nominal speed*.	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. Unit is percent of the motor nominal frequency.	50.0%
	1.0…200.0%	Frequency.	1 = 1%
97.135	*UDC ripple*	Calculates ripple voltage.	-
	0.0…200.0 V	Voltage	1 = 1 V

No.	Name/Value	Description	Def/FbEq16
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.	
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.	

No.	Name/Value	Description	Def/FbEq16
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.	100 = 1 ohm
98.10	*Rr user SI*	Defines the rotor resistance R_R of the motor model. **Note:** This parameter is valid only for asynchronous motors.	0.00000 ohm
	0.00000…100.00000 ohm	Rotor resistance.	100 = 1 ohm
98.11	*Lm user SI*	Defines the main inductance L_M of the motor model. **Note:** This parameter is valid only for asynchronous motors.	0.00 mH
	0.00…100000.00 mH	Main inductance.	1 = 1 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 = 1 mH
98.13	*Ld user SI*	Defines the direct axis (synchronous) inductance. **Note:** This parameter is valid only for permanent magnet motors.	0.00 mH
	0.00…100000.00 mH	Direct axis inductance.	1 = 1 mH
98.14	*Lq user SI*	Defines the quadrature axis (synchronous) inductance. **Note:** This parameter is valid only for permanent magnet motors.	0.00 mH
	0.00…100000.00 mH	Quadrature axis inductance.	1 = 1 mH

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 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

No.	Name/Value	Description	Def/FbEq16
99.04	Motor control mode	Selects the motor control mode.	Scalar
	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*. **Notes:** • 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. • To achieve a better motor control performance, you can perform a normal ID run without load. See also section *Operating modes of the drive* (page *57*).	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 systems 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 *Operating modes of the drive* (page *57*).	1
99.06	Motor nominal current	Defines the nominal motor current. Must be equal to the value on the motor rating plate. If multiple motors are connected to the drive, enter the total current of the motors. **Notes:** • Correct motor operation requires that the magnetizing current of the motor does not exceed 90% of the nominal current of the drive. • This parameter cannot be changed while the drive is running. For 16-bit scaling, see parameter *46.05 Current scaling*.	0.0 A
	0.0…6400.0 A	Nominal current of the motor. The allowable range is 1/6…2 × I_N of the drive (0…2 × I_N with scalar control mode).	1 = 1 A

No.	Name/Value	Description	Def/FbEq16
99.07	*Motor nominal voltage*	Defines the nominal motor voltage supplied to the motor. This setting must match the value on the rating plate of the motor. **Notes:** • With permanent magnet motors, the nominal voltage is the BackEMF voltage at nominal speed of the motor. If the voltage is given as voltage per rpm, for example, 60 V per 1000 rpm, the voltage for a nominal speed of 3000 rpm is 3 × 60 V = 180 V. • The stress on the motor insulation is always dependent on the drive supply voltage. This also applies to the case where the motor voltage rating is lower than that of the drive and the supply. • This parameter cannot be changed while the drive is running.	0.0 V
	0.0…960.0 V	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
99.09	*Motor nominal speed*	Defines the nominal motor speed. The setting must match the value on the rating plate of the motor. **Note:** This parameter cannot be changed while the drive is running.	0 rpm
	0…30000 rpm	Nominal speed of the motor.	1 = 1 rpm
99.10	*Motor nominal power*	Defines the nominal motor power. The setting must match the value on the rating plate of the motor. If multiple motors are connected to the drive, enter the total power of the motors. The unit is selected by parameter *96.16 Unit selection*. **Note:** This parameter cannot be changed while the drive is running. For 16-bit scaling, see parameter *46.04 Power scaling*.	0.00 kW or hp
	0.00… 10000.00 kW or 0.00… 13404.83 hp	Nominal power of the motor.	1 = 1 unit
99.11	*Motor nominal cos Φ*	Defines the cosphi of the motor for a more accurate motor model. The value is not obligatory, but is useful with an asynchronous motor, especially when performing a standstill identification run. With a permanent magnet or synchronous reluctance motor, this value is not needed. **Notes:** • Do not enter an estimated value. If you do not know the exact value, leave the parameter at zero. • This parameter cannot be changed while the drive is running.	0.00
	0.00…1.00	Cosphi of the motor.	100 = 1

No.	Name/Value	Description	Def/FbEq16
99.12	*Motor nominal torque*	Defines the nominal motor shaft torque 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
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* (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, for example, 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%. • With scalar control mode (*99.04 Motor control mode* = *Scalar*), the ID run is not requested automatically. However, an ID run can be performed for more accurate torque estimation. • Once the ID run is activated, it can be canceled by stopping the drive. • The ID run must be performed every time any of the motor parameters (*99.04*, *99.06*…*99.12*) have been changed. • Ensure that the Safe Torque Off and emergency stop circuits (if any) are closed during the ID run. • Mechanical brake (if present) is not opened by the logic for the ID run. • This parameter cannot be changed while the drive is running.	*None*
	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	Def/FbEq16
	Normal	Normal ID run. Guarantees good control accuracy for all cases. The ID run takes about 90 seconds. This mode should be selected whenever it is possible. **Notes:** • If the load torque will be higher than 20% of motor nominal torque, or if the machinery is not able to withstand the nominal torque transient during the ID run, then the driven machinery must be de-coupled from the motor during a Normal ID run. • Check the direction of rotation of the motor before starting the ID run. During the run, the motor will rotate in the forward direction. ⚠ **WARNING!** The motor will run at up to approximately 50…100% of the nominal speed during the ID run. ENSURE THAT IT IS SAFE TO RUN THE MOTOR BEFORE PERFORMING THE ID RUN!	1
	Reduced	Reduced ID run. This mode should be selected instead of the *Normal* or *Advanced* ID run if • mechanical losses are higher than 20% (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
	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 (for example, with lift or crane applications).	3
	Reserved		4
	Current measurement calibration	Current offset and gain measurement calibration is set to calibrate the control loops. The calibration will be performed at the next start. Only for frames R6…R9.	5

No.	Name/Value	Description	Def/FbEq16
	Advanced	Advanced ID run. Only for frames R6…R11 and ACH531-31 and ACH531-31 drives. 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
	Reserved		7
	Adaptive	Adaptive ID run. Improves the motor model accuracy during normal operation of the drive. The drive performs a Standstill ID run first. Motor parameters are then updated with better accuracy during an adaptation sequence when following user's driving profile. When the adaptation is complete, parameters *99.14 Last ID run performed* changes from Standstill to Adaptive. Motor parameters are updated automatically and the user is not required to update any other parameter. **Note:** For vector control only.	8
99.14	*Last ID run performed*	Shows the type of ID run that was performed last. For more information about the different modes, see the selections of parameter *99.13 ID run requested*.	*None*
	None	No ID run has been performed.	0
	Normal	*Normal* ID run.	1
	Reduced	*Reduced* ID run.	2
	Standstill	*Standstill* ID run.	3
	Reserved		4
	Current measurement calibration	Current measurement calibration.	5
	Advanced	*Advanced* ID run.	6
	Reserved		7
	Adaptive	*Adaptive* ID run.	8
99.15	*Motor polepairs calculated*	Calculated number of pole pairs in the motor.	-
	0…1000	Number of pole pairs.	1 = 1

No.	Name/Value	Description	Def/FbEq16
99.16	*Motor phase order*	Switches the rotation direction of motor. This parameter can be used if the motor turns in the wrong direction (for example, because of the wrong phase order in the motor cable), and correcting the cabling is considered impractical. **Note:** • Changing this parameter does not affect speed reference polarities, so positive speed reference will rotate the motor forward. The phase order selection just ensures that "forward" is in fact the correct direction.	*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 *Supply frequency 60 Hz* 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. 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 though these parameters are not listed in the table.

No.	**Name**	*95.20 HW options word 1* bit *Supply frequency 60 Hz* = **50 Hz**	*95.20 HW options word 1* bit *Supply frequency 60 Hz* = **60 Hz**
11.45	*Freq in 1 at scaled max*	1500.000	1800.000
15.35	*Freq out 1 src max*	1500.000	1800.000
12.20	*AI1 scaled at AI1 max*	50.000	60.000
13.18	*AO1 source max*	50.0	60.0
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 *Supply frequency 60 Hz* = **50 Hz**	*95.20 HW options word 1* bit *Supply frequency 60 Hz* = **60 Hz**
30.12	*Maximum speed*	1500.00 rpm	1800.00 rpm
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
46.31	*Above speed limit*	1500.00 rpm	1800.00 rpm
46.32	*Above frequency limit*	50.00 Hz	60.00 Hz

Parameters supported by Modbus legacy compatibility

Legacy compatibility mode is a way to communicate with a legacy drive in such a way that it looks like the legacy drive over Modbus RTU or Modbus TCP. This mode can be enabled by changing parameter *96.78 Legacy Modbus mapping* to *Enable*.

In the legacy compatibility mode all supported parameters can be read as if the drive were a legacy drive. Some parameters are read only and do not support writes. See the table below to see which parameters support writes.

Legacy parameter	Name	Read/Write
01.01	SPEED & DIR	Read only
01.02	SPEED	Read only
01.03	OUTPUT FREQ	Read only
01.04	CURRENT	Read only
01.05	TORQUE	Read only
01.06	POWER	Read only
01.07	DC BUS VOLTAGE	Read only
01.09	OUTPUT VOLTAGE	Read only
01.10	DRIVE TEMP	Read only
01.11	EXTERNAL REF 1	Read only
01.13	CTRL LOCATION	Read only
01.14	RUN TIME	Read only
01.15	KWH COUNTER	Read only
01.18	DI 1-3 STATUS	Read only
01.19	DI 4-6 STATUS	Read only
01.20	AI 1	Read only
01.21	AI 2	Read only
01.22	RO 1-3 STATUS	Read only
01.23	RO 4-6 STATUS	Read only
01.24	AO 1	Read only
01.25	AO 2	Read only
01.26	PID 1 OUTPUT	Read only
01.27	PID 2 OUTPUT	Read only
01.28	PID 1 SETPNT	Read only
01.29	PID 2 SETPNT	Read only
01.30	PID 1 FBK	Read only
01.31	PID 2 FBK	Read only
01.32	PID 1 DEVIATION	Read only
01.33	PID 2 DEVIATION	Read only
01.34	COMM RO WORD	Read only
01.35	COMM VALUE 1	Read only
01.36	COMM VALUE 2	Read only
01.41	MWH COUNTER	Read only
01.43	DRIVE ON TIME	Read only
01.45	MOTOR TEMP	Read only
01.50	CB TEMP	Read only
01.74	SAVED KWH	Read only
01.75	SAVED MWH	Read only
01.77	SAVED AMOUNT 2	Read only
01.78	SAVED CO2	Read only
03.01	FB CMD WORD 1	Read only
03.02	FB CMD WORD 2	Read only
03.03	FB STS WORD 1	Read only
03.04	FB STS WORD 2	Read only
03.05	FAULT WORD 1	Read only
03.06	FAULT WORD 2	Read only
03.07	FAULT WORD 3	Read only
03.08	ALARM WORD 1	Read only
03.09	ALARM WORD 2	Read only
04.01	LAST FAULT	Read only
04.12	PREVIOUS FAULT 1	Read only
04.13	PREVIOUS FAULT 2	Read only
10.01	EXT1 COMMANDS	Read/Write
10.02	EXT2 COMMANDS	Read/Write
10.03	DIRECTION	Read/Write
10.04	JOGGING SEL	Read/Write
11.02	EXT1/EXT2 SEL	Read/Write
11.03	REF1 SELECT	Read/Write

Legacy parameter	Name	Read/Write
11.04	REF1 MIN	Read/Write
11.05	REF1 MAX	Read/Write
11.06	REF2 SEL	Read/Write
11.07	REF2 MIN	Read/Write
11.08	REF2 MAX	Read/Write
12.01	CONST SPEED SEL	Read/Write
12.02	CONST SPEED 1	Read/Write
12.03	CONST SPEED 2	Read/Write
12.04	CONST SPEED 3	Read/Write
12.05	CONST SPEED 4	Read/Write
12.06	CONST SPEED 5	Read/Write
12.07	CONST SPEED 6	Read/Write
15.02	CONST SPEED 7	Read/Write
15.04	MINIMUM AO1	Read/Write
15.05	MAXIMUM AO1	Read/Write
15.08	AO2 CONTENT MIN	Read/Write
15.09	AO2 CONTENT MAX	Read/Write
15.10	MINIMUM AO2	Read/Write
15.11	MAXIMUM AO2	Read/Write
16.01	RUN ENABLE	Read/Write
16.02	PARAMETER LOCK	Read/Write
16.03	PASS CODE	Read/Write
16.08	START ENABLE 1	Read/Write
16.09	START ENABLE 2	Read/Write
20.01	MINIMUM SPEED	Read/Write
20.02	MAXIMUM SPEED	Read/Write
20.03	MAX CURRENT	Read/Write
20.06	UNDERVOLT CRTL	Read/Write
20.07	MINIMUM FREQ	Read/Write
20.08	MAXIMUM FREQ	Read/Write
20.13	MIN TORQUE SEL	Read/Write
20.14	MAX TORQUE SEL	Read/Write
20.15	MIN TORQUE 1	Read/Write
20.16	MIN TORQUE 2	Read/Write
20.17	MAX TORQUE 1	Read/Write
20.18	MAX TORQUE 2	Read/Write
21.02	STOP FUNCTION	Read/Write
21.03	DC MAGN TIME	Read/Write

Legacy parameter	Name	Read/Write
21.05	DC HOLD SPEED	Read/Write
21.06	DC CURR REF	Read/Write
21.09	EMERG STOP SEL	Read/Write
21.12	ZERO SPEED DELAY	Read/Write
21.13	START DELAY	Read/Write
22.02	ACCELER TIME 1	Read/Write
22.03	DECELER TIME 1	Read/Write
22.04	RAMP SHAPE 1	Read/Write
22.05	ACCELER TIME 2	Read/Write
22.06	DECELER TIME 2	Read/Write
22.07	RAMP SHAPE 2	Read/Write
22.08	EMERG DEC TIME	Read/Write
23.01	PROP GAIN	Read/Write
23.02	INTEGRATION TIME	Read/Write
23.03	DERIVATION TIME	Read/Write
23.04	ACC COMPENSATION	Read/Write
30.02	PANEL COMM ERR	Read/Write
30.03	EXTERNAL REF 1	Read/Write
30.04	EXTERNAL REF 2	Read/Write
30.05	MOT THERM POT	Read/Write
30.06	MOT THERM TIME	Read/Write
30.07	MOT LOAD CURVE	Read/Write
30.08	ZERO SPEED LOAD	Read/Write
30.09	BREAK POINT FREQ	Read/Write
30.10	STALL FUNCTION	Read/Write
30.11	STALL FREQUENCY	Read/Write
30.12	STALL TIME	Read/Write
30.17	EARTH FAULT	Read/Write
30.18	COMM FAULT FUNC	Read/Write
30.19	COMM FAULT TIME	Read/Write
30.22	AI2 FAULT LIMIT	Read/Write
30.23	WIRING FAULT	Read/Write
33.01	FIRMWARE	Read only
33.02	LOADING PACKAGE	Read only
33.03	TEST DATE	Read only
33.04	DRIVE RATING	Read only
40.01	GAIN	Read/Write
40.02	INTEGRATION TIME	Read/Write
40.03	DERIVATION TIME	Read/Write

Legacy parameter	Name	Read/Write
40.04	PID DERIV FILTER	Read/Write
40.08	0% VALUE	Read/Write
40.09	100% VALUE	Read/Write
40.10	SET POINT SEL	Read/Write
40.11	INTERNAL SETPNT	Read/Write
40.12	SETPOINT MIN	Read/Write
40.13	SETPOINT MAX	Read/Write
40.14	FBK SEL	Read/Write
40.15	FBK MULTIPLIER	Read/Write
40.16	ACT 1 INPUT	Read/Write
40.17	ACT 2 INPUT	Read/Write
40.24	PID SLEEP DELAY	Read/Write
40.25	WAKE-UP DEV	Read/Write
40.26	WAKE-UP DELAY	Read/Write
40.27	PID 1 PARAM SET	Read/Write
41.01	GAIN	Read/Write
41.02	INTEGRATION TIME	Read/Write
41.03	DERIVATION TIME	Read/Write
41.04	PID DERIV FILTER	Read/Write
41.08	0% VALUE	Read/Write
41.09	100% VALUE	Read/Write
41.10	SET POINT SEL	Read/Write

Legacy parameter	Name	Read/Write
41.11	INTERNAL SETPNT	Read/Write
41.12	SETPOINT MIN	Read/Write
41.13	SETPOINT MAX	Read/Write
41.14	FBK SEL	Read/Write
41.15	FBK MULTIPLIER	Read/Write
41.16	ACT 1 INPUT	Read/Write
41.17	ACT 2 INPUT	Read/Write
41.24	PID SLEEP DELAY	Read/Write
41.25	WAKE-UP DEV	Read/Write
41.26	WAKE-UP DELAY	Read/Write
42.11	INTERNAL SETPNT	Read/Write
53.05	EFB CTRL PROFILE	Read/Write
99.01	LANGUAGE	Read/Write
99.04	MOTOR CTRL MODE	Read/Write
99.05	MOTOR NOM VOLT	Read/Write
99.06	MOTOR NOM CURR	Read/Write
99.07	MOTOR NOM FREQ	Read/Write
99.08	MOTOR NOM SPEED	Read/Write
99.09	MOTOR NOM POWER	Read/Write
99.10	ID RUN	Read/Write
99.15	MOTOR COS PHI	Read/Write

7

Additional parameter data

What this chapter contains

This chapter lists the parameters with some additional data such as their ranges and 32-bit fieldbus scaling. For parameter descriptions, see chapter *Parameters* (page *123*).

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 control panel and the integer used in communication when a 32-bit value is selected for transmission to an external system. The corresponding 16-bit scalings are listed in chapter *Parameters* (page *123*).
List	Selection list.

Term	Definition
No.	Parameter number.
PB	Packed Boolean (bit list).
Real	Real number.
Type	Parameter type. See *Analog src*, *Binary src*, *List*, *PB*, *Real*.

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%
01.06	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 = kW
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
01.31	Ambient temperature	*Real*	-40.0…120.0	°C or °F	10 = 1 unit
01.50	Current hour kWh	*Real*	0.00…1000000.00	kWh	100 = 1 kWh
01.51	Previous hour kWh	*Real*	0.00…1000000.00	kWh	100 = 1 kWh
01.52	Current day kWh	*Real*	0.00…1000000.00	kWh	100 = 1 kWh
01.53	Previous day kWh	*Real*	0.00…1000000.00	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		0.00…30000.00	rpm	100 = 1 rpm
01.62	Abs motor speed %		0.00…1000.00%	%	100 = 1%
01.63	Abs output frequency		0.00…500.00 Hz	Hz	100 = 1 Hz
01.64	Abs motor torque		0.0…1600.0	%	10 = 1%
01.65	Abs output power		0.00…32767.00	kW	100 = 1 kW
01.66	Abs output power % motor nom		0.00…300.00	%	100 = 1%
01.68	Abs motor shaft power		0.00…32767.00	kW or hp	100 = 1 unit

No.	Name	Type	Range	Unit	FbEq32
03 Input references					
03.01	Panel reference	Real	-100000.00…100000.00	-	100 = 1
03.02	Panel reference remote	Real	-100000.00…100000.00	-	100 = 1
03.05	FB A reference 1	Real	-100000.00…100000.00	-	100 = 1
03.06	FB A reference 2	Real	-100000.00…100000.00	-	100 = 1
03.09	EFB reference 1	Real	-30000.00…30000.00	-	100 = 1
03.10	EFB reference 2	Real	-30000.00…30000.00	-	100 = 1
04 Warnings and faults					
04.01	Tripping fault	Data	0000h…FFFFh	-	1 = 1
04.02	Active fault 2	Data	0000h…FFFFh	-	1 = 1
04.03	Active fault 3	Data	0000h…FFFFh	-	1 = 1
04.06	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	PB	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, 04.47, 04.49, …	…	…	…	…	
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 or °F	10 = 1 unit
05.11	Inverter temperature	Real	-40.0…160.0	%	10 = 1%
05.20	Diagnostic word 1	PB	0000h…FFFFh	-	
05.21	Diagnostic word 2	PB	0000h…FFFFh	-	
05.22	Diagnostic word 3	PB	0000h…FFFFh	-	
05.80	Motor speed at fault	Real	-30000…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

No.	Name	Type	Range	Unit	FbEq32
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	*Real*	-40.0…160.0	%	10 = 1%
05.88	Reference used at fault	*Real*	-500.00…500.00 or -30000.00…30000.00	Hz or rpm	100 = 1 unit
05.89	HVAC status word at fault	*PB*	0000h…FFFFh	-	1 = 1
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
06.22	HVAC status word	*PB*	0000h…FFFFh	-	1 = 1
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*	0…999	-	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
07.10	Language file set	*List*	1…3	-	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	Not applicable.			
07.31	AP sequence state	Not applicable.			
07.35	Drive configuration		0000h…FFFFh		
07.36	Drive configuration 2		0000h…FFFFh		

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
10.09	DI3 ON delay	*Real*	0.0…3000.0	s	10 = 1 s
10.10	DI3 OFF delay	*Real*	0.0…3000.0	s	10 = 1 s
10.11	DI4 ON delay	*Real*	0.0…3000.0	s	10 = 1 s
10.12	DI4 OFF delay	*Real*	0.0…3000.0	s	10 = 1 s
10.13	DI5 ON delay	*Real*	0.0…3000.0	s	10 = 1 s
10.14	DI5 OFF delay	*Real*	0.0…3000.0	s	10 = 1 s
10.15	DI6 ON delay	*Real*	0.0…3000.0	s	10 = 1 s
10.16	DI6 OFF delay	*Real*	0.0…3000.0	s	10 = 1 s
10.21	RO status	*PB*	0000h…FFFFh	-	1 = 1
10.22	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
10.27	RO2 source	*Binary src*	-	-	1 = 1
10.28	RO2 ON delay	*Real*	0.0…3000.0	s	10 = 1 s
10.29	RO2 OFF delay	*Real*	0.0…3000.0	s	10 = 1 s
10.30	RO3 source	*Binary src*	-	-	1 = 1
10.31	RO3 ON delay	*Real*	0.0…3000.0	s	10 = 1 s
10.32	RO3 OFF delay	*Real*	0.0…3000.0	s	10 = 1 s
10.99	RO/DIO control word	*PB*	0000h…FFFFh	-	1 = 1
10.101	RO1 toggle counter	*Real*	0…4294967000	-	1 = 1
10.102	RO2 toggle counter	*Real*	0…4294967000	-	1 = 1
10.103	RO3 toggle counter	*Real*	0…4294967000	-	1 = 1
11 Standard DIO, FI, FO					
11.21	DI5 configuration	*List*	0…1	-	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

No.	Name	Type	Range	Unit	FbEq32
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
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
12.05	AI supervision force	*PB*	0000h…FFFFh	-	1 = 1
12.11	AI1 actual value	*Real*	0.000…22.000 mA or 0.000…11.000 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*	0.000…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*	0.000…20.000 mA or 0.000…10.000 V	mA or V	1000 = 1 unit
12.18	AI1 max	*Real*	0.000…22.000 mA or 0.000…11.000 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*	0.000…22.000 mA or 0.000…11.000 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*	0.000…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*	0.000…20.000 mA or 0.000…10.000 V	mA or V	1000 = 1 unit
12.28	AI2 max	*Real*	0.000…22.000 mA or 0.000…11.000 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	AI1 percent value	*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 or 0.000…11000 V	mA or V	1000 = 1 unit
13.12	AO1 source	*Analog src*	-	-	1 = 1

No.	Name	Type	Range	Unit	FbEq32
13.13	AO1 forced value	*Real*	0.000…22.000 mA or 0.000…11000 V	mA or V	1000 = 1 unit
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 or 0.000…11000 V	mA or V	1000 = 1 unit
13.20	AO1 out at AO1 src max	*Real*	0.000…22.000 mA or 0.000…11000 V	mA or V	1000 = 1 unit
13.21	AO2 actual value	*Real*	0.000…22.000	mA	1000 = 1 mA
13.22	AO2 source	*Analog src*	-	-	1 = 1
13.23	AO2 forced value	*Real*	0.000…22.000	mA	1000 = 1 mA
13.26	AO2 filter time	*Real*	0.000…30.000	s	1000 = 1 s
13.27	AO2 source min	*Real*	-32768.0…32767.0	-	10 = 1
13.28	AO2 source max	*Real*	-32768.0…32767.0	-	10 = 1
13.29	AO2 out at AO2 src min	*Real*	0.000…22.000	mA	1000 = 1 mA
13.30	AO2 out at AO2 src max	*Real*	0.000…22.000	mA	1000 = 1 mA
13.91	AO1 data storage	*Real*	-327.68…327.67	-	100 = 1
13.92	AO2 data storage	*Real*	-327.68…327.67	-	100 = 1
15 I/O extension module					
15.01	Extension module type	*List*	0…4	-	1 = 1
15.02	Detected extension module	*List*	0…5	-	1 = 1
15.04	RO/DO status	*PB*	0000h…FFFFh	-	1 = 1
15.05	RO/DO force selection	*PB*	0000h…FFFFh	-	1 = 1
15.06	RO/DO 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
15.22	DO1 configuration	*List*	0, 2	-	1 = 1
15.23	DO1 source	*Binary src*	-	-	1 = 1
15.24	DO1 ON delay	*Real*	0.0…3000.0	s	10 = 1 s
15.25	DO1 OFF delay	*Real*	0.0…3000.0	s	10 = 1 s
15.32	Freq out 1 actual value	*Real*	0…16000	Hz	1 = 1 Hz
15.33	Freq out 1 source	*Analog src*	-	-	1 = 1
15.34	Freq out 1 src min	*Real*	-32768.0…32767.0	-	1000 = 1

No.	Name	Type	Range	Unit	FbEq32
15.35	Freq out 1 src max	*Real*	-32768.0…32767.0	-	1000 = 1
15.36	Freq out 1 at src min	*Real*	0…16000	Hz	1 = 1 Hz
15.37	Freq out 1 at src max	*Real*	0…16000	Hz	1 = 1 Hz
15.40	AI force selection	*Real*	0000h…FFFFh	-	1 = 1
15.41	AI supervision function	*List*	0…4	-	1 = 1
15.42	AI supervision selection	*Real*	0000h…FFFFh	-	1 = 1
15.43	AI supervision force selection	*Real*	0000h…FFFFh	-	1 = 1
15.44	AI dead band	*Real*	0.00…100.00	-	1000 = 1
15.45	AO force selection	*Real*	0000h…FFFFh	-	1 = 1
15.51	AI3 actual value	*Real*	-11.000 V / -22.000 mA …11.000 V / 22.000 mA	mA or V	1000 = 1 unit
15.52	AI3 scaled value	*Real*	-32768…32767	-	1 = 1
15.53	AI3 percent value	*Real*	0…110	%	1 = 1 %
15.54	AI3 forced value	*Real*	-11.000 V / -22.000 mA …11.000 V / 22.000 mA	mA or V	1000 = 1 unit
15.55	AI3 unit selection	*List*	-	-	1 = 1
15.56	AI3 filter time	*Real*	0.000…30.000	s	1000 = 1 s
15.57	AI3 min	*Real*	-11.000 V / -22.000 mA …11.000 V / 22.000 mA	mA or V	1000 = 1 unit
15.58	AI3 max	*Real*	-11.000 V / -22.000 mA …11.000 V / 22.000 mA	mA or V	1000 = 1 unit
15.59	AI3 scaled at AI3 min	*Real*	-32768…32767	-	1 = 1
15.60	AI3 scaled at AI3 max	*Real*	-32768…32767	-	1 = 1
15.61	AI4 actual value	*Real*	-11.000 V / -22.000 mA …11.000 V / 22.000 mA	mA or V	1000 = 1 unit
15.62	AI4 scaled value	*Real*	-32768…32767	-	1 = 1
15.63	AI4 percent value	*Real*	0…110	%	1 = 1 %
15.64	AI4 forced value	*Real*	-11.000 V / -22.000 mA …11.000 V / 22.000 mA	mA or V	1000 = 1 unit
15.65	AI4 unit selection	*Binary src*	-	-	1 = 1
15.66	AI4 filter time	*Real*	0.000…30.000	s	1000 = 1 s

No.	Name	Type	Range	Unit	FbEq32
15.67	AI4 min	*Real*	-11.000 V / -22.000 mA …11.000 V / 22.000 mA	mA or V	1000 = 1 unit
15.68	AI4 max	*Real*	-11.000 V / -22.000 mA …11.000 V / 22.000 mA	mA or V	1000 = 1 unit
15.69	AI4 scaled at AI4 min	*Real*	-32768…32767	-	1 = 1
15.70	AI4 scaled at AI4 max	*Real*	-32768…32767	-	1 = 1
15.71	AI5 actual value	*Real*	-11.000 V / -22.000 mA …11.000 V / 22.000 mA	mA or V	1000 = 1 unit
15.72	AI5 scaled value	*Real*	-32768…32767	-	1 = 1
15.73	AI5 percent value	*Real*	0…110	%	1 = 1 %
15.74	AI5 forced value	*Real*	-11.000 V / -22.000 mA …11.000 V / 22.000 mA	mA or V	1000 = 1 unit
15.75	AI5 unit selection	*Binary src*	-	-	1 = 1
15.76	AI5 filter time	*Real*	0.000…30.000	s	1000 = 1 s
15.77	AI5 min	*Real*	-11.000 V / -22.000 mA …11.000 V / 22.000 mA	mA or V	1000 = 1 unit
15.78	AI5 max	*Real*	-11.000 V / -22.000 mA …11.000 V / 22.000 mA	mA or V	1000 = 1 unit
15.79	AI5 scaled at AI5 min	*Real*	-32768…32767	-	1 = 1
15.80	AI5 scaled at AI5 max	*Real*	-32768…32767	-	1 = 1
15.81	AO3 actual value	*Real*	0.000mA / 0.000V…22.000mA / 11.000V	mA or V	1000 = 1 unit
15.82	AO3 source	*Binary src*	-	-	1 = 1
15.83	AO3 forced value	*Real*	0.000 V / 0.000 mA …11.000 V / 22.000 mA	mA or V	1000 = 1 unit
15.84	AO3 data storage	*Real*	-327-68…327.67	-	1 = 1
15.85	AO3 unit selection	*List*	-	mA	1 = 1 mA
15.86	AO3 filter time	*Real*	0.000…30.000	s	1000 = 1 s
15.87	AO3 source min	*Real*	-32768.0…32767.0	-	1000 = 1

No.	Name	Type	Range	Unit	FbEq32
15.88	AO3 source max	*Real*	-32768.0…32767.0	-	1000 = 1
15.89	AO3 out at AO3 source min	*Real*	0.000 V / 0.000 mA …11.000 V / 22.000 mA	mA or V	1000 = 1 unit
15.90	AO3 out at AO3 source max	*Real*	0.000 V / 0.000 mA …11.000 V / 22.000 mA	mA or V	1000 = 1 unit
15.91	AO4 actual value	*Real*	0.000 V / 0.000 mA …11.000 V / 22.000 mA	mA or V	1000 = 1 unit
15.92	AO4 source	*Binary src*	-	-	1 = 1
15.93	AO4 forced value	*Real*	0.000 V / 0.000 mA …11.000 V / 22.000 mA	mA or V	1000 = 1 unit
15.94	AO4 data storage	*Real*	-327.68…327.67	-	1000 = 1
15.95	AO4 unit selection	*List*	-	mA or V	
15.96	AO4 filter time	*Real*	0.000…30.000	s	1000 = 1 s
15.97	AO4 source min	*Real*	-32768.0…32767.0	-	1000 = 1
15.98	AO4 source max	*Real*	-32768.0…32767.0	-	1000 = 1
15.99	AO4 out at AO4 source min	*Real*	0.000 V / 0.000 mA …11.000 V / 22.000 mA	mA or V	1000 = 1 unit
15.100	AO4 out at AO4 source max	*Real*	0.000 V / 0.000 mA …11.000 V / 22.000 mA	mA or V	1000 = 1 unit
19 Operation mode					
19.01	Actual operation mode	*List*	1…6, 10, 20	-	1 = 1
19.11	Ext1/Ext2 selection	*Binary src*	-	-	1 = 1
19.18	HAND/OFF disable source	*Binary src*	-	-	1 = 1
19.19	HAND/OFF disable action	*List*	0…2	-	1 = 1
20 Start/stop/direction					
20.01	Ext1 commands	*List*	0…6, 11…12, 14	-	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

No.	Name	Type	Range	Unit	FbEq32
20.05	Ext1 in3 source	*Binary src*	-	-	1 = 1
20.06	Ext2 commands	*List*	0…6, 11…12, 14	-	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
20.21	Direction	*List*	0…2	-	1 = 1
20.30	Enable signal warning function	*PB*	0000h…FFFFh	-	1 = 1
20.40	Run permissive	*Binary src*	-	-	1 = 1
20.41	Start interlock 1	*Binary src*	-	-	1 = 1
20.42	Start interlock 2	*Binary src*	-	-	1 = 1
20.43	Start interlock 3	*Binary src*	-	-	1 = 1
20.44	Start interlock 4	*Binary src*	-	-	1 = 1
20.45	Start interlock stop mode	*Binary src*	-	-	1 = 1
20.46	Run permissive text	*Binary src*	-	-	1 = 1
20.47	Start interlock 1 text	*Binary src*	-	-	1 = 1
20.48	Start interlock 2 text	*Binary src*	-	-	1 = 1
20.49	Start interlock 3 text	*Binary src*	-	-	1 = 1
20.50	Start interlock 4 text	*Binary src*	-	-	1 = 1
20.51	Start interlock condition	*Binary src*	-	-	1 = 1
21 Start/stop mode					
21.01	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…2	-	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*	0000b…0011b	-	1 = 1
21.09	DC hold speed	*Real*	0.00…1000.00	rpm	100 = 1 rpm

No.	Name	Type	Range	Unit	FbEq32
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*	0…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
21.23	Smooth start	*Real*	0…2	-	1 = 1
21.24	Smooth start current	*Real*	10.0…200.0	%	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	s	10 = 1 s
21.30	Speed compensated stop mode	*Real*	0…3	-	1 = 1
21.31	Speed comp 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
21.35	Preheating power	*Real*	0.00…10.00	kW	100 = 1
21.36	Preheating unit	*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…5	-	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…5	-	1 = 1
22.21	Constant speed function	*PB*	0000h…FFFFh	-	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
22.25	Constant speed sel4	*Binary src*	-	-	1 = 1
22.26	Constant speed 1	*Real*	-30000.00…30000.00	rpm	100 = 1 rpm

No.	Name	Type	Range	Unit	FbEq32
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
22.46	Constant speed sel5	*Binary src*	-	-	1 = 1
22.47	Constant speed sel6	*Binary src*	-	-	1 = 1
22.51	Critical speed function	*PB*	00b…11b	-	1 = 1
22.52	Critical speed 1 low	*Real*	-30000.00…30000.00	rpm	100 = 1 rpm
22.53	Critical speed 1 high	*Real*	-30000.00…30000.00	rpm	100 = 1 rpm
22.54	Critical speed 2 low	*Real*	-30000.00…30000.00	rpm	100 = 1 rpm
22.55	Critical speed 2 high	*Real*	-30000.00…30000.00	rpm	100 = 1 rpm
22.56	Critical speed 3 low	*Real*	-30000.00…30000.00	rpm	100 = 1 rpm
22.57	Critical speed 3 high	*Real*	-30000.00…30000.00	rpm	100 = 1 rpm
22.70	Motor potentiometer reference enable	*List*	0…4	-	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
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
23.23	Emergency stop time	*Real*	0.000…1800.000	s	1000 = 1 s

No.	Name	Type	Range	Unit	FbEq32
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
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 adaption enable	*List*	0…1	-	1 = 1
25.33	Speed controller auto tune	*Binary src*	-	-	1 = 1
25.34	Auto tune control preset	*List*	0…2	-	1 = 1
25.37	Mechanical time constant	*Real*	0.00…1000.00	s	100 = 1 s
25.38	Auto tune torque step	*Real*	0.00…20.00	%	100 = 1%
25.39	Auto tune speed step	*Real*	0.00…20.00	%	100 = 1%
25.40	Auto tune 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%
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…5	-	1 = 1

No.	Name	Type	Range	Unit	FbEq32
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…5	-	1 = 1
28.21	Constant frequency function	PB	00b…11b	-	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
28.25	Constant frequency sel4	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
28.46	Constant frequency sel5	Binary src	-	-	1 = 1
28.47	Constant frequency sel6	Binary src	-	-	1 = 1
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	Acc/Dec curve time 1	Real	0.000…1800.000	s	1000 = 1s
28.83	Acc/Dec curve time 2	Real	0.000…1800.000	s	1000 = 1s
28.92	Frequency ref act 3	Real	-500.00…500.00	Hz	100 = 1 Hz

No.	Name	Type	Range	Unit	FbEq32
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
30 Limits					
30.01	Limit word 1	*PB*	0000h…FFFFh	-	1 = 1
30.02	Torque limit status	*PB*	0000h…FFFFh	-	1 = 1
30.11	Minimum speed	*Real*	-30000.00…30000.00	rpm	100 = 1 rpm
30.12	Maximum speed	*Real*	-30000.00…30000.00	rpm	100 = 1 rpm
30.13	Minimum frequency	*Real*	-500.00…500.00	Hz	100 = 1 Hz
30.14	Maximum frequency	*Real*	-500.00…500.00	Hz	100 = 1 Hz
30.17	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	Minimum speed source	*Analog src*	-	-	1 = 1
30.38	Maximum speed source	*Analog src*	-	-	1 = 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

No.	Name	Type	Range	Unit	FbEq32
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
31.20	Earth fault	*List*	0…2	-	1 = 1
31.21	Supply phase loss	*List*	0…1	-	1 = 1
31.22	STO indication run/stop	*List*	0…5	-	1 = 1
31.23	Wiring or earth fault	*List*	0…1	-	1 = 1
31.24	Stall function	*List*	0…2	-	1 = 1
31.25	Stall current limit	*Real*	0.0…1600.0	%	10 = 1%
31.26	Stall speed limit	*Real*	0.00…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
31.35	Main fan fault function	*List*	0…2	-	1 = 1
31.36	Aux fan fault function	*List*	0…1	-	1 = 1
31.40	Disable warning messages	*PB*	0000h…FFFFh	-	1 = 1
31.54	Fault action	*List*	0…1	-	1 = 1
32 Supervision					
32.01	Supervision status	*PB*	0000h…FFFFh	-	1 = 1
32.05	Supervision 1 function	*List*	0…7	-	1 = 1
32.06	Supervision 1 action	*List*	0…3	-	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*	-21474836.00…21474836.00	-	100 = 1
32.10	Supervision 1 high	*Real*	-21474836.00…21474836.00	-	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…3	-	1 = 1

No.	Name	Type	Range	Unit	FbEq32
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*	-21474836.00… 21474836.00	-	100 = 1
32.20	Supervision 2 high	*Real*	-21474836.00… 21474836.00	-	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…3	-	1 = 17
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*	-21474836.00… 21474836.00	-	100 = 1
32.30	Supervision 3 high	*Real*	-21474836.00… 21474836.00	-	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…3	-	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*	-21474836.00… 21474836.00	-	100 = 1
32.40	Supervision 4 high	*Real*	-21474836.00… 21474836.00	-	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…3	-	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*	-21474836.00… 21474836.00	-	100 = 1
32.50	Supervision 5 high	*Real*	-21474836.00… 21474836.00	-	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…3	-	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*	-21474836.00… 21474836.00	-	100 = 1

No.	Name	Type	Range	Unit	FbEq32
32.60	Supervision 6 high	*Real*	-21474836.00… 21474836.00	-	100 = 1
32.61	Supervision 6 hysteresis	*Real*	0.00…100000.00	-	100 = 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

No.	Name	Type	Range	Unit	FbEq32
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*	0000h…FFFFh	-	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
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*	0000h…FFFFh	-	1 = 1
34.101	Timed function 2	*PB*	0000h…FFFFh	-	1 = 1
34.102	Timed function 3	*PB*	0000h…FFFFh	-	1 = 1
34.110	Boost time function	*PB*	0000h…FFFFh	-	1 = 1
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 or -76…1832 °F	°C or °F	1 = 1 unit
35.02	Measured temperature 1	*Real*	-60…5000 °C or -76…9032 °F, 0 ohm or [*35.12*] ohm	°C, °F or ohm	1 = 1 unit

No.	Name	Type	Range	Unit	FbEq32
35.03	Measured temperature 2	*Real*	-60…5000 °C or -76…9032 °F, 0 ohm or [*35.12*] ohm	°C, °F or ohm	1 = 1 unit
35.05	Motor overload level	*Real*	0.0…100.0%	%	100 = 1%
35.11	Temperature 1 source	*List*	0…2, 5…8, 11…16, 19…20, 21…23	-	1 = 1
35.12	Temperature 1 fault limit	*Real*	-60…5000 °C or -76…9032 °F	°C, °F or ohm	1 = 1 unit
35.13	Temperature 1 warning limit	*Real*	-60…5000 °C or -76…9032 °F	°C, °F or ohm	1 = 1 unit
35.14	Temperature 1 AI source	*Analog src*	-	-	1 = 1
35.21	Temperature 2 source	*List*	0…2, 5…8, 11…16, 19…20, 21…23	-	1 = 1
35.22	Temperature 2 fault limit	*Real*	-60…5000 °C or -76…9032 °F	°C, °F or ohm	1 = 1 unit
35.23	Temperature 2 warning limit	*Real*	-60…5000 °C or -76…9032 °F	°C, °F or ohm	1 = 1 unit
35.24	Temperature 2 AI source	*Analog src*	-	-	1 = 1
35.31	Safe motor temperature enable	*List*	0…1	-	1 = 1
35.50	Motor ambient temperature	*Real*	-60…100 °C or -76 … 212 °F	°C or °F	1 = 1 unit
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 or 32…572 °F	°C or °F	1 = 1 unit
35.55	Motor thermal time constant	*Real*	100…10000	s	1 = 1 s
35.56	Motor overload action	*List*	0…2	-	1 = 1
35.57	Motor overload class	*List*	0…5	-	1 = 1
36 Load analyzer					
36.01	PVL signal source	*Analog src*	-	-	1 = 1
36.02	PVL filter time	*Real*	0.00…120.00	s	100 = 1 s
36.06	AL2 signal source	*Analog src*	-	-	1 = 1
36.07	AL2 signal scaling	*Real*	0.00…32767.00	-	100 = 1
36.09	Reset loggers	*List*	0…3	-	1 = 1
36.10	PVL peak value	*Real*	-32768.00…32767.00	-	100 = 1
36.11	PVL peak date	*Data*	-	-	1 = 1
36.12	PVL peak time	*Data*	-	-	1 = 1
36.13	PVL current at peak	*Real*	-32768.00…32767.00	A	100 = 1 A
36.14	PVL DC voltage at peak	*Real*	0.00…2000.00	V	100 = 1 V

No.	Name	Type	Range	Unit	FbEq32
36.15	PVL speed at peak	*Real*	-30000.00… 30000.00	rpm	100 = 1 rpm
36.16	PVL reset date	*Data*	-	-	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
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

No.	Name	Type	Range	Unit	FbEq32
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 %
40.02	Process PID feedback actual	*Real*	-200000.00…200000.00	PID unit 1	100 = 1 PID unit 1
40.03	Process PID setpoint actual	*Real*	-200000…200000	PID unit 1	100 = 1 PID unit 1
40.04	Process PID deviation actual	*Real*	-200000.00…200000.00	PID unit 1	100 = 1 PID unit 1
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…13	-	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…13	-	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 unit 1	100 = 1 PID unit 1
40.22	Set 1 internal setpoint 2	*Real*	-200000.00…200000.00	PID unit 1	100 = 1 PID unit 1
40.23	Set 1 internal setpoint 3	*Real*	-200000.00…200000.00	PID unit 1	100 = 1 PID unit 1

No.	Name	Type	Range	Unit	FbEq32
40.24	Set 1 internal setpoint 0	*Real*	-200000.00…200000.00	PID unit 1	100 = 1 PID unit 1
40.26	Set 1 setpoint min	*Real*	-200000.00…200000.00	PID unit 1	100 = 1 PID unit 1
40.27	Set 1 setpoint max	*Real*	-200000.00…200000.00	PID unit 1	100 = 1 PID unit 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	-	100 = 1
40.37	Set 1 output max	*Real*	-200000.00…200000.00	-	100 = 1
40.38	Set 1 output freeze enable	*Binary src*	-	-	1 = 1
40.39	Set 1 deadband range	*Real*	0…200000.0	-	10 = 1
40.40	Set 1 deadband delay	*Real*	0.0…3600.0	s	10 = 1 s
40.43	Set 1 sleep level	*Real*	0.0…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*	0.0…200000.0	PID unit 1	100 = 1 PID unit 1
40.47	Set 1 wake-up deviation	*Real*	-200000.00…200000.00	PID unit 1	100 = 1 PID unit 1
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
40.57	PID set1/set2 selection	*Binary src*	-	-	1 = 1
40.58	Set 1 increase prevention	*Binary src*	-	-	1 = 1
40.59	Set 1 decrease prevention	*Binary src*	-	-	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 unit 1	100 = 1 PID unit 1

No.	Name	Type	Range	Unit	FbEq32
40.70	Compensated setpoint	*Real*	-21474836.48…21474835.20	PID unit 1	100 = 1 PID unit 1
40.71	Set 1 compensation input source	*List*	0, 2…4, 8, 10…12, 15…16, 19…20, 24	-	1 = 1
40.72	Set 1 compensation input 1	*Real*	-200000.00…200000.00	-	100 = 1
40.73	Set 1 compensated output 1	*Real*	-200000.00…200000.00	-	100 = 1
40.74	Set 1 compensation input 2	*Real*	-200000.00…200000.00	-	100 = 1
40.75	Set 1 compensated output 2	*Real*	-200000.00…200000.00	-	100 = 1
40.76	Set 1 compensation non-linearity	*Real*	0…100	%	1= 1%
40.79	Set 1 units	*List*		-	1 = 1
40.80	Set 1 PID output min source	*List*	0…1	-	1 = 1
40.81	Set 1 PID output max source	*List*	0…1	-	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…13	-	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…13	-	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 unit 1	100 = 1 PID unit 1
41.22	Set 2 internal setpoint 2	*Real*	-200000.00…200000.00	PID unit 1	100 = 1 PID unit 1
41.23	Set 2 internal setpoint 3	*Real*	-200000.00…200000.00	PID unit 1	100 = 1 PID unit 1

No.	Name	Type	Range	Unit	FbEq32
41.24	Set 2 internal setpoint 0	*Real*	-200000.00…200000.00	PID unit 1	100 = 1 PID unit 1
41.26	Set 2 setpoint min	*Real*	-200000.00…200000.00	PID unit 1	100 = 1 PID unit 1
41.27	Set 2 setpoint max	*Real*	-200000.00…200000.00	PID unit 1	100 = 1 PID unit 1
41.28	Set 2 setpoint increase time	*Real*	0.0…1800.0	s	10 = 1 s
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*	0.10…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	-	100 = 1
41.37	Set 2 output max	*Real*	-200000.00…200000.00	-	100 = 1
41.38	Set 2 output freeze enable	*Binary src*	-	-	1 = 1
41.39	Set 2 deadband range	*Real*	0…200000.0	-	10 = 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…200000.0	-	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*	0.0…200000.0	PID unit 1	10 = 1 PID unit 1
41.47	Set 2 wake-up deviation	*Real*	-200000.00…200000.00	PID unit 1	100 = 1 PID unit 1
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
41.58	Set 2 increase prevention	*Binary src*	-	-	1 = 1
41.59	Set 2 decrease prevention	*Binary src*	-	-	1 = 1
41.60	Set 2 PID activation source	*Binary src*	-	-	1 = 1
41.71	Set 2 compensation input source	*List*	0, 2…4, 8, 10…12, 15…16, 19…20, 24	-	1 = 1
41.72	Set 2 compensation input 1	*Real*	-200000.00…200000.00	-	100 = 1
41.73	Set 2 compensated output 1	*Real*	-200000.00…200000.00	-	100 = 1
41.74	Set 2 compensation input 2	*Real*	-200000.00…200000.00	-	100 = 1
41.75	Set 2 compensated output 2	*Real*	-200000.00…200000.00	-	100 = 1

No.	Name	Type	Range	Unit	FbEq32
41.76	Set 2 compensation non-linearity	*Real*	0…100	%	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
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…999.9	kWh	10 = 1 kWh
45.04	Saved energy	*Real*	0.0…214748364.0	kWh	10 = 1 kWh
45.05	Saved money x1000	*Real*	0…4294967295 thousands	(definable)	1 = 1 currency unit
45.06	Saved money	*Real*	0.00…999.99	(definable)	100 = 1 currency unit
45.07	Saved amount	*Real*	0.00…21474830.08	(definable)	100 = 1 currency 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…214748300.8	metric ton	10 = 1 metric ton
45.11	Energy optimizer	*List*	0…1	-	1 = 1
45.12	Energy tariff 1	*Real*	0.000…4294966.296	(definable)	1000 = 1 currency unit
45.13	Energy tariff 2	*Real*	0.000…4294966.296	(definable)	1000 = 1 currency unit
45.14	Tariff selection	*Binary src*	-	-	1 = 1
45.18	CO2 conversion factor	*Real*	0.000…65.535	tn/ MWh	1000 = 1 tn/MWh
45.19	Comparison power	*Real*	0.00…10000000.00	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

No.	Name	Type	Range	Unit	FbEq32
45.31	Monthly peak power value (resettable)	*Real*	-30000.00…30000.00	kW	1 = 1 kW
45.32	Monthly peak power date	*Real*			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
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 kW or hp	kW or hp	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
46.31	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
46.41	kWh pulse scaling	*Real*	0.001…1000.000	kWh	1000 = 1 kWh
46.43	Power decimals	*Real*	0…3	-	1 = 1
46.44	Current decimals	*Real*	0…3	-	1 = 1
47 Data storage					
47.01	Data storage 1 real32	*Real*	-2147483.000… 2147483.000	-	1000 = 1
47.02	Data storage 2 real32	*Real*	-2147483.000… 2147483.000	-	1000 = 1
47.03	Data storage 3 real32	*Real*	-2147483.000… 2147483.000	-	1000 = 1
47.04	Data storage 4 real32	*Real*	-2147483.000… 2147483.000	-	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

No.	Name	Type	Range	Unit	FbEq32
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		-	-	
49.219	Basic panel home view 4		0000h…FFFFh	-	
49.220	Basic panel home view 5		0000h…FFFFh	-	
49.221	Basic panel home view 6		0000h…FFFFh	-	
50 Fieldbus adapter (FBA)					
50.01	FBA A enable	*List*	0…1	-	1 = 1
50.02	FBA A comm loss func	*List*	0…5	-	1 = 1
50.03	FBA A comm loss t out	*Real*	0.3…6553.5	s	10 = 1 s
50.04	FBA A ref1 type	*List*	0…5	-	1 = 1
50.05	FBA A ref2 type	*List*	0…5	-	1 = 1
50.06	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…1	-	1 = 1
50.13	FBA A control word	*Data*	00000000h…FFFFFFFFh	-	1 = 1
50.14	FBA A reference 1	*Real*	-2147483648… 2147483647	-	1 = 1
50.15	FBA A reference 2	*Real*	-2147483648… 2147483647	-	1 = 1
50.16	FBA A status word	*Data*	00000000h…FFFFFFFFh	-	1 = 1
50.17	FBA A actual value 1	*Real*	-2147483648… 2147483647	-	1 = 1
50.18	FBA A actual value 2	*Real*	-2147483648… 2147483647	-	1 = 1

No.	Name	Type	Range	Unit	FbEq32
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…2, 5, 7	-	1 = 1
58.02	Protocol ID	*Real*	0000h…FFFFh	-	1 = 1
58.03	Node address	*Real*	0…255	-	1 = 1
58.04	Baud rate	*List*	0…7	-	1 = 1
58.05	Parity	*List*	0…3	-	1 = 1
58.06	Communication control	*List*	0…2	-	1 = 1
58.07	Communication diagnostics	*PB*	0000h…FFFFh	-	1 = 1
58.08	Received packets	*Real*	0…4294967295	-	1 = 1
58.09	Transmitted packets	*Real*	0…4294967295	-	1 = 1
58.10	All packets	*Real*	0…4294967295	-	1 = 1
58.11	UART errors	*Real*	0…4294967295	-	1 = 1
58.12	CRC errors	*Real*	0…4294967295	-	1 = 1
58.13	Token counter	*Real*	0…4294967295	-	1 = 1
58.14	Communication loss action	*List*	0…5	-	1 = 1
58.15	Communication loss mode	*List*	1…2	-	1 = 1
58.16	Communication loss time	*Real*	0.0…6000.0	s	10 = 1 s
58.17	Transmit delay	*Real*	0…65535	ms	1 = 1 ms
58.18	EFB control word	*PB*	00000000h…FFFFFFFFh	-	1 = 1
58.19	EFB status word	*PB*	00000000h…FFFFFFFFh	-	1 = 1
58.25	Control profile	*List*	0, 5	-	1 = 1

No.	Name	Type	Range	Unit	FbEq32
58.26	EFB ref1 type	*List*	0…5	-	1 = 1
58.27	EFB ref2 type	*List*	0…5	-	1 = 1
58.28	EFB act1 type	*List*	0…5	-	1 = 1
58.29	EFB act2 type	*List*	0…5	-	1 = 1
58.30	EFB status word transparent source	*Analog src*	-	-	1 = 1
58.31	EFB act1 transparent source	*Analog src*	-	-	1 = 1
58.32	EFB act2 transparent source	*Analog src*	-	-	1 = 1
58.33	Addressing mode	*List*	0…2	-	1 = 1
58.34	Word order	*List*	0…1	-	1 = 1
58.40	Device object ID	*Real*	0…4194303	-	1 = 1
58.101	Data I/O 1	*Analog src*	-	-	1 = 1
58.102	Data I/O 2	*Analog src*	-	-	1 = 1
58.103	Data I/O 3	*Analog src*	-	-	1 = 1
58.104	Data I/O 4	*Analog src*	-	-	1 = 1
58.105	Data I/O 5	*Analog src*	-	-	1 = 1
58.106	Data I/O 6	*Analog src*	-	-	1 = 1
58.107	Data I/O 7	*Analog src*	-	-	1 = 1
…	…	…	…	…	
58.114	Data I/O 14	*Analog src*	-	-	1 = 1
70 Override					
70.01	Override status	*PB*	0000h…FFFFh	-	1 = 1
70.02	Override enable	*List*	0…1	-	1 = 1
70.03	Override activation source	*Binary src*	-	-	1 = 1
70.04	Override reference source	*List*	0…6	-	1 = 1
70.05	Override direction	*Binary src*	-	-	1 = 1
70.06	Override frequency	*Real*	-500.0…500.0	Hz	100 = 1 Hz
70.07	Override speed	*Real*	-30000.0…30000.0	rpm	100 = 1 rpm
70.10	Override enables selection	*PB*	0000h…FFFFh	-	1 = 1
70.20	Override fault handling	*List*	0…1	-	1 = 1
70.21	Override auto reset trials	*Real*	0…5	-	1 = 1
70.22	Override auto reset time	*Real*	5.0…120.0	s	10 = 1
70.40	Override log 1 start date	*Real*		-	

No.	Name	Type	Range	Unit	FbEq32
70.41	Override log 1 start time	*Real*		-	
70.42	Override log 1 end date	*Real*		-	
70.43	Override log 1 end time	*Real*		-	
70.44	Override log 1 fault 1	*Real*		-	
70.45	Override log 1 fault 2	*Real*		-	
70.46	Override log 1 fault 3	*Real*		-	
70.47	Override log 1 warning 1	*Real*		-	
70.48	Override log 1 warning 2	*Real*		-	
70.49	Override log 1 warning 3	*Real*		-	
70.50	Override log 2 start date	*Real*		-	
70.51	Override log 2 start time	*Real*		-	
70.52	Override log 2 end date	*Real*		-	
70.53	Override log 2 end time	*Real*		-	
70.54	Override log 2 fault 1	*Real*		-	
70.55	Override log 2 fault 2	*Real*		-	
70.56	Override log 2 fault 3	*Real*		-	
70.57	Override log 2 warning 1	*Real*		-	
70.58	Override log 2 warning 2	*Real*		-	
70.59	Override log 2 warning 3	*Real*		-	
70.60	Override log 3 start date	*Real*		-	
70.61	Override log 3 start time	*Real*		-	
70.62	Override log 3 end date	*Real*		-	
70.63	Override log 3 end time	*Real*		-	
70.64	Override log 3 fault 1	*Real*		-	
70.65	Override log 3 fault 2	*Real*		-	
70.66	Override log 3 fault 3	*Real*		-	
70.67	Override log 3 warning 1	*Real*		-	
70.68	Override log 3 warning 2	*Real*		-	
70.69	Override log 3 warning 3	*Real*		-	
71 External PID1					
71.01	External PID act value	*Real*	-200000.00…200000.00	%	100 = 1%
71.02	Feedback act value	*Real*	-200000.00…200000.00	PID unit 1	100 = 1 PID unit 1
71.03	Setpoint act value	*Real*	-200000.00…200000.00	PID unit 1	100 = 1 PID unit 1
71.04	Deviation act value	*Real*	-200000.00…200000.00	PID unit 1	100 = 1 PID unit 1
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

No.	Name	Type	Range	Unit	FbEq32
71.14	Setpoint scaling	*Real*	-200000.00…200000.00	-	100 = 1
71.15	Output scaling	*Real*	-200000.00…200000.00	-	100 = 1
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	PID unit 1	100 = 1 PID unit 1
71.22	Internal setpoint 2	*Real*	-200000.00…200000.00	PID unit 1	100 = 1 PID unit 1
71.23	Internal setpoint 3	*Real*	-200000.00…200000.00	PID unit 1	100 = 1 PID unit 1
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	*Binary src*	-	-	1 = 1
71.59	Decrease prevention	*Binary src*	-	-	1 = 1
71.62	Internal setpoint actual	*Real*	-200000.00…200000.00	PID unit 1	100 = 1 PID unit 1
71.79	External PID units	*List*		-	1 = 1
76 Multipump configuration					
76.01	PFC status	*PB*	0000h…FFFFh	-	1 = 1
76.02	Multipump system status	*List*	0…3, 100…103, 200…202, 300…302, 400, 500, 600, 700, 800…801, 4…9	-	1 = 1
76.11	Pump/fan status 1	*PB*	0000h…FFFFh	-	1 = 1
76.12	Pump/fan status 2	*PB*	0000h…FFFFh	-	1 = 1
76.13	Pump/fan status 3	*PB*	0000h…FFFFh	-	1 = 1
76.14	Pump/fan status 4	*PB*	0000h…FFFFh	-	1 = 1
76.15	Pump/fan status 5	*PB*	0000h…FFFFh	-	1 = 1

No.	Name	Type	Range	Unit	FbEq32
76.16	Pump/fan status 6	*PB*	0000h…FFFFh	-	1 = 1
76.21	Multipump configuration	*List*	0, 1…3	-	1 = 1
76.25	Number of motors	*Real*	1…8	-	1 = 1
76.26	Min number of motors allowed	*Real*	0…8	-	1 = 1
76.27	Max number of motors allowed	*Real*	1…8	-	1 = 1
76.30	Start point 1	*Real*	0.00…32767.00	rpm/Hz	1 = 1 unit
76.31	Start point 2	*Real*	0.00…32767.00	rpm/Hz	1 = 1 unit
76.32	Start point 3	*Real*	0.00…32767.00	rpm/Hz	1 = 1 unit
76.33	Start point 4	*Real*	0.00…32767.00	rpm/Hz/m	1 = 1 unit
76.34	Start point 5	*Real*	0.00…32767.00	rpm/Hz/m	1 = 1 unit
76.41	Stop point 1	*Real*	0.00…32767.00	rpm/Hz	1 = 1 unit
76.42	Stop point 2	*Real*	0.00…32767.00	rpm/Hz	1 = 1 unit
76.43	Stop point 3	*Real*	0.00…32767.00	rpm/Hz	1 = 1 unit
76.44	Stop point 4	*Real*	0.00…32767.00	rpm/Hz/m	1 = 1 unit
76.45	Stop point 5	*Real*	0.00…32767.00	rpm/Hz/m	1 = 1 unit
76.55	Start delay	*Real*	0.00…12600.00	s	100 = 1 s
76.56	Stop delay	*Real*	0.00…12600.00	s	100 = 1 s
76.57	PFC speed hold on	*Real*	0.00…1000.00	s	100 = 1 s
76.58	PFC speed hold off	*Real*	0.00…1000.00	s	100 = 1 s
76.59	PFC contactor delay	*Real*	0.20…600.00	s	100 = 1 s
76.60	PFC ramp acceleration time	*Real*	0.00…1800.00	s	100 = 1 s
76.61	PFC ramp deceleration time	*Real*	0.00…1800.00	s	100 = 1 s
76.70	PFC Autochange	*List*	0…13	-	1 = 1
76.71	PFC Autochange interval	*Real*	0.00…42949672.95	h	100 = 1 h
76.72	Maximum wear imbalance	*Real*	0.00…1000000.00	h	100 = 1 h
76.73	Autochange level	*Real*	0.0…300.0	%	10 = 1%
76.74	Autochange auxiliary PFC	*List*	0…1	-	1 = 1
76.81	PFC 1 interlock	*Binary src*	-	-	1 = 1
76.82	PFC 2 interlock	*Binary src*	-	-	1 = 1
76.83	PFC 3 interlock	*Binary src*	-	-	1 = 1
76.84	PFC 4 interlock	*Binary src*	-	-	1 = 1
76.85	PFC 5 interlock	*Binary src*	-	-	1 = 1
76.86	PFC 6 interlock	*Binary src*	-	-	1 = 1
76.95	Regulator bypass control	*Binary src*	-	-	-
77 Multipump maintenance and monitoring					
77.10	PFC runtime change	*List*	0…7	-	1 = 1

No.	Name	Type	Range	Unit	FbEq32
77.11	Pump/fan 1 running time	*Real*	0.00…42949672.95	h	100 = 1 h
77.12	Pump/fan 2 running time	*Real*	0.00…42949672.95	h	100 = 1 h
77.13	Pump/fan 3 running time	*Real*	0.00…42949672.95	h	100 = 1 h
77.14	Pump/fan 4 running time	*Real*	0.00…42949672.95	h	100 = 1 h
77.15	Pump/fan 5 running time	*Real*	0.00…42949672.95	h	100 = 1 h
77.16	Pump/fan 6 running time	*Real*	0.00…42949672.95	h	100 = 1 h
95 HW configuration					
95.01	Supply voltage	*List*	0…3, 5	-	1 = 1
95.02	Adaptive voltage limits	*List*	0…3, 5	-	1 = 1
95.03	Estimated AC supply voltage	*Real*	0…65535	V	1 = 1 V
95.04	Control board supply	*List*	0…1	-	1 = 1
95.15	Special HW settings	*PB*	00000000h…FFFFFFFFh	-	1 = 1
95.20	HW options word 1	*PB*	0000h…FFFFh	-	1 = 1
95.21	HW options word 2	*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 level status	*PB*	00000000h…FFFFFFFFh	-	1 = 1
96.04	Macro select	*List*	0…1	-	1 = 1
96.05	Macro active	*List*	1	-	1 = 1
96.06	Parameter restore	*List*	0, 2, 8, 32, 62, 512, 1024, 34560	-	1 = 1
96.07	Parameter save manually	*List*	0…1	-	1 = 1
96.08	Control board boot	*List*	0…1	-	1 = 1
96.10	User set status	*List*	0…7, 20…23	-	1 = 1
96.11	User set save/load	*List*	0…5, 18…21	-	1 = 1
96.12	User set I/O mode in1	*Binary src*	-	-	-
96.13	User set I/O mode in2	*Binary src*	-	-	-
96.16	Unit selection	*PB*	0000h…FFFFh		1 = 1
96.20	Time sync primary source	*List*	0, 3, 6, 8, 9	-	1 = 1
96.24	Full days since 1st Jan 1980	*Real*	1…59999	-	1 = 1
96.25	Time in minutes within 24 h	*Real*	0…1439	-	1 = 1
96.26	Time in ms within one minute	*Real*	0…59999	-	1 = 1
96.39	Event configuration	*Real*	0…1	-	1 = 1
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*	0000h…FFFFh	-	1 = 1
96.68	Actual checksum A	*PB*	00000000h…FFFFFFFFh	-	1 = 1

No.	Name	Type	Range	Unit	FbEq32
96.69	Actual checksum B	*PB*	00000000h…FFFFFFFFh	-	1 = 1
96.70	Disable adaptive program	*List*	Not applicable.		
96.71	Approved checksum A	*PB*	00000000h…FFFFFFFFh	-	1 = 1
96.72	Approved checksum B	*PB*	00000000h…FFFFFFFFh	-	1 = 1
96.78	Legacy Modbus mapping	*List*	0…1	-	1 = 1
96.79	Legacy control profile	*List*	0…3	-	1 = 1
96.100	Change user pass code	*Data*	10000000…99999999	-	1 = 1
96.101	Confirm user pass code	*Data*	10000000…99999999	-	1 = 1
96.102	User lock functionality	*PB*	0000h…FFFFh	-	1 = 1
97 Motor control					
97.01	Switching frequency reference	*List*	2, 4, 8, 12	kHz	1 = 1 kHz
97.02	Minimum switching frequency	*List*	1, 2, 4, 8, 12	kHz	1 = 1 kHz
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
97.08	Optimizer minimum torque	*Real*	0.0…1600.0	%	10 = 1%
97.10	Signal injection	*List*	0…4	-	1 = 1
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*	0…1	-	1 = 1
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	%	1 = 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.

No.	Name	Type	Range	Unit	FbEq32
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
99 Motor data					
99.03	Motor type	*List*	0…2	-	1 = 1
99.04	Motor control mode	*List*	0…1	-	1 = 1
99.06	Motor nominal current	*Real*	0.0…6400.0	A	10 = 1 A
99.07	Motor nominal voltage	*Real*	0.0…960.0	V	10 = 1 V
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*	0.00…10000.00 kW or 0.00 … 13404.83 hp	kW or hp	100 = 1 unit
99.11	Motor nominal cos Φ	*Real*	0.00 … 1.00	-	100 = 1
99.12	Motor nominal torque	*Real*	0.000…4000000.000 N·m or 0.000…2950248.597 lb·ft	N·m or lb·ft	1000 = 1 unit
99.13	ID run requested	*List*	0…3, 5…6, 8	-	1 = 1
99.14	Last ID run performed	*List*	0…3, 5…6, 8	-	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

What this chapter contains

The chapter lists the warning and fault messages including possible causes and corrective actions. The causes of most warnings and faults can be identified and corrected using the information in this chapter. If not, contact an ABB service representative. If you have a possibility to 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 below in separate tables. Each table is sorted by warning/fault code.

Safety

WARNING! Only qualified electricians are allowed to service the drive. Read the instructions in 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 trip the drive and it 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 or from a selectable source (parameter *31.11 Fault reset selection*) such as the digital inputs of the drive. 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 *414*.

Warning/fault history

Event log

All indications are stored in the event log with a time stamp and other information. The event log stores information on

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- 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 *412*.

To clear the fault and event logger, set parameter *96.51 Clear fault and event logger* to value Clear.

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 control 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*…*05.89*.

For active faults and warnings, see

- parameters in group *04 Warnings and faults* (page *131*).

For previously occurred faults and warnings, see

- parameters in group *04 Warnings and faults* (page *131*).

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]).

Warning messages

Note: The list also contains events that only appear in the Event log.

Code (hex)	Warning / Aux. code	Cause	What to do
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) 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.
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.

Code (hex)	Warning / Aux. code	Cause	What to do
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.
A2C1	BU current difference	Difference check warning for currents	Informative warning.
A2C3	BU commutation difference	Branching unit difference check warning for CDX and CDY.	Informative warning.
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.	
A3C2	BU voltage difference	Branching unit difference check warning for main voltage	Informative warning.
A490	Incorrect temperature sensor setup	Temperature cannot be supervised due to incorrect adapter setup.	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*.
A4A0	Control board temperature	Control board temperature is too high.	Check the auxiliary code. See actions for each code below.
	(none)	Temperature above warning limit	Check ambient conditions. Check air flow and fan operation. Check heatsink fins for dust pick-up.
	0001	Thermistor broken	Contact an ABB service representative for control board replacement.
A4A1	IGBT overtemperature	Estimated drive IGBT temperature is excessive.	Check ambient conditions. Check air flow and fan operation. Check heatsink fins for dust pick-up. Check motor power against drive power.

Code (hex)	Warning / Aux. code	Cause	What to do
A4A9	Cooling	Drive module temperature is excessive.	Check ambient temperature. If it exceeds 40 °C/104 °F (IP21 frames R4) or if it exceeds 50 °C /122 °F (IP21 frames R1…R6), ensure that load current does not exceed deNominal load capacity 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. Check the auxiliary code.
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.
A581	Fan	Cooling fan feedback missing.	Check the auxiliary code to identify the fan. Code **0** denotes main fan 1. Other codes (format XYZ): “X” specifies state code (**1:** ID run, **2:** normal). “Y” = 0, “Z” specifies the index of the fan (**1:** Main fan 1, **2:** Main fan 2, **3:** Main fan 3). Check fan operation and connection. Replace fan if faulty.
A582	Auxiliary fan missing	An auxiliary cooling fan (IP55 internal fan) is stuck or disconnected.	Check the auxiliary code. Check the auxiliary fan and connection. Replace faulty fan. Make sure the front cover of the drive is in place and tightened. If the commissioning of the drive requires that the cover is off, set parameter *31.36 Aux fan fault function* temporarily to value *No action* within two minutes from power-up.
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 *253*). Check the value of parameter *95.04 Control board supply*.
A5EA	Measurement circuit temperature	Problem with internal temperature measurement of the drive.	Check the auxiliary code. They depend on the control unit type.
		Frames R1…R5	Contact your local ABB representative.
	0000 0001	IGBT temperature	
	0000 0003	Board temperature	
	0000 0006	Power supply temperature	
		Frames R6	Contact your local ABB representative.
	0000 0001	U-phase IGBT	
	0000 0002	V-phase IGBT	
	0000 0003	W-phase IGBT	
	0000 0004	Board temperature	
	0000 0005	Brake chopper	
	0000 0006	Air inlet (TEMP3)	
	0000 0007	Power supply temperature	
	0000 0008	du/dt (TEMP2)	
	0000 0009	TEMP1	
	FAh =1111 1010	Ambient temperature	
A5EB	PU board powerfail	Power unit power supply failure.	Contact your local ABB representative.
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.
A682	Flash erase speed exceeded	The flash memory (in the memory unit) has been erased too frequently, compromising the lifetime of the memory.	Avoid forcing unnecessary parameter saves by parameter *96.07* or cyclic parameter writes (such as user logger triggering through parameters). Check the auxiliary code (format XYYY YZZZ). "X" specifies the source of warning (**1:** generic flash erase supervision). "ZZZ" specifies the flash subsector number that geneNominal the warning.

Code (hex)	Warning / Aux. code	Cause	What to do
A685	Power fail saving	Power fail saving is requested too frequently. Due to the limited saving interval some of the requests do not trigger the saving and power fail data might be lost. This might be caused by DC voltage oscillation.	Check the power supply of the control unit. If it is the internal power supply of the drive, check the supply voltage of the drive.
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.
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. The drive is not dimensioned correctly.	Check the auxiliary code. See actions for each code below.
	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*.

Code (hex)	Warning / Aux. code	Cause	What to do
A6A7	System time not set	System time is not set. Timed functions cannot be used and fault log dates are not correct.	Set the system time manually or connect the control panel to the drive to synchronize the clock. If basic control panel is used, synchronize the clock through the EFB or a fieldbus module. Set parameter *34.10 Timed functions enable* to *Disabled* to disable the timed functions if they are not used.
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 *Parameter checksum calculation* (page *127*).
A6B1	User pass code not confirmed	A new user pass code has been entered in parameter *96.100* but not confirmed in *96.101*.	Confirm the new pass code by entering the same code in *96.101*. To cancel, close the user lock without confirming the new code. See section *Parameter checksum calculation* (page *127*).
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 group *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 either the hardware setting (on the drive control unit) or parameter *12.15*/*12.25*. **Note:** Control board reboot (either by cycling the power or through parameter *96.08 Control board boot*) is required to validate any changes in the hardware settings.
A6E6	ULC configuration	User load curve configuration error.	Check the auxiliary code. 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 (*37.20*…*37.16*) 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, for example, 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 for overloaded motor. Adjust the parameters used for the motor overload function (*35.51*…*35.53*) and *35.55*…*35.56*.

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Code (hex)	Warning / Aux. code	Cause	What to do
A784	Motor disconnect	All three output phases are disconnected from motor.	Check that switches between drive and motor are closed. Check that 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.
A7AB	Extension I/O configuration failure	Installed extension module is not the same as configured.	Check that the installed extension module (shown by parameter *15.02 Detected extension module*) is the same as selected by parameter *15.01 Extension module type*.
A7AC	I/O module internal error	I/O module internal error.	
A7B0	Motor speed feedback	No motor speed feedback is received.	Check the settings of the parameters in groups 90 Feedback selection, 91 Encoder module settings, 92 Encoder 1 configuration and 93 Encoder 2 configuration. Check encoder installation.
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.
A7DC	FSx undefined warning	FSX undefined warning is not yet defined inside the drive. Gather the aux codes from this warning and contact ABB.	
A7DD	FSx safety bus warning	user_manual_desc	
A7E1	Encoder error	No motor speed feedback is received.	Check the settings of the parameters in groups 90 Feedback selection, 91 Encoder module settings, 92 Encoder 1 configuration and 93 Encoder 2 configuration. Check encoder installation.

Code (hex)	Warning / Aux. code	Cause	What to do
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.
A88F	Cooling fan	Maintenance timer limit exceeded.	Consider changing the cooling fan. Parameter *05.04 Fan on-time counter* shows the running time of the cooling fan.
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*.
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. Check the auxiliary code, which identifies the relay output.
	0001	Relay output 1	Change the control board or stop using relay output 1.
	0002	Relay output 2	Change the control board or stop using relay output 2.
	0003	Relay output 3	Change the control board or stop using relay output 3.
A8A2	RO toggle warning	The relay output is changing states faster than recommended, for example, 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. Check the auxiliary code, which identifies the relay output source parameter.
	0001	Relay output 1	Select a different signal with parameter *10.24 RO1 source*.
	0002	Relay output 2	Select a different signal with parameter *10.27 RO2 source*.
	0003	Relay output 3	Select a different signal with parameter *10.30 RO3 source*.
A8B0	ABB Signal supervision 1 (Editable message text) Programmable warning: *32.06 Supervision 1 action*	Warning geneNominal by the signal supervision function 1.	Check the source of the warning (parameter *32.07 Supervision 1 signal*).
A8B1	ABB Signal supervision 2 (Editable message text) Programmable warning: *32.16 Supervision 2 action*	Warning geneNominal by the signal supervision function 2.	Check the source of the warning (parameter *32.17 Supervision 2 signal*).
A8B2	ABB Signal supervision 3 (Editable message text) Programmable warning: *32.26 Supervision 3 action*	Warning geneNominal by the signal supervision function 3.	Check the source of the warning (parameter *32.27 Supervision 3 signal*).

Code (hex)	Warning / Aux. code	Cause	What to do
A8B3	ABB Signal supervision 4 (Editable message text) Programmable warning: *32.36 Supervision 4 action*	Warning geneNominal by the signal supervision function 4.	Check the source of the warning (parameter *32.37 Supervision 4 signal*).
A8B4	ABB Signal supervision 5 (Editable message text) Programmable warning: *32.46 Supervision 5 action*	Warning geneNominal by the signal supervision function 5.	Check the source of the warning (parameter *32.47 Supervision 5 signal*).
A8B5	ABB Signal supervision 6 (Editable message text) Programmable warning: *32.56 Supervision 6 action*	Warning geneNominal by the signal supervision function 6.	Check the source of the warning (parameter *32.57 Supervision 6 signal*).
A8BE	ULC overload warning Programmable fault: *37.03 ULC overload actions*	Selected signal has exceeded the user overload curve.	Check for any operating conditions increasing the monitored signal (for example, the loading of the motor if the torque or current is being monitored). Check the definition of the load curve (parameter group *37 User load curve*).
A8BF	ULC underload warning Programmable fault: *37.04 ULC underload actions*	Selected signal has fallen below the user underload curve.	Check for any operating conditions decreasing the monitored signal (for example, loss of load if the torque or current is being monitored). Check the definition of the load curve (parameter group *37 User load curve*).
A981	External warning 1 (Editable message text) Programmable warning: *31.01 External event 1 source* *31.02 External event 1 type*	Fault in external device 1.	Check the external device. Check setting of parameter *31.01 External event 1 source*.
A982	External warning 2 (Editable message text) Programmable warning: *31.03 External event 2 source* *31.04 External event 2 type*	Fault in external device 2.	Check the external device. Check setting of parameter *31.03 External event 2 source*.
A983	External warning 3 (Editable message text) Programmable warning: *31.05 External event 3 source* *31.06 External event 3 type*	Fault in external device 3.	Check the external device. Check setting of parameter *31.05 External event 3 source*.
A984	External warning 4 (Editable message text) Programmable warning: *31.07 External event 4 source* *31.08 External event 4 type*	Fault in external device 4.	Check the external device. Check setting of parameter *31.07 External event 4 source*.

Code (hex)	Warning / Aux. code	Cause	What to do
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*.
AF8C	Process PID sleep mode		
AF90	Speed controller autotuning	The speed controller autotune routine did not complete successfully.	Check the auxiliary code. See actions for each code below.
	0000	Drive was stopped before the autotune was complete.	Start the drive and repeat autotune until successful.
	0001	The drive was started and it 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 *108*).
	0002	Required torque reference could not be reached before the drive reached maximum speed.	Decrease the torque step (parameter *25.38*) or increase the speed step (parameter *25.39*).
	0003	Motor could not accelerate/ to maximum speed.	Increase the torque step (parameter *25.38*) or decrease the speed step (parameter *25.39*).
	0004	Motor could not decelerate to minimum speed.	Increase the torque step (parameter *25.38*) or decrease the speed step (parameter *25.39*).
	0005	Motor could not decelerate with full autotune torque.	Decrease the torque step (parameter *25.38*) or the speed step (parameter *25.39*).
	0006	Autotune could not write a parameter.	Run the drive one more time.
	0007	Drive was ramping down when the autotune was activated.	Run the drive to the set point and start the autotune one more time.
	0008	Drive was ramping up when the autotune was activated.	Wait until the drive reaches the set point and start autotune.
	0009	Drive was running outside of autotune speed limits during the autotune activation.	Check the limits, set the correct setpoint and repeat the autotune.
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.	

Code (hex)	Warning / Aux. code	Cause	What to do
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 received.	Check the setting of (and source selected by) parameter 20.12. Switch run enable signal on (eg. in the fieldbus control word).
AFED	Run permissive	Run permissive is keeping the drive from running the motor.	Check the setting of (and source selected by) parameter *20.40 Run permissive*.
AFEE	Start interlock 1	Start interlock 1 is keeping the drive from starting.	Check the signal source selected for parameter *20.41 Start interlock 1*.
AFEF	Start interlock 2	Start interlock 2 is keeping the drive from starting.	Check the signal source selected for parameter *20.42 Start interlock 2*.
AFF0	Start interlock 3	Start interlock 3 is keeping the drive from starting.	Check the signal source selected for parameter *20.43 Start interlock 3*.
AFF1	Start interlock 4	Start interlock 4 is keeping the drive from starting.	Check the signal source selected for parameter *20.44 Start interlock 4*.
AFF2	Run permissive forced warning	A forced DI is used as a source for parameter *20.40 Run permissive*.	If *20.40 Run permissive* uses DIx as the source, check if the bit corresponding to DIx in parameter *10.03 DI force selection* is 1.
AFF3	Start interlock forced warning	One or more forced DIs is used as a source for one or more of parameters *20.41 Start interlock 1* … *20.44 Start interlock 4*.	Check all parameters *20.41 Start interlock 1* … *20.44 Start interlock 4*. If any of these parameters uses DIx as the source, check if the bit corresponding to DIx in parameter *10.03 DI force selection* is 1.
AFF5	Override new start required	The Safe torque off function was active and has been reset while in Override.	A new start signal is required to start the drive again.
AFF6	Identification run	Motor ID run will occur at next start.	Informative warning.
AFF7	Autophasing	Autophasing routine will be performed at next start to determine the angular position of the magnetic flux (with a permanent magnet synchronous motor) or the magnetic axis (with a synchronous reluctance motor).	Informative warning.
AFF8	Motor heating active	Pre-heating is being performed	Informative warning. Motor pre-heating is active. Current specified by parameter *21.16 Pre-heating current* is being passed through the motor.
AFFE	Override active	Drive is in Override mode.	Informative warning.

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Code (hex)	Warning / Aux. code	Cause	What to do
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.	Informative warning. 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 *253*).
B5A2	Power up Programmable event: *96.39 Event configuration*	The drive has been powered up.	Informative event.
B681	Hand mode selected	The drive was placed in Hand mode.	Informative event. Check the control panel to ensure that the current control location is correct.
B682	Off mode selected	The drive was placed in Off mode.	Informative event. Check the control panel to ensure that the current control location is correct.
B683	Auto mode selected	The drive was placed in Auto mode.	Informative event. Check the control panel to ensure that the current control location is correct.
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 *418*).
D501	No more available PFC motors	No more PFC motors can be started because they can be interlocked or in the Hand mode.	Check that there are no interlocked PFC motors, see parameters: *76.81*…*76.84*. If all motors are in use, the PFC system is not adequately dimensioned to handle the demand.
D502	All motors interlocked	All the motors in the PFC system are interlocked.	Check that there are no interlocked PFC motors, see parameters *76.81*…*76.84*.
D503	VSD controlled PFC motor interlocked	The motor connected to the drive is interlocked (unavailable).	Motor connected to the drive is interlocked and thus cannot be started. Remove the corresponding interlock to start the drive controlled PFC motor. See parameters *76.81*…*76.84*.
D506		Pump cleaning cannot be started. The drive needs to be in remote control and start signal is activated.	Change control location to Auto.

Fault messages

Code (hex)	Fault / Aux. code	Cause	What to do
1080	Backup/Restore timeout	Control 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 (select *Current measurement calibration* at parameter *99.13 ID run requested*). If the fault persists, contact your local ABB representative. Auxiliary codes are shown below.
	0001	Too high offset error in U-phase current.	
	0002	Too high offset error in V-phase current.	
	0003	Too high offset error in W-phase current.	
	0004	Too high gain difference detected between phase current measurements.	
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 motor load. Check acceleration times in parameter group *23 Speed reference ramp* (speed control) or *28 Frequency reference chain* (frequency control). Also check parameters *46.01 Speed scaling*, *46.02 Frequency scaling* and *46.03 Torque scaling*. Check motor and motor cable (including phasing and delta/star connection). Check there are no contactors opening and closing in motor cable. Check that the start-up data in parameter group 99 corresponds to the motor rating plate. Check that there are no power factor correction capacitors or surge absorbers in motor cable. Check 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	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.	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. Auxiliary codes are shown below.
	0080	State feedback from output phases does not match control signals. For frames R6.	
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.
2392	BU earth leakage	Earth fault detected by the branching unit: sum of all currents is exceeding the level.	Contact your local ABB representative.
3130	Input phase loss Programmable fault: *31.21 Supply phase loss*	Intermediate circuit DC voltage is oscillating due to missing input power line phase or blown fuse.	Check input power line fuses. Check for loose power cable connections. Check for input power supply imbalance.
3181	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.
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.

Code (hex)	Fault / Aux. code	Cause	What to do
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.
3291	DC voltage difference	Difference in DC voltages between parallelconnected inverter modules.	Contact your local ABB representative.
3293	DC unbalance fault	DC unbalance of 3level devices.	Contact your local ABB representative.
3381	Output phase loss Programmable fault: *31.19 Motor phase loss*	Motor circuit fault due to missing motor connection (all three phases are not connected).	Connect motor cable.
4110	Control board temperature	Control board temperature is too high.	Check proper cooling of the drive. Check the auxiliary cooling fan.
4210	IGBT overtemperature	Estimated drive IGBT temperature is excessive.	Check ambient conditions. Check air flow and fan operation. Check heatsink fins for dust pick-up. Check motor power against drive power.
4290	Cooling	Drive module temperature is excessive.	Check ambient temperature. If it exceeds 40 °C/104 °F (IP21 frames R4…R6) or if it exceeds 50 °C /122 °F (IP21 frames R1…R6), ensure that load current does not exceed deNominal load capacity of 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.
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. Check the auxiliary code.
	FA	Ambient temperature	
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).

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Code (hex)	Fault / Aux. code	Cause	What to do
4982	External temperature 2 (Editable message text)	Measured temperature 2 has exceeded fault limit.	Check the value of parameter *35.03 Measured temperature 2*. Check the cooling of the motor (or other equipment whose temperature is being measured).
4990	CPTC-02 not found	CPTC-02 extension module is not detected in option slot 2.	Power down the drive and check that the module is properly inserted in option slot 2. See also *CPTC-02 ATEX-certified thermistor protection module, Ex II (2) GD (+L537+Q971) user's manual* (3AXD50000030058 [English]).
4991	Safe motor temperature	The CPTC-02 module indicates overtemperature: • motor temperature is too high, or • the thermistor is in short-circuit or disconnected	Check the cooling of the motor. Check the motor load and drive ratings. Check the wiring of the temperature sensor. Repair wiring if faulty. Measure the resistance of the sensor. Replace the sensor if faulty.
5080	Fan	Cooling fan feedback missing.	See *A581 Fan* (page *416*).
5081	Auxiliary fan broken	An auxiliary cooling fan (connected to the fan connectors on the control unit) is stuck or disconnected.	Check the auxiliary code, which identifies the broken fan. Check auxiliary fan(s) and connection(s). Replace fan if faulty. Make sure the front cover of the drive is in place and tightened. If the commissioning of the drive requires that the cover is off, set parameter *31.36 Aux fan fault function* temporarily to value *No action* within two minutes from power-up. Reboot the control unit (using parameter *96.08 Control board boot*) or by cycling power.
	0001	Auxiliary fan 1 broken.	
	0002	Auxiliary fan 2 broken.	
5089	SMT circuit malfunction	Fault *4991 Safe motor temperature* is geneNominal but drive STO is not activated. **Note:** If only one STO channel is opened, fault *FA81 Safe torque off 1* or *FA82 Safe torque off 2* is geneNominal.	Check connection between the relay output of the CPTC-02 module and the STO terminal. Check CPTC-02 module. Replace if faulty. See also *CPTC-02 ATEX-certified thermistor protection module, Ex II (2) GD (+L537+Q971) user's manual* (3AXD50000030058 [English]).
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, ie, 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 *253*). Check the value of parameter *95.04 Control board supply*.

Code (hex)	Fault / Aux. code	Cause	What to do
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, for example, after a firmware update.	Cycle the power to the drive. You may have to be repeat this.
5094	Measurement circuit temperature	Problem with internal temperature measurement of the drive.	Contact your local ABB representative.
5095	Redundant measurement	Redundant measurement supervision has indicated a difference in the duplicated measurements that is outside the limits.	Contact your local ABB representative.
5096	Overtemperature hw	Hardware overtemperature	Contact your local ABB representative.
5098	I/O communication loss	Internal standard I/O communication failure.	Try resetting the fault or reboot 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.	Contact your local ABB representative.
5691	Measurement circuit ADC	Measurement circuit fault.	Contact your local ABB representative.
5692	PU board powerfail	Power unit power supply failure.	Contact your local ABB representative.
5693	Measurement circuit DFF	Measurement circuit fault.	Contact your local ABB representative.
5695	Reduced run	Some of the configured power units are not found. The reduced run is possible if configured.	Contact your local ABB representative.
5696	PU state feedback	State feedback supervision supervises the state feedback signals from the output phases and compares the signals to the actual control signals. All of the output phases are sampled invidually.	Contact your local ABB representative.
5697	Charging feedback	Charging feedback signal missing.	Check the feedback signal coming from the charging system.
5698	Unknown PU fault	The power unit logic has geneNominal a fault which is not known by the software.	Check the logic and software compatibility.

Code (hex)	Fault / Aux. code	Cause	What to do
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
6200	Checksum mismatch Programmable fault: *96.54 Checksum action*	The calculated parameter checksum does not match any enabled reference checksum.	See *A686 Checksum mismatch* (page *418*).
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
64A4	Rating ID fault	Rating ID load error.	Contact your local ABB representative.
64A6	Adaptive program	Error running the adaptive program.	Check the auxiliary code (format XXYY ZZZZ). “XX” specifies the number of the state (00=base program) and “YY” specifies the number of the function block (0000=generic error). ”ZZZZ” indicates the problem.
	000A	Program corrupted or block non-existent	Restore the template program or download the program to the drive.
	000C	Required block input missing	Check the inputs of the block.
	000E	Program corrupted or block non-existent	Restore the template program or download the program to the drive.
	0011	Program too large.	Remove blocks until the error stops.
	0012	Program is empty.	Correct the program and download it to the drive.
	001C	A non-existing parameter or block is used in the program.	Edit the program to correct the parameter reference, or to use an existing block.
	001D	Parameter type invalid for selected pin.	Edit the program to correct the parameter reference.
	001E	Output to parameter failed because the parameter was write-protected.	Check the parameter reference in the program. Check for other sources affecting the target parameter.
	0023 0024	Program file incompatible with current firmware version.	Adapt the program to current block library and firmware version.
	Other	-	Contact your local ABB representative, quoting the auxiliary code.

Code (hex)	Fault / Aux. code	Cause	What to do
64B1	Internal SSW fault	Internal fault.	Reboot the control unit (using parameter *96.08 Control board boot*) or by cycling power. If the problem persists, contact your local ABB representative.
64B2	User set fault	Loading of user parameter set failed because • requested set does not exist • set is not compatible with control program • drive was switched off during loading.	Ensure that a valid user parameter set exists. Reload if uncertain.
64B3	Macro parameterization error	Macro file has parameter defined in such way that it cannot be written. Check auxcode for exact parameter group and index, and check if parameter exists in the drive, and if value from macro file matches parameter's minimum and maximum limits.	If aux code is zero, generic file error happened and you should consult ABB representative. Otherwise auxcode in hexadecimal format contains: 8bit Group, 8bit Index, 16bit error code:
	5	Parameter is not accessible from macro file.	
	9	Value written is below parameter's minimum limit.	
	A	Value written is below parameter's minimum limit.	
	B	Value written is below parameter's minimum limit.	
	C	Value written is not listed in parameter's selection list.	
	D	Parameter does not exist.	
	1F	Parameter in macro file does not match parameter in drive. Unit or display format are different with each other.	
	22	Pointer parameter is written to target a parameter or bit that does not exist or that is not available to be targeted from macro.	
64E1	Kernel overload	Operating system error.	Reboot the control unit (using parameter *96.08 Control board boot*) or by cycling power. If the problem persists, contact your local ABB representative.
64FF	Fault reset	A fault has been reset from the control panel, Drive composer PC tool, fieldbus or I/O.	Event. Informative only.
6581	Parameter system	Parameter load or save failed.	Try forcing a save using parameter *96.07 Parameter save manually*. Retry.
6591	Backup/Restore timeout	During backup creating or restoring operation a control panel or PC tool has failed to communicate with the drive as part this operation.	Check control panel or PC tool communication and if it is still in backup or restore state.
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*.

Code (hex)	Fault / Aux. code	Cause	What to do
6681	EFB comm loss Programmable fault: *58.14 Communication loss action*	Communication break in embedded fieldbus (EFB) communication.	Check the status of the fieldbus master (online/offline/error etc.). Check cable connections to the 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*.
6684	EFB load fault	Embedded fieldbus (EFB) protocol firmware could not be loaded. Version mismatch between EFB protocol firmware and drive firmware.	Contact your local ABB representative.
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 installation of IO module.
7085	Incompatible option module	Fieldbus option module not supported.	Replace the module with a supported type.
7086	AI Overvoltage	An overvoltage has been detected on an analog input. The analog input has temporarily been changed to voltage mode and will be changed back to current mode when the AI signal level is back within acceptable limits.	Check AI signal levels.
7100	Excitation current	Excitation current feedback low or missing	
7121	Motor stall Programmable fault: *31.24 Stall function*	Motor is operating in stall region because of, for example, excessive load or insufficient motor power.	Check motor load and drive ratings. Check fault function parameters.

Code (hex)	Fault / Aux. code	Cause	What to do
7122	Motor overload	Motor current is too high.	Check for overloaded motor. Adjust the parameters used for the motor overload function (*35.51*…*35.53*) and *35.55*…*35.56*.
7181	Brake resistor	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.
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).
71A2	Mech brake closing failed	Mechanical brake control fault. Activated eg. if brake acknowledgement is not as expected during brake closing:	' Check mechanical brake connection. Check mechanical brake settings in parameter group 44. Check that acknowledgment signal matches actual status of brake.
71A3	Mech brake opening failed	Mechanical brake control fault. Activated eg. if brake acknowledgement is not as expected during brake opening:	Check mechanical brake connection. Check mechanical brake settings in parameter group 44. Check that acknowledgment signal matches actual status of brake.
71A5	Mech brk opening not allowed	Open conditions of mechanical brake cannot be fulfilled (for example, brake has been prevented from opening by parameter 44.11):	Check mechanical brake settings in parameter group 44 (especially 44.11). Check that acknowledgment signal (if used) matches actual status of brake.
7301	Motor speed feedback	No motor speed feedback received.	Check the setting of parameter 90.41, and the actual source selected.
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 feedback fault	No motor speed feedback received.	Check the setting of parameter 90.41, and the actual source selected. Check if the encoder cables are connected.
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).

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Code (hex)	Fault / Aux. code	Cause	What to do
73F0	Overfrequency	Maximum allowed output frequency exceeded.	Check the auxiliary code.
	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 *31.13 Minimum frequency* and *31.14 Maximum frequency*. Check used supply voltage and voltage selection parameter *95.01 Supply voltage*.
	Other	-	Contact your local ABB representative, quoting the auxiliary code.
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.
7A9A	FSx undefined fault	FSx undefined fault is not yet defined inside the drive.	Gather the AUX codes from this fault and contact your local ABB representative.
7A9B	FSx internal fault	FSx internal fault	Gather the AUX codes from this fault and contact your local ABB representative.
7A9C	FSx STO diagnostics fault	FSx STO diagnostics fault	Gather the AUX codes from this fault and contact your local ABB representative.
7A9D	FSx temperature fault	FSx temperature fault	Gather the AUX codes from this fault and contact your local ABB representative.
7A9E	FSx configuration fault	FSx configuration fault	Gather the AUX codes from this fault and contact your local ABB representative.
7A9F	FSx communication fault	FSx communication fault	Gather the AUX codes from this fault and contact your local ABB representative.
7AA0	FSx safety ramp fault	FSx safety ramp fault	Gather the AUX codes from this fault and contact your local ABB representative.
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 auxiliary code. Check the wiring connected to the input. Check the minimum and maximum limits of the input in parameter group *12 Standard AI*.
	0001	AI1LessMIN	
	0002	AI1GreaterMAX	
	0003	AI2LessMIN.	

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Code (hex)	Fault / Aux. code	Cause	What to do
	0004	AI2GreaterMAX	
80B0	Signal supervision 1 (Editable message text) Programmable fault: *32.06 Supervision 1 action*	Fault geneNominal by the signal supervision function 1.	Check the source of the fault (parameter *32.07 Supervision 1 signal*).
80B1	Signal supervision 2 (Editable message text) Programmable fault: *32.16 Supervision 2 action*	Fault geneNominal by the signal supervision function 2.	Check the source of the fault (parameter *32.17 Supervision 2 signal*).
80B2	Signal supervision 3 (Editable message text) Programmable fault: *32.26 Supervision 3 action*	Fault geneNominal by the signal supervision function 3.	Check the source of the fault (parameter *32.27 Supervision 3 signal*).
80B3	Signal supervision 4 (Editable message text) Programmable fault: *32.36 Supervision 4 action*	Fault geneNominal by the signal supervision function 4.	Check the source of the fault (parameter *32.37 Supervision 4 signal*).
80B4	Signal supervision 5 (Editable message text) Programmable fault: *32.46 Supervision 5 action*	Fault geneNominal by the signal supervision function 5.	Check the source of the fault (parameter *32.47 Supervision 5 signal*).
80B5	Signal supervision 6 (Editable message text) Programmable fault:, *32.56 Supervision 6 action*	Fault geneNominal by the signal supervision function 6.	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 4.	Check the external device. Check setting of parameter *31.07 External event 4 source*.
9085	External fault 5 (Editable message text) Programmable fault: *31.09 External event 5 source*, *31.10 External event 5 type*	Fault in external device 5.	Check the external device. Check setting of parameter *31.09 External event 5 source*.

Code (hex)	Fault / Aux. code	Cause	What to do
D401	Max cleaning fault	The maximum number of cleanings are reached in the defined time. The pump cleaning is unable to clean the pump and hence, manual cleaning is required.	Check the pump for blockages. Clean the pump manually if needed. Check parameters to.
D402	High level	Water level is reached the high level limit. Level control is unable to control the level for the following reasons: • running out of pumping capacity or • analog feedback sensor failure.	Check the analog level sensor. Check that all pumps are operating normally. Check parameters and.
D403	Low level	Water level is reached the low level limit. Level control is unable to control the level for the following reasons: • running out of pumping capacity or • analog feedback sensor failure.	Check the analog level sensor. Check that all pumps are operating normally. Check parameters and.
FA81	Safe torque off 1	Safe torque off function is active, that is, 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 *253*). Check the value of parameter *95.04 Control board supply*.
FA82	Safe torque off 2	Safe torque off function is active, that is, STO circuit 2 is broken.	
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.

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Code (hex)	Fault / Aux. code	Cause	What to do
	0002	Maximum speed limit or calculated field weakening point too low.	Check settings of parameters • *30.11 Minimum speed* • *30.12 Maximum speed* • *99.07 Motor nominal voltage* • *99.08 Motor nominal frequency* • *99.09 Motor nominal speed*. Make sure that • *30.12* > (0.55 × *99.09*) > (0.50 × synchronous speed) • *30.11* ≤ 0, and • supply voltage ≥ (0.66 × *99.07*.
	0003	Maximum torque limit too low.	Check settings of parameter *99.12 Motor nominal torque*, and the torque limits in group *30 Limits*. Make sure that the maximum torque limit in force is greater than 100%.
	0004	Current measurement calibration did not finish within reasonable time	Contact your local ABB representative.
	0005…0008	Internal error.	Contact your local ABB representative.
	0009	(Asynchronous motors only) Acceleration did not finish within reasonable time.	Contact your local ABB representative.
	000A	(Asynchronous motors only) Deceleration did not finish within reasonable time.	Contact your local ABB representative.
	000B	(Asynchronous motors only) Speed dropped to zero during ID run.	Contact your local ABB representative.
	000C	(Permanent magnet motors only) First acceleration did not finish within reasonable time.	Contact your local ABB representative.
	000D	(Permanent magnet motors only) Second acceleration did not finish within reasonable time.	Contact your local ABB representative.
	000E…0010	Internal error.	Contact your local ABB representative.
	0011	(Synchronous reluctance motors only) Pulse test error.	Contact your local ABB representative.
	0012	Motor too large for advanced standstill ID run.	Check that the motor and drive sizes are compatible. Contact your local ABB representative.
	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.
FF63	STO diagnostics failure.	SW internal malfunction.	Reboot the control unit (using parameter *96.08 Control board boot*) or by cycling power.

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Code (hex)	Fault / Aux. code	Cause	What to do
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.

7

Modbus RTU control through the embedded fieldbus interface (EFB)

What this chapter contains

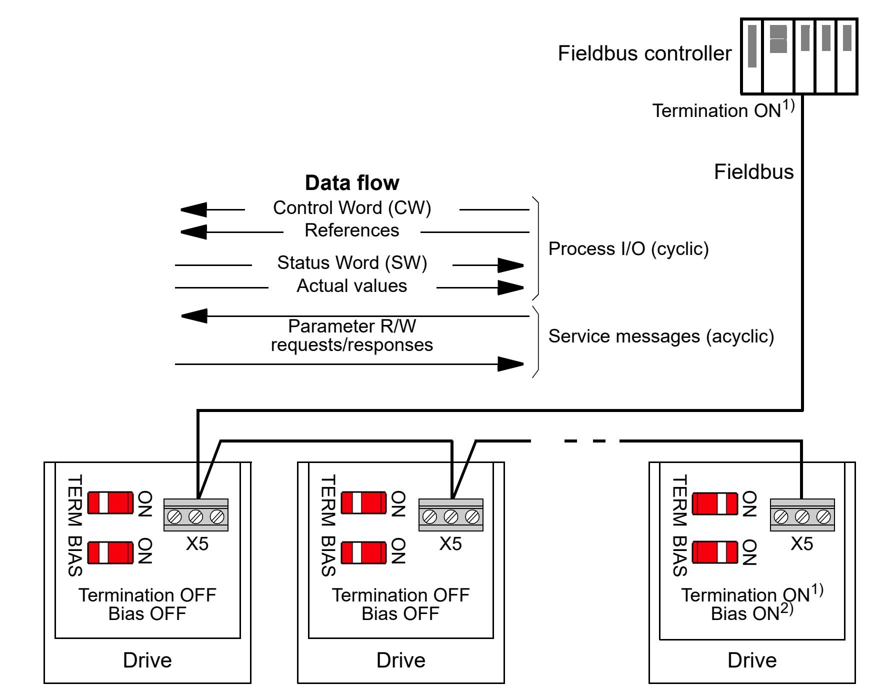
The chapter describes how the drive can be controlled by external devices over a communication network (fieldbus) using the embedded fieldbus interface.

System overview

The drive can be connected to an external control system through a communication link using either a fieldbus adapter or the embedded fieldbus interface.

The embedded fieldbus interface supports the Modbus RTU protocol. The drive control program can handle 10 Modbus registers in a 10-millisecond time level. For example, if the drive receives a request to read 20 registers, it will start its response within 22 ms of receiving the request – 20 ms for processing the request and 2 ms overhead for handling the bus. The actual response time depends on other factors as well, such as the baud rate (a parameter setting in the drive).

The drive can be set to receive all of its control information through the fieldbus interface, or the control can be distributed between the embedded fieldbus interface and other available sources, for example, digital and analog inputs.



1) The device at both ends on the fieldbus must have termination on.
2) One device, preferably at either end on the fieldbus must have bias on.

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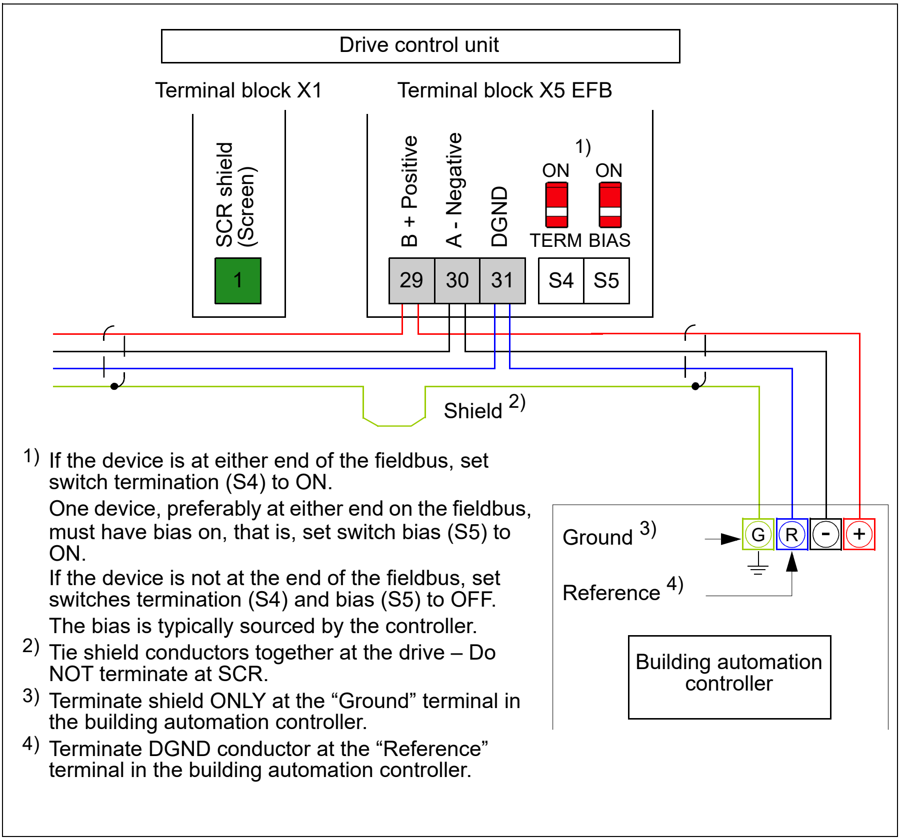
Connecting the drive to the fieldbus

Connect terminal block X5 with B+, A- and DGND terminals on the control unit of the drive to the fieldbus. The connection diagram is shown below.

See also chapter *BACnet MS/TP control through the embedded fieldbus interface (EFB)*, section *Hardware installation* (page *472*).

Use preferably three conductors and a shield for the connection.



Setting up the embedded fieldbus interface

Set the drive up for the embedded fieldbus communication with the parameters shown in the table below. The **Setting for fieldbus control** column gives either the value to use or the default value. The **Function/Information column** gives a description of the parameter.

Parameter		**Setting for fieldbus control**	**Function/Information**
COMMUNICATION INITIALIZATION			
58.01	*Protocol enable*	*Modbus RTU*	Initializes embedded fieldbus communication.
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*	*No action* (default)	Defines the action taken when a communication loss is detected.
58.15	*Communication loss mode*	*Cw / Ref1 / Ref2* (default)	Enables/disables communication loss monitoring and defines the means for resetting the counter of the communication loss delay.
58.16	*Communication loss time*	30.0 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 *169*).
58.26 *58.27*	*EFB ref1 type* *EFB ref2 type*	*Speed or frequency* (default for *58.26*), *Transparent*, *General*, *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 *58.29*	*EFB act1 type* *EFB act2 type*	*Speed or frequency* (default for *58.28*), *Transparent* (default for *58.29*), *General*, *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.

Parameter		Setting for fieldbus control	Function/Information
58.31 *58.32*	*EFB act1 transparent source* *EFB act2 transparent source*	*Not selected*	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 … *58.114*	*Data I/O 1* … *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) *RO/DIO control word*, *AO1 data storage*, *AO2 data storage*, *Feedback data storage*, *Setpoint data storage*	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. These settings write the incoming data into storage parameters *10.99 RO/DIO control word*, *13.91 AO1 data storage*, *13.92 AO2 data storage*, *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.

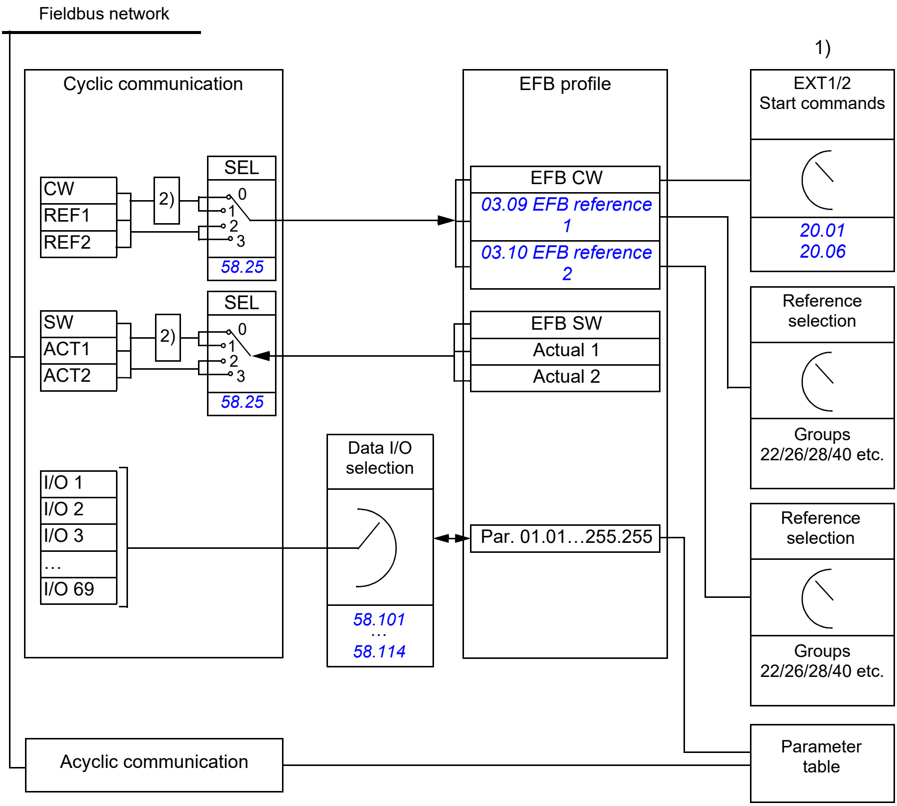
Parameter	Setting for fieldbus control	Function/Information
CONTROL COMMAND SOURCE SELECTION		
20.01 Ext1 commands	*Embedded fieldbus*	Selects fieldbus as the source for the start and stop commands when EXT1 is selected as the active control location.

Parameter	Setting for fieldbus control	Function/Information
20.06 Ext2 commands	*Embedded fieldbus*	Selects fieldbus as the source for the start and stop commands when EXT2 is selected as the active control location.
SPEED REFERENCE SELECTION		
22.11 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.
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* (page *172*).

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 EXT1 and EXT2, 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* (page *172*).

The fieldbus Status Word (SW) is a 16-bit or 32-bit packed boolean word. It contains status information from the drive to the fieldbus controller. The drive SW is either written to the fieldbus SW as it is or the data is converted. See section *About the control profiles* (page *172*).

References

EFB references 1 and 2 are 16-bit or 32-bit signed integers. The contents of each reference word can be used as the source of virtually any signal, such as the speed, frequency, torque or process reference. In embedded fieldbus communication, references 1 and 2 are displayed by *03.09 EFB reference 1* and *03.10 EFB reference 2* respectively. Whether the references are scaled or not depends on the settings of *58.26 EFB ref1 type* and *58.27 EFB ref2 type*. See section *About the control profiles* (page *172*).

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Actual values

Fieldbus actual signals (ACT1 and ACT2) are 16-bit or 32-bit signed integers. They convey selected drive parameter values from the drive to the master. Whether the actual values are scaled or not depends on the settings of *58.28 EFB act1 type* and *58.29 EFB act2 type*. See section *About the control profiles* (page *172*).

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.

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

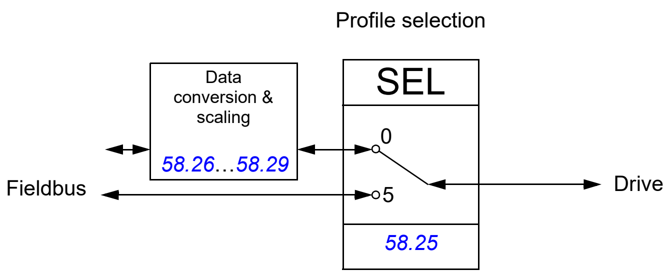
A control profile defines the rules for data transfer between the drive and the fieldbus master, for example:

- 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 *180*.

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 permissive signal must be active; see the drive documentation. If the drive is set to receive the Run permissive signal from the fieldbus, this bit activates the signal.
		0	Inhibit operation. Proceed to **OPERATION INHIBITED**.
4	RAMP_OUT_ ZERO	1	Normal operation. Proceed to **RAMP FUNCTION GENERATOR: OUTPUT ENABLED**.
		0	Force Ramp Function Generator output to zero. Drive ramps to stop (current and DC voltage limits in force).
5	RAMP_HOLD	1	Enable ramp function. Proceed to **RAMP FUNCTION GENERATOR: ACCELERATOR ENABLED**.
		0	Halt ramping (Ramp Function Generator output held).
6	RAMP_IN_ ZERO	1	Normal operation. Proceed to **OPERATING**. **Note:** This bit is effective only if the fieldbus interface is set as the source for this signal by drive parameters.
		0	Force Ramp Function Generator input to zero.
7	RESET	0=>1	Fault reset if an active fault exists. Proceed to **SWITCH-ON INHIBITED**. **Note:** This bit is effective only if the fieldbus interface is set as the source for this signal by drive parameters.
		0	Continue normal operation.

Bit	Name	Value	STATE/Description
8	Reserved		
9	Reserved		
10	REMOTE_CMD	1	Fieldbus control d.
		0	Control Word <> 0 or Reference <> 0: Retain last Control Word and Reference. Control Word = 0 and Reference = 0: Fieldbus control d. 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	Direction of motor rotation depends on the sign of reference: Positive reference: Forward Negative reference: Reverse.
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	RAMP_PAIR _2	1	Select ramp set 2 (Acceleration time 2 / Deceleration time 2) when parameter *23.11 Ramp set selection* is set to *EFB DCU CW bit 10*.
		0	Select ramp set 1 (Acceleration time 1 / Deceleration time 1) when parameter *23.11 Ramp set selection* is set to *EFB DCU CW bit 10*.
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	Drive does not switch to local control mode (see parameter *19.18 HAND/OFF disable source*.
		0	Drive can switch between local and external control modes.
15	TORQ_LIM_PAIR_2	1	Select torque limit set 2 (Minimum torque 2 / Maximum torque 2) when parameter *30.18 Torq lim sel* is set to *EFB*.
		0	Select torque limit set 1 (Minimum torque 1 / Maximum torque 1) when parameter *30.18 Torq lim sel* is set to *EFB*.
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)
18	Reserved for RUN_DISABLE_1		Not yet implemented.

Bit	Name	Value	State/Description
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 *180*.

Bit	Name	Value	STATE/Description
0	RDY_ON	1	**READY TO SWITCH ON**.
		0	**NOT READY TO SWITCH ON**.
1	RDY_RUN	1	**READY TO OPERATE**.
		0	**OFF1 ACTIVE**.
2	RDY_REF	1	**OPERATION ENABLED**.
		0	**OPERATION INHIBITED**.
3	TRIPPED	1	**FAULT**.
		0	No fault.
4	OFF_2_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, for example, 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 Above speed limit* and *46.32 Above frequency limit*. These parameters are indicated by bit 10 of *06.11 Main status word*.
		0	Actual frequency or speed within supervision limit.

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Bit	Name	Value	STATE/Description
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.

Bit	Name	Value	State/Description
0	READY	1	Drive is ready to receive the start command.
		0	Drive is not ready.
1	ENABLED	1	Run permissive and all start interlocks are active.
		0	Run permissive and all start interlocks are not active.
2	STARTED	1	Drive has received start command.
		0	Drive has not received start command.
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	Drive speed is increasing.
		0	Drive speed is not increasing.
6	DECELERATING	1	Drive speed is decreasing.
		0	Drive speed is not decreasing.
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 Above speed limit* and *46.32 Above frequency limit*.
		0	Actual value (speed, frequency or torque) is within limits.
10	REVERSE_REF	1	Drive reference is in the reverse direction.
		0	Drive reference is in the forward direction
11	REVERSE_ACT	1	Drive is running in the reverse direction
		0	Drive is running in the forward direction

Bit	Name	Value	State/Description
12	PANEL_LOCAL	1	Control panel/keypad (or PC tool) is in local control mode.
		0	Control 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	DIRLOCK	1	Direction lock is ON. (Direction change is locked out.)
		0	Direction lock is OFF.
19	LOCALLOCK	1	Local mode lock is ON. (Local mode is locked out.)
		0	Local mode lock is OFF.
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 has been granted to this channel.
		0	Control has not been granted to this channel.
27	REQ_REF1	1	Reference 1 has been requested in this channel.
		0	Reference 1 has not been requested in this channel.
28	REQ_REF2	1	Reference 2 has been requested in this channel.
		0	Reference 2 has not been requested in this channel.
29…31	Reserved		

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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 *173* and *Status Word for the ABB Drives profile* on page *177*.

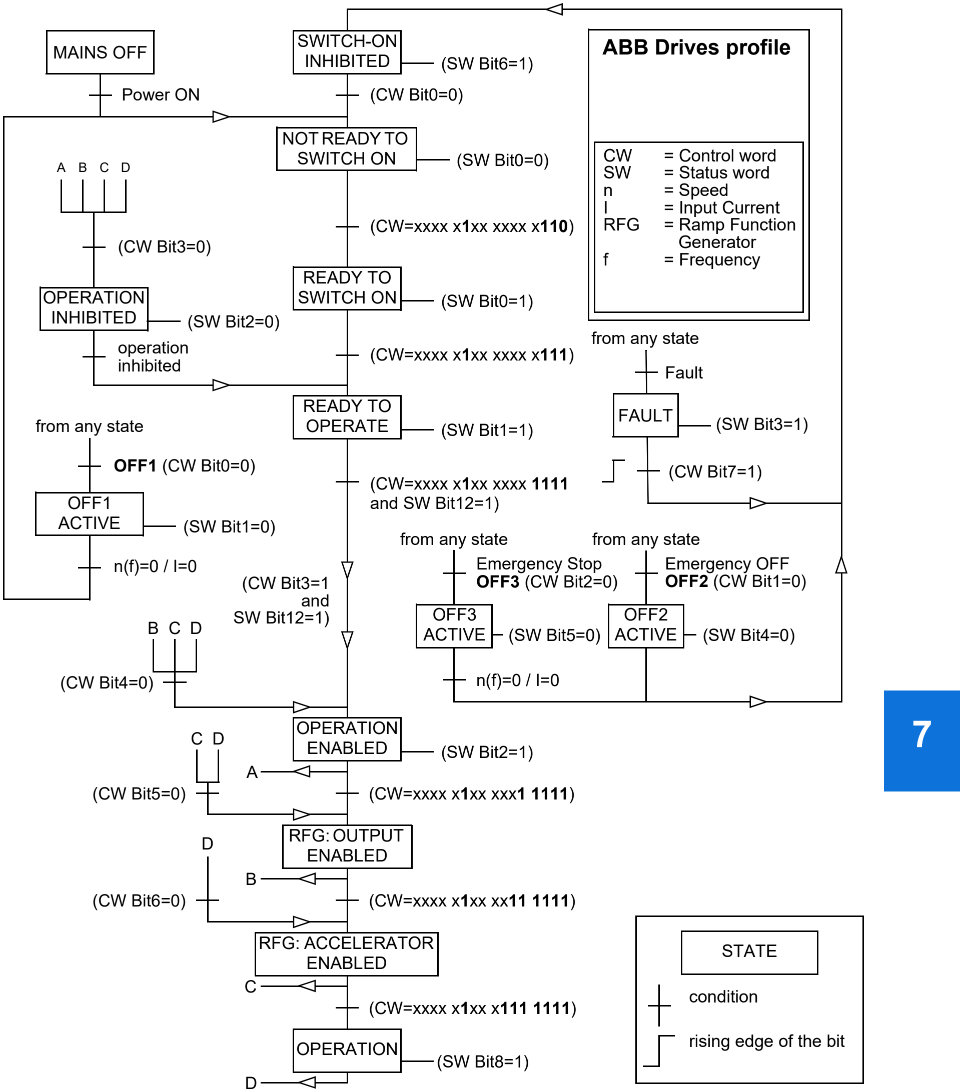


ABB Drives profile
CW = Control word
SW = Status word
n = Speed
I = Input Current
RFG = Ramp Function Generator
f = Frequency
MAINS OFF
Power ON
SWITCH-ON INHIBITED
(SW Bit6=1)
(CW Bit0=0)
NOT READY TO SWITCH ON
(SW Bit0=0)
(CW=xxxx x1xx xxxx x110)
READY TO SWITCH ON
(SW Bit0=1)
(CW=xxxx x1xx xxxx x111)
READY TO OPERATE
(SW Bit1=1)
(CW=xxxx x1xx xxxx 1111 and SW Bit12=1)
A B C D
(CW Bit3=0)
OPERATION INHIBITED
(SW Bit2=0)
operation inhibited
from any state
OFF1 (CW Bit0=0)
OFF1 ACTIVE
(SW Bit1=0)
n(f)=0 / I=0
(CW Bit3=1 and SW Bit12=1)
B C D
(CW Bit4=0)
OPERATION ENABLED
(SW Bit2=1)
C D
A
(CW Bit5=0)
(CW=xxxx x1xx xxx1 1111)
RFG: OUTPUT ENABLED
D
B
(CW Bit6=0)
(CW=xxxx x1xx xx11 1111)
RFG: ACCELERATOR ENABLED
C
(CW=xxxx x1xx x111 1111)
OPERATION
(SW Bit8=1)
D
from any state
Fault
FAULT
(SW Bit3=1)
(CW Bit7=1)
from any state
Emergency Stop
OFF3 (CW Bit2=0)
OFF3 ACTIVE
(SW Bit5=0)
n(f)=0 / I=0
from any state
Emergency OFF
OFF2 (CW Bit1=0)
OFF2 ACTIVE
(SW Bit4=0)
STATE
condition
rising edge of the bit
7

The start and stop sequences are given below.

Control word:

Start:

- 1142 (476h) –> NOT READY TO SWITCH ON
- If MSW bit 0 = 1 then
  - 1150 (47Eh) –> READY TO SWITCH ON (Stopped)
  - 1151 (47Fh) –> OPERATION (Running)

Stop:

- 1143 (477h) = Stop according to *21.03 Stop mode* (Preferred)
- 1150 (47Eh) = OFF1 ramp stop (Note: uninterruptable ramp stop)
- 1149 (47Dh) = OFF2 emergency coast to stop
- 1147 (47Bh) = OFF3 emergency ramp stop

Fault reset:

- Rising edge of MCW bit 7

Start after STO:

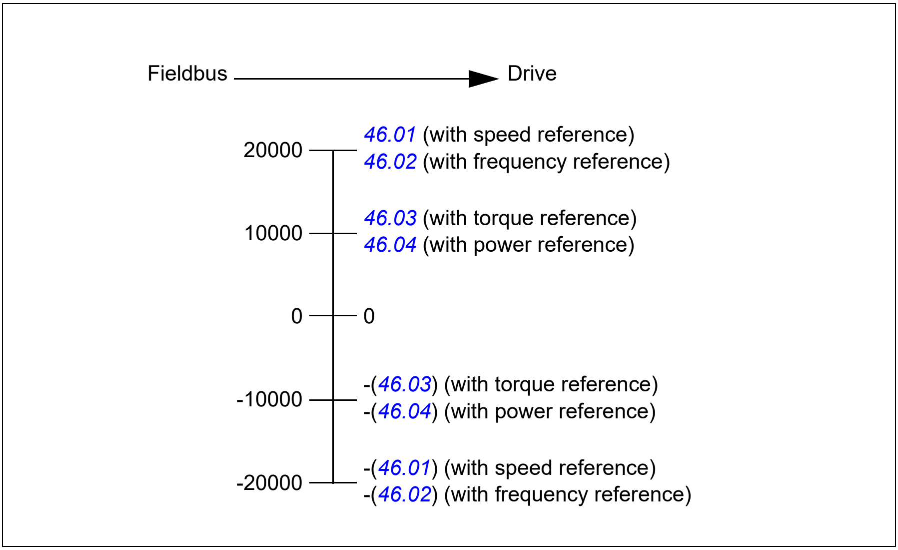
- If *31.22 STO indication run/stop* is not Fault/ Fault, check that *06.18 Start inhibit status word*, bit 7 STO = 0 before giving a start command.

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*.



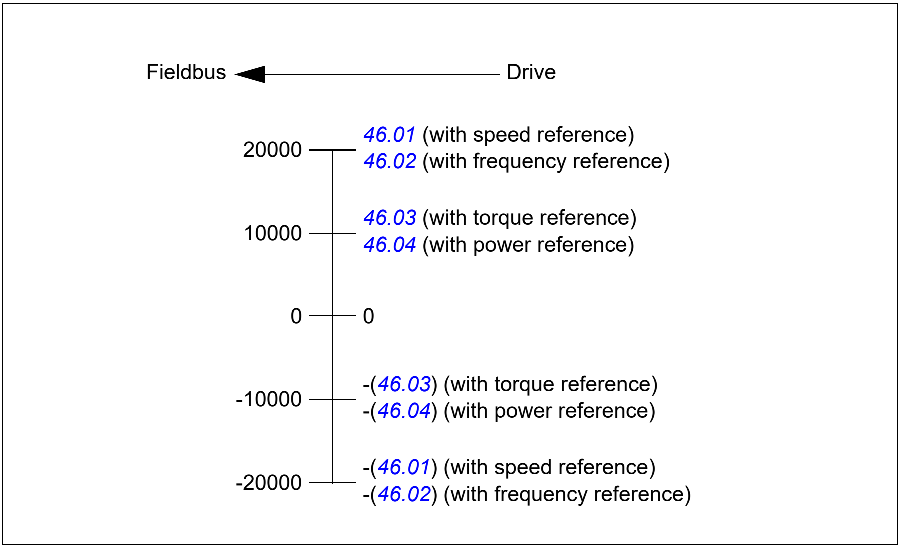
The scaled references are shown by parameters *03.09 EFB reference 1* and *03.10 EFB reference 2*.

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*.



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 *173*) and *Control Word for the DCU Profile* (page *174*). 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 *58.103 Data I/O 3*.
400004	Default: Status Word (*SW 16bit*). See sections *Status Word for the ABB Drives profile* (page *177*) and *Status Word for the DCU Profile* (page *178*). The selection can be changed using parameter *58.104 Data I/O 4*.
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 *192*).
400101...465536	Parameter read/write. Parameters are mapped to register addresses according to parameter *58.33 Addressing mode*.

Modbus function codes

The table below shows the Modbus function codes supported by the embedded fieldbus interface.

Code	Function name	Description
01h	Read Coils	Reads the 0/1 status of coils (0X references).
02h	Read Discrete Inputs	Reads the 0/1 status of discrete inputs (1X references).
03h	Read Holding Registers	Reads the binary contents of holding registers (4X references).
05h	Write Single Coil	Forces a single coil (0X reference) to 0 or 1.
06h	Write Single Register	Writes a single holding register (4X reference).
08h	Diagnostics	Provides a series of tests for checking the communication, or for checking various internal error conditions. Supported subcodes: • 00h Return Query Data: Echo/loopback test. • 01h Restart Comm Option: Restarts and initializes the EFB, clears communications event counters. • 04h Force Listen Only Mode • 0Ah Clear Counters and Diagnostic Register • 0Bh Return Bus Message Count • 0Ch Return Bus Comm. Error Count • 0Dh Return Bus Exception Error Count • 0Eh Return Slave Message Count • 0Fh Return Slave No Response Count • 10h Return Slave NAK (negative acknowledge) Count • 11h Return Slave Busy Count • 12h Return Bus Character Overrun Count • 14h Clear Overrun Counter and Flag
0Bh	Get Comm Event Counter	Returns a status word and an event count.
0Fh	Write Multiple Coils	Forces a sequence of coils (0X references) to 0 or 1.
10h	Write Multiple Registers	Writes the contents of a contiguous block of holding registers (4X references).
16h	Mask Write Register	Modifies the contents of a 4X register using a combination of an AND mask, an OR mask, and the register's current contents.

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Code	Function name	Description
17h	Read/Write Multiple Registers	Writes the contents of a contiguous block of 4X registers, then reads the contents of another group of registers (the same or different than those written) in a server device.
2Bh / 0Eh	Encapsulated Interface Transport	Supported subcodes: • 0Eh Read Device Identification: Allows reading the identification and other information. Supported ID codes (access type): • 00h: Request to get the basic device identification (stream access) • 04h: Request to get one specific identification object (individual access) Supported Object IDs: • 00h: Vendor Name (“ABB”) • 01h: Product Code (for example, “AHVKx”) • 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: (“ACH531”).

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 *192*.

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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
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	Not for ACH531	STOPMODE_EMERGENCY_RAMP
000010	Not for ACH531	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	Reserved
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

Reference	ABB Drives profile	DCU Profile
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 RO2 (parameter *10.99 RO/DIO control word*, bit 1)	Control for relay output RO2 (parameter *10.99 RO/DIO control word*, bit 1)
000035	Control for relay output RO3 (parameter *10.99 RO/DIO control word*, bit 2)	Control for relay output RO3 (parameter *10.99 RO/DIO control word*, bit 2)
000036	Control for relay output RO4 (parameter *10.99 RO/DIO control word*, bit 3)	Control for relay output RO4 (parameter *10.99 RO/DIO control word*, bit 3)
000037	Control for relay output RO5 (parameter *10.99 RO/DIO control word*, bit 4)	Control for relay output RO5 (parameter *10.99 RO/DIO control word*, bit 4)
000038	Control for relay output RO6 (parameter *10.99 RO/DIO control word*, bit 5)	Control for relay output RO6 (parameter *10.99 RO/DIO control word*, bit 5)
000039	Control for relay output RO7 (parameter *10.99 RO/DIO control word*, bit 6)	Control for relay output RO7 (parameter *10.99 RO/DIO control word*, bit 6)
000040	Control for relay output DO1 (parameter *10.99 RO/DIO control word*, bit 8)	Control for relay output DO1 (parameter *10.99 RO/DIO control word*, bit 8)

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
100001	RDY_ON	READY
100002	RDY_RUN	D
100003	RDY_REF	Reserved
100004	TRIPPED	RUNNING
100005	OFF_2_STATUS	ZERO_SPEED
100006	OFF_3_STATUS	Reserved
100007	SWC_ON_INHIB	Reserved
100008	ALARM	AT_SETPOINT
100009	AT_SETPOINT	LIMIT
100010	REMOTE	SUPERVISION
100011	ABOVE_LIMIT	Reserved
100012	USER_0	Reserved
100013	USER_1	PANEL_LOCAL
100014	USER_2	FIELDBUS_LOCAL
100015	USER_3	EXT2_ACT
100016	Reserved	FAULT
100017	Reserved	ALARM
100018	Reserved	Reserved
100019	Reserved	Reserved
100020	Reserved	Reserved
100021	Reserved	CTL_MODE
100022	Reserved	Reserved
100023	Reserved	USER_0
100024	Reserved	USER_1
100025	Reserved	USER_2
100026	Reserved	USER_3
100027	Reserved	REQ_CTL
100028	Reserved	Reserved
100029	Reserved	Reserved
100030	Reserved	Reserved
100031	Reserved	Reserved
100032	Reserved	Reserved

Reference	ABB Drives profile	DCU Profile
100033	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)
100034	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)
100035	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)
100036	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)
100037	Delayed status of digital input DI5 (parameter *10.02 DI delayed status*, bit 4)	Delayed status of digital input DI5 (parameter *10.02 DI delayed status*, bit 4)
100038	Delayed status of digital input DI6 (parameter *10.02 DI delayed status*, bit 5)	Delayed status of digital input DI6 (parameter *10.02 DI 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
400090	Reset Error Registers	1 = Reset internal error registers (91…95). 0 = Do nothing.
400091	Error Function Code	Function code of the failed query.
400092	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
400093	Failed Register	The last register (discrete input, coil, input register or holding register) that failed to be read or written.
400094	Last Register Written Successfully	The last register (discrete input, coil, input register or holding register) that was written successfully.
400095	Last Register Read Successfully	The last register (discrete input, coil, input register or holding register) that was read successfully.

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BACnet MS/TP control through the embedded fieldbus interface (EFB)

Contents of this chapter

The chapter describes BACnet MS/TP control through the embedded fieldbus interface (EFB): supported functionality, services and objects as well as how to configure the BACnet with parameters.

BACnet overview

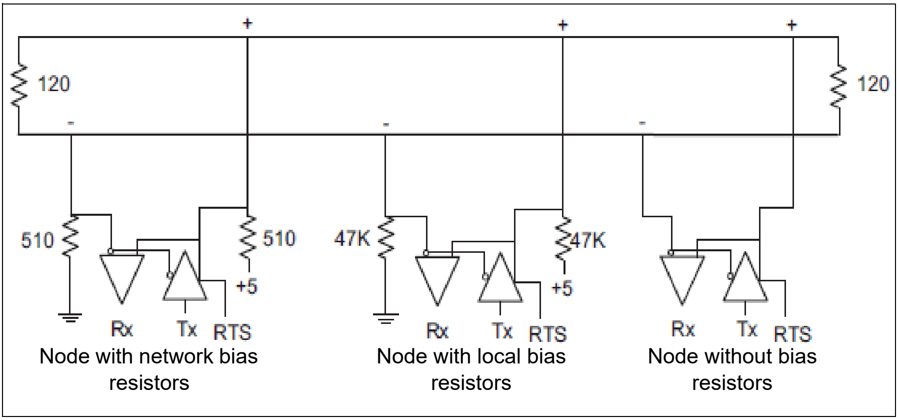
BACnet is an open standard for data communication that enables interoperability between different building systems (eg fire, security, lighting, HVAC, elevator, etc.) and devices in building automation and control applications. It enables data sharing among different types of devices from a broad set of suppliers.

You will find BACnet Protocol Implementation Conformance Statement (PICS) (3AXD10000387059 [English]) for the ACH531 in the ABB Document library on the Internet.You can also download the most recent version from *https://www.bacnetinternational.net/btl/*.

Hardware installation

Connecting devices to a BACnet MS/TP EIA-485 network

The figure shows three types of nodes connected on the EIA-485 network. See also the diagram on page 163.



Connecting the drive to the building automation controller

For connecting the EFB terminal block X5 of the drive to the building automation controller via the EIA-485 network, see section *Connecting the drive to the fieldbus* on page *164*.

Starting up fieldbus communication with parameters

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Follow these steps to setup fieldbus communication with parameters in the **Parameters** menu. For example of appropriate values, see section *Activating drive control functions* on page *473*.

1. Power up the drive.
2. Enable BACnet communication by setting parameter *58.01 Protocol enable* to *BACnet MSTP*.
3. Configure network settings with parameters *58.03 Node address* and *58.04 Baud rate*.
4. Define the device object instance value with parameter *58.40 Device object ID*.

Note: The object instance value should be unique and in the range 1…4194303.

5. Define communication loss function to detect communication loss between EFB and the drive:
   - Set the communication loss mode and communication loss time with parameters *58.15 Communication loss mode* and *58.16 Communication loss time*.
   - Select how the drive reacts to an EFB communication break with parameter *58.14 Communication loss action*.
6. Save the valid parameter values to permanent memory by setting parameter *96.07 Parameter save manually* to *Save*.
7. Validate the settings made in parameter group *58 Embedded fieldbus* by setting parameter *58.06 Communication control* to *Refresh settings*.
8. You can use parameters *58.07*…*58.13* for diagnostics. You can reset counters *58.08*…*58.12* by setting the parameter value to 0.
9. Set the relevant drive control parameters to control the drive according to the application.

Note: You find all embedded fieldbus parameters in group *58 Embedded fieldbus* on page *448*.

Activating drive control functions

Drive control

To enable fieldbus control of various drive functions through BACnet MS/TP, do the following:

- Configure the drive to accept embedded fieldbus communication by enabling BACnet communication and defining the node address and device id for the drive.
- Select the individual control functions to use the embedded fieldbus as a source. This makes the input source come from the corresponding BACnet object.

Note: Change those parameter of the functions that you want to control through BACnet MS/TP. All other parameters can remain as factory default values.

Start/stop direction control

For Start/stop direction control through fieldbus, configure the following drive parameters and set the fieldbus controller supplied command(s) in the appropriate location:

Drive parameter	Value	Description	BACnet object
20.01 Ext1 commands	Embedded fieldbus	Start/stop by fieldbus with Ext1 selected	BV10
20.07 Ext2 commands	Embedded fieldbus	Start/stop by fieldbus with Ext2 selected	BV10

Drive parameter	Value	Description	BACnet object
20.21 Direction	Request	Direction by fieldbus, if required	BV11

Input reference select

The tables below show how to use the BACnet embedded fieldbus to select the drive input references for frequency and speed control modes

- For frequency control, set parameter *99.04 Motor control mode* = *Scalar* (default value for ACH531). See section *Frequency reference* on page *474* and parameter group *28 Frequency reference chain* on page *348*.
- For speed control, set parameter *99.04 Motor control mode* = *Vector*. See section *Speed reference* on page *474* and parameter group *22 Speed reference selection* on page *328*.

Vector control has better accuracy than scalar control, but vector control cannot be used in all situations. See parameter *99.04 Motor control mode*.

Frequency reference

For using the BACnet embedded fieldbus to provide input frequency references to the drive, configure the following drive parameters and set the fieldbus controller supplied reference word(s) in the appropriate location:

Drive parameter	Value	Description	BACnet object
19.11 Ext1/Ext2 selection	32 = *EFB MCW bit 11*	Reference set selection by fieldbus	BV13
28.11 Ext1 frequency ref1	8 = *EFB ref1* 1)	Frequency reference source 1	AV16 Input Reference1
28.15 Ext2 frequency ref1	9 =*EFB ref2* 1)	Frequency reference source 2	AV17 Input Reference 2
46.02 Frequency scaling	50.00 Hz 1)	16-bit scaling of frequency-related parameters	No direct BACnet object

1) As an example

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Speed reference

For using the BACnet embedded fieldbus to provide input speed references to the drive, configure the following drive parameters and set the fieldbus controller supplied reference word(s) in the appropriate location:

Drive parameter	Value	Description	BACnet object
19.11 Ext1/Ext2 selection	32 =*EFB MCW bit 11*	Reference set selection by fieldbus	BV13
22.11 Ext1 speed ref1	8 = *EFB ref1* 1)	Speed reference source 1	AV16 Input Reference1
22.18 Ext2 speed ref1	9 = *EFB ref2* 1)	Speed reference source 2	AV17 Input Reference 2
46.01 Speed scaling	1500 rpm 1)	16-bit scaling of speed-related parameters	No direct BACnet object

1) As an example

Interlocks and permissives

To use the BACnet embedded fieldbus for different drive control functions, configure the following drive parameters and set the fieldbus controller supplied command(s) in the appropriate location:

Drive parameter	Value	Description	BACnet object
20.40 Run permissive	15 = *Embedded fieldbus*	Run permission by fieldbus	BV12
No direct drive parameter. Via BACnet object the fault reset always goes through.	-	Fault reset via fieldbus	BV14
20.41 Start interlock 1	15 = *Embedded fieldbus*	Source for start interlock 1 is fieldbus	BV20
20.42 Start interlock 2	15 = *Embedded fieldbus*	Source for start interlock 2 is fieldbus	BV21

Relay output control

For relay output control through BACnet embedded fieldbus,

- set the following drive parameters to select the source for the ROs
- program the drive for control through BACnet.

Drive parameter	Value	Description	BACnet object
10.24 RO1 source	40 = *RO/DIO control word bit0*	Relay output 1 controlled by fieldbus	BO0
10.27 RO2 source	41 = *RO/DIO control word bit1*	Relay output 2 controlled by fieldbus	BO1
10.30 RO3 source	42 = *RO/DIO control word bit2*	Relay output 3 controlled by fieldbus	BO2
15.07 RO4 source	Other (*10.99 RO/DIO control word*, bit 3)	Relay output 4 controlled by fieldbus	BO3
15.10 RO5 source	Other (*10.99 RO/DIO control word*, bit 4)	Relay output 5 controlled by fieldbus	BO4
15.23 DO1 source	Other (*10.99 RO/DIO control word*, bit 8)	Digital output 1 controlled by fieldbus	BO5

Data point connections

The BACnet objects control parameter *10.99 RO/DIO control word* bit values. These bits need to be connected to the corresponding RO and DO sources as above.

Drive parameter	Description	BACnet object
10.99 RO/DIO control word	Storage parameter for relay outputs and digital output	BO0…BO5

Analog output control

For analog output control through BACnet embedded fieldbus, configure the following drive parameters and set the fieldbus controller supplied analog value(s) in the appropriate location:

Drive parameter	Value	Description	BACnet object
13.12 AO1 source	37 = *AO1 data storage*	Analog output 1 controlled by fieldbus	AO0
13.22 AO2 source	38 = *AO2 data storage*	Analog output 2 controlled by fieldbus	AO1
13.17 AO1 source min	0.0 [1)]	Minimum value of signal selected by parameter *13.12 AO1 source*	No direct BACnet object
13.18 AO1 source max	100.0 [1)]	Maximum value of signal selected by parameter *13.12 AO1 source*	No direct BACnet object
13.27 AO2 source min	0.0 [1)]	Minimum value of signal selected by parameter *13.22 AO2 source*	No direct BACnet object
13.28 AO2 source max	100.0 [1)]	Maximum value of signal selected by parameter *13.22 AO2 source*	No direct BACnet object

[1)] As an example

Data point connections

The BACnet objects control parameters *13.91 AO1 data storage* and *13.92 AO2 data storage* values. These values need to be connected to the corresponding AO sources as above.

Drive parameter	Description	BACnet object
13.91 AO1 data storage	Storage parameter for AO1	AO0
13.92 AO2 data storage	Storage parameter for AO2	AO1

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PID control

For PID control through BACnet embedded fieldbus, configure the following drive parameters and set the fieldbus controller supplied PID value(s) in the appropriate location:

Drive parameter	Value	Description	BACnet object
40.08 Set 1 feedback 1 source	10 = *Feedback data storage*	Feedback 1 source data storage	AV43
40.09 Set 1 feedback 2 source	10 = *Feedback data storage*	Feedback 2 source data storage	AV43
40.16 Set 1 setpoint 1 source	24 = *Setpoint data storage*	Setpoint 1 source data storage	AV42
40.17 Set 1 setpoint 2 source	24 = *Setpoint data storage*	Setpoint 2 source data storage	AV42

Data point connections

The BACnet objects control parameters *40.91 Feedback data storage* and *40.92 Setpoint data storage*. These values need to be connected to the corresponding PID setpoint and feedback values as above.

Drive parameter	Description	BACnet object
40.91 Feedback data storage	Storage parameter for process feedback value	AV43
40.92 Setpoint data storage	Storage parameter for process setpoint value	AV42

Communication fault

BACnet has no built-in feature to detect communication timeout, because it is not a synchronous protocol. If communication timeouts are needed, you can use the following parameters to detect timeouts based on different packets and specifying the drive action.

Drive parameter	Value	Description
58.15 Communication loss mode	1 = *Any message* 2 = *Cw / Ref1 / Ref2*	Defines which message types reset the timeout counter for detecting an EFB communication loss.
58.14 Communication loss action	0 = *No action* 1 = *Fault* 2 = *Last speed* 3 = *Speed ref safe* 4 = *Fault always* 5 = *Warning*	Selects how the drive reacts to an EFB communication break. Changes to this parameter take effect after the control unit is rebooted or the new settings are validated by parameter *58.06 Communication control* (1 = *Refresh settings*).
58.16 Communication loss time	0.0…6000.0 s	Sets a timeout for EFB communication. If a communication break lasts longer than the timeout, the action specified by parameter *58.16 Communication loss time* is taken.

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Drive feedback

The inputs to the BMS controller (drive output signals) have pre-defined content. These drive feedback signals do not require any additional drive configuration. The following table lists a subset of the supported feedback data. For a complete listing, see the Protocol Implementation Conformance Statement (PICS) (3AXD10000387059 [English]), which you can find in the ABB Document library on the Internet.

Drive parameter	Description	BACnet object
01.01 Motor speed used	Estimated motor speed (rpm)	AV0
01.06 Output frequency	Estimated drive output frequency (Hz)	AV1
01.11 DC voltage	DC link voltage (V)	AV2
01.13 Output voltage	Calculated motor voltage (V AC)	AV3
01.07 Motor current	Measured (absolute) motor current (A)	AV4
01.10 Motor torque	Motor torque in percent of the nominal motor torque (%)	AV5

Drive parameter	Description	BACnet object
01.14 Output power	Drive output power (kW)	AV6
05.11 Inverter temperature	Estimated drive temperature in percent of fault limit (%)	AV7
01.20 Inverter kWh counter	Amount of energy that has passed through the drive (in either direction) in full kilowatthours. Whenever the counter rolls over, *01.19 Inverter MWh counter* is incremented. The minimum value is zero.	AV9
35.01 Motor estimated temperature	Displays the motor temperature (°C or °F) as estimated by the internal motor thermal protection model. The unit is selected by parameter *96.16 Unit selection*.	AV15
01.03 Motor speed %	Motor speed in percent of the synchronous motor speed.	AV31
40.01 Process PID output actual	PID controller output	AV44
40.04 Process PID deviation actual	PID deviation	AV49
01.50 Current hour 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. If the power is cycled, after the drive is again up and running, the parameter value is set to the value it had before the power cycle.	AV130
01.51 Previous hour kWh	Previous hour energy consumption. The value *01.50 Current hour kWh* is stored here when its values has been cumulated for 60 minutes. If the power is cycled, after the drive is again up and running, the parameter value is set to the value it had before the power cycle.	AV131
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. If the power is cycled, after the drive is again up and running, the parameter value is set to the value it had before the power cycle.	AV132
01.53 Previous day kWh	Previous day energy consumption. The value *01.52 Current day kWh* is stored here when its value has been cumulated for 24 hours. If the power is cycled, after the drive is again up and running, the parameter value is set to the value it had before the power cycle.	AV133
04.01 Tripping fault	Fault that caused the current trip (active fault)	AV18
04.11 Latest fault	Previous fault (non-active)	AV19
04.12 2nd latest fault	Fault before the previous fault (non-active)	AV20

The actual output values of the drive can be read from AV0…AV6, AV31 and AV32:

Object ID	Default object name	Description	Min/max present value	Unit	Present value access type
AV0	Output-RPM	Motor speed	0, nominal speed	rpm	R
AV1	Output-Freq	Output frequency	-500, 500	Hz	R

Object ID	Default object name	Description	Min/max present value	Unit	Present value access type
AV2	DC-Voltage	DC link voltage	0, 2000	V	R
AV3	Output-Voltage	AC output voltage	0, 2000	V	R
AV4	Output-Current	Output current of drive	0, nominal current	A	R
AV5	Output-Torque	Output torque of motor as a percentage of nominal torque	-1600, 1600	%	R
AV6	Output-Power	Output power in kW	nominal power (+/-)	kW	R
AV31	Output-Speed	Actual motor speed	-200, 200	%	R
AV32	Output-Current-Range	Actual motor current	0, 200	%	R

Parameter setting example

Frequency control

The table below shows an example of how to configure a basic frequency control application. The rest of parameters can be left as default values.

Drive parameter	Settings	Description
58.06 Communication control	0 = *Enabled*	Normal operation
58.03 Node address	181 [1)]	Defines the node address of the drive on the fieldbus link.
58.40 Device object ID	51 [1)]	Configures device object ID.
58.16 Communication loss time	30 [1)]	Sets the communication timeout as 30 seconds.
58.15 Communication loss mode	1 = *Any message* [1)]	The timeout feature monitors any directed message received from the drive.
58.06 Communication control	0 = *Refresh settings*	Refreshes settings and takes changed EFB configuration settings in use.
20.01 Ext1 commands		Selects the embedded fieldbus interface as the source of start and stop commands for external control location 1.
28.11 Ext1 frequency ref1		Selects embedded fieldbus reference 1 as the source for frequency reference 1.

[1)] Example

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BACnet protocol implementation conformance statement

Document: 3AXD10000387059, Rev 10

Date: May 18, 2018
Vendor name: ABB, Vendor ID 127
Product name: HVAC Drive
Product model number: ACH531
Applications software version: Drive FW: 2.x.x.x BACnet Appl: 2025
Firmware revision: 14.01
BACnet protocol revision: 14

Product description:

The ACH531 is a high-performance variable speed drive (VSD) designed for HVAC and refrigeration applications. Product supports native BACnet, connecting directly to the MS/TP LAN. MS/TP baud rates are supported up to 115.2 kbps, as well as master and slave mode functionalities. Over BACnet, the drive can be fully controlled and monitored as a standard variable speed drive. In addition, the drive's standard I/O is available over BACnet to the user application.

BACnet standardized device profile (Annex L):

- ☐ BACnet Operator Workstation (B-OWS)
- ☐ BACnet Advanced Operator Workstation (B-AWS)
- ☐ BACnet Operator Display (B-OD)
- ☐ BACnet Building Controller (B-BC)
- ☐ BACnet Advanced Application Controller (B-AAC)
- ☑ BACnet Application specific Controller (B-ASC)
- ☐ BACnet Smart Sensor (B-SS)
- ☐ BACnet Smart Actuator (B-SA)

List all BACnet interoperability building blocks supported (Annex K):

DS-RP-B	Data Sharing-ReadProperty
DS-RPM-B	Data Sharing-ReadProperty Multiple
DS-WP-B	Data Sharing-WriteProperty
DS-WPM-B	Data Sharing-WriteProperty Multiple
DS-COV-B	Data Sharing-Change of Value
DM-DDB-B	Device Management-DynamicDeviceBinding
DM-DOB-B	Device Management-DynamicObjectBinding
DM-DCC-B	Device Management-DeviceCommunicationControl
DM-RD-B	Device Management-ReinitializeDevice
DM-TS-B	Device Management-Time Synchronization

Segmentation capability:

- ☐ Able to transmit segmented messages — Window size: -
- ☐ Able to receive segmented messages — Window size: -

Standard object types supported:

Object instantiation is static, i.e. objects cannot be created or deleted. Refer to tables at end of this document for object details.

Data link layer options:

- ☐ BACnet IP, (Annex J)
- ☐ BACnet IP, (Annex J), foreign device
- ☐ ISO 8802-3, Ethernet (Clause 7)
- ☐ ATA 878.1, 2.5 Mb. ARCNET (Clause 8)
- ☐ ATA 878.1, EIA-485 ARCNET (Clause 8), baud rate(s) ____________
- ☑ MS/TP master (Clause 9), baud rate(s): 9.6k, 19.2k, 38.4k, 76.8k, 115.2k
- ☑ MS/TP slave (Clause 9), baud rate(s): 9.6k, 19.2k, 38.4k, 76.8k, 115.2k
- ☐ Point-to-point, EIA 232 (Clause 10), baud rate(s):__________
- ☐ Point-to-point, modem, (Clause 10), baud rate(s):__________
- ☐ LonTalk, (Clause 11), medium: __________
- ☐ BACnet/ZigBee (ANNEX O)
- ☐ Other: __________

Device address binding:

Is static device binding supported? (This is currently necessary for two-way communication with MS/TP slaves and certain other devices.) ☐ Yes ☑ No

Networking options:

- ☐ Router, Clause 6
  - BACnet/IP to MS/TP
  - BACnet/ ISO 8802-3, Ethernet to MS/TP
  - BACnet/IP to BACnet/ ISO 8802-3, Ethernet
  - BACnet/IP to BACnet/ ISO 8802-3, Ethernet to MS/TP
- ☐ Annex H, BACnet tunneling router over IP
- ☐ BACnet/IP broadcast management device (BBMD)
  - Does the BBMD support registrations by foreign devices? ☐ Yes ☐ No
    - Max BDT (Broadcast distribution table)-entries:
  - Does the BBMD support network address translation? ☐ Yes ☐ No

Network security options:

- ☑ Non-secure device - is capable of operating without BACnet network security
- ☐ Secure device - is capable of using BACnet network security (NS-SD BIBB)
  - ☐ Multiple application-specific keys:
  - ☐ Supports encryption (NS-ED BIBB)
  - ☐ Key server (NS-KS BIBB)

Character sets supported:

Indicating support for multiple character sets does not imply that they can all be supported simultaneously.

☑ ISO 10646 (UTF-8)	☐ IBM /Microsoft DBCS	☐ ISO 8859-1
☐ ISO 10646 (UCS-2)	☐ ISO 10646 (UCS-4)	☐ JIS X 0208

If this product is a communication gateway, describe the types of non-BACnet equipment/network(s) that the gateway supports:

Object/Property support matrix

The following table summarizes the object types/properties supported and default values:

Property	Object type							
	Binary input	Binary output	Binary value	Analog input	Analog output	Analog value	Multistate value	Loop
Object identifier	R	R	R	R	R	R	R	R
Object name	W, P	W, P	R	W, P	W, P	R(1)	R	W,P
Object type	R	R	R	R	R	R	R	R
Present value	R	C	C	R	C	C	R	R
Status flags	R	R	R	R	R	R	R	R
Event state	R	R	R	R	R	R	R	R
Out-of-service	W	W	W	W	W	W	W	W
Polarity	W, P	W, P						
Active text	R	R	R					
Inactive text	R	R	R					
Units				R	R	R		
Min present value				R	R	R		
Max present value				R	R	R		
Priority array		R	R		R	R		
Relinquish default		W, P	W,P		W, P	W, P		
COV increment				W,P	W,P	W,P		
Number of states							R	
State text							R	
Property list	R	R	R	R	R	R	R	R
	• R = Read only, W = Writable, C = Commandable, P = Persist • AV16, AV17, AV21, AV22, AV40- AV44, AV55, AV56, AV59, AV120-129 have W, P • Max length of writable object names is 25 characters							

Device object instance summary

The following table summarizes the device object supported:

Device object			
Property	**Flag**	**Type**	**Default value**
Object identifier	W, P	OID	4194303
Object name	W, P	CharString, max length 25	AC Drive 4194303
Object type	R	Enum	DEV (8)
System status	R	Enum	
Vendor name	R	CharString	ABB
Vendor identifier	R	Unsigned	127
Model name	R	CharString	ACH531

Firmware revision	R	CharString	14.01
Application software revision	R	CharString	
Description	W, P	CharString, max length 100	"ACH531 is a high-performance variable speed drive designed for HVAC and refrigeration applications."
Location	W, P	CharString, max length 50	"(not set)"
Protocol version	R	Unsigned	1
Protocol revision	R	Unsigned	14
Protocol services supported	R	BitString	
Protocol object types supported	R	BitString	
Object list	R	Array of OID	
Max APDU length accepted	R	Unsigned	480
Segmentation supported	R	Enum	No segmentation (3)
Local time	R	BACnetTime	
Local date	R	BACnetDate	
APDU timeout	W, P	Unsigned	10000 ms
Number of APDU retries	W, P	Unsigned	3
Max master	W, P	Unsigned	127
Max info frames	W, P	Unsigned	1
Device address binding	R	List of Struct	
Database revision	R, P	Unsigned	
Active COV subscriptions	R	Array of BACnetCOVSubscription	
Serial number	R	CharString	
Property list	R	Array of Unsigned	
	Flags: R = Read only, W = Writable, C = Commandable, P = Persist		

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Binary input object instance summary

The following table summarizes the binary input objects supported:

Object ID	Object name	Description	Active/Inactive text	Present value access type
BI0	RO1-Monitor	Status of relay output 1	On / Off	R
BI1	RO2-Monitor	Status of relay output 2	On / Off	R
BI2	RO3-Monitor	Status of relay output 3	On / Off	R
BI3	RO4-Monitor	Status of relay output 4	On / Off	R
BI4	RO5-Monitor	Status of relay output 5	On / Off	R
BI5	DO1-Monitor	Status of digital output 1	On / Off	R
BI6	DI1-Monitor	Status of digital input 1	On / Off	R
BI7	DI2-Monitor	Status of digital input 2	On / Off	R
BI8	DI3-Monitor	Status of digital input 3	On / Off	R

Object ID	Object name	Description	Active/Inactive text	Present value access type
BI9	DI4-Monitor	Status of digital input 4	On / Off	R
BI10	DI5-Monitor	Status of digital input 5	On / Off	R
BI11	DI6-Monitor	Status of digital input 6	On / Off	R

Note: For present value access types, R = Read-only, W = Writeable, C = Commandable. Commandable values support priority arrays & relinquish defaults.

Binary output object instance summary

The following table summarizes the binary output objects supported:

Object ID	Object name	Description	Active/Inactive text	Present value access type
BO0	RO1-Command	Output state of relay 1	On / Off	C
BO1	RO2-Command	Output state of relay 2	On / Off	C
BO2	RO3-Command	Output state of relay 3	On / Off	C
BO3	RO4-Command	Output state of relay 4	On / Off	C
BO4	RO4-Command	Output state of relay 5	On / Off	C
BO5	DO1-Command	Output state of digital output 1	On / Off	C

Note: For present value access types, R = Read-only, W = Writeable, C = Commandable. Commandable values support priority arrays & relinquish defaults.

Binary value object instance summary

The following table summarizes the binary value objects supported:

Object ID	Object name	Description	Active/Inactive text	Present value access type
BV0	RUN-STOP-Monitor	Drive's run status	Run / Stop	R
BV1	Direction-Monitor	Rotational direction of the motor	Reverse / Forward	R
BV2	OK-FAULT-Monitor	Actual fault status of drive	Fault / OK	R
BV3	EXT1-EXT2-Monitor	Actual control source	Ext2 / Ext1	R
BV4	HAND-AUTO-Monitor	Actual operating mode.	Hand / Auto	R
BV5	Warning-Monitor	Actual warning status	Warning / OK	R
BV7	Ready-Monitor	Actual ready status	Ready / Not-Ready	R
BV8	At-Setpoint-Monitor	Actual at setpoint status	Yes / No	R
BV9	Enabled-Monitor	Actual run enabled status	Enable / Disable	R

Object ID	Object name	Description	Active/Inactive text	Present value access type
BV10	RUN-STOP-Command	Command to start drive	Run / Stop	C
BV11	Direction-Command	Command to rotational direction	Reverse / Forward	C
BV12	Run-Permissive-Command	Command to run permissive command	Enable / Disable	C
BV13	EXT1-EXT2-Command	Commanded to external 1 or external 2 selection	Ext2 / Ext1	C
BV14	Fault-Reset-Command	Commanded to fault reset	Reset / No	W
BV15-BV16	<Reserved>			
BV17	Lock-Parameters	Actual status of parameter lock.	Lock / Unlock	R
BV18	Control-Override-Command	Command the drive into BACnet control override. In this mode, BACnet acquires drive control from its normal source. Note that HAND mode of the panel has priority over BACnet Control Override.	On / Off	C
BV19	Control-Override-Monitor	Indicates if drive has been placed in BACnet control override by commanding BV18. In this mode, BACnet acquires drive control from its normal source. Note that HAND mode of the panel has priority over BACnet control override.	On / Off	R
BV20	Start-Interlock-1-Command	Command to start enable 1	Enable / Disable	C
BV21	Start-Interlock-2-Command	Command to start enable 2	Enable / Disable	C
BV24	Started-Monitor	Actual start status	Started / Not-Started	R
BV25	Safe-Torque-Off-Monitor	Actual status of Safe Torque Off	Active / OK	R
BV26	Underload-Monitor	Indicates if ULC signal is lower than the Underload curve	Underload / OK	R
BV27	Overload-Monitor	Indicates if ULC signal is higher than the overload curve	Overload / OK	R
BV28	Motor-Heating-Command	Command to motor heating mode	On / Off	W
BV29	Motor-Heating-Monitor	Actual status of motor heating mode	On / Off	R
BV30	User0-Monitor	Actual status of “User bit0” in drive status word	On / Off	R
BV31	User1-Monitor	Actual status of “User bit1” in drive status word	On / Off	R
BV32	User2-Monitor	Actual status of “User bit2” in drive status word	On / Off	R

Object ID	Object name	Description	Active/Inactive text	Present value access type
BV33	User3-Monitor	Actual status of “User bit3” in drive status word	On / Off	R
BV34	User0-Command	Commands “User bit0” in drive status word	On / Off	C
BV35	User1-Command	Commands “User bit1” in drive status word	On / Off	C
BV36	User2-Command	Commands “User bit2” in drive status word	On / Off	C
BV37	User3-Command	Commands “User bit3” in drive status word	On / Off	C
BV38	<Reserved>			
BV39	Parameter-Save-Command	Command to save drive parameters and BACnet property data (properties marked as ‘P=Persist’)	Save / No	W
BV40	PID-Set-Select	Command to Process PID set1 or Process PID set2 selection	Set1 / Set2	W

Note: For present value access types, R = Read-only, W = Writeable, C = Commandable. Commandable values support priority arrays & relinquish defaults.

Analog input object instance summary

The following table summarizes the analog input objects supported:

Object ID	Default object name	Description	Min / Max present value	Units	Present value access type
AI0	AI1-Monitor	Indicates the input level of analog input 1.	0…100	Percent (%)	R
AI1	AI2-Monitor	Indicates the input level of analog input 2.	0…100	Percent (%)	R

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Note: For present value access types, R = Read-only, W = Writeable, C = Commandable. Commandable values support priority arrays & relinquish defaults.

Analog output object instance summary

The following table summarizes the analog output objects supported:

Object ID	Default object name	Description	Min / Max present value	Units	Present value access type
AO0	AO1-Command	Controls analog output 1 (drive must be configured for BACnet control).	0…100	Percent	C
AO1	AO2-Command	Controls analog output 2 (drive must be configured for BACnet control).	0…100	Percent	C

Note: For present value access types, R = Read-only, W = Writeable, C = Commandable. Commandable values support priority arrays & relinquish defaults.

Analog value object instance summary

The following table summarizes the analog value objects supported:

Object ID	Default object name	Description	Min / Max present value	Units	Present value access type
AV0	Output-RPM	Motor speed	0, nominal speed	rpm	R
AV1	Output-Freq	Output frequency	-500, 500	Hz	R
AV2	DC-Voltage	DC bus voltage	0, 2000	V	R
AV3	Output-Voltage	AC output voltage	0, 2000	V	R
AV4	Output-Current	Output current of drive	0, nominal current	A	R
AV5	Output-Torque	Output torque of motor as a percentage of nominal torque	-1600, 1600	%	R
AV6	Output-Power	Output power in kW	nominal power (+/-)	kW	R
AV7	Operating-Temp-Range	Heatsink temperature	-40, 160	%	R
AV8	Kilowatt-Hour-Meter-R	Drive's cumulative energy usage. This value is resettable.	0,65535	kWh	W
AV9	Kilowatt-Hour-Meter-NR	Drive's cumulative energy usage. This value is not resettable.	0, 65535999999	kWh	R
AV10	Process-PID-Feedback	This object is the process PID feedback signal.	0, 100	%	R
AV11	Process-PID-Deviation	This object is the process PID output signal's deviation from its setpoint.	0, 100	%	R
AV12	External-PID-Feedback	This object is the external PID feedback signal.	0, 100	%	R
AV13	External-PID-Deviation	This object is the external PID output signal's deviation from its setpoint.	0, 100	%	R
AV14	Running-Hours	Drive's resettable run time (reset by writing 0).	0, 3.40282347e38	hours	R
AV15	Motor-Temp-Degrees-C	Motor temperature	-10, 200	°C	R
AV16	Input-Reference-1	Speed setpoint 1	-150, 150	%	C

Object ID	Default object name	Description	Min / Max present value	Units	Present value access type
AV17	Input-Reference-2	Speed setpoint 2.	-150, 150	%	C
AV18	Active-Fault	Displays most recent fault currently active.			R
AV19	Previous-Fault-1	Displays most recent stored (non-active) fault			R
AV20	Previous-Fault-2	Displays the second most recent stored (non-active) fault			R
AV21	AO1-Monitor	Output level of analog output 1	0, 100	%	R
AV22	AO2-Monitor	Output level of analog output 2	0, 100	%	R
AV23	Accel-1-Seconds	Ramp1 acceleration time	0, 1800	s	W
AV24	Decel-1-Seconds	Ramp 1 deceleration time	0, 1800	s	W
AV25	Mbox-Param	Parameter number to be used by mailbox function.		No Units	W
AV26	Mbox-Data	Set (W) or indicate (R) of the data value of mailbox function		No Units	W
AV27	External-PID-Setpoint	This object sets the external PID controller setpoint	0, 100	%	C
AV27-AV28	<Reserved>				
AV29	Min-Speed	Defines the allowed minimum output frequency	-500, 500	Hz	W
AV30	Max-Speed	Defines the allowed maximum output frequency	-500, 500	Hz	W
AV31	Output-Speed	Actual motor speed	-200, 200	%	R
AV32	Output-Current-Range	Actual motor current	0, 200	%	R
AV33	Max-Current	Max motor current	0, nominal current	A	W
AV34-AV39	<Reserved>				
AV40	LOOP-Feedback-Monitor	Loop controller feedback value after source selection, mathematical function and filtering (read-only)	0, 100	%	R
AV41	LOOP-Setpoint-Monitor	Loop controller setpoint value after source selection, mathematical function limitation and ramping (read-only)	0,100	%	R

10

Object ID	Default object name	Description	Min / Max present value	Units	Present value access type
AV42	LOOP-Setpoint	Command to store loop controller setpoint value used as input for the process	0,100	%	C
AV43	LOOP-Feedback	Stores the feedback value for loop controller	0, 100	%	W
AV44	LOOP-Output	Loop controller output	0, 100	%	R
AV45	LOOP- Gain	Loop controller gain	0.1, 100	No Units	W
AV46	LOOP-Integration-Time	Loop controller integration time	0, 3600	s	W
AV47-AV48	<Reserved>				
AV49	LOOP-Deviation-Monitor	Loop controller deviation	0, 100	%	R
AV50-AV52	<Reserved>				
AV53	LOOP-1-Gain	Loop controller gain (set 2)	0.1, 100	No Units	W
AV54	LOOP-1-Integration-Time	Loop controller integration time (set 2)	0, 3600	s	W
AV55	LOOP-2-Feedback-Monitor	External loop controller feedback value after source selection, mathematical function and filtering (read-only)	0, 100	%	R
AV56	LOOP-2-Setpoint-Monitor	External loop controller setpoint value after source selection, mathematical function limitation and ramping (read-only)	0, 100	%	R
AV57-AV58	<Reserved>				
AV59	LOOP-2-Output	External loop controller output	0, 100	%	R
AV60	LOOP-2-Gain	External loop controller gain	0.1, 100	No Units	W
AV61	LOOP-2-Integration-Time	External loop controller integration time	0, 3600	s	W
AV62-AV63	<Reserved>				
AV64	LOOP-2-Deviation-Monitor	External loop controller deviation	0, 100	%	R
AV65-119	<Reserved>			No Units	W
AV120	Data-IO-1	Holds the value of drive parameter, which is mapped using Data I/O parameter 58.101		No Units	W

Object ID	Default object name	Description	Min / Max present value	Units	Present value access type
AV121	Data-IO-2	Holds the value of drive parameter, which is mapped using Data I/O parameter 58.102		No Units	W
AV122	Data-IO-3	Holds the value of drive parameter, which is mapped using Data I/O parameter 58.103		No Units	W
AV123	Data-IO-4	Holds the value of drive parameter, which is mapped using Data I/O parameter 58.104		No Units	W
AV124	Data-IO-5	Holds the value of drive parameter, which is mapped using Data I/O parameter 58.105 (Read-only)		No Units	R
AV125	Data-IO-6	Holds the value of drive parameter, which is mapped using Data I/O parameter 58.106 (Read-only)		No Units	R
AV126	Data-IO-7	Holds the value of drive parameter, which is mapped using Data I/O parameter 58.107 (Read-only)		No Units	R
AV127	Data-IO-8	Holds the value of drive parameter, which is mapped using Data I/O parameter 58.108 (Read-only)		No Units	R
AV128	Data-IO-9	Holds the value of drive parameter, which is mapped using Data I/O parameter 58.109 (Read-only)		No Units	R
AV129	Data-IO-10	Holds the value of drive parameter, which is mapped using Data I/O parameter 58.110 (Read-only)		No Units	R
AV130	Kilowatt-Hour-This-Hour	Current hour energy consumption	0, 3.40282347e38	kWh	R
AV131	Kilowatt-Hour-Last-Hour	Last hour energy consumption	0, 3.40282347e38	kWh	R
AV132	Kilowatt-Hour-This-Day	Current day energy consumption	0, 3.40282347e38	kWh	R
AV133	Kilowatt-Hour-Last-Day	Last day energy consumption	0, 3.40282347e38	kWh	R

Note: For present value access types, R = Read-only, W = Writeable, C = Commandable. Commandable values support priority arrays & relinquish defaults.

Multistate value object instance summary

The following table summarizes the multistate value objects supported:

Object ID	Object name	Description	State text	Present value access type
MSV0	HAND-AUTO-Reference	Indicates whether the drive is under Hand or Auto control, or if Override mode is active.	Off, Hand, Auto, Override	R
MSV1	Active-Fault-1	Enumerated type of the most recent fault currently active	None, Comm-Error, Overcurrent, Overtemperature, Overspeed, Overvoltage, Undervoltage, Short-Circuit, Ground-Fault, Motor-Overload, Inverter-Overload, Motor-Underload, External-Fault, Operator-Interface-Error, Config-Error, Feedback-Failure, Output-Phase-Loss Motor-Stall, Power-Unit-Error, Input-Phase-Fault, Internal-Failure, STO-Active, Other	R

Object ID	Object name	Description	State text	Present value access type
MSV2	Active-Fault-2	Enumerated type of the 2nd most recent fault currently active	None, Comm-Error, Overcurrent, Overtemperature, Overspeed, Overvoltage, Undervoltage, Short-Circuit, Ground-Fault, Motor-Overload, Inverter-Overload, Motor-Underload, External-Fault, Operator-Interface-Error, Config-Error, Feedback-Failure, Output-Phase-Loss Motor-Stall, Power-Unit-Error, Input-Phase-Fault, Internal-Failure, STO-Active, Other	R
MSV3	Active-Fault-3	Enumerated type of the 3rd most recent fault currently active	None, Comm-Error, Overcurrent, Overtemperature, Overspeed, Overvoltage, Undervoltage, Short-Circuit, Ground-Fault, Motor-Overload, Inverter-Overload, Motor-Underload, External-Fault, Operator-Interface-Error, Config-Error, Feedback-Failure, Output-Phase-Loss Motor-Stall, Power-Unit-Error, Input-Phase-Fault, Internal-Failure, STO-Active, Other	R

Object ID	Object name	Description	State text	Present value access type
MSV4	Active-Warning-1	Enumerated type of the most recent warning currently active	None, Comm-Error, Current-Limit, Overtemperature, Start-Interlock-1, Start-Interlock-2, Start-Interlock-3, Start-Interlock-4, Run-Permissive, Internal-Warning, Start-Delay, Other	R
MSV5	Active-Warning-2	Enumerated type of the 2nd most recent warning currently active	None, Comm-Error, Current-Limit, Overtemperature, Start-Interlock-1, Start-Interlock-2, Start-Interlock-3, Start-Interlock-4, Run-Permissive, Internal-Warning, Start-Delay, Other	R
MSV6	Active-Warning-3	Enumerated type of the 3rd most recent warning currently active	None, Comm-Error, Current-Limit, Overtemperature, Start-Interlock-1, Start-Interlock-2, Start-Interlock-3, Start-Interlock-4, Run-Permissive, Internal-Warning, Start-Delay, Other	R

Note: For present value access types, R = Read-only, W = Writeable, C = Commandable. Commandable values support priority arrays & relinquish defaults.

Loop object instance summary

The following table summarizes the loop objects supported:

Object ID	Object name	Description	Manipulated variable reference	Controlled variable reference	Setpoint reference	Present value access type
LOOP0	LOOP-Set1	Loop object for process PID set 1	AV44 Present Value	AV43 Present Value	AV42 Present Value	R

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Object ID	Object name	Description	Manipulated variable reference	Controlled variable reference	Setpoint reference	Present value access type
LOOP1	LOOP-Set2	Loop object for process PID set 2	AV44 Present Value	AV43 Present Value	AV42 Present Value	R

Note: For present value access types, R = Read-only, W = Writeable, C = Commandable. Commandable values support priority arrays & relinquish defaults.

Mailbox function

The drive provides a Mailbox function to access parameters that have not been pre-defined by the protocol. Using mailbox, any drive parameter can be identified and read. Mailbox can also be used to adjust parameter settings by writing a value to any parameter identified. The following table shows the mailbox objects.

Object ID	Default object name	Description	Min/max present value	Unit	Present value access type
AV25	Mbox-Param	Parameter number to be used by mailbox function.		No units	W
AV26	Mbox-Data	Set (W) or indicate (R) of the data value of mailbox function			W

To use the Mailbox function, write the parameter address to the Mbox-Param object as a floating point value. The three lowest digits in the integer part are used for the parameter index within the parameter group.

Example: For parameter 47.01, write the address as 47001.00 to the Mbox-Param object. For parameter 47.999, write the address as 47999.00 to the Mbox-Param object.

10

Read or write the value to the Mbox-Data object as a floating point value. If the parameter is a decimal type parameter, its value is shown as a decimal number. The value of an integer type parameter is shown as an integer number.

Example: If parameter 47.01 has value 12.554 it is shown just as it is. If parameter 47.21 has value 125, it is shown just like that, without a decimal part.

9

Fieldbus control through a fieldbus adapter

What this chapter contains

This chapter describes how the drive can be controlled by external devices over a communication network (fieldbus) through an optional fieldbus adapter module.

The fieldbus control interface of the drive is described first, followed by a configuration example.

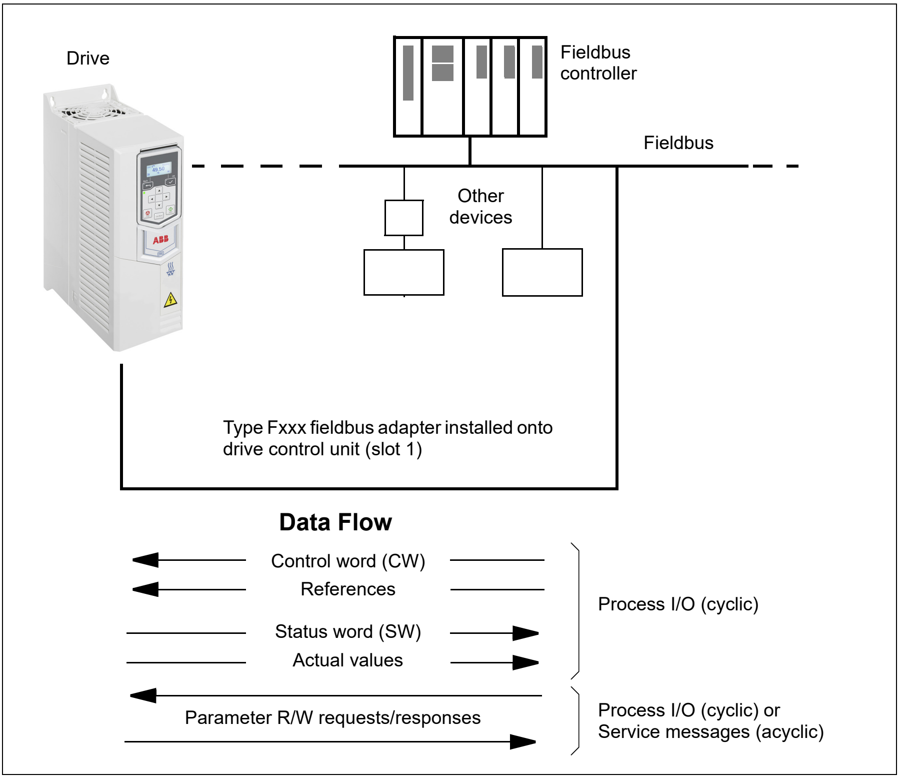
System overview

The drive can be connected to an external control system through an optional fieldbus adapter ("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 the control can be distributed between the fieldbus interface and other available sources such as digital and analog inputs, depending on how control locations EXT1 and EXT2 are configured.

Fieldbus adapters are available for various communication systems and protocols, for example:

- BACnet/IP (FBIP-21 adapter)
- CANopen (FCAN-01 adapter)
- ControlNet (FCNA-01 adapter)
- DeviceNet™ (FDNA-01 adapter)
- Ethernet POWERLINK (FEPL-02 adapter)
- EtherCAT (FECA-01 adapter)
- EtherNet/IP™ (FEIP-21 adapter, FENA-21 adapter)
- Modbus/RTU (FSCA-01 adapter, FMBA-01 adapter)
- ModbusTCP (FBMT-21 adapter, FENA-21 adapter)
- PROFINET IO (FPNO-21 adapter, FENA-21 adapter)
- PROFIBUS DP (FPBA-01 adapter).

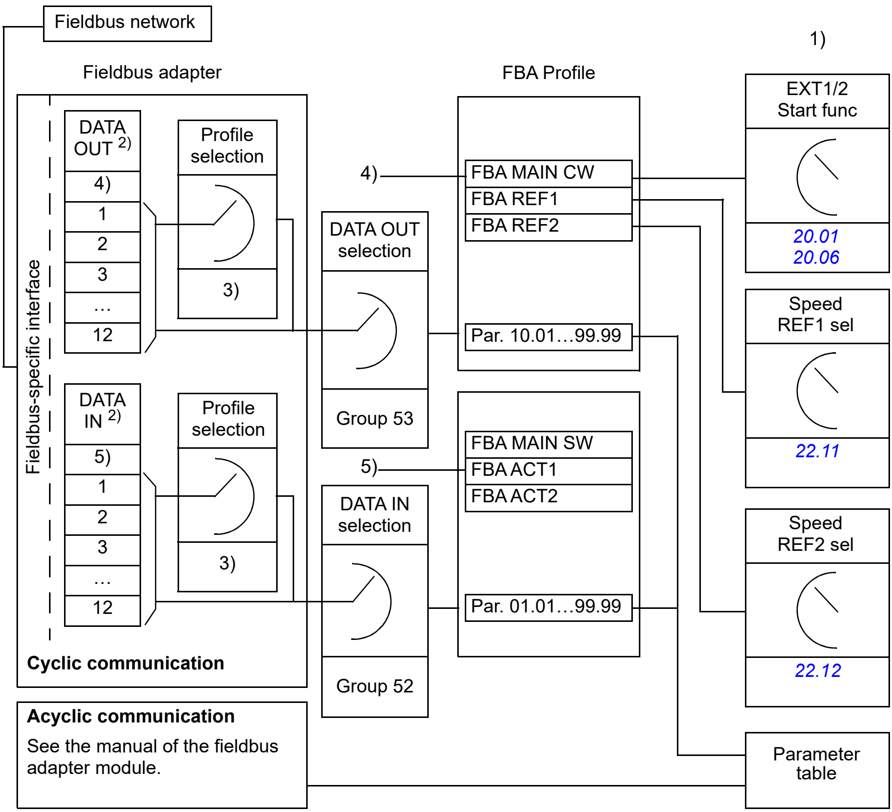
Note: The text and examples in this chapter describe the configuration of one fieldbus adapter (FBA A) by parameters *50.01* …*50.18* and parameter groups *51 FBA A settings*…*53 FBA A data out*.



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.

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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 226 and 227, respectively. The drive states are presented in the state diagram (page 228). For other fieldbus-specific communication profiles, see the *User's manual* of the fieldbus adapter.

Debugging the network words

If parameter *50.12 FBA A debug mode* is set to *Fast*, the Control word received from the fieldbus is shown by parameter *50.13 FBA A control word*, and the Status word transmitted to the fieldbus network by *50.16 FBA A status word*. This "raw" data is very useful to determine if the fieldbus master is transmitting the correct data before handing control to the fieldbus network.

References

References are 16-bit words containing a sign bit and a 15-bit integer. A negative reference (indicating reversed direction of rotation) is formed by calculating the two's complement from the corresponding positive reference.

ABB drives can receive control information from multiple sources including analog and digital inputs, the drive control panel and a fieldbus adapter module. In order to have the drive controlled through the fieldbus, the module must be defined as the source for control information such as reference. This is done using the source selection parameters in groups *22 Speed reference selection* and *28 Frequency reference chain*.

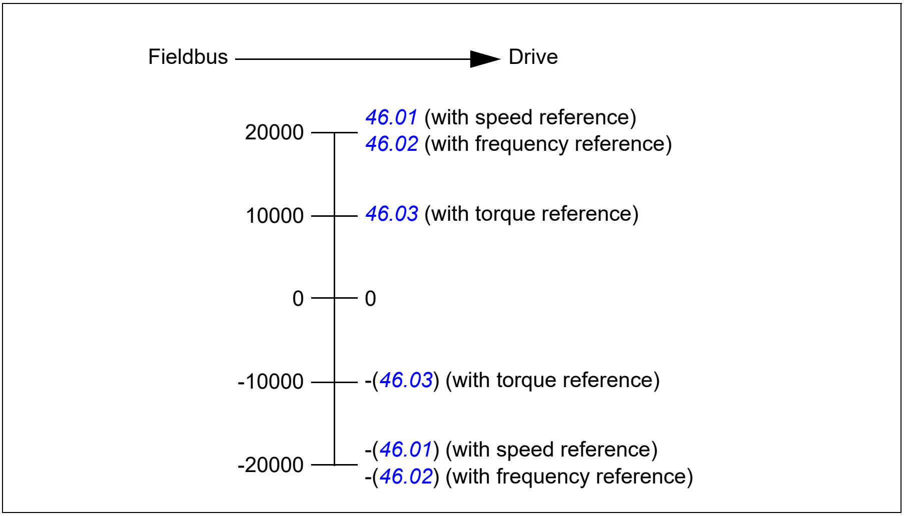
Debugging the network words

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 *User's 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

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 *User's manual* of the fieldbus adapter.

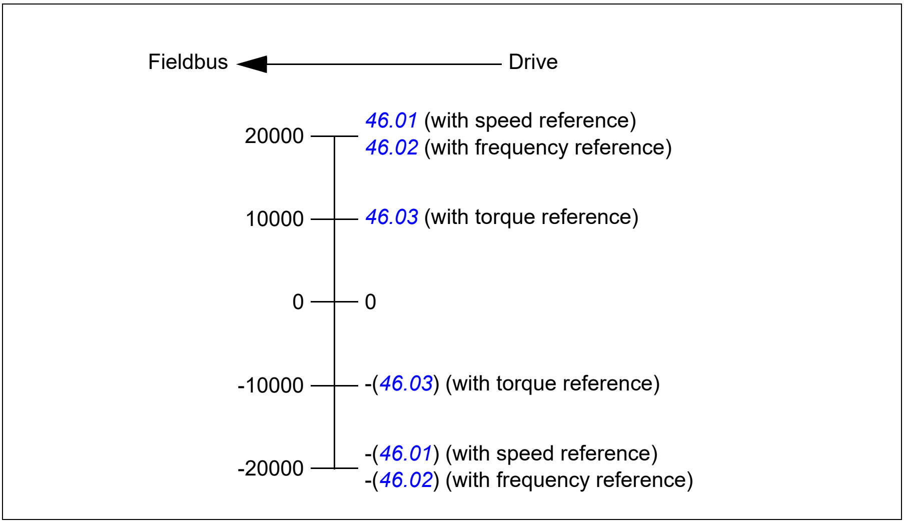
Actual values are 16-bit words containing information on the operation of the drive. The types of the monitored signals are selected by parameters *50.07 FBA A actual 1 type* and *50.08 FBA A actual 2 type*.

Debugging the network words

If parameter *50.12 FBA A debug mode* is set to *Fast*, the actual values sent to the fieldbus are displayed by *50.17 FBA A actual value 1* and *50.18 FBA A actual value 2*.

Scaling of actual values

The actual values are scaled as defined by parameters *46.01…46.04*; which scaling is in use depends on the setting of parameters *50.07 FBA A actual 1 type* and *50.08 FBA A actual 2 type*.



Contents of the fieldbus Control word (ABB Drives profile)

The upper case boldface text refers to the states shown in the state diagram (page *228*).

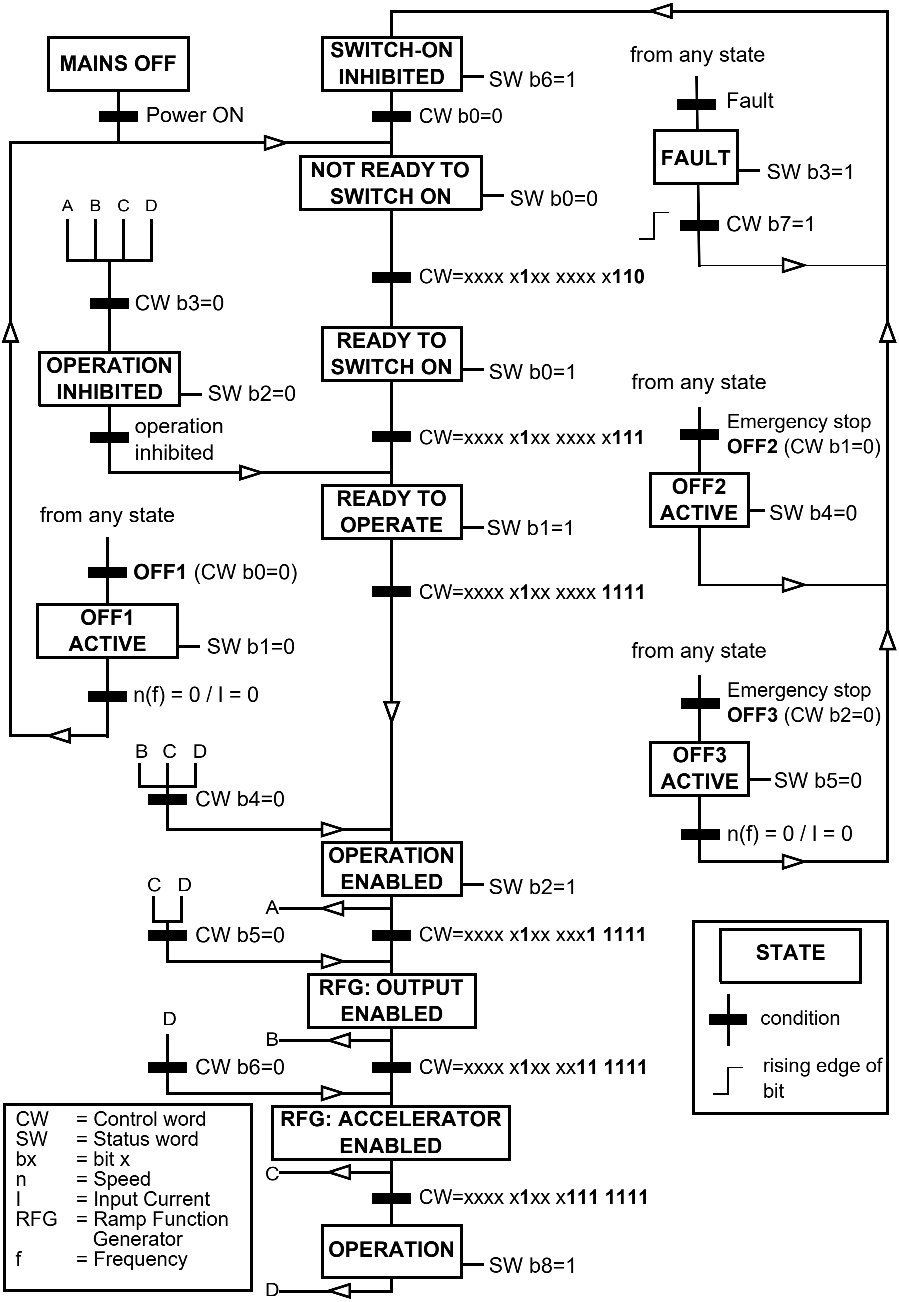
Bit	Name	Value	STATE/Description
0	Off1 control	1	Proceed to **READY TO OPERATE**.
		0	Stop along currently active deceleration ramp. Proceed to **OFF1 ACTIVE**; proceed to **READY TO SWITCH ON** unless other interlocks (OFF2, OFF3) are active.
1	Off2 control	1	Continue operation (OFF2 inactive).
		0	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 permissive signal must be active; see the drive documentation. If the drive is set to receive the Run permissive signal from the fieldbus, this bit activates the signal. See also parameter *06.18 Start inhibit status word*.
		0	Inhibit operation. Proceed to **OPERATION INHIBITED**.
4	Ramp out zero	1	Normal operation. Proceed to **RAMP FUNCTION GENERATOR: OUTPUT ENABLED**.
		0	Force Ramp function generator output to zero. The drive will immediately decelerate to zero speed (observing the torque limits).
5	Ramp hold	1	Enable ramp function. Proceed to **RAMP FUNCTION GENERATOR: ACCELERATOR ENABLED**.
		0	Halt ramping (Ramp Function Generator output held).
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…9	Reserved		
10	Remote cmd	1	Fieldbus control enabled.
		0	Control word and reference not getting through to the drive, except for bits 0…2.
11	Ext ctrl loc	1	Select External Control Location EXT2. Effective if control location is parameterized to be selected from fieldbus.
		0	Select External Control Location EXT1. Effective if control location is parameterized to be selected from fieldbus.
12	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 (page 228).

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*.
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*…*46.22*).
		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



Setting up the drive for fieldbus control

1. Install the fieldbus adapter module mechanically and electrically according to the instructions given in the *User's manual* of the module.

2. Power up the drive.

3. Enable the communication between the drive and the fieldbus adapter module with parameter *50.01 FBA A enable*.

4. With *50.02 FBA A comm loss func*, select how the drive should react to a fieldbus communication break.
Note: This function monitors both the communication between the fieldbus master and the adapter module and the communication between the adapter module and the drive.

5. With *50.03 FBA A comm loss t out*, define the time between communication break detection and the selected action.

6. Select application-specific values for the rest of the parameters in group *50 Fieldbus adapter (FBA)*, starting from *50.04*. Examples of appropriate values are shown in the tables below.

7. Set the fieldbus adapter module configuration parameters in group *51 FBA A settings*. As a minimum, set the required node address and the communication profile.

8. Define the process data transferred to and from the drive in parameter groups *52 FBA A data in* and *53 FBA A data out*.
Note: Depending on the communication protocol and profile being used, the Control word and Status word may already be configured to be sent/received by the communication system.

9. Save the valid parameter values to permanent memory by setting parameter *96.07 Parameter save manually* to *Save*.

10. Validate the settings made in parameter groups 51, 52 and 53 by setting parameter *51.27 FBA A par refresh* to *Configure*.

11. Configure control locations EXT1 and EXT2 to allow control and reference signals to come from the fieldbus. Examples of appropriate values are shown in the tables below.

Parameter setting example: FPBA (PROFIBUS DP) with ABB Drives profile

This example shows how to configure a basic speed control application that uses the ABB Drives communication profile with PPO Type 2. The start/stop commands and reference are according to the ABB Drives profile, speed control mode.

The reference values sent over the fieldbus have to be scaled within the drive so they have the desired effect. The reference value ±20000 corresponds to the range of speed set in parameter *46.01 Speed scaling* (both forward and reverse directions). For example, if *46.01* is set to 480 rpm, then 20000 sent over fieldbus will request 480 rpm.

Direction	PZD1	PZD2	PZD3	PZD4	PZD5	PZD6
Out	Control word	Speed reference	Acc time 1		Dec time 1	
In	Status word	Speed actual value	Motor current		DC voltage	

The table below gives the recommended drive parameter settings.

Drive parameter	Setting for ACH531 drives	Description
50.01 FBA A enable	**1** = [slot number]	Enables/disables communication between the drive and the fieldbus adapter module.
50.04 FBA A ref1 type	**4** = *Speed*	Selects the fieldbus A reference 1 type and scaling.
50.07 FBA A actual 1 type	**0** = *Speed or frequency*	Selects the actual value type and scaling according to the currently active Ref1 mode defined in parameter *50.04*.
51.01 FBA A type	**1** = FPBA[1)]	Displays the type of the fieldbus adapter module.
51.02 Node address	3[2)]	Defines the PROFIBUS node address of the fieldbus adapter module.
51.03 Baud rate	12000[1)]	Displays the current baud rate on the PROFIBUS network in kbit/s.
51.04 MSG type	**1** = PPO2[1)]	Displays the telegram type selected by the PLC configuration tool.
51.05 Profile	**1** = ABB Drives	Selects the Control word according to the ABB Drives profile (speed control mode).
51.07 RPBA mode	**0** = Disabled	Disables the RPBA emulation mode.
52.01 FBA A data in1	**4** = SW 16bit[1)]	Status word
52.02 FBA data in2	**5** = Act1 16bit	Actual value 1
52.03 FBA data in3	01.07[2)]	Motor current
52.05 FBA data in5	01.11[2)]	DC voltage
53.01 FBA data out1	**1** = CW 16bit[1)]	Control word

Drive parameter	Setting for ACH531 drives	Description
53.02 FBA data out2	**2** = Ref1 16bit	Reference 1 (speed)
53.03 FBA data out3	23.12[2)]	Acceleration time 1
53.05 FBA data out5	23.13[2)]	Deceleration time 1
51.27 FBA A par refresh	**1** = *Configure*	Validates the configuration parameter settings.
20.01 Ext1 commands	**12** = *Fieldbus A*	Selects fieldbus adapter A as the source of the start and stop commands for external control location EXT1.
20.02 Ext1 start trigger type	**1** = *Level*	Selects a level-triggered start signal for external control location EXT1.
22.11 Ext1 speed ref1	**4** = *FB A ref1*	Selects fieldbus A reference 1 as the source for speed reference 1.

[1)] Read-only or automatically detected/set

[2)] Example

Parameter setting example: FPBA (PROFIBUS DP) with PROFIdrive profile

This example shows how to configure a basic speed control application that uses the PROFIdrive communication profile with PPO Type 2. The start/stop commands and reference are according to the PROFIdrive profile, speed control mode.

The reference values sent over the fieldbus have to be scaled within the drive so they have the desired effect. The reference value ±16384 (4000h) corresponds to the range of speed set in parameter *46.01 Speed scaling* (both forward and reverse directions). For example, if *46.01* is set to 480 rpm, then 4000h sent over fieldbus will request 480 rpm.

Direction	**PZD1**	**PZD2**	**PZD3**	**PZD4**	**PZD5**	**PZD6**
Out	Control word	Speed reference	Acc time 1		Dec time 1	
In	Status word	Speed actual value	Motor current		DC voltage	

The table below gives the recommended drive parameter settings.

Drive parameter	**Setting for ACH531 drives**	**Description**
50.01 FBA A enable	**1** = [slot number]	Enables/disables communication between the drive and the fieldbus adapter module.
50.04 FBA A ref1 type	**4** = *Speed*	Selects the fieldbus A reference 1 type and scaling.
50.07 FBA A actual 1 type	**0** = *Speed or frequency*	Selects the actual value type and scaling according to the currently active Ref1 mode defined in parameter *50.04*.
51.01 FBA A type	**1** = FPBA[1)]	Displays the type of the fieldbus adapter module.
51.02 Node address	3[2)]	Defines the PROFIBUS node address of the fieldbus adapter module.
51.03 Baud rate	12000[1)]	Displays the current baud rate on the PROFIBUS network in kbit/s.
51.04 MSG type	**1** = PPO2[1)]	Displays the telegram type selected by the PLC configuration tool.
51.05 Profile	**0** = PROFIdrive	Selects the Control word according to the PROFIdrive profile (speed control mode).
51.07 RPBA mode	**0** = Disabled	Disables the RPBA emulation mode.
52.01 FBA A data in1	**4** = SW 16bit[1)]	Status word
52.02 FBA data in2	**5** = Act1 16bit	Actual value 1
52.03 FBA data in3	01.07[2)]	Motor current
52.05 FBA data in5	01.11[2)]	DC voltage
53.01 FBA data out1	**1** = CW 16bit[1)]	Control word

Drive parameter	Setting for ACH531 drives	Description
53.02 FBA data out2	**2** = Ref1 16bit	Reference 1 (speed)
53.03 FBA data out3	23.12[2)]	Acceleration time 1
53.05 FBA data out5	23.13[2)]	Deceleration time 1
51.27 FBA A par refresh	**1** = *Configure*	Validates the configuration parameter settings.
20.01 Ext1 commands	**12** = *Fieldbus A*	Selects fieldbus adapter A as the source of the start and stop commands for external control location EXT1.
20.02 Ext1 start trigger type	**1** = *Level*	Selects a level-triggered start signal for external control location EXT1.
22.11 Ext1 speed ref1	**4** = *FB A ref1*	Selects fieldbus A reference 1 as the source for speed reference 1.

[1)] Read-only or automatically detected/set

[2)] Example

The start and stop sequences for the parameter examples above are given below.

Control word:

Start:

- 1142 (476h) –> NOT READY TO SWITCH ON
- If MSW bit 0 = 1 then
  - 1150 (47Eh) –> READY TO SWITCH ON (Stopped)
  - 1151 (47Fh) –> OPERATION (Running)

Stop:

  - 1143 (477h) = Stop according to *21.03 Stop mode* (Preferred)
  - 1150 (47Eh) = OFF1 ramp stop (Note: uninterruptable ramp stop)
  - 1149 (47Dh) = OFF2 emergency coast to stop
  - 1147 (47Bh) = OFF3 emergency ramp stop

Fault reset:

  - Rising edge of MCW bit 7

Start after STO:

- If *31.22 STO indication run/stop* is not Fault/ Fault, check that *06.18 Start inhibit status word*, bit 7 STO = 0 before giving a start command.

Automatic drive configuration for fieldbus control

The parameters set on module detection are shown in the table below. See also parameters *07.35 Drive configuration* and *07.36 Drive configuration 2*

Option	50.01 FBA A enable	50.02 FBA A comm loss func	51.02 FBA A Par2	51.04 FBA A Par4	51.05 FBA A Par5	51.06 FBA A Par6
FENA-21	1 (Enable)	0 (No action)	11	0	-	-
FECA-01	1 (Enable)	0 (No action)	0	-	-	-
FPBA-01	1 (Enable)	0 (No action)	-	-	1	-
FCAN-01	1 (Enable)	0 (No action)	-	-	0	-
FSCA-01	1 (Enable)	0 (No action)	-	-	-	10
FEIP-21	1 (Enable)	0 (No action)	100	0	-	-
FMBT-21	1 (Enable)	0 (No action)	0	0	-	-
FBIP-21	1 (Enable)	0 (No action)	-	0	-	-
FPNO-21	1 (Enable)	0 (No action)	11	0	-	-
FEPL-02	1 (Enable)	0 (No action)	-	-	-	-
FLON-01	1 (Enable)	0 (No action)	-	-	-	-
FDNA-01	1 (Enable)	0 (No action)	-	-	-	-
FCNA-01	1 (Enable)	0 (No action)	-	-	-	-

Option	51.07 FBA A Par7	51.21 FBA A Par21	51.23 FBA A Par23	51.24 FBA A Par24	52.01 FBA data in1	52.02 FBA data in2
FENA-21	-	-	-	-	4	5
FECA-01	-	-	-	-	-	-
FPBA-01	-	-	-	-	4	5
FCAN-01	-	-	-	-	-	-
FSCA-01	1	-	-	-	-	
FEIP-21	-	-	128	128	-	-
FMBT-21	-	1	-	-	-	-
FBIP-21	-	-	-	-	-	-
FPNO-21	-	-	-	-	4	5
FEPL-02	-	-	-	-	-	-
FLON-01	-	-	-	-	-	-
FDNA-01	-	-	-	-	-	-
FCNA-01	-	-	-	-	-	-

Option	53.01 FBA data out1	53.02 FBA data out2
FENA-21	1	2
FECA-01	-	-
FPBA-01	1	2
FCAN-01	-	-

Option	**53.01 FBA data out1**	**53.02 FBA data out2**
FSCA-01		
FEIP-21	-	-
FMBT-21	-	-
FBIP-21	-	-
FPNO-21	1	2
FEPL-02	-	-
FLON-01	-	-
FDNA-01	-	-
FCNA-01	-	-

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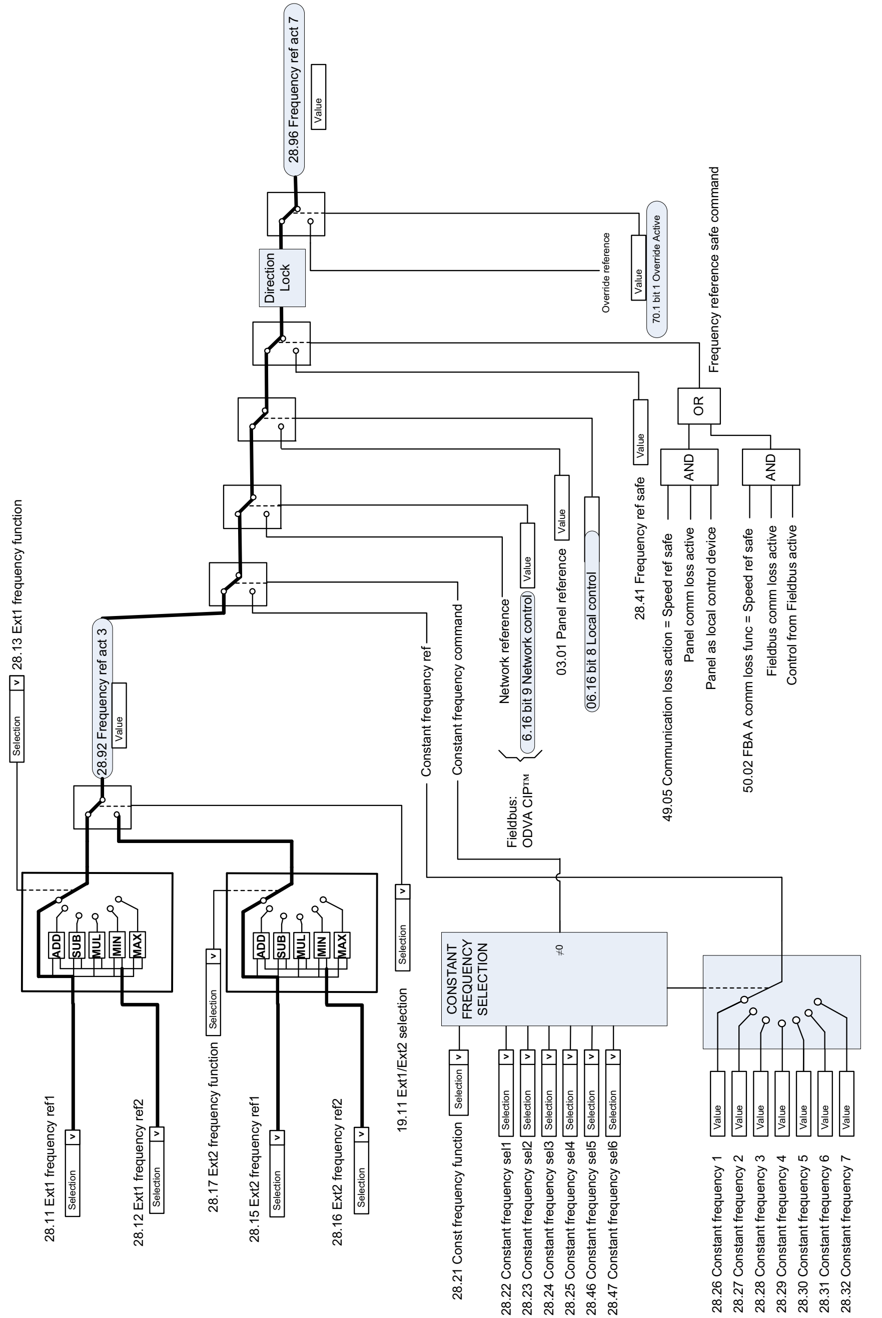
Control chain diagrams

Contents of this chapter

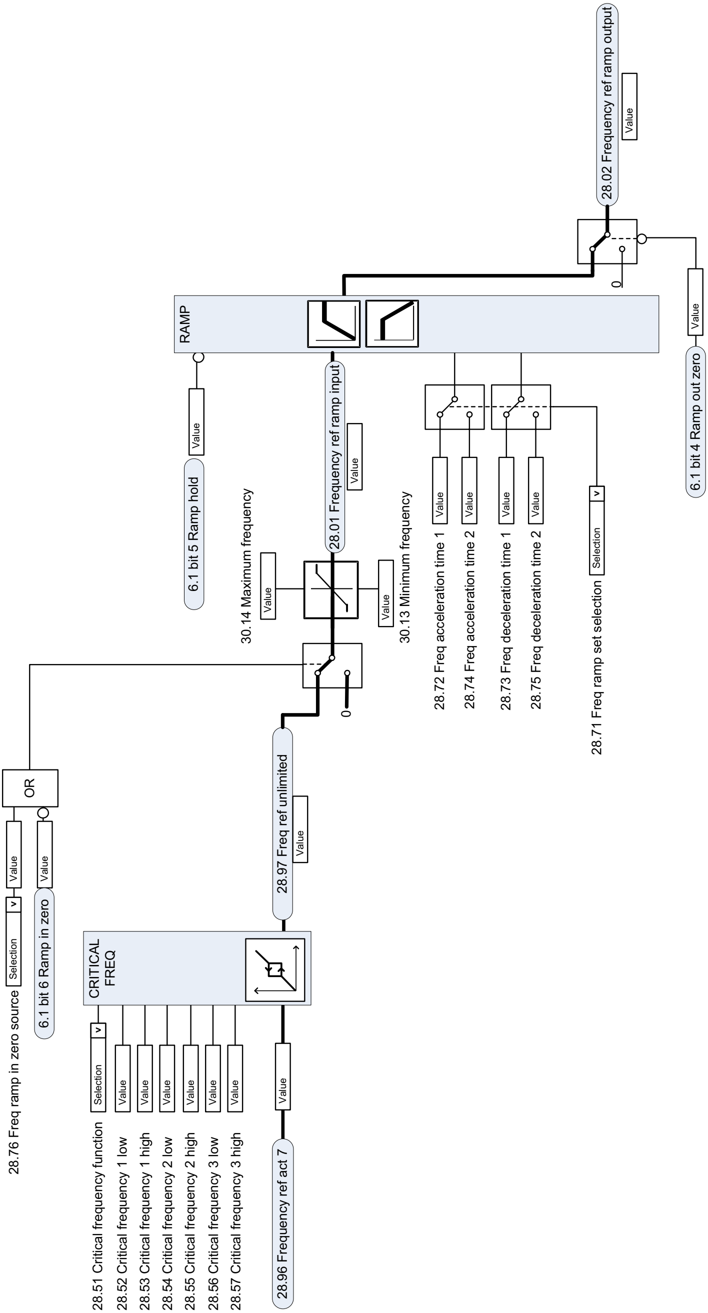
The chapter presents the reference chains of the drive. The control chain diagrams can be used to trace how parameters interact and where parameters have an effect within the drive parameter system.

For a more general diagram, see section *Operating modes of the drive* (page *59*).

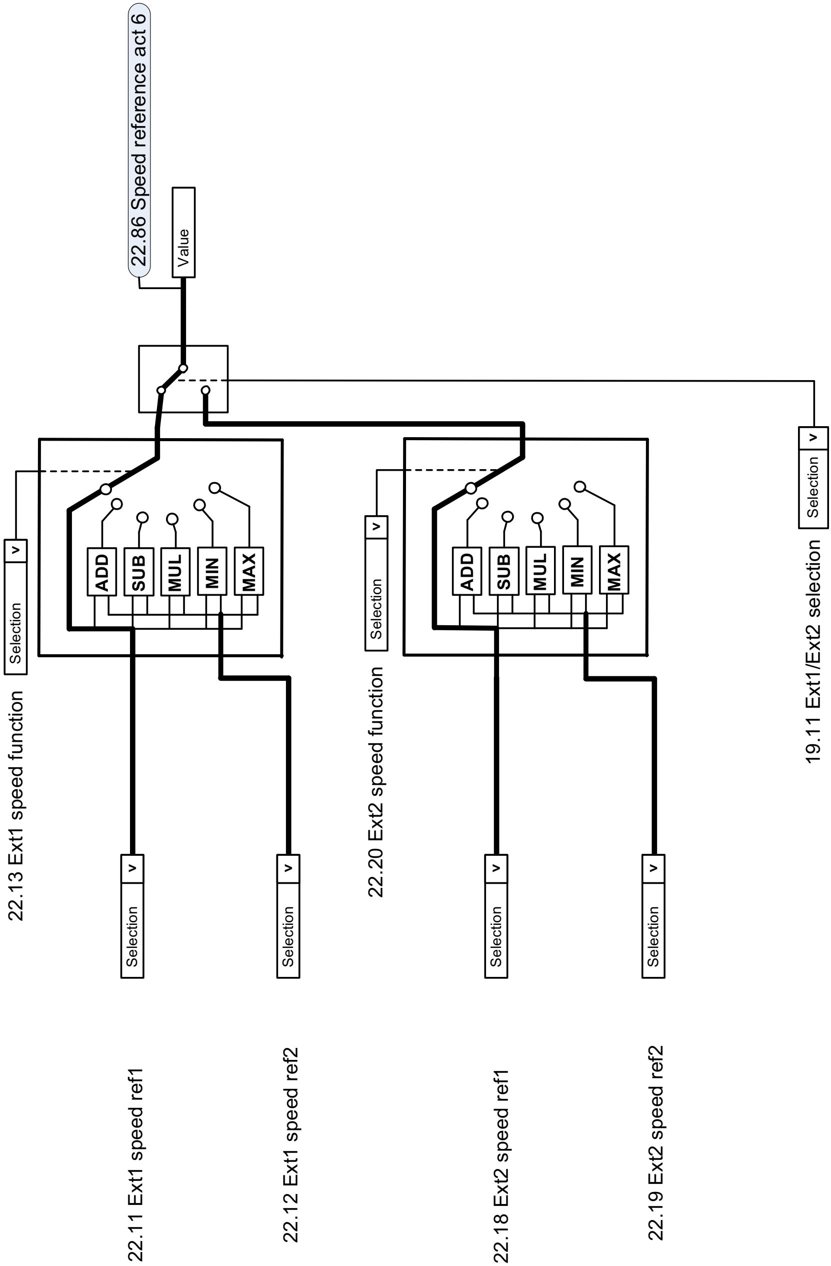
Frequency reference selection



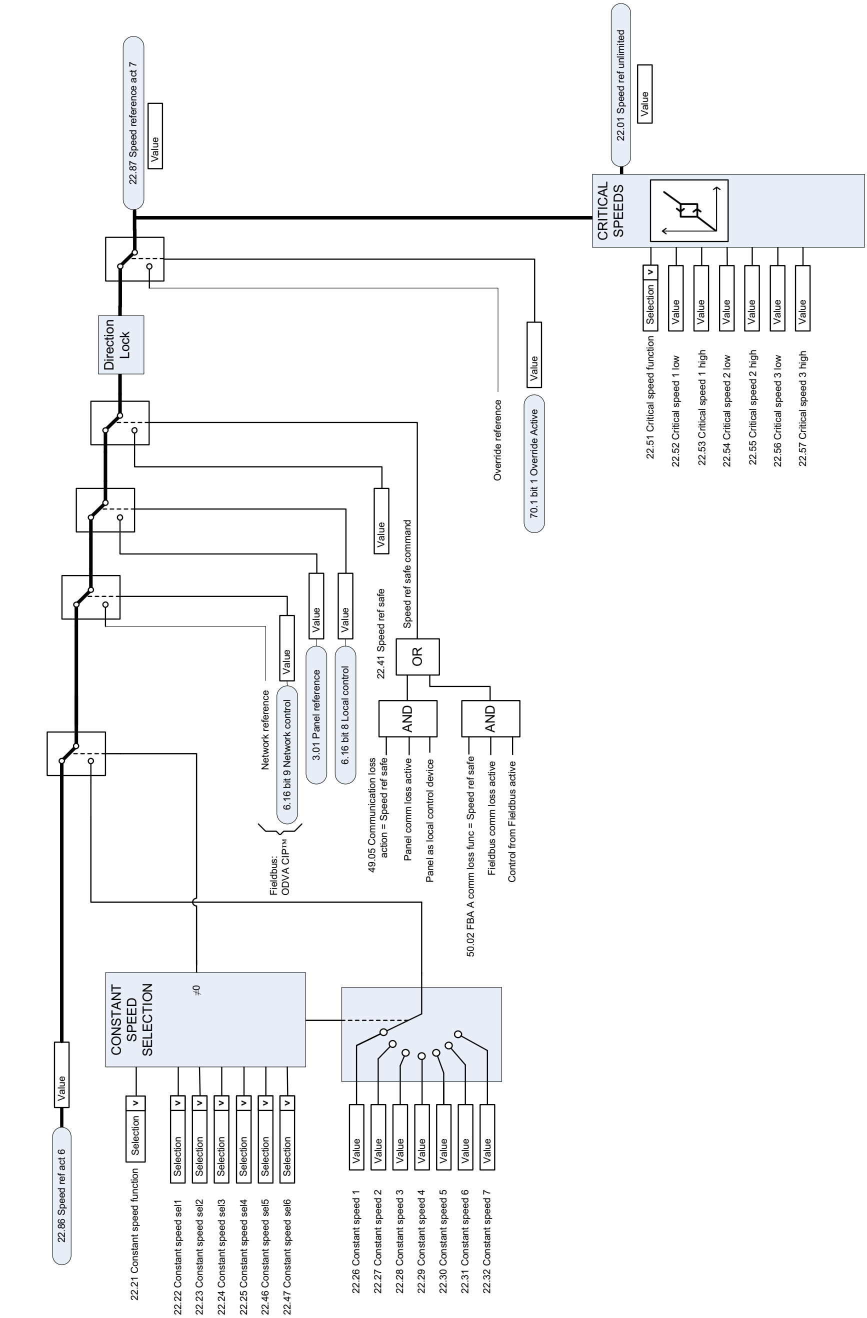
Frequency reference modification



Speed reference source selection I



Speed reference source selection II



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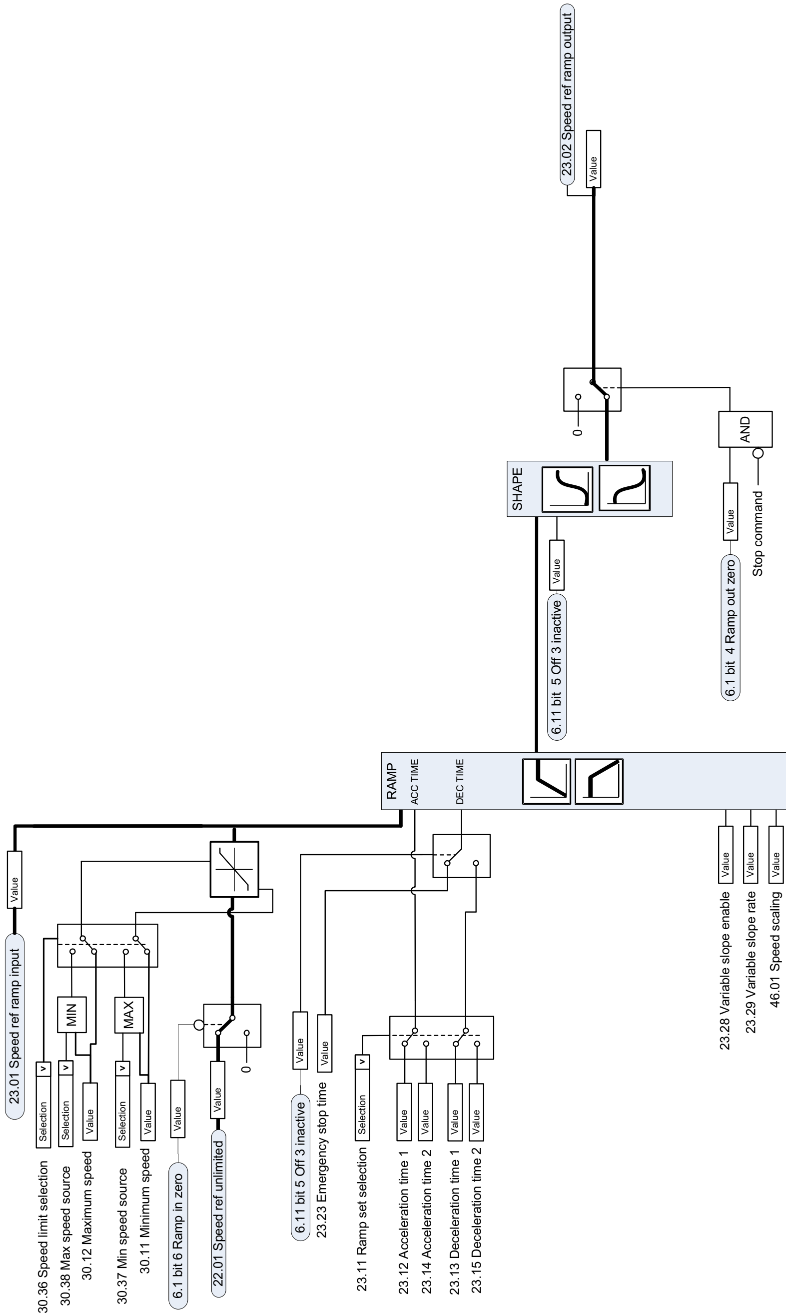
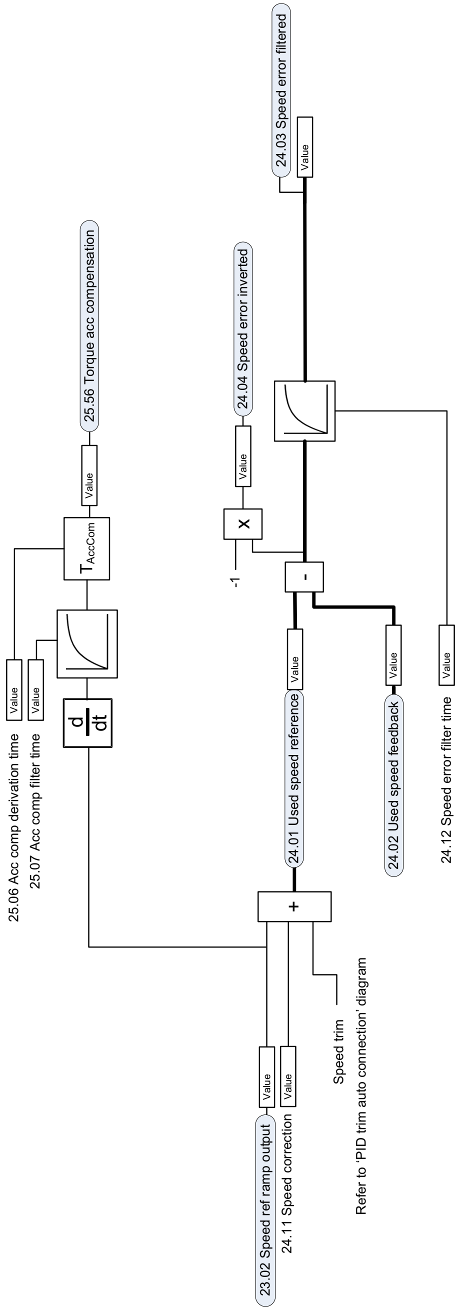
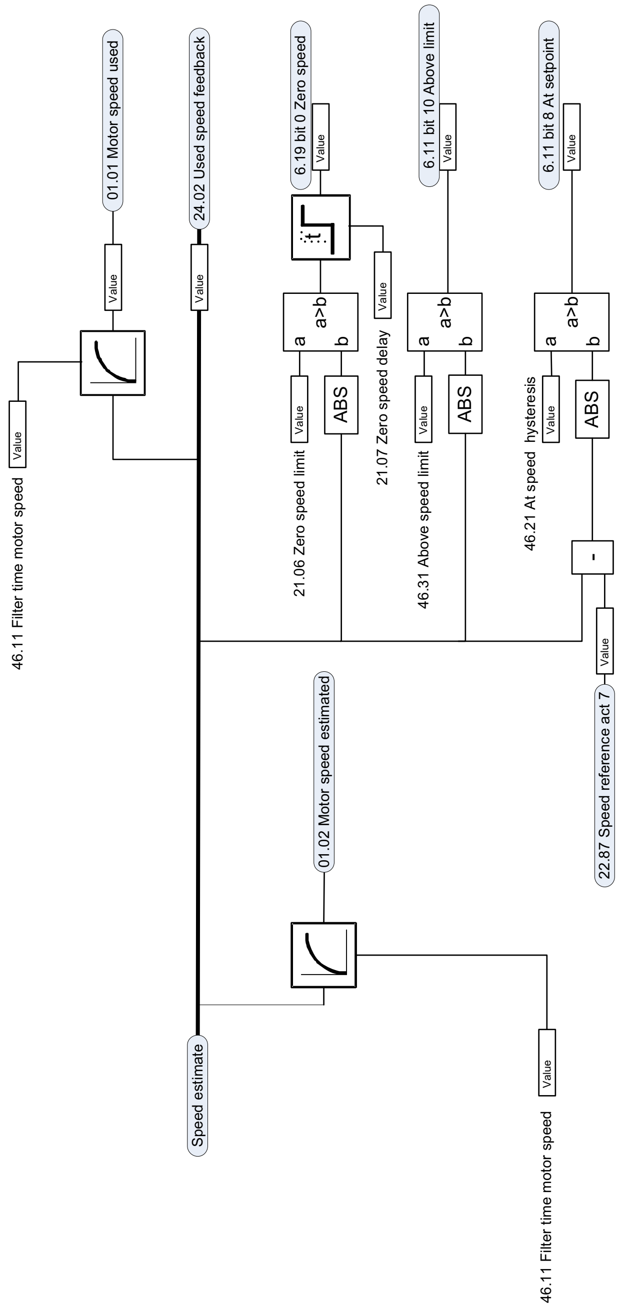
Speed reference ramping and shaping



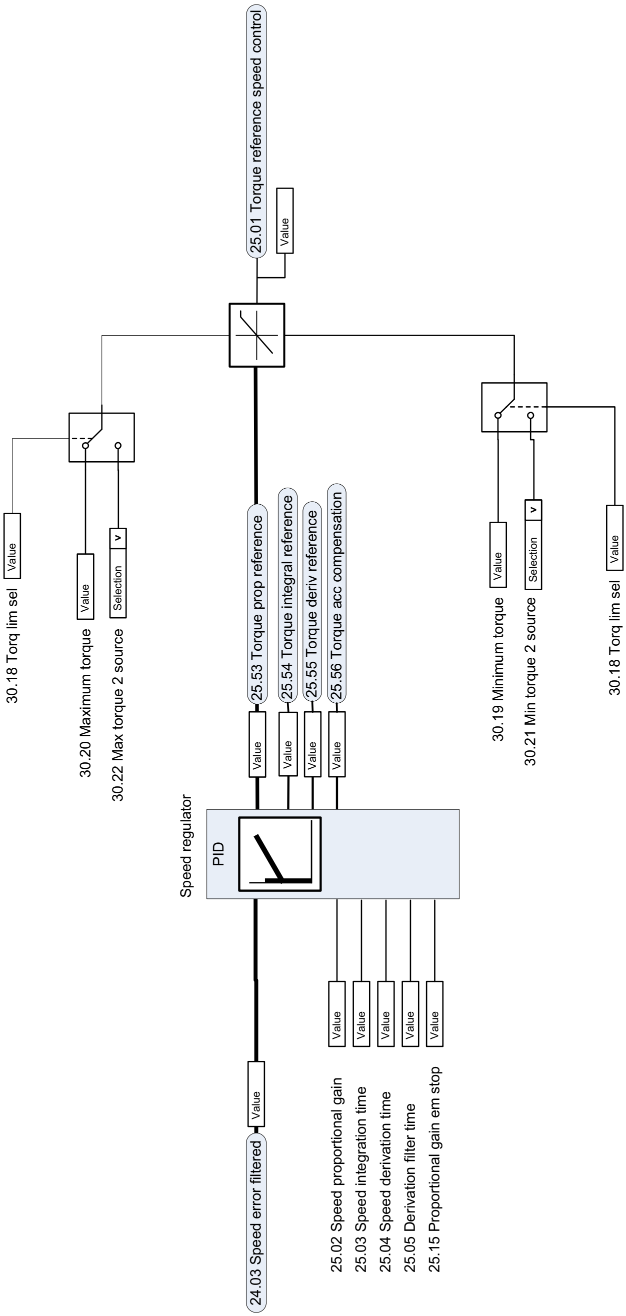
Speed error calculation



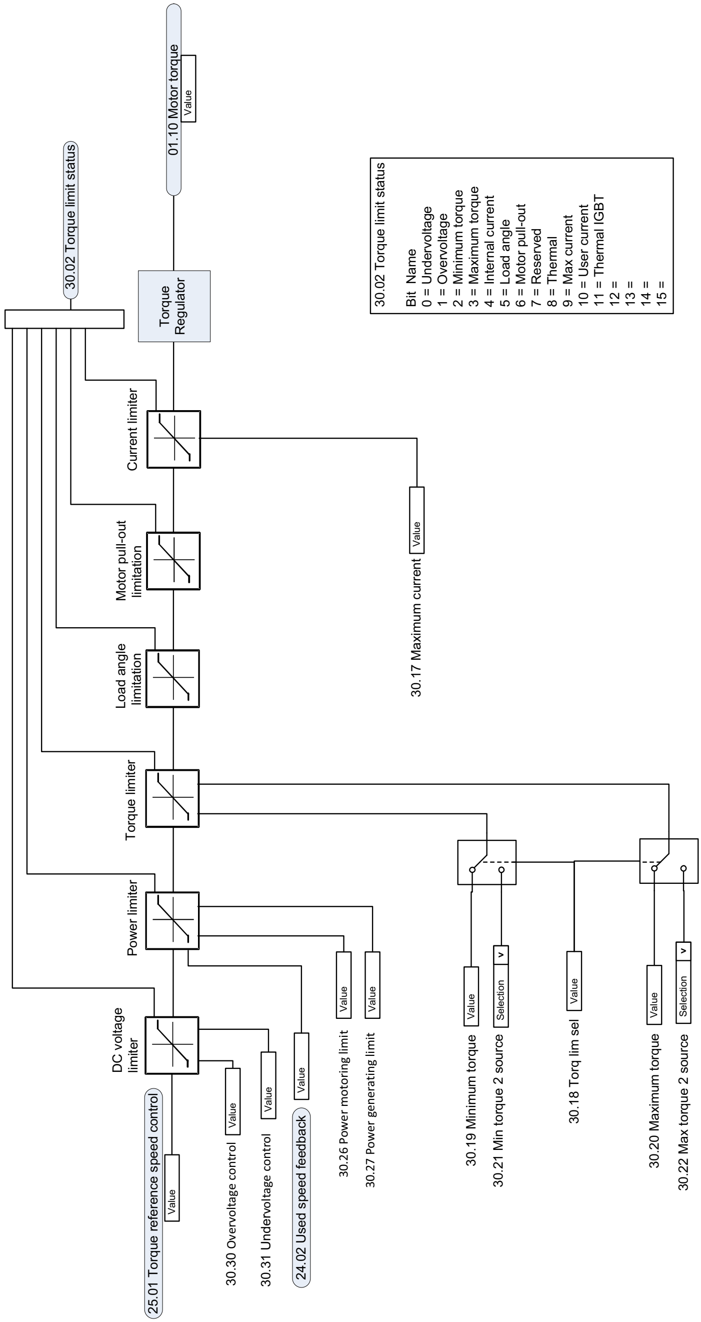
Speed feedback



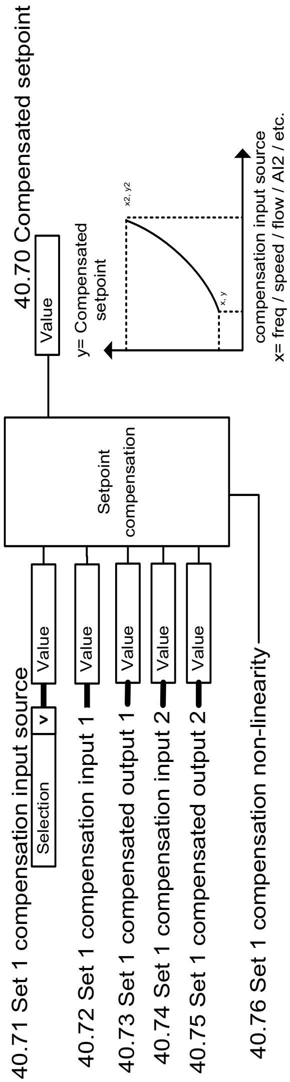
Speed controller



Torque limitation



PID setpoint compensation



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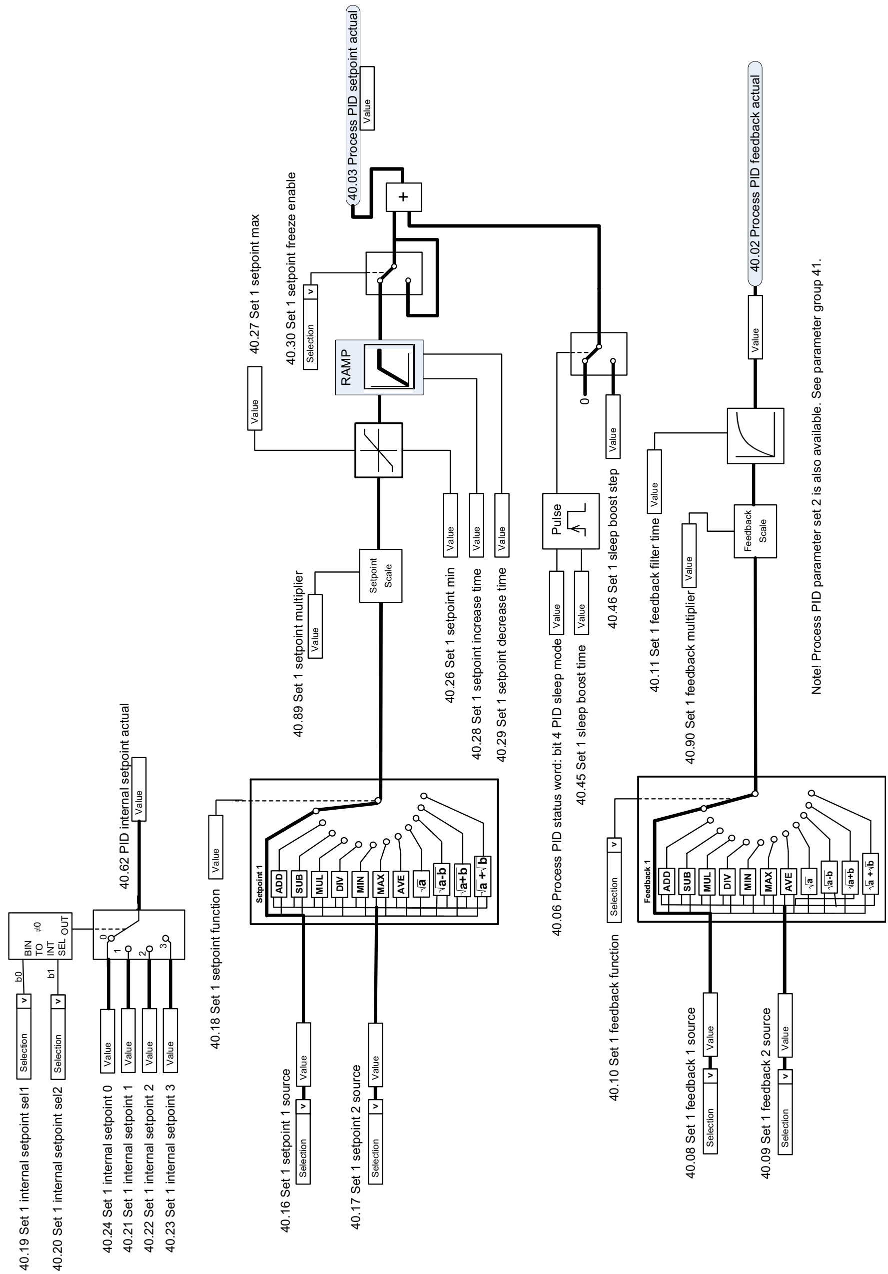
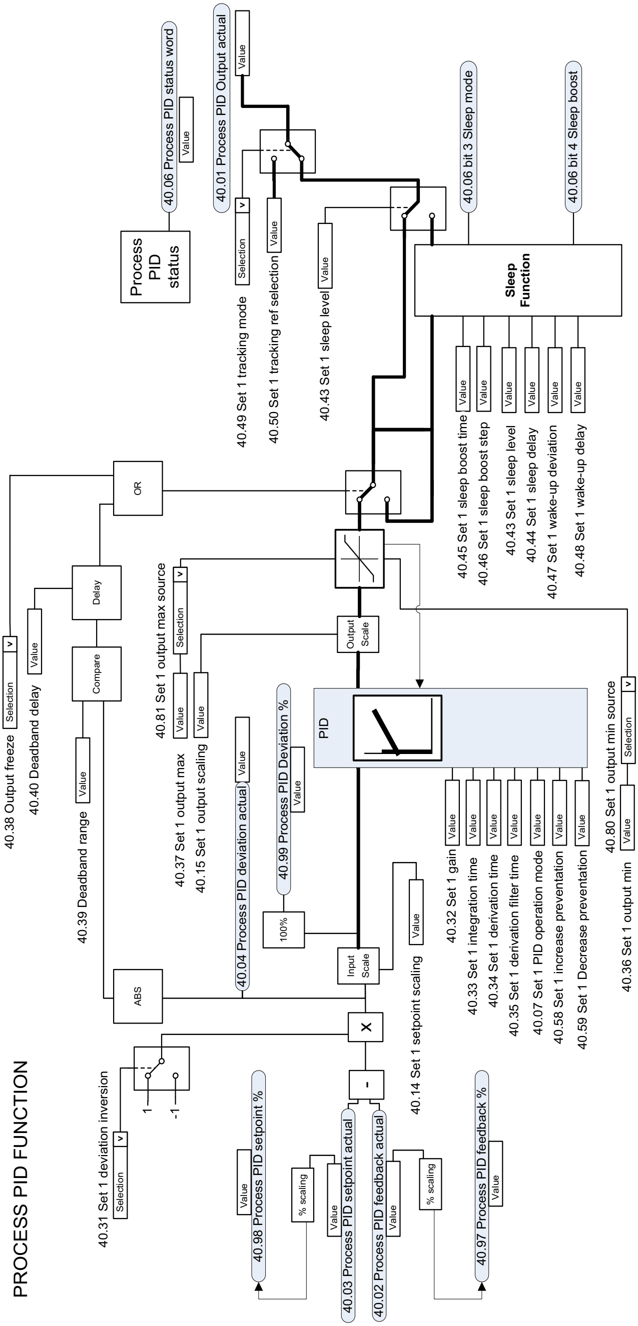
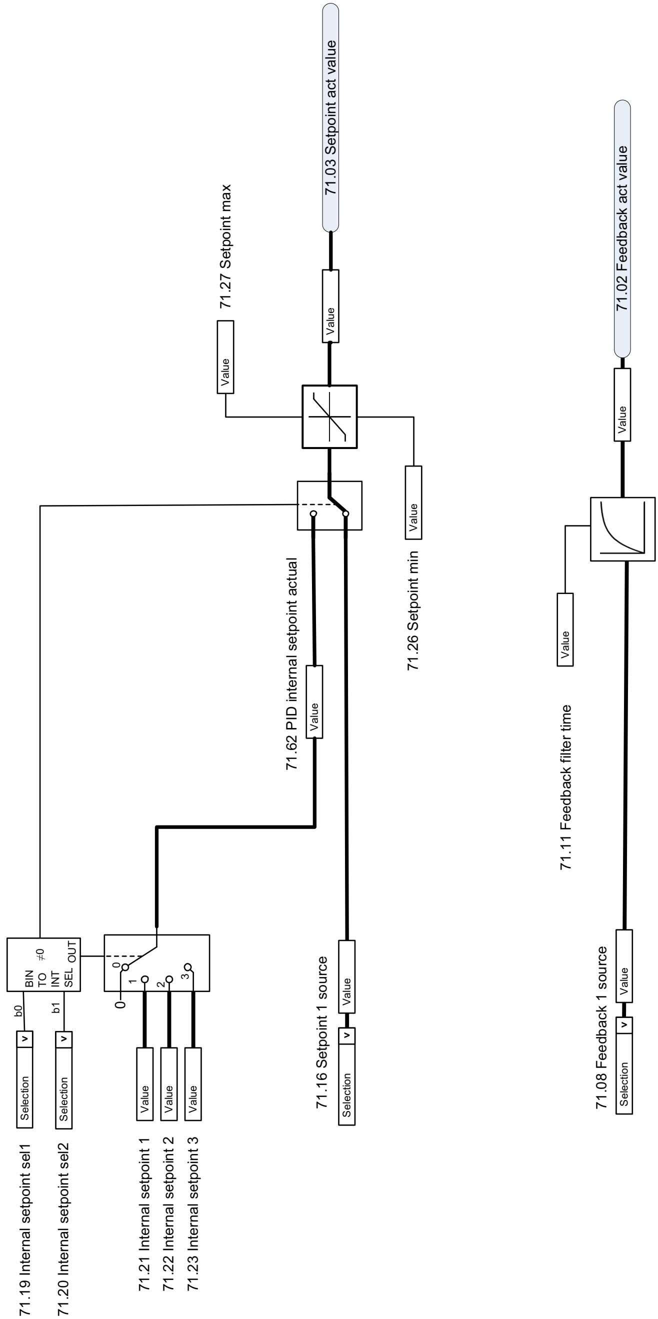
Process PID setpoint and feedback source selection



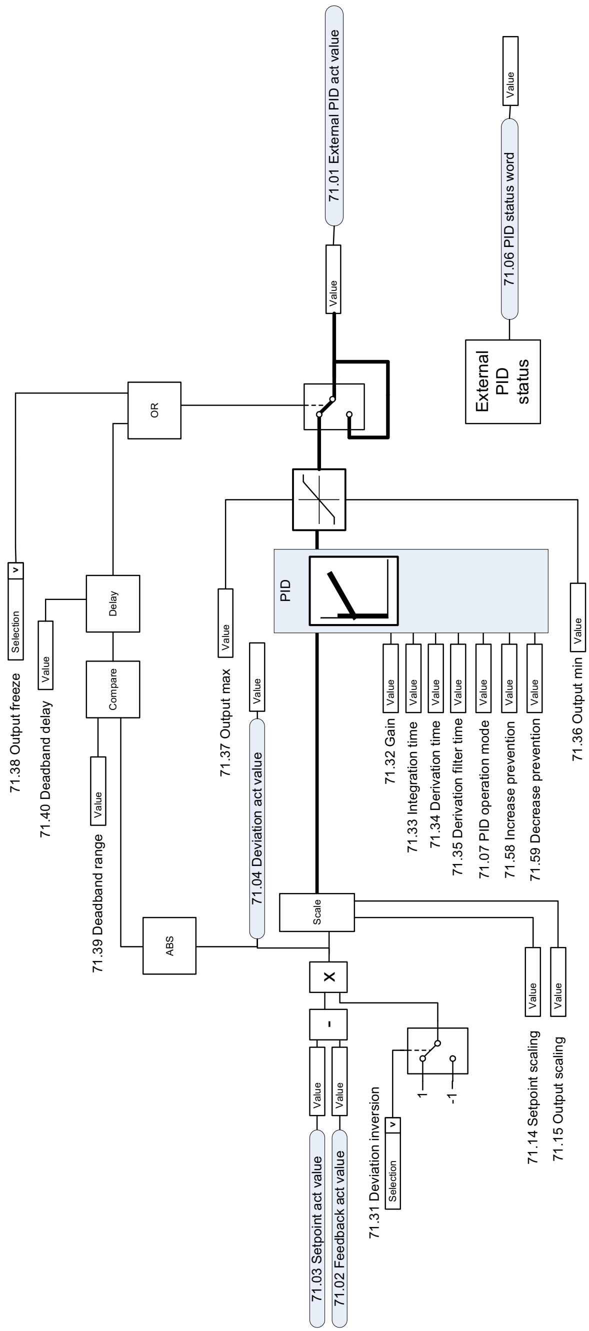
Process PID controller



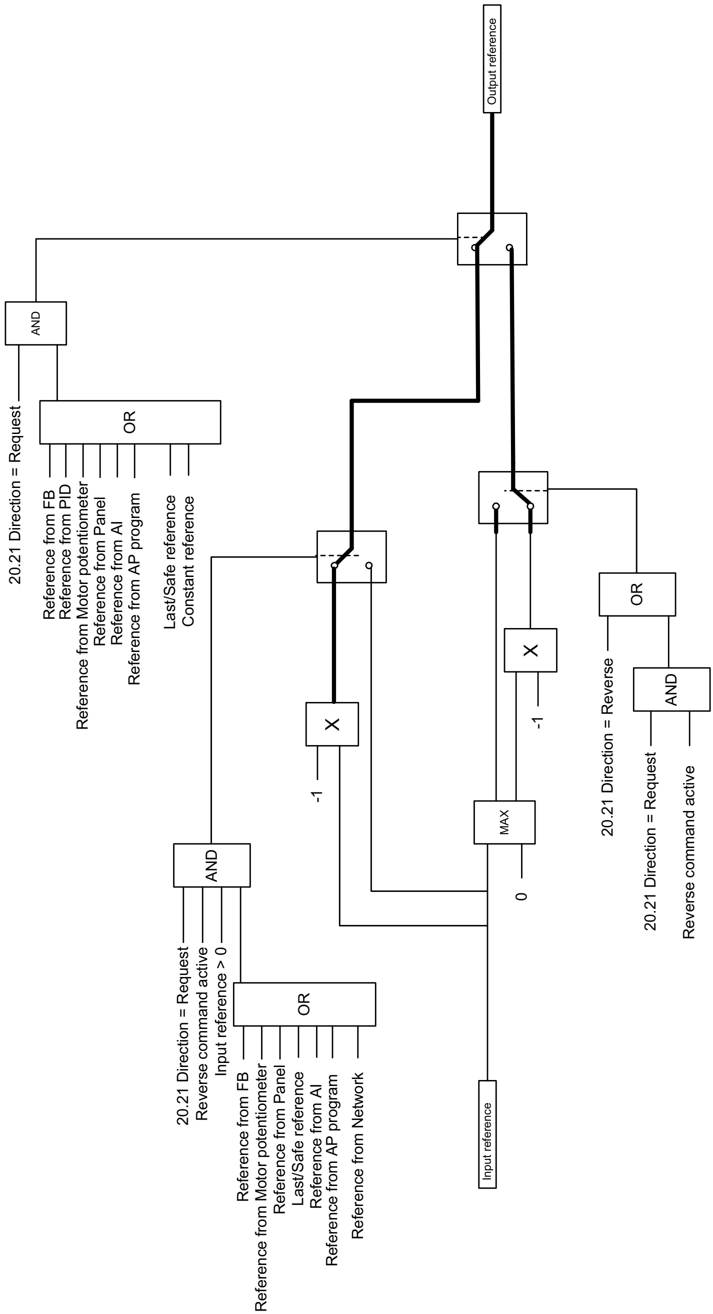
External PID setpoint and feedback source selection



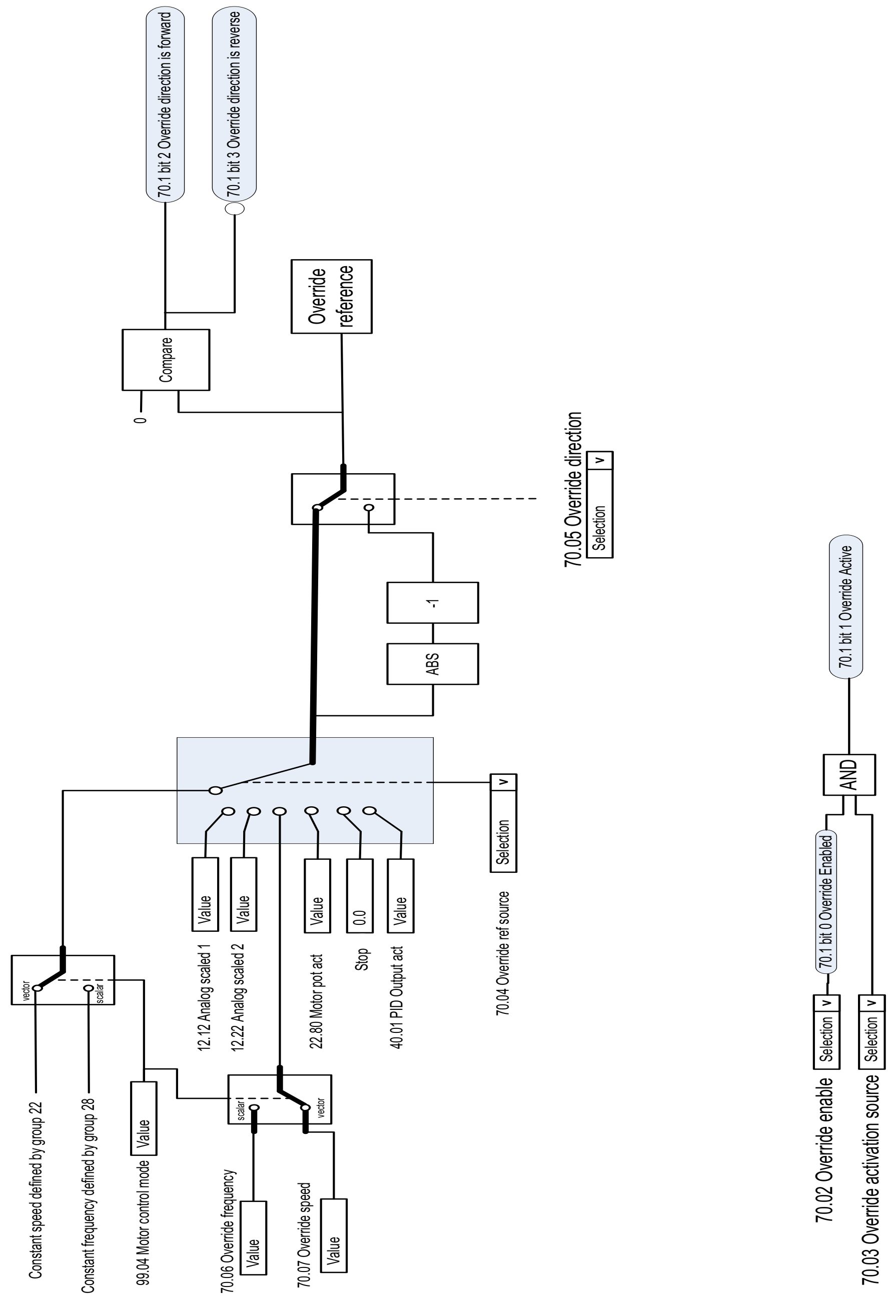
External PID controller



Direction lock



Override


70.1 bit 2 Override direction is forward
70.1 bit 3 Override direction is reverse
Compare
0
Override reference
70.05 Override direction
Selection
v
-1
ABS
70.1 bit 1 Override Active
AND
Selection
v
70.04 Override ref source
Value
12.12 Analog scaled 1
Value
12.22 Analog scaled 2
Value
22.80 Motor pot act
0.0
Stop
Value
40.01 PID Output act
vector
scalar
Constant speed defined by group 22
Constant frequency defined by group 28
Value
99.04 Motor control mode
scalar
vector
Value
70.06 Override frequency
Value
70.07 Override speed
70.1 bit 0 Override Enabled
Selection
v
70.02 Override enable
Selection
v
70.03 Override activation source

Further information

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