ABB GENERAL PURPOSE DRIVES

ACS560 standard control program

Firmware manual

List of related manuals

See section Related documents on page 14.

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

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

ACS560 manuals

Firmware manual

ACS560 standard control program

3AXD50000044997 Rev H
EN
EFFECTIVE: 2020-11-10

Table of contents

1. Introduction to the manual

2. Start-up, control with I/O and ID run

3. Using the control panel

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9. Fieldbus control through the embedded fieldbus interface (EFB)

10. Fieldbus control through a fieldbus adapter

11. Control chain diagrams

12. Parameterization with drive composer

13. Parameterization with automation builder drive manager

Further information

1

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 ACS560 standard control program IGPKX version 2.14.0.0. IGPKA is used for frames R0...R2, IGPK2 is used for frames R3...R5 and IGPK4 for frames R6...R8.

To check the firmware version of the control program in use, see system information parameter *07.05 Firmware version* (see page *179*) 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 *161*.

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.

Purpose of the manual

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

Contents of this manual

The manual consists of the following chapters:

- *Introduction to the manual* (this chapter, page *11*) describes applicability, target audience, purpose and contents of this manual. At the end, it lists terms and abbreviations.
- *Start-up, control with I/O and ID run* (page *19*) describes how to start up the drive as well as how to start, stop, change the direction of the motor rotation and adjust the motor speed through the I/O interface.
- *Using the control panel* (page *31*) contains instructions for removing and reinstalling the assistant control panel and briefly describes its display, keys and key shortcuts.
- *Program features* (page *33*) describes program features with lists of related user settings, actual signals, and fault and warning messages.
- *Control macros* (page *101*) contains a short description of each macro together with a connection diagram. Macros are pre-defined applications which will save the user time when configuring the drive.
- *Parameters* (page *161*) describes the parameters used to program the drive.
- *Additional parameter data* (page *377*) contains further information on the parameters.
- *Fault tracing* (page *411*) lists the warning and fault messages with possible causes and remedies.
- *Fieldbus control through the embedded fieldbus interface (EFB)* (page *441*) describes the communication to and from a fieldbus network using the embedded fieldbus interface of the drive.
- *Fieldbus control through a fieldbus adapter* (page *471*) describes the communication to and from a fieldbus network using an optional fieldbus adapter module
- *Control chain diagrams* (page *489*) describes the parameter structure within the drive.
- *Parameterization with drive composer* (page *509*) describes about managing the drive parameters with drive composer application.
- *Parameterization with automation builder drive manager* (page *513*) describes about managing the drive parameters with automation builder drive manager application.
- *Further information* (inside of the back cover, page *517*) 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.

Categorization by frame (size)

The ACS560 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.

Related documents

Drive manuals and guides	Code (English)	Code (Hindi)
ACS560 standard control program firmware manual	3AXD50000044997	3AXD50000045887
ACS560 (0.75 to 160 kW, 1.0 to 215 hp) hardware manual	3AXD50000044998	3AXD50000045888
ACS560 drives quick installation and start-up guide	3AXD50000042620	(Multi Lingual)
Optional manuals or guides		
ACS-AP-x Assistant control panels user's manual	3AUA0000085685	
ACS-BP-S Basic control panel user's manual	3AXD50000032527	
CDPI-01/-02 communication adapter module user's manual	3AXD50000009929	
DPMP-01 mounting platform for ACS-AP control panel	3AUA0000100140	
DPMP-02/03 mounting platform for ACS-AP control panel	3AUA0000136205	
FCAN-01 CANopen adapter module user's manual	3AFE68615500	
FECA-01 EtherCAT adapter module user's manual	3AUA0000068940	
FENA-01/-11/-21 Ethernet adapter module user's manual	3AUA0000093568	
FPBA-01 PROFIBUS DP adapter module user's manual	3AFE68573271	
FSCA-01 RS-485 adapter module user's manual	3AUA0000109533	
FPNO-21 PROFINET IO fieldbus adapter module user's manual	3AXD50000158614	
FMBT-21 Modbus/TCP Adapter Module User's Manual	3AXD50000158607	
FEIP-21 EtherNet/IP fieldbus adapter module User's manual	3AXD50000158621	
CCA-01 communication adapter quick guide	3AXD50000018457	
AOCH, NOCH du/dt filters hardware manual	3AFE58933368	
Sine filter hardware manual	3AXD50000016814	
NBRA-6xx Braking Choppers Inst/Start-up Guide	3AFY58920541	
Flange mounting kit installation supplement	3AXD50000019100	

Flange mounting kit quick installation guide for ACX580-01 frames R0 to R5	3AXD50000036610
Flange mounting kit quick installation guide for ACS880-01 and ACX580-01 frames R6 to R8	3AXD50000019099
Tool and maintenance manuals and guides	
Drive composer PC tool user's manual	3AUA0000094606
Converter module capacitor reforming instructions	38FE64059629
NETA-21 remote monitoring tool user's manual	3AUA0000096939
NETA-21 remote monitoring tool installation and start-up guide	3AUA0000096881

Terms and abbreviations

Term/abbreviation	Explanation
ACS-BP-S	Basic control panel, basic operator keypad for communication with the drive.
ACS-AP-x	Assistant control panel, advanced operator keypad for communication with the drive. The ACS560 supports types ACS-AP-I, ACS-AP-S and ACS-AP-W.
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).
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.
BIO-01	Optional I/O extension module underneath the fieldbus adapter module.
Control board	Circuit board in which the control program runs.
DC link	DC circuit between rectifier and inverter
DC link capacitors	Energy storage which stabilizes the intermediate circuit DC voltage
DI	Digital input; interface for digital input signals
DPMP-01	Mounting platform for ACS-AP control panel (flange mounting)
DPMP-02/03	Mounting platform for ACS-AP control panel (surface mounting)
Drive	Frequency converter for controlling AC motors
EFB	Embedded fieldbus
FBA	Fieldbus adapter

Term/abbreviation	Explanation
FCAN-01	Optional CANopen adapter module
FCNA-01	ControlNet adapter module
FECA-01	Optional EtherCAT adapter module
FENA-01/-11/-21	Optional Ethernet adapter module for EtherNet/IP, Modbus TCP and PROFINET IO protocols
FEPL-02	Ethernet POWERLINK adapter module
FLON-01	LONWORKS® adapter module
FPBA-01	Optional PROFIBUS DP adapter module
Frame (size)	Refers to drive physical size, for example R0 and R1. 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.
IGBT	Insulated gate bipolar transistor: used for high efficiency and fast switching
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
Macro	Pre-defined default values of parameters in drive control program. Each macro is intended for a specific application. See chapter *Control macros* on page *101*.
NETA-21	Remote monitoring tool
Network control	With fieldbus protocols based on the Common Industrial Protocol (CIP^{TM}), such as 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 manual: *FENA-01/-11/-21 Ethernet adapter module user's manual* (3AUA0000093568 [English]).
Parameter	User-adjustable operation instruction to the drive, or signal measured or calculated by the drive
PID/Loop controller	Proportional–integral–derivative 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
R0, R1,...	*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.

Term/abbreviation	**Explanation**
STO	Safe torque off. See chapter *The Safe torque off function* in the *Hardware manual* of the drive.

Cyber security disclaimer

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

2

Start-up, control with I/O and ID run

Contents of this chapter

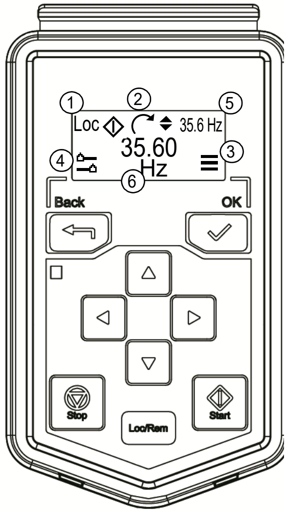
The chapter describes how to:

- perform the start-up
- start, stop, change the direction of the motor rotation and adjust the speed of the motor through the I/O interface
- perform an Identification run (ID run) for the drive.

How to start up the drive

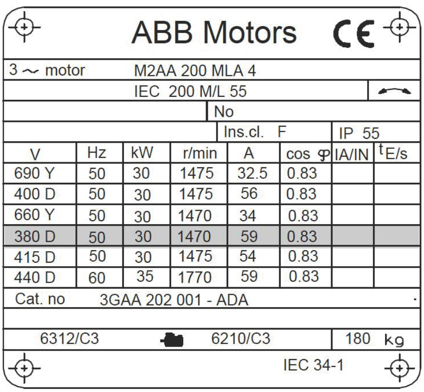
How to start up the drive using the basic control panel

Safety	
Do not start-up the drive unless you are a qualified electrician. Read and obey the instructions in chapter *Safety instructions* at the beginning of the *Hardware manual* of the drive. Ignoring the instructions can cause physical injury or death, or damage to the equipment	
☐	Check the installation. See chapter *Installation checklist* in the *Hardware manual* of the drive.
☐	Make sure there that the active start command is not on (DI1 in factory settings, i.e. ABB standard macro). The drive will start up automatically at power-up if the external run command is on and the drive is in the remote control mode. Check that the starting of the motor does not cause any danger. **De-couple the driven machine** if • there is a risk of damage in case of an incorrect direction of rotation, or • a **Normal** ID run is required during the drive start-up, when the load torque is higher than 20% or the machinery is not able to withstand the nominal torque transient during the ID run.
General Information	
☐	The settings and examples referred in this chapter are with respect to the basic control panel. For more information on basic control panel settings and menu details, see *Quick installation and start-up guide* (3AXD50000042620) or *ACS-BP-S basic control panel's user's manual (*3AXD50000032527 [English]). If you are performing the procedure with assistant control panel, see *ACS-AP-x assistant control panels user's manual* (3AUA0000085685 [English]).

	Hints on using the basic control panel	
	Display The control panel display shows the following elements: 1. **Control location and related icons**: Indicates how the drive is controlled. • **Loc**: The drive is in local control, that is, controlled from the control panel. • **Rem**: The drive is in remote control, that is, controlled through I/O or fieldbus. 2. **Rotation direction**: Shows the forward (clockwise) or reverse (counter-clockwise) rotation of motor. 3. **Main**: Navigates to the Main menu. 4. **Option**: Navigates to the Options menu. 5. **Reference value**: Allows to define the reference value of speed, frequency or current and its unit using the Up/Down arrow buttons. 6. **Actual value**: Shows the actual value of speed, frequency or current and its unit.	
	1 – First start assistant guided settings: Language, unit, and motor nominal values	
☐	Have the motor name plate data in hand. Power up the drive.	
☐	Navigate to **Main menu** ≡ → **Complete parameter list** → **parameter** *96.01* and select the desired language. Press ✔ (**OK**).	
☐	Navigate to **Main menu** ≡ → **Complete parameter list** → **parameter** *96.16* and change the unit, if needed. Press ✔ (**OK**).	

Refer to the motor nameplate for the following nominal value settings of the motor. Enter the values exactly as shown on the motor nameplate.

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



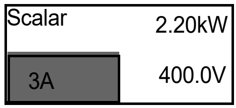
V	Hz	kW	r/min	A	cos φ	IA/IN	tE/s
690 Y	50	30	1475	32.5	0.83		
400 D	50	30	1475	56	0.83		
660 Y	50	30	1470	34	0.83		
380 D	50	30	1470	59	0.83		
415 D	50	30	1475	54	0.83		
440 D	60	35	1770	59	0.83		

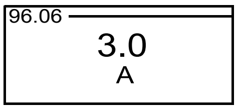
☐ Navigate to **Main menu** ☰ and select **Motor data**.

☐ Set the motor nominal current:

- Use ◄ and ► to move the cursor left and right.
- Use ▲ and ▼ to change the value.

Press ✔ (**OK**) to accept the new setting, or press ← (**Back**) to go back to the previous view without making changes.

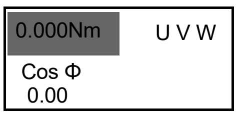


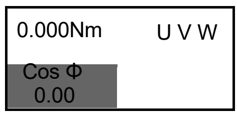


☐ Set the torque and motor Cos Φ, if needed. Motor nominal cos Φ and nominal torque are optional.

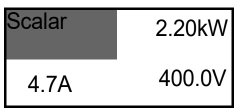
- Use ◄ and ► to move the cursor left and right.
- Use ▲ and ▼ to change the value.

Press ✔ (**OK**) to accept the new setting, or press ← (**Back**) to go back to the previous view without making changes.

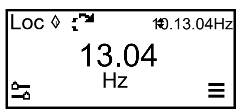


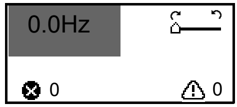
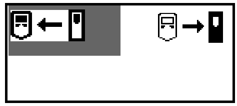
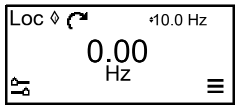
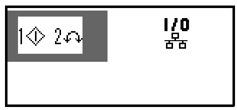
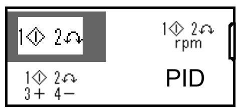


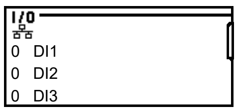
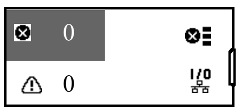
☐ Set the desired motor control mode. If Vector motor control mode is selected, make sure that ID run is performed. See *ID run procedure*.

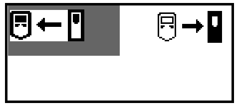


☐ Navigate to **Options menu** → and set the direction.



☐	Navigate to the **Options menu** and set the frequency/speed reference. Use ▲ and ▼ to change the value. Press ✔ (**OK**) to accept the new setting, or press ← (**Back**) to go back to the previous view without making changes.	
☐	Press **Start**. Make sure that the motor is running in the required direction. The direction symbol is displayed in the home page. The forward direction is indicated by ↷ and the reverse direction is indicated by ↶.	
☐	Press **Stop**.	
☐	If you want to make a backup of the settings made so far, navigate to **Main menu** ☰ and select **Backup**. You can restore and back up the data between drive and panel. Select the option and press ✔ (**OK**) to accept or press ← (**Back**) to go back to the previous view without making changes.	
☐	The first start setup is complete and the drive is ready for use. The home view displays the values of selected signals.	
2 – Additional settings **Macro/start-stop reference, ramp, and limit settings**		
☐	You can make any additional changes to the macro, ramp, and limits, if required.	
☐	**Macro settings** Navigate to the **Main menu** ☰ and select **I/O connection**. Select the desired macro. Use ◄ and ► to move the cursor left and right. Press ✔ (**OK**) to accept or press ← (**Back**) to go back to the previous view without making changes.	 
	Notes: • Changing the macro resets all settings to the default values of the selected macro and updates the I/O signals used in the drive. You can see the currently used I/O signals in the I/O menu. • All macros, except the ABB standard (vector) and Pharma macro, use scalar motor control by default. You can change the motor control mode in the **Motor data**.	

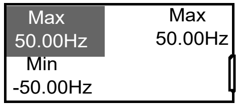
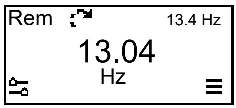
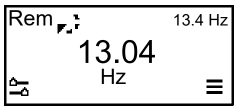
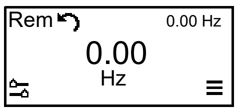
☐	**Start, stop, and reference values** If you do not wish to use a macro, navigate to **Main menu** → **Complete parameter list** → **Parameter groups** *20*, *21*, and *23* and manually define the settings for start, stop and reference. **Notes:** • Changing the start, stop, and reference settings, changes the I/O signals used in the drive. You can see the currently used I/O signals in the menu. • Make sure that the used I/O connection matches with the actual I/O wiring. See *Control macros* on page *101*.	
☐	**Ramp settings** Navigate to **Main menu** → **Complete parameter list** → **Parameter group** *23* and change the parameters according to your need. For example, acceleration time, deceleration time, emergency stop time etc. After making the changes, press **OK** to accept or press (**Back**) to the previous view without making changes.	
☐	**Limit settings** Navigate to **Main menu** → **Complete parameter list** → **Parameter group** *30* and change the parameters according to your need. For example, minimum speed, maximum speed, maximum current, etc. After making the changes, press **OK** to accept or press (**Back**) to the previous view without making changes.	
	3 – I/O menu	
☐	After the additional changes, make sure that the used I/O connection matches with the actual I/O wiring. See *Control macros* on page *101*. To see the currently used I/O signals, navigate to **Main menu** →**I/O menu** →**I/O status** .	
☐	Use and to check the values.	
	4 – Diagnostics menu	
☐	After the additional adjustments and I/O connection validation, navigate to **Main menu** →**Diagnostics** and make sure that the setup is functioning correctly. Diagnostics menu displays the active faults , fault history , active warnings , and I/O status .	

5 – Backup		
☐	After the start-up, it is recommended that you make a backup of the configured parameters. You can restore and back up the data between drive and panel. To backup the settings, navigate to **Main menu** → . Select or as desired. Press **Ok** to accept or press **Back** to go back to the previous view without making changes.	

How to control the drive through the I/O interface

The table below describes how to operate the drive through the digital and analog inputs when:

- the motor start-up is performed, and
- the default parameter settings of the ABB standard macro are in use.

<table>
<tr><th colspan="2">Preliminary settings</th></tr>
<tr><td>If you need to change the direction of rotation, navigate to Menu → Motor control and make sure that the minimum speed/frequency limit has a negative value and the maximum speed/frequency limit has a positive value.</td><td>
</td></tr>
<tr><td colspan="2">Make sure that the ABB standard macro control connections are correct. See ABB standard macro on page 102.
Make sure that the drive is in remote control. Press key Loc/Rem to switch between remote and local control.
In remote control, the panel display shows text Rem at the top left.</td></tr>
<tr><th colspan="2">Starting and controlling the speed of the motor</th></tr>
<tr><td>Switch on the digital input DI1 on.
Observe the rotating arrow next to Rem. The dotted arrow appears until the setpoint is reached.
Regulate the drive output frequency (motor speed) by changing the voltage of analog input AI1.</td><td>
</td></tr>
<tr><th colspan="2">Changing the direction of the motor rotation</th></tr>
<tr><td>To change the direction, perform as follows
• For reverse direction, switch on the digital input DI2.
• For forward direction, switch off the digital input DI2.</td><td>
</td></tr>
<tr><th colspan="2">Stopping the motor</th></tr>
<tr><td>To stop the motor, switch digital input DI1 to off.
Observe that the arrow stops rotating.</td><td>
</td></tr>
</table>

Identification (ID) run

During Identification (ID) run the drive identifies the characteristics of the motor for optimum motor control.

When the drive is started for the first time in vector control mode and after any parameter is changed in the parameter group *99 Motor data*, the drive automatically performs the *Standstill* ID run.

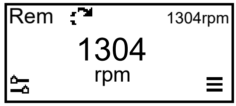
In most applications there is no need to perform a separate ID run. ID run needs to be performed manually if:

- vector control mode is used (parameter *99.04 Motor control mode* is set to *Vector* [0]), and
- drive operates near zero speed references, or
- operation at torque range above the motor nominal torque, over a wide speed range is needed.

To perform the ID run manually, see *ID run procedure*.

ID run procedure

	Pre-check	
	WARNING! The motor will run at up to approximately 50…80% of the nominal speed during the ID run. The motor will rotate in the forward direction. **Make sure that it is safe to run the motor before performing the ID run!**	
☐	De-couple the motor from the driven equipment	
☐	Check that the values of the motor data parameters are equivalent to those on the motor nameplate.	
☐	Check that the STO circuit is closed.	
	If parameter values (from group *10 Standard DI, RO* to group *99 Motor data*) are changed before the ID run, check that the new settings meet the following conditions:	
☐	*30.11 Minimum speed* ≤ 0 rpm	
☐	*30.12 Maximum speed* = motor rated speed (Normal ID run procedure needs the motor to be run at 100% speed.)	
☐	*30.17 Maximum current* > I_{HD}	
☐	*30.20 Maximum torque 1* > 50%	
	Check that signals	
☐	run enable (parameter *20.12 Run enable 1 source*) is active	
☐	start enable (parameter *20.19 Enable start command*) is active	
☐	enable to rotate (parameter *20.22 Enable to rotate*) is active.	
☐	Make sure that the panel is in local control (text Local shown at the top left). Press key Loc/Rem to switch between local and remote control.	
	ID run	
☐	Navigate to **Main menu** → **Complete parameter list** → **parameter** *99.13* and select the type of ID run you want to do. Press (**OK**)	99.13 [0] [1] [2]
	Panel LED starts blinking green to indicate an active warning (*AFF6*). You can hide the warning view by pressing (**Back**). Press the start key ( ) to start the ID run. **Note:** In general, it is recommended not to press any control panel keys during the ID run. However, you can stop the ID run at any time by pressing the stop key ( ).	Warning: AFF6 99.13 [0] [1] [2]

☐	During the ID run the arrow rotates at the top. After the ID run is completed, the arrow stops rotating and the rpm turns to 0.00. If the ID run fails, fault *FF61 ID run* is shown. For more information, see chapter *Fault tracing* on page *411*. **Note:** You must repeat the ID run procedure if you have changed the motor parameters (*99 Motor data*) after the ID run was competed.	 

3

Using the control panel

The ACS560 drive supports both basic and assistant control panels. For more information, refer:

- *ACX-AP-x assistant control panel's user's manual* (3AUA0000085685 [English])

and

- *ACS-BP-S basic control panel's user's manual* (3AXD50000032527 [English])

4

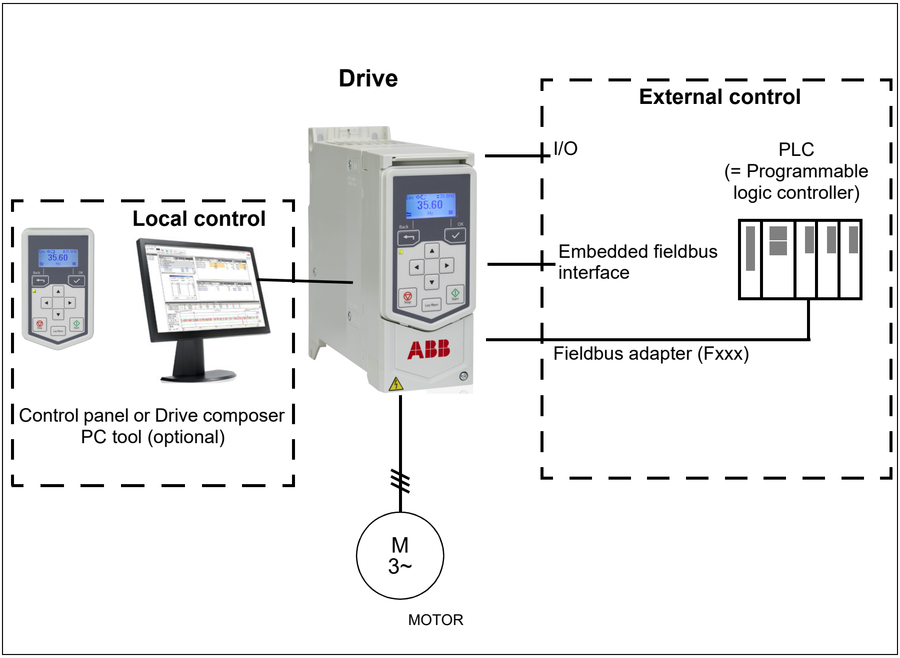
Program features

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 AC560 drive has two main control locations, external and local. The control location is selected with the **Loc/Rem** key on the control panel or in the PC tool. The local control allows you to control the drive through control panel or drive composer and the remote control allows you to control the drive through PLC/fieldbus adapter/ I/O connections/embedded fieldbus controller.



Local control

The control commands are given from the control panel keypad or from a PC equipped with Drive composer when the drive is in local control. Speed control mode is available in vector motor control mode and frequency mode is available when scalar motor control mode is used (see parameter *19.16 Local control mode*).

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

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

External control

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

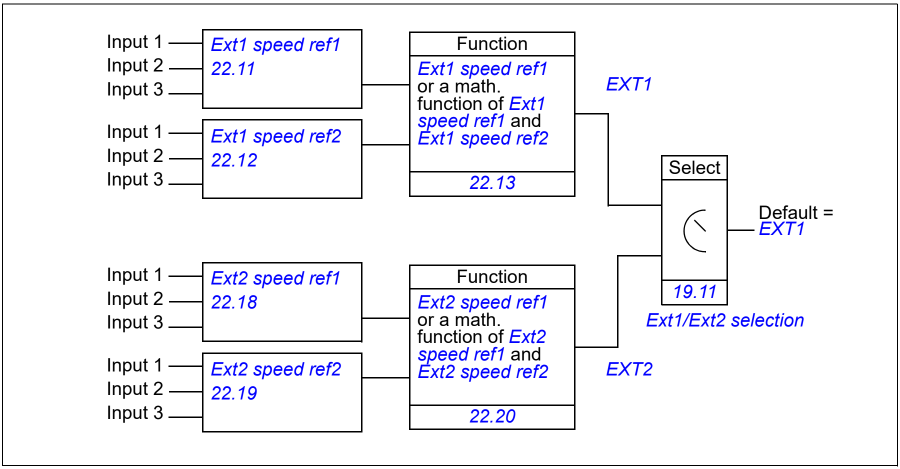
- the I/O terminals (digital and analog inputs), or optional I/O extension modules
- the fieldbus interface (via the embedded fieldbus interface or an optional fieldbus adapter module).

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*…*20.10*. 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.

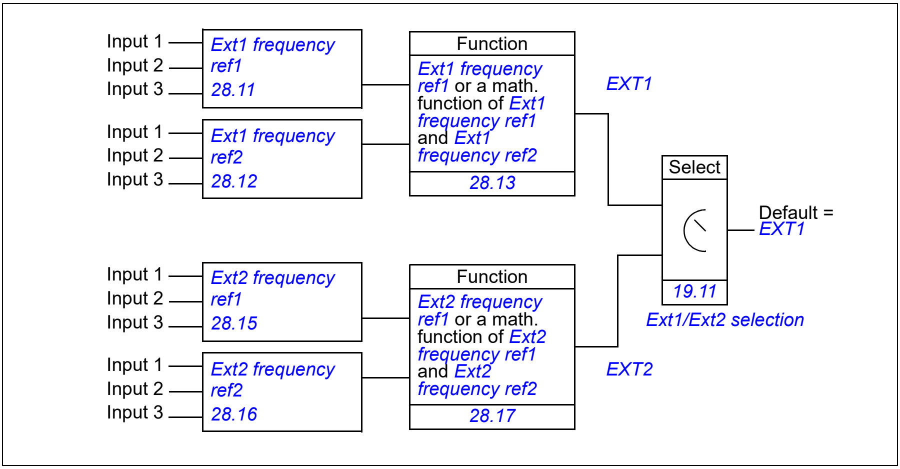
Communication fail functionality

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).

EXT1/EXT2 selection for speed control

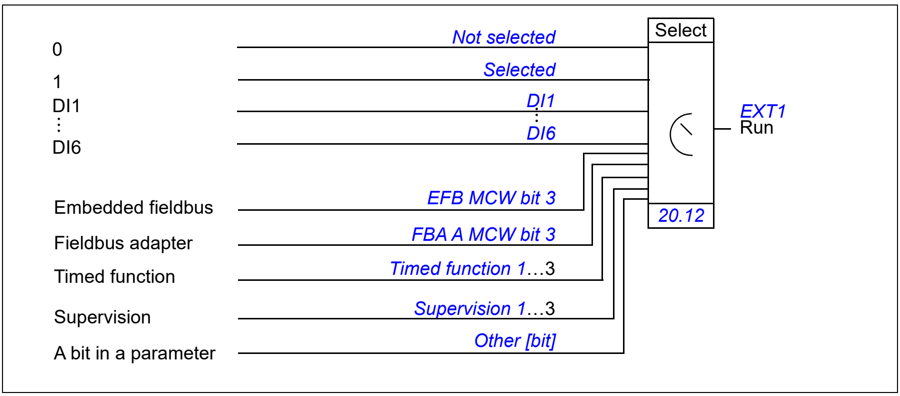


EXT1/EXT2 selection for frequency control



Block diagram: Run enable source for EXT1

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

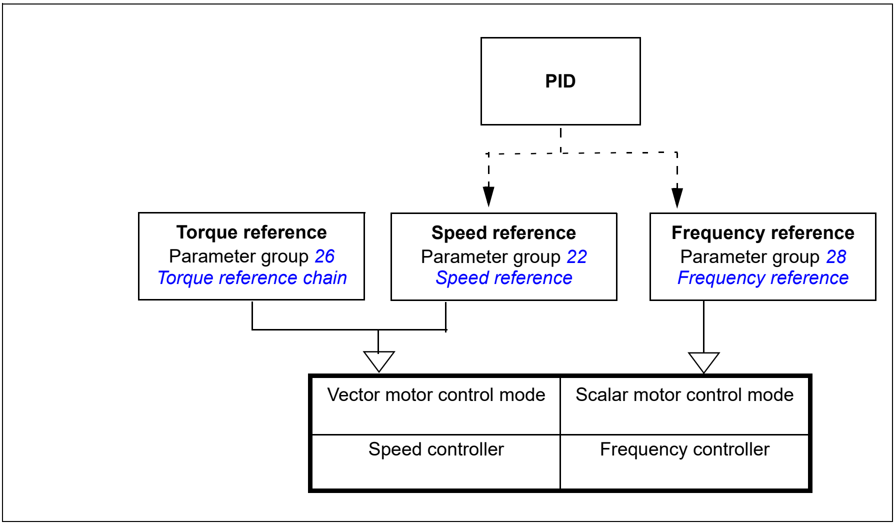


Settings

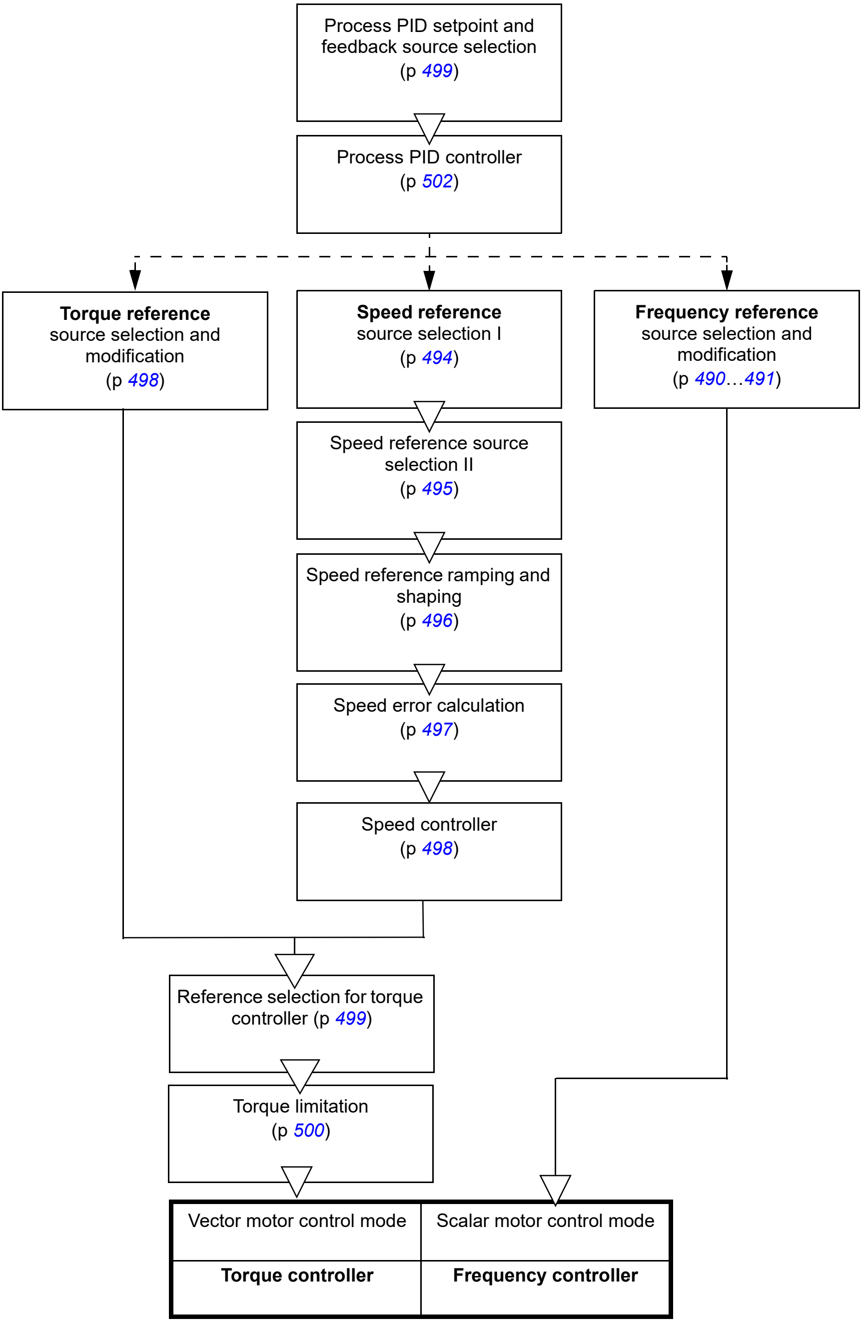
Parameters *19.11 Ext1/Ext2 selection* (page *200*); *20.01*…*20.10* (page *201*).

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.



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


Process PID setpoint and feedback source selection (p 499)
Process PID controller (p 502)
Torque reference source selection and modification (p 498)
Speed reference source selection I (p 494)
Frequency reference source selection and modification (p 490…491)
Speed reference source selection II (p 495)
Speed reference ramping and shaping (p 496)
Speed error calculation (p 497)
Speed controller (p 498)
Reference selection for torque controller (p 499)
Torque limitation (p 500)
Vector motor control mode
Scalar motor control mode
Torque controller
Frequency controller

Speed control mode

The motor follows a speed reference given to the drive. This mode can be used either 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. You can select speed reference using parameters in group *22 Speed reference selection* on page *219*.

Torque control mode

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

Torque control uses torque reference chain. Select torque reference with parameters in group *26 Torque reference chain* on page *239*.

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. You can select frequency reference using parameters in group *28 Frequency reference chain* on page *243*.

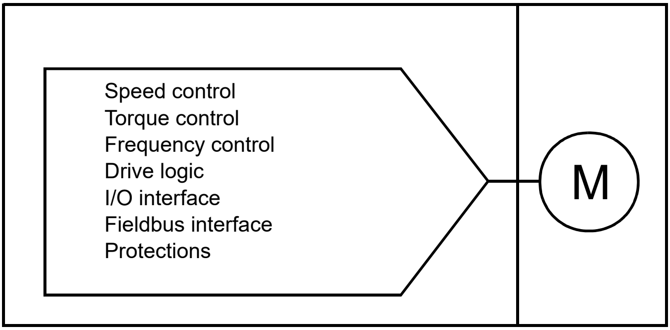
Special control modes

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

- Process PID control. For more information, see section *Process PID control* (page *50*).
- Emergency stop modes OFF1 and OFF3: Drive stops along the defined deceleration ramp and drive modulation stops.
- Jogging mode: Drive starts and accelerates to the defined speed when the jogging signal is activated. For more information, see section *Jogging* (page *72*).
- Pre-magnetization: DC magnetization of the motor before start. For more information, see section *Pre-magnetization* (page *69*).
- DC hold: Locking the rotor at (near) zero speed in the middle of normal operation. For more information, see section *DC hold* (page *69*).
- Pre-heating (motor heating): Keeping the motor warm when the drive is stopped. For more information, see section *Pre-heating (Motor heating)* (page *70*).

Drive configuration and programming

The drive control program performs the main control functions, including speed, torque 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 parameters

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

- the control panel, as described in chapter *Using the control panel*
- the Drive composer PC tool, see chapter *Parameterization with drive composer*
- the automation builder drive manager, see *Parameterization with automation builder drive manager* or
- the fieldbus interface, as described in chapters *Fieldbus control through the embedded fieldbus interface (EFB)* and *Fieldbus control through a fieldbus adapter*.

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

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

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 by a switch on the control unit, or with parameters. Each input can be filtered, inverted and scaled.

Settings

Parameter group *12 Standard AI* (page *188*).

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 by a switch on the control unit, or with a parameter. Analog output 2 always uses current. Each output can be filtered, inverted and scaled.

Settings

Parameter group *13 Standard AO* (page *193*).

Programmable digital inputs and outputs

The control unit has six digital inputs.

Digital input DI5 can be used as a frequency input or digital input.

Settings

Parameter groups *10 Standard DI, RO* (page *179*) and *11 Standard DIO, FI, FO* (page *187*).

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 *179*).

Fieldbus control

The drive can be connected to several different automation systems through its fieldbus interfaces. See chapters *Fieldbus control through the embedded fieldbus interface (EFB)* (page *441*) and *Fieldbus control through a fieldbus adapter* (page *471*).

Programmable I/O extensions

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

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

Location	Digital inputs (DI)	Digital outputs (DO)	Digital I/Os (DIO)	Analog inputs (AI)	Analog outputs (AO)	Relay outputs (RO)
Base unit	2	-	-	-	-	1
BIO-01 (old)	3	1	-	1	-	-
BIO-01 (new)	Max. 3	Max. 1	-	1	Max. 1	-

New BIO-01 extension module

A new BIO-01 extension module has been introduced. The firmware supports both new and old BIO-01 extension modules.

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

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

Settings

Parameter groups *50 Fieldbus adapter (FBA)* (page *328*), *51 FBA A settings* (page *332*), *52 FBA A data in* (page *333*), and *53 FBA A data out* (page *334*) and *58 Embedded fieldbus* (page *334*).

Parameter *05.99 BIO-01 DIP switch status*.

Application control

Reference ramping

Acceleration and deceleration ramping times can be set individually for speed, torque and frequency reference (**Main menu** ≡ → **Motor control**).

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

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

Variable slope

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

Variable slope is only supported in remote external control.

Settings

Parameters *23.28 Variable slope* (page *230*) and *23.29 Variable slope rate* (page *230*).

Special acceleration/deceleration ramps

The acceleration/deceleration times for the jogging function can be defined separately; see section *Jogging* (page *72)*.

The change rate of the motor potentiometer function (page *75*) is adjustable. The same rate applies in both directions.

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

Settings

- Menu ≡ → Motor control.
- Speed reference ramping: Parameters *23.11*…*23.15* and *46.01* (pages *228* and *321*).
- Torque reference ramping: Parameters*01.30*, *26.18* and *26.19* (pages *166* and *241*).
- Frequency reference ramping: Parameters *28.71*…*28.75* and *46.02* (pages *251* and *322*).
- Jogging: Parameters *23.20* and *23.21* (page *229*).
- Motor potentiometer: Parameter *22.78*/*22.79* (page *227*).
- Emergency stop (“Off3” mode): Parameter *23.23 Emergency stop time* (page *230*).

Constant speeds/frequencies

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

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

Settings

Parameter groups *22 Speed reference selection* (page *219*) and *28 Frequency reference chain* (page *243*).

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.

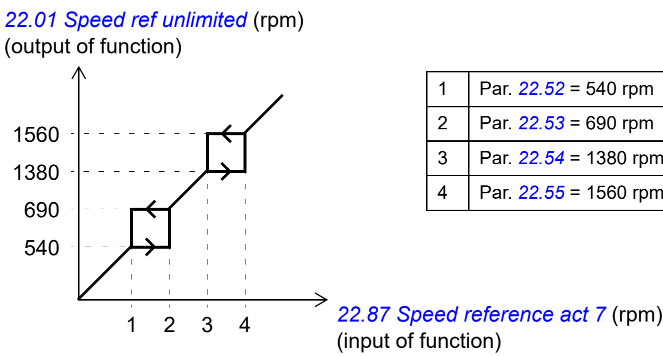
When the drive is limiting the allowed output speeds/frequencies, it limits to the absolutely lowest critical speed (critical speed low or critical frequency low) when accelerating from standstill, unless the speed reference is over the upper critical speed/ frequency limit.

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*.

Example

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

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



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

Settings

- Critical speeds: parameters *22.51*…*22.57* (page *225*)
- Critical frequencies: parameters *28.51*…*28.57* (page *250*).

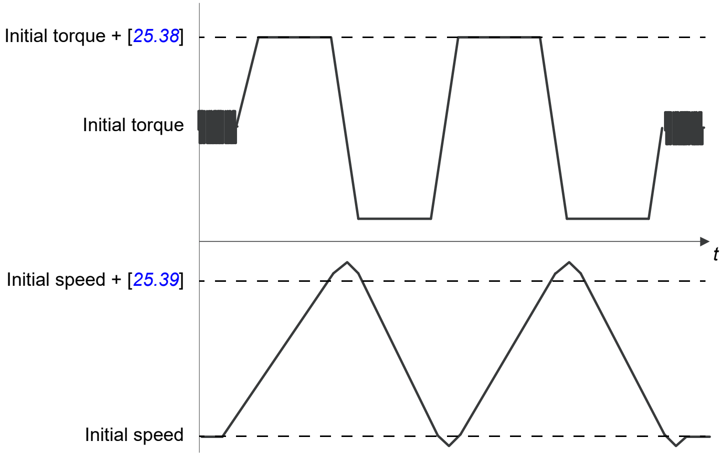
Speed controller autotune

The speed controller of the drive can be automatically adjusted using the autotune function. Autotuning is based on an estimation of the mechanical time constant (inertia) of the motor and machine.

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

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

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



Notes:

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

Before activating the autotune routine

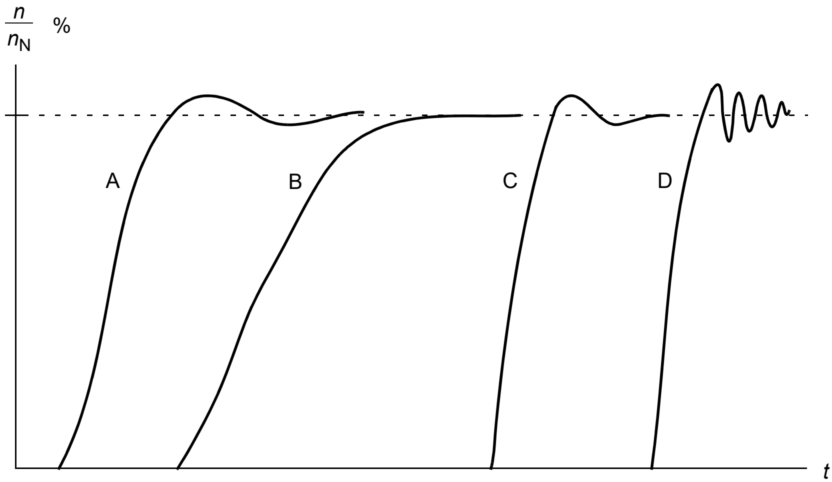
The prerequisites for performing the autotune routine are:

- The motor identification run (ID run) has been successfully completed
- Speed and torque limits (parameter group *30 Limits*) have been set
- The drive has been started and is running in speed control mode.

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

Autotune modes

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



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

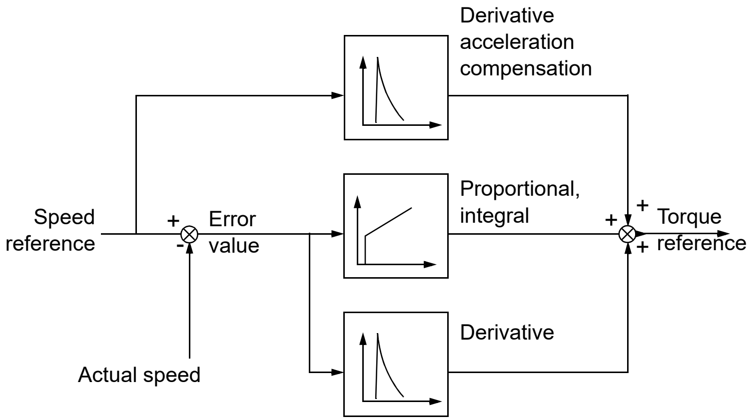
Autotune results

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

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

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

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



Warning indications

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

<u>Settings and diagnostics</u>

Parameters groups: *25 Speed control* (page *232*), *30 Limits* (page *254*) and *99 Motor data* (page *369*).

Parameters: *25.02 Speed proportional gain* (page *233*), *25.03 Speed integration time* (page *234*), *25.33 Speed controller autotune*...*25.40 Autotune repeat times* (page *238*), *30.12 Maximum speed* (page *256*) and *99.09 Motor nominal speed* (page *370*).

Events: *AF90 Speed controller autotuning* (page *424*).

User Load Curve

The User Load Curve (ULC) provides a supervisory function that monitors an input signal as a function of speed and load. The ULC consists of an overload and an underload curve, or just one of them.

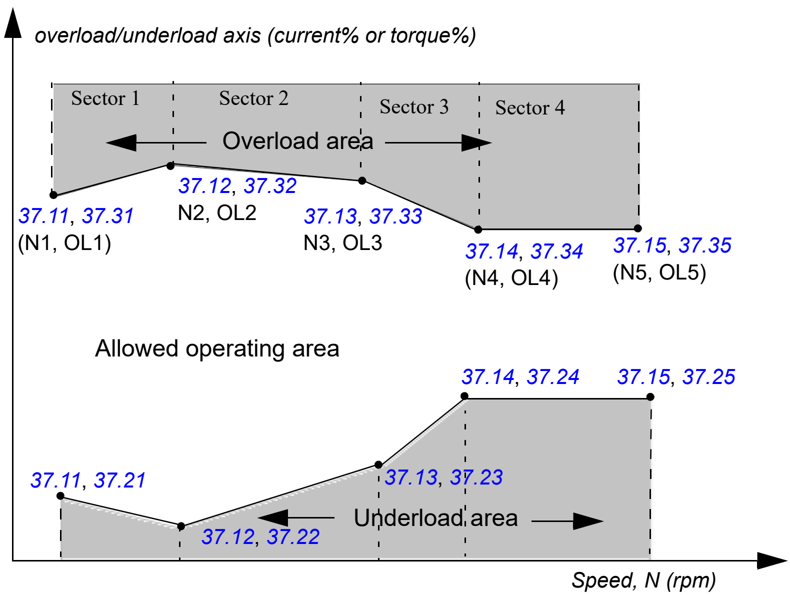
Note: This feature is available only in vector control mode.

Some of the salient features of the ULC are:

- Formed by five points -The underload and overload curve are formed by five points where the points represent monitored signal as a function of speed.
- Warning and/or fault for overload and underload - A warning and/or fault can be displayed, if the monitored signal stays continuously over the overload/underload limit for a defined time. You can define the time in parameter *37.41 ULC overload timer*/*37.42 ULC underload timer* and the action in parameter *37.03 ULC overload actions*/*37.04 ULC underload actions*.
- Sector based warning / fault - The five points makes four sectors and a warning and/or fault can be displayed at each sector. This helps to find the speed range that causes the fault or warning and the investigation can be performed accordingly.

For example, overload can be used to monitor for saw blade hitting a knot or fan load profiles becoming too high. Underload can be used to monitor for load dropping and breaking of conveyer belts or fan belts.

The below graph shows the underload and overload points in a user load curve.



Example

If,

N1 = 300 rpm, defined by parameter *37.11 ULC speed table point 1*

N2 = 600rpm, defined by parameter *37.12 ULC speed table point 2*

OL1 = 10%, defined by parameter *37.31 ULC overload point 1*

OL2 = 20%, defined by parameter *37.32 ULC overload point 2*

Parameter *37.03* = *Warning*

Overload axis = torque%, defined by parameter *37.02 ULC supervision signal*

Drive speed = 450 rpm,

the drive generates *A8BE* (Aux code 0001) warning, if the actual torque exceeds 15% (calculated by leaner interpolation between point (N1, OL1) and (N2, Ol2) for the predefined time), after the time period mentioned in parameter *37.41 ULC overload timer*.

If the parameter *37.03* is set as *Disabled*, the drive does not generate any warning.

Settings

Parameter group *37 User load curve* (page *295*).

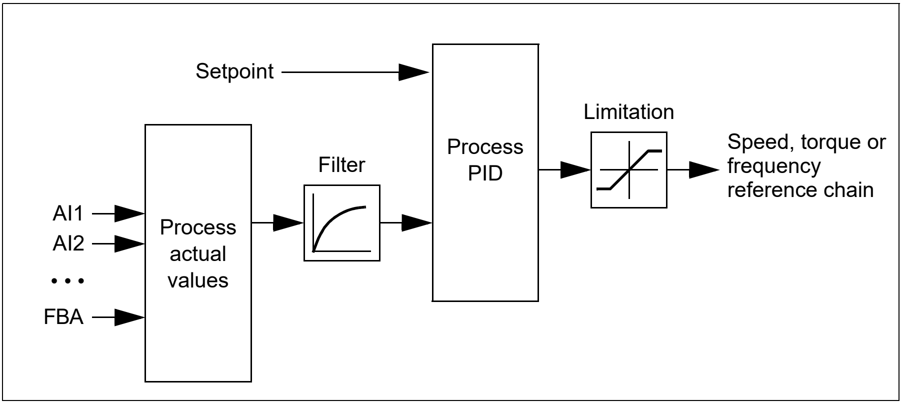
Process PID control

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 *499* and *502*.

The drive contains two complete set of process PID controller settings that can be used in place of the other as and when required. See parameter *40.57 PID set1/set2 selection*.



Note: Process PID control is available only in external control location EXT2. See section *Local control vs. external control* (page *33*).

Quick configuration of the process PID controller

1. Activate the process PID controller: **Menu - Primary settings - PID - PID controls**
2. Select a feedback source: **Menu - Primary settings - PID - Feedback**
3. Select a setpoint source: **Menu - Primary settings - PID - Setpoint**
4. Set the gain, integration time, derivation time: **Menu - Primary settings - PID - Tuning**
5. Set the PID output limits: **Menu - Primary settings - PID - PID output**
6. Select the PID controller output as the source of, for example, *22.11 Ext1 speed ref1*22.11 Ext1 speed ref1: **Menu - Primary settings - Start, stop, reference - Reference from**

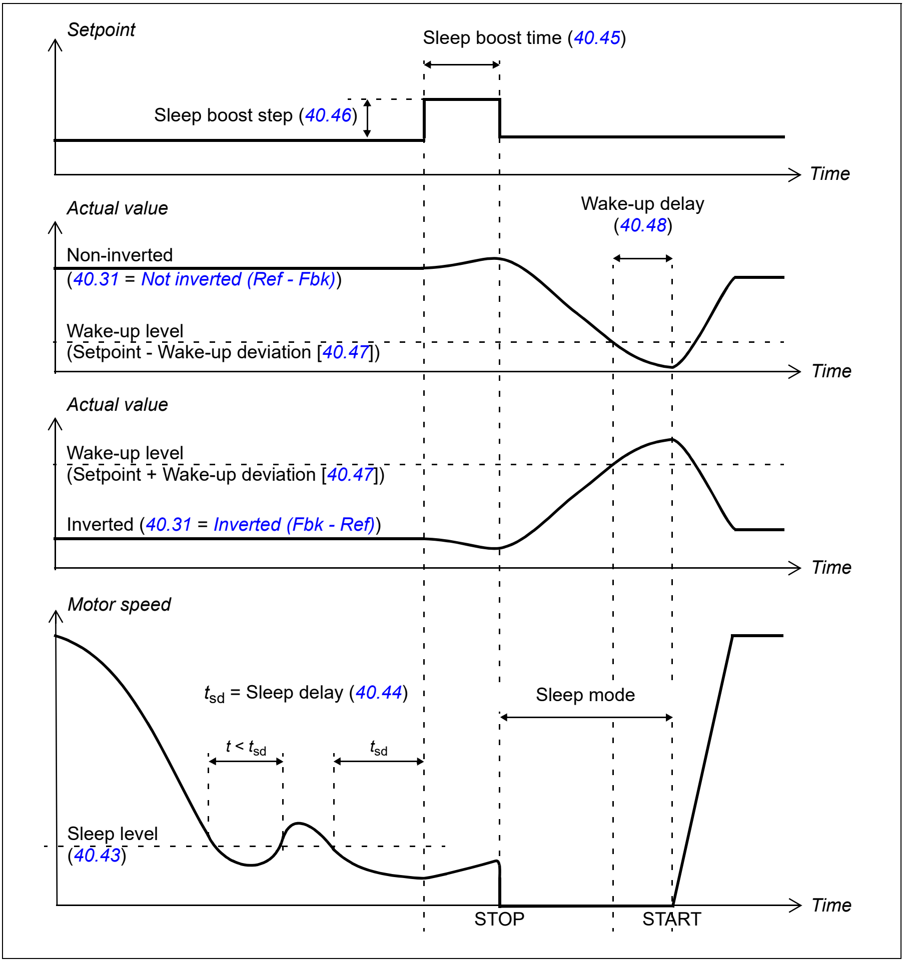
Sleep and boost functions for process PID control

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 wakeup 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.

Sleep and boost function - Timing diagram



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

- Main menu ≡ → Connection macro → PID or Main menu ≡ → Complete parameter list → parameter *96.04* → PID.
- Parameter groups *40 Process PID set 1* (page *298*) and *41 Process PID set 2* (page *312*).

PID trim function

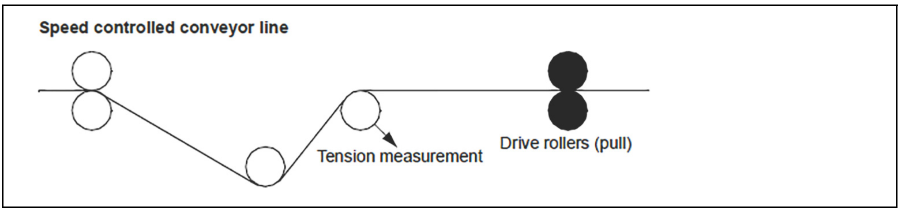
The PID trim function is used to maintain the set tension either by trimming the drive main speed reference or torque reference (speed controller output).

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

PID trim is implemented as one of the Process PID functions (parameter group *40 Process PID set 1* and *41 Process PID set 2*). Both PID set1 and PID set 2 can be used for this functionality.

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

PID trim functionality in Variable Frequency Drive (VFD) is used in applications where tension control of the material is very essential. For example, auxiliary drives in metal process industries, infeed and outfeed of rotogravure printing machines, surface winder etc.



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

The following modes are available:

- *Direct*
- *Proportional*, and
- *Combined*

Direct

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

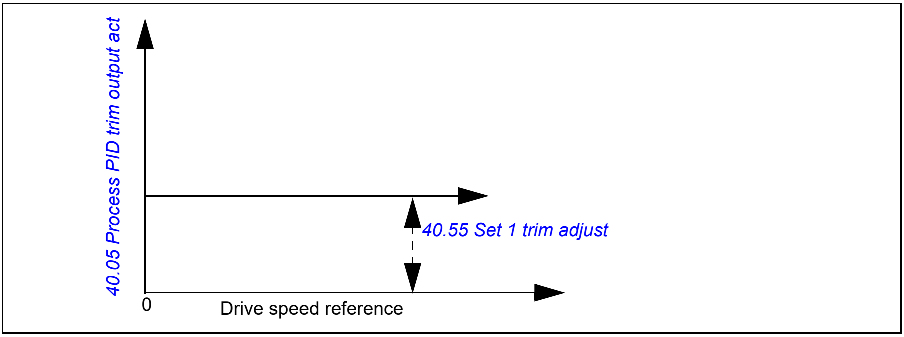
In this mode, the PID trimmed output (*40.05 Process PID trim output act*) is relative to the maximum speed (parameter *30.12 Maximum speed*), torque (*30.20 Maximum torque 1*) or frequency (*30.14 Maximum frequency*). The selection between these can be made by parameter *40.52 Set 1 trim selection*.

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

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

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

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



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

<u>Example</u>

If,

Par. *40.52 Set 1 trim selection* = *Speed*

Par. *40.56 Set 1 trim source* = *PID output*

Par. *30.12 Maximum speed* = 1500 rpm

Par. *40.01 Process PID output actual* = 100 (limited to 100)

Par. *40.55 Set 1 trim adjust* = 0.5

Then,

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

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

Proportional

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

In this mode, the PID trimmed output (*40.05 Process PID trim output act*) is relative to the reference selected by parameter *40.53 Set 1 trimmed ref pointer* and with *40.01 Process PID output actual* or *40.03 Process PID setpoint actual*.

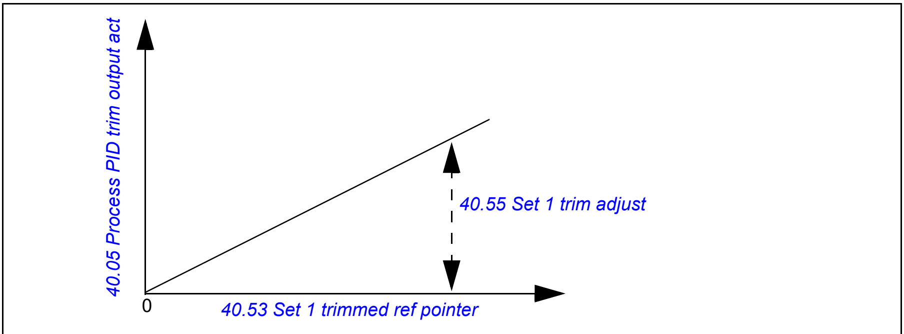
It is recommended that the speed reference selected in *40.53 Set 1 trimmed ref pointer* and the reference source selected in *22.11 Ext1 speed ref1* and *40.53 Set 1 trimmed ref pointer* are same. This is required to make the proportional mode active.

In most of the use cases, the process speed reference is connected in *40.53 Set 1 trimmed ref pointer*. For example, if EXT1 control mode is used and the reference source is AI scaled, then *22.11 Ext1 speed ref1* and *40.53 Set 1 trimmed ref pointer* should be configured to AI1 scaled.

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

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

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



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

<u>Example</u>

If,

Par. *40.52 Set 1 trim selection* = *Speed*

Par. *40.56 Set 1 trim source* = *PID output*

Par. *40.53 Set 1 trimmed ref pointer* = *AI1 scaled*

Par. *22.11 Ext1 speed ref1* = *AI1 scaled*

Par. *12.20 AI1 scaled at AI1 max* = 1500

Par. *12.12 AI1 scaled value* = 750 (AI1 actual scaled value)

Par. *40.01 Process PID output actual* = 100

Par. *40.55 Set 1 trim adjust* = 0.5

Then,

$$\mathrm{Par}40.05 = \left(\frac{100}{100}\right) \times 750 \times 0.5$$

$$\mathrm{Par}40.05 = 375$$

Combined

The combined is suitable for applications where you need to maintain tension from zero speed to maximum speed

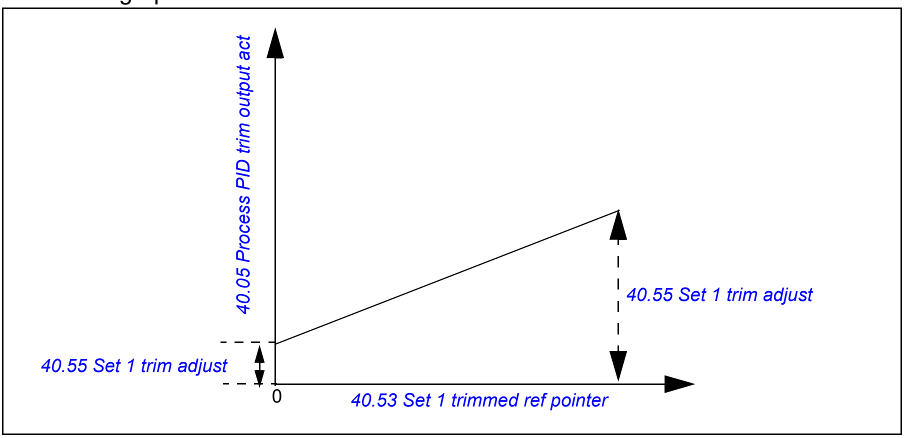
Combined method is a combination of direct and proportional mode. Here, the trim for zero speed is defined by *40.54 Set 1 trim mix* and the trim for speed greater than zero speed is defined by *40.55 Set 1 trim adjust*. The trim value is directly proportional to value of *40.53 Set 1 trimmed ref pointer*.

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

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

$$\mathrm{Par}40.05 = \{(\mathrm{Par}30.12 \times \mathrm{Par}40.54) + [(1 - \mathrm{Par}40.54) \times \mathrm{Par}40.53]\} \times \mathrm{Par}40.55$$

The below graph shows the trim increase in combined mode.



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

Example

If,

Par. *40.52 Set 1 trim selection* = *Speed*

Par. *40.56 Set 1 trim source* = *PID output*

Par. *30.12 Maximum speed* = 1500 rpm

Par. *40.53 Set 1 trimmed ref pointer* = *AI1 scaled*

Par. *22.11 Ext1 speed ref1* = *AI1 scaled*

Par. *12.20 AI1 scaled at AI1 max* = 1500

Par. *12.12 AI1 scaled value* = 750 (AI1 actual scaled value)

Par. *40.01 Process PID output actual* = 100 (limited to 100)

Par. *40.54 Set 1 trim mix* = 0.1

Par. *40.55 Set 1 trim adjust* = 0.5

Then,

If *40.53 Set 1 trimmed ref pointer* is 0.

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

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

If *40.53 Set 1 trimmed ref pointer* is 750.

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

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

If *40.53 Set 1 trimmed ref pointer* is 1500.

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

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

PID trim auto connection

PID trim auto connection (*40.65 Trim auto connection*) enables the connection of PID trim output actual (*40.05 Process PID trim output act*) to the respective speed, torque or frequency reference chains. You can use parameter *40.52 Set 1 trim selection* (for PID set 1) or *41.52 Set 2 trim selection* (for PID set 2) to select the respective trim (speed, torque or frequency).

The motor control mode (*99.04 Motor control mode*) also impacts the PID trim output actual (*40.05 Process PID trim output act*) added to the speed, torque or frequency reference chains. In scalar control mode, the speed trim and torque trim values are zero and in vector control mode, the frequency trim value is zero.

See the control chain diagram on page *507*.

Note: If the parameter *40.65 Trim auto connection* is disabled or the drive stops by *21.04 Emergency stop mode*, *Ramp stop (Off1)* or *Eme ramp stop (Off3)*, the PID trim output actual (*40.05 Process PID trim output act*) is not added during the drive deceleration condition

Speed trim connection

Speed trim is added to *23.02 Speed ref ramp output*. The parameter *24.01 Used speed reference* displays the final speed reference after the addition of speed trim.

Torque trim connection

Torque trim is added to the parameter *26.75 Torque reference act 5*. The parameter *26.76 Torque reference act 6* displays the final torque reference after the addition of torque trim.

Frequency trim connection

Frequency trim is added to the parameter *28.02 Frequency ref ramp output* and generates the final frequency after the trim addition. At present, no parameter displays the final frequency reference after the addition of frequency trim.

Settings

- Parameter group *40 Process PID set 1* and parameters *40.51*...*40.56* (page *308*).
- Parameter group *41 Process PID set 2* and parameters *41.51*...*41.56* (page *313*).

Timed functions

Timed function enables to configure the drive to perform automated functions at a desired time on any day of a week. The function includes 12 timers, exception day settings, and boost time settings that help to configure the desired operation needed in the system.

Settings

Parameter group *34 Timed functions* (page *276*).

Mechanical brake control

A mechanical brake is used for holding the motor and driven machinery at zero speed when the drive is stopped, or not powered. The brake control logic observes the settings of parameter group *44 Mechanical brake control* as well as several external signals, and moves between the states presented in the diagram on page *61*. The tables below the state diagram detail the states and transitions. The timing diagram on page *62* shows an example of a close-open-close sequence.

Inputs of the brake control logic

The start command of the drive (bit 5 of *06.16 Drive status word 1*) is the main control source of the brake control logic.

Outputs of the brake control logic

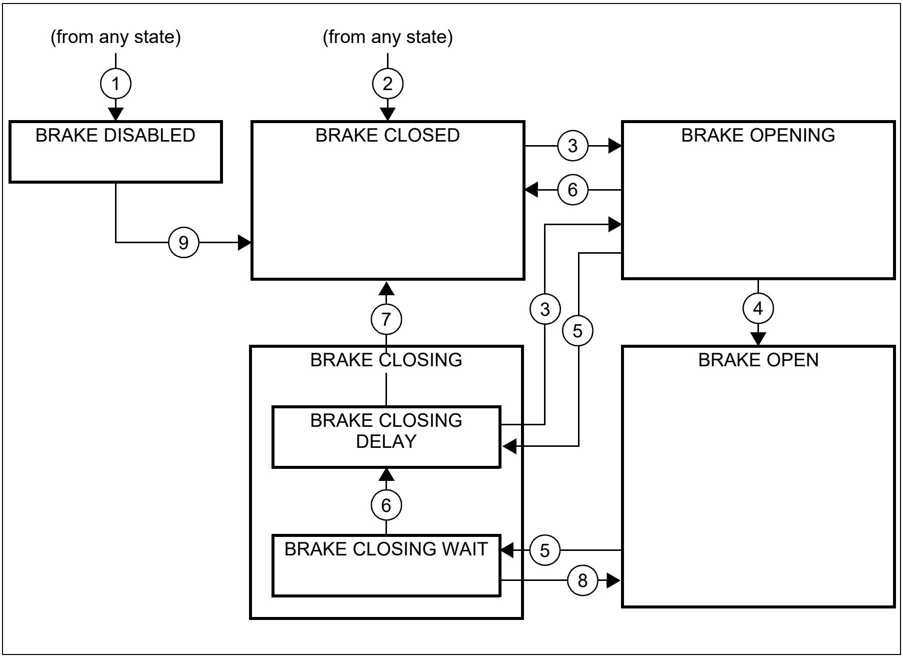
The mechanical brake is to be controlled by bit 0 of parameter *44.01 Brake control status*. This bit should be selected as the source of a relay output (or a digital input/output in output mode) which is then wired to the brake actuator through a relay. See the wiring example on page *62*.

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

Settings

Parameter group *44 Mechanical brake control* (page *316*).

Brake state diagram



<u>State descriptions</u>

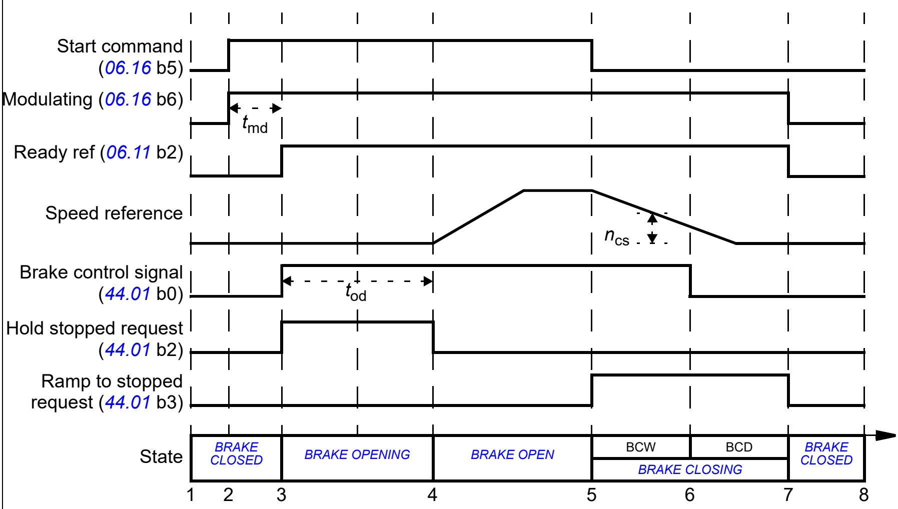
State name	Description
BRAKE DISABLED	Brake control is disabled (parameter *44.06 Brake control enable* = 0, and *44.01 Brake control status* b4 = 0). The open signal is active (*44.01 Brake control status* b0 = 1).
BRAKE OPENING:	Brake has been requested to open. (*44.01 Brake control status* b2 = 1). Open signal has been activated (*44.01 Brake control status* b0 is set). The load is held in place by the speed control of the drive until *44.08 Brake open delay* elapses.
BRAKE OPEN	The brake is open (*44.01 Brake control status* b0 = 1). Hold request is removed (*44.01 Brake control status* b2 = 0), and the drive is allowed to follow the reference.
BRAKE CLOSING:	
BRAKE CLOSING WAIT	Brake has been requested to close. The drive logic is requested to ramp down the speed to a stop (*44.01 Brake control status* b3 = 1). The open signal is kept active (*44.01 Brake control status* b0 = 1). The brake logic will remain in this state until the motor speed is below *44.14 Brake close level*.
BRAKE CLOSING DELAY	Closing conditions have been met. The open signal is deactivated (*44.01 Brake control status* b0 → 0). The ramp-down request is maintained (*44.01 Brake control status* b3 = 1). The brake logic will remain in this state until *44.13 Brake close delay* has elapsed. At this point, the logic proceeds to *BRAKE CLOSED* state.
BRAKE CLOSED	The brake is closed (*44.01 Brake control status* b0 = 0). The drive is not necessarily modulating.

State change conditions (n)

1 Brake control disabled (parameter *44.06 Brake control enable* → 0).
2 *06.11 Main status word*, bit 2 = 0.
3 Brake has been requested to open.
4 *44.08 Brake open delay* has elapsed.
5 Brake has been requested to close.
6 Motor speed is below closing speed *44.14 Brake close level*.
7 *44.13 Brake close delay* has elapsed.
8 Brake has been requested to open.
9 Brake control enabled (parameter *44.06 Brake control enable* → 1).

Timing diagram

The simplified timing diagram below illustrates the operation of the brake control function. Refer to the state diagram above.Wiring example

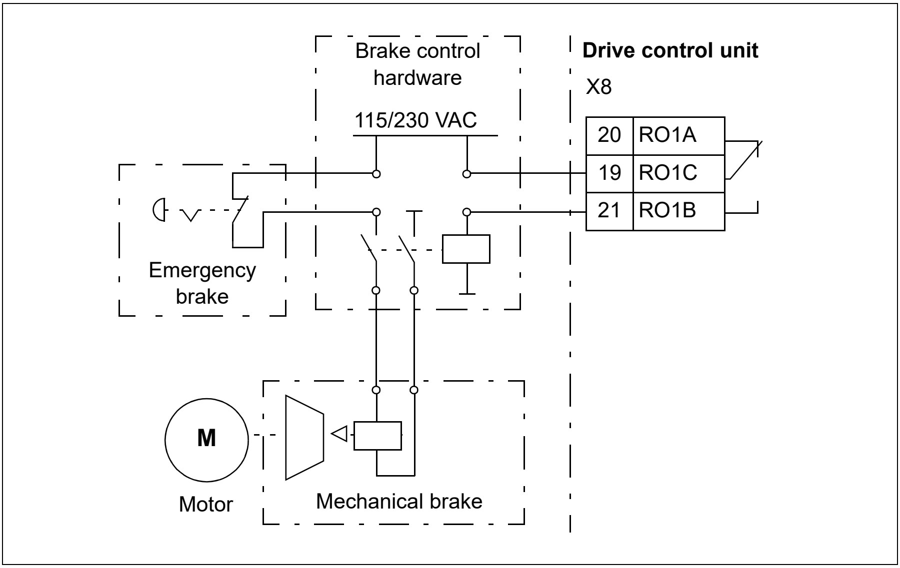


t_{md} Motor magnetization delay
t_{od} Brake open delay (parameter *44.08 Brake open delay*)
n_{cs} Brake close speed (parameter *44.14 Brake close level*)
t_{cd} Brake close delay (parameter *44.13 Brake close delay*)
BCW *BRAKE CLOSING WAIT*
BCD *BRAKE CLOSING DELAY*

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

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

The brake is controlled by bit 0 of parameter *44.01 Brake control status*. In this example, parameter *10.24 RO1 source* is set to *Brake command* (i.e. bit 0 of *44.01 Brake control status*.



Motor control

Motor types

The drive supports asynchronous AC induction.

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.

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

Settings

99.13 ID run requested (page *371*).

Scalar motor control

Scalar motor control is the default motor control method. In scalar control mode, the drive is controlled with a frequency reference.

ABB recommends to activate the scalar motor control mode in the following situations:

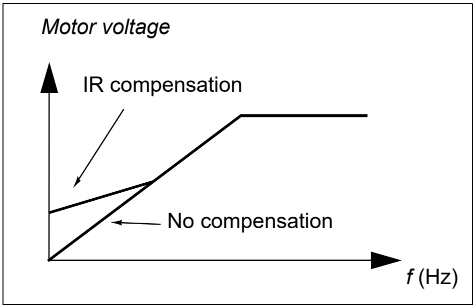
- If the exact nominal motor values are not available or the drive needs to run different motors after commissioning.
- If a short commissioning time is needed.
- If ID run is not required.
- In multimotor systems:
  - if the load is not equally shared between the motors
  - if the motors are of different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

Note: Performance of the vector control is not achieved in scalar control.

See also section *Operating modes of the drive* (page *37*).

IR compensation for scalar motor control

IR compensation (also known as voltage boost) is available only when the motor control mode is scalar. When IR compensation is activated, the drive gives an extra voltage boost to the motor at low speeds. IR compensation is useful in applications, such as positive displacement pumps, that require a high break-away torque.



Note: IR compensation is not possible or required in vector control. The compensation is applied automatically.

Settings

- Parameters *97.13 IR compensation* (page *366*)
- Main menu ≡ → Motor data or Main menu ≡ → Complete parameter list → Parameter *99.04*.
- Parameter group *28 Frequency reference chain* (page *243*).

Vector control

Vector control is the motor control mode intended for applications where high control accuracy is needed. It offers better control over the 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, e.g. sine filters.

Vector control is based on stator flux and motor torque values.

- Stator flux is calculated by integrating the motor voltage in vector space.

  The estimate of stator flux can be improved by utilizing the identified motor model.
- Motor torque is calculated as a cross product of the stator flux and the rotor current.

Both values can be achieved by controlling the output semiconductors switching. The output frequency is changed only when the actual values of stator flux and motor torque are different from their reference values by more than the allowed hysteresis. The reference value for the torque controller comes from the speed controller or directly from an external torque reference source.

Notes:

- Actual motor shaft speed is not needed for motor control.
- Vector control also requires measurement of the DC voltage and two motor phase currents.

The difference of vector control from the traditional control are:

- Torque control operates at the same time level as the power switch control.

- There is no separate voltage and frequency controlled PWM modulator.

- The output stage switching is based on the electromagnetic state of the motor.

- The best motor control accuracy is achieved by activating a separate motor. identification run (normal ID run).

See also section *Speed compensated stop* (page *75*).

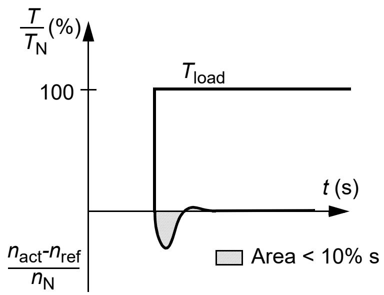
Settings

- Main menu ≡ → Motor data or Main menu ≡ → Complete parameter list → parameter *99.04*.
- Parameter *99.13 ID run requested* (page *371*).

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)
Tuned speed controller	< 2% s with 100% torque step

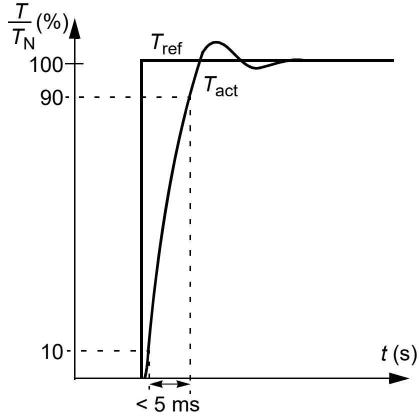


T_N = rated motor torque
n_N = rated motor speed
n_{act} = actual speed
n_{ref} = speed reference

Torque control performance figures

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

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



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

Power loss ride-through

See section *Undervoltage control (power loss ride-through)* on page *76*.

U/f ratio

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

The function has the following modes:

- Linear
- Squared.

Linear mode

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

Squared mode

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

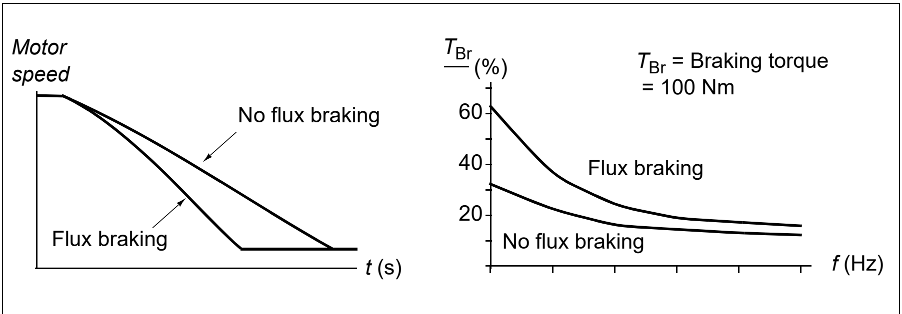
The *U*/f function cannot be used with energy optimization. If parameter *45.11 Energy optimizer* is set to *Enable*, parameter *97.20 U/F ratio* is ignored.

Settings

Parameter *97.20 U/F ratio* (page *366*).

Flux braking

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



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

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

Two braking power levels are available:

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

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

Settings

Parameter *97.05 Flux braking* (page *365*).

DC magnetization

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

Pre-magnetization

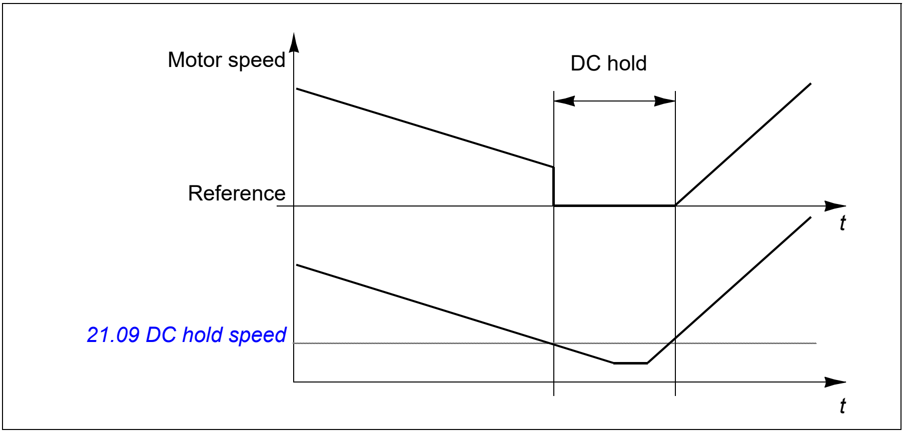
Pre-magnetization refers to DC magnetization of the motor before start. Depending on the selected start mode (*21.01 Start mode* or *21.19 Scalar start mode*), pre-magnetization can be applied to guarantee the highest possible breakaway torque, up to 200% of the nominal torque of the motor. By adjusting 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*

Post-magnetization

This 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 *212*), *21.08 DC current control* and *21.11 Pre-heating input source*.

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 zero speed (see bit 0 in parameter *06.19 Speed control status word*). If the drive is running above zero speed, pre-heating is delayed by 60 seconds 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.
- Pre-heating uses DC hold to produce current.

Settings

Parameters *21.14 Pre-heating input source* and *21.16 Pre-heating current* (page *215*)

Energy optimization

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

Settings

- Menu ≡ → Energy efficiency
- Parameter *45.11 Energy optimizer* (page *319*)

Switching frequency

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

For derating, see 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, set both the reference and the minimum switching frequency to this value and the drive will retain this switching frequency.

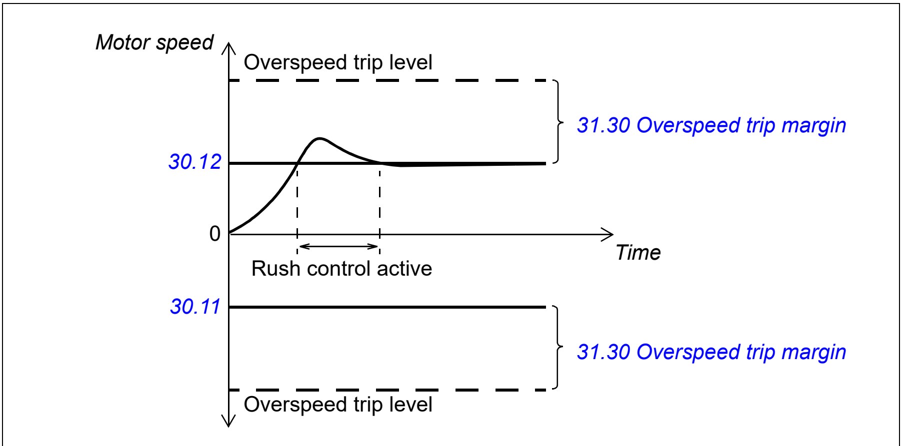
Example 2: If the reference switching frequency is set to 12 kHz and the minimum switching frequency is set to the smallest available value, the drive maintains the highest possible switching frequency to reduce motor noise and only when the drive heats it will decrease the switching frequency. This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

Settings

Parameter *97.01 Switching frequency reference* and *97.02 Minimum switching frequency* (page *355*).

Rush control

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



The function is based on a PI controller. The program sets the proportional gain to 10.0 and integration time to 2.0 s.

Settings

Parameters *26.81 Rush control gain* (page *242*) and *26.82 Rush control integration time* (page *242*)

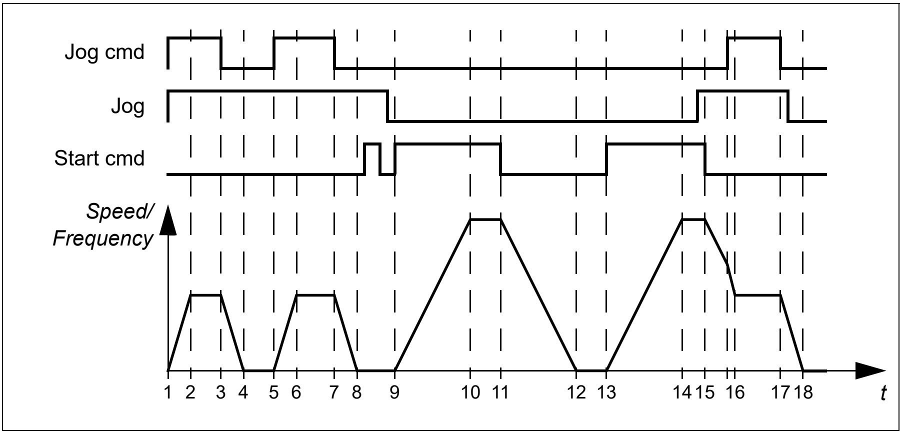
Jogging

The jogging function enables the use of a momentary switch to briefly rotate the motor. The jogging function is typically used during servicing or commissioning to control the machinery locally. The function is available in both scalar and vector control. In vector control mode, the jogging speed reference is provided by parameters *22.42 Jogging 1 ref* and *22.43 Jogging 2 ref*. In scalar control mode, the jogging frequency reference is provided by *28.42 Jogging 1 frequency ref* and *28.43 Jogging 2 frequency ref*.

Two jogging functions (1 and 2) are available, each with their own activation sources and references. The signal sources are selected by parameters *20.26 Jogging 1 start source* and *20.27 Jogging 2 start source*. When jogging is activated, the drive starts and accelerates to the defined jogging speed or frequency along the defined jogging acceleration ramp (*23.20 Acc time jogging*). After the activation signal switches off, the drive decelerates to a stop along the defined jogging deceleration ramp (*23.21 Dec time jogging*).

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

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



Phase	Jog cmd	Jog	Start cmd	Description
1-2	1	1	0	Drive accelerates to the jogging speed along the acceleration ramp of the jogging function.
2-3	1	1	0	Drive follows the jog reference.
3-4	0	1	0	Drive decelerates to zero speed along the deceleration ramp of the jogging function.
4-5	0	1	0	Drive is stopped.
5-6	1	1	0	Drive accelerates to the jogging speed along the acceleration ramp of the jogging function.
6-7	1	1	0	Drive follows the jog reference.

Phase	Jog cmd	Jog	Start cmd	Description
7-8	0	1	0	Drive decelerates to zero speed/frequency along the deceleration ramp of the jogging function.
8-9	0	1->0	0	Drive is stopped. As long as the jog signal is on, start commands are ignored. After jog switches off, a fresh start command is required.
9-10	x	0	1	Drive accelerates to the speed/frequency reference along the selected acceleration ramp (parameters *23.11*…*23.15*).
10-11	x	0	1	Drive follows the speed/frequency reference.
11-12	x	0	0	Drive decelerates to zero speed/frequency along the selected deceleration ramp (parameters *23.11*…*23.15*).
12-13	x	0	0	Drive is stopped.
13-14	x	0	1	Drive accelerates to the speed/frequency reference along the selected acceleration ramp (parameters *23.11*…*23.15*).
14-15	x	0->1	1	Drive follows the speed/frequency reference. As long as the start command is on, the jog signal is ignored. If the jog signal is on when the start command switches off, jogging is enabled immediately.
15-16	0->1	1	0	Start command switches off. The drive starts to decelerate along the selected deceleration ramp (parameters *23.11*…*23.15*). When the jog command switches on, the decelerating drive adopts the deceleration ramp of the jogging function.
16-17	1	1	0	Drive follows the jog reference.
17-18	0	1->0	0	Drive decelerates to zero speed/frequency along the deceleration ramp of the jogging function.

See also the block diagram on page *496*.

Notes:

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

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

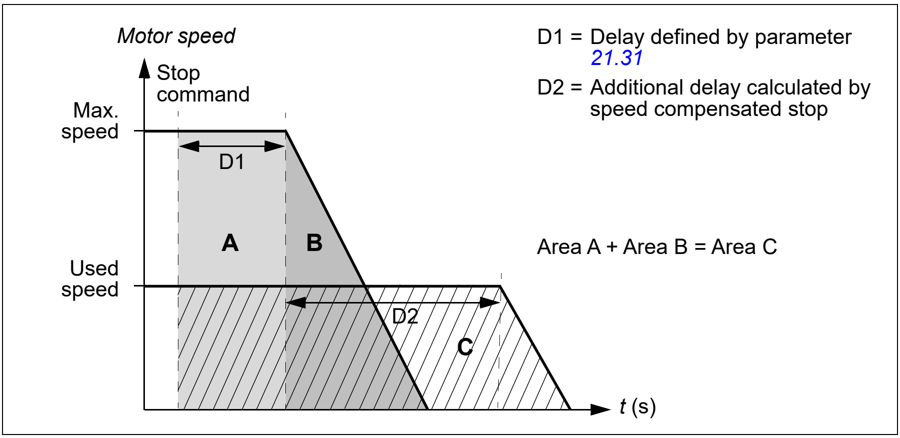
- If both jogging functions are activated, the one that was activated first has priority.
- The inching functions activated through fieldbus (see *06.01 Main control word*, bits 8…9) use the references and ramp times defined for jogging, but do not require the jog signal.

Settings

Parameters *20.25 Jogging enable* (page *209*), *20.26 Jogging 1 start source* (page *209*), *20.27 Jogging 2 start source* (page *210*), *22.42 Jogging 1 ref* (page *224*), *22.43 Jogging 2 ref* (page *224*), *28.42 Jogging 1 frequency ref* (page *249*) *28.43 Jogging 2 frequency ref* (page *249*),*23.20 Acc time jogging* (page *229*) and *23.21 Dec time jogging* (page *229*).

Speed compensated stop

Speed compensation stop is available for example for applications where a conveyer needs to travel a certain distance after receiving the stop command. At maximum speed, the motor is stopped normally along the defined deceleration ramp, after the application of a user defined delay to adjust the distance traveled. Below maximum speed, stop is delayed still more by running the drive at current speed before the motor is ramped to a stop. As shown in the figure, the distance traveled after the stop command is the same in both cases, that is, area A + area B equals area C. Speed compensation does not take into account shape times (parameters *23.32 Shape time 1* and *23.33 Shape time 2*). Positive shape times lengthen the distance traveled.



Speed compensation can be restricted to forward or reverse rotating direction.

Speed compensation is supported in both vector and scalar motor control.

Settings

Parameters *21.30 Speed compensated stop mode* (page *218*), *21.31 Speed comp stop delay* (page *218*) and *21.32 Speed comp stop threshold* (page *218*).

DC voltage control

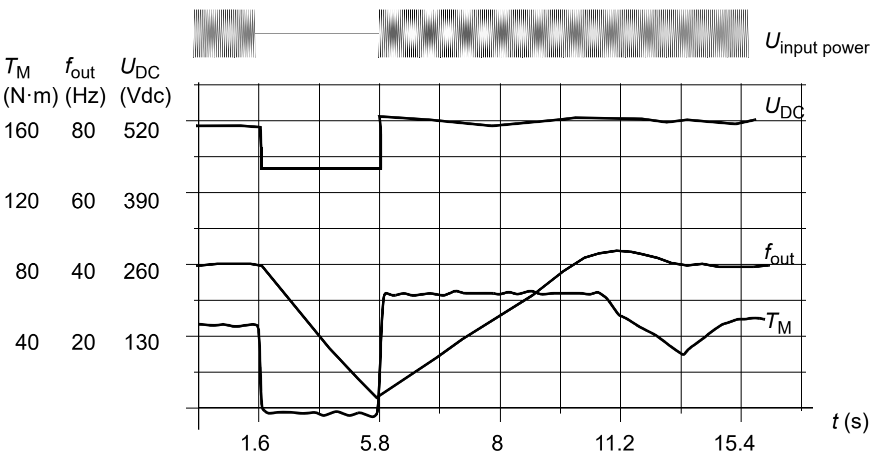
Overvoltage control

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 is fully operational as long as the motor rotates and generates energy to the drive. The drive can continue operation after the break if the main contactor (if present) remained closed.

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



U_{DC} = Intermediate circuit voltage of the drive, f_{out} = Output frequency of the drive, T_M = Motor torque

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

Implementing the undervoltage control (power loss ride-through)

Implement the undervoltage control function as follows:

- Check that the undervoltage control function of the drive is enabled with parameter *30.31 Undervoltage control*.
- Parameter *21.01 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. 5 seconds) power supply failure by using the Automatic restart function, provided that the drive is allowed to run for 5 seconds without the cooling fans operating.

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

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

If the DC voltage is restored before the expiration of the period defined by parameter *21.18 Auto restart time* and the start signal is still on, normal operation will continue. However, if the DC voltage remains too low at that point, the drive trips on a fault, *3220 DC link undervoltage*.

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

Voltage control and trip limits

The control and trip limits of the intermediate DC voltage regulator are relative to the supply voltage as well as drive/inverter type. The 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 following table shows the values of selected DC voltage levels. The drive DC voltage limits are calculated based on the parameter *95.01 Supply voltage* and *95.02 Adaptive voltage limits*.

Notes:

- parameter *95.03 Estimated AC supply voltage* is the estimated voltage during start-up of the drive and is not continuously updated during the time lim eit.
- The absolute voltages vary according to the drive/inverter type and AC supply voltage range.

DC Voltage level [V]	*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 1) 0.85×1.35×380 = 436 2)	0.85×1.41×par *95.03* value 1) 0.85×1.35×440 = 463 2)	0.85×1.41×par *95.03* value 1) 0.85×1.35×440 = 463 2)
Undervoltage control limit	0.78×1.41×par *95.03* value 1) 0.78×1.35×380 = 400 2)	0.78×1.41×par *95.03* value 1) 0.78×1.35×440 = 463 2)	0.78×1.41×par *95.03* value 1) 0.78×1.35×440 = 463 2)
Charging relay closing limit	0.78×1.41×par *95.03* value 1) 0.78×1.35×380 = 400 2)	0.78×1.41×par *95.03* value 1) 0.78×1.35×440 = 463 2)	0.78×1.41×par *95.03* value 1) 0.78×1.35×440 = 463 2)
Charging relay opening limit	0.73×1.41×par *95.03* value 1) 0.73×1.35×380 = 374 2)	0.73×1.41 ×par *95.03* value 1) 0.73×1.35×440 = 433 2)	0.73×1.41 ×par *95.03* value 1) 0.73×1.35×440 = 433 2)
Undervoltage fault limit	0.73×1.41×par *95.03* value 1) 0.73×1.35×380 = 374 2)	0.73×1.41×par *95.03* value 1) 0.73×1.35×440 = 433 2)	0.73×1.41×par *95.03* value 1) 0.45×1.35×440 = 433 2)
DC voltage at upper bound of supply voltage range (U_{DCmax})	560	648	648
DC voltage at lower bound of supply voltage range (U_{DCmin})	513	594	594

DC Voltage level [V]	*95.01 Supply voltage*		
	AC supply voltage range [V] 380…415	**AC supply voltage range [V] 440…480**	**Automatic/Not selected**
Charging activation/ standby limit [3]	0.73×1.41×par *95.03* value [1] 0.73×1.35×380 = 374 [2]	0.73×1.41×par *95.03* value [1] 0.73×1.35×440 = 433 [2]	0.73×1.41×par *95.03* value [1] 0.73×1.35×440 = 433 [2]

[1] Parameter *Adaptive voltage limits* is set to *Enable*
[2] Parameter *Adaptive voltage limits* is set to *Disable*
[3] When standby is activated, drive modulation is stopped, the fan is stopped and the pre-charge circuit is activated. If the voltage exceeds this level again, the drive has to complete charging before it will automatically continue operation.

A warning *A3A2 DC link undervoltage* is generated during any of the below conditions occurs:

- When drive is not modulating and the DC link voltage *01.11 DC voltage* is below 85% of the undervoltage warning limit.
- The drive is modulating, the DC link voltage *01.11 DC voltage* is below 73% of the standby limit and the parameter *21.18 Auto restart time* > 0. The warning continues to appear if the DC link voltage is continuously less than the standby limit until auto restart time elapses.
  Note: Control board must be externally powered with 24 VDC to enable warning in this condition. Else, the control switches off once the DC voltage goes below hardware limit.

A fault *3220 DC link undervoltage* is generated during any of the below conditions:

- The DC link voltage *01.11 DC voltage* value is less than the undervoltage trip limit and the parameter *21.18 Auto restart time* is not enabled.
- The DC link voltage *01.11 DC voltage* value is less than the undervoltage trip limit and the parameter *21.18 Auto restart time* is enabled. The undervoltage trip occurs only if the warning continues to appear until auto restart time elapses.
  Notes:
  - Control board must be externally powered with 24 VDC to enable warning in this condition. Else, the control switches off once the DC voltage goes below the hardware limit.
  - DC voltage stabilization parameter is available in service level parameters list. For more information, contact your local ABB representative.

Settings

Parameters *01.11 DC voltage* (page *165*), *30.30 Overvoltage control* (page *259*), *30.31 Undervoltage control* (page *259*), *95.01 Supply voltage* (page *355*) and *95.02 Adaptive voltage limits* (page *355*).

Brake chopper

A brake chopper can be used to handle the energy generated by a decelerating motor. When the DC voltage rises high enough, the chopper connects the DC circuit to an external brake resistor. The chopper operation is based on hysteresis.

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

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

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

Settings

Parameter *01.11 DC voltage* (page *165*), *30.30 Overvoltage control* (page *259*) and parameter group *43 Brake chopper* (page *314*).

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 *76*.

DC undervoltage

See section *Undervoltage control (power loss ride-through)* on page *76*.

Drive temperature

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

Short circuit

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

Emergency stop

The emergency stop signal is connected to the input selected by parameter *21.05 Emergency stop source*. An emergency stop can also be generated through fieldbus (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*.

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

Settings

Parameters *21.04 Emergency stop mode* (page *212*), *21.05 Emergency stop source* (page *212*), and *23.23 Emergency stop time* (page *230*).

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%.

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

Implementing a motor temperature sensor connection

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

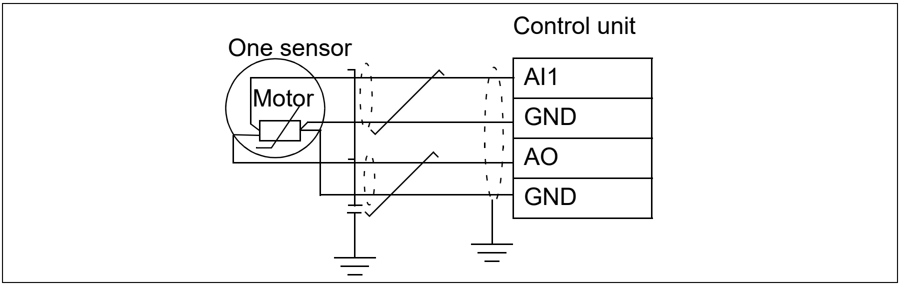
You have four implementation alternatives:

- If there is double or reinforced insulation between the sensor and the live parts of the motor, you can connect the sensor directly to the analog/digital input(s) of the drive.
- If there is basic insulation between the sensor and the live parts of the motor, you can connect the sensor to the analog/digital input(s) of the drive if all other circuits connected to the digital and analog inputs (typically extra-low voltage circuits) are protected against contact and insulated with basic insulation from other low-voltage circuits. The insulation must be rated for the same voltage level as the drive main circuit. Note that extra-low voltage circuits (such as 24 V DC) typically do not meet these requirements.
- Alternative (for R0...R2 frames only): You can connect the sensor with a basic insulation to the analog/digital input(s) of the drive if you do not connect any other external control circuits to drive digital and analog inputs.

Temperature monitoring using PTC sensors

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

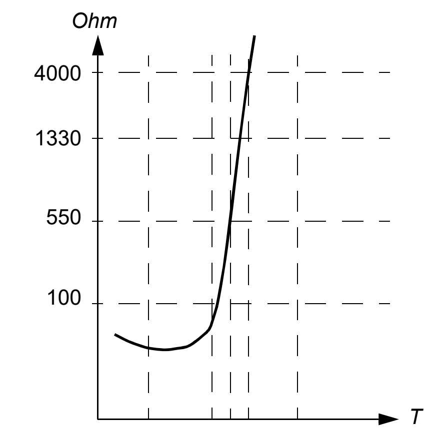
The analog output feeds a constant excitation current of 1.6 mA through the sensor. The sensor resistance increases as the motor temperature rises, as does the voltage over the sensor. The temperature measurement function calculates the resistance of the sensor and generates an indication if overtemperature is detected.



Leave the sensor end of the cable shield unconnected.

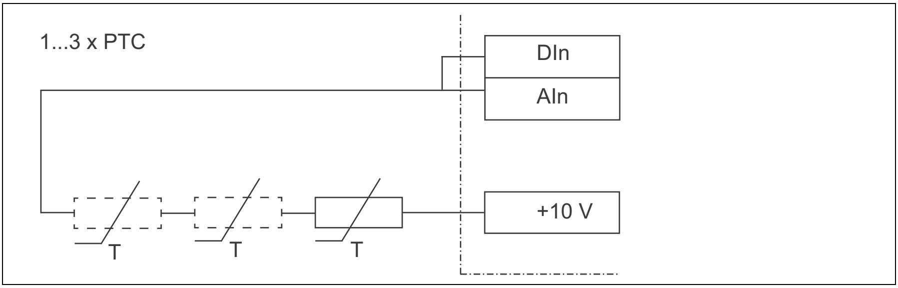
For wiring of the sensor, refer to the drive hardware manual

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



In R0...R2 frames, when an analog output is not available or used for other purposes, it is possible to setup a voltage divider connection that uses the internal resistance of a digital input.

1...3 PTC sensors can be connected in series with 10 V reference and digital and analog inputs. The temperature measurement function reads the voltage over the internal resistance of the digital input from the analog input and calculates the PTC resistance.



Note: RIIO-01 or BIO-01 is required for the analog input. By default, RIIO-01 is provided with the ACS560 drives.

Example settings

The parameters are set as follows for monitoring the temperature with PTC sensors:

Parameter	Value
35.11 Temperature 1 source	PTC analog I/O (20). For R0...R2 frames, it can be PTC AI/DI Voltage Divider tree (23) also.
35.14 Temperature 1 AI source	AI1
12.15 AI1 actual value	V
13.12 AO1 source	Temp sensor 1 excitation (20). **Note:** This is not applicable for R0...R2, if PTC AI/DI Voltage Divider tree is used.
35.12 Temperature 1 fault limit	Desired value

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. Obey the electrical planning guidelines for implementing the motor temperature sensor connection. If you ignore them, injury or death, or damage to the equipment can occur

For wiring of the sensor, refer to the drive hardware manual.

Make sure that the DI used is not configured to any other use in the drive control program.

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 *Implementing a motor temperature sensor connection* on page *82*.

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

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 *Implementing a motor temperature sensor connection* on page *82*.

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

Temperature monitoring using Ni1000 sensors

One Ni1000 sensor can be connected to an analog input and an analog output on the control unit.

The analog output feeds a constant excitation current of 9.1 mA through the sensor. The sensor resistance increases as the motor temperature rises, as does the voltage over the sensor. The temperature measurement function reads the voltage through the analog input and converts it into degrees Celsius.

See section *Implementing a motor temperature sensor connection* on page *82*.

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

Temperature monitoring using KTY84 sensors

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

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

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

See section *Implementing a motor temperature sensor connection* on page 82.

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

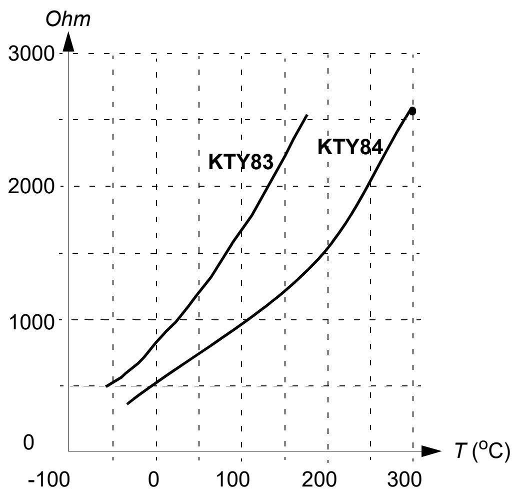
Temperature monitoring using KTY83 sensors

One KTY83 sensor can be connected to an analog input and an analog output on the control unit.

The analog output feeds a constant excitation current of 1.0 mA through the sensor. The sensor resistance increases as the motor temperature rises, as does the voltage over the sensor. The temperature measurement function reads the voltage through the analog input and converts it into degrees Celsius.

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

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



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

See section *Implementing a motor temperature sensor connection* on page 82.

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

Connection of motor temperature sensor to the drive via a relay

PTC alternative A: This table shows the insulation requirement for a customer's external relay, and the insulation requirement for the sensor to fulfill decisive voltage class A (double insulation) of IEC 60800-5-1.

PTC relay		**Temperature sensor insulation requirement**
Type	**Insulation**	
External relay	Basic insulation 6 kV	Basic insulation

PTC alternative B: Decisive voltage class B of IEC 60800-5-1 (basic insulation) is provided with a 6 kV relay. Circuits connected to all motor protection relay inputs and outputs must be protected against direct contact.

Pt100 alternative A: This table shows the insulation requirement for a customer's external relay, and the insulation requirement for the sensor to fulfill decisive voltage class A (double insulation) of IEC 60800-5-1.

Pt100 relay		**Temperature sensor insulation requirement between sensor and live parts of motor**
Type	**Insulation**	
External relay	Basic insulation 6 kV	Basic insulation

Pt100 alternative B: Decisive voltage class B of IEC 60800-5-1 (basic insulation) can be achieved when there is basic insulation between the sensor and live parts of the motor. Circuits connected to all motor protection relay inputs and outputs must be protected against direct contact.

Settings and diagnostics

Menu - **Primary settings** - **Motor** - **Thermal protection estimated**,
Menu - **Primary settings** - **Motor** - **Thermal protection measured**

Settings

Parameter group *35 Motor thermal protection* (page *283*).

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 *81*.

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*, *35.52* and *35.53*. The tripping level is the motor current at which the overload protection will ultimately trip if the motor current remains at this level continuously.

The motor overload class (class of operation), parameter *35.57 Motor overload class*, is given as the time required for the overload relay to trip when operating at 7.2 times

the tripping level in the case of IEC 60947-4-1 and 6 times the tripping level in the case of NEMA ICS 2. The standards also specify the time to trip for current levels between the tripping level and the 6 times tripping level. The drive satisfies the IEC standard and NEMA standard trip times.

Using class 20 satisfies the UL 508C requirements.

The motor overload algorithm monitors the squared ratio (motor current / tripping level)2 and accumulates this over time. This is sometimes to as I2t protection. The accumulated value is shown with parameter *35.05*.

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

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

Settings and diagnostics

Parameters common to motor thermal protection and motor overload protection: *35.51 Motor load curve*...*35.53 Break point* (page *291*).

Parameters specific to motor overload protection: *35.05 Motor overload level* (page *283*), *35.56 Motor overload action*...*35.57 Motor overload class* (page *293*).

Events: *A783 Motor overload* (page *419*) and *7122 Motor overload* (page *434*).

Programmable protection functions

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

Five different event signals from the process can be connected to selectable inputs to generate trips and warnings for the driven equipment. When the signal is lost, an external event (fault, warning, or a mere log entry) is generated.

Motor phase loss detection (parameter *31.19*)

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

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

- With the vector control, the motor phase loss detection is always on and there are no operational limits.
- With the scalar control, the motor phase loss detection activates when the motor frequency is above 10% of the motor nominal frequency. This limit cannot be changed.

With motors having nominal current below 1/6 of drive nominal current, the supervision must be disabled as the drive cannot measure the motor current accurately.

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 generated or not.

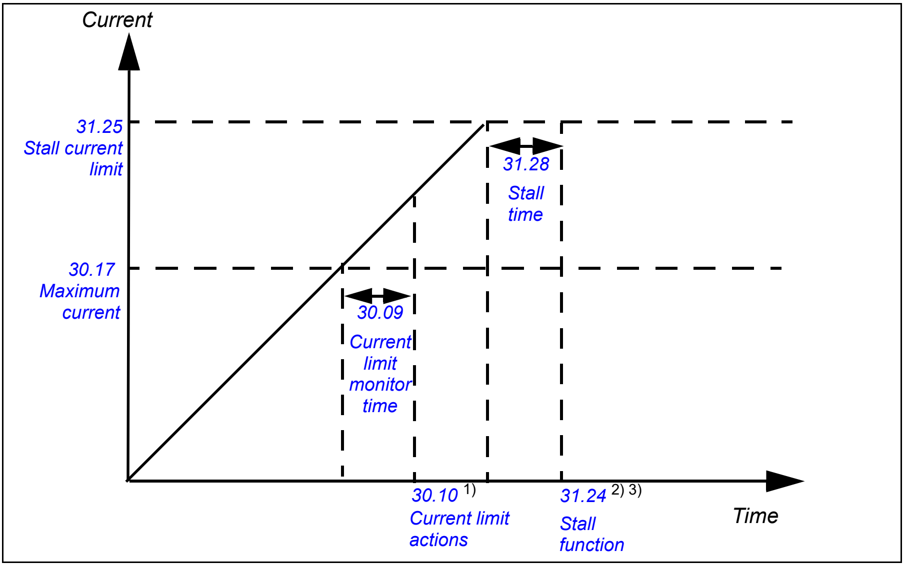
Current limit function (parameters *30.09*, *30.17*, and *30.10*)

The drive monitors the maximum current limit, its related parameters and helps the motor not to reach its stall current limit. The maximum current, monitoring time, and how the drive should react to these conditions can be set in the parameters ***30.17*, *30.09***, and ***30.10*** respectively.

By default, when the drive reaches the maximum current limit and exceeds the monitor time, a warning message (*A8B6*) is displayed.

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

The drive monitors the stall current limit, its related parameters and helps to prevent stalling of the motor. You can adjust the supervision limits (current, frequency and time) and choose how the drive reacts to a stall condition.



Notes

[1] By default, displays a warning message when the drive reaches maximum current limit (*30.17*) and exceeds the current limit monitor time (*30.09*). You can configure the actions as required.

[2] The stall condition occurs when 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*.

[3] If enabled, displays a warning message when the drive reaches stall current limit (*31.25*) and exceeds the stall time (*31.28*). You can configure the actions as required. By default, no action is configured.

Overspeed protection (parameter *31.30*)

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

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*…*12.05*)

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.

Fan control (*95.200*)

Fan control prevents overheating and dust accumulation in the drive. The user can set the fan to run continuously in maximum speed (Always on [1]) or can set to run the fan in auto mode (Auto [0]). In auto mode, the fan operates according to the temperature of the drive.

Automatic fault resets

The drive can automatically reset itself after over-current, over-voltage, 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 *263*).

Diagnostics

Signal supervision

Six signals can be selected to be supervised by this function. Whenever a supervised signal exceeds or falls below predefined limits, a bit in *32.01 Supervision status* is activated, and a warning or fault generated.

For example, if user wants to monitor DC voltage and generate a warning/fault message if it exceeds certain limit, he/she can select DC Voltage [7] in the parameter *32.07 Supervision 1 signal*, set low/high limit in the parameter *32.09*/*32.10* and set the action in the parameter *32.06 Supervision 1 action*.

The supervised signal is low-pass filtered.

Settings

Parameter group *32 Supervision* (page *269*).

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, INR (based on the currency selected in *45.17*) or volume of CO_2 emissions, and
- A load analyzer showing the load profile of the drive (see separate section on page *93*).

By default energy tariff 1 (*45.12*) is 5 INR and energy tariff 1 (*45.13*) is 6 INR. This helps to display the saved money (*45.05*/*45.06*/*45.07*) in INR.

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

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

Settings

- Main menu ≡ → Energy efficiency
- Parameter group *45 Energy efficiency* (page *317*).
- Parameters *01.50 Current hour kWh*, *01.51 Previous hour kWh*, *01.52 Current day kWh* and *01.53 Previous day kWh* on page *166*.

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.

Settings

Parameter group *36 Load analyzer* (page *294*).

Diagnostics menu

The **Diagnostics** menu provides quick information about active faults, warnings, fault history and I/O connection status. It also helps you to find out why the drive is not starting, stopping or running at the desired.

- Active faults 0 : Use this view to see the currently active faults. For information on the fault codes, see list of *Fault messages* on page *427*.
- Fault history : Use this view to see the fault history. For information on the fault codes, see list of *Fault messages* on page *427*.
- Active warnings 0 : Use this view to see currently active warnings. For information on the warning codes, see list of *Warning messages* on page *414*.
- I/O status I/O : Use this view to see currently active I/O settings.

Settings

Menu ≡ → Diagnostics

Miscellaneous

Backup and restore

You can make backups of the settings manually to the control panel and can restore backup to the drive, or a new drive replacing a faulty one. You can also make backups and restore on the panel 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 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 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 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

- Main menu ≡ → Backup data
- Parameter *96.07 Parameter save manually* (page *359*).

User parameter sets

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

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

- 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 settings (groups 50…53 and 58)
- parameter *95.01 Supply voltage*.

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

Settings

Parameters *96.10*…*96.13* (page *360*).

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 *324*).

User lock

For better cyber security, it is highly recommended that you set a master pass code to prevent 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 *Cyber security disclaimer* (page *18*).

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

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

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

Settings

Parameters *96.02* (page *358*) and *96.100*…*96.102* (page *363*).

Sine filter support

The control program has a setting that enables the use of ABB sine filters (available separately). With a sine filter connected to the output of the drive, bit 1 of *95.01 Special HW settings* must be switched on. The setting forces the drive to use the scalar motor control mode, and limits the switching and output frequencies to

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

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

Settings

Parameter *95.01 Special HW settings* (page *355*).

Dead-band function

With the Dead-band function, you can freeze the AI reference for a defined area (that is, dead-band) or ignore a low AI reference caused by possible electromagnetic interference issues.

In voltage mode:

AI dead band value = 10V* AI dead band (*12.110*) * 0.01

In current mode:

AI dead band value = 20mA* AI dead band (*12.110*) * 0.01

In addition, 10% of the dead-band value is added as dead-band hysteresis positive and negative. This value is internally set in the firmware and cannot be changed.

$$\text{AI Hysteresis} = \text{AI dead-band value} \times 10\%$$

Notes: AI dead-band (*12.110*) is applicable for both AI1 and AI2.

Example of using dead-band in AI1 (voltage mode)

If,

12.15 AI1 unit selection = V

12.110 AI dead band = 50

12.18 AI1 max = 0 - 10 V

then,

AI dead-band value = 10 * 50 * 0.01 = 5 V

AI Hysteresis value = 5 * 0.1 = 0.5 V

Hysteresis positive value = 5 + 0.5 = 5.5 V

Hysteresis negative value = 5 - 0.5 = 4.5 V

When AI1 input voltage increases, up to 5.5 V, the AI1 actual value (*12.11*) displays zero. After AI1 input voltage reaches 5.5 V, the AI1 actual value displays 5.5 V and continues to display the detected value up to the maximum AI1 value10 V (*12.18*).

When AI1 input voltage decreases, the AI1 actual value displays the detected value up to 4.5 V. From 4.5 V to zero, the AI1 actual value displays Zero till it reaches 0V.

Example of using dead-band in AI1 (current mode)

If,

12.15 AI1 unit selection = mA

12.110 AI dead band = 50

12.18 AI1 max = 0 - 20 mA

then,

AI dead-band value = 20 * 50 * 0.01 = 10 mA

AI Hysteresis value = 10 * 0.1 = 1.0 mA

Hysteresis positive value = 10 + 1.0 = 11.0 mA

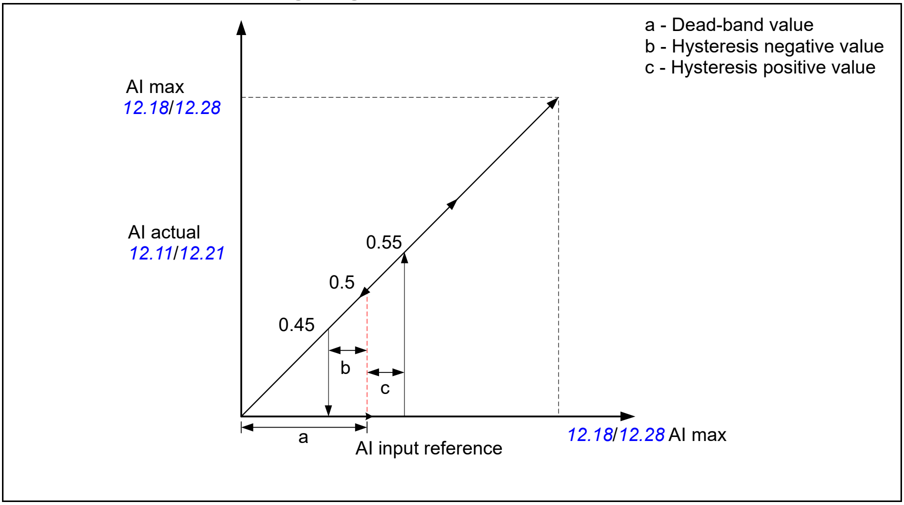
Hysteresis negative value = 10 - 1.0 = 9.0 mA

When AI1 input voltage increases, up to 11 mA, the AI1 actual value (*12.11*) displays zero. After AI1 input voltage reaches 11 mA, the AI1 actual value displays 11 mA and continues to display the detected value up to the maximum AI1 value 20 mA (*12.18*).

When AI1 input voltage decreases, the AI1 actual value displays the detected value up to 9.0 mA. From 9.0 mA to zero, the AI1 actual value displays Zero till it reaches 0V.

See the timing diagram below:

Dead-band function timing diagram



Settings

Parameter *12.110 AI dead band* (page *193*)

Short and Long menu

The drive uses short menu and long menu structure in the parameter list. The short menu displays common parameter list and the long menu displays complete parameter list. The Long and short menus are adjusted by parameter 96.02 password. The default value is short menu [1].

Settings

Parameter *96.02 Pass code* (page *358*).

Basic panel home view options

The drive provides 3 basic panel home view screens. The basic panel home view settings allows the user to select the parameters that needs to be displayed in each screen. The basic panel home view 1, 2, and 3 is applied when external control location is EXT 1 (*19.11 Ext1/Ext2 selection* = EXT 1) and the basic panel home view 4, 5, and 6 is applied when the external control location is EXT 2 (*19.11 Ext1/Ext2 selection* = EXT 2).

Settings

Parameter *49.19 Basic panel home view 1*...*49.19 Basic panel home view 1*(page *326*).

5

Control macros

Contents of this chapter

This chapter describes the intended use, operation and default control connections of the application. Apart from this, it also includes the list of parameter default values for each macro.

The settings and the example referred in this chapter are with respect to the basic control panel. However, you can also perform these actions using the assistant control panel.

Overview

Control macros are set of default parameter values suitable for a certain control configuration. When starting the drive, the user typically selects the best-suited control macro as a starting point and then makes necessary changes to tailor the settings to meet the requirements.

Control macros has the following features:

- Results in a much lower number of user edits compared to the traditional way of programming a drive.
- Allows quick configuration of the drive and enables quick start of the motor.

There are two ways of selecting the control macro from the **Main menu** ≡ →:

- **Connection macro** → **Macro**

  or

- **Parameters** → **Complete parameter list** → **parameter** *96.04*

Notes:

- Scalar control is the default control mode for all macros, except for the macros ABB standard and Pharma.
- ABB standard macro with vector motor control mode is available as a different macro. For the other applications, you can change the motor control mode manually from the **Main menu** ≡ →**Motor data** .
- If Vector motor control mode is selected, make sure that ID run is performed. See *ID run procedure*.

The control macros are categorized as application macros and communication macros.

Application macros

Application macros set the default parameters needed for certain industrial applications.

The available application macros are:

- *ABB standard macro*
- *ABB standard macro (vector)*
- *3-wire macro*
- *Motor potentiometer macro*
- *PID macro*
- *Panel PID macro*
- *Torque control macro*
- *Pump and Fan Control (PFC) macro*
- *Soft Pump and Fan Control (SPFC) macro*
- *Pharma macro*
- *Plastic extrusion macro*
- *Jigar macro*

ABB standard macro

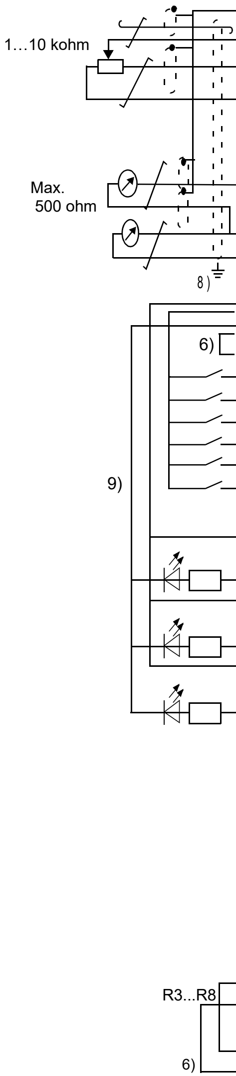
ABB standard macro 1◇ 2↶ is the default macro

The macro has the following features:

- 2-wire I/O configuration with three constant frequency references
- Applicable for normal control purpose
- One signal is used to start or stop the motor and another signal is used to select the direction
- Uses scalar control by default.

Note: For vector control you can use the ABB standard (vector) macro (page *105*).

Default control connections for the ABB standard macro



X1	Reference voltage and analog inputs	
1	SCR	Signal cable shield (screen)
2	AI1	**External frequency reference: 0…10 V[1) 4) 10)]**: see *22.11*
3	AGND	Analog input circuit, common
4	+10V	10 V DC reference voltage
5	AI2	Not configured [2)]
6	AGND	Analog input circuit, common
7	AO1	**Output frequency, 0…20 mA**[11)]: see *13.12*
8	AO2	**Motor current**[11)]: see *13.22*
9	AGND	Analog output circuit common

X2, X3	Aux. voltage output and programmable digital inputs	
10	+24V	Aux. voltage output +24 VDC, max. 250 mA[3)]
11	DGND	Aux. voltage output common
12	DCOM	Digital input common for all
13	DI1	**Stop (0) / Start (1)**[10)]: see *20.03*
14	DI2	**Forward (0) / reverse (1)**[10)]: see *20.03*
15	DI3	**Constant frequency sel 1**[10)]:
16	DI4	**Constant frequency sel 2** [4) 10)]: see *28.23*
17	DI5	**Ramp 1 (0) / Ramp 2 (1)** [5) 9)]: see *28.71*
18	DI6	Not configured

X6, X7, X8	Relay outputs	
19	RO1C	**Ready Run** [11)]: see *10.24* 250 V AC / 30 V DC 2 A
20	RO1A	
21	RO1B	
22	RO2C	**Running** [11)]: see *10.27* 250 V AC / 30 V DC 2 A
23	RO2A	
24	RO2B	
25	RO3C	**Fault (-1)** [11)]: see *10.30* 250 V AC / 30 V DC 2 A
26	RO3A	
27	RO3B	

X5	Built-in fieldbus	
29	B+	Internal Modbus RTU (EIA-485), see *Fieldbus control through the embedded fieldbus interface (EFB)*
30	A-	
31	DGND	
(Frame R0...R2)		
S100	TERM&BIAS	Termination resistor and bias resistor switch
(Frame R3...R8)		
S100	TERM	Termination resistor switch
S200	BIAS	Bias resistor switch

X4	Safety torque off		
	R0...R2	**R3...R8**	
33	-	OUT1	Safety torque off function. Factory connection. Both circuits must be closed for the drive to start. See *Safe torque off function* in the drive *hardware* manual.
34	SGND	OUT2	
35	OUT1	SGND	
36	7) IN1	IN1	
37	6) IN2	IN2	

X10	24 V AC/DC (frames R6...R8 only)	
40	24 V AC/DC- in	24V AC/DC input, for control unit power supply when external main power is disconnected.
41	24 V AC/DC+ in	

X11	Redundant auxiliary voltage output (frames R0...R2 only)	
42	+24 V	Aux. voltage output +24 V DC, max. 250 mA[3)]
43	DGND	Aux. voltage output common
44	DCOM	Digital input common for all

Terminal sizes

- (frames R0…R8): 0.14…1.5 mm^2 (all terminals)
- Tightening torques: 0.5…0.6 N·m (0.4 lbf·ft)

Notes

1) Current [0(4)…20 mA, R_{in} < 500 ohm] or voltage [0(2)…10 V, R_{in} > 200 kohm] input as selected with parameter *12.15 AI1 unit selection*.

2) Current [0(4)…20 mA, R_{in} = 100 ohm] or voltage [0(2)…10 V, R_{in} > 200 kohm] input as selected with parameter *12.25 AI2 unit selection*.

3) Total load capacity of the auxiliary voltage output +24V (X2:10) = 6.0 W (250 mA / 24 V) - User can use this source for either of the I/O connections (DI1... DI2- RO1 or DI3...DI6 - RO2~RO3).

4) The constant speed are set based on the combination of sources as follows:

Source defined by parameter *28.22*	Source defined by parameter *28.23*	Constant speed active
0	0	Set speed through AI1
1	0	*Constant frequency 1*
0	1	*Constant frequency 2*

5) The speed reference ramp is set based on the combination of sources as follows:

DI5 parameter *28.71*	Ramp set	Parameters
		Scalar control (default)
0	*Acc/Dec time 1*	*28.72 Freq acceleration time 1*
		28.73 Freq deceleration time 1
1	*Acc/Dec time 2*	*28.74 Freq acceleration time 2*
		28.75 Freq acceleration time 2

6 Connected with jumpers at the factory.

7) Applicable for R0...R2 frames only.

8) Use shielded twisted-pair cables for digital signals.

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

10) Input signal

11) Output signal

For information on cable connection and drive operation, see *Control Connections* in the *hardware manual (3AXD50000044998)*.

ABB standard macro (vector)

The ABB standard macro (vector) is similar to the ABB standard macro. The ABB standard uses scalar motor control mode where as the ABB standard macro (vector) uses vector control as motor control mode.

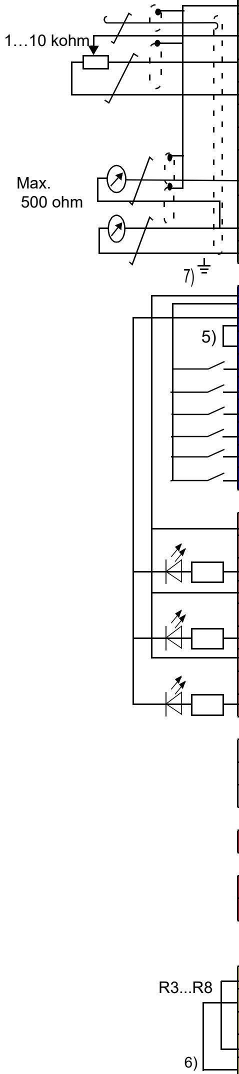
Similar to ABB standard macro, ABB standard (vector) has the following features:

- 2-wire I/O configuration with three constant frequency references
- Applicable for normal control purpose
- One signal is used to start or stop the motor and another signal is used to select the direction.

To enable the macro, navigate to:

- **Main menu** ≡ → **Connection macro** → **ABB standard (vector)**
  or
- **Main menu** ≡ → **Complete parameter list** **parameter** *96.04 Macro select* → [17] *ABB standard (vector)*.

Default control connections for the ABB standard (Vector) macro



X1	Reference voltage and analog inputs	
1	SCR	Signal cable shield (screen)
2	AI1	**External speed reference: 0…10 V**[1) 4) 8)]: see *22.11*
3	AGND	Analog input circuit, common
4	+10V	10 V DC reference voltage
5	AI2	Not configured [2)]
6	AGND	Analog input circuit, common
7	AO1	**Output frequency, 0…20 mA**[9)]: see *13.12*
8	AO2	**Motor current, 0…20 mA**[9)]: see *13.22*
9	AGND	Analog output circuit common
X2, X3	**Aux. voltage output and programmable digital inputs**	
10	+24V	Aux. voltage output +24 VDC, max. 250 mA[3)]
11	DGND	Aux. voltage output common
12	DCOM	Digital input common for all
13	DI1	**Stop (0) / Start (1)**: see *20.03*
14	DI2	**Forward (0) / reverse (1)**: see *20.03*
15	DI3	**Constant speed sel 1** [4) 8)]: see .*22.22*
16	DI4	**Constant speed sel 2** [4) 8)]: see *22.23*
17	DI5	**Ramp 1 (0) / Ramp 2 (1)**[5) 8)]: see *23.11*
18	DI6	Not configured
X6, X7, X8	**Relay outputs**	
19	RO1C	**Ready Run**[9)]: see *10.24*
20	RO1A	250 V AC / 30 V DC
21	RO1B	2 A
22	RO2C	**Running**[9)]: see. *10.27*
23	RO2A	250 V AC / 30 V DC
24	RO2B	2 A
25	RO3C	**Fault(-1)**[9)]: see. *10.30*
26	RO3A	250 V AC / 30 V DC
27	RO3B	2 A
X5	**Built-in fieldbus**	
29	B+	Internal Modbus RTU (EIA-485), see *Fieldbus control through the embedded fieldbus interface (EFB)*
30	A-	
31	DGND	
(Frame R0...R2)		
S100	TERM&BIAS	Termination resistor and bias resistor switch
(Frame R3...R8)		
S100	TERM	Termination resistor switch
S200	BIAS	Bias resistor switch

X4	Safety torque off		
	R0...R2	**R3...R8**	
33	-	OUT1	Safety torque off function. Factory connection. Both circuits must be closed for the drive to start. See *Safe torque off function* in the drive *hardware* manual.
34	SGND	OUT2	
35	OUT1	SGND	
36	6) IN1	IN1	
37	10) N2	IN2	

X10	24 V AC/DC (frames R6...R8 only)	
40	24 V AC/DC- in	24V AC/DC input, for control unit power supply when external main power is disconnected.
41	24 V AC/DC+ in	
X11	**Redundant auxiliary voltage output**	
42	+24 V	Aux. voltage output +24 V DC, max. 250 mA[3)]
43	DGND	Aux. voltage output common
44	DCOM	Digital input common for all

Terminal sizes

- (frames R0…R8): 0.14…1.5 mm^2 (all terminals)
- Tightening torques: 0.5…0.6 N·m (0.4 lbf·ft)

Notes

[1)] Current [0(4)…20 mA, R_{in} < 500 ohm] or voltage [0(2)…10 V, R_{in} > 200 kohm] input as selected with parameter *12.15 AI1 unit selection*.

[2)] Current [0(4)…20 mA, R_{in} = 100 ohm] or voltage [0(2)…10 V, R_{in} > 200 kohm] input as selected with parameter *12.25 AI2 unit selection*.

[3)] Total load capacity of the auxiliary voltage output +24V (X2:10) = 6.0 W (250 mA / 24 V). User can use this source for either of the I/O connections (DI1... DI2- RO1 or DI3...DI6 - RO2~RO3).

[4)] The constant speed are set based on the combination of sources as follows:

Source defined by par.*22.22*	Source defined by par.*22.23*	Constant speed active
0	0	Set speed through AI1
1	0	*Constant speed 1*

[5)] The speed reference ramp is set based on the combination of sources as follows:

DI5	Ramp set	Parameters
		Vector control (default)
0	1	*23.12 Acceleration time 1*
		23.13 Deceleration time 1
1	2	*23.14 Acceleration time 2*
		23.15 Deceleration time 2

[6)] Connected with jumpers at the factory.

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

[8)] Input signal

[9)] Output signal

[10)] For R0...R2 frames only

For information on cable connection and drive operation, see *Control Connections* in the *hardware manual (3AXD50000044998)*.

3-wire macro

This macro is used when the drive is controlled using momentary push-buttons. It provides three constant speeds. To enable the macro, select it in the **Primary settings** menu or set parameter *96.04 Macro select* to *3-wire*.

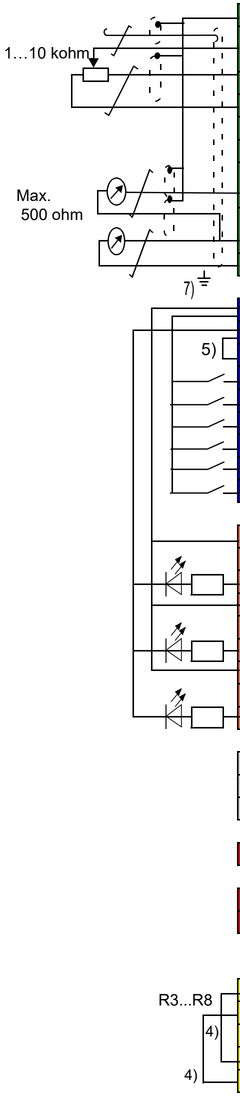
To enable the macro, navigate to:

- **Main menu** ≡ → **Connection macro** I/O → **3-wire macro**

  or

Main menu ≡ → **Complete parameter list** parameter *96.04 Macro select* → [17] *3-wire*.

Default control connections for the 3-wire macro



X1 Reference voltage and analog inputs

1	SCR	Signal cable shield (screen)
2	AI1	**External speed reference: 0…10 V**[1) 6)] : see *22.11*
3	AGND	Analog input circuit, common
4	+10V	10 V DC reference voltage
5	AI2	Not configured [6)]
6	AGND	Analog input circuit, common
7	AO1	**Output frequency, 0…20 mA**[6) 9)]: see *13.12*
8	AO2	**Motor current, 0…20 mA**[9)]: see *13.22*
9	AGND	Analog output circuit common

X2, X3 Aux. voltage output and programmable digital inputs

10	+24V	Aux. voltage output +24 VDC, max. 250 mA[3)]
11	DGND	Aux. voltage output common
12	DCOM	Digital input common for all
13	DI1	**Stop (0)**: see *20.03*
14	DI2	**Stop (1)**: see *20.03*
15	DI3	**Forward(0)/Reverse (1)**[8)]: see *20.03*
16	DI4	**Constant speed sel 2** [2) 8)]: see *22.23*
17	DI5	**Constant speed sel 2** [2) 8)]: see *22.23*
18	DI6	Not configured

X6, X7, X8 Relay outputs

19	RO1C	**Ready Run**[9)]: see *10.24* 250 V AC / 30 V DC 2 A
20	RO1A	
21	RO1B	
22	RO2C	**Running**[9)]: see. *10.27* 250 V AC / 30 V DC 2 A
23	RO2A	
24	RO2B	
25	RO3C	**Fault(-1)**[9)]: see. *10.30* 250 V AC / 30 V DC 2 A
26	RO3A	
27	RO3B	

X5 Built-in fieldbus

29	B+	Internal Modbus RTU (EIA-485), see *Fieldbus control through the embedded fieldbus interface (EFB)*
30	A-	
31	DGND	

(Frame R0...R2)

S100	TERM&BIAS	Termination resistor and bias resistor switch

(Frame R3...R8)

S100	TERM	Termination resistor switch
S200	BIAS	Bias resistor switch

X4 Safety torque off

	R0...R2	R3...R8	
33	-	OUT1	Safety torque off function. Factory connection. Both circuits must be closed for the drive to start. See *Safe torque off function* in the drive *hardware* manual.
34	SGND	OUT2	
35	OUT1	SGND	
36	IN1 [6)]	IN1	
37	IN2 [10)]	IN2	

X10 24 V AC/DC (frames R6...R8 only)

40	24 V AC/DC- in	24V AC/DC input, for control unit power supply when external main power is disconnected.
41	24 V AC/DC+ in	

X11 Redundant auxiliary voltage output

42	+24 V	Aux. voltage output +24 V DC, max. 250 mA[7)]
43	DGND	Aux. voltage output common
44	DCOM	Digital input common for all

Terminal sizes:

- (frames R0…R8: 0.14…1.5 mm^2 (all terminals)
- Tightening torques: 0.5…0.6 N·m (0.4 lbf·ft)

Notes:

[1] AI1 is used as a speed reference if vector control is selected.

[2] In scalar control (default): See **Menu - Primary settings - Start, stop, reference - Constant frequencies** or parameter group *28 Frequency reference chain*.
In vector control: See **Menu - Primary settings - Start, stop, reference - Constant speeds** or parameter group *22 Speed reference selection*.

DI4	DI5	Operation/Parameter	
		Scalar control (default)	**Vector control**
0	0	Set frequency through AI1	Set speed through AI1
1	0	*28.26 Constant frequency 1*	*22.26 Constant speed 1*
0	1	*28.27 Constant frequency 2*	*22.27 Constant speed 2*
1	1	*28.28 Constant frequency 3*	*22.28 Constant speed 3*

[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] Only frames R6…R11 have terminals 40 and 41 for external 24 V AC/DC input.

[6] Select voltage or current for inputs AI1 and AI2 and output AO1 with parameters *12.15*, *12.25* and *13.15*, respectively.

[7] Total load capacity of the auxiliary voltage output +24V (X2:10) = 6.0 W (250 mA /24 V). User can use this source for either of the I/O connections (DI1... DI2- RO1 or DI3...DI6 - RO2~RO3).

[8] Input signal

[9] Output signal

Input signals

- Analog speed/frequency reference (AI1)
- Start, pulse (DI1)
- Stop, pulse (DI2)
- Direction selection (DI3)
- Constant speed/frequency selection (DI4, DI5)

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)

Motor potentiometer macro

The motor potentiometer macro can be used to adjust the speed of the motor with two-push buttons or with PLCs that change the speed of the motor using two digital signals.

The source for the digital signals, used to increase the values, can be selected by parameters *22.73 Motor potentiometer up source* and *22.74 Motor potentiometer down source*.

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

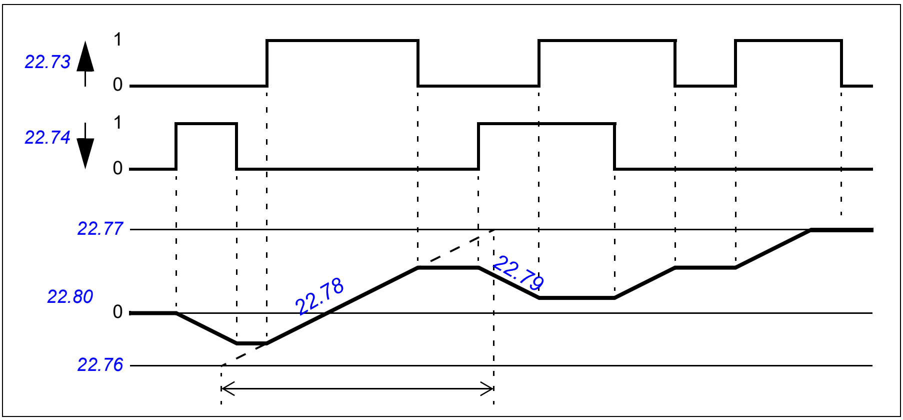
The time to increase the speed from the minimum (*22.76 Motor potentiometer min value*) to the maximum (*22.77 Motor potentiometer max value*) is defined in the parameter *22.78 Motor potentiometer ramp up*.

The time to decrease the speed from the maximum (*22.77 Motor potentiometer max value*) value to the minimum (*22.76 Motor potentiometer min value*) value is defined in the parameter *22.79 Motor potentiometer ramp down*.

If the up and down signals are simultaneously on, the motor potentiometer value does not change.

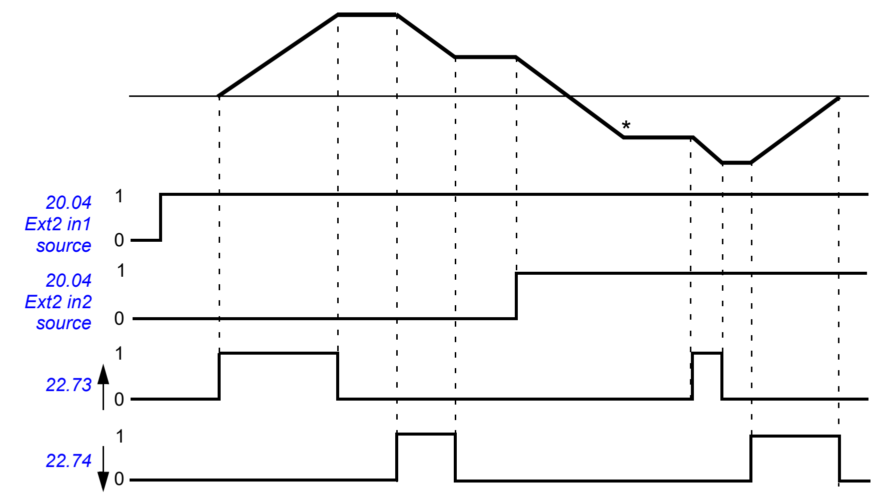
The output of the function is shown by *22.80 Motor potentiometer ref act*, which can directly be set as the reference source in the main selector parameters, or used as an input by other source selector parameters, both in scalar and vector control.

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



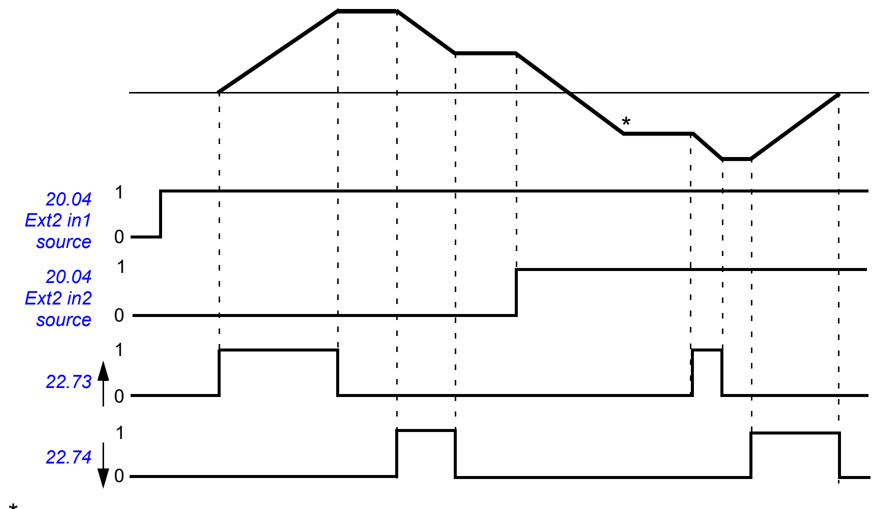
Parameters *22.73 Motor potentiometer up source* and *22.74 Motor potentiometer down source* control speed or frequency from zero to maximum speed or frequency.

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.

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.

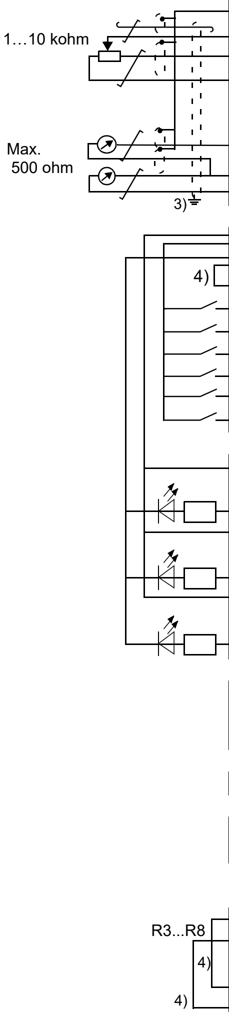


* Output speed or frequency has reached the reference value.

To enable the macro, navigate to:

- **Main menu** ≡ → **Connection macro** I/O → **Motor potentiometer**
  or
- **Main menu** ≡ → **Complete parameter list** **parameter** *96.04 Macro select* → [13] *Motor potentiometer*.

Default control connections for the ABB potentiometer macro



X1	Reference voltage and analog inputs and outputs	
1	SCR	Signal cable shield (screen)
2	AI1	Not configured
3	AGND	Analog input circuit, common
4	+10V	10 V DC reference voltage
5	AI2	Not configured
6	AGND	Analog input circuit, common
7	AO1	**Output frequency: 0…20 mA**[6]: see *13.12*
8	AO2	**Motor current: 0…20 mA**[6]: see *13.22*
9	AGND	Analog output circuit common
X2, X3	**Aux. voltage output and programmable digital inputs**	
10	+24V	Aux. voltage output +24 VDC, max. 250 mA[2]
11	DGND	Aux. voltage output common
12	DCOM	Digital input common for all
13	DI1	**Stop (0) / Start (1)**[5]: see *20.03*
14	DI2	**Forward (0) / reverse (1)**[5]: see *20.03*
15	DI3	**Reference up** [1,5]: see *22.73*
16	DI4	**Reference down**[1,5]: see *22.74*
17	DI5	**Constant frequency**[5]:see *28.22*
18	DI6	**Run enable (if 0, drive stops)**[5]: see *20.12*
X6,X7, X8	**Relay outputs**	
19	RO1C	**Ready run**[6]: see *10.24*. 250 V AC / 30 V DC 2 A
20	RO1A	
21	RO1B	
22	RO2C	**Running**[6]: see *10.27*. 250 V AC / 30 V DC 2 A
23	RO2A	
24	RO2B	
25	RO3C	**Fault (-1)**[6]: see *10.30*. 250 V AC / 30 V DC 2 A
26	RO3A	
27	RO3B	
X5	**Built-in fieldbus**	
29	B+	Internal Modbus RTU (EIA-485). See *Fieldbus control through the embedded fieldbus interface (EFB)*.
30	A-	
31	DGND	
(Frame R0...R2)		
S100	TERM&BIAS	Termination resistor and bias resistor switch
(Frame R3...R8)		
S100	TERM	Termination resistor switch
S200	BIAS	Bias resistor switch

X4	Safety torque off		
	R0...R2	**R3...R**	
33	-	OUT1	Safety torque off function. Factory connection. Both circuits must be closed for the drive to start. See *Safe torque off function* in the drive *hardware* manual.
34	SGND	OUT2	
35	OUT1	SGND	
36	7) IN1	IN1	
37	4) IN2	IN2	

X10	24 V AC/DC (frames R6...R8 only)	
40	24 V AC/DC- in	24V AC/DC input, for control unit power supply when external main power is disconnected.
41	24 V AC/DC+ in	
X11	**Redundant auxiliary voltage output (frames R0...R2)**	
42	+24 V	Aux. voltage output +24 V DC, max. 250 mA[2]
43	DGND	Aux. voltage output common
44	DCOM	Digital input common for all

Terminal sizes

- (frames R0…R8): 0.14…1.5 mm^2 (all terminals)
- Tightening torques: 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) Total load capacity of the auxiliary voltage output +24V (X2:10) = 6.0 W (250 mA / 24 V). User can use this source for either of the I/O connections (DI1... DI2- RO1 or DI3...DI6 - RO2~RO3).

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) Input signal

6) Output signal

7) For R0...R2 frames only

In addition, below input is automatically set as follows:

No.	Name (Input/Setting)	Value
23.11	*Ramp set selection*	0 = *Acc/Dec time 1*

For information on cable connection and drive operation, see *Control Connections* in the *Hardware manual (3AXD50000044998)*.

PID macro

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

To enable the macro, navigate to:

- **Main menu** ≡ → **Connection macro** I/O → **PID**
  or
- **Main menu** ≡ → **Complete parameter list** parameter *96.04 Macro select* → [14] *PID*.

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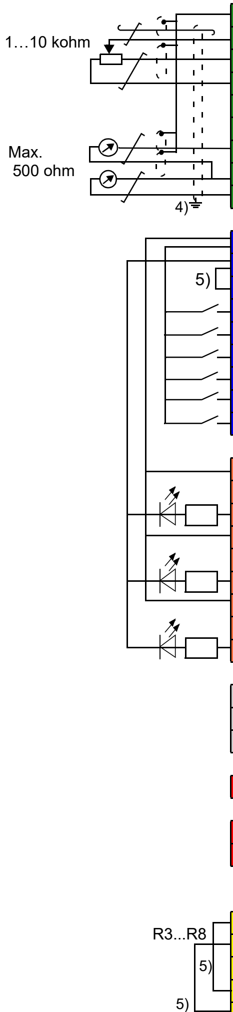
Default control connections for the ABB PID macro



X1	**Reference voltage and analog inputs and outputs**	
1	SCR	Signal cable shield (screen)
2	AI1	**External PID reference: 0…10V** [7]: see *40.16*.
3	AGND	Analog input circuit, common
4	+10V	10 V DC reference voltage
5	AI2	**PID feedback: 4...20mA**[1] [7]: see *40.08*
6	AGND	Analog input circuit, common
7	AO1	**Output frequency: 0…20 mA**[8]: see *13.12*
8	AO2	**Motor current: 0…20 mA[8]**: see *13.22*
9	AGND	Analog output circuit common
X2, X3	**Aux. voltage output and programmable digital inputs**	
10	+24V	Aux. voltage output +24 VDC, max. 250 mA[6]
11	DGND	Aux. voltage output common
12	DCOM	Digital input common for all
13	DI1	**Stop (0) / Start (1) PID:** see *20.03*
14	DI2	**Internal setpoint 1**[3] [7]: see *40.19*.
15	DI3	**Internal setpoint 2**[3] [7]: see*40.20*.
16	DI4	**Constant frequency 1**[2] [7]: see *28.26*.
17	DI5	**Run enable (if 0, drive stops)**[7]: see *20.12*
18	DI6	Not configured
X6,X7, X8	**Relay outputs**	
19	RO1C	**Ready run[8]**: see *10.24*. 250 V AC / 30 V DC 2 A
20	RO1A	
21	RO1B	
22	RO2C	**Running**[8]: see *10.27*. 250 V AC / 30 V DC 2 A
23	RO2A	
24	RO2B	
25	RO3C	**Fault (-1)**[8]: see *10.30*. 250 V AC / 30 V DC 2 A
26	RO3A	
27	RO3B	
X5	**Built-in fieldbus**	
29	B+	Internal Modbus RTU (EIA-485). See *Fieldbus control through the embedded fieldbus interface (EFB)*.
30	A-	
31	DGND	
(Frame R0...R2)		
S100	TERM&BIAS	Termination resistor and bias resistor switch
(Frame R3...R8)		
S100	TERM	Termination resistor switch
S200	BIAS	Bias resistor switch

X4	**Safety torque off**		
	R0...R2	**R3...R**	
33	-	OUT1	Safety torque off function. Factory connection. Both circuits must be closed for the drive to start. See *Safe torque off function* in the drive *hardware* manual.
34	SGND	OUT2	
35	OUT1	SGND	
36	9) IN1	IN1	
37	5) IN2	IN2	

X10	**24 V AC/DC (frames R6...R8 only)**	
40	24 V AC/DC- in	24V AC/DC input, for control unit power supply when external main power is disconnected.
41	24 V AC/DC+ in	
X11	**Redundant auxiliary voltage output (frames R0...R2)**	
42	+24 V	Aux. voltage output +24 V DC, max. 250 mA[6]
43	DGND	Aux. voltage output common
44	DCOM	Digital input common for all

Terminal sizes

- (frames R0…R8): 0.14…1.5 mm^2 (all terminals)
- Tightening torques: 0.5…0.6 N·m (0.4 lbf·ft)

Notes

[1] The signal source is powered externally. See the manufacturer's instructions. To use sensors supplied by the drive aux. voltage output, see chapter *Electrical installation*, section *Connection examples of two-wire and three-wire sensors* in the *Hardware manual* of the drive

[2] If Constant frequency is activated it overrides the reference from the PID controller output.

[3] The internal setpoint are set based on the combination of sources as follows:

Source defined by par. *40.19* **DI2**	**Source defined by par. *40.20*** **DI3**	**Internal setpoint active**
0	0	Setpoint source: AI1
1	0	*Set 1 internal setpoint 1*
0	1	*Set 1 internal setpoint 2*
1	1	*Set 1 internal setpoint 3*

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

[5] Connected with jumpers at the factory.

[6] Total load capacity of the auxiliary voltage output +24V (X2:10) = 6.0 W (250 mA / 24 V). User can use this source for either of the I/O connections (DI1... DI2- RO1 or DI3...DI6 - RO2~RO3).

[7] Input signal

[8] Output signal

[9] For R0...R2 frames only

In addition, below inputs are set automatically as follows:

Parameter No.	**Name (Input/Setting)**	**Value**
20.01	*Ext1 commands*	1= *In1 Start*
23.11	*Ramp set selection*	0 = *Acc/Dec time 1*

For information on cable connection and drive operation, see *Control Connections* in the *Hardware manual (3AXD50000044998)*.

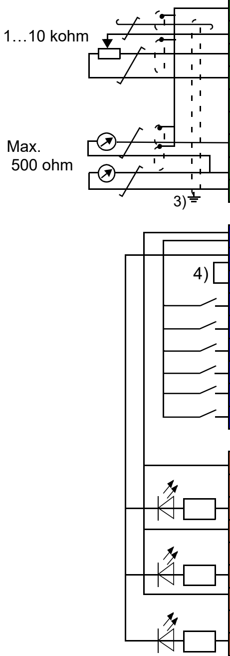
Panel PID macro

The panel PID macro is suitable for applications where the drive is always controlled by a PID controller and the setpoint is defined with the control panel.

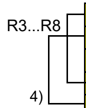
To enable the macro, navigate to:

- **Main menu** ≡ → **Connection macro** I/O → **Panel PID** PID
  or
- **Main menu** ≡ → **Complete parameter list** **parameter** *96.04 Macro select* → [15] *Panel PID*.

Default control connections for the Panel PID macro



X1	Reference voltage and analog inputs and outputs	
1	SCR	Signal cable shield (screen)
2	AI1	Not configured[6]
3	AGND	Analog input circuit, common
4	+10V	10 V DC reference voltage
5	AI2	**PID feedback, 4...20mA**[1] [7] : see *40.08*
6	AGND	Analog input circuit, common
7	AO1	**Output frequency, 0…20 mA**[8]: see *13.12*
8	AO2	**Motor current, 0…20 mA**[8]: see *13.22*
9	AGND	Analog output circuit common
X2, X3	**Aux. voltage output and programmable digital inputs**	
10	+24V	Aux. voltage output +24 VDC, max. 250 mA[5]
11	DGND	Aux. voltage output common
12	DCOM	Digital input common for all
13	DI1	**Stop (0) / Start (1) PID**[7]: see *20.03*
14	DI2	Not configured
15	DI3	Not configured
16	DI4	**Constant frequency 1**[2] [7]: see *28.26*
17	DI5	**Run enable (if 0, drive stops)**[7]**:** see *20.12*
18	DI6	Not configured
X6,X7, X8	**Relay outputs**	
19	RO1C	**Ready run**[8]: see *10.24* 250 V AC / 30 V DC 2 A
20	RO1A	
21	RO1B	
22	RO2C	**Running**[8]: see *10.27* 250 V AC / 30 V DC 2 A
23	RO2A	
24	RO2B	
25	RO3C	**Fault (-1)**[8]: see *10.30* 250 V AC / 30 V DC 2 A
26	RO3A	
27	RO3B	
X5	**Built-in fieldbus**	
29	B+	Internal Modbus RTU (EIA-485). Internal Modbus RTU (EIA-485). See *Fieldbus control through the embedded fieldbus interface (EFB)*.
30	A-	
31	DGND	
(Frame R0...R2)		
S100	TERM&BIAS	Termination resistor and bias resistor switch
(Frame R3...R8)		
S100	TERM	Termination resistor switch
S200	BIAS	Bias resistor switch



X4	Safety torque off		
	R0...R2	**R3...R**	
33	-	OUT1	Safety torque off function. Factory connection. Both circuits must be closed for the drive to start. See *Safe torque off function* in the drive *hardware* manual.
34	SGND	OUT2	
35	OUT1	SGND	
36	9) IN1	IN1	
37	4) IN2	IN2	

X10	24 V AC/DC (frames R6...R8 only)	
40	24 V AC/DC- in	24V AC/DC input, for control unit power supply when external main power is disconnected.
41	24 V AC/DC+ in	

X11	Redundant auxiliary voltage output (frames R0...R2)	
42	+24 V	Aux. voltage output +24 V DC, max. 250 mA[5]
43	DGND	Aux. voltage output common
44	DCOM	Digital input common for all

Terminal sizes

- (frames R0…R8): 0.14…1.5 mm^2 (all terminals)
- Tightening torques: 0.5…0.6 N·m (0.4 lbf·ft)

Notes

[1)] The signal source is powered externally. See the manufacturer's instructions. To use sensors supplied by the drive aux. voltage output, see chapter Electrical installation, section *Connection examples* of two-wire and three-wire sensors in the Hardware manual of the drive.

[2)] If Constant frequency is activated it overrides the reference from the PID controller output.

[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)] Total load capacity of the auxiliary voltage output +24V (X2:10) = 6.0 W (250 mA / 24 V). User can use this source for either of the I/O connections (DI1... DI2- RO1 or DI3...DI6 - RO2~RO3).

[6)] PID setpoint is from control panel reference

[7)] Input signal

[8)] Output signal

[9)] For R0...R2 frames only

In addition, below inputs are set automatically as follows:

Parameter No.	Name (Input/Setting)	Value
20.01	*Ext1 commands*	1= *In1 Start*
23.11	*Ramp set selection*	0 = *Acc/Dec time 1*

For information on cable connection and drive operation, see *Control Connections* in the *Hardware manual (3AXD50000044998)*.

Torque control macro

This macro is used in applications in which torque control of the motor is required. These are typically tension applications, where a particular tension needs to be maintained in the mechanical system.

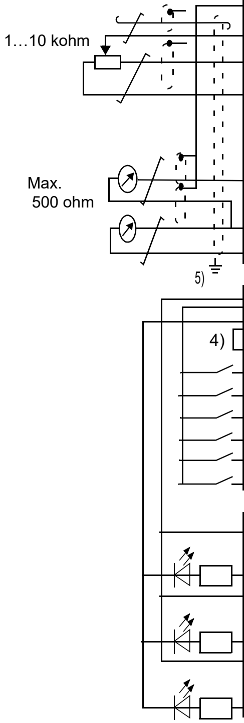
Torque reference is given through analog input AI2, typically as a current signal in the range of 0…20 mA (corresponding to 0…100% of rated motor torque).

The start/stop signal is connected to digital input DI1. The direction is determined by DI2. Through digital input DI3, it is possible to select speed control (EXT1) instead of torque control (EXT2). As with the PID control macro, speed control can be used for commissioning the system and checking the motor direction.

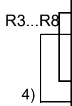
It is also possible to change the control to local (control panel or PC tool) by pressing the Loc/Rem key. By default, the local reference is speed; if a torque reference is required, the value of parameter *19.16 Local control mode* should be changed to Torque.

A constant speed (by default, 300 rpm) can be activated through DI4. DI5 switches between acceleration/deceleration time sets 1 and 2. The acceleration and deceleration times are defined by parameters *23.12*…*23.15*.

Default control connections for the Torque control macro



X1	Reference voltage and analog inputs	
1	SCR	Signal cable shield (screen)
2	AI1	**External speed reference: 0…10 V[1) 4) 8)]:** see *22.11*
3	AGND	Analog input circuit, common
4	+10V	10 V DC reference voltage
5	AI2	Torque reference [2)]
6	AGND	Analog input circuit, common
7	AO1	**Motor speed used: 0…20 mA[9)]:** see *13.12*
8	AO2	**Motor current: 0…20 mA[9)]:** see *13.22*
9	AGND	Analog output circuit common
X2, X3	**Aux. voltage output and programmable digital inputs**	
10	+24V	Aux. voltage output +24 VDC, max. 250 mA[3)]
11	DGND	Aux. voltage output common
12	DCOM	Digital input common for all
13	DI1	**Stop (0) / Start (1)**
14	DI2	**Forward (0) / Reverse (1)**
15	DI3	**Speed control (0) / Torque control (1)**
16	DI4	**Constant speed 1 (1 = On)**
17	DI5	**Acc/Dec time set 1(0) / set 2(1)**
18	DI6	**Run enable (1 = On)**
X6, X7, X8	**Relay outputs**	
19	RO1C	**Ready run**[9)]: see. *10.24*
20	RO1A	250 V AC / 30 V DC
21	RO1B	2 A
22	RO2C	**Running**[9)]: see. *10.27*
23	RO2A	250 V AC / 30 V DC
24	RO2B	2 A
25	RO3C	**Fault (-1)**[9)]: see. *10.30*
26	RO3A	250 V AC / 30 V DC
27	RO3B	2 A
X5	**Built-in fieldbus**	
29	B+	Internal Modbus RTU (EIA-485), see *Fieldbus control through the embedded fieldbus interface (EFB)*
30	A-	
31	DGND	
(Frame R0...R2)		
S100	TERM&BIAS	Termination resistor and bias resistor switch
(Frame R3...R8)		
S100	TERM	Termination resistor switch
S200	BIAS	Bias resistor switch



X4	Safety torque off		
	R0...R2	**R3...R8**	
33	-	OUT1	Safety torque off function. Factory connection. Both circuits must be closed for the drive to start. See *Safe torque off function* in the drive *hardware* manual.
34	SGND	OUT2	
35	OUT1	SGND	
36	10) IN1	IN1	
37	4) IN2	IN2	
X10	**24 V AC/DC (frames R6...R8 only)**		
40	24 V AC/DC- in		24V AC/DC input, for control unit power supply when external main power is
41	24 V AC/DC+ in		
X11	**Redundant auxiliary voltage output**		
42	+24 V		Aux. voltage output +24 V DC, max. 250 mA[3)]
43	DGND		Aux. voltage output common
44	DCOM		Digital input common for all

Terminal sizes

- (frames R0…R8): 0.14…1.5 mm^2 (all terminals)
- Tightening torques: 0.5…0.6 N·m (0.4 lbf·ft)

Notes

1) Current [0(4)…20 mA, R_{in} < 500 ohm] or voltage [0(2)…10 V, R_{in} > 200 kohm] input as selected with parameter *12.15 AI1 unit selection*.

2) Current [0(4)…20 mA, R_{in} = 100 ohm] or voltage [0(2)…10 V, R_{in} > 200 kohm] input as selected with parameter *12.25 AI2 unit selection*.

3) Total load capacity of the auxiliary voltage output +24V (X2:10) = 6.0 W (250 mA / 24 V). User can use this source for either of the I/O connections (DI1... DI2- RO1 or DI3...DI6 - RO2~RO3).

4) Connected with jumpers at the factory.

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

6) Can be used to set up pressure alarm warning.

7) Can be used for cold start prevention with connection to 'temperature reached' output of temperature controller or PLC

8) Input signal

9) Output signal

10) For R0...R2 frames only

In addition, some inputs and settings are set automatically as follows:

No.	Name (Input/Setting)	Value
19.11	*Ext1/Ext2 selection*	5 = *DI3*
19.14	*Ext2 control mode*	3 = *Torque*
20.02	*Ext1 start trigger type*	1 = *Level*
20.06	*Ext2 commands*	2 = *In1 Start; In2 Dir*
20.07	*Ext2 start trigger type*	1 = *Level*
20.08	*Ext2 in1 source*	2 = *DI1*
20.09	*Ext2 in2 source*	2 = *DI2*
20.12	*Run enable 1 source*	7 = *DI6*
22.22	*Constant speed sel1*	5 = *DI4*
23.11	*Ramp set selection*	0 = *DI5*
26.11	*Torque ref1 source*	2 = *AI2 scaled*
31.11	*Fault reset selection*	0 = *Not used*

For information on cable connection and drive operation, see *Control Connections* in the *Hardware manual (3AXD50000044998)*

Pump and Fan Control (PFC) macro

The PFC macro is suitable for pump or fan systems consisting of one drive and multiple pumps/fans.

The PFC macro can be used to:

- Control the speed of one of the pumps/fans
- Connect or disconnect the auxiliary pumps in Direct On Line (DOL) connection as and when required.

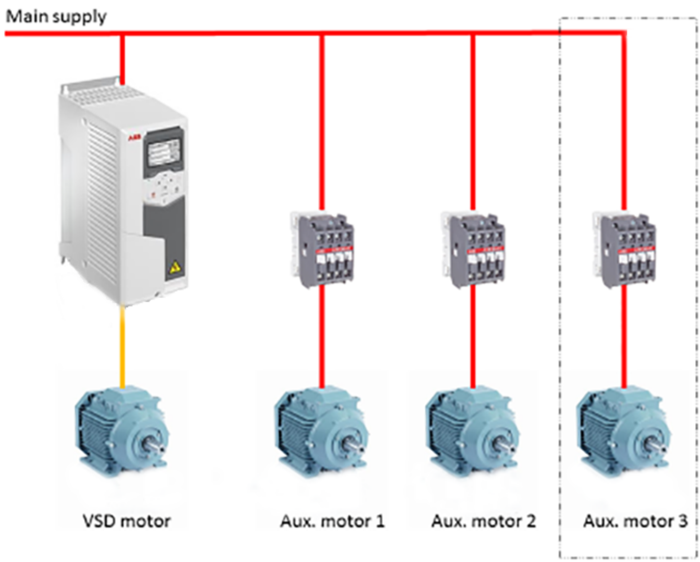
For example, in a pump application with multiple pumps, the PFC logic controls the pumps as follows:

1. The drive varies the motor speed (VSD motor) to control the output of the first pump. This pump is the speed regulated pump.
2. 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 the auxiliary pump using the drive relay output.
3. The PFC logic reduces the speed of the first pump to balance the system output and to get the optimum energy efficiency.
4. The PID controller adjusts the speed/frequency of the first pump in such a way that the system output meets the process need.
5. If the demand further increases, the PFC logic adds further auxiliary pumps in similar manner.
6. When the demand drops, the drive reduces the speed of the first pump and when it reaches below the minimum limit (user defined speed/frequency limit), the PFC logic automatically stops the auxiliary pump. At the same time, the PFC logic increases the speed of the first pump to account for the missing output of the stopped auxiliary pump.

Note: The PFC is supported in external control location EXT2 only. However, you can use EXT1 for manual control of pump 1.

The below timing diagram explains how and when an auxiliary pump is connected with the PFC logic.

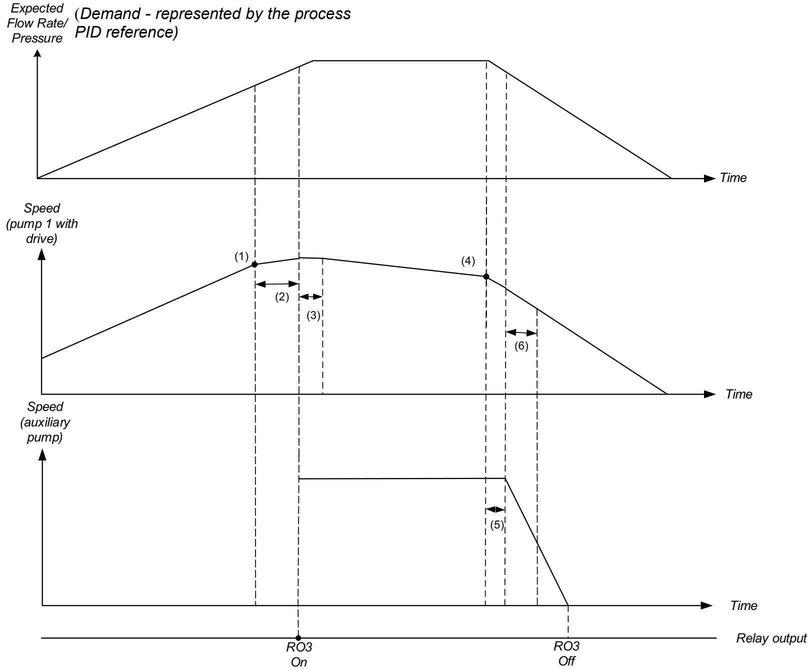
Example of a 3-pump constant pressure water supply application:



Pump 1 - connected to VSD motor
Pump 2 - connected to auxiliary motor 1
Pump 3 - connected to auxiliary motor 2

Flow consumption versus pump status			
Consumption	**Pump 1**	**Pump 2**	**Pump 3**
Low ↓ High ↓ Low	VSD	Off	Off
	VSD	DOL	Off
	VSD	DOL	DOL
	VSD	DOL	Off
	VSD	Off	Off
VSD	Variable Speed Drive (yellow colour connecting line in the figure). Controlled by drive, tuning the output speed according to PID control.		
DOL	Direct On Line (red colour connecting line in the figure). Pump is running at fixed motor nominal speed.		
Off	Off-line. Pump stops.		

PFC enabled pump control timing diagram



(1) *76.30 Start point 1* - Start speed for the auxiliary motor.

(2) *76.55 Start delay* - Delay time to start the auxiliary pump. The pump is started only when speed of pump 1 is higher or equal to the start speed (*76.30*) for the duration mentioned in this parameter.

(3) *76.57 PFC speed hold on* - Duration for pump 1 to maintain the speed momentum. This time is used to compensate the time needed to accelerate the auxiliary pump to a speed where it produces the flow.

(4) *76.41 Stop point 1* - Stop speed for the auxiliary motor.

(5) *76.56 Stop delay* - Delay time to turn off the auxiliary pump when speed of pump 1 is lower or equal to stop speed (*76.41*) for the duration mentioned in this parameter.

(6) *76.58 PFC speed hold off* - Time needed to compensate the pump 1 acceleration to the speed that produces flow.

In addition, the PFC logic also supports the following features:

Autochange

Autochange functionality or the automatic rotation can be used to automatically rotate the start order of the PFC system. This function has the following features:

- Keeps the run time of the pumps/fans equal over time to even their wear .
- Prevent any pump/fan from standing still for too long, which otherwise 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.

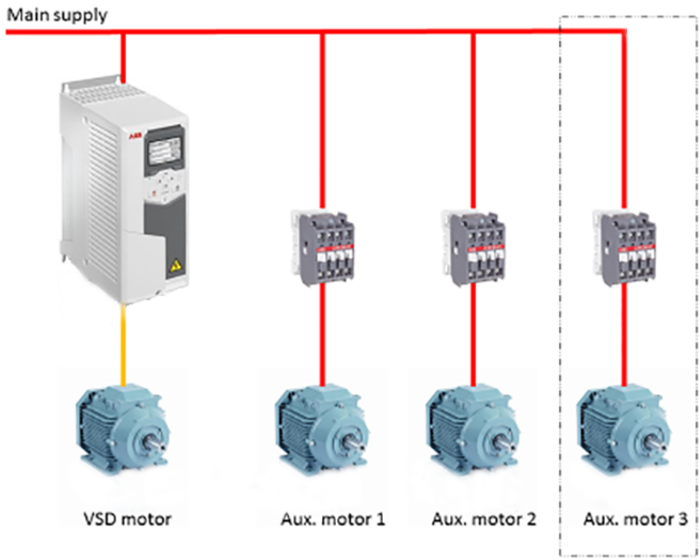
The Autochange function can be defined in the parameter group *76 PFC configuration*.

Note: The Autochange function also triggered by the Timed function. See description on page *59*.

There are 2 modes of auto change with PFC:

1. Autochange PFC with auxiliary motors
   In this mode auto rotation happens with only 2nd and 3rd pump. Two pumps meet the flow consumption for long term running and the 3rd pump is reserved for shifting.

Example of PFC autochange with auxiliary pumps in a 3-pump constant pressure water supply application:



Pump 1 - connected to VSD motor

Pump 2 - connected to auxiliary motor 1

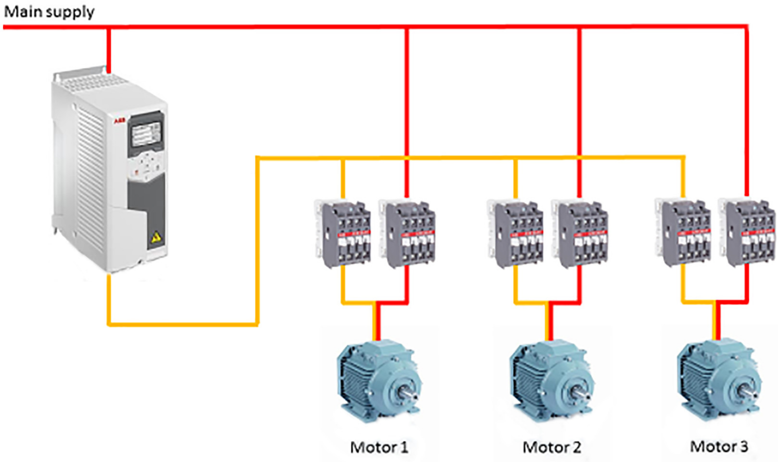
Pump 3 - connected to auxiliary motor 2

Flow consumption versus 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	Variable Speed Drive (yellow colour connecting line in the figure). Controlled by drive, tuning the output speed according to PID control.		
DOL	Direct On Line (red colour connecting line in the figure). Pump is running at fixed motor nominal speed.		
Off	Off-line. Pump stops.		

2. Autochange PFC with all the motors
   In this mode, all motors involves in the autochange. VSD motor moves to next

pump one by one, but the auxiliary motor is always is on-line in DOL mode. Two pumps meet the flow consumption for long term running and the 3rd pump is reserved for shifting. All the motors shifts for autochange routine and special auxiliary circuit is needed for the same. This system is similar to the SPFC.

Example of PFC autochange with all motors in a 3-pump constant pressure water supply application:



Pump 1 - connected to Motor 1

Pump 2 - connected to Motor 2

Pump 3 - connected to Motor 23

Flow consumption versus 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	Variable Speed Drive (yellow colour connecting line in the figure). Controlled by drive, tuning the output speed according to PID control.		
DOL	Direct On Line (red colour connecting line in the figure). Pump is running at fixed motor nominal speed.		
Off	Off-line. Pump stops.		

Interlock

The Interlock function can be used to notify the PFC logic on when a motor is not available. For example, when a motor is under maintenance or due to manual direct-on-line starting.

When the interlock signal of a motor is in Available status, the motor participates in the PFC starting sequence. If the signal is in Interlocked status, the motor is excluded from the PFC sequence.

The interlock function can be defined in the parameter group *76 PFC configuration*.

Parameter Settings

To enable the PFC macro, navigate to:

- **Main menu** ≡ → **Connection macro** → **PFC**

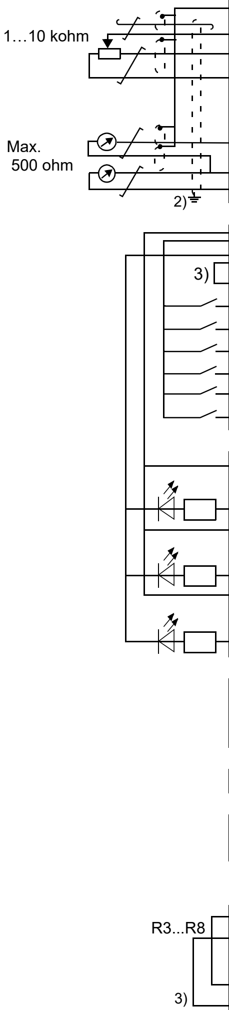
  or

- **Main menu** ≡ → **Complete parameter list** **parameter** *96.04 Macro select* → [16] *PFC*.

The following default values are used for PFC macro:

No.	Value	No.	Value
10.24	7 = *Running*	*20.08*	7 = *DI6*
10.27	15 = *Fault (-1)*	*20.09*	0 = *Always off*
10.30	46 = *PFC2*	*20.12*	3 = *DI2*
12.17	0	*20.19*	1 = *Selected*
12.20	50.0	*21.03*	0 = *Coast*
13.12	2 = *Output frequency*	*22.11*	1 = *AI1 scaled*
13.18	50.0	*22.18*	16 = *PID*
19.11	1 = *DI3*	*22.22*	0 = *Always off*
19.17	0=*No*	*22.23*	0 = *Always off*
20.01	1 =*In1 Start*	*22.73*	0 = *Not used*
20.03	2 = *DI1*	*22.74*	0 = *Not used*
20.04	0 = *Always off*	*23.11*	0 = *Acc/Dec time 1*
20.05	0 = *Always off*	*28.11*	1 = *AI1 scaled*
20.06	1 = *In1 Start*	*28.15*	16 = *PID*
28.22	0 = *Always off*	*40.19*	0 = *Not selected*
28.23	0 = *Always off*	*40.20*	0 = *Not selected*
28.71	0 = *Acc/Dec time 1*	*40.32*	2.50
30.11	-1500 rpm	*40.33*	3.0
31.01	1 = *Inactive (true)*	*76.21*	2 = *PFC*
31.02	0 = *Fault*	*76.25*	2
40.07	2 = *On when drive running*	*76.27*	2
40.16	11 = *AI1 percent*	*99.04*	0 = *Scalar*
40.17	0 = *Not selected*		

Default control connections for the PFC macro



X1	Reference voltage and analog inputs and outputs	
1	SCR	Signal cable shield (screen)
2	AI1	**PID setpoint, 0…10 V**[1) 5)]: see *40.16*
3	AGND	Analog input circuit, common
4	+10V	10 V DC reference voltage
5	AI2	**PID feedback, 4...20mA**[1) 5)]: see *40.08*
6	AGND	Analog input circuit, common
7	AO1	**Output frequency: 0…20 mA** [6)]: see *13.12*
8	AO2	**Motor current, 0…20 mA** [6)]: see *13.22*
9	AGND	Analog output circuit common
X2, X3	**Aux. voltage output and programmable digital inputs**	
10	+24V	Aux. voltage output +24 VDC, max. 250 mA[4)]
11	DGND	Aux. voltage output common
12	DCOM	Digital input common for all
13	DI1	**Stop (0) / Start (1) (EXT 1)** [5)]: see *20.03*
14	DI2	**Run enable (if 0, drive stops)** [5)]: see *20.12*.
15	DI3	**EXT1 (0) / EXT 2 (1)** [5)]: see *19.11*
16	DI4	Not configured
17	DI5	Not configured
18	DI6	Not configured
X6,X7, X8	**Relay outputs**	
19	RO1C	**Running** [6)]: see *10.27* 250 V AC / 30 V DC 2 A
20	RO1A	
21	RO1B	
22	RO2C	**Fault (-1)**[6)]: see *10.30* 250 V AC / 30 V DC 2 A
23	RO2A	
24	RO2B	
25	RO3C	**PFC2 (the 2nd motor = the first auxiliary motor)** [6)]: see *10.30* 250 V AC / 30 V DC
26	RO3A	
27	RO3B	
X5	**Built-in fieldbus**	
29	B+	Internal Modbus RTU (EIA-485). See *Fieldbus control through the embedded fieldbus interface (EFB)*.
30	A-	
31	DGND	
(Frame R0...R2)		
S100	TERM&BIAS	Termination resistor and bias resistor switch
(Frame R3...R8)		
S100	TERM	Termination resistor switch
S200	BIAS	Bias resistor switch

X4	Safety torque off		
	R0...R2	**R3...R**	
33	-	OUT1	Safety torque off function. Factory connection. Both circuits must be closed for the drive to start. See *Safe torque off function* in the drive *hardware* manual.
34	SGND	OUT2	
35	OUT1	SGND	
36	7) IN1	IN1	
37	3) IN2	IN2	

X10	24 V AC/DC (frames R6...R8 only)	
40	24 V AC/DC- in	24V AC/DC input, for control unit power supply when external main power is disconnected.
41	24 V AC/DC+ in	
X11	**Redundant auxiliary voltage output (frames R0...R2)**	
42	+24 V	Aux. voltage output +24 V DC, max. 250 mA[4)]
43	DGND	Aux. voltage output common
44	DCOM	Digital input common for all

Terminal sizes

- (frames R0…R8): 0.14…1.5 mm^2 (all terminals)
- Tightening torques: 0.5…0.6 N·m (0.4 lbf·ft)

Notes

1) The signal source is powered externally. See the manufacturer's instructions. To use sensors supplied by the drive aux. voltage output, see chapter *Electrical installation*, section *Connection examples of two-wire and three-wire sensors* in the Hardware manual of the drive.

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) Total load capacity of the auxiliary voltage output +24V (X2:10) = 6.0 W (250 mA / 24 V). User can use this source for either of the I/O connections (DI1... DI2- RO1 or DI3...DI6 - RO2~RO3).

5) Input signal

6) Output signal

7) For R0...R2 frames only

For information on cable connection and drive operation, see *Control Connections* in the *hardware manual (3AXD50000044998)*.

Soft Pump and Fan Control (SPFC) macro

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.

In SPFC all the pumps are auxiliary pump and get connected to Direct On Line (DOL) or drive as and when required. In PFC only primary pump is connected to the drive.

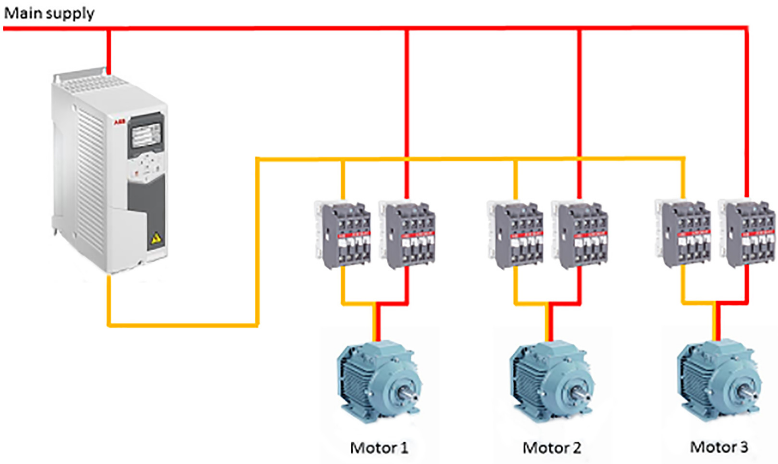
In SPFC logic the auxiliary pumps are connected as follows:

1. As the expected flow rate/demand increases, the speed of auxiliary pump 1 increases accordingly. When the auxiliary pump reaches the start speed (*76.30*) and exceeds the start delay (*76.55*), the drive connects the drive controlled motor (auxiliary pump 1) to the supply network in a flying start, that is, while the motor is still coasting.
2. The drive then connects to the auxiliary pump 2 and starts controlling the speed.
3. The auxiliary pump 1 is connected DOL through a contactor.
4. Further auxiliary motors, if connected, are started in a similar manner. The motor stopping routine is the same as for the normal PFC routine.
5. 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.

Note: The SPFC is supported in external control location EXT2 only. EXT1 can be used for the manual control of pump 1.

The below timing diagram explains how and when an auxiliary pump is connected with the SPFC logic.

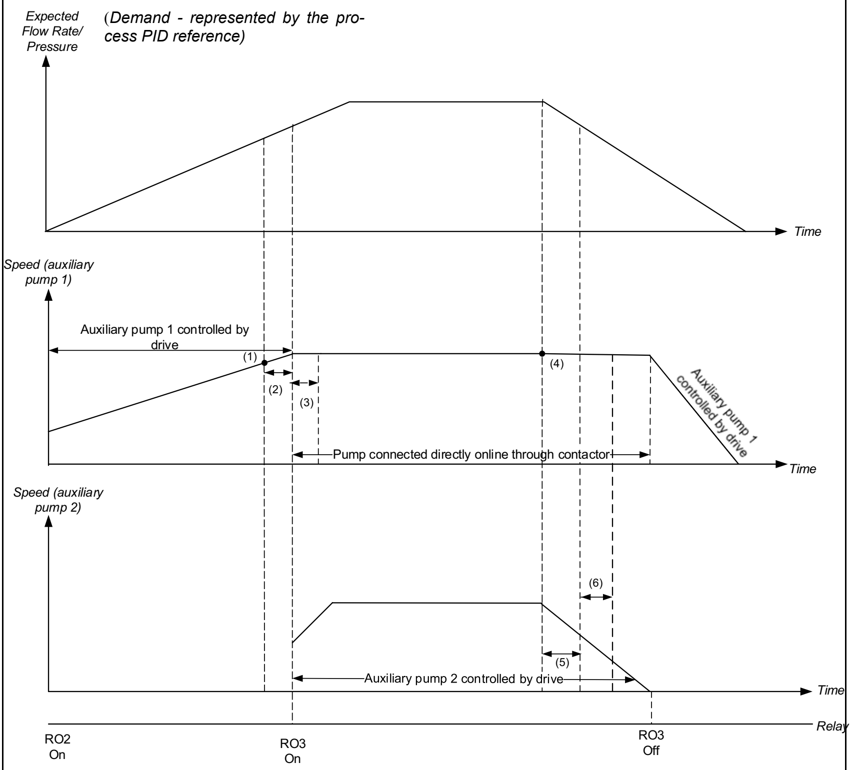
Example of a 3-pump constant pressure water supply application:



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

Flow consumption versus pump status			
Consumption	**Pump 1**	**Pump 2**	**Pump 3**
Low	VSD	Off	Off
↓	DOL	VSD	Off
High	DOL	DOL	DOL
↓	DOL	Off	VSD
Low	Off	Off	Off
↓	VSD	Off	DOL
High	DOL	VSD	DOL
↓	DOL	VSD	Off
Low	Off	VSD	Off
↓	VSD	DOL	Off
High	DOL	DOL	VSD
VSD	Variable Speed Drive (yellow colour connecting line in the figure). Controlled by drive, tuning the output speed according to PID control.		
DOL	Direct On Line (red colour connecting line in the figure). Pump is running at fixed motor nominal speed.		
Off	Off-line. Pump stops.		

SPFC enabled pump control timing diagram.



(1) *76.30 Start point 1* - Start speed for the auxiliary pump 2.

(2) *76.55 Start delay* - Delay time to start auxiliary pump 2. The pump is started only when the speed of the auxiliary pump 1 is higher or same as the start speed (*76.30*) for the duration mentioned in this parameter.

(3) *76.57 PFC speed hold on* - Time used to compensate the time needed to accelerate the auxiliary pump 2 to a speed where it produces flow. For duration mentioned in the parameter, the auxiliary pump 1 maintains its speed momentum.

(4) *76.41 Stop point 1* - Stop speed for the auxiliary pump 2.

(5) *76.56 Stop delay* - Delay time to turn off the auxiliary pump 2 when the speed of the auxiliary pump 1 is lower or same as the stop speed (*76.41*) for the duration mentioned in this parameter.

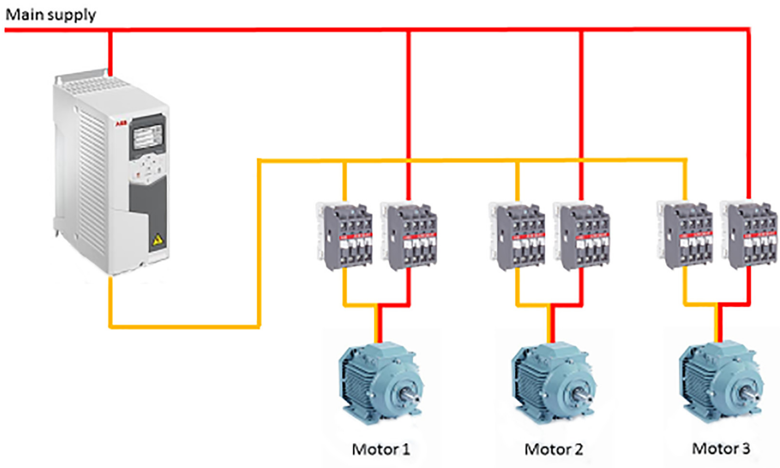
(6) *76.58 PFC speed hold off* - Time is used to compensate the time needed to accelerate the auxiliary pump 1 to a speed where it produces flow.

Autochange

SPFC system supports autochange naturally as the drive starts all the pump. Autochange functionality in SPFC is similar to autochange function in PFC except that autochange with auxiliary motor is not applicable for SPFC. See section *Autochange* on *128*.

In autochange, two pumps meet the flow consumption for long term running and the 3rd pump is reserved for shifting.

Example of a 3-pump constant pressure water supply application:



Pump 1 - connected to Motor 1

Pump 2 - connected to Motor 2

Pump 3 - connected to Motor 3

Flow consumption versus pump status			
Consumption	**Pump 1**	**Pump 2**	**Pump 3**
Low	VSD	Off	Off
Normal	DOL	VSD	Off
	Off	DOL	VSD
↓	VSD	DOL	Off
Normal	DOL	VSD	Off
VSD	Variable Speed Drive (yellow colour connecting line in the figure). Controlled by drive, tuning the output speed according to PID control.		
DOL	Direct On Line (red colour connecting line in the figure). Pump is running at fixed motor nominal speed.		
Off	Off-line. Pump stops.		

Parameter Settings

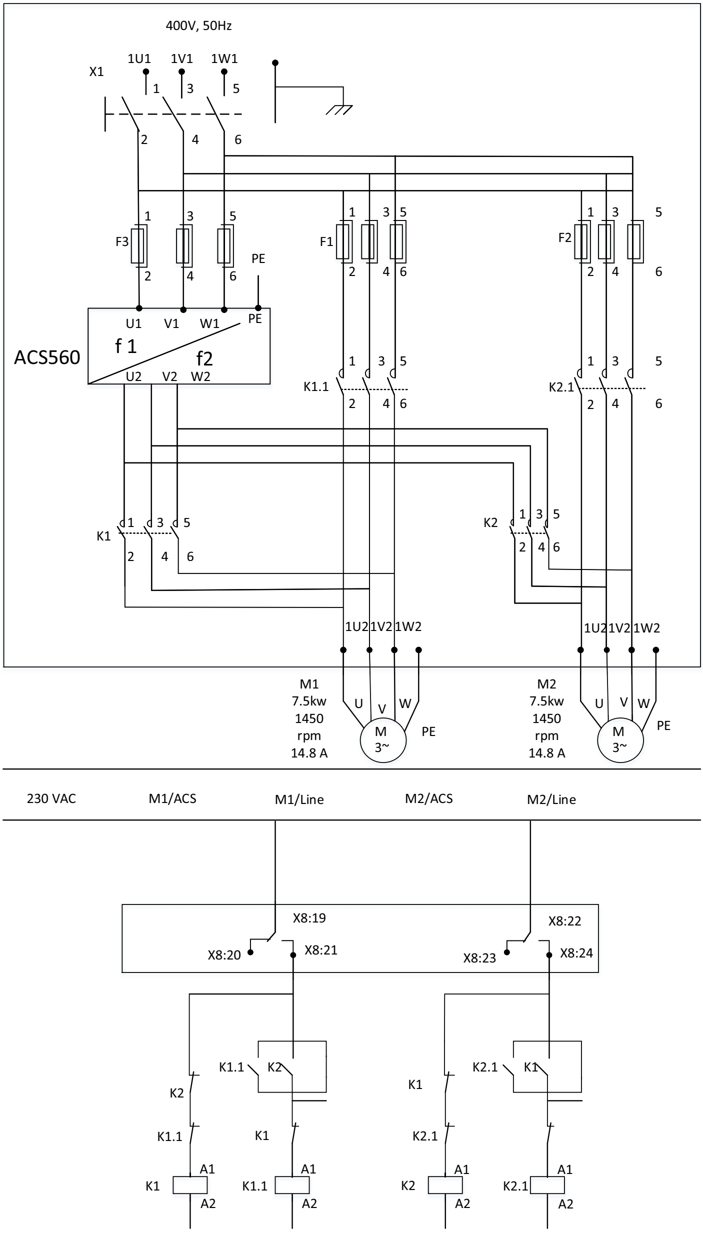
To enable the SPFC macro, navigate to :

- **Main menu ≡ → Connection macro I/O → SPFC**
  or
- **Main menu ≡ → Complete parameter list parameter** *96.04 Macro select* → [18] *SPFC*.

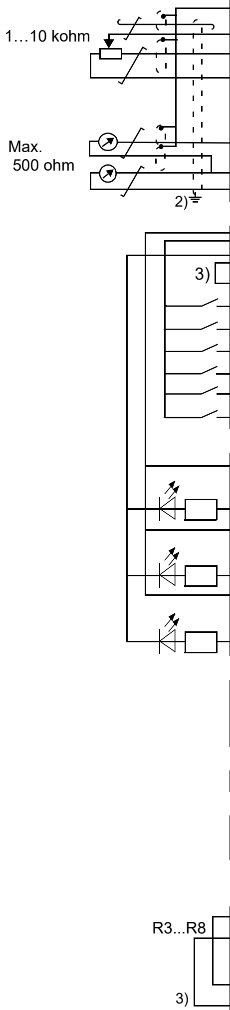
The following default values are used for the SPFC macro:

No.	Value	No.	Value
10.24	7 = *Running*	*22.73*	0 = *Not used*
10.27	45 = *PFC1*	*22.74*	0 = *Not used*
10.30	46 = *PFC2*	*23.11*	6 = *DI5*
12.17	0	*28.11*	1 = *AI1 scaled*
12.20	50.0	*28.15*	16 = *PID*
13.12	2 = *Output frequency*	*28.22*	0 = *Always off*
13.18	50.0	*28.23*	0 = *Always off*
19.11	5 = *DI3*	*28.71*	0 = *Acc/Dec time 1*
19.17	0 = *No*	*30.11*	-1500 rpm
20.01	1 = *In1 Start*	*31.01*	1 = *Inactive (true)*
20.03	2 = *DI1*	*31.02*	0 = *Fault*
20.04	0 = *Always off*	*40.07*	2 = *On when drive running*
20.05	0 = *Always off*	*40.16*	11 = *AI1 percent*
20.06	1 = *In1 Start*	*40.17*	0 = *Not selected*
20.08	7 = *DI6*	*40.19*	0 = *Not selected*
20.09	0 = *Always off*	*40.20*	0 = *Not selected*
20.12	3 = *DI2*	*40.32*	2.50
20.19	1 = *Selected*	*40.33*	3.0
21.03	0 = *Coast*	*76.21*	2 = *SPFC*
22.11	16 = *PID*	*76.25*	2
22.18	16 = *PID*	*76.27*	2
22.22	0 = *Always off*	*99.04*	0 = *Scalar*
22.23	0 = *Always off*		

SPFC circuit diagram



Default control connections for the SPFC macro



X1	Reference voltage and analog inputs and outputs	
1	SCR	Signal cable shield (screen)
2	AI1	**PID setpoint, 0…10 V**[1) 5)]: see *40.16*
3	AGND	Analog input circuit, common
4	+10V	10 V DC reference voltage
5	AI2	**PID feedback, 4...20mA**[1) 5)]: see *40.08*
6	AGND	Analog input circuit, common
7	AO1	**Output frequency: 0…20 mA** [6)]: see *13.12*
8	AO2	**Motor current, 0…20 mA** [6)]: see *13.22*
9	AGND	Analog output circuit common

X2, X3	Aux. voltage output and programmable digital inputs	
10	+24V	Aux. voltage output +24 V DC, max. 250 mA[4)]
11	DGND	Aux. voltage output common
12	DCOM	Digital input common for all
13	DI1	**Stop (0) / Start (1) (EXT 1)** [5)]: see *20.03*
14	DI2	**Run enable** [5)]: see *20.12* (if 0, drive stops).
15	DI3	**EXT1 (0) / EXT 2 (1)** [5)]: see *19.11*
16	DI4	Not configured
17	DI5	Not configured
18	DI6	**Stop (0) / Start (1) (EXT 2)**: see *20.04*

X6,X7, X8	Relay outputs	
19	RO1C	**Running** [6)]: see *10.24* 250 V AC / 30 V DC 2 A
20	RO1A	
21	RO1B	
22	RO2C	**PFC1 (1st auxiliary pump)** [6)]: see *10.27* 250 V AC / 30 V DC 2 A
23	RO2A	
24	RO2B	
25	RO3C	**PFC2 (2nd auxiliary pump)** [6)]: see *10.30* 250 V AC / 30 V DC 2 A
26	RO3A	
27	RO3B	

X5	Built-in fieldbus	
29	B+	Internal Modbus RTU (EIA-485). See *Fieldbus control through the embedded fieldbus interface (EFB)*.
30	A-	
31	DGND	
(Frame R0...R2)		
S100	TERM&BIAS	Termination resistor and bias resistor switch
(Frame R3...R8)		
S100	TERM	Termination resistor switch
S200	BIAS	Bias resistor switch

X4	Safety torque off		
	R0...R2	**R3...R**	
33	-	OUT1	Safety torque off function. Factory connection. Both circuits must be closed for the drive to start. See *Safe torque off function* in the drive *hardware* manual.
34	SGND	OUT2	
35	OUT1	SGND	
36	7) IN1	IN1	
37	3) IN2	IN2	

X10	24 V AC/DC (frames R6...R8 only)	
40	24 V AC/DC- in	24V AC/DC input, for control unit power supply when external main power is disconnected.
41	24 V AC/DC+ in	

X11	Redundant auxiliary voltage output (frames R0...R2)	
42	+24 V	Aux. voltage output +24 V DC, max. 250 mA[4)]
43	DGND	Aux. voltage output common
44	DCOM	Digital input common for all

Terminal sizes

- (frames R0…R8): 0.14…1.5 mm^2 (all terminals)
- Tightening torques: 0.5…0.6 N·m (0.4 lbf·ft)

Notes

1) The signal source is powered externally. See the manufacturer's instructions. To use sensors supplied by the drive aux. voltage output, see chapter *Electrical installation*, section *Connection examples of two-wire and three-wire sensors* in the Hardware manual of the drive.

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) Total load capacity of the auxiliary voltage output +24V (X2:10) = 6.0 W (250 mA / 24 V). User can use this source for either of the I/O connections (DI1... DI2- RO1 or DI3...DI6 - RO2~RO3).

5) Input signal

6) Input signal

7) For R0...R2 frames only

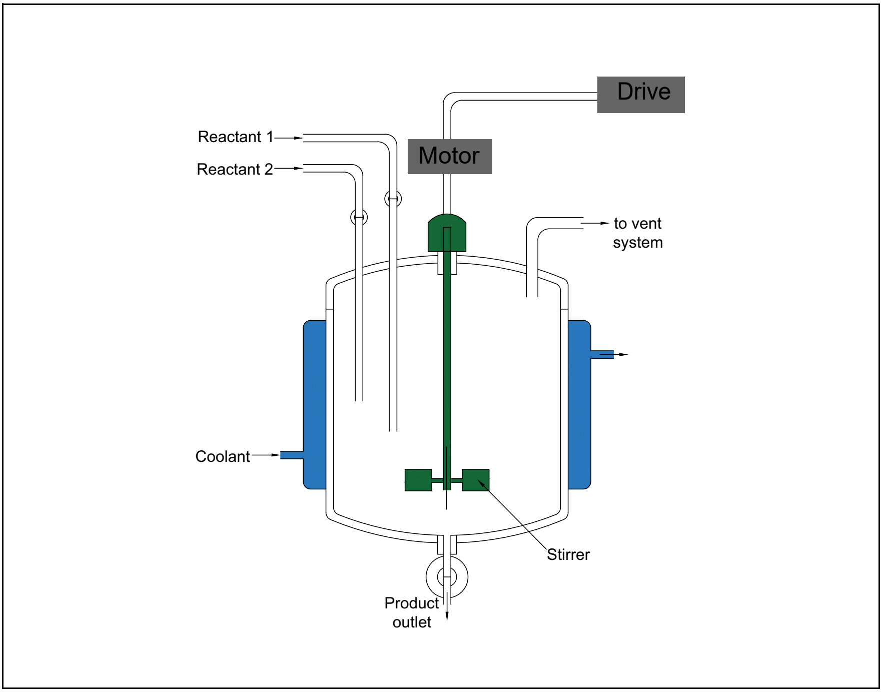
For information on cable connection and drive operation, see *Control Connections* in the *hardware manual (3AXD50000044998)*.

Pharma macro

The various machines used in the pharmaceutical industry, e.g. Agitators, mixers, centrifuges, etc. are driven by motors which are controlled by drives. You can use the Pharma macro to automatically configure the basic drive parameters required to control these machines.The following settings are configured automatically with this macro:

- Start, stop, and multiple constant speed selections
- Ramp time
- Motor control
- Relay output
- Analog output

The below figure explains how a drive is connected to a motor in a reactor.

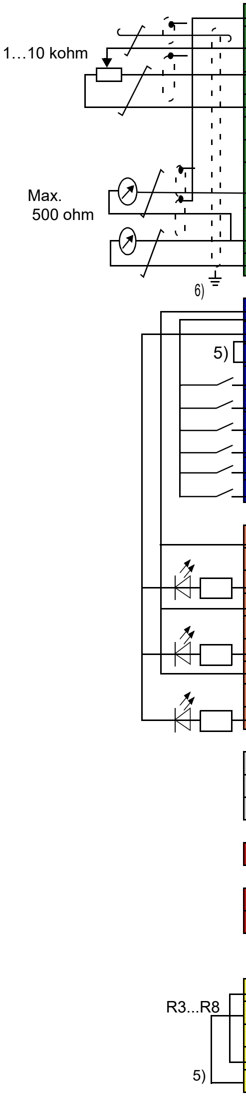


To enable the Pharma macro, navigate to :

- **Main menu** ≡ → **Connection macro** → **Pharma**

  or
- **Main menu** ≡ → **Complete parameter list** **parameter** *96.04 Macro select* → [19] *Pharma Application*.

Default control connections for the Pharma macro



Terminal	Name	Description
X1	**Reference voltage and analog inputs**	
1	SCR	Signal cable shield (screen)
2	AI1	**External speed reference: 0…10 V**[1) 4) 7)]: see *22.11*
3	AGND	Analog input circuit, common
4	+10V	10 V DC reference voltage
5	AI2	Not configured
6	AGND	Analog input circuit, common
7	AO1	**Motor speed used: 0…20 mA**[8)]: see *13.12*
8	AO2	**Motor current: 0…20 mA**[8)]: see *13.22*
9	AGND	Analog output circuit common
X2, X3	**Aux. voltage output and programmable digital inputs**	
10	+24V	Aux. voltage output +24 VDC, max. 250 mA[3)]
11	DGND	Aux. voltage output common
12	DCOM	Digital input common for all
13	DI1	**Pulse start**[7)]: see *20.03*
14	DI2	**Stop**[7)] **:** see *20.04*
15	DI3	**Constant speed sel 1**[7)]: see.*22.22*[4)]
16	DI4	**Constant speed sel 2**[7)]: see. *22.23*[4)]
17	DI5	**Constant speed sel 3**[7)]: see.*22.24* [4)]
18	DI6	Not configured
X6, X7,	**Relay outputs**	
19	RO1C	**Enabled**[8)]: see. *10.24* 250 V AC / 30 V DC 2 A
20	RO1A	
21	RO1B	
22	RO2C	**Running**[8)]: see. *10.27* 250 V AC / 30 V DC 2 A
23	RO2A	
24	RO2B	
25	RO3C	**Fault**[8)]: see. *10.30* 250 V AC / 30 V DC 2 A
26	RO3A	
27	RO3B	
X5	**Built-in fieldbus**	
29	B+	Internal Modbus RTU (EIA-485), see *Fieldbus control through the embedded fieldbus interface (EFB)*
30	A-	
31	DGND	
(Frame R0...R2)		
S100	TERM&BIAS	Termination resistor and bias resistor switch
(Frame R3...R8)		
S100	TERM	Termination resistor switch
S200	BIAS	Bias resistor switch

X4	**Safety torque off**		
	R0...R2	**R3...R8**	
33	-	OUT1	Safety torque off function. Factory connection. Both circuits must be closed for the drive to start. See *Safe torque off function* in the drive *hardware* manual.
34	SGND	OUT2	
35	OUT1	SGND	
36	5) 9) IN1	IN1	
37	IN2	IN2	

Terminal	Name	Description
X10	**24 V AC/DC (frames R6...R8 only)**	
40	24 V AC/DC- in	24V AC/DC input, for control unit power supply when external main power is disconnected.
41	24 V AC/DC+ in	
X11	**Redundant auxiliary voltage output**	
42	+24 V	Aux. voltage output +24 V DC, max. 250 mA[3)]
43	DGND	Aux. voltage output common
44	DCOM	Digital input common for all

Terminal sizes

- (frames R0…R8): 0.14…1.5 mm^2 (all terminals)
- Tightening torques: 0.5…0.6 N·m (0.4 lbf·ft)

Notes

1) Current [0(4)…20 mA, R_{in} < 500 ohm] or voltage [0(2)…10 V, R_{in} > 200 kohm] input as selected with parameter *12.15 AI1 unit selection*.

2) Current [0(4)…20 mA, R_{in} = 100 ohm] or voltage [0(2)…10 V, R_{in} > 200 kohm] input as selected with parameter *12.25 AI2 unit selection*.

3) Total load capacity of the auxiliary voltage output +24V (X2:10) = 6.0 W (250 mA / 24 V). User can use this source for either of the I/O connections (DI1... DI2- RO1 or DI3...DI6 - RO2~RO3).

4) The constant speed is set based on the following combination of sources:

Source defined by No.*22.22*	Source defined by No.*22.23*	Source defined by par.*22.24*	Constant speed active	Value
0	0	0	Set speed through AI1	-
1	0	0	*Constant speed 1*	600
0	1	0	*Constant speed 2*	900
0	0	1	*Constant speed 4*	1480

5) Connected with jumpers at the factory.

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

7) Input signal

8) Output signal

9) For R0...R2 frames only

In addition, some inputs and settings are set automatically as follows:

No.	Name (Input/Setting)	Value
20.01	*Ext1 commands*	4 = *In1P Start; In2 Stop*
21.03	*Stop mode*	1 = *Ramp*
23.11	*Ramp set selection*	0 = *Acc/Dec time 1*
23.12	*Acceleration time 1*	300 s
23.13	*Deceleration time 1*	300 s
99.04	*Motor control mode*	1 = *Vector*

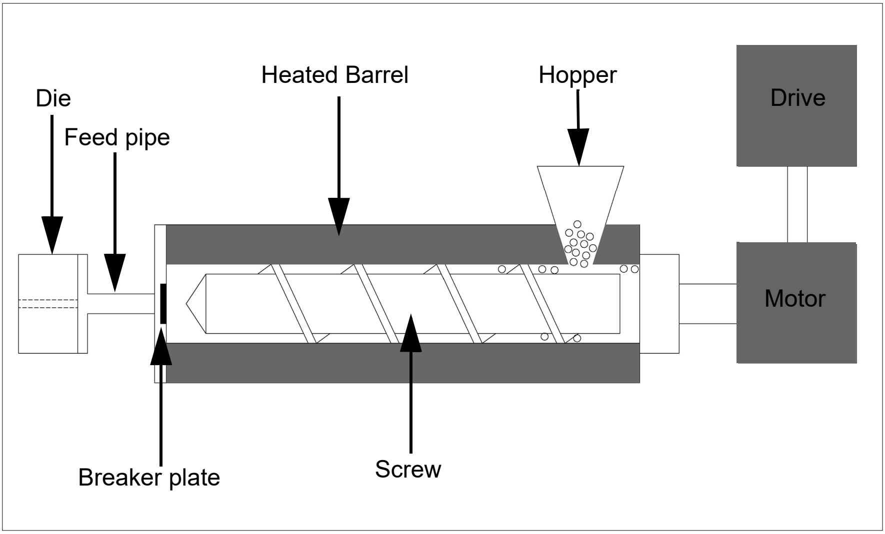
For information on cable connection and drive operation, see *Control Connections* in the *Hardware manual (3AXD50000044998)*.

Plastic extrusion macro

Plastic extrusion in a plastic industry is a process of converting plastic materials from solid to liquid states and reconstituting them as finished components.

The below diagram shows the different process involved in a plastic extrusion.

Basic plastic extrusion block diagram



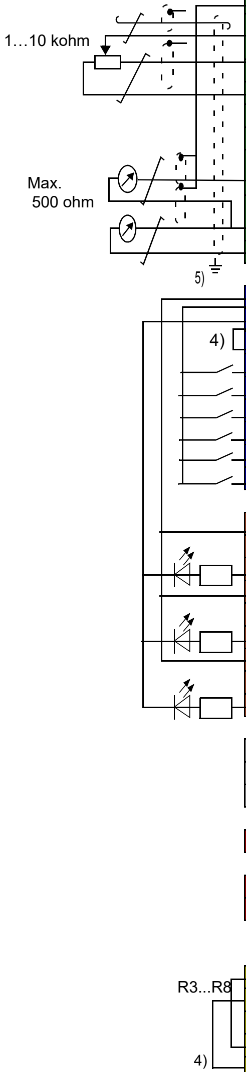
The plastic granules (in solid state) are fed as input which then goes through various process in the extruder machine to get the desired plastic product as output. The extruder operates with five to six motors and drives, depending on the type of extruder machine.

The Plastic extrusion macro is suitable for the drives used in plastic extrusion industry.

To enable the macro, navigate to:

- **Main menu** ≡ → **Connection macro** I/O → **Plastic extrusion**
  or
- **Main menu** ≡ → **Complete parameter list** **parameter** *96.04 Macro select* → [20] *Plastic Extrusion*.

Default control connections for the ABB Plastic extrusion macro



X1	Reference voltage and analog inputs	
1	SCR	Signal cable shield (screen)
2	AI1	**External speed reference: 0…10 V**[1) 4) 8)]: see 22.11
3	AGND	Analog input circuit, common
4	+10V	10 V DC reference voltage
5	AI2	Not configured
6	AGND	Analog input circuit, common
7	AO1	**Motor speed used: 0…20 mA**[9)]: see 13.12
8	AO2	**Motor current: 0…20 mA**[9)]: see13.22
9	AGND	Analog output circuit common
X2, X3	**Aux. voltage output and programmable digital inputs**	
10	+24V	Aux. voltage output +24 VDC, max. 250 mA[3)]
11	DGND	Aux. voltage output common
12	DCOM	Digital input common for all
13	DI1	**Ext1 in1 source**[8)]: see 20.03
14	DI2	Not configured
15	DI3	**External event 1 source**[6) 8)]: see 31.01
16	DI4	Not configured
17	DI5	Not configured
18	DI6	Not configured
X6, X7, X8	**Relay outputs**	
19	RO1C	**Zero speed**[9)]: see. 10.24 250 V AC / 30 V DC 2 A
20	RO1A	
21	RO1B	
22	RO2C	**Running**[9)]: see. 10.27 250 V AC / 30 V DC 2 A
23	RO2A	
24	RO2B	
25	RO3C	**Fault**[9)]: see. 10.30 250 V AC / 30 V DC 2 A
26	RO3A	
27	RO3B	
X5	**Built-in fieldbus**	
29	B+	Internal Modbus RTU (EIA-485), see *Fieldbus control through the embedded fieldbus interface (EFB)*
30	A-	
31	DGND	
(Frame R0...R2)		
S100	TERM&BIAS	Termination resistor and bias resistor switch
(Frame R3...R8)		
S100	TERM	Termination resistor switch
S200	BIAS	Bias resistor switch

X4	Safety torque off		
	R0...R2	**R3...R8**	
33	-	OUT1	Safety torque off function. Factory connection. Both circuits must be closed for the drive to start. See *Safe torque off function* in the drive *hardware* manual.
34	SGND	OUT2	
35	OUT1	SGND	
36	10) IN1	IN1	
37	4) IN2	IN2	

X10	24 V AC/DC (frames R6...R8 only)	
40	24 V AC/DC- in	24V AC/DC input, for control unit power supply when external main power is
41	24 V AC/DC+ in	
X11	**Redundant auxiliary voltage output**	
42	+24 V	Aux. voltage output +24 V DC, max. 250 mA[3)]
43	DGND	Aux. voltage output common
44	DCOM	Digital input common for all

Terminal sizes

- (frames R0…R8): 0.14…1.5 mm^2 (all terminals)
- Tightening torques: 0.5…0.6 N·m (0.4 lbf·ft)

Notes

1) Current [0(4)…20 mA, R_{in} < 500 ohm] or voltage [0(2)…10 V, R_{in} > 200 kohm] input as selected with parameter *12.15 AI1 unit selection*.

2) Current [0(4)…20 mA, R_{in} = 100 ohm] or voltage [0(2)…10 V, R_{in} > 200 kohm] input as selected with parameter *12.25 AI2 unit selection*.

3) Total load capacity of the auxiliary voltage output +24V (X2:10) = 6.0 W (250 mA / 24 V). User can use this source for either of the I/O connections (DI1... DI2- RO1 or DI3...DI6 - RO2~RO3).

4) Connected with jumpers at the factory.

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

6) Can be used to set up pressure alarm warning.

7) Can be used for cold start prevention with connection to ‘temperature reached’ output of temperature controller or PLC

8) Input signal

9) Output signal

10) For R0...R2 frames only

For information on cable connection and drive operation, see *Control Connections* in the *hardware manual (3AXD50000044998)*.

Additional Notes

- Some inputs and settings are set automatically as follows:

No.	Name (Input/Setting)	Value
20.01	*Ext1 commands*	*In1 Start*
21.03	*Stop mode*	*Ramp*

- As per the default settings, when the AI1 reference is at any value, the drive can be started. If you want to enable the drive to start the motor only when the AI reference is below minimum value, set the parameter as follows:

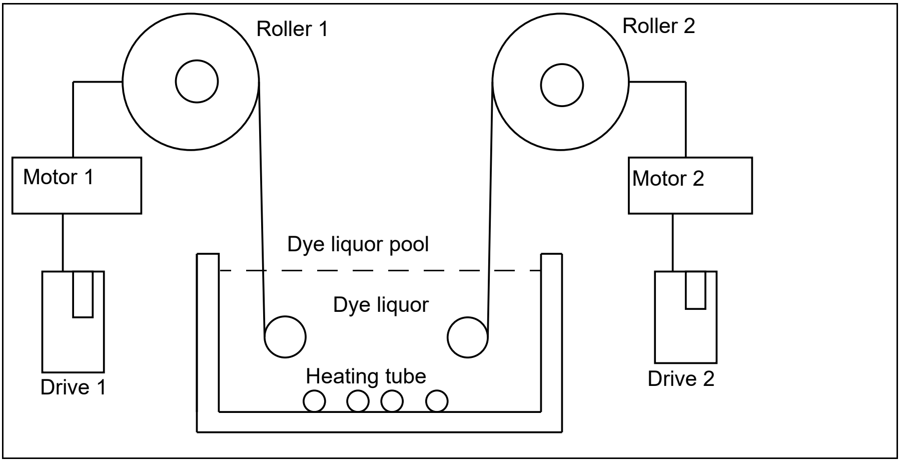
No.	Name (Input/Setting)	Value
32.07	*Supervision 1 signal*	*AI1*
32.09	*Supervision 1 low*	1.00V
32.05	*Supervision 1 function*	*Low*
20.19	*Enable start command*	*Supervision 1*

When the extruder is jammed and the motor is stopped, you can use these settings to prevent the motor to start with existing AI reference. This helps to prevent damage of the screw in the extruder.

Jigar macro

The Jigar machine is a machine used in the textile industry. The ABB Jigar macro is suitable for the Jigar machine and automatically configures the drive parameters required for Jigar machine applications.

Jigar machine has two main rollers controlled by two separate drive. If one act as winder and the other act as unwinder and vice versa.



Jigar machine sequence

The Jigar machine has two operation sequences:

1. The fabric rolls on the first roller and passes it to the coloring section. In the coloring section, the fabric winds to the second roller.
2. Once the second roller fills, the process reverses and the second roller starts unwinding and the first roller winds the fabric.

	Machine sequence 1		**Machine sequence 2**	
	Drive 1 (Winder)	Drive 2 (Unwinder)	Drive 2 (Winder)	Drive 1 (Unwinder)
Unwinding	*Speed* / Forward direction		*Speed* / Forward direction	
Winding		*Torque* mode - Reverse direction		*Torque* mode - Reverse direction

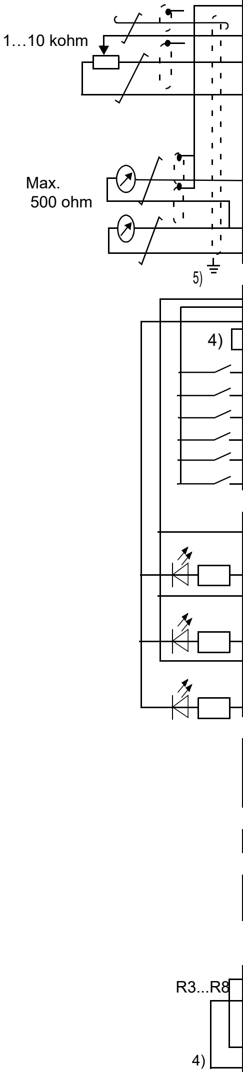
To enable the macro, navigate to:

- **Main menu** ≡ → **Connection macro** → **Jigar**

  or

Main menu ≡ → **Complete parameter list** **parameter** *96.04 Macro select* → [30] *Jigar*.

Default control connections for the ABB Jigar macro



X1	Reference voltage and analog inputs	
1	SCR	Signal cable shield (screen)
2	AI1	**External speed reference: 0…10 V**[1) 4) 8)]: see *22.11*
3	AGND	Analog input circuit, common
4	+10V	10 V DC reference voltage
5	AI2	**Torque reference** [2) 4) 8)] see *22.12*
6	AGND	Analog input circuit, common
7	AO1	**Motor speed used: 0…20 mA**[9)]: see *13.12*
8	AO2	**Motor current: 0…20 mA**[9)]: see *13.22*
9	AGND	Analog output circuit common
X2, X3	**Aux. voltage output and programmable digital inputs**	
10	+24V	Aux. voltage output +24 VDC, max. 250 mA[3)]
11	DGND	Aux. voltage output common
12	DCOM	Digital input common for all
13	DI1	**Stop (0) / Start (1) (EXT 1)** [8) 11)]: see *20.03*
14	DI2	**Stop (0) / Start (1) (EXT 2)** [8) 12)]: see *20.03*
15	DI3	**Ext1 (0) / EXT 2 (1)** [5) 13)] : see *19.11*
16	DI4	Not configured
17	DI5	Not configured
18	DI6	Not configured
X6, X7, X8	**Relay outputs**	
19	RO1C	**Zero speed**[9)]: see. *10.24* 250 V AC / 30 V DC 2 A
20	RO1A	
21	RO1B	
22	RO2C	**Running**[9)]: see. *10.27* 250 V AC / 30 V DC 2 A
23	RO2A	
24	RO2B	
25	RO3C	**Fault**[9)]: see. *10.30* 250 V AC / 30 V DC 2 A
26	RO3A	
27	RO3B	
X5	**Built-in fieldbus**	
29	B+	Internal Modbus RTU (EIA-485), see *Fieldbus control through the embedded fieldbus interface (EFB)*
30	A-	
31	DGND	
(Frame R0...R2)		
S100	TERM&BIAS	Termination resistor and bias resistor switch
(Frame R3...R8)		
S100	TERM	Termination resistor switch
S200	BIAS	Bias resistor switch

X4	Safety torque off		
	R0...R2	**R3...R8**	
33	-	OUT1	Safety torque off function. Factory connection. Both circuits must be closed for the drive to start. See *Safe torque off function* in the drive *hardware* manual.
34	SGND	OUT2	
35	OUT1	SGND	
36	10) IN1	IN1	
37	4) IN2	IN2	

X10	24 V AC/DC (frames R6...R8 only)	
40	24 V AC/DC- in	24V AC/DC input, for control unit power supply when external main power is
41	24 V AC/DC+ in	
X11	**Redundant auxiliary voltage output**	
42	+24 V	Aux. voltage output +24 V DC, max. 250 mA[3)]
43	DGND	Aux. voltage output common
44	DCOM	Digital input common for all

Terminal sizes

- (frames R0…R8): 0.14…1.5 mm^2 (all terminals)
- Tightening torques: 0.5…0.6 N·m (0.4 lbf·ft)

Notes

1) Current [0(4)…20 mA, R_{in} < 500 ohm] or voltage [0(2)…10 V, R_{in} > 200 kohm] input as selected with parameter *12.15 AI1 unit selection*.

2) Current [0(4)…20 mA, R_{in} = 100 ohm] or voltage [0(2)…10 V, R_{in} > 200 kohm] input as selected with parameter *12.25 AI2 unit selection*.

3) Total load capacity of the auxiliary voltage output +24V (X2:10) = 6.0 W (250 mA / 24 V). User can use this source for either of the I/O connections (DI1... DI2- RO1 or DI3...DI6 - RO2~RO3).

4) Connected with jumpers at the factory.

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

6) Can be used to set up pressure alarm warning.

7) Can be used for cold start prevention with connection to 'temperature reached' output of temperature controller or PLC

8) Input signal

9) Output signal

10) For R0...R2 frames only

11) The start in forward direction is connected to digital input DI1 and the start/stop in reverse direction is connected to digital input DI2.

12) The start is connected to digital input DI1 and the torque reversal is connected to digital input DI2.

13) EXT1 is configured for speed control and EXT2 is configured for torque control in both drive 1 and drive 2.

For information on cable connection and drive operation, see *Control Connections* in the *hardware manual (3AXD50000044998)*.

Additional Notes

Some inputs and settings are set automatically as follows:

No.	Name (Input/Setting)	Value
12.20	*AI1 scaled at AI1 max*	1500.000
12.30	*AI2 scaled at AI2 max*	100.000
19.11	*Ext1/Ext2 selection*	*DI3*
19.14	*Ext2 control mode*	*Torque*
20.01	*Ext1 commands*	*In1 Start fwd; In2 Start rev*
20.06	*Ext2 commands*	*In1 Start*
20.08	*Ext2 in1 source*	*DI1*
22.22	*Constant speed sel1*	*Always off*
22.23	*Constant speed sel2*	*Always off*
23.11	*Ramp set selection*	*Acc/Dec time 1*
26.11	*Torque ref1 source*	*AI2 scaled*
26.20	*Torque reversal*	*DI2*
99.04	*Motor control mode*	*Vector*

Parameter default values for different application macros

The default values listed in the *Parameters* table on page *161* are applicable for ABB standard macro (factory macro). The default values may differ for other macros. The different default values for each application macros are listed in the below table.

Parameter		*96.04 Macro select*			
		ABB standard **(1)**	***ABB standard (vector)*** **(17)**	***Torque control*** **(26)**	***3-wire*** **(11)**
10.24	*RO1 source*	2 = *Ready run*	2 = *Ready run*	2 = *Ready run*	2 = *Ready run*
10.27	*RO2 source*	7 = *Running*	7 = *Running*	7 = *Running*	7 = *Running*
10.30	*RO3 source*	15 = *Fault (-1)*	15 = *Fault (-1)*	15 = *Fault (-1)*	15 = *Fault (-1)*
12.20	*AI1 scaled at AI1 max*	50.000	1500.000	1500.000	50.000
12.30	*AI2 scaled at AI2 min*	50.000	1500.000	100.000	50.000
13.12	*AO1 source*	2 = *Output frequency*	1 = *Motor speed used*	1 = *Motor speed used*	2 = *Output frequency*
13.18	*AO1 source max*	50.0	1500.0	1500.0	50.0
19.11	*Ext1/Ext2 selection*	0 = *EXT1*	0 = *EXT1*	5 = *DI3*	0 = *EXT1*
19.14	*Ext2 control mode*	2 = *Speed*	2 = *Speed*	3 = *Torque*	2 = *Speed*
20.01	*Ext1 commands*	2 = *In1 Start; In2 Dir*	2 = *In1 Start; In2 Dir*	2 = *In1 Start; In2 Dir*	2 = *In1P Start; In2 Stop; In3 Dir*
20.03	*Ext1 in1 source*	2 = *DI1*	2 = *DI1*	2 = *DI1*	2 = *DI1*
20.04	*Ext1 in2 source*	3 = *DI2*	3 = *DI2*	3 = *DI2*	3 = *DI2*
20.05	*Ext1 in3 source*	0 = *Always off*	0 = *Always off*	0 = *Always off*	0 = *Always off*
20.06	*Ext2 commands*	0 = *Not selected*	0 = *Not selected*	1 = *In1 Start*	1 = *In1 Start*
20.08	*Ext2 in1 source*	0 = *Always off*	0 = *Always off*	2 = *DI1*	2 = *DI1*
20.09	*Ext2 in2 source*	0 = *Always off*	0 = *Always off*	3 = *DI2*	3 = *DI2*
20.12	*Run enable 1 source*	1 = *Selected*	1 = *Selected*	7 = *DI6*	4 = *DI3*
21.03	*Stop mode*	1 = *Coast*	1 = *Coast*	1 = *Coast*	1 = *Coast*
22.11	*Ext1 speed ref1*	1 = *AI1 scaled*	1 = *AI1 scaled*	1 = *AI1 scaled*	1 = *AI1 scaled*
22.18	*Ext2 speed ref1*	0 = *Zero*	0 = *Zero*	0 = *Zero*	0 = *Zero*
22.21	*Constant speed function*	0b0001	0b0001	0b0000	
22.22	*Constant speed sel1*	4 = *DI3*	4 = *DI3*	5 = *DI4*	5 = *DI4*
22.23	*Constant speed sel2*	5 = *DI4*	5 = *DI4*	5 = *DI4*	6 = *DI5*
22.24	*Constant speed sel3*	0 = *Always off*	0 = *Always off*	0 = *Always off*	0 = *Always off*

Parameter		96.04 Macro select			
		ABB standard (1)	*ABB standard (vector)* (17)	*Torque control* (26)	*3-wire* (11)
22.27	*Constant speed 2*	600	600	600	600
22.29	*Constant speed 4*	1200	1200	1200	1200
22.71	*Motor potentiometer*	0 = *Disabled*	0 = *Disabled*	0 = *Disabled*	0 = *Disabled*
22.73	*Motor potentiometer up*	0 = *Not used*	0 = *Not used*	0 = *Not used*	0 = *Not used*
22.74	*Motor potentiometer*	0 = *Not used*	0 = *Not used*	0 = *Not used*	0 = *Not used*
23.11	*Ramp set selection*	6 = *DI5*	6 = *DI5*	6 = *DI5*	0 = *Acc/Dec time 1*
23.12	*Acceleration time 1*	20.000s	20.000s	20.000s	20.000s
23.13	*Deceleration time 1*	20.000s	20.000s	20.000s	20.000s
28.11	*Ext1 frequency ref1*	1 = *AI1 scaled*	1 = *AI1 scaled*	1 = *AI1 scaled*	1 = *AI1 scaled*
28.15	*Ext1 frequency ref2*	0 = *Zero*	0 = *Zero*	0 = *Zero*	0 = *Zero*
28.22	*Constant frequency sel1*	4 = *DI3*	4 = *DI3*	4 = *DI3*	5 = *DI4*
28.23	*Constant frequency sel2*	5 = *DI4*	5 = *DI4*	5 = *DI4*	6 = *DI5*
28.71	*Freq ramp set selection*	6 = *DI5*	6 = *DI5*	6 = *DI5*	0 = *Acc/Dec time 1*
30.10	*Current limit actions*	0 = *No action*	0 = *No action*	0 = *No action*	0 = *No action*
30.11	*Minimum speed*	-1500.00	-1500.00	-1500.00	-1500.00
31.11	*Fault reset selection*	0 = *Not used*	0 = *Not used*	0 = *Not used*	0 = *Not used*
40.07	*Process PID operation mode*	0 = *Off*	0 = *Off*	0 = *Off*	0 = *Off*
40.16	*Set 1 setpoint 1 source*	11 = *AI1 percent*	11 = *AI1 percent*	1 = *AI1 percent*	1 = *AI1 percent*
40.17	*Set 1 setpoint 2 source*	0 = *Not selected*	0 = *Not selected*	0 = *Not selected*	0 = *Not selected*
40.19	*Set 1 internal setpoint sel1*	0 = *Not selected*	0 = *Not selected*	0 = *Not selected*	0 = *Not selected*
40.20	*Set 1 internal setpoint sel2*	0 = *Not selected*	0 = *Not selected*	0 = *Not selected*	0 = *Not selected*
40.32	*Set 1 gain*	1.00	1.00	1.00	1.00
40.33	*Set 1 integration time*	60.0	60.0	60.0	60.0
76.21	*PFC configuration*	0 = *Off*	0 = *Off*	0 = *Off*	0 = *Off*
76.25	*Number of motors*	1	1	1	1
76.27	*Max number of motors allowed*	1	1	1	1
99.04	*Motor control mode*	1 = *Scalar*	0 = *Vector*	0 = *Vector*	1 = *Scalar*

Parameter		96.04 Macro select		
	***Motor potentiometer* (13)**	***Pharma Application* (19)**	***PID* (14)**	***Panel PID* (15)**
10.24 RO1 source	11 = *Ready run*	2 = *Ready run*	2 = *Ready run*	2 = *Ready run*
10.27 RO2 source	7 = *Running*	7 = *Running*	7 = *Running*	7 = *Running*
10.30 RO3 source	15 = *Fault (-1)*	14 = *Fault*	15 = *Fault (-1)*	15 = *Fault (-1)*
12.20 AI1 scaled at AI1 max	50.000	1500.000	50.000	50.000
12.30 AI2 scaled at AI2 min	50.000	50.000	50.000	50.000
13.12 AO1 source	2 = *Output frequency*	1 = *Motor speed used*	2 = *Output frequency*	2 = *Output frequency*
13.18 AO1 source max	50.0	1500.0	50.0	50.0
19.11 Ext1/Ext2 selection	0 = *EXT1*	0 = *EXT1*	0 = *EXT1*	0 = *EXT1*
19.14 Ext2 control mode	2 = *Speed*	2 = *Speed*	2 = *Speed*	2 = *Speed*
19.17 Local control mode	0 = *No*	0 = *No*	0 = *No*	0 = *No*
20.01 Ext1 commands	2 = *In1 Start; In2 Dir*	4 = *In1P Start; In2 Stop*	1 = *In1 Start*	1 = *In1 Start*
20.03 Ext1 in1 source	2 = *DI1*	2 = *DI1*	2 = *DI1*	2 = *DI1*
20.04 Ext1 in2 source	3 = *DI2*	3 = *DI2*	0 = *Always off*	0 = *Always off*
20.05 Ext1 in3 source	0 = *Always off*	0 = *Always off*	0 = *Always off*	0 = *Always off*
20.06 Ext2 commands	0 = *Not selected*	0 = *Not selected*	0 = *Not selected*	0 = *Not selected*
20.08 Ext2 in1 source	0 = *Always off*	0 = *Always off*	0 = *Always off*	0 = *Always off*
20.09 Ext2 in2 source	0 = *Always off*	0 = *Always off*	0 = *Always off*	0 = *Always off*
20.12 Run enable 1 source	7 = *DI6*	1 = *Selected*	6 = *DI5*	6 = *DI5*
21.03 Stop mode	1 =*Coast*	1 = *Ramp*	0 = *Coast*	0 = *Coast*
22.11 Ext1 speed ref1	15 = *Motor potentiometer*	1 = *AI1 scaled*	16 = *PID*	16 = *PID*
22.18 Ext2 speed ref1	0 = *Zero*	0 = *Zero*	0 = *Zero*	0 = *Zero*
22.21 Constant speed function	0b000	0b0001	0b0000	0b0000
22.22 Constant speed sel1	6 = *DI5*	4 = *DI3*	5 = *DI4*	5 = *DI4*
22.23 Constant speed sel2	0 = *Always off*	5 = *DI4*	0 = *Always off*	0 = *Always off*
22.24 Constant speed sel3	0 = *Always off*	5 = *DI5*	0 = *Always off*	0 = *Always off*
22.26 Constant speed 1	300	600	300	300
22.27 Constant speed 2	600	900	600	600

Parameter		96.04 Macro select			
		Motor potenti-ometer (13)	**Pharma Application (19)**	**PID (14)**	**Panel PID (15)**
22.29	Constant speed 4	1200	1480	1200	1200
22.71	Motor potentiometer function	1 = Enabled (init at stop /power-	0 = Disabled	0 = Disabled	0 = Disabled
22.73	Motor potentiometer up source	4 = DI3	0 = Not used	0 = Not used	0 = Not used
22.74	Motor potentiometer down source	5 = DI4	0 = Not used	0 = Not used	0 = Not used
23.11	Ramp set selection	0 = Acc/Dec time 1	0 = Acc/Dec time 1	0 = Acc/Dec time 1	0 = Acc/Dec time 1
23.12	Acceleration time 1	20.000s	300s	20.000s	20.000s
23.13	Deceleration time 1	20.000s	300s	20.000s	20.000s
28.11	Ext1 frequency ref1	15 = Motor potentiometer	1 = AI1 scaled	16 = PID	16 = PID
28.15	Ext1 frequency ref2	0 = Zero	0 = Zero	0 = Zero	0 = Zero
28.22	Constant frequency sel1	6 = DI5	4 = DI3	5 = DI4	5 = DI4
28.23	Constant frequency sel2	0 = Always off	5 = DI4	0 = Always off	0 = Always off
28.71	Freq ramp set selection	0 = Acc/Dec time 1	6 = DI5	0 = Acc/Dec time 1	0 = Acc/Dec time 1
30.10	Current limit actions	0 = No action	0 = No action	0 = No action	0 = No action
30.11	Minimum speed	-1500.00	-1500.00	-1500.00	-1500.00
31.11	Fault reset selection	0 = Not used	0 = Not used	0 = Not used	0 = Not used
40.07	Process PID operation mode	0 = Off	0 = Off	2 = On when drive running	2 = On when drive running
40.16	Set 1 setpoint 1 source	11 = AI1 percent	11 = AI1 percent	11 = AI1 percent	13 = Control panel (ref saved)
40.17	Set 1 setpoint 2 source	0 = Not selected	0 = Not selected	2 = Internal setpoint	0 = Not selected
40.19	Set 1 internal setpoint sel1	0 = Not selected	0 = Not selected	3 = DI2	0 = Not selected
40.20	Set 1 internal setpoint sel2	0 = Not selected	0 = Not selected	4 = DI3	0 = Not selected
40.32	Set 1 gain	1.00	1.00	1.00	1.00
40.33	Set 1 integration time	60.0	60.0	60.0	60.0
76.21	PFC configuration	0 = Off	0 = Off	0 = Off	0 = Off
76.25	Number of motors	1	1	1	1
76.27	Max number of motors allowed	1	1	1	1
99.04	Motor control mode	1 = Scalar	0 = Vector	1 = Scalar	1 = Scalar

Parameter	*96.04 Macro select*			
	PFC **(16)**	***SPFC*** **(18)**	***Plastic Extrusion*** **(20)**	***Jigar*** **(30)**
10.24 RO1 source	7 = *Running*	7 = *Running*	11 = *Zero speed*	11 = *Ready run*
10.27 RO2 source	15 = *Fault (-1)*	43 = *PFC1*	7 = *Running*	7 = *Running*
10.30 RO3 source	46 = *PFC2*	46 = *PFC2*	14 = *Fault*	14 = *Fault (-1)*
12.20 AI1 scaled at AI1 max	50.000	50.000	1500.000	1500.000
12.30 AI2 scaled at AI2 max	50.000	50.000	50.000	100.000
13.12 AO1 source	2 = *Output frequency*	2 = *Output frequency*	1 = *Motor speed used*	1 = *Output frequency*
13.18 AO1 source max	50.0	50.0	1500.0	50.0
19.11 Ext1/Ext2 selection	1 = *DI3*	5 = *DI3*	0 = *EXT1*	0 = *DI3*
19.14 Ext2 control mode	2 = *Speed*	2 = *Speed*	2 = *Speed*	2 = *Torque*
19.17 Local control mode	0 = *No*	0 = *No*	1 = *Yes*	1 = *No*
20.01 Ext1 commands	1 = *In1 Start*	1 = *In1 Start*	1 = *In1 Start*	1 = *In1 Start fwd; In2 Start rev*
20.03 Ext1 in1 source	2 = *DI1*	2 = *DI1*	2 = *DI1*	2 = *DI1*
20.04 Ext1 in2 source	0 = *Always off*	0 = *Always off*	3 = *DI2*	3 = *DI2*
20.05 Ext1 in3 source	0 = *Always off*	0 = *Always off*	0 = *Always off*	0 = *Always off*
20.06 Ext2 commands	1 = *In1 Start*	1 = *In1 Start*	0 = *Always off*	0 = *In1 Start*
20.08 Ext2 in1 source	7 = *DI6*	7 = *DI6*	0 = *Always off*	0 = *DI1*
20.09 Ext2 in2 source	0 = *Always off*	0 = *Always off*	0 = *Always off*	0 = *Always off*
20.12 Run enable 1 source	3 = *DI2*	3 = *DI2*	1 = *Selected*	1 = *Selected*
21.03 Stop mode	0 = *Coast*	0 = *Coast*	1 = *Ramp*	1 = *Coast*
22.11 Ext1 speed ref1	1 = *AI1 scaled*	1 = *AI1 scaled*	1 = *AI1 scaled*	1 = *AI1 scaled*
22.18 Ext2 speed ref1	16 = *PID*	0 = *Zero*	0 = *Zero*	0 = *Zero*
22.21 Constant speed function	0b0001	0b0001	0b0001	0b0001
22.22 Constant speed sel1	0 = *Always off*	4 = *DI3*	4 = *DI3*	4 = *Always off*
22.23 Constant speed sel2	0 = *Always off*	5 = *DI4*	5 = *DI4*	5 = *Always off*
22.24 Constant speed sel3	0 = *Always off*	0 = *Always off*	0 = *Always off*	0 = *Always off*
22.26 Constant speed 1	300.00	300.00	300.00	300.00
22.27 Constant speed 2	600.00	600.00	600.00	600.00

Parameter	96.04 Macro select			
	PFC (16)	*SPFC* (18)	*Plastic Extrusion* (20)	*Jigar* (30)
22.29 *Constant speed 4*	1200.00	1200.00	1200.00	1200.00
22.71 *Motor potentiometer function*	0 = *Disabled*	0 = *Disabled*	0 = *Disabled*	0 = *Disabled*
22.73 *Motor potentiometer up source*	0 = *Not used*	0 = *Not used*	0 = *Not used*	0 = *Not used*
22.74 *Motor potentiometer down source*	0 = *Not used*	0 = *Not used*	0 = *Not used*	0 = *Not used*
23.11 *Ramp set selection*	0 = *Acc/Dec time 1*	6 = *DI5*	6 = *DI5*	6 = *Acc/Dec time 1*
23.12 *Acceleration time 1*	20.000s	20.000s	20.000s	20.000s
23.13 *Deceleration time 1*	20.000s	20.000s	20.000s	20.000s
26.11 *Torque ref1 source*	0 = *Zero*	0 = *Zero*	0 = *Zero*	2 = *AI2 scaled*
28.11 *Ext1 frequency ref1*	1 = *AI1 scaled*	1 = *AI1 scaled*	1 = *AI1 scaled*	1 = *AI1 scaled*
28.15 *Ext1 frequency ref2*	16 = *PID*	16 = *PID*	0 = *Zero*	0 = *Zero*
28.22 *Constant frequency sel1*	0 = *Always off*	0 = *Always off*	4 = *DI3*	4 = *DI3*
28.23 *Constant frequency sel2*	0 = *Always off*	0 = *Always off*	5 = *DI4*	5 = *DI4*
28.71 *Freq ramp set selection*	0 = *Acc/Dec time 1*	0 = *Acc/Dec time 1*	6 = *DI5*	6 = *DI5*
30.10 *Current limit actions*	0 = *No action*	0 = *No action*	1 = *Warning*	1 = *No action*
30.11 *Minimum speed*	-1500.00	-1500.00	0.00	0.00
31.11 *Fault reset selection*	0 = *Not used*	0 = *Not used*	0 = *Not used*	0 = *Not used*
40.07 *Process PID operation mode*	2 = *On when drive running*	2 = *On when drive running*	0 = *Off*	0 = *Off*
40.16 *Set 1 setpoint 1 source*	11 = *AI1 percent*	11 = *AI1 percent*	11 = *AI1 percent*	11 = *AI1 percent*
40.17 *Set 1 setpoint 2 source*	0 = *Not selected*	0 = *Not selected*	0 = *Not selected*	0 = *Not selected*
40.19 *Set 1 internal setpoint sel1*	0 = *Not selected*	0 = *Not selected*	0 = *Not selected*	0 = *Not selected*
40.20 *Set 1 internal setpoint sel2*	0 = *Not selected*	0 = *Not selected*	0 = *Not selected*	0 = *Not selected*
40.32 *Set 1 gain*	2.50	2.50	1.00	1.00
40.33 *Set 1 integration time*	3.0	3.0	60.0 s	60.0 s
76.21 *PFC configuration*	2 = *PFC*	2 = *SPFC*	0 = *Off*	0 = *Off*
76.25 *Number of motors*	2	2	1	1
76.27 *Max number of motors allowed*	2	2	1	1
99.04 *Motor control mode*	1 = *Scalar*	1 = *Scalar*	0 = *Vector*	0 = *Vector*

6

Parameters

What this chapter contains

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

The ACS560 parameter list uses long and short menu structure. ACS560 parameter list adopts long and short menu structure. The short menu displays common parameter list and the long menu displays complete parameter list. The long and short menus are adjusted by parameter *96.02 Pass code*. The default value is short menu [1].

Parameters	Input password	Long and short menu
96.02 password	1	Short menu
	2	Long menu

Terms and abbreviations

Term	Definition
Actual signal	Type of *parameter* that is the result of a measurement or calculation by the drive, or contains status information. Most actual signals are read-only, but some (especially counter-type actual signals) can be reset.
Def	(In the following table, shown on the same row as the parameter name) The default value of a *parameter* when used in the Factory macro. For information on other macro-specific parameter values, see chapter *Control macros* (page *101*).
FbEq16	(In the following table, shown on the same row as the parameter range, or for each selection) 16-bit fieldbus equivalent: The scaling between the value shown on the panel and the integer used in communication when a 16-bit value is selected for transmission to an external system. A dash (-) indicates that the parameter is not accessible in 16-bit format. The corresponding 32-bit scalings are listed in chapter *Additional parameter data* (page *377*).
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

Group	Contents	Page
49 Panel port communication	Communication settings for the control panel port on the drive.	*325*
50 Fieldbus adapter (FBA)	Fieldbus communication configuration.	*328*
51 FBA A settings	Fieldbus adapter A configuration.	*332*
52 FBA A data in	Selection of data to be transferred from drive to fieldbus controller through fieldbus adapter A.	*333*
53 FBA A data out	Selection of data to be transferred from fieldbus controller to drive through fieldbus adapter A.	*334*
58 Embedded fieldbus	Configuration of the embedded fieldbus (EFB) interface.	*334*
70 Override	Enabling/disabling of override function, override activation signal and override speed/frequency.	*342*
71 External PID1	Configuration of external PID.	*344*
76 PFC configuration	PFC (Pump and fan control) and Autochange configuration parameters. See also section Pump and Fan Control (PFC) macro on page 125.	*348*
77 PFC maintenance and monitoring	PFC (Pump and fan control) and Autochange configuration parameters. See also section Pump and Fan Control (PFC) macro on page 125.	*354*
95 HW configuration	Various hardware-related settings.	*355*
96 System	Language selection; access levels; macro selection; parameter save and restore; control unit reboot; user parameter sets; unit selection.	*357*
97 Motor control	Switching frequency; slip gain; voltage reserve; flux braking; anti-cogging (signal injection); IR compensation.	*364*
98 User motor parameters	Motor values supplied by the user that are used in the motor model.	*368*
99 Motor data	Motor configuration settings.	*369*

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.	1 = 1 A
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. 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.	1 = 1%
01.17	*Motor shaft power*	Estimated mechanical power at motor shaft. The unit is selected by parameter *96.16 Unit selection*.	-
	-32768.00… 32767.00 hp or kW	Motor shaft power.	See par. *46.04*
01.18	*Inverter GWh counter*	Amount of energy that has passed through the drive (in either direction) in full gigawatt-hours. The minimum value is zero.	-
	0…65535 GWh	Energy in GWh.	1 = 1 GWh
01.19	*Inverter MWh counter*	Amount of energy that has passed through the drive (in either direction) in full megawatt-hours. Whenever the counter rolls over, *01.18 Inverter GWh counter* is incremented. The minimum value is zero.	-
	0…1000 MWh	Energy in MWh.	1 = 1 MWh
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. **Note:** This parameter is applicable only for frames R6 or larger.	-
	°C or °F	Temperature	1 = 1 °
01.50	*Current hour kWh*	Current hour energy consumption. This is the energy of the last 60 minutes (not necessarily continuous) the drive has been running, not the energy of a calendar hour. The value is set to the value before the power cycle when the drive is again up and running.	-
	0.00… 1000000.00 kWh	Energy.	1 = 1 kWh

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. The value is set to the value before the power cycle when the drive is again up and running.	-
	0.00… 1000000.00 kWh	Energy.	1 = 1 kWh
01.52	*Current day kWh*	Current day energy consumption. This is the energy of the last 24 hours (not necessarily continuous) the drive has been running, not the energy of a calendar day. The value is set to the value before the power cycle when the drive is again up and running.	-
	0.00… 1000000.00 kWh	Energy.	1 = 1 kWh
01.53	*Previous day kWh*	Previous day energy consumption. The value *01.52 Current day kWh* is stored here when its value has been cumulated for 24 hours. The value is set to the value before the power cycle when the drive is again up and running.	-
	0.00… 1000000.00 kWh	Energy.	1 = 1 kWh
01.54	*Cumulative inverter energy*	Amount of energy that has passed through the drive (in either direction) in full kilowatt-hours. The minimum value is zero.	-
	-200000000.0… 200000000.0 kWh	Energy in kWh.	10 = 1 kWh
01.55	*Inverter GWh counter (resettable)*	Amount of energy that has passed through the drive (in either direction) in full gigawatt-hours. The minimum value is zero. You can reset the value by setting it to zero. Resetting any of parameters *01.55*…*01.58* resets all of them.	-
	0…65535 GWh	Energy in GWh.	1 = 1 GWh
01.56	*Inverter MWh counter (resettable)*	Amount of energy that has passed through the drive (in either direction) in full megawatt-hours. Whenever the counter rolls over, *01.55 Inverter GWh counter (resettable)* is incremented. The minimum value is zero. You can reset the value by setting it to zero. Resetting any of parameters *01.55*…*01.58* resets all of them.	-
	0....1000 MWh	Energy in MWh.	1 = 1 MWh
01.57	*Inverter MWh counter (resettable)*	Amount of energy that has passed through the drive (in either direction) in full kilowatt-hours. Whenever the counter rolls over, *01.56 Inverter MWh counter (resettable)* is incremented. The minimum value is zero. You can reset the value by setting it to zero. Resetting any of parameters *01.55*…*01.58* resets all of them.	-
	0…1000 kWh	Energy in kWh.	10 = 1 kWH
01.58	*Inverter kWh counter (resettable)*	Amount of energy that has passed through the drive (in either direction) in full kilowatt-hours. The minimum value is zero. You can reset the value by setting it to zero. Resetting any of parameters *01.55*…*01.58* resets all of them.	-
	-200000000.0… 200000000.0 kWh	Energy in kWh.	10 = 1 kWH
01.61	*Abs motor speed used*	Absolute value of parameter *01.01 Motor speed used*.	-
	0.00… 30000.00 rpm	Estimated motor speed.	See par. *46.01*

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

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* (page *471*).	-
	-100000.00… 100000.00	Reference 1 from fieldbus adapter A.	1 = 10
03.06	*FB A reference 2*	Reference 2 received through fieldbus adapter A.	-
	-100000.00… 100000.00	Reference 2 from fieldbus adapter A.	1 = 10
03.09	*EFB reference 1*	Scaled reference 1 received through the embedded fieldbus interface.	1 = 10
	-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.	1 = 10
	-30000.00… 30000.00	Scaled reference 2 received through the embedded fieldbus interface.	1 = 10

No.	Name/Value	Description	Def/FbEq16
04 Warnings and faults		Information on warnings and faults that occurred last. For explanations of individual warning and fault codes, see chapter *Fault tracing*. All parameters in this group are read-only unless otherwise noted.	
04.01	*Tripping fault*	Code of the 1st active fault (the fault that caused the current trip).	0x0000
	0x0000...0xffff	1st active fault.	1 = 1
04.02	*Active fault 2*	Code of the 2nd active fault.	0x0000
	0x0000...0xffff	2nd active fault.	1 = 1
04.03	*Active fault 3*	Code of the 3rd active fault.	0x0000
	0x0000...0xffff	3rd active fault.	1 = 1
04.06	*Active warning 1*	Code of the 1st active warning.	0x0000
	0x0000...0xffff	1st active warning.	1 = 1
04.07	*Active warning 2*	Code of the 2nd active warning.	0x0000
	0x0000...0xffff	2nd active warning.	1 = 1
04.08	*Active warning 3*	Code of the 3rd active warning.	0x0000
	0x0000...0xffff	3rd active warning.	1 = 1
04.11	*Latest fault*	Code of the 1st stored (non-active) fault.	0x0000
	0x0000...0xffff	1st stored fault.	1 = 1
04.12	*2nd latest fault*	Code of the 2nd stored (non-active) fault.	0x0000
	0x0000...0xffff	2nd stored fault.	1 = 1
04.13	*3rd latest fault*	Code of the 3rd stored (non-active) fault.	0x0000
	0x0000...0xffff	3rd stored fault.	1 = 1
04.16	*Latest warning*	Code of the 1st stored (non-active) warning.	0x0000
	0x0000...0xffff	1st stored warning.	1 = 1
04.17	*2nd latest warning*	Code of the 2nd stored (non-active) warning.	0x0000
	0x0000...0xffff	2nd stored warning.	1 = 1
04.18	*3rd latest warning*	Code of the 3rd stored (non-active) warning.	0x0000
	0x0000...0xffff	3rd stored warning.	1 = 1
04.40	*Event word 1*	Shows the user-defined event word. This word collects the status of the events (warnings, faults or pure events) selected by parameters *04.41*…*04.71*. 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

No.	Name/Value	Description	Def/FbEq16
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*).	0x2310h
	0000h…FFFFh	Code of event.	1 = 1
04.43	*Event word 1 bit 1 code*	Selects the hexadecimal code of an event (warning, fault or pure event) whose status is shown as bit 1 of *04.40 Event word 1*. The event codes are listed in chapter *Fault tracing* (page *411*).	0x3210h
	0000h…FFFFh	Code of event.	1 = 1
04.45, 04,47, 04,49, …	…	…	…
04.71	*Event word 1 bit 15 code*	Selects the hexadecimal code of an event (warning, fault or pure event) whose status is shown as bit 15 of *04.40 Event word 1*. The event codes are listed in chapter *Fault tracing* (page *411*).	0x2330h
	0000h…FFFFh	Code of event.	1 = 1

05 Diagnostics		Various run-time-type counters and measurements related to drive maintenance. All parameters in this group are read-only unless otherwise noted.	
05.01	*On-time counter*	On-time counter. The counter runs when the drive is powered.	0
	0…65535 d	On-time counter.	1 = 1 d
05.02	*Run-time counter*	Motor run-time counter. The counter runs when the inverter modulates.	0
	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 keeping Reset down for over 3 seconds.	0
	0…65535 d	Cooling fan run-time counter.	1 = 1 d
05.10	*Control board temperature*	Measured temperature of the control board.	0
	-100… 300 °C	Control board temperature in degrees Celsius or Fahrenheit.	1 = unit
05.11	*Inverter temperature*	Estimated drive temperature in percent of fault limit. The fault limit varies according to the type of the drive. 0.0% = 0 °C (32 °F) 100.0% = Fault limit	0
	-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*.	0b0000

Bit	Name	Value
0	Any warning or fault	Yes = Drive has generated a warning or tripped on a fault.
1	Any warning	Yes = Drive has generated a warning.
2	Any fault	Yes = Drive has tripped on a fault.
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
	0b0000...0b1111	Diagnostic word 1.	1 = 1
05.21	*Diagnostic word 2*	Diagnostic word 2. For possible causes and remedies, see chapter *Fault tracing*.	0b0000

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

No.	Name/Value	Description	Def/FbEq16
	0b0000...0b1111	Diagnostic word 2.	1 = 1
05.22	*Diagnostic word 3*	Diagnostic word 3. For possible causes and remedies, see chapter *Fault tracing*.	0b0000

Bit	Name	Value
0...8	Reserved.	
9	kWh pulse	1 = kWh pulse is active.
10	Reserved.	
11	Fan command.	1 = Drive fan is rotating above idle speed.
12...15	Reserved	

No.	Name/Value	Description	Def/FbEq16
	0b0000...0b1111	Diagnostic word 3.	1 = 1
05.80	*Motor speed at fault*	Displays the parameter *24.02 Used speed feedback* at which fault occurred. This is applicable in both scalar and speed control mode.	-
	-30000.00…30000.00 rpm	Motor speed at fault.	See par. *46.01*
05.81	*Output frequency at fault*	Displays the output frequency (*01.06*) at which fault occurred.	-
	-500.00…500.00 Hz	Output frequency at fault.	See par. *46.02*
05.82	*DC voltage at fault*	Displays the DC link volt age (*01.11*) at which fault occurred.	-
	0.00…2000.00 V	DC voltage at fault.	10 = 1 V

No.	Name/Value	Description	Def/FbEq16
05.83	*Motor current at fault*	Displays the motor current (*01.07*) at which fault occurred.	-
05.84	*Motor torque at fault*	Displays the motor torque (*01.10*) at which fault occurred.	-
	-1600.0…1600.0%	Motor torque at fault.	See par. *46.03*
05.85	*Main status word at fault*	Displays the main status word (*06.11*) at which fault occurred. For the bit list, see parameter *06.11 Main status word*.	0x0000

Bit	Name
0	Ready to switch ON
1	Ready run
2	Ready ref
3	Tripped
4	Not in use
5	Not in use
6	Not in use
7	Warning
8	Modulating
9	Remote
10	Net OK
11	User bit 0
12	User bit 1
13	User bit 2
14	Charging
15	User bit 3

No.	Name/Value	Description	Def/FbEq16
	0x0000...0xffff	Main status word at fault.	1 = 1
05.86	*DI delayed status at fault*	Displays the DI delayed status (*10.02*) at which fault occurred. For the bit list, see parameter *10.02 DI delayed status*.	0b0000
	0b0000...0b1111	DI delayed status at fault.	1 = 1
05.87	*Inverter temperature at fault*	Displays the inverter temperature (*05.11*) at which fault occurred.	-
	-40…160°C	Inverter temperature at fault.	1 = 1°C
05.88	*Reference used at fault*	Displays the reference used (*28.01*/*23.01*) at which fault occurred. The type of the reference depends on the selected operation mode (*19.01*).	-
	-500.00...500.00 Hz/ -1600.0…1600.0%/ 30000.00... 30000.00 rpm	Reference used at fault.	See par. *46.02*/ See par. *46.03*/ See par. *46.01*

No.	Name/Value	Description	Def/FbEq16
05.99	*BIO-01 DIP switch status*	Displays the states of the BIO-01 extension module DIP switches S1 and S2. **Notes:** • This feature is not available with the standard BIO-01. For information on the availability on new BIO-01 module, contact ABB sales team. • This parameter is applicable for frames R0...R2 when the new BIO-01 module is attached. • Both DIP switches cannot be connected simultaneously to DO1. The forbidden bit combination S1=0 and S2 = 1 generates fault *7087 I/O module configuration*.	-

Bit	Name	Description
0	S1	0 = OFF = DO1 on port S1, 1 = ON = AO1 on port S1
1	S2	0 = OFF = DI3 on port S2 1 = ON = DO1 on port S2
2...5	Reserved	

	0000h...FFFh	States of the BIO-01 DIP switches S1 and S2	1 = 1
06 Control and status words		Drive control and status words.	
06.01	*Main control word*	The main control word of the drive. This parameter shows the control signals as received from the selected sources (such as digital inputs, the fieldbus interfaces and the application program). For the bit descriptions see page *478*. The related status word and state diagram are presented on pages *480* and *481* respectively. This parameter is read-only.	0x0000

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

	0x0000...0xffff	Main control word.	1 = 1

No.	Name/Value	Description	Def/FbEq16
06.11	Main status word	Main status word of the drive. For the bit descriptions see page 480. The related control word and state diagram are presented on pages 478 and 481 respectively. This parameter is read-only.	0x0000

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
	0x0000...0xffff	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.	0b0000

Bit	Name	Description
0	Enabled	1 = Both run enable (see par. *20.12*) and start enable (*20.19*) signals are present.
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 *16*).
10	Ext1 active	1 = Control location EXT1 active.
11	Ext2 active	1 = Control location EXT2 active.
12	Reserved	
13	Start request	1 = Start requested. 0 = When Enable to rotate signal (see par. *20.22*) is 0 (rotating of the motor is disabled).
14	Running	1 = Drive is controlling speed or frequency, in PID sleep or pre-magnetization.
15	Reserved	

No.	Name/Value	Description	Def/FbEq16
	0b0000...0b1111	Drive status word 1.	1 = 1
06.17	*Drive status word 2*	Drive status word 2. This parameter is read-only.	0b0000

Bit	Name	Description
0	Identification run done	1 = Motor identification (ID) run has been performed.
1	Magnetized	1 = The motor has been magnetized.
2	Torque control	1 = Torque control mode active.
3	Speed control	1 = Speed control mode active.
4	Reserved	
5	Safe reference active	1 = A “safe” reference is applied by functions such as parameters *49.05* and *50.02*.
6	Last speed active	1 = A “last speed” reference is applied by functions such as parameters *49.05* and *50.02*.
7...8	Reserved	
9	Jogging active	1 = Jogging enable signal is on.
10	Above limit	1 = Actual speed, frequency or torque equals or exceeds limit (defined by parameters *46.31*…*46.33*). Valid in both directions of rotation.
11…12	Reserved	
13	Start delay active	1 = Start........ delay (par. *21.22*) active.
14…15	Reserved	

No.	Name/Value	Description	Def/FbEq16
	0b0000...0b1111	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.	0b0000

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

No.	Name/Value	Description	Def/FbEq16
	0b0000...0b1111	Start inhibit status word.	1 = 1
06.19	*Speed control status word*	Speed control status word. This parameter is read-only.	0b0000

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
	0b0000...0b1111	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 *44*). This parameter is read-only.	0b0000

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

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

Bit	Name	Description
0	DC hold active	1 = DC hold is active.
1	Post-magnetizing active	1 = Post-magnetizing is active.
2	Motor pre-heating active	1 = Motor pre-heating is active.
3…15	Reserved	

No.	Name/Value	Description	Def/FbEq16
	0b0000...0b1111	Drive status word 1.	1 = 1
06.29	*MSW bit 10 selection*	Selects a binary source whose status is transmitted as bit 10 (User bit 0) of *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 *175*).	2
	Other [bit]	Source selection (see *Terms and abbreviations* on page *162*).	-
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 *174*).	2
	Other [bit]	Source selection (see *Terms and abbreviations* on page *162*).	-
06.31	*MSW bit 12 selection*	Selects a binary source whose status is transmitted as bit 12 (User bit 1) of *06.11 Main status word*.	*Ext run enable*
	False	0	0
	True	1	1
	Ext run enable	Status of the external run enable signal (see parameter *20.12 Run enable 1 source*)	2
	Other [bit]	Source selection (see *Terms and abbreviations* on page *162*).	-

No.	Name/Value	Description	Def/FbEq16
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 *162*)	-
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 *162*)	-
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.)	Not selected
07.04	*Firmware name*	Firmware identification.	-
07.05	*Firmware version*	Version number of the firmware.	0.00.0.0
	0.00.0.0...255.255.255.255	-	1=1
07.06	*Loading package name*	Name of the firmware loading package.	-
07.07	*Loading package version*	Version number of the firmware loading package.	0.00.0.0
	0.00.0.0...255.255.255.255	-	1=1
07.11	*Cpu usage*	Microprocessor load in percent.	0
	0…100%	Microprocessor load.	1 = 1
07.35	*Drive configuration*	Plug ‘n’ play configuration. Drive automatically detects and enables any installed fieldbus or C-series option.	0x0000

Bit	Name	Bit	Name
0	Reserved	8	BIO-01
1	Base unit	9	RIIO-01
2	Reserved	10	FSCA-01
3	FENA-21	11	FEIP-21
4	FECA-01	12	FMBT-21
5	FPBA-01	13	
6	FCAN-01	14	FPNO-21
7	Reserved	15	FEPL-02

No.	Name/Value	Description	Def/FbEq16
	0x0000...0xffff	Drive configuration.	1 = 1

No.	Name/Value	Description	Def/FbEq16
07.36	*Drive configuration 2*	Plug 'n' play configuration. Drive automatically detects and enables any installed fieldbus or C-series option.	0x0000

Bit	Name	Bit	Name
0	FLON-01	4	CMOD-02
1	FDNA-01	5	CPTC-02
2	FCNA-01	6	CHDI-01
3	CMOD-01	7...15	Reserved

No.	Name/Value	Description	Def/FbEq16
	0x0000...0xffff	Drive configuration 2.	1 = 1
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.	0b0000

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
	0b0000...0b1111	Status for digital inputs.	1 = 1
10.02	*DI delayed status*	Displays the 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.	0b0000

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
	0b0000...0b1111	Delayed status for digital inputs.	1 = 1

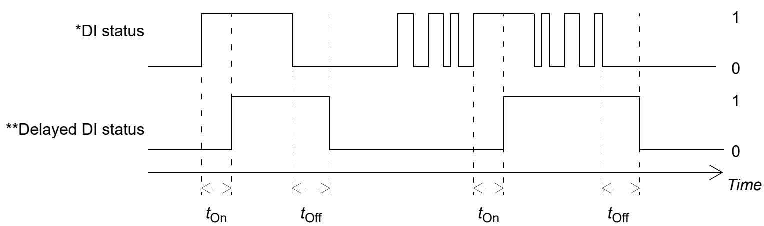
No.	Name/Value	Description	Def/FbEq16
10.03	*DI force selection*	The electrical statuses of the digital inputs can be overridden for e.g. testing purposes. A bit in parameter *10.04 DI forced data* is provided for each digital input, and its value is applied whenever the corresponding bit in this parameter is 1. **Note:** Boot and power cycle reset the force selections (parameters *10.03* and *10.04*).	0b0000

Bit	Value
0	1 = Force DI1 to value of bit 0 of parameter *10.04 DI forced data*. (0 = Normal mode)
1	1 = Force DI2 to value of bit 1 of parameter *10.04 DI forced data*. (0 = Normal mode)
2	1 = Force DI3 to value of bit 2 of parameter *10.04 DI forced data*. (0 = Normal mode)
3	1 = Force DI4 to value of bit 3 of parameter *10.04 DI forced data*. (0 = Normal mode)
4	1 = Force DI5 to value of bit 4 of parameter *10.04 DI forced data*. (0 = Normal mode)
5	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
	0b0000...0b1111	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.	0b0000

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

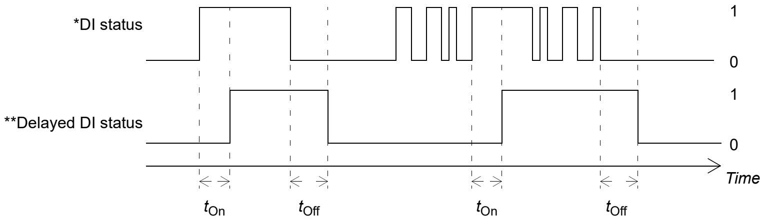
No.	Name/Value	Description	Def/FbEq16
	0b0000...0b1111	Forced values of digital inputs.	1 = 1
10.05	*DI1 ON delay*	Defines the activation delay for digital input DI1.	0.0 s



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

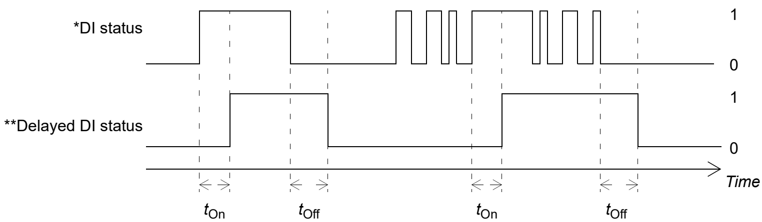
No.	Name/Value	Description	Def/FbEq16
	0.0 … 3000.0 s	Activation delay for DI1.	10 = 1 s
10.06	*DI1 OFF delay*	Defines the deactivation delay for digital input DI1. See parameter *10.05 DI1 ON delay*.	0.0 s
	0.0 … 3000.0 s	Deactivation delay for DI1.	10 = 1 s

No.	Name/Value	Description	Def/FbEq16
10.07	*DI2 ON delay*	Defines the activation delay for digital input DI2.	0.0 s



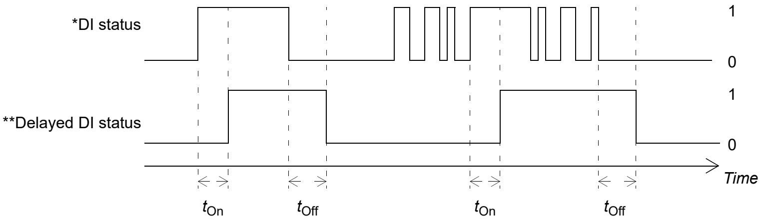
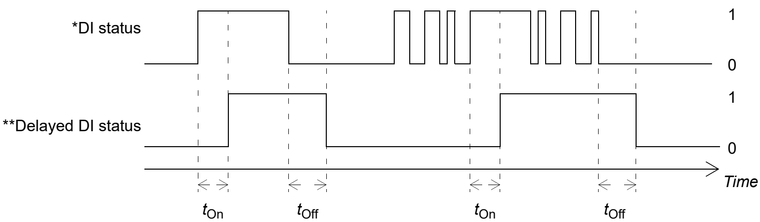
t_{On} = *10.07 DI2 ON delay*
t_{Off} = *10.08 DI2 OFF delay*
*Electrical status of digital input. Indicated by *10.01 DI status*.
**Indicated by *10.02 DI delayed status*.

No.	Name/Value	Description	Def/FbEq16
	0.0 … 3000.0 s	Activation delay for DI2.	10 = 1 s
10.08	*DI2 OFF delay*	Defines the deactivation delay for digital input DI2. See parameter *10.07 DI2 ON delay*.	0.0 s
	0.0 … 3000.0 s	Deactivation delay for DI2.	10 = 1 s
10.09	*DI3 ON delay*	Defines the activation delay for digital input DI3.	0.0 s

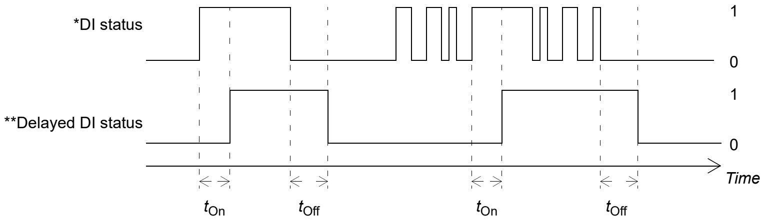


t_{On} = *10.09 DI3 ON delay*
t_{Off} = *10.10 DI3 OFF delay*
*Electrical status of digital input. Indicated by *10.01 DI status*.
**Indicated by *10.02 DI delayed status*.

No.	Name/Value	Description	Def/FbEq16
	0.0 … 3000.0 s	Activation delay for DI3.	10 = 1 s
10.10	*DI3 OFF delay*	Defines the deactivation delay for digital input DI3. See parameter *10.09 DI3 ON delay*.	0.0 s
	0.0 … 3000.0 s	Deactivation delay for DI3.	10 = 1 s

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

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



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

No.	Name/Value	Description	Def/FbEq16
	0.0 … 3000.0 s	Activation delay for DI6.	10 = 1 s
10.16	*DI6 OFF delay*	Defines the deactivation delay for digital input DI6. See parameter *10.15 DI6 ON delay*.	0.0 s
	0.0 … 3000.0 s	Deactivation delay for DI6.	10 = 1 s
10.21	*RO status*	Status of relay outputs RO3…RO1.	0b0000

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
	0b0000...0b1111	Status of relay outputs.	1 = 1
10.22	*RO force selection*	The signals connected to the relay outputs can be overridden for e.g. 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*).	0b0000

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

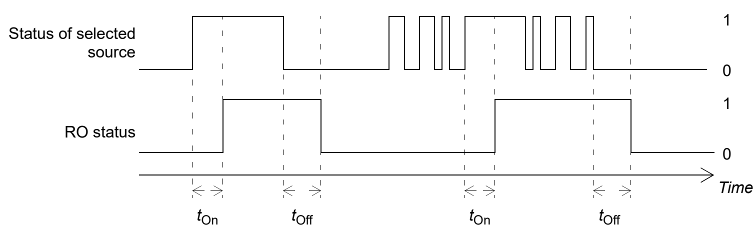
No.	Name/Value	Description	Def/FbEq16
	0b0000...0b1111	Override selection for relay outputs.	1 = 1

No.	Name/Value	Description	Def/FbEq16
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.	0b0000

Bit	Value
0	Force the value of this bit to RO1, if so defined in parameter *10.22 RO force selection*.
1	Force the value of this bit to RO2, if so defined in parameter *10.22 RO force selection*.
2	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
	0b0000...0b1111	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 *174*).	2
	Enabled	Bit 0 of *06.16 Drive status word 1* (see page *175*).	4
	Started	Bit 5 of *06.16 Drive status word 1* (see page *175*).	5
	Magnetized	Bit 1 of *06.17 Drive status word 2* (see page *175*).	6
	Running	Bit 6 of *06.16 Drive status word 1* (see page *175*).	7
	Ready ref	Bit 2 of *06.11 Main status word* (see page *174*).	8
	At setpoint	Bit 8 of *06.11 Main status word* (see page *174*).	9
	Reverse	Bit 2 of *06.19 Speed control status word* (see page *176*).	10
	Zero speed	Bit 0 of *06.19 Speed control status word* (see page *176*).	11
	Above limit	Bit 10 of *06.17 Drive status word 2* (see page *175*).	12
	Warning	Bit 7 of *06.11 Main status word* (see page *174*).	13
	Fault	Bit 3 of *06.11 Main status word* (see page *174*).	14
	Fault (-1)	Inverted bit 3 of *06.11 Main status word* (see page *174*).	15
	Fault/Warning	Bit 3 of *06.11 Main status word* OR bit 7 of *06.11 Main status word* (see page *174*).	16
	Overcurrent	Fault *2310 Overcurrent* has occurred.	17
	Overvoltage	Fault *3210 DC link overvoltage* has occurred.	18
	Drive temp	Fault *2381 IGBT overload* or *4110 Control board temperature* or *4210 IGBT overtemperature* or *4290 Cooling* or *42F1 IGBT temperature* or *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
	Brake command	Bit 0 of *44.01 Brake control status* (see page *316*).	22
	Ext2 active	Bit 11 of *06.16 Drive status word 1* (see page *175*).	23
	Remote control	Bit 9 of *06.11 Main status word* (see page *174*).	24
	Timed function 1	Bit 0 of *34.01 Timed functions status* (see page *276*).	27
	Timed function 2	Bit 1 of *34.01 Timed functions status* (see page *276*).	28
	Timed function 3	Bit 2 of *34.01 Timed functions status* (see page *276*).	29
	Reserved		30...32

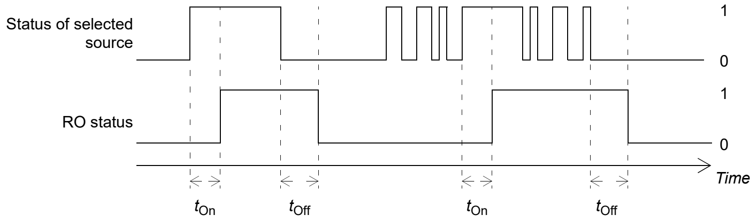
No.	Name/Value	Description	Def/FbEq16
	Supervision 1	Bit 0 of *32.01 Supervision status* (see page *269*).	33
	Supervision 2	Bit 1 of *32.01 Supervision status* (see page *269*).	34
	Supervision 3	Bit 2 of *32.01 Supervision status* (see page *269*).	35
	Start delay	Bit 13 of *06.17 Drive status word 2* (see page *175*).	39
	RO/DIO control word bit0	Bit 0 of *10.99 RO/DIO control word* (see page *186*).	40
	RO/DIO control word bit1	Bit 1 of *10.99 RO/DIO control word* (see page *186*).	41
	RO/DIO control word bit2	Bit 2 of *10.99 RO/DIO control word* (see page *186*).	42
	PFC1	Bit 0 of *76.01 PFC status* (see page *348*).	45
	PFC2	Bit 1 of *76.01 PFC status* (see page *348*).	46
	PFC3	Bit 2 of *76.01 PFC status* (see page *348*).	47
	PFC4	Bit 3 of *76.01 PFC status* (see page *348*).	48
	Event word 1	Event word 1 = 1 if any bit of *04.40 Event word 1* (see page *169*) is 1, that is, if any warning, fault or pure event that has been defined with parameters *04.43*…*04.71* is on.	53
	User load curve	Bit 3 (Outside load limit) of *37.01 ULC output status word* (see page *295*).	61
	RO/DIO control word	Maps to corresponding bit in parameter *10.99 RO/DIO control word*. For example, Bit 0 of *10.99 RO/DIO control word* controls RO1, Bit 1 of *10.99 RO/DIO control word* controls RO2, and so on.	62
	Other [bit]	Source selection (see *Terms and abbreviations* on page *162*).	-
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*

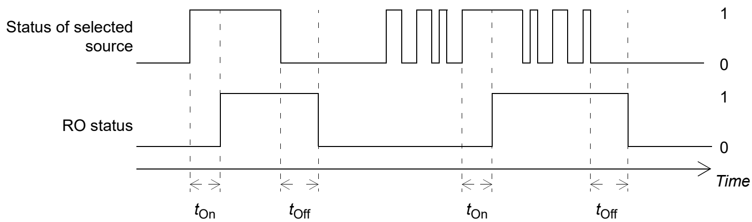
	0.0 … 3000.0 s	Activation delay for RO1.	10 = 1 s
10.26	*RO1 OFF delay*	Defines the deactivation delay for relay output RO1. See parameter *10.25 RO1 ON delay*.	0.0 s
	0.0 … 3000.0 s	Deactivation delay for RO1.	10 = 1 s
10.27	*RO2 source*	Selects a drive signal to be connected to relay output RO2. For the available selections, see parameter *10.24 RO1 source*.	*Running*

No.	Name/Value	Description	Def/FbEq16
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
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

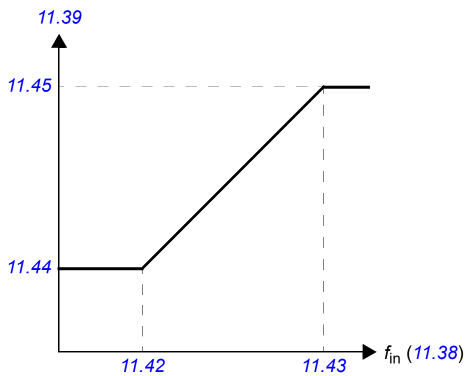


t_{On} = *10.31 RO3 ON delay*
t_{Off} = *10.32 RO3 OFF delay*

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 e.g. 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.	0b0000

Bit	Name	Description
0	RO1	Source bits for relay outputs RO1…RO3. See parameters *10.24*, *10.27* and *10.30*.
1	RO2	
2	RO3	
3…15	Reserved	

No.	Name/Value	Description	Def/FbEq16
	0b0000...0b1111	RO/DIO control word.	1 = 1
10.101	*RO1 toggle counter*	Displays the number of times relay output RO1 has changed states.	0
	0…4294967000	State change count.	1 = 1
10.102	*RO2 toggle counter*	Displays the number of times relay output RO2 has changed states.	0
	0…4294967000	State change count.	1 = 1
10.103	*RO3 toggle counter*	Displays the number of times relay output RO3 has changed states.	0
	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 DI6DI5 when it is used as a frequency input) before scaling. See parameter *11.42 Freq in 1 min*. This parameter is read-only.	0
	0 … 16000 Hz	Unscaled value of frequency input 1.	1 = 1 Hz
11.39	*Freq in 1 scaled value*	Displays the value of frequency input 1 (via DI5 or DI6 when it is used as a frequency input) after scaling. See parameter *11.42 Freq in 1 min*. This parameter is read-only.	0
	-32768.000… 32767.000	Scaled value of frequency input 1 (DI5 or DI6).	1 = 1
11.42	*Freq in 1 min*	Defines the minimum for the frequency actually arriving at frequency input 1 (DI5 or DI6 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 or DI6).	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 or DI6 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 or DI6).	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*.	50.000
	-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 e.g. testing purposes. A forced value parameter is provided for each analog input, and its value is applied whenever the corresponding bit in this parameter is 1. **Note:** AI filter times (parameters *12.16 AI1 filter time* and *12.26 AI2 filter time*) have no effect on forced AI values (parameters *12.13 AI1 forced value* and *12.23 AI2 forced value*). **Note:** Boot and power cycle reset the force selections (parameters *12.02* and *12.03*).	0b0000

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

No.	Name/Value	Description	Def/FbEq16
	0b000...0b1111	Forced values selector for analog inputs AI1 and AI2.	1 = 1
12.03	*AI supervision function*	Selects how the drive reacts when an analog input signal moves out of the minimum and/or maximum limits specified for the input. The supervision applies a margin of 0.5 V or 1.0 mA to the limits. For example, if the maximum limit for the input is 7.000 V, the maximum limit supervision activates at 7.500 V. The inputs and the limits to be observed are selected by parameter *12.04 AI supervision selection*.	*No action*
	No action	No action taken.	0
	Fault	Drive trips on *80A0 AI supervision*.	1
	Warning	Drive generates an *A8A0 AI supervision* warning.	2
	Last speed	Drive generates a warning (*A8A0 AI supervision*) and freezes the speed (or frequency) to the level the drive was operating at. The speed/frequency is determined on the basis of actual speed using 850 ms low-pass filtering. **WARNING!** Make sure that it is safe to continue operation in case of a communication break.	3

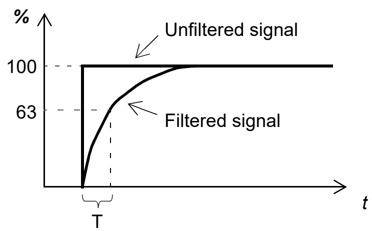
No.	Name/Value	Description	Def/FbEq16
	Speed ref safe	Drive generates a warning (*A8A0 AI supervision*) and sets the speed to the speed defined by parameter *22.41 Speed ref safe* (or *28.41 Frequency ref safe* when frequency reference is being used). **WARNING!** Make sure that it is safe to continue operation in case of a communication break.	4
12.04	*AI supervision selection*	Specifies the analog input limits to be supervised. See parameter *12.03 AI supervision function*. **Note:** The control location based AI supervision function can be either activated or deactivated with parameter *12.05 AI supervision force*.	0b0000

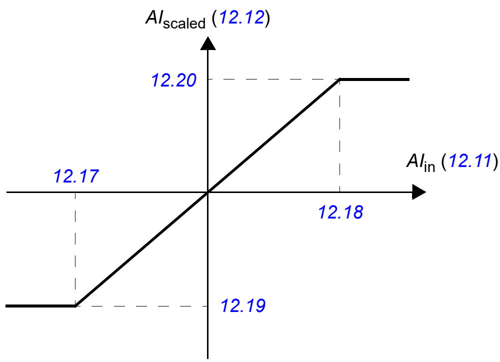
Bit	Name	Description
0	AI1 < MIN	1 = Minimum limit supervision of AI1 active.
1	AI1 > MAX	1 = Maximum limit supervision of AI1 active.
2	AI2 < MIN	1 = Minimum limit supervision of AI2 active.
3	AI2 > MAX	1 = Maximum limit supervision of AI2 active.
4…15	Reserved	

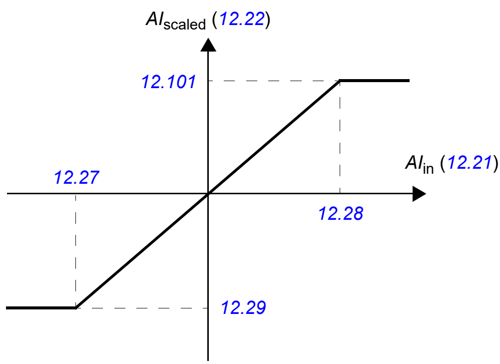
No.	Name/Value	Description	Def/FbEq16
	0b000...0b1111	Activation of analog input supervision.	1 = 1
12.05	*AI supervision force*	Activates/deactivates analog input supervision for each control location (see section *Local control vs. external control* on page *33*). When a control location does not utilize AI for referencing, you can use this parameter to deactivate the AI supervision (*12.04*). This hides the warning or fault generated by AI supervision function (*12.03*), for the selected control location. For example, if *19.11 Ext1/Ext2 selection* = EXT1 *12.04 AI supervision selection* = Bit 0 or Bit 1 is 1 *12.05 AI supervision force* = Bit 0 is 0 then, AI1 supervision is masked in EXT1.	0b0000

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

No.	Name/Value	Description	Def/FbEq16
	0b000...0b1111	Activation/deactivation of analog input supervision.	1 = 1
12.11	*AI1 actual value*	Displays the value of analog input AI1 in mA or V (depending on whether the input is set to current or voltage by a hardware setting). This parameter is read-only.	0
	0.000…11.000 V	Value of analog input AI1.	1000 = 1 unit

No.	Name/Value	Description	Def/FbEq16
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.	0
	-32768.000… 32767.000	Scaled value of analog input AI1.	1 = 1
12.13	*AI1 forced value*	Forced value that can be used instead of the true reading of the input. See parameter *12.02 AI force selection*.	0
	0.000…11.000 V	Forced value of analog input AI1.	1000 = 1 unit
12.15	*AI1 unit selection*	Selects the unit for readings and settings related to analog input AI1. **Note:** In firmware ASCL2 and ASCL4), this setting must match the corresponding hardware setting on the drive control unit. See chapter *Electrical installation*, section *Switches* in the *Hardware manual* of the drive and the default control connections for the macro in use in chapter *Control macros* (page *101*). Control board reboot (either by cycling the power or through parameter *96.08 Control board boot*) is required to validate any changes in the hardware settings.	*V*
	V	Volts.	2
	mA	Milliamperes.	10
12.16	*AI1 filter time*	Defines the filter time constant for analog input AI1.  O = I × (1 - e$^{-t/T}$) I = filter input (step) O = filter output *t* = time T = filter time constant **Note:** The signal is also filtered due to the signal interface hardware (approximately 0.25 ms time constant). This cannot be changed by any parameter.	0.100 s
	0.000…30.000 s	Filter time constant.	1000 = 1
12.17	*AI1 min*	Defines the minimum site value for analog input AI1. Set the value actually sent to the drive when the analog signal from plant is wound to its minimum setting. See also parameter *12.19 AI1 scaled at AI1 min*.	0.000
	0.000…11.000 V	Minimum value of AI1.	1000 = 1

No.	Name/Value	Description	Def/FbEq16
12.18	*AI1 max*	Defines the maximum site value for analog input AI1. Set the value actually sent to the drive when the analog signal from plant is wound to its maximum setting. See also parameter *12.19 AI1 scaled at AI1 min*.	10.000
	0.000…11.000 V	Maximum value of AI1.	1000 = 1
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
	-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	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.	0.000
	-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
	0.000…22.000 mA	Forced value of analog input AI2.	1000 = 1 unit

No.	Name/Value	Description	Def/FbEq16
12.25	*AI2 unit selection*	Selects the unit for readings and settings related to analog input AI2. **Note:** In firmware ASCL2 and ASCL4), this setting must match the corresponding hardware setting on the drive control unit. See chapter *Electrical installation*, section *Switches* in the *Hardware manual* of the drive and the default control connections for the macro in use in chapter *Control macros* (page *101*). Control board reboot (either by cycling the power or through parameter *96.08 Control board boot*) is required to validate any changes in the hardware settings.	*mA*
	V	Volts.	2
	mA	Milliamperes.	10
12.26	*AI2 filter time*	Defines the filter time constant for analog input AI2. See parameter *12.16 AI1 filter time*.	0.100 s
	0.000…30.000 s	Filter time constant.	1000 = 1 s
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	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	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 minimum 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

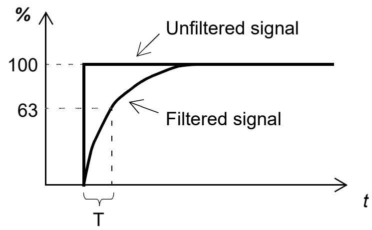
No.	Name/Value	Description	Def/FbEq16
12.101	AI1 percent value	Value of analog input AI1 in percent of AI1 scaling (12.18 AI1 max - 12.17 AI1 min).	0
	0.00…100.00%	AI1 value	100 = 1%
12.102	AI2 percent value	Value of analog input AI2 in percent of AI2 scaling (12.28 AI2 max - 12.27 AI2 min).	0
	0.00…100.00%	AI2 value	100 = 1%
12.110	AI dead band	Defines AI dead band value in percentage where 100% = 10V in voltage mode and 100% = 20mA in current mode. This is applicable for both AI1 and AI2. **Note:** 10% of the AI dead-band value is internally added to the firmware as AI dead-band hysteresis (positive and negative). This value cannot be changed. For more information on dead-band function and its calculation, see section Dead-band function on page 96.	0.40%
	0.00…100.00%	Deadband for AI signals.	100 = 1%

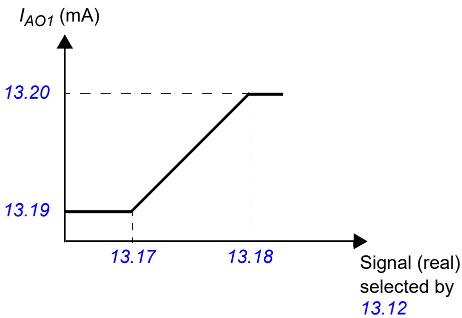
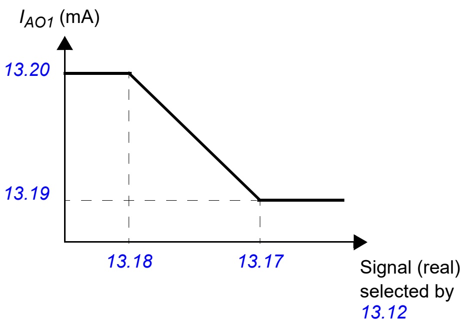
13 Standard AO		Configuration of standard analog outputs.	
13.02	AO force selection	The source signals of the analog outputs can be overridden for e.g. testing purposes. A forced value parameter is provided for each analog output, and its value is applied whenever the corresponding bit in this parameter is 1. **Note:** Boot and power cycle reset the force selections (parameters 13.02 and 13.11).	0b0000

Bit	Value
0	1 = Force AO1 to value of parameter 13.13 AO1 forced value. (0 = Normal mode)
1	1 = Force AO2 to value of parameter 13.23 AO2 forced value. (0 = Normal mode)
2…15	Reserved

	0b0000…0b1111	Forced values selector for analog outputs AO1 and AO2.	1 = 1
13.11	AO1 actual value	Displays the value of AO1 in mA This parameter is read-only.	-
	0.000…22.000 mA	Value of AO1.	1 = 1 mA
13.12	AO1 source	Selects a signal to be connected to analog output AO1.	Output frequency
	Zero	None.	0
	Motor speed used	01.01 Motor speed used (page 165).	1
	Output frequency	01.06 Output frequency (page 165).	3
	Motor current	01.07 Motor current (page 165).	4
	Motor current % of motor nominal	01.08 Motor current % of motor nom (page 165).	5
	Motor torque	01.10 Motor torque (page 165).	6
	DC voltage	01.11 DC voltage (page 165).	7
	Output power	01.14 Output power (page 166).	8
	Freq ref used	28.02 Frequency ref ramp output (page 243).	14
	Process PID out	40.01 Process PID output actual (page 298).	16

No.	Name/Value	Description	Def/FbEq16
	Temp sensor 1 excitation	The output is used to feed an excitation current to the temperature sensor 1, see parameter *35.11 Temperature 1 source*. See also section *Motor thermal protection* (page *81*).	20
	Temp sensor 2 excitation	The output is used to feed an excitation current to the temperature sensor 2, see parameter *35.21 Temperature 2 source*. See also section *Motor thermal protection* (page *81*).	21
	Abs motor speed used	*01.61 Abs motor speed used* (page *168*).	26
	Abs motor speed %	*01.62 Abs motor speed %* (page *168*).	27
	Abs output frequency	*01.63 Abs output frequency* (page *168*).	28
	Abs motor torque	*01.64 Abs motor torque* (page *168*).	30
	Abs output power	*01.65 Abs output power* (page *168*).	31
	Abs motor shaft power	*01.68 Abs motor shaft power* (page *168*).	32
	AO1 data storage	*13.91 AO1 data storage* (page *199*).	37
	AO2 data storage	*13.92 AO2 data storage* (page *199*).	38
	Other	Source selection (see *Terms and abbreviations* on page *162*).	-
13.13	*AO1 forced value*	Forced value that can be used instead of the selected output signal. See parameter *13.02 AO force selection*.	0.000 mA
	0.000…22.000 mA / 0.000…11.000 V	Forced value for AO1.	1 = 1 unit
13.15	*AO1 unit selection*	Selects the unit for readings and settings related to analog input AO1. **Note:** In firmware ASCL2 and ASCL4), this setting must match the corresponding hardware setting on the drive control unit. See chapter *Electrical installation*, section *Switches* in the *Hardware manual* of the drive and the default control connections for the macro in use in chapter *Control macros* (page *101*). Control board reboot (either by cycling the power or through parameter *96.08 Control board boot*) is required to validate any changes in the hardware settings.	*mA*
	V	Volts.	2
	mA	Milliamperes.	10

No.	Name/Value	Description	Def/FbEq16
13.16	*AO1 filter time*	Defines the filtering time constant for analog output AO1.  $O = I \times (1 - e^{-t/T})$ I = filter input (step) O = filter output *t* = time T = filter time constant	0.100 s
	0.000 … 30.000 s	Filter time constant.	1000 = 1 s

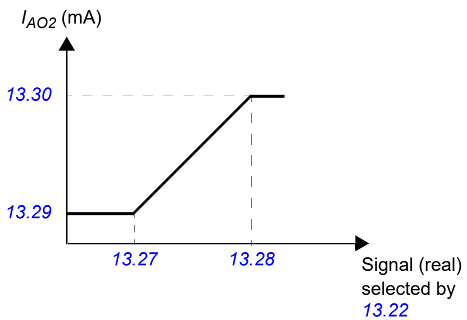
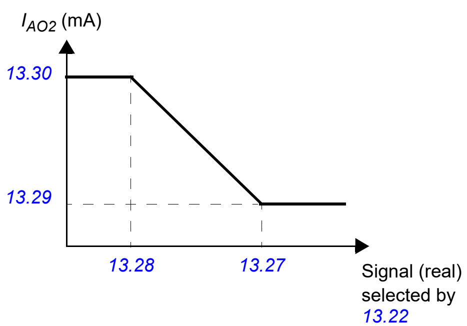
No.	Name/Value	Description	Def/FbEq16
13.17	*AO1 source min*	Defines the real minimum value of the signal (selected by parameter *13.12 AO1 source*) that corresponds to the minimum required AO1 output value (defined by parameter *13.19 AO1 out at AO1 src min*).  Programming *13.17* as the maximum value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

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*
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*
37	*AO1 data storage*	*13.91 AO1 data storage* (page *199*).	-
38	*AO2 data storage*	*13.92 AO2 data storage* (page *199*).	-
	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
	-32768.0…32767.0	Real signal value corresponding to maximum AO1 output value.	1 = 1
13.19	*AO1 out at AO1 src min*	Defines the minimum output value for analog output AO1. See also drawing at parameter *13.17 AO1 source min*.	0.000 mA
	0.000…22.000 mA / 0.000…11.000 V	Minimum AO1 output value.	1000 = 1 mA
13.20	*AO1 out at AO1 src max*	Defines the maximum output value for analog output AO1. See also drawing at parameter *13.17 AO1 source min*.	20.000 mA
	0.000…22.000 mA / 0.000…11.000 V	Maximum AO1 output value.	1000 = 1 mA

No.	Name/Value	Description	Def/FbEq16
13.21	*AO2 actual value*	Displays the value of AO2 in mA. This parameter is read-only.	0.000
	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
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

No.	Name/Value	Description	Def/FbEq16
13.28	*AO2 source max*	Defines the real maximum value of the signal (selected by parameter *13.22 AO2 source*) that corresponds to the maximum required AO2 output value (defined by parameter *13.30 AO2 out at AO2 src max*). See parameter *13.27 AO2 source min*. See parameter *13.17 AO1 source min* about the AO automatic scaling.	3.2
	-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
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 e.g. 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 e.g. 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

19 Operation mode		Selection of local and external control location sources and operating modes. See also section *Operating modes of the drive* (page *37*).	
19.01	*Actual operation mode*	Displays the operating mode currently used. See parameters *19.11*…*19.14*. This parameter is read-only.	*Scalar (Hz)*
	Zero	None.	1
	Speed	Speed control (in vector motor control mode).	2
	Torque	Torque control (in vector motor control mode).	3
	Min	The torque selector is comparing the output of the speed controller (*25.01 Torque reference speed control*) and torque reference (*26.74 Torque ref ramp out*) and the smaller of the two is used (in vector motor control mode).	4
	Max	The torque selector is comparing the output of the speed controller (*25.01 Torque reference speed control*) and torque reference (*26.74 Torque ref ramp out*) and the greater of the two is used (in vector motor control mode).	5
	Add	The speed controller output is added to the torque reference (in vector motor control mode).	6
	Reserved		7...9

No.	Name/Value	Description	Def/FbEq16
	Scalar (Hz)	Frequency control in scalar motor control mode (in scalar motor control mode).	10
	Forced magn.	Motor is in magnetizing mode.	20
19.11	*Ext1/Ext2 selection*	Selects the source for external control location EXT1/EXT2 selection. 0 = EXT1 1 = EXT2	*EXT1*
	EXT1	EXT1 (permanently selected).	0
	EXT2	EXT2 (permanently selected).	1
	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
	Timed function 1	Bit 0 of *34.01 Timed functions status* (see page *276*).	19
	Timed function 2	Bit 1 of *34.01 Timed functions status* (see page *276*).	20
	Timed function 3	Bit 2 of *34.01 Timed functions status* (see page *276*).	21
	Supervision 1	Bit 0 of *32.01 Supervision status* (see page *269*).	25
	Supervision 2	Bit 1 of *32.01 Supervision status* (see page *269*).	26
	Supervision 3	Bit 2 of *32.01 Supervision status* (see page *269*).	27
	EFB MCW bit 11	Control word bit 11 received through the embedded fieldbus interface.	32
	FBA A connection loss	Detected communication loss of fieldbus interface A changes control mode to EXT2.	33
	EFB connection loss	Detected communication loss of embedded fieldbus interface changes control mode to EXT2.	35
	Other [bit]	Source selection (see *Terms and abbreviations* on page *162*).	-
19.12	*Ext1 control mode*	Selects the operating mode for external control location EXT1 in vector motor control mode.	*Speed*
	Zero	None.	1
	Speed	Speed control. The torque reference used is *25.01 Torque reference speed control* (output of the speed reference chain).	2
	Torque	Torque control. The torque reference used is *26.74 Torque ref ramp out* (output of the torque reference chain).	3
	Minimum	Combination of selections Speed and Torque: the torque selector compares the speed controller output (*25.01 Torque reference speed control*) and the torque reference (*26.74 Torque ref ramp out*) and selects the smaller of the two. If speed error becomes negative, the drive follows the speed controller output until speed error becomes positive again. This prevents the drive from accelerating uncontrollably if the load is lost in torque control.	4

<table>
<tr><th>No.</th><th>Name/Value</th><th>Description</th><th>Def/FbEq16</th></tr>
<tr><td></td><td>Maximum</td><td>Combination of selections Speed and Torque: the torque selector compares the speed controller output (25.01 Torque reference speed control) and the torque reference (26.74 Torque ref ramp out) and selects the greater of the two.
If speed error becomes positive, the drive follows the speed controller output until speed error becomes negative again. This prevents the drive from accelerating uncontrollably if the load is lost in torque control.</td><td>5</td></tr>
<tr><td>19.14</td><td>Ext2 control mode</td><td>Selects the operating mode for external control location EXT2 in vector motor control mode.
For the selections, see parameter 19.12 Ext1 control mode.</td><td>Speed</td></tr>
<tr><td>19.16</td><td>Local control mode</td><td>Selects the operating mode for local control in vector motor control mode.</td><td>Speed</td></tr>
<tr><td></td><td>Speed</td><td>Speed control. The torque reference used is 25.01 Torque reference speed control (output of the speed reference chain).</td><td>0</td></tr>
<tr><td></td><td>Torque</td><td>Torque control. The torque reference used is 26.74 Torque ref ramp out (output of the torque reference chain).</td><td>1</td></tr>
<tr><td>19.17</td><td>Local control disable</td><td>Enables/disables local control (startHand and stopOff buttons on the control panel, and the local controls on the PC tool).
WARNING! Before disabling local control, ensure that the control panel is not needed for stopping the drive.</td><td>No</td></tr>
<tr><td></td><td>No</td><td>Local control enabled.</td><td>0</td></tr>
<tr><td></td><td>Yes</td><td>Local control disabled.</td><td>1</td></tr>
</table>

<table>
<tr><td colspan="2">20 Start/stop/direction</td><td>Start/stop/direction and run/start/jog enable signal source selection; positive/negative reference enable signal source selection.
For information on control locations, see section Local control vs. external control (page 33).</td><td></td></tr>
<tr><td>20.01</td><td>Ext1 commands</td><td>Selects the source of start, stop and direction commands for external control location 1 (EXT1).
See also parameters 20.02…20.05. See parameter 20.21 for the determination of the actual direction.</td><td>In1 Start; In2 Dir</td></tr>
<tr><td></td><td>Not selected</td><td>No start or stop command sources selected.</td><td>0</td></tr>
<tr><td></td><td>In1 Start</td><td>The source of the start and stop commands is selected by parameter 20.03 Ext1 in1 source. The state transitions of the source bits are interpreted as follows:
<table><tr><th>State of source 1 (20.03)</th><th>Command</th></tr><tr><td>0 -> 1 (20.02 = Edge)
1 (20.02 = Level)</td><td>Start</td></tr><tr><td>0</td><td>Stop</td></tr></table></td><td>1</td></tr>
</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:

Parameter 20.02 Ext1 start trigger type has no effect with this setting.
When source 2 is 0, the Start and Stop keys on the control panel are disabled.
</td><td>4</td></tr>
</table>

<table>
<tr><th>No.</th><th>Name/Value</th><th>Description</th><th>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:
• Parameter 20.02 Ext1 start trigger type has no effect with this setting.
• When source 2 is 0, the Start and Stop keys on the control panel are disabled.</td><td>5</td></tr>
<tr><td></td><td>In1P Start fwd; In2P Start rev; In3 Stop</td><td>The sources of the start and stop commands are selected by parameters 20.03 Ext1 in1 source, 20.04 Ext1 in2 source and 20.05 Ext1 in3 source. The source selected by 20.05 Ext1 in3 source determines the 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>
Note: Parameter 20.02 Ext1 start trigger type has no effect with this setting.</td><td>6</td></tr>
<tr><td></td><td>Control panel</td><td>The start and stop commands are taken from the control panel (or PC connected to the 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>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: This parameter is not effective if a pulse-type start signal is selected. See the descriptions of the selections of parameter 20.01 Ext1 commands.</td><td>Level</td></tr>
<tr><td></td><td>Edge</td><td>The start signal is edge-triggered.</td><td>0</td></tr>
<tr><td></td><td>Level</td><td>The start signal is level-triggered.</td><td>1</td></tr>
<tr><td>20.03</td><td>Ext1 in1 source</td><td>Selects source 1 for parameter 20.01 Ext1 commands.</td><td>DI1</td></tr>
<tr><td></td><td>Always off</td><td>0 (always off).</td><td>0</td></tr>
<tr><td></td><td>Always on</td><td>1 (always on).</td><td>1</td></tr>
<tr><td></td><td>DI1</td><td>Digital input DI1 (10.02 DI delayed status, bit 0).</td><td>2</td></tr>
<tr><td></td><td>DI2</td><td>Digital input DI2 (10.02 DI delayed status, bit 1).</td><td>3</td></tr>
</table>

<table>
<tr><th>No.</th><th>Name/Value</th><th>Description</th><th>Def/FbEq16</th></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>Timed function 1</td><td>Bit 0 of 34.01 Timed functions status (see page 276).</td><td>18</td></tr>
<tr><td></td><td>Timed function 2</td><td>Bit 1 of 34.01 Timed functions status (see page 276).</td><td>19</td></tr>
<tr><td></td><td>Timed function 3</td><td>Bit 2 of 34.01 Timed functions status (see page 276).</td><td>20</td></tr>
<tr><td></td><td>Supervision 1</td><td>Bit 0 of 32.01 Supervision status (see page 269).</td><td>24</td></tr>
<tr><td></td><td>Supervision 2</td><td>Bit 1 of 32.01 Supervision status (see page 269).</td><td>25</td></tr>
<tr><td></td><td>Supervision 3</td><td>Bit 2 of 32.01 Supervision status (see page 269).</td><td>26</td></tr>
<tr><td></td><td>Other [bit]</td><td>Source selection (see Terms and abbreviations on page 162).</td><td>-</td></tr>
<tr><td>20.04</td><td>Ext1 in2 source</td><td>Selects source 2 for parameter 20.01 Ext1 commands.
For the available selections, see parameter 20.03 Ext1 in1 source.</td><td>DI2</td></tr>
<tr><td>20.05</td><td>Ext1 in3 source</td><td>Selects source 3 for parameter 20.01 Ext1 commands.
For the available selections, see parameter 20.03 Ext1 in1 source.</td><td>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 also parameters 20.07…20.10. See parameter 20.21 for the determination of the actual direction.</td><td>Not selected</td></tr>
<tr><td></td><td>Not selected</td><td>No start or stop command sources selected.</td><td>0</td></tr>
<tr><td></td><td>In1 Start</td><td>The source of the start and stop commands is selected by parameter 20.08 Ext2 in1 source. The state transitions of the source bits are interpreted as follows:
<table>
<tr><th>State of source 1 (20.08)</th><th>Command</th></tr>
<tr><td>0 -> 1 (20.07 = Edge)
1 (20.07 = Level)</td><td>Start</td></tr>
<tr><td>0</td><td>Stop</td></tr>
</table></td><td>1</td></tr>
<tr><td></td><td>In1 Start; In2 Dir</td><td>The source selected by 20.08 Ext2 in1 source is the start signal; the source selected by 20.09 Ext2 in2 source determines the direction. The state transitions of the source bits are interpreted as follows:
<table>
<tr><th>State of source 1 (20.08)</th><th>State of source 2 (20.09)</th><th>Command</th></tr>
<tr><td>0</td><td>Any</td><td>Stop</td></tr>
<tr><td rowspan="2">0 -> 1 (20.07 = Edge)
1 (20.07 = Level)</td><td>0</td><td>Start forward</td></tr>
<tr><td>1</td><td>Start reverse</td></tr>
</table></td><td>2</td></tr>
</table>

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

Parameter 20.07 Ext2 start trigger type has no effect with this setting.
When source 2 is 0, the Start and Stop keys on the control panel are disabled.
</td><td>4</td></tr>
<tr><td></td><td>In1P Start; In2 Stop; In3 Dir</td><td>The sources of the start and stop commands are selected by parameters 20.08 Ext2 in1 source and 20.09 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:

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

<table>
<tr><th>No.</th><th>Name/Value</th><th>Description</th><th>Def/FbEq16</th></tr>
<tr><td></td><td>In1P Start fwd; In2P Start rev; In3 Stop</td><td>The sources of the start and stop commands are selected by parameters 20.08 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>
Note: Parameter 20.07 Ext2 start trigger type has no effect with this setting.</td><td>6</td></tr>
<tr><td></td><td>Control panel</td><td>The start and stop commands are taken from the control panel (or PC connected to the 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>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: This parameter is not effective if a pulse-type start signal is selected. See the descriptions of the selections of parameter 20.06 Ext2 commands.</td><td>Level</td></tr>
<tr><td></td><td>Edge</td><td>The start signal is edge-triggered.</td><td>0</td></tr>
<tr><td></td><td>Level</td><td>The start signal is level-triggered.</td><td>1</td></tr>
<tr><td>20.08</td><td>Ext2 in1 source</td><td>Selects source 1 for parameter 20.06 Ext2 commands.
For the available selections, see parameter 20.03 Ext1 in1 source.</td><td>Always off</td></tr>
<tr><td>20.09</td><td>Ext2 in2 source</td><td>Selects source 2 for parameter 20.06 Ext2 commands.
For the available selections, see parameter 20.03 Ext1 in1 source.</td><td>Always off</td></tr>
<tr><td>20.10</td><td>Ext2 in3 source</td><td>Selects source 3 for parameter 20.06 Ext2 commands.
For the available selections, see parameter 20.03 Ext1 in1 source.</td><td>Always off</td></tr>
<tr><td>20.11</td><td>Run enable stop mode</td><td>Selects the way the motor is stopped when the run enable signal switches off.
The source of the run enable signal is selected by parameter 20.12 Run enable 1 source.</td><td>Coast</td></tr>
<tr><td></td><td>Coast</td><td>Stops 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>Stops along the active deceleration ramp. See parameter group 23 Speed reference ramp on page 228.</td><td>1</td></tr>
<tr><td></td><td>Torque limit</td><td>Stops according to torque limits (parameters 30.19 and 30.20).</td><td>2</td></tr>
</table>

No.	Name/Value	Description	Def/FbEq16
20.12	*Run enable 1 source*	Selects the source of the external run enable signal. If the run enable signal is switched off, the drive will not start. If already running, the drive will stop according to the setting of parameter *20.11 Run enable stop mode*. 1 = Run enable signal on. See also parameter *20.19 Enable start command*.	*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
	Timed function 1	Bit 0 of *34.01 Timed functions status* (see page *276*)	18
	Timed function 2	Bit 1 of *34.01 Timed functions status* (see page *276*)	19
	Timed function 3	Bit 2 of *34.01 Timed functions status* (see page *276*)	20
	Supervision 1	Bit 0 of *32.01 Supervision status* (see page *269*)	24
	Supervision 2	Bit 1 of *32.01 Supervision status* (see page *269*)	25
	Supervision 3	Bit 2 of *32.01 Supervision status* (see page *269*)	26
	FBA A MCW bit 3	Control word bit 3 received through fieldbus interface A	30
	EFB MCW bit 3	Control word bit 3 received through the embedded fieldbus interface	32
	Other [bit]	Source selection (see *Terms and abbreviations* on page *162*)	-
20.19	*Enable start command*	Selects the source for the start enable signal. 1 = Start enable. With the signal switched off, any drive start command is inhibited. (Switching the signal off while the drive is running will not stop the drive.) See also parameter *20.12 Run enable 1 source*.	*Selected*
	Not selected	0	0
	Selected	1	1
	DI1	Digital input DI1 (*10.02 DI delayed status*, bit 0)	2
	DI2	Digital input DI2 (*10.02 DI delayed status*, bit 1)	3
	DI3	Digital input DI3 (*10.02 DI delayed status*, bit 2)	4
	DI4	Digital input DI4 (*10.02 DI delayed status*, bit 3)	5
	DI5	Digital input DI5 (*10.02 DI delayed status*, bit 4)	6
	DI6	Digital input DI6 (*10.02 DI delayed status*, bit 5)	7
	Timed function 1	Bit 0 of *34.01 Timed functions status* (see page *276*)	18
	Timed function 2	Bit 1 of *34.01 Timed functions status* (see page *276*)	19
	Timed function 3	Bit 2 of *34.01 Timed functions status* (see page *276*)	20
	Supervision 1	Bit 0 of *32.01 Supervision status* (see page *269*)	24
	Supervision 2	Bit 1 of *32.01 Supervision status* (see page *269*)	25
	Supervision 3	Bit 2 of *32.01 Supervision status* (see page *269*)	26

No.	Name/Value	Description	Def/FbEq16
	Other [bit]	Source selection (see *Terms and abbreviations* on page *162*)	-
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 DI configured in *20.01 Ext1 commands* or *20.06 Ext2 commands* and its related parameters).	*Request*

Par. *20.21 Direction*	DI = Forward	DI = Reverse	DI not defined
Forward	Motor rotates in forward direction	Motor rotates in forward direction	Same as forward DI
Reverse	Motor rotates in reverse direction	Motor rotates in reverse direction	Same as reverse DI
Request			
Reference from motor potentiometer reference /other	Motor rotates in forward direction	Motor rotates in reverse direction	Same as forward DI
Reference from AI/FB/EFB/ Control Panel Ref Saved & Copied/Safe Speed / Last Speed	Motor rotates in direction of reference	Motor rotates always in reverse direction (-1 * ABS [Reference])	Same as forward DI
Reference from Constant Speed / PID / Jog ref	Motor rotates in direction of reference [DI have no effect]	Motor rotates in direction of reference [DI have no effect]	DI have no effect

No.	Name/Value	Description	Def/FbEq16
	Request	Refer the table above for rotation direction of motor.	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
	Reverse	Motor rotates reverse regardless of the sign of the external reference. (Negative reference values are replaced by zero. Positive reference values are multiplied by -1.)	2
20.22	*Enable to rotate*	Setting this parameter to 0 stops motor rotating but does not affect any other conditions for rotating. Setting the parameter back to 1 starts motor rotating again. This parameter can be used for example with a signal from some external equipment to prevent the motor rotating before the equipment is ready. When this parameter is 0 (rotating of the motor is disabled), bit 13 of parameter *06.16 Drive status word 1* is set to 0.	*Selected*
	Not selected	0 (always off)	0
	Selected	1 (always on)	1
	DI1	Digital input DI1 (*10.02 DI delayed status*, bit 0)	2
	DI2	Digital input DI2 (*10.02 DI delayed status*, bit 1)	3
	DI3	Digital input DI3 (*10.02 DI delayed status*, bit 2)	4
	DI4	Digital input DI4 (*10.02 DI delayed status*, bit 3)	5
	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
	Timed function 1	Bit 0 of *34.01 Timed functions status* (see page *276*)	18
	Timed function 2	Bit 1 of *34.01 Timed functions status* (see page *276*)	19
	Timed function 3	Bit 2 of *34.01 Timed functions status* (see page *276*).	20
	Supervision 1	Bit 0 of *32.01 Supervision status* (see page *269*)	24
	Supervision 2	Bit 1 of *32.01 Supervision status* (see page *269*)	25
	Supervision 3	Bit 2 of *32.01 Supervision status* (see page *269*)	26
	Other [bit]	Source selection (see *Terms and abbreviations* on page *162*)	-
20.25	*Jogging enable*	Selects the source for a jog enable signal. (The sources for jogging activation signals are selected by parameters *20.26 Jogging 1 start source* and *20.27 Jogging 2 start source*.) 1 = Jogging is enabled. 0 = Jogging is disabled. **Note:** Jogging can be enabled only when no start command from an external control location is active. On the other hand, if jogging is already enabled, the drive cannot be started from an external control location (apart from inching commands through fieldbus). See section *Rush control* (page *72*).	*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
	Timed function 1	Bit 0 of *34.01 Timed functions status* (see page *276*)	18
	Timed function 2	Bit 1 of *34.01 Timed functions status* (see page *276*)	19
	Timed function 3	Bit 2 of *34.01 Timed functions status* (see page *276*)	20
	Supervision 1	Bit 0 of *32.01 Supervision status* (see page *269*)	24
	Supervision 2	Bit 1 of *32.01 Supervision status* (see page *269*)	25
	Supervision 3	Bit 2 of *32.01 Supervision status* (see page *269*)	26
	Other [bit]	Source selection (see *Terms and abbreviations* on page *162*)	-
20.26	*Jogging 1 start source*	If enabled by parameter *20.25 Jogging enable*, selects the source for the activation of jogging function 1. (Jogging function 1 can also be activated through fieldbus regardless of parameter *20.25*.) 1 = Jogging 1 active **Notes:** • If both jogging 1 and 2 are activated, the one that was activated first has priority. • This parameter cannot be changed while the drive is running.	*Not selected*
	Not selected	0	0
	Selected	1	1

No.	Name/Value	Description	Def/FbEq16
	DI1	Digital input DI1 (*10.02 DI delayed status*, bit 0)	2
	DI2	Digital input DI2 (*10.02 DI delayed status*, bit 1)	3
	DI3	Digital input DI3 (*10.02 DI delayed status*, bit 2)	4
	DI4	Digital input DI4 (*10.02 DI delayed status*, bit 3)	5
	DI5	Digital input DI5 (*10.02 DI delayed status*, bit 4)	6
	DI6	Digital input DI6 (*10.02 DI delayed status*, bit 5)	7
	Timed function 1	Bit 0 of *34.01 Timed functions status* (see page *276*)	18
	Timed function 2	Bit 1 of *34.01 Timed functions status* (see page *276*)	19
	Timed function 3	Bit 2 of *34.01 Timed functions status* (see page *276*)	20
	Supervision 1	Bit 0 of *32.01 Supervision status* (see page *269*)	24
	Supervision 2	Bit 1 of *32.01 Supervision status* (see page *269*)	25
	Supervision 3	Bit 2 of *32.01 Supervision status* (see page *269*)	26
	Other [bit]	Source selection (see *Terms and abbreviations* on page *162*)	-
20.27	*Jogging 2 start source*	If enabled by parameter *20.25 Jogging enable*, selects the source for the activation of jogging function 2. (Jogging function 2 can also be activated through fieldbus regardless of parameter *20.25*.) 1 = Jogging 2 active. For the selections, see parameter *20.26 Jogging 1 start source*. **Notes:** • If both jogging 1 and 2 are activated, the one that was activated first has priority. • This parameter cannot be changed while the drive is running.	*Not selected*
20.30	*Enable signal warning function*	Selects *20.22 Enable to rotate* and *20.12 Run enable 1 source* warnings to be suppressed. This parameter can be used to prevent these warnings from being added to the event log. Whenever a bit of this parameter is set to 1, the corresponding warning is suppressed.	0000h

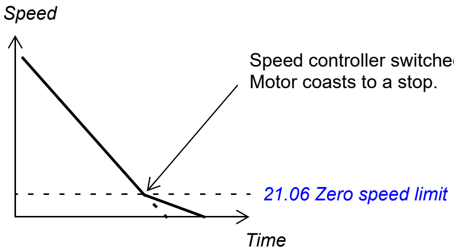
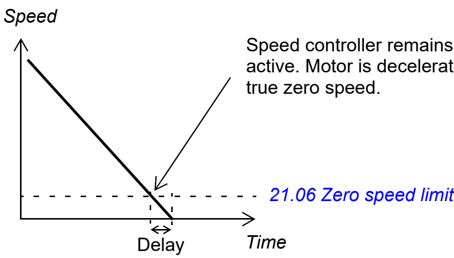
Bit	Name	Value
0	Enable to rotate	1 = Warning *AFED Enable to rotate* is suppressed.
1	Run enable missing	1 = Warning *AFEB Run enable missing* is suppressed.
2…15	Reserved	

No.	Name/Value	Description	Def/FbEq16
	0000h...FFFFh	Word for disabling enable signal warnings.	1 = 1

No.	Name/Value	Description	Def/FbEq16
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*). • This parameter cannot be changed while the drive is running. See also section *DC magnetization* (page *69*).	*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 (e.g. if the motor start must be synchronized with the release of a mechanical brake). This setting also guarantees the highest possible break-away torque when the pre-magnetizing time is set long enough. **WARNING!** The drive will start after the set magnetizing time has passed even if motor magnetization is not completed. In applications where a full break-away torque is essential, ensure that the constant magnetizing time is long enough to allow generation of full magnetization and torque.	1
	Automatic	Automatic start guarantees optimal motor start in most cases. It includes the flying start function (starting into a rotating motor) and the automatic restart function. The drive motor control program identifies the flux as well as the mechanical state of the motor and starts the motor instantly under all conditions. **Note:** If parameter *99.04 Motor control mode* is set to *Scalar*, no flying start or automatic restart is possible unless parameter *21.19 Scalar start mode* is set to *Automatic*.	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</td></tr>
<tr><td></td><td>0…10000 ms</td><td>Constant DC magnetizing time.</td><td>1 = 1</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>Stops 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>Stops along the active deceleration ramp. See parameter group 23 Speed reference ramp on page 228 or 28 Frequency reference chain on page 243.</td><td>1</td></tr>
<tr><td></td><td>Torque limit</td><td>Stops 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 (see section Rush control [page 72]). 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
	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 *162*).	-
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. Without zero speed delay: The drive receives a stop command and decelerates along a ramp. When actual motor speed falls below the value of parameter *21.06 Zero speed limit*, inverter modulation is stopped and the motor coasts to a standstill.  With zero speed delay: The drive receives a stop command and decelerates along a ramp. When actual motor speed falls below the value of parameter *21.06 Zero speed limit*, the zero speed delay function activates. During the delay the function keeps the speed controller live: the inverter modulates, motor is magnetized and the drive is ready for a quick restart. Zero speed delay can be used e.g. with the jogging function. 	0 ms
	0…30000 ms	Zero speed delay.	1 = 1

No.	Name/Value	Description	Def/FbEq16
21.08	*DC current control*	Activates/deactivates the DC hold and post-magnetization functions. See section *DC magnetization* (page *69*). **Note:** DC magnetization causes the motor to heat up. In applications where long DC magnetization times are required, externally ventilated motors should be used. If the DC magnetization period is long, DC magnetization cannot prevent the motor shaft from rotating if a constant load is applied to the motor.	0b0000

Bit	Value
0	1 = Enable DC hold. See section *DC hold* (page *69*). **Note:** The DC hold function has no effect if the start signal is switched off.
1	1 = Enable post-magnetization. See section *Settings* (page *70*). **Note:** Post-magnetization is only available when ramping is the selected stop mode (see parameter *21.03 Stop mode*).
2…15	Reserved

No.	Name/Value	Description	Def/FbEq16
	0b000…0b1111	DC magnetization selection.	1 = 1
21.09	*DC hold speed*	Defines the DC hold speed in speed control mode. See parameter *21.08 DC current control*, and section *DC hold* (page *69*).	5.00 rp
	0.00…1000.00 rpm	DC hold speed.	See par. *46.01*
21.10	*DC current reference*	Defines the DC hold current in percent of the motor nominal current. See parameter *21.08 DC current control*, and section *DC magnetization* (page *69*). 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
	0…3000 s	Post-magnetization time.	1 = 1
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
	DI2	Digital input DI2 (*10.02 DI delayed status*, bit 1)	3
	DI3	Digital input DI3 (*10.02 DI delayed status*, bit 2)	4
	DI4	Digital input DI4 (*10.02 DI delayed status*, bit 3)	5
	DI5	Digital input DI5 (*10.02 DI delayed status*, bit 4)	6
	DI6	Digital input DI6 (*10.02 DI delayed status*, bit 5)	7

No.	Name/Value	Description	Def/FbEq16
	Supervision 1	Bit 0 of *32.01 Supervision status* (see page *269*)	8
	Supervision 2	Bit 1 of *32.01 Supervision status* (see page *269*)	9
	Supervision 3	Bit 2 of *32.01 Supervision status* (see page *269*)	10
	Timed function 1	Bit 0 of *34.01 Timed functions status* (see page *276*)	11
	Timed function 2	Bit 1 of *34.01 Timed functions status* (see page *276*)	12
	Timed function 3	Bit 2 of *34.01 Timed functions status* (see page *276*)	13
	Other [bit]	Source selection (see *Terms and abbreviations* on page *162*)	-
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 *77*). When this parameter is set to 0.0 seconds, automatic restarting is disabled. Otherwise, the parameter defines the maximum duration of the power failure after which restarting is attempted. Note that this time also includes the DC precharging delay. ⚠ **WARNING!** 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
	0.0 s	Automatic restarting disabled.	0
	0.1…10.0 s	Maximum power failure duration.	1 = 1
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*. • This parameter cannot be changed while the drive is running. See also section *DC magnetization* (page *69*).	*Normal*
	Normal	Immediate start from zero speed.	0
	Const time	The drive pre-magnetizes the motor before start. The pre-magnetizing time is defined by parameter *21.02 Magnetization time*. This mode should be selected if constant pre-magnetizing time is required (e.g. if the motor start must be synchronized with the release of a mechanical brake). This setting also guarantees the highest possible break-away torque when the pre-magnetizing time is set long enough. **Note:** This mode cannot be used to start into a rotating motor. ⚠ **WARNING!** The drive will start after the set 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

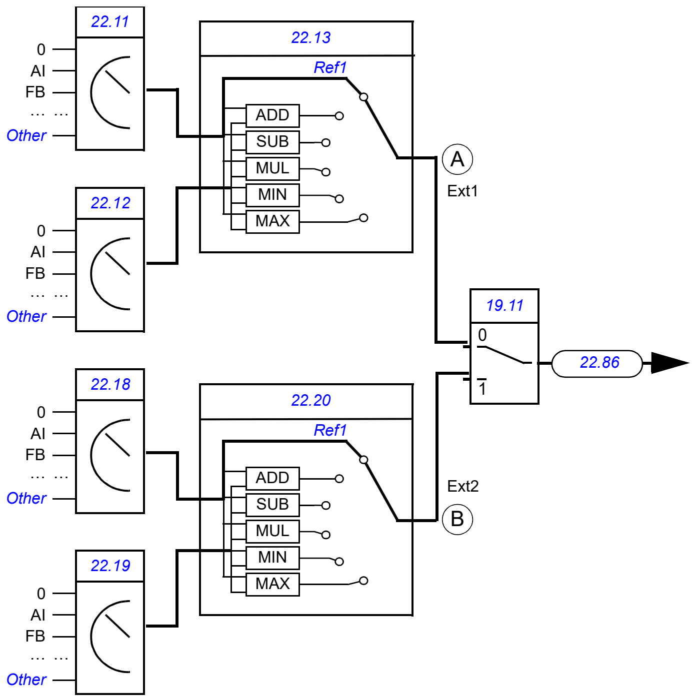
No.	Name/Value	Description	Def/FbEq16
	Automatic	The drive automatically selects the correct output frequency to start a rotating motor. This is useful for flying starts: if the motor is already rotating, the drive will start smoothly at the current frequency. **Note:** Cannot be used in multimotor systems.	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 20 Hz 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
	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. **Note** During flying start, the drive will at first run in vector control mode. This is why, when using flying start, the drive nominal current setting must be in the allowed range for vector control mode, see parameter *99.06 Motor nominal current*.	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 *69*).	5.00
	0.00…1000.00 Hz	DC hold frequency.	1 = 1
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
	0.00…60.00 s	Start delay	1 = 1

No.	Name/Value	Description	Def/FbEq16
21.26	*Torque boost current*	Maximum current supplied during torque boost.	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.	20.0 s
	0.0...60.0 s	Nominal motor time.	1 = 1%

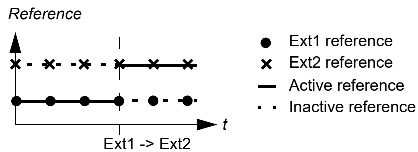
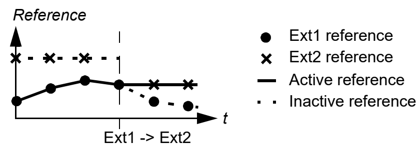
21.30	*Speed compensated stop mode*	Selects the method used to stop the drive. See also section. *Speed compensated stop* (page *75*).
		Speed compensated stop is active only if
		• the operation mode is not torque, and
		  • parameter *21.03 Stop mode* is *Ramp*, or
		  • parameter *20.11 Run enable stop mode* is *Ramp* (in case Run enable is missing).
			Off

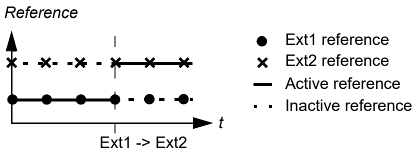
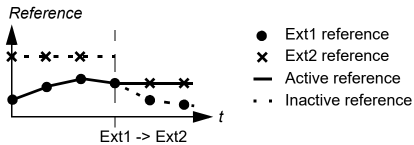
	Off	Stop according parameter *21.03 Stop mode*, no speed compensated stop.	0
	Speed comp FWD	If the direction of rotation is forward, speed compensation is used for constant distance braking. Speed difference (between used speed and maximum speed) is compensated by running the drive with current speed before the motor is stopped along a ramp. If the direction of rotation is reverse, the drive is stopped along a ramp.	1
	Speed comp REV	If the direction of rotation is reverse, speed compensation is used for constant distance braking. Speed difference (between used speed and maximum speed) is compensated by running the drive with current speed before the motor is stopped along a ramp. If the direction of rotation is forward, the drive is stopped along a ramp.	2
	Speed comp bipolar	Regardless of the direction of rotation, speed compensation is used for constant distance braking. Speed difference (between used speed and maximum speed) is compensated by running the drive with current speed before the motor is stopped along a ramp.	3
21.31	*Speed 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
	0.00…1000.00 s	Speed delay.	1 = 1
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%
21.34	*Force auto restart*	Forces automatic restart. The parameter is applicable only if parameter *95.04 Supply voltage* is set to *External 24V*.	*Disable*
	Disable	Force auto restart disabled. Parameter *21.18 Auto restart time* is in effect if its value is more than 0.0 s.	0

No.	Name/Value	Description	Def/FbEq16
	Enable	Force auto restart enabled. Parameter *21.18 Auto restart time* is ignored. The drive never trips on the undervoltage fault and the start signal is on forever. When he DC voltage is restored, the normal operation continues.	1
22 Speed reference selection		Speed reference selection; motor potentiometer settings. See the control chain diagrams on pages *491*…*493*.	
22.01	*Speed ref unlimited*	Displays the output of the speed reference selection block. See the control chain diagram on page *493*. This parameter is read-only.	-
	-30000.00… 30000.00 rpm	Value of the selected speed reference.	See par. *46.01*
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

No.	Name/Value	Description	Def/FbEq16
	AI1 scaled	*12.12 AI1 scaled value* (see page *190*).	1
	AI2 scaled	*12.22 AI2 scaled value* (see page *191*).	2
	FB A ref1	*03.05 FB A reference 1* (see page *168*).	4
	FB A ref2	*03.06 FB A reference 2* (see page *168*).	5
	EFB ref1	*03.09 EFB reference 1* (see page *168*).	8
	EFB ref2	*03.10 EFB reference 2* (see page *168*).	9
	Motor potentiometer	*22.80 Motor potentiometer ref act* (output of the motor potentiometer).	15
	PID	*40.01 Process PID output actual* (output of the process PID controller).	16
	Frequency input	*11.38 Freq in 1 actual value* (when DI5 or DI6 is used as a frequency input).	17
	Control panel (ref saved)	Panel reference (*03.01 Panel reference*, see page *168*) saved by the control system for the location where the control returns is used as the reference. 	18
	Control panel (ref copied)	Panel reference (*03.01 Panel reference*, see page *168*) 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 *162*).	-
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

No.	Name/Value	Description	Def/FbEq16
	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
22.18	*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 *190*).	1
	AI2 scaled	*12.22 AI2 scaled value* (see page *191*).	2
	FB A ref1	*03.05 FB A reference 1* (see page *168*).	4
	FB A ref2	*03.06 FB A reference 2* (see page *168*).	5
	EFB ref1	*03.09 EFB reference 1* (see page *168*).	8
	EFB ref2	*03.10 EFB reference 2* (see page *168*).	9
	Motor potentiometer	*22.80 Motor potentiometer ref act* (output of the motor potentiometer).	15
	PID	*40.01 Process PID output actual* (output of the process PID controller).	16
	Frequency input	*11.38 Freq in 1 actual value* (when DI5 or DI6 is used as a frequency input).	17
	Control panel (ref saved)	Panel reference (*03.01 Panel reference*, see page *168*) saved by the control system for the location where the control returns is used as the reference.  	18
	Control panel (ref copied)	Panel reference (*03.01 Panel reference*, see page *168*) 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 *162*).	-
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.	0b0001

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

	0b0000...0b1111	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 (always off).	0
	Always on	1 (always on).	1
	DI1	Digital input DI1 (*10.02 DI delayed status*, bit 0).	2
	DI2	Digital input DI2 (*10.02 DI delayed status*, bit 1).	3
	DI3	Digital input DI3 (*10.02 DI delayed status*, bit 2).	4
	DI4	Digital input DI4 (*10.02 DI delayed status*, bit 3).	5
	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 *276*).	18
	Timed function 2	Bit 1 of *34.01 Timed functions status* (see page *276*).	19
	Timed function 3	Bit 2 of *34.01 Timed functions status* (see page *276*).	20
	Supervision 1	Bit 0 of *32.01 Supervision status* (see page *269*).	24
	Supervision 2	Bit 1 of *32.01 Supervision status* (see page *269*).	25
	Supervision 3	Bit 2 of *32.01 Supervision status* (see page *269*).	26
	Other [bit]	Source selection (see *Terms and abbreviations* on page *162*).	-
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*.	*DI4*
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*

No.	Name/Value	Description	Def/FbEq16
22.26	*Constant speed 1*	Defines constant speed 1 (the speed the motor will turn when constant speed 1 is selected).	300.00
	-30000.00… 30000.00 rpm	Constant speed 1.	See par. *46.01*
22.27	*Constant speed 2*	Defines constant speed 2.	600.00
	-30000.00… 30000.00 rpm	Constant speed 2.	See par. *46.01*
22.28	*Constant speed 3*	Defines constant speed 3.	900.00
	-30000.00… 30000.00 rpm	Constant speed 3.	See par. *46.01*
22.29	*Constant speed 4*	Defines constant speed 4.	1200.00
	-30000.00… 30000.00 rpm	Constant speed 4.	See par. *46.01*
22.30	*Constant speed 5*	Defines constant speed 5.	1500.00
	-30000.00… 30000.00 rpm	Constant speed 5.	See par. *46.01*
22.31	*Constant speed 6*	Defines constant speed 6.	2400.00
	-30000.00… 30000.00 rpm	Constant speed 6.	See par. *46.01*
22.32	*Constant speed 7*	Defines constant speed 7.	3000.00
	-30000.00… 30000.00 rpm	Constant speed 7.	See par. *46.01*
22.41	*Speed ref safe*	Defines a safe speed reference value that is used with supervision functions such as • *12.03 AI supervision function* • *49.05 Communication loss action* • *50.02 FBA A comm loss func*.	0.00
	-30000.00… 30000.00 rpm	Safe speed reference.	See par. *46.01*
22.42	*Jogging 1 ref*	Defines the speed reference for jogging function 1. For more information on jogging, see page *72*.	0.00
	-30000.00… 30000.00 rpm	Speed reference for jogging function 1.	See par. *46.01*
22.43	*Jogging 2 ref*	Defines the speed reference for jogging function 2. For more information on jogging, see page *72*.	0.00
	-30000.00… 30000.00 rpm	Speed reference for jogging function 2.	See par. *46.01*

No.	Name/Value	Description	Def/FbEq16
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 *44*).	0b0000

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	

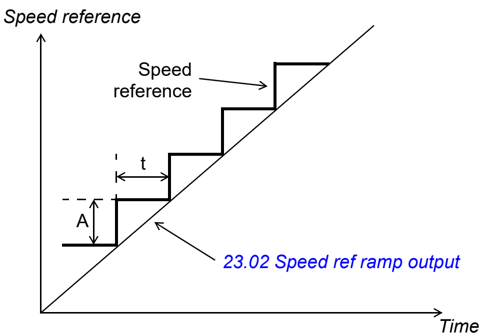
No.	Name/Value	Description	Def/FbEq16
	0b000...0b1111	Critical speeds configuration word.	1 = 1
22.52	*Critical speed 1 low*	Defines the low limit for critical speed range 1. **Note:** This value must be less than or equal to the value of *22.53 Critical speed 1 high*.	0.00
	-30000.00… 30000.00 rpm	Low 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
	-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
	-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
	-30000.00… 30000.00 rpm	High limit for critical speed 2.	See par. *46.01*
22.56	*Critical speed 3 low*	Defines the low limit for critical speed range 3. **Note:** This value must be less than or equal to the value of *22.57 Critical speed 3 high*.	0.00
	-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
	-30000.00… 30000.00 rpm	High limit for critical speed 3.	See par. *46.01*
22.71	*Motor potentiometer function*	Activates and selects the mode of the motor potentiometer. See section *Speed compensated stop* (page *75*).	*Disabled*
	Disabled	Motor potentiometer is disabled and its value set to 0.	0

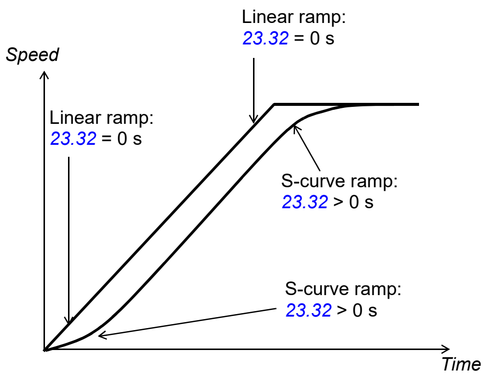
No.	Name/Value	Description	Def/FbEq16
	Enabled (init at stop /power-up)	When enabled, the motor potentiometer first adopts the value defined by parameter *22.72 Motor potentiometer initial value*. The value can then be adjusted from the up and down sources defined by parameters *22.73 Motor potentiometer up source* and *22.74 Motor potentiometer down source*. A stop or a power cycle will reset the motor potentiometer to the initial value (*22.72*).	1
	Enabled (resume always)	As *Enabled (init at stop /power-up)*, but the motor potentiometer value is retained over a stop or power cycle.	2
	Enabled (init to actual)	Whenever another reference source is selected, the value of the motor potentiometer follows that reference. After the source of reference returns to the motor potentiometer, its value can again be changed by the up and down sources (defined by *22.73* and *22.74*).	3
	Enabled (resume/init to Actual)	As *Enabled (init to actual)*, but the motor potentiometer ref act value is retained over power cycle.	4
22.72	*Motor potentiometer initial value*	Defines an initial value (starting point) for the motor potentiometer. See the selections of parameter *22.71 Motor potentiometer function*.	0.00
	-32768.00… 32767.00	Initial value for motor potentiometer.	1 = 1
22.73	*Motor potentiometer up source*	Selects the source of motor potentiometer up signal. 0 = No change 1 = Increase motor potentiometer value. (If both the up and down sources are on, the potentiometer value will not change.) **Note:** 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 *Motor potentiometer macro* on page *111*.	*Not used*
	Not used	Not used	0
	Not used	Not used	1
	DI1	Digital input DI1 (*10.02 DI delayed status*, bit 0).	2
	DI2	Digital input DI2 (*10.02 DI delayed status*, bit 1).	3
	DI3	Digital input DI3 (*10.02 DI delayed status*, bit 2).	4
	DI4	Digital input DI4 (*10.02 DI delayed status*, bit 3).	5
	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 *276*).	18
	Timed function 2	Bit 1 of *34.01 Timed functions status* (see page *276*).	19
	Timed function 3	Bit 2 of *34.01 Timed functions status* (see page *276*).	20
	Supervision 1	Bit 0 of *32.01 Supervision status* (see page *269*).	24
	Supervision 2	Bit 1 of *32.01 Supervision status* (see page *269*).	25
	Supervision 3	Bit 2 of *32.01 Supervision status* (see page *269*).	26
	Other [bit]	Source selection (see *Terms and abbreviations* on page *162*).	-

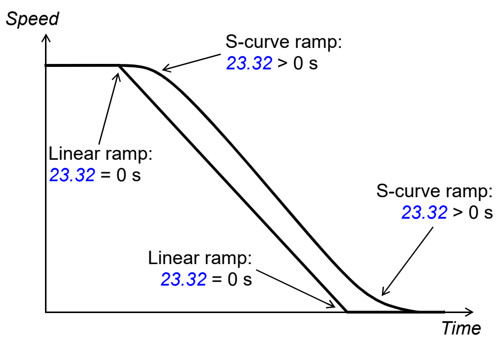
No.	Name/Value	Description	Def/FbEq16
22.74	*Motor potentiometer down source*	Selects the source of motor potentiometer down signal. 0 = No change 1 = Decrease motor potentiometer value. (If both the up and down sources are on, the potentiometer value will not change.) **Note:** Motor potentiometer function 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 *Motor potentiometer macro* on page *111*. For the selections, see parameter *22.73 Motor potentiometer up source*.	*Not used*
22.76	*Motor potentiometer min value*	Defines the minimum value of the motor potentiometer. **Note:** If vector control mode is used, value of this parameter must be changed.	-50.00
	-32768.00… 32767.00	Motor potentiometer minimum.	1 = 1
22.77	*Motor potentiometer max value*	Defines the maximum value of the motor potentiometer. **Note:** If vector control mode is used, value of this parameter must be changed.	50.00
	-32768.00… 32767.00	Motor potentiometer maximum.	1 = 1
22.78	*Motor potentiometer ramp up*	Defines the time required for the motor potentiometer to change from minimum (*22.76*) to maximum (*22.77*).	40.0 s
	0.0...3600.0 s	Motor potentiometer change time.	10=1
22.79	*Motor potentiometer ramp down*	Defines the time required for the motor potentiometer to change from maximum (*22.77*) to minimum (*22.76*).	40.0 s
	0.0...3600.0 s	Motor potentiometer change time.	10=1
22.80	*Motor potentiometer ref act*	The output of the motor potentiometer function. (The motor potentiometer is configured using parameters *22.71*…*22.74*.) This parameter is read-only.	0.00
	-32768.00… 32767.00	Value of motor potentiometer.	1 = 1
22.86	*Speed reference act 6*	Displays the value of the speed reference (EXT1 or EXT2) that has been selected by *19.11 Ext1/Ext2 selection*. See diagram at *22.11 Ext1 speed ref1* or the control chain diagram on page *490*. This parameter is read-only.	-
	-30000.00… 30000.00 rpm	Speed reference after additive 2.	See par. *46.01*

No.	Name/Value	Description	Def/FbEq16
22.87	*Speed reference act 7*	Displays the value of speed reference before application of critical speeds. See the control chain diagram on page *493*. The value is received from *22.86 Speed reference act 6* unless overridden by • any constant speed • a jogging reference • *network control* reference • control panel reference • safe speed reference. This parameter is read-only.	-
	-30000.00…30000.00 rpm	Speed reference before application of critical speeds.	See par. *46.01*
23 Speed reference ramp		Speed reference ramp settings (programming of the acceleration and deceleration rates for the drive). See the control chain diagram on page *496*.	
23.01	*Speed ref ramp input*	Displays the used speed reference (in rpm) before it enters the ramping and shaping functions. See the control chain diagram on page *496*. This parameter is read-only.	0.00
	-30000.00…30000.00 rpm	Speed reference before ramping and shaping.	See par. *46.01*
23.02	*Speed ref ramp output*	Displays the ramped and shaped speed reference in rpm. See the control chain diagram on page *496*. This parameter is read-only.	0.00
	-30000.00…30000.00 rpm	Speed reference after ramping and shaping.	See par. *46.01*
23.11	*Ramp set selection*	Selects the source that switches between the two sets of acceleration/deceleration ramp times defined by parameters *23.12*…*23.15*. 0 = Acceleration time 1 and deceleration time 1 are active 1 = Acceleration time 2 and deceleration time 2 are active	*DI5*
	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
	FBA A	For Transparent16 and Transparent32 profiles only. DCU control word bit 10 received through the fieldbus adapter.	18
	EFB DCU CW bit 10	Only for the DCU profile. DCU control word bit 10 received through the embedded fieldbus interface.	20
	Other [bit]	Source selection (see *Terms and abbreviations* on page *162*).	-

No.	Name/Value	Description	Def/FbEq16
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
	0.000…1800.000 s	Acceleration time 1.	10 = 1
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
	0.000…1800.000 s	Deceleration time 1.	10 = 1
23.14	*Acceleration time 2*	Defines acceleration time 2. See parameter *23.12 Acceleration time 1*.	60.000
	0.000…1800.000 s	Acceleration time 2.	10 = 1
23.15	*Deceleration time 2*	Defines deceleration time 2. See parameter *23.13 Deceleration time 1*.	60.000
	0.000…1800.000 s	Deceleration time 2.	10 = 1
23.20	*Acc time jogging*	Defines the acceleration time for the jogging function ie. the time required for the speed to change from zero to the speed value defined by parameter *46.01 Speed scaling*. See section *Jogging* (page *72*).	60.000
	0.000…1800.000 s	Acceleration time for jogging.	10 = 1
23.21	*Dec time jogging*	Defines the deceleration time for the jogging function ie. the time required for the speed to change from the speed value defined by parameter *46.01 Speed scaling* to zero. See section *Jogging* (page *72*).	60.000
	0.000…1800.000 s	Deceleration time for jogging.	10 = 1

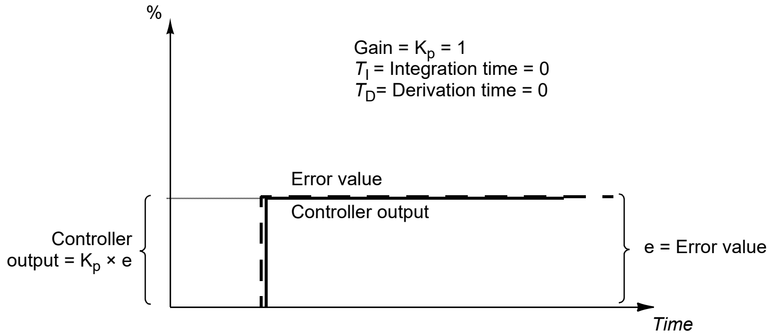
No.	Name/Value	Description	Def/FbEq16
23.23	*Emergency stop time*	Defines the time inside which the drive is stopped if an emergency stop Off3 is activated (ie. the time required for the speed to change from the speed value defined by parameter *46.01 Speed scaling* or *46.02 Frequency scaling* to zero). 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. **Note:** • Emergency stop Off1 uses the standard deceleration ramp as defined by parameters *23.11*…*23.1523.12*…*23.13*. • The same parameter value is also used in frequency control mode (ramp parameters *28.71*…*28.7528.72*…*28.73*).	3.000
	0.000…1800.000 s	Emergency stop Off3 deceleration time.	10 = 1
23.28	*Variable slope*	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 remote external control.	*Off*
	Off	Variable slope disabled.	0
	On	Variable slope enabled (not available in local control).	1
23.29	*Variable slope rate*	Defines the rate of the speed reference change when variable slope is enabled by parameter *23.28 Variable slope*. For the best result, enter the reference update interval into this parameter.	50
	2…30000 ms	Variable slope rate.	1 = 1

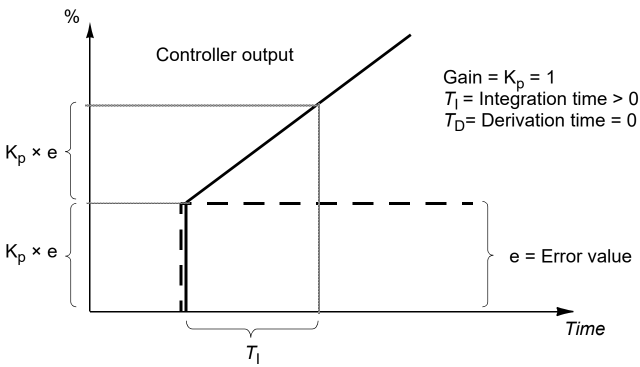
<table>
<tr><th>No.</th><th>Name/Value</th><th>Description</th><th>Def/FbEq16</th></tr>
<tr><td>23.32</td><td>Shape time 1</td><td>Defines the shape of the acceleration and deceleration ramps used with the set 1.
0.000 s: Linear ramp. Suitable for steady acceleration or deceleration and for slow ramps.
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:


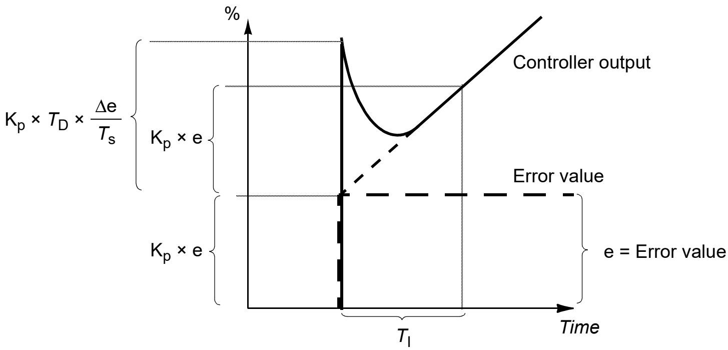
Deceleration:

</td><td>0.000</td></tr>
<tr><td></td><td>0.000…1800.000 s</td><td>Ramp shape at start and end of acceleration and deceleration.</td><td>10 = 1</td></tr>
<tr><td>23.33</td><td>Shape time 2</td><td>Defines the shape of the acceleration and deceleration ramps used with the set 2. See parameter 23.32 Shape time 1.</td><td>0.000</td></tr>
<tr><td></td><td>0.000…1800.000 s</td><td>Ramp shape at start and end of acceleration and deceleration.</td><td>10 = 1</td></tr>
</table>

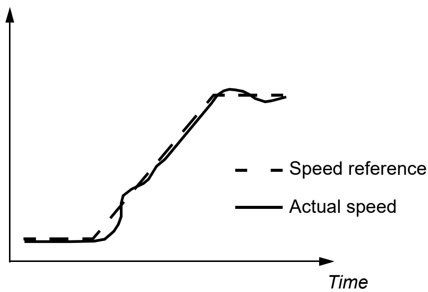
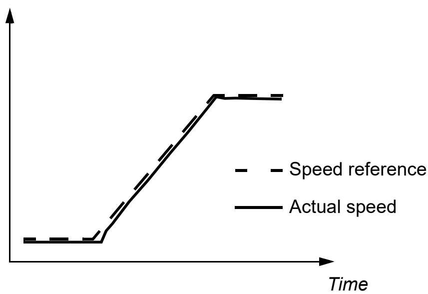
No.	Name/Value	Description	Def/FbEq16
24 Speed reference conditioning		Speed error calculation; speed error window control configuration; speed error step. See the control chain diagram on page *496*.	
24.01	*Used speed reference*	Displays the ramped and corrected speed reference (before speed error calculation). See the control chain diagram on page *496*. This parameter is read-only.	-
	-30000.00… 30000.00 rpm	Speed reference used for speed error calculation.	See par. *46.01*
24.02	*Used speed feedback*	Displays the speed feedback used for speed error calculation. See the control chain diagram on page *496*. This parameter is read-only.	-
	-30000.00… 30000.00 rpm	Speed feedback used for speed error calculation.	See par. *46.01*
24.03	*Speed error filtered*	Displays the filtered speed error. See the control chain diagram on page *496*. This parameter is read-only.	-
	-30000.0… 30000.0 rpm	Filtered speed error.	See par. *46.01*
24.12	*Speed error filter time*	Defines the time constant of the speed error low-pass filter. If the used speed reference changes rapidly, the possible interferences in the speed measurement can be filtered with the speed error filter. Reducing the ripple with this filter may cause speed controller tuning problems. A long filter time constant and fast acceleration time contradict one another. A very long filter time results in unstable control.	0 ms
	0...10000 ms	Speed error filtering time constant. 0 = filtering disabled.	1 = 1 ms

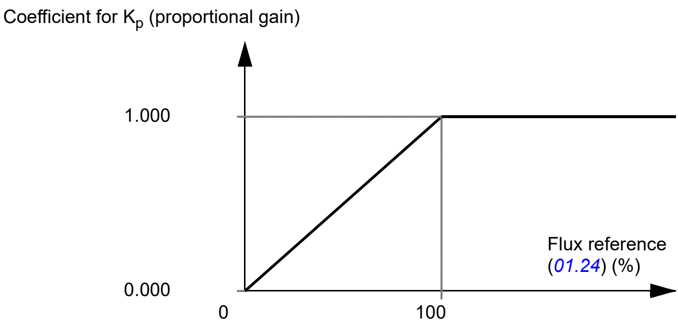
No.	Name/Value	Description	Def/FbEq16
25 Speed control		Speed controller settings. See the control chain diagrams on pages *497* and *498*.	
25.01	*Torque reference speed control*	Displays the speed controller output that is transferred to the torque controller. See the control chain diagram on page *497*. This parameter is read-only.	0.0
	-1600.0…1600.0%	Limited speed controller output torque.	See par. *46.03*

No.	Name/Value	Description	Def/FbEq16
25.02	*Speed proportional gain*	Defines the proportional gain (K_p) of the speed controller. Too high a gain may cause speed oscillation. The figure below shows the speed controller output after an error step when the error remains constant.  If gain is set to 1, 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.	5.00
	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
	0.00…1000.00 s	Integration time for speed controller.	10 = 1

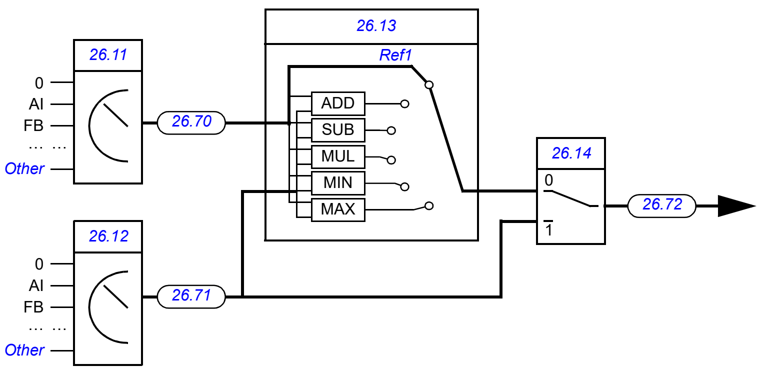
No.	Name/Value	Description	Def/FbEq16
25.04	*Speed derivation time*	Defines the derivation time of the speed controller. Derivative action boosts the controller output if the error value changes. The longer the derivation time, the more the speed controller output is boosted during the change. If the 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
	0.000…10.000 s	Derivation time for speed controller.	1000 = 1
25.05	*Derivation filter time*	Defines the derivation filter time constant. See parameter *25.04 Speed derivation time*.	8
	0…10000 ms	Derivation filter time constant.	1 = 1

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
	0.00…1000.00 s	Acceleration compensation derivation time.	10 = 1
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
	0.0…1000.0 ms	Acceleration/deceleration compensation filter time.	1 = 1
25.30	*Flux adaptation enable*	*Visible only when user lock is open with pass code 584. See parameter 96.02 Pass code.)* Enables/disables speed controller adaptation based on motor flux reference (*01.24 Flux actual %*). The proportional gain of the speed controller is multiplied by a coefficient of 0…1 between 0…100% flux reference respectively.	*Enable*

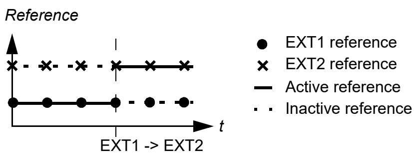
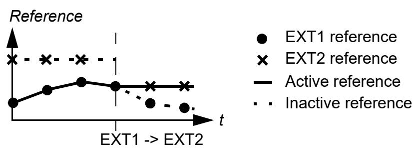
No.	Name/Value	Description	Def/FbEq16
			
	Disable	Speed controller adaptation based on flux reference disabled.	1
	Enable	Speed controller adaptation based on flux reference enabled.	0
25.33	*Speed controller autotune*	Activates (or selects a source that activates) the speed controller autotune function. See section *Speed controller autotune* (page *387*). The autotune will automatically set parameters *25.02 Speed proportional gain*, *25.03 Speed integration time* and *25.37 Mechanical time constant*. The prerequisites for performing the autotune routine are: • the motor identification run (ID run) has been successfully completed • the speed and torque limits (parameter group *30 Limits*) have been set • speed feedback filtering (parameter group 90 Feedback selection), speed error filtering (*24 Speed reference conditioning*) and zero speed (*21 Start/stop mode*) have been set, and • the drive has been started and is running in speed control mode. **WARNING:** The motor and machinery will run against the torque and speed limits during the autotune routine. MAKE SURE IT IS SAFE TO ACTIVATE THE AUTOTUNE FUNCTION! The autotune routine can be aborted by stopping the drive. 0?1 = Activate speed controller autotune **Note:** The value does not revert to 0 automatically	*Off*
	Off	0	0
	On	1	1
25.34	*Speed controller autotune mode*	Defines a control preset for the speed controller autotune function. The setting affects the way the torque reference will respond to a speed reference step.	*Normal*
	Smooth	Slow but robust response.	0
	Normal	Medium setting.	1
	Tight	Fast response. May produce too high a gain value for some applications.	2

No.	Name/Value	Description	Def/FbEq16
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
	0.00...1000.00 s	Mechanical time constant.	100 = 1 s
25.38	*Autotune torque step*	Defines an added torque value used by the autotune function. This value is scaled to motor nominal torque. Note that the torque used by the autotune function can also be limited by the torque limits (in parameter group *30 Limits*) and nominal motor torque.	10.00
	0.00...100.00%	Autotune torque step.	100 = 1%
25.39	*Autotune speed step*	Defines a speed value added to the initial speed for the autotune routine. The initial speed (speed used when autotune is activated) plus the value of this parameter is the calculated maximum speed used by the autotune routine. The maximum speed can also be limited by the speed limits (in parameter group *30 Limits*) and nominal motor speed. The value is scaled to motor nominal speed. **Note:** The motor will exceed the calculated maximum speed slightly at the end of each acceleration stage.	10.00
	0.00...100.00%	Autotune speed step.	100 = 1%
25.40	*Autotune repeat times*	Determines how many acceleration/deceleration cycles are performed during the autotune routine. Increasing the value will improve the accuracy of the autotune function, and allow the use of smaller torque or speed step values.	5
	1...10		1 = 1
25.53	*Torque prop reference*	Displays the output of the proportional (P) part of the speed controller. See the control chain diagram on page *497*. This parameter is read-only.	0.0
	-30000.0… 30000.0%	P-part output of speed controller.	See par. *46.03*
25.54	*Torque integral reference*	Displays the output of the integral (I) part of the speed controller. See the control chain diagram on page *497*. This parameter is read-only.	0.0
	-30000.0… 30000.0%	I-part output of speed controller.	See par. *46.03*
25.55	*Torque deriv reference*	Displays the output of the derivative (D) part of the speed controller. See the control chain diagram on page *497*. This parameter is read-only.	0.0
	-30000.0… 30000.0%	D-part output of speed controller.	See par. *46.03*
25.56	*Torque acc compensation*	Displays the output of the acceleration compensation function. See the control chain diagram on page *497*. This parameter is read-only.	0.0
	-30000.0… 30000.0%	Output of acceleration compensation function.	See par. *46.03*

No.	Name/Value	Description	Def/FbEq16
26 Torque reference chain		Settings for the torque reference chain. See the control chain diagrams on pages 498 and 499.	
26.01	*Torque reference to TC*	Displays the final torque reference given to the torque controller in percent. This reference is then acted upon by various final limiters, like power, torque, load etc. See the control chain diagrams on pages 498 and 499. This parameter is read-only.	0.0
	-1600.0…1600.0%	Torque reference for torque control.	See par. 46.03
26.02	*Torque reference used*	Displays the final torque reference (in percent of motor nominal torque) given to the torque controller, and comes after frequency, voltage and torque limitation. See the control chain diagram on page 500. This parameter is read-only.	0.0
	-1600.0…1600.0%	Torque reference for torque control.	See par. 46.03
26.08	*Minimum torque ref*	Defines the minimum torque reference. Allows for local limiting of the torque reference before it is passed on to the torque ramp controller. For absolute torque limiting, refer to parameter *30.19 Minimum torque 1*.	-300.0%
	-1000.0…0.0%	Minimum torque reference.	See par. 46.03
26.09	*Maximum torque ref*	Defines the maximum torque reference. Allows for local limiting of the torque reference before it is passed on to the torque ramp controller. For absolute torque limiting, refer to parameter *30.20 Maximum torque 1*.	300.0%
	0.0…1000.0%	Maximum torque reference.	See par. 46.03
26.11	*Torque ref1 source*	Selects torque reference source 1. Two signal sources can be defined by this parameter and *26.12 Torque ref2 source*. A digital source selected by *26.14 Torque ref1/2 selection* can be used to switch between the two sources, or a mathematical function (*26.13 Torque ref1 function*) applied to the two signals to create the reference.	*Zero*



	Zero	None.	0

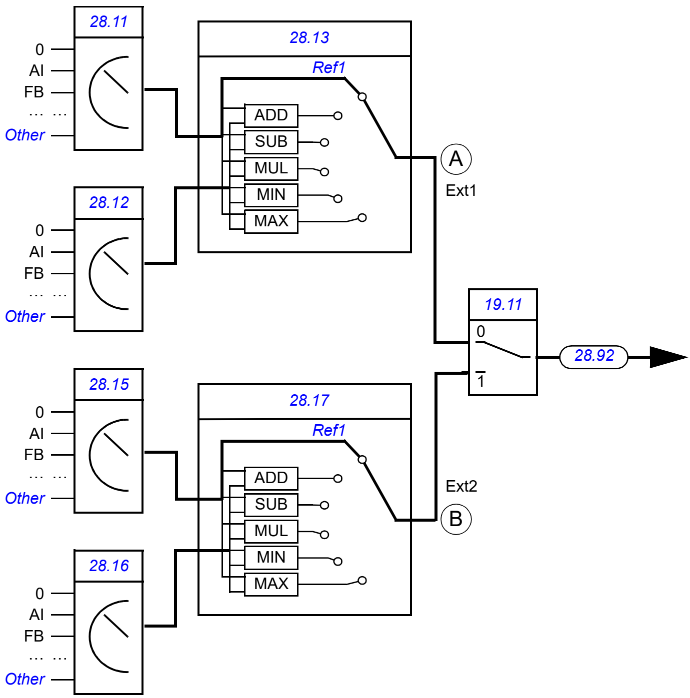
No.	Name/Value	Description	Def/FbEq16
	AI1 scaled	*12.12 AI1 scaled value* (see page *190*).	1
	AI2 scaled	*12.22 AI2 scaled value* (see page *191*).	2
	Reserved		3
	FB A ref1	*03.05 FB A reference 1* (see page *168*).	4
	FB A ref2	*03.06 FB A reference 2* (see page *168*).	5
	Reserved		6…7
	EFB ref1	*03.09 EFB reference 1* (see page *168*).	8
	EFB ref2	*03.10 EFB reference 2* (see page *168*).	9
	Reserved		10…14
	Motor potentiometer	*22.80 Motor potentiometer ref act* (output of the motor potentiometer).	15
	PID	*40.01 Process PID output actual* (output of the process PID controller).	16
	Frequency input	*11.38 Freq in 1 actual value* (when DI5 is used as a frequency input).	17
	Control panel (ref saved)	Panel reference (*03.01 Panel reference*, see page *168*) saved by the control system for the location where the control returns is used as the reference.  	18
	Control panel (ref copied)	Panel reference (*03.01 Panel reference*, see page *168*) 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 (e.g. frequency/speed/torque/PID); otherwise, the actual signal is used as the new reference.  	19
	Other	Source selection (see *Terms and abbreviations* on page *162*).	-
26.12	*Torque ref2 source*	Selects torque reference source 2. For the selections, and a diagram of reference source selection, see parameter *26.11 Torque ref1 source*.	*Zero*
26.13	*Torque ref1 function*	Selects a mathematical function between the reference sources selected by parameters *26.11 Torque ref1 source* and *26.12 Torque ref2 source*. See diagram at *26.11 Torque ref1 source*.	*Ref1*
	Ref1	Signal selected by *26.11 Torque ref1 source* is used as torque reference 1 as such (no function applied).	0
	Add (ref1 + ref2)	The sum of the reference sources is used as torque reference 1.	1

No.	Name/Value	Description	Def/FbEq16
	Sub (ref1 - ref2)	The subtraction ([*26.11 Torque ref1 source*] - [*26.12 Torque ref2 source*]) of the reference sources is used as torque reference 1.	2
	Mul (ref1 × ref2)	The multiplication of the reference sources is used as torque reference 1.	3
	Min (ref1, ref2)	The smaller of the reference sources is used as torque reference 1.	4
	Max (ref1, ref2)	The greater of the reference sources is used as torque reference 1.	5
26.14	*Torque ref1/2 selection*	Configures the selection between torque references 1 and 2. See diagram at *26.11 Torque ref1 source*. 0 = Torque reference 1 1 = Torque reference 2	*Torque reference 1*
	Torque reference 1	0	0
	Torque reference 2	1	1
	Follow Ext1/Ext2 selection	Torque reference 1 is used when external control location EXT1 is active. Torque reference 2 is used when external control location EXT2 is active. See also parameter *19.11 Ext1/Ext2 selection*.	2
	DI1	Digital input DI1 (*10.02 DI delayed status*, bit 0)	3
	DI2	Digital input DI2 (*10.02 DI delayed status*, bit 1)	4
	DI3	Digital input DI3 (*10.02 DI delayed status*, bit 2)	5
	DI4	Digital input DI4 (*10.02 DI delayed status*, bit 3)	6
	DI5	Digital input DI5 (*10.02 DI delayed status*, bit 4)	7
	DI6	Digital input DI6 (*10.02 DI delayed status*, bit 5)	8
	Other [bit]	Source selection (see *Terms and abbreviations* on page *162*)	-
26.17	*Torque ref filter time*	Defines a low-pass filter time constant for the torque reference.	0.000 s
	0.000…30.000 s	Filter time constant for torque reference.	1000 = 1 s
26.18	*Torque ramp up time*	Defines the torque reference ramp-up time, ie. the time for the reference to increase from zero to nominal motor torque.	0.000 s
	0.000…60.000 s	Torque reference ramp-up time.	100 = 1 s
26.19	*Torque ramp down time*	Defines the torque reference ramp-down time, ie. the time for the reference to decrease from nominal motor torque to zero.	0.000 s
	0.000…60.000 s	Torque reference ramp-down time.	100 = 1 s
26.20	*Torque reversal*	Selects the source of torque reversal function.	*Always off*
	Always off	Torque reversal function is disabled.	0
	Always on	Torque reversal function is enabled.	1
	DI1	Digital input DI1 (*10.02 DI delayed status*, bit 0).	2
	DI2	Digital input DI2 (*10.02 DI delayed status*, bit 1).	3
	DI3	Digital input DI3 (*10.02 DI delayed status*, bit 2).	4
	DI4	Digital input DI4 (*10.02 DI delayed status*, bit 3).	5
	DI5	Digital input DI5 (*10.02 DI delayed status*, bit 4).	6
	DI6	Digital input DI6 (*10.02 DI delayed status*, bit 5).	7
	Timed function 1	Bit 0 of *34.01 Timed functions status* (see page *276*).	8
	Timed function 2	Bit 1 of *34.01 Timed functions status* (see page *276*).	9

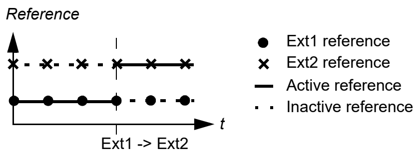
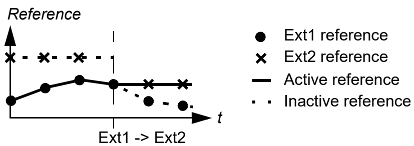
No.	Name/Value	Description	Def/FbEq16
	Timed function 3	Bit 2 of *34.01 Timed functions status* (see page *276*).	10
	Supervision 1	Bit 0 of *32.01 Supervision status* (see page *269*).	11
	Supervision 2	Bit 1 of *32.01 Supervision status* (see page *269*).	12
	Supervision 3	Bit 2 of *32.01 Supervision status* (see page *269*).	13
	Other [bit]	Source selection (see *Terms and abbreviations* on page *162*).	-
26.70	*Torque reference act 1*	Displays the value of torque reference source 1 (selected by parameter *26.11 Torque ref1 source*). See the control chain diagram on page *498*. This parameter is read-only.	0.0
	-1600.0…1600.0%	Value of torque reference source 1.	See par. *46.03*
26.71	*Torque reference act 2*	Displays the value of torque reference source 2 (selected by parameter *26.12 Torque ref2 source*). See the control chain diagram on page *498*. This parameter is read-only.	0.0
	-1600.0…1600.0%	Value of torque reference source 2.	See par. *46.03*
26.72	*Torque reference act 3*	Displays the torque reference after the function applied by parameter *26.13 Torque ref1 function* (if any), and after selection (*26.14 Torque ref1/2 selection*). See the control chain diagram on page *498*. This parameter is read-only.	0.0
	-1600.0…1600.0%	Torque reference after selection.	See par. *46.03*
26.73	*Torque reference act 4*	Displays the torque reference after application of reference additive 1. See the control chain diagram on page *498*. This parameter is read-only.	0.0
	-1600.0…1600.0%	Torque reference after application of reference additive 1.	See par. *46.03*
26.74	*Torque ref ramp out*	Displays the torque reference after limiting and ramping. See the control chain diagram on page *498*. This parameter is read-only.	0.0
	-1600.0…1600.0%	Torque reference after limiting and ramping.	See par. *46.03*
26.75	*Torque reference act 5*	Displays the torque reference after control mode selection. See the control chain diagram on page *499*. This parameter is read-only.	0.0
	-1600.0…1600.0%	Torque reference after control mode selection.	See par. *46.03*
26.76	*Torque reference act 6*	Displays the torque reference after the trim addition to the parameter *26.75 Torque reference act 5*.	0.0
	-1600.0…1600.0%	Torque reference after control mode selection.	See par. *46.03*
26.81	*Rush control gain*	Rush controller gain term. See section *Rush control* (page *72*).	5.0
	0.0...10000.0	Rush controller gain (0.0 = disabled).	1 = 1
26.82	*Rush control integration time*	Rush controller integration time term.	2.0s
	0.0...10.0 s	Rush controller integration time (0.0 = disabled).	1 = 1s

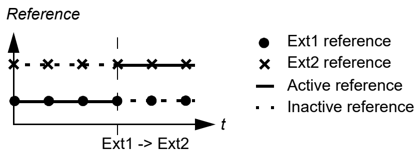
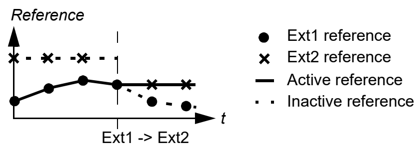
No.	Name/Value	Description	Def/FbEq16
28 Frequency reference chain		Settings for the frequency reference chain. See the control chain diagrams on pages *490* and *491*.	
28.01	*Frequency ref ramp input*	Displays the used frequency reference before ramping. See the control chain diagram on page *490*. This parameter is read-only.	0.00
	-500.00…500.00 Hz	Frequency reference before ramping.	See par. *46.02*
28.02	*Frequency ref ramp output*	Displays the final frequency reference (after selection, limitation and ramping). See the control chain diagram on page *490*. This parameter is read-only.	0.00
	-500.00…500.00 Hz	Final frequency reference.	See par. *46.02*

No.	Name/Value	Description	Def/FbEq16
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 *190*)	1
	AI2 scaled	*12.22 AI2 scaled value* (see page *191*)	2
	FB A ref1	*03.05 FB A reference 1* (see page *168*)	4
	FB A ref2	*03.06 FB A reference 2* (see page *168*)	5
	EFB ref1	*03.09 EFB reference 1* (see page *168*)	8
	EFB ref2	*03.10 EFB reference 2* (see page *168*)	9
	Motor potentiometer	*22.80 Motor potentiometer ref act* (output of the motor potentiometer)	15
	PID	*40.01 Process PID output actual* (output of the process PID controller)	16

No.	Name/Value	Description	Def/FbEq16
	Frequency input	*11.38 Freq in 1 actual value* (when DI5 or DI6 is used as a frequency input).	17
	Control panel (ref saved)	Panel reference (*03.01 Panel reference*, see page *168*) saved by the control system for the location where the control returns is used as the reference.  	18
	Control panel (ref copied)	Panel reference (*03.01 Panel reference*, see page *168*) 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 *162*).	-
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
	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 *190*).	1

No.	Name/Value	Description	Def/FbEq16
	AI2 scaled	*12.22 AI2 scaled value* (see page *191*).	2
	FB A ref1	*03.05 FB A reference 1* (see page *168*).	4
	FB A ref2	*03.06 FB A reference 2* (see page *168*).	5
	EFB ref1	*03.09 EFB reference 1* (see page *168*).	8
	EFB ref2	*03.10 EFB reference 2* (see page *168*).	9
	Reserved		10…14
	Motor potentiometer	*22.80 Motor potentiometer ref act* (output of the motor potentiometer).	15
	PID	*40.01 Process PID output actual* (output of the process PID controller).	16
	Frequency input	*11.38 Freq in 1 actual value* (when DI5 or DI6 is used as a frequency input).	17
	Control panel (ref saved)	Panel reference (*03.01 Panel reference*, see page *168*) saved by the control system for the location where the control returns is used as the reference. 	18
	Control panel (ref copied)	Panel reference (*03.01 Panel reference*, see page *168*) 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 *162*).	-
28.16	*Ext2 frequency ref2*	Selects Ext2 frequency reference source 2. For the selections, and a diagram of reference source selection, see parameter *28.15 Ext2 frequency ref1*.	*Zero*
28.17	*Ext2 frequency function*	Selects a mathematical function between the reference sources selected by parameters *28.15 Ext2 frequency ref1* and *28.16 Ext2 frequency ref2*. See diagram at *28.15 Ext2 frequency ref1*.	*Ref1*
	Ref1	Signal selected by *28.15 Ext2 frequency ref1* is used as frequency reference 1 as such (no function applied).	0
	Add (ref1 + ref2)	The sum of the reference sources is used as frequency reference 1.	1
	Sub (ref1 - ref2)	The subtraction ([*28.15 Ext2 frequency ref1*] - [*28.16 Ext2 frequency ref2*]) of the reference sources is used as frequency reference 1.	2

No.	Name/Value	Description	Def/FbEq16
	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.	0b0001

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 = Accord Par: The running direction for the constant speed is determined by the sign of the constant speed setting (parameters *22.26*…*22.32*).
2	Frequency step	Frequency step: 1 = Freq step enable; 0 = Freq step disable
3…15	Reserved	

	0b000...0b1111	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:	*DI3*

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

	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
	Timed function 1	Bit 0 of *34.01 Timed functions status* (see page *276*).	18
	Timed function 2	Bit 1 of *34.01 Timed functions status* (see page *276*).	19
	Timed function 3	Bit 2 of *34.01 Timed functions status* (see page *276*).	20
	Supervision 1	Bit 0 of *32.01 Supervision status* (see page *269*).	24
	Supervision 2	Bit 1 of *32.01 Supervision status* (see page *269*).	25
	Supervision 3	Bit 2 of *32.01 Supervision status* (see page *269*).	26
	Other [bit]	Source selection (see *Terms and abbreviations* on page *162*).	-
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*.	*DI4*

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*
28.26	*Constant frequency 1*	Defines constant frequency 1 (the frequency the motor will turn when constant frequency 1 is selected).	5.00 Hz
	-500.00…500.00 Hz	Constant frequency 1.	See par. *46.02*
28.27	*Constant frequency 2*	Defines constant frequency 2.	10.00 Hz
	-500.00…500.00 Hz	Constant frequency 2.	See par. *46.02*
28.28	*Constant frequency 3*	Defines constant frequency 3.	15.00 Hz
	-500.00…500.00 Hz	Constant frequency 3.	See par. *46.02*
28.29	*Constant frequency 4*	Defines constant frequency 4.	20.00 Hz
	-500.00…500.00 Hz	Constant frequency 4.	See par. *46.02*
28.30	*Constant frequency 5*	Defines constant frequency 5.	25.00 Hz
	-500.00…500.00 Hz	Constant frequency 5.	See par. *46.02*
28.31	*Constant frequency 6*	Defines constant frequency 6.	40.00 Hz
	-500.00…500.00 Hz	Constant frequency 6.	See par. *46.02*
28.32	*Constant frequency 7*	Defines constant frequency 7.	50.00 Hz
	-500.00…500.00 Hz	Constant frequency 7.	See par. *46.02*
28.41	*Frequency ref safe*	Defines a safe frequency reference value that is used with supervision functions such as • *12.03 AI supervision function* • *49.05 Communication loss action* • *50.02 FBA A comm loss func*.	0.00 Hz
	-500.00…500.00 Hz	Safe frequency reference.	See par. *46.02*
28.42	*Jogging 1 frequency ref*	Defines the frequency reference for jogging function 1 in scalar control mode.	0.00 Hz
	-500.00…500.00 Hz	Jogging 1 frequency reference.	See par. *46.02*
28.43	*Jogging 2 frequency ref*	Defines the frequency reference for jogging function 2 in scalar control mode.	0.00 Hz

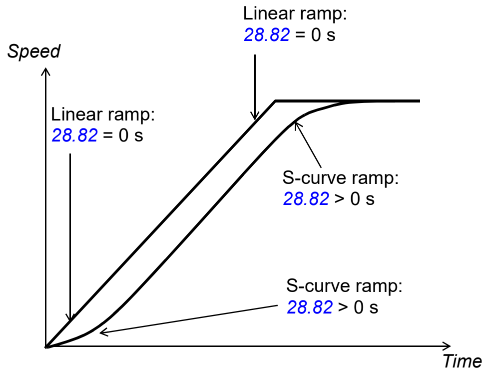
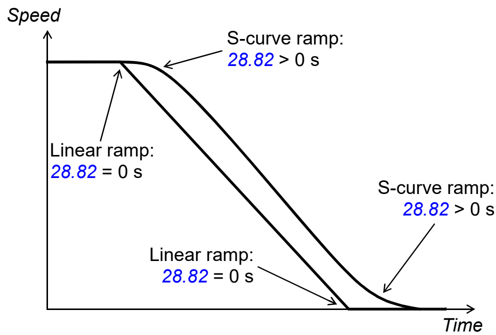
No.	Name/Value	Description	Def/FbEq16
	-500.00…500.00 Hz	Jogging 2 frequency reference.	See par. *46.02*
28.51	*Critical frequency function*	Enables/disables the critical frequencies function. Also determines whether the specified ranges are effective in both rotating directions or not. See also section *Critical speeds/frequencies* (page *44*).	0b0000

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.
2...5	Reserved	

	0b0000…0b1111	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*
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*

No.	Name/Value	Description	Def/FbEq16
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	*DI5*
	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
	FBA A	Only for the Transparent16 or Transparent32 profile. Transparent16 or Transparent32 control word bit received through the fieldbus A interface.	18
	EFB DCU CW bit 10	Only for the DCU profile. DCU control word bit 10 received through the embedded fieldbus interface.	20
	Other [bit]	Source selection (see *Terms and abbreviations* on page *162*).	-
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.	20.000 s
	0.000…1800.000 s	Acceleration time 1.	10 = 1 s
28.73	*Freq deceleration time 1*	Defines deceleration time 1 as the time required for the frequency to change from the frequency defined by parameter *46.02 Frequency scaling* (**not** from parameter *30.14 Maximum frequency*) to zero. If there is any doubt about the deceleration time being too short, ensure that DC overvoltage control (*30.30 Overvoltage control*) is on. **Note:** If a short deceleration time is needed for a high inertia application, the drive should be equipped with braking equipment such as a brake chopper and brake resistor.	20.000 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

No.	Name/Value	Description	Def/FbEq16
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 *162*)	-

No.	Name/Value	Description	Def/FbEq16
28.82	*Shape time 1*	Defines the shape of the acceleration and deceleration ramps used with the set 1. 0.000 s: Linear ramp. Suitable for steady acceleration or deceleration and for slow ramps. 0.001…1000.000 s: S-curve ramp. S-curve ramps are ideal for lifting applications. The S-curve consists of symmetrical curves at both ends of the ramp and a linear part in between. **Acceleration:**  **Deceleration:** 	0.000 s
	0.000…1800.000 s	Ramp shape at start and end of acceleration and deceleration.	10 = 1 s
28.83	*Shape time 2*	Defines the shape of the acceleration and deceleration ramps used with the set 2. See parameter *28.82 Shape time 1*.	0.000 s
	0.000…1800.000 s	Ramp shape at start and end of acceleration and deceleration.	10 = 1 s

No.	Name/Value	Description	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 the control chain diagram on page *490*. This parameter is read-only.	0.00
	-500.00…500.00 Hz	Frequency reference after selection.	See par. *46.02*
28.96	*Frequency ref act 7*	Displays the frequency reference after application of constant frequencies, control panel reference, etc. See the control chain diagram on page *490*. This parameter is read-only.	0.00
	-500.00…500.00 Hz	Frequency reference 7.	See par. *46.02*
28.97	*Frequency ref unlimited*	Displays the frequency reference after application of critical frequencies, but before ramping and limiting. See the control chain diagram on page *490*. This parameter is read-only.	0.00
	-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.f	0b0000
	0b0000…0b1111	Limit word 1.	1 = 1

Bit table for *30.01 Limit word 1*:

Bit	Name	Description
0	Torq lim	1 = Drive torque is 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 ramp input is being limited by *26.09 Maximum torque ref*, *30.20 Maximum torque 1*, *30.26 Power motoring limit*, or *30.27 Power generating limit*. See the diagram on page *500*.
4	Torq ref min	1 = Torque reference ramp input is being limited by *26.08 Minimum torque ref*, *30.19 Minimum torque 1*, *30.26 Power motoring limit*, or *30.27 Power generating limit*. See the diagram on page *500*.
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*

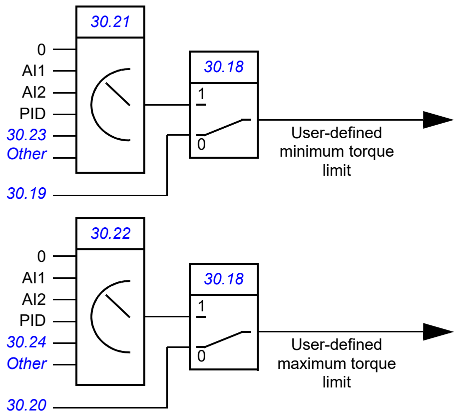
No.	Name/Value	Description	Def/FbEq16
30.02	*Torque limit status*	Displays the torque controller limitation status word. This parameter is read-only.	0b0000

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	Not applicable
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
	0b0000…0b1111	Torque limitation status word.	1 = 1
30.09	*Current limit monitor time*	Defines the drive current limit monitor time after which action is taken as specified in the parameter *30.10*.	10.00
	0...120s	Current limit monitor time.	100=1
30.10	*Current limit actions*	Selects how the drive reacts when the drive reaches the current limit (*30.17 Maximum current*) and exceeds the monitor time set by parameter *30.09 Current limit monitor time*.	*No action*
	No action	None (current limit action disabled).	0
	Warning	The drive generates an *A8B6 Current limit* warning.	1
	Fault	The drive trips on fault *8009 Current limit*.	2
30.11	*Minimum speed*	Defines the minimum allowed speed. **WARNING!** This value must not be higher than *30.12 Maximum speed*. **WARNING!** In speed control mode only. In frequency control mode, use frequency limits (*30.13* and *30.14*).	-1500.00 rpm
	-30000.00…30000.00 rpm	Minimum allowed speed.	See par. *46.01*

No.	Name/Value	Description	Def/FbEq16
30.12	*Maximum speed*	Defines the maximum allowed speed. **Note:** This parameter does not affect the speed acceleration and deceleration ramp times. See parameter *46.01 Speed scaling*. **WARNING!** This value must not be lower than *30.11 Minimum speed*. **WARNING!** In speed control mode only. In frequency control mode, use frequency limits (*30.13* and *30.14*).	1500.00 rpm
	-30000.00… 30000.00 rpm	Maximum speed.	See par. *46.01*
30.13	*Minimum frequency*	Defines the minimum allowed frequency. **WARNING!** This value must not be higher than *30.14 Maximum frequency*. **WARNING!** in frequency control mode only.	-50.00 Hz
	-500.00…500.00 Hz	Minimum frequency.	See par. *46.02*
30.14	*Maximum frequency*	Defines the maximum allowed frequency. **Note:** This parameter does not affect the frequency acceleration and deceleration ramp times. See parameter *46.02 Frequency scaling*. **WARNING!** This value must not be lower than *30.13 Minimum frequency*. **WARNING!** in frequency control mode only.	50.00 Hz
	-500.00…500.00 Hz	Maximum frequency.	See par. *46.02*
30.17	*Maximum current*	Defines the maximum allowed drive current. The system sets the default value to 90% of the rated current. If required, you can increase the parameter value by 10%. **Note:** The maximum current range and default value depends on the drive type.	2.92 A
	0.00...3.24 A	Maximum drive current.	1 = 1 A

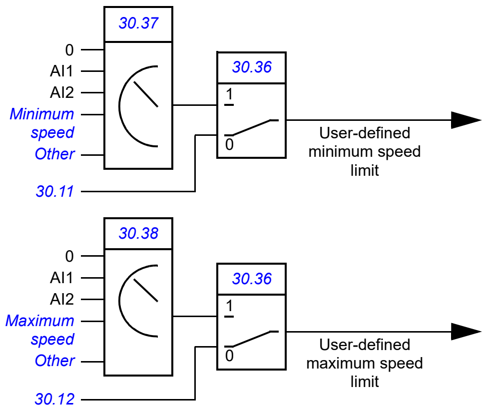
<table>
<tr><th>No.</th><th>Name/Value</th><th>Description</th><th>Def/FbEq16</th></tr>
<tr><td>30.18</td><td>Torq lim sel</td><td>Selects a source that switches between two different predefined minimum torque limit sets.
0 = minimum torque limit defined by 30.19 and maximum torque limit defined by 30.20 are active
1 = minimum torque limit selected by 30.21 and maximum torque limit defined by 30.22 are active
The user can define two sets of torque limits, and switch between the sets using a binary source such as a digital input.
The first set of limits is defined by parameters 30.19 and 30.20. The second set has selector parameters for both the minimum (30.21) and maximum (30.22) limits that allows the use of a selectable analog source (such as an analog input).



Note: In addition to the user-defined limits, torque may be limited for other reasons (such as power limitation). See block diagram Torque limitation on page 500.</td><td>Torque limit set 1</td></tr>
<tr><td></td><td>Torque limit set 1</td><td>0 (minimum torque limit defined by 30.19 and maximum torque limit defined by 30.20 are active).</td><td>0</td></tr>
<tr><td></td><td>Torque limit set 2</td><td>1 (minimum torque limit selected by 30.21 and maximum torque limit defined by 30.22 are active).</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…10</td></tr>
<tr><td></td><td>EFB</td><td>Only for the DCU profile. DCU control word bit 15 received through the embedded fieldbus interface.</td><td>11</td></tr>
<tr><td></td><td>Other [bit]</td><td>Source selection (see Terms and abbreviations on page 162).</td><td>-</td></tr>
</table>

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).	-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).	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 *190*).	1
	AI2 scaled	*12.22 AI2 scaled value* (see page *191*).	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 *162*).	-
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 *190*).	1
	AI2 scaled	*12.22 AI2 scaled value* (see page *191*).	2
	Reserved		3…14
	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 *162*).	-
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*

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

No.	Name/Value	Description	Def/FbEq16
30.36	*Speed limit selection*	Selects a source that switches between two different predefined adjustable speed limit sets. 0 = minimum speed limit defined by *30.11* and maximum speed limit defined by *30.12* are active 1 = minimum speed limit selected by *30.37* and maximum speed limit defined by *30.38* are active. The user can define two sets of speed limits, and switch between the sets using a binary source such as a digital input. The user can define two sets of speed limits, and switch between the sets using a binary source such as a digital input. The first set of limits is defined by parameters *30.11 Minimum speed* and *30.12 Maximum speed*. The second set has selector parameters for both the minimum (*30.37*) and maximum (*30.38*) limits that allows the use of a selectable analog source (such as an analog input). 	*Not selected*
	Not selected	Adjustable speed limits are disabled. (Minimum speed limit defined by *30.11 Minimum speed* and maximum speed limit defined by *30.12 Maximum speed* are active).	0
	Selected	Adjustable speed limits are enabled. (Minimum speed limit defined by *30.37 Min speed source* source and maximum speed limit defined by *30.38 Max speed source* are active).	1
	Ext1 active	Adjustable speed limits are enabled if EXT1 is active.	2
	Ext2 active	Adjustable speed limits are enabled if EXT2 is active.	3
	Torque control	Adjustable speed limits are enabled if Torque control mode (vector motor control) is active.	4
	DI1	Digital input DI1 (*10.02 DI delayed status*, bit 0).	5
	DI2	Digital input DI2 (*10.02 DI delayed status*, bit 1).	6
	DI3	Digital input 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

No.	Name/Value	Description	Def/FbEq16
	DI6	Digital input DI6 (*10.02 DI delayed status*, bit 5).	10
	Other	Source selection (see *Terms and abbreviations* on page *162*).	-
30.37	*Min speed source*	Defines the source of a minimum speed limit for the drive when the source is selected by *30.36 Speed limit selection*. ⚠ **WARNING!** In vector motor control mode only. In scalar motor control mode, use frequency limits *30.13* and *30.14*.	*Minimum speed*
	Zero	None.	0
	AI1 scaled	*12.12 AI1 scaled value*.	1
	AI2 scaled	*12.22 AI2 scaled value*.	2
	Minimum speed	*30.11 Minimum speed*.	11
	Other	Source selection (see *Terms and abbreviations* on page *162*).	-
30.38	*Max speed source*		*Minimum speed*
	Zero	None.	0
	AI1 scaled	*12.12 AI1 scaled value*.	1
	AI2 scaled	*12.22 AI2 scaled value*.	2
	Maximum speed	*30.12 Maximum speed*.	12
	Other	Source selection (see *Terms and abbreviations* on page *162*).	-

No.	Name/Value	Description	Def/FbEq16
31 Fault functions		Configuration of external events; selection of behavior of the drive upon fault situations.	
31.01	*External event 1 source*	Defines the source of external event 1. See also parameter *31.02 External event 1 type*. 0 = Trigger event 1 = Normal operation	*Inactive (true)*
	Active (false)	0.	0
	Inactive (true)	1.	1
	DI1	Digital input DI1 (*10.02 DI delayed status*, bit 0).	3
	DI2	Digital input DI2 (*10.02 DI delayed status*, bit 1).	4
	DI3	Digital input DI3 (*10.02 DI delayed status*, bit 2).	5
	DI4	Digital input DI4 (*10.02 DI delayed status*, bit 3).	6
	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 *162*).	-
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

No.	Name/Value	Description	Def/FbEq16
	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
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 $\longrightarrow$ 1 = Reset **Notes:** • When the start stop signal is through DIs (parameter *20.01* or *20.06*) or from local control mode and the user wants a fault reset through the fieldbus, selecton FBA A and EFB MCW bit 7 can be used. • Whenever the remote control mode is in fieldbus (Start stop command and reference is through fieldbus), the fault can be reset from the fieldbus regardless of the selection of the parameter.	*Not used*
	Not used	Not used.	0
	Not used	Not used.	1
	DI1	Digital input DI1 (*10.02 DI delayed status*, bit 0).	2
	DI2	Digital input DI2 (*10.02 DI delayed status*, bit 1).	3
	DI3	Digital input DI3 (*10.02 DI delayed status*, bit 2).	4
	DI4	Digital input DI4 (*10.02 DI delayed status*, bit 3).	5
	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 *276*).	18
	Timed function 2	Bit 1 of *34.01 Timed functions status* (see page *276*).	19

No.	Name/Value	Description	Def/FbEq16
	Timed function 3	Bit 2 of *34.01 Timed functions status* (see page *276*).	20
	Supervision 1	Bit 0 of *32.01 Supervision status* (see page *269*).	24
	Supervision 2	Bit 1 of *32.01 Supervision status* (see page *269*).	25
	Supervision 3	Bit 2 of *32.01 Supervision status* (see page *269*).	26
	FBA A MCW bit 7	Control word bit 7 received through fieldbus interface A.	30
	EFB MCW bit 7	Control word bit 7 received through the embedded fieldbus interface.	32
	Other [bit]	Source selection (see *Terms and abbreviations* on page *162*).	-
31.12	*Autoreset selection*	Selects faults that are automatically reset. The parameter is a 16-bit word with each bit corresponding to a fault type. Whenever a bit is set to 1, the corresponding fault is automatically reset. **WARNING!** Before you activate the function, make sure that no dangerous situations can occur. The function restarts the drive automatically and continues operation after a fault. The bits of this binary number correspond to the following faults:	0x0000

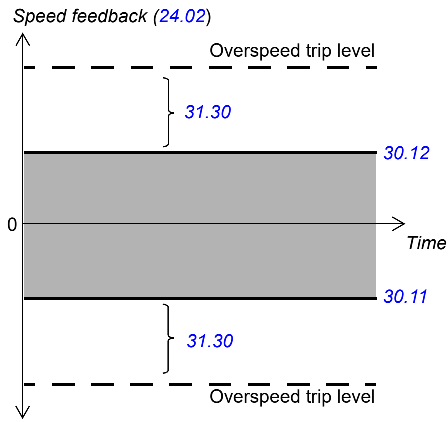
Bit	Fault
0	Overcurrent
1	Overvoltage
2	Undervoltage
3	AI supervision fault
4…9	Reserved
10	Selectable fault (see parameter *31.13 Selectable fault*)
11	External fault 1 (from source selected by parameter *31.01 External event 1 source*)
12	External fault 2 (from source selected by parameter *31.03 External event 2 source*)
13	External fault 3 (from source selected by parameter *31.05 External event 3 source*)
14	External fault 4 (from source selected by parameter *31.07 External event 4 source*)
15	External fault 5 (from source selected by parameter *31.09 External event 5 source*)

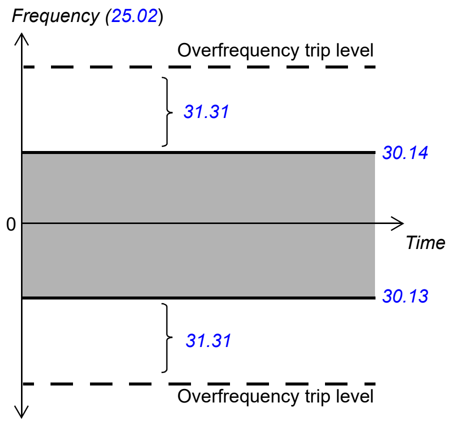
	0x0000…0xffff	Automatic reset configuration word.	1 = 1
31.13	*Selectable fault*	Defines the fault that can be automatically reset using parameter *31.12 Autoreset selection*, bit 10. Faults are listed in chapter *Fault tracing* (page *427*).	0x0000
	0x0000…0xffff	Fault code.	10 = 1
31.14	*Number of trials*	Defines the maximum number of automatic resets that the drive is allowed to attempt within the time defined by parameter *31.15 Total trials time*. If the fault persists, subsequent reset attempts will be made at intervals defined by *31.16 Delay time*. The faults to be automatically reset are defined by 31.12 Autoreset selection.	0
	0…5	Number of automatic resets.	10 = 1

<table>
<tr><th>No.</th><th>Name/Value</th><th>Description</th><th>Def/FbEq16</th></tr>
<tr><td>*31.15*</td><td>*Total trials time*</td><td>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.</td><td>30.0 s</td></tr>
<tr><td></td><td>1.0…600.0 s</td><td>Time for automatic resets.</td><td>10 = 1 s</td></tr>
<tr><td>*31.16*</td><td>*Delay time*</td><td>Defines the time that the drive will wait after a fault before attempting an automatic reset. See parameter *31.12 Autoreset selection*.</td><td>0.0 s</td></tr>
<tr><td></td><td>0.0…120.0 s</td><td>Autoreset delay.</td><td>10 = 1 s</td></tr>
<tr><td>*31.19*</td><td>*Motor phase loss*</td><td>Selects how the drive reacts when a motor phase loss is detected.</td><td>*Fault*</td></tr>
<tr><td></td><td>No action</td><td>No action taken.</td><td>0</td></tr>
<tr><td></td><td>Fault</td><td>The drive trips on fault *3381 Output phase loss*.</td><td>1</td></tr>
<tr><td>*31.22*</td><td>*STO indication run/stop*</td><td>Selects which indications are given when one or both Safe torque off (STO) signals are switched off or lost. The indications also depend on whether the drive is running or stopped when this occurs.
The tables at each selection below show the indications generated with that particular setting.
Notes:
• This parameter does not affect the operation of the STO function itself. The STO function will operate regardless of the setting of this parameter: a running drive will stop upon removal of one or both STO signals, and will not start until both STO signals are restored and all faults reset.
• The loss of only one STO signal always generates a fault as it is interpreted as a malfunction.
For more information on the STO, see chapter *The Safe torque off function* in the *Hardware manual* of the drive.</td><td>*Fault/Fault*</td></tr>
<tr><td></td><td>Fault/Fault</td><td>
<table>
<tr><th colspan="2">Inputs</th><th rowspan="2">Indication (running or stopped)</th></tr>
<tr><th>IN1</th><th>IN2</th></tr>
<tr><td>0</td><td>0</td><td>Fault *5091 Safe torque off*</td></tr>
<tr><td>0</td><td>1</td><td>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>
</table>

<table>
<tr><th>No.</th><th>Name/Value</th><th>Description</th><th>Def/FbEq16</th></tr>
<tr><td></td><td>Fault/Warning</td><td>
<table>
<tr><th colspan="2">Inputs</th><th colspan="2">Indication</th></tr>
<tr><th>IN1</th><th>IN2</th><th>Running</th><th>Stopped</th></tr>
<tr><td>0</td><td>0</td><td>Fault 5091 Safe torque off</td><td>Warning A5A0 Safe torque off</td></tr>
<tr><td>0</td><td>1</td><td>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>
<tr><td></td><td>Fault/Event</td><td>
<table>
<tr><th colspan="2">Inputs</th><th colspan="2">Indication</th></tr>
<tr><th>IN1</th><th>IN2</th><th>Running</th><th>Stopped</th></tr>
<tr><td>0</td><td>0</td><td>Fault 5091 Safe torque off</td><td>Event B5A0 Safe torque off</td></tr>
<tr><td>0</td><td>1</td><td>Faults 5091 Safe torque off and FA81 Safe torque off 1</td><td>Event B5A0 Safe torque off and fault FA81 Safe torque off 1</td></tr>
<tr><td>1</td><td>0</td><td>Faults 5091 Safe torque off and FA82 Safe torque off 2</td><td>Event B5A0 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>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>
</table>

<table>
<tr><th>No.</th><th>Name/Value</th><th>Description</th><th>Def/FbEq16</th></tr>
<tr><td></td><td>No indication/No indication</td><td><table>
<tr><th colspan="2">Inputs</th><th rowspan="2">Indication (running or stopped)</th></tr>
<tr><th>IN1</th><th>IN2</th></tr>
<tr><td>0</td><td>0</td><td>None</td></tr>
<tr><td>0</td><td>1</td><td>Fault FA81 Safe torque off 1</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>The drive trips on fault 3181 Wiring or earth fault.</td><td>1</td></tr>
<tr><td>31.24</td><td>Stall function</td><td>Selects how the drive reacts to a stall condition.
A stall condition is defined as follows:
• The drive exceeds the stall current limit (31.25 Stall current limit), and
• the output frequency is below the level set by parameter 31.27 Stall frequency limit or the motor speed is below the level set by parameter 31.26 Stall speed limit, and
• the conditions above have been true longer than the time set by parameter 31.28 Stall time.</td><td>No action</td></tr>
<tr><td></td><td>No action</td><td>None (stall supervision disabled).</td><td>0</td></tr>
<tr><td></td><td>Warning</td><td>The drive generates an A780 Motor stall (Programmable warning: 31.24 Stall function) warning.</td><td>1</td></tr>
<tr><td></td><td>Fault</td><td>The drive trips on fault 7121 Motor stall.</td><td>2</td></tr>
<tr><td>31.25</td><td>Stall current limit</td><td>Stall current limit in percent of the nominal current of the motor. See parameter 31.24 Stall function.</td><td>200.0%</td></tr>
<tr><td></td><td>0.0…1600.0%</td><td>Stall current limit.</td><td>-</td></tr>
<tr><td>31.26</td><td>Stall speed limit</td><td>Stall speed limit in rpm. See parameter 31.24 Stall function.</td><td>150.00 rpm</td></tr>
<tr><td></td><td>0.00…10000.00 rpm</td><td>Stall speed limit.</td><td>See par. 46.01</td></tr>
<tr><td>31.27</td><td>Stall frequency limit</td><td>Stall frequency limit. See parameter 31.24 Stall function.
Note: Setting the limit below 10 Hz is not recommended.</td><td>15.00 Hz</td></tr>
<tr><td></td><td>0.00…1000.00 Hz</td><td>Stall frequency limit.</td><td>See par. 46.02</td></tr>
<tr><td>31.28</td><td>Stall time</td><td>Stall time. See parameter 31.24 Stall function.</td><td>20 s</td></tr>
<tr><td></td><td>0…3600 s</td><td>Stall time.</td><td>-</td></tr>
</table>

No.	Name/Value	Description	Def/FbEq16
31.30	*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*) 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. If the speed (*28.01 Frequency ref ramp input*) exceeds the frequency limit defined by parameter *30.13* or *30.14* by more than the value of this parameter, the drive trips on the*73F0 Overfrequency* fault. **WARNING!** This function only supervises the speed in scalar motor control mode. The function is not effective in vector motor control mode. **Example:** If the maximum speed is 40 Hz and speed trip margin is 10 Hz, the drive trips at 50 Hz.  	15.00 Hz
	0.00…10000.00 Hz	Overfrequency trip margin.	See par. *46.02*
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. This parameter is applicable only for frames R3 or larger. On frame sizes R3…R5, the auxiliary fan is attached to connector X10 and on frame sizes R6 and larger to connector X16.	*Warning*
	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 a 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 the warnings to be suppressed. This parameter is a 16-bit word with each bit corresponding to a warning. Whenever a bit is set to 1, the corresponding warning is 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.
6	Emergency stop (off1or 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
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 *Signal supervision* (page *92*).	
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*.	0b000

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
	0b0000…0b1111	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 low and high 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 low limit.	1
	High	Action is taken whenever the signal rises above its high limit.	2
	Abs low	Action is taken whenever the absolute value of the signal falls below its (absolute) low limit.	3
	Abs high	Action is taken whenever the absolute value of the signal rises above its (absolute) high limit.	4

No.	Name/Value	Description	Def/FbEq16
	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 high limit + 0.5 hysteresis. The action is deactivated when the signal falls below the value defined by the low limit - 0.5 hysteresis.	7
32.06	*Supervision 1 action*	Selects whether the drive generates a fault, warning or neither when the value monitored by signal supervision 1 exceeds its limits. **Note:** This parameter does not affect the status indicated by *32.01 Supervision status*.	*No action*
	No action	No warning or fault generated.	0
	Warning	Warning *A8B0 Signal supervision 1* is generated.	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 *165*).	1
	Frequency	*01.06 Output frequency* (page *165*).	3
	Current	*01.07 Motor current* (page *165*).	4
	Torque	*01.10 Motor torque* (page *165*).	6
	DC voltage	*01.11 DC voltage* (page *165*).	7
	Output power	*01.14 Output power* (page *166*).	8
	AI1	*12.11 AI1 actual value* (page *189*).	9
	AI2	*12.21 AI2 actual value* (page *191*).	10
	Inverter temperature	*05.11 Inverter temperature* (page *170*).	23
	Process PID output	*40.01 Process PID output actual* (page *298*).	24
	Process PID feedback	*40.02 Process PID feedback actual* (page *298*).	25
	Process PID setpoint	*40.03 Process PID setpoint actual* (page *298*).	26
	Process PID deviation	*40.04 Process PID deviation actual* (page *298*).	27
	Other	Source selection (see *Terms and abbreviations* on page *162*).	-
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.	-

No.	Name/Value	Description	Def/FbEq16
32.10	*Supervision 1 high*	Defines the high limit for signal supervision 1.	0.00
	-21474836.00… 21474836.00	High limit.	-
32.11	*Supervision 1 hysteresis*	Defines the hysteresis for the signal monitored by signal supervision 1.	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 low and high 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 low limit.	1
	High	Action is taken whenever the signal rises above its high limit.	2
	Abs low	Action is taken whenever the absolute value of the signal falls below its (absolute) low limit.	3
	Abs high	Action is taken whenever the absolute value of the signal rises above its (absolute) high 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 high limit + 0.5 hysteresis. The action is deactivated when the signal falls below the value defined by the low limit - 0.5 hysteresis.	7
32.16	*Supervision 2 action*	Selects whether the drive generates a fault, warning or neither when the value monitored by signal supervision 2 exceeds its limits. **Note:** This parameter does not affect the status indicated by *32.01 Supervision status*.	*No action*
	No action	No warning or fault generated.	0
	Warning	Warning *A8B1 Signal supervision 2* is generated.	1
	Fault	Drive trips on fault *80B1 Signal supervision 2*.	2
	Fault if running	If running, the drive trips on fault *80B0 Signal supervision 1*.	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 low limit for signal supervision 2.	0.00
	-21474836.00… 21474836.00	Low limit.	-
32.20	*Supervision 2 high*	Defines the high limit for signal supervision 2.	0.00
	-21474836.00… 21474836.00	High limit.	-

No.	Name/Value	Description	Def/FbEq16
32.21	*Supervision 2 hysteresis*	Defines the hysteresis for the signal monitored by signal supervision 2.	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 low and high 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 low limit.	1
	High	Action is taken whenever the signal rises above its high limit.	2
	Abs low	Action is taken whenever the absolute value of the signal falls below its (absolute) low limit.	3
	Abs high	Action is taken whenever the absolute value of the signal rises above its (absolute) high 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 falls below its (hysteresis) low limit or rises above its (hysteresis) high limit.	7
32.26	*Supervision 3 action*	Selects whether the drive generates a fault, warning or neither when the value monitored by signal supervision 3 exceeds its limits. **Note:** This parameter does not affect the status indicated by *32.01 Supervision status*.	*No action*
	No action	No warning or fault generated.	0
	Warning	Warning *A8B2 Signal supervision 3* is generated.	1
	Fault	Drive trips on fault *80B2 Signal supervision 3*.	2
	Fault if running	If running, the drive trips on fault *80B0 Signal supervision 1*.	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 low limit for signal supervision 3.	0.00
	-21474836.00… 21474836.00	Low limit.	-
32.30	*Supervision 3 high*	Defines the high limit for signal supervision 3.	0.00
	-21474836.00… 21474836.00	High limit.	-
32.31	*Supervision 3 hysteresis*	Defines the hysteresis for the signal monitored by signal supervision 3.	0.00
	0.00…100000.00	Hysteresis.	-

No.	Name/Value	Description	Def/FbEq16
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 low and high 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 low limit.	1
	High	Action is taken whenever the signal rises above its high limit.	2
	Abs low	Action is taken whenever the absolute value of the signal falls below its (absolute) low limit.	3
	Abs high	Action is taken whenever the absolute value of the signal rises above its (absolute) high 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 falls below its (hysteresis) low limit or rises above its (hysteresis) high limit.	7
32.36	*Supervision 4 action*	Selects whether the drive generates a fault, warning or neither when the value monitored by signal supervision 4 exceeds its limits. **Note:** This parameter does not affect the status indicated by *32.01 Supervision status*.	*No action*
	No action	No warning or fault generated.	0
	Warning	Warning *A8B3 Signal supervision 4* is generated.	1
	Fault	Drive trips on fault *80B3 Signal supervision 4*.	2
	Fault if running	Drive trips on fault *80B0 Signal supervision 1* if the motor is running.	3
32.37	*Supervision 4 signal*	Selects the signal to be monitored by signal supervision function 4. For the available selections, see parameter *32.07 Supervision 1 signal*.	*Zero*
32.38	*Supervision 4 filter time*	Defines a filter time constant for the signal monitored by signal supervision 4.	0.000 s
	0.000 … 30.000 s	Signal filter time.	1000 = 1 s
32.39	*Supervision 4 low*	Defines the low limit for signal supervision 4.	0.00
	-21474836.00… 21474836.00	Low limit.	-
32.40	*Supervision 4 high*	Defines the high limit for signal supervision 4.	0.00
	-21474836.00… 21474836.00	High limit.	-
32.41	*Supervision 4 hysteresis*	Defines the hysteresis for the signal monitored by signal supervision 4.	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 low and high 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 low limit.	1
	High	Action is taken whenever the signal rises above its high limit.	2
	Abs low	Action is taken whenever the absolute value of the signal falls below its (absolute) low limit.	3
	Abs high	Action is taken whenever the absolute value of the signal rises above its (absolute) high 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 falls below its (hysteresis) low limit or rises above its (hysteresis) high limit.	7
32.46	*Supervision 5 action*	Selects whether the drive generates a fault, warning or neither when the value monitored by signal supervision 5 exceeds its limits. **Note:** This parameter does not affect the status indicated by *32.01 Supervision status*.	*No action*
	No action	No warning or fault generated.	0
	Warning	Warning *A8B4 Signal supervision 5* is generated.	1
	Fault	Drive trips on fault *80B4 Signal supervision 5*.	2
	Fault if running	Drive trips on fault *80B0 Signal supervision 1* if the motor is running.	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 low limit for signal supervision 5.	0.00
	-21474836.00… 21474836.00	Low limit.	-
32.50	*Supervision 5 high*	Defines the high limit for signal supervision 5.	0.00
	-21474836.00… 21474836.00	High limit.	-
32.51	*Supervision 5 hysteresis*	Defines the hysteresis for the signal monitored by signal supervision 5.	0.00
	0.00…100000.00	Hysteresis.	-

No.	Name/Value	Description	Def/FbEq16
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 low and high 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 low limit.	1
	High	Action is taken whenever the signal rises above its high limit.	2
	Abs low	Action is taken whenever the absolute value of the signal falls below its (absolute) low limit.	3
	Abs high	Action is taken whenever the absolute value of the signal rises above its (absolute) high 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 falls below its (hysteresis) low limit or rises above its (hysteresis) high limit.	7
32.56	*Supervision 6 action*	Selects whether the drive generates a fault, warning or neither when the value monitored by signal supervision 6 exceeds its limits. **Note:** This parameter does not affect the status indicated by *32.01 Supervision status*.	*No action*
	No action	No warning or fault generated.	0
	Warning	Warning *A8B5 Signal supervision 6* is generated.	1
	Fault	Drive trips on fault *80B5 Signal supervision 6*.	2
	Fault if running	Drive trips on fault *80B0 Signal supervision 1* if the motor is running.	3
32.57	*Supervision 6 signal*	Selects the signal to be monitored by signal supervision function 6. For the available selections, see parameter *32.07 Supervision 1 signal*.	*Zero*
32.58	*Supervision 6 filter time*	Defines a filter time constant for the signal monitored by signal supervision 6.	0.000 s
	0.000 … 30.000 s	Signal filter time.	1000 = 1 s
32.59	*Supervision 6 low*	Defines the low limit for signal supervision 6.	0.00
	-21474836.00… 21474836.00	Low limit.	-
32.60	*Supervision 6 high*	Defines the high limit for signal supervision 6.	0.00
	-21474836.00… 21474836.00	High limit.	-
32.61	*Supervision 6 hysteresis*	Defines the hysteresis for the signal monitored by signal supervision 6.	0.00
	0.00…100000.00	Hysteresis.	-

No.	Name/Value	Description	Def/FbEq16
34 Timed functions		Configuration of the timed functions. See also section *Motor control* (page *64*).	
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.	0b0000

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

No.	Name/Value	Description	Def/FbEq16
	0b0000...0b1111	Status of combined timers 1…3.	1 = 1
34.02	*Timer status*	Status of timers 1…12. This parameter is read-only.	0b0000

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
	0b0000...0b1111	Timer status.	1 = 1

No.	Name/Value	Description	Def/FbEq16
34.04	*Season/exception day status*	Status of seasons 1…3, 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.	0b0000

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
	0b0000...0b11110b 1111	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 *162*).	-

No.	Name/Value	Description	Def/FbEq16
34.11	*Timer 1 configuration*	Defines when timer 1 is active.	0b0111

Bit	Name	Description
0	Monday	1 = Monday is an active start day.
1	Tuesday	1 = Tuesday is an active start day.
2	Wednesday	1 = Wednesday is an active start day.
3	Thursday	1 = Thursday is an active start day.
4	Friday	1 = Friday is an active start day.
5	Saturday	1 = Saturday is an active start day.
6	Sunday	1 = Sunday is an active start day.
7	Season 1	1 = Timer is active in season 1.
8	Season 2	1 = Timer is active in season 2.
9	Season 3	1 = Timer is active in season 3.
10	Season 4	1 = Timer is active in season 4.
11	Exceptions	0 = Exceptions days are disabled. 1 = Exception days are enabled. Bits 12 and 13 are taken into account.
12	Holidays	0 = Timer is inactive on exception days configured as "Holiday". 1 = Timer is active on exception days configured as "Holiday".
13	Workdays	0 = Timer is inactive on exception days configured as "Workday". 1 = Timer is active on exception days configured as "Workday".
14…15	Reserved	

No.	Name/Value	Description	Def/FbEq16
	0b0000...0b1111	Configuration of timer 1.	1 = 1
34.12	*Timer 1 start time*	Defines the daily start time of timer 1. The time can be changed in second steps. The timer can be started at an other time than the start time. E.g. if the timer's duration is more than one day and the active session starts during the time, the timer is started at 00:00 and stopped when there is no duration left.	00:00:00
	00:00:00…23:59:59	Daily start time of the timer.	1 = 1
34.13	*Timer 1 duration*	Defines the duration of timer 1. The duration can be changed in minute steps. The duration can extend over the change of the day but if an exception day becomes active, the period is interrupted at midnight. In the same way the period started on an exception day stays active only until the end of the day, even if the duration is longer. The timer will continue after a break if there is duration left.	00 00:00
	00 00:00…07 00:00	Timer duration.	1 = 1
34.14	*Timer 2 configuration*	See *34.11 Timer 1 configuration*.	0b0111
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*.	0b0111

No.	Name/Value	Description	Def/FbEq16
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*.	0b0111
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*.	0b0111
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*.	0b0111
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*.	0b0111
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*.	0b0111
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*.	0b0111
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*.	0b0111
34.39	*Timer 10 start time*	See *34.12 Timer 1 start time*.	00:00:00
34.40	*Timer 10 duration*	See *34.13 Timer 1 duration*.	00 00:00
34.41	*Timer 11 configuration*	See *34.11 Timer 1 configuration*.	0b0111
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*.	0b0111
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

No.	Name/Value	Description	Def/FbEq16
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.	1.1
	-	Season start date.	
34.61	*Season 2 start date*	Defines the start date of season 2. See *34.60 Season 1 start date*.	1.1
34.62	*Season 3 start date*	Defines the start date of season 3. See *34.60 Season 1 start date*.	1.1
34.63	*Season 4 start date*	Defines the start date of season 4. See *34.60 Season 1 start date*.	1.1
34.70	*Number of active exceptions*	Defines how many of the exceptions are active by specifying the last active one. All preceding exceptions are active. Exceptions 1…3 are periods (duration can be defined) and exceptions 4…16 are days (duration is always 24 hours). **Example:** If the value is 4, exceptions 1…4 are active, and exceptions 5…16 are not active.	3
	0…16	Number of active exception periods or days.	-
34.71	*Exception types*	Defines the types of exceptions 1…16 as workday or holiday. Exceptions 1…3 are periods (duration can be defined) and exceptions 4…16 are days (duration is always 24 hours).	0b0000

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

No.	Name/Value	Description	Def/FbEq16
	0b0000…0b1111	Types of exception period or days.	1 = 1

No.	Name/Value	Description	Def/FbEq16
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.	1.1
	-	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
34.74	*Exception 2 start*	See *34.72 Exception 1 start*.	1.1
34.75	*Exception 2 length*	See *34.73 Exception 1 length*.	0 d
34.76	*Exception 3 start*	See *34.72 Exception 1 start*.	1.1
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.	1.1
	-	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*.	1.1
34.80	*Exception day 6*	See *34.79 Exception day 4*.	1.1
34.81	*Exception day 7*	See *34.79 Exception day 4*	1.1
34.82	*Exception day 8*	See *34.79 Exception day 4*.	1.1
34.83	*Exception day 9*	See *34.79 Exception day 4*.	1.1
34.84	*Exception day 10*	See *34.79 Exception day 4*.	1.1
34.85	*Exception day 11*	See *34.79 Exception day 4*.	1.1
34.86	*Exception day 12*	See *34.79 Exception day 4*.	1.1
34.87	*Exception day 13*	See *34.79 Exception day 4*.	1.1
34.88	*Exception day 14*	See *34.79 Exception day 4*.	1.1
34.89	*Exception day 15*	See *34.79 Exception day 4*.	1.1
34.90	*Exception day 16*	See *34.79 Exception day 4*.	1.1

No.	Name/Value	Description	Def/FbEq16
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*.	0b0000

Bit	Name	Description
0	Timer 1	0 = Inactive. 1 = Active.
1	Timer 2	0 = Inactive. 1 = Active.
2	Timer 3	0 = Inactive. 1 = Active.
3	Timer 4	0 = Inactive. 1 = Active.
4	Timer 5	0 = Inactive. 1 = Active.
5	Timer 6	0 = Inactive. 1 = Active.
6	Timer 7	0 = Inactive. 1 = Active.
7	Timer 8	0 = Inactive. 1 = Active.
8	Timer 9	0 = Inactive. 1 = Active.
9	Timer 10	0 = Inactive. 1 = Active.
10	Timer 11	0 = Inactive. 1 = Active.
11	Timer 12	0 = Inactive. 1 = Active.
12…15	Reserved	

No.	Name/Value	Description	Def/FbEq16
	0b0000…0b1111	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*.	0b0000
34.102	*Timed function 3*	Defines which timers are connected to combined timer 3. See *34.01 Timed functions status*.	0b0000
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.	0b0000

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
	0b0000…0b1111	Combined timers including the extra timer.	1 = 1
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

No.	Name/Value	Description	Def/FbEq16
	Other [bit]	Source selection (see *Terms and abbreviations* on page *162*).	-
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
35 Motor thermal protection		Motor thermal protection settings such as temperature measurement configuration, load curve definition and motor fan control configuration. See also section *Motor thermal protection* (page *81*).	
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.	0
	-60…1000 °C or -76…1832 °F	Estimated motor temperature.	1 = 1°C
35.02	*Measured temperature 1*	Displays the temperature received through the source defined by parameter *35.11 Temperature 1 source*. The unit is selected by parameter *96.16 Unit selection*. This parameter is read-only.	0
	-60…5000 °C or -76…9032 °F, 0...5000 ohm or [*35.12*] ohm	Measured temperature 1. **Note:** With a PTC sensor, the unit is ohm. If the measured temperature source selection (*35.11*) is PTC analog I/O, the motor thermal protection function converts the analog input signal (*35.14* to PTC resistance value (ohms), and shows it in this parameter. This is the case even the parameter name and unit refer to motor temperature (°C or °F). You cannot change the unit to ohm for the time being (*96.16*).	1 = 1 unit
35.03	*Measured temperature 2*	Displays the temperature received through the source defined by parameter *35.21 Temperature 2 source*. The unit is selected by parameter *96.16 Unit selection*.	0
	-60…5000 °C or -76…9032 °F, 0...5000 ohm or [*35.22*] ohm	Measured temperature 2. **Note:** With a PTC sensor, the unit is ohms. If the measured temperature source selection (*35.21*) is PTC analog I/O , the motor thermal protection function converts the analog input signal (*35.24*) to PTC resistance value (ohms), and shows it in this parameter. This is the case even the parameter name and unit refer to motor temperature (°C or °F). You cannot change the unit to ohm for the time being (*96.16*).	1 = 1 unit
35.05	*Motor overload level*	Shows the motor overload level as a percentage of the motor overload fault limit.See section *Motor overload protection* (page *87*). This parameter is read-only.	0.0%

No.	Name/Value	Description	Def/FbEq16
	0.0...300.0 %	Motor overload level. 0.0% No motor overloading. 88.0% Motor overloaded to warning level. 100.0% Motor overloaded to fault level.	10 = 1%
35.11	*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

No.	Name/Value	Description	Def/FbEq16
	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 *35.13 Temperature 1 warning limit* (excessive temperature) will be shown by *35.02 Measured temperature 1*. If a user wants to trigger faults, set the value of parameter *35.12 Temperature 1 fault limit* below or equal to the warning limit.	8
	Reserved		9...10
	Direct temperature	The temperature is taken from the source selected by parameter *35.14 Temperature 1 AI source*. The value of the source is assumed to be in the unit of temperature specified by parameter *96.16 Unit selection*.	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	Not applicable.	19
	PTC analog I/O	PTC sensor connected to the analog input selected by parameter *35.14 Temperature 1 AI source* 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 connected relay 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
35.12	*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*. **Note**: With a PTC sensor, the unit is ohms.	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
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*. **Note**: With a PTC sensor, the unit is ohms.	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

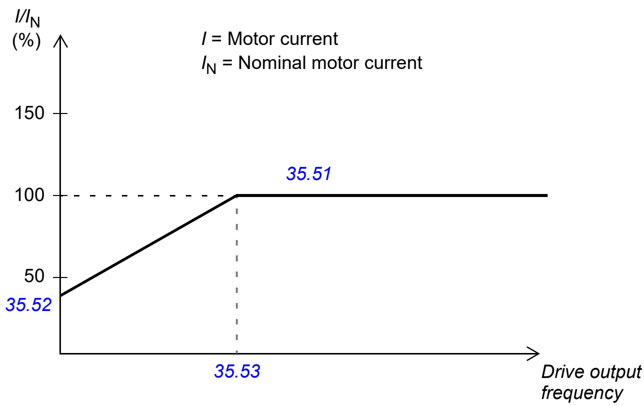
No.	Name/Value	Description	Def/FbEq16
35.14	*Temperature 1 AI source*	Specifies the analog input when the setting of *35.11 Temperature 1 source* requires measurement through an analog input.	*Not selected*
	Not selected	None.	0
	AI1 actual value	Analog input AI1 on the control unit.	1
	AI2 actual value	Analog input AI2 on the control unit.	2
	Other	Source selection (see *Terms and abbreviations* on page *162*).	-
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
	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

No.	Name/Value	Description	Def/FbEq16
	2 × Pt100 analog I/O	As selection *1 × Pt100 analog I/O*, but with two sensors connected in series. Using multiple sensors improves measurement accuracy significantly.	6
	3 × Pt100 analog I/O	As selection *1 × Pt100 analog I/O*, but with three sensors connected in series. Using multiple sensors improves measurement accuracy significantly.	7
	PTC DI6	PTC sensor 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 *35.23 Temperature 2 warning limit* (excessive temperature) will be shown by *35.03 Measured temperature 2*. If a user wants a faults to be triggered, the value of parameter *35.22 Temperature 2 fault limit* has to be set below or equal to the warning limit.	8
	Reserved		9...10
	Direct temperature	The temperature is taken from the source selected by parameter *35.24 Temperature 2 AI source*. The value of the source is assumed to be in the unit of temperature specified by parameter *96.16 Unit selection*.	11
	KTY83 analog I/O	KTY83 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.	12
	1 × Pt1000 analog I/O	Pt1000 sensor connected to a standard analog input selected by parameter *35.24 Temperature 2 AI source* and an analog output. The 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

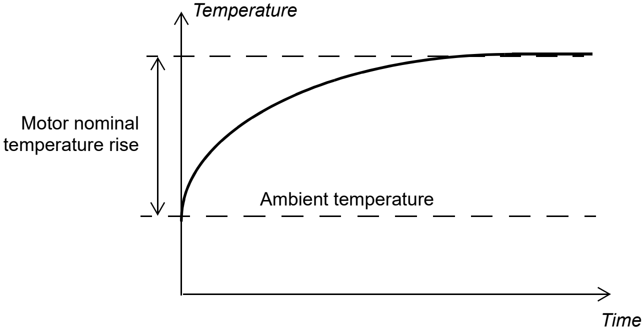
No.	Name/Value	Description	Def/FbEq16
	3 × Pt1000 analog I/O	As selection*1 × Pt1000 analog I/O*, but with three sensors connected in series. Using multiple sensors improves measurement accuracy significantly.	15
	Ni1000	Ni1000 sensor connected to the analog input selected by parameter *35.24 Temperature 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.	16
	Reserved		17...18
	PTC extension module	Not applicable.	19
	PTC analog I/O	PTC sensor connected to the analog input selected by parameter *35.24 Temperature 2 AI source* 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 connected relay 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*. **Note:** With a PTC sensor, the unit is ohms.	130 °C or 266 °For 4500 ohm
	-60…5000 °C or -76…9032 °F or 0...5000 ohm	Fault limit for temperature monitoring function 2. **Note:** 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). Also this limit is then a resistance value even the parameter name and unit refer to motor temperature (°C or °F). You cannot change the unit to ohm by the time being (*96.16*).	1 = 1 unit

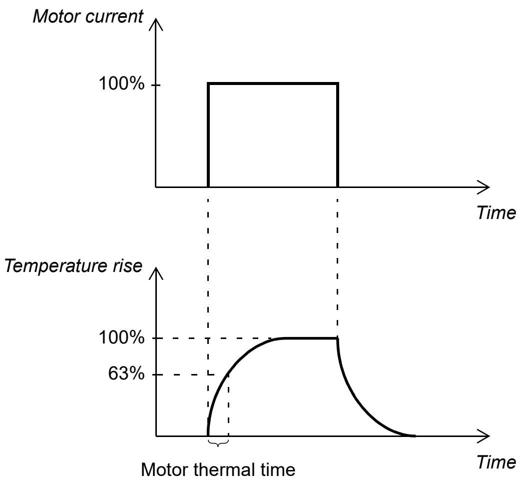
No.	Name/Value	Description	Def/FbEq16
35.23	*Temperature 2 warning limit*	Defines the warning limit for temperature supervision function 2. When measured temperature 1 exceeds the limit, warning *A492 External temperature 2* is generated. The unit is selected by parameter *96.16 Unit selection*. **Note:** With a PTC sensor, the unit is ohms.	110 °C or 230 °F or 0...4000 ohm
	-60…5000 °C or -76…9032 °F or 0...5000 ohm	Warning limit for temperature monitoring function 2. **Note:** 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). Also this limit is then a resistance value even the parameter name and unit refer to motor temperature (°C or °F). You cannot change the unit to ohm by the time being (*96.16*).	1 = 1 unit
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 *162*).	-
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
	-60…100 °C or -76 … 212 °F	Ambient temperature.	1 = 1°

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

No.	Name/Value	Description	Def/FbEq16
35.54	*Motor nominal temperature rise*	Defines the temperature rise of the motor above ambient when the motor is loaded with nominal current. See the motor manufacturer's recommendations. The unit is selected by parameter *96.16 Unit selection*.	80 °C
			
	0…300 °C or 32…572 °F	Temperature rise.	1 = 1°

No.	Name/Value	Description	Def/FbEq16
35.55	*Motor thermal time const*	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..  	256 s
	100…10000 s	Motor thermal time constant.	1 = 1 s
35.56	*Motor overload action*	Selects how the drive reacts when the motor reaches overload condition.	*Warning and fault*
	No action	None.	0
	Warning only	The drive generates an *A783 Motor overload* warning 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	The drive generates an *A783 Motor overload* warning 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*	Selects 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* on page *87*.	*Class 20*
	Class 5	Class 5 relay trip class	0
	Class 10	Class 10 relay trip class	1
	Class 20	Class 20 relay trip class	2

No.	Name/Value	Description	Def/FbEq16
	Class 30	Class 30 relay trip class	3
	Class 40	Class 40 relay trip class	4
36 Load analyzer		Peak value and amplitude logger settings. See also section *Load analyzer* (page *93*).	
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.	*Motor current*
	Not selected	None (peak value logger disabled).	0
	Motor speed used	*01.01 Motor speed used* (page *165*).	1
	Output frequency	*01.06 Output frequency* (page *165*).	3
	Motor current	*01.07 Motor current* (page *165*).	4
	Motor torque	*01.10 Motor torque* (page *165*).	6
	DC voltage	*01.11 DC voltage* (page *165*).	7
	Output power	*01.14 Output power* (page *166*).	8
	Speed ref ramp in	*23.01 Speed ref ramp input* (page *228*).	10
	Speed ref ramp out	*23.02 Speed ref ramp output* (page *228*).	11
	Torque ref used	*26.02 Torque reference used* (page *239*).	13
	Freq ref used	*28.02 Frequency ref ramp output* (page *243*).	14
	Process PID out	*40.01 Process PID output actual* (page *298*).	16
	Other	Source selection (see *Terms and abbreviations* on page *162*).	-
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
36.09	*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
	PVL	Reset the peak value logger.	2
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.	1/1/1980
	1/1/1980...6/5/2159	Peak occurrence date.	-
36.12	*PVL peak time*	The time at which the peak value was recorded.	00:00:00
	00:00:00...23:59:59	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

No.	Name/Value	Description	Def/FbEq16
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*
36.16	*PVL reset date*	The date on which the peak value logger was last reset.	1/1/1980
	1/1/1980...6/5/2159	Last reset date of the peak value logger.	-
36.17	*PVL reset time*	The time at which the peak value logger was last reset.	00:00:00
	00:00:00...23:59:59	Last reset time of the peak value logger.	-

37 User load curve		Settings for user load curve. See also section *User Load Curve* (page *49*).	
37.01	*ULC output status word*	Displays the status of the monitored signal.	0b0000

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.
3…15	Reserved	

	0b0000…0b1111	Status of the monitored signal.	1 = 1
37.02	*ULC supervision signal*	Selects the signal to be supervised.	*Motor torque %*
	Not selected	No signal selected. ULC disabled.	0
	Motor speed %	*01.03 Motor speed %* (page *165*).	1
	Motor current %	*01.08 Motor current % of motor nom* (page *165*).	2
	Motor torque %	*01.10 Motor torque* (page *165*).	3
	Output power % of motor nominal	*01.15 Output power % of motor nom* (page *166*).	4
	Other	Source selection (see *Terms and abbreviations* on page *162*).	-
37.03	*ULC overload actions*	Selects an action taken if the signal stays over the overload curve in a sector for a defined time.	*Disabled*
	Disabled	No warnings or fault generated.	0
	Warning	The drive generates an *A8BE ULC overload warning* if the signal has been continuously over the overload curve for a time defined by parameter *37.41 ULC overload timer*.	1
	Fault	The drive generates a *8002 ULC overload fault* if the signal has been continuously over the overload curve for a time defined by parameter *37.41 ULC overload timer*.	2
	Warning/Fault	The drive generates an *A8BE ULC overload warning* if the signal has been continuously over the overload curve for a time defined by parameter *37.41 ULC overload timer*. The drive generates a *8002 ULC underload fault* if the signal has been continuously over the overload curve for a time defined by parameter *37.41 ULC overload timer*.	3

No.	Name/Value	Description	Def/FbEq16
37.04	*ULC underload actions*	Selects an action taken if the signal stays under the underload curve for a defined time.	*Disabled*
	Disabled	No warnings or fault generated.	0
	Warning	The drive generates an *A8BF ULC underload warning* if the signal has been continuously under the underload curve for a time defined by parameter *37.42 ULC underload timer*.	1
	Fault	The drive generates a *8001 ULC underload fault* if the signal has been continuously under the underload curve for a time defined by parameter *37.42 ULC underload timer*.	2
	Warning/Fault	The drive generates an *A8BF ULC underload warning* if the signal has been continuously under the underload curve for a time defined by parameter *37.42 ULC underload timer*. The drive generates an *A8BF ULC underload warning* if the signal has been continuously under 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. The values of the parameters must satisfy: -30000.0 rpm ≤ *37.11 ULC speed table point 1* < *37.12 ULC speed table point 2* < *37.13 ULC speed table point 3* < *37.14 ULC speed table point 4* < *37.15 ULC speed table point 5* ≤ 30000.0 rpm. Speed points are used if parameter *99.04 Motor control mode* is set to *Vector* or if *99.04 Motor control mode* is set to *Scalar* and the reference unit is rpm.	150.0 rpm
	-30000.0…30000.0 rpm	Speed.	1 = 1 rpm
37.12	*ULC speed table point 2*	Defines the second speed point. See parameter *37.11 ULC speed table point 1*.	750.0 rpm
	-30000.0…30000.0 rpm	Speed.	1 = 1 rpm
37.13	*ULC speed table point 3*	Defines the third speed point. See parameter *37.11 ULC speed table point 1*.	1290.0 rpm
	-30000.0…30000.0 rpm	Speed.	1 = 1 rpm
37.14	*ULC speed table point 4*	Defines the fourth speed point. See parameter *37.11 ULC speed table point 1*.	1500.0 rpm
	-30000.0…30000.0 rpm	Speed.	1 = 1 rpm
37.15	*ULC speed table point 5*	Defines the fifth speed point. See parameter *37.11 ULC speed table point 1*.	1800.0 rpm
	-30000.0…30000.0 rpm	Speed.	1 = 1 rpm

No.	Name/Value	Description	Def/FbEq16
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*) define the underload (lower) curve. The following conditions must be fulfilled: • *37.21 ULC underload point 1* <= *37.31 ULC overload point 1* • *37.22 ULC underload point 2* <= *37.32 ULC overload point 2* • *37.23 ULC underload point 3* <= *37.33 ULC overload point 3* • *37.24 ULC underload point 4* <= *37.34 ULC overload point 4* • *37.25 ULC underload point 5* <= *37.35 ULC overload point 5*	10.0%
	-1600.0…1600.0%	Underload point.	1 = 1%
37.22	*ULC underload point 2*	Defines the second underload point. See parameter *37.21 ULC underload point 1*.	15.0%
	-1600.0…1600.0%	Underload point.	1 = 1%
37.23	*ULC underload point 3*	Defines the third underload point. See parameter *37.21 ULC underload point 1*	25.0%
	-1600.0…1600.0%	Underload point.	1 = 1%
37.24	*ULC underload point 4*	Defines the fourth underload point. See parameter *37.21 ULC underload point 1*	30.0%
	-1600.0…1600.0%	Underload point.	1 = 1%
37.25	*ULC underload point 5*	Defines the fifth underload point. See parameter *37.21 ULC underload point 1*	30.0%
	-1600.0…1600.0%	Underload point.	1 = 1%
37.31	*ULC overload point 1*	Defines the first of the five points on the Y-axis that together with the corresponding point on the X-axis (*37.11 ULC speed table point 1*…*37.15 ULC speed table point 5*) define the overload (higher) curve. At each of the five points the value of the underload curve point must be equal to or smaller than the value of the overload curve point. See parameter *37.21 ULC underload point 1*.	300.0%
	-1600.0…1600.0%	Overload point.	1 = 1%
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 period for which time the monitored signal must remain continuously over the overload curve.	20.0 s
	0.0…10000.0 s	Time.	1 = 1 s

No.	Name/Value	Description	Def/FbEq16
37.42	*ULC underload timer*	Defines the time period for which time the monitored signal must remain continuously below the underload curve.	20.0 s
	0.0…10000.0 s	Time.	1 = 1 s

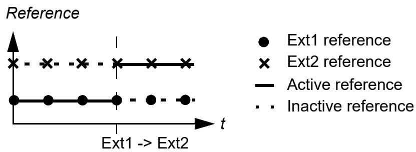
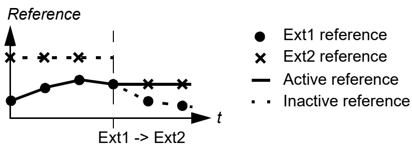
40 Process PID set 1		Parameter values for process PID control. The drive output can be controlled by the process PID. When the process PID control is enabled, the drive controls the process feedback to the reference value. Two different parameter sets can be defined for the process PID. One parameter 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 the control chain diagrams on pages *499* and *502*.	
40.01	*Process PID output actual*	Displays the output of the process PID controller. See the control chain diagram on page *502*. This parameter is read-only.	-
	-200000.00... 200000.00	Process PID controller output.	1 = 1
40.02	*Process PID feedback actual*	Displays the value of process feedback after source selection, mathematical function (parameter *40.10 Set 1 feedback function*), and filtering. See the control chain diagram on page *499*. This parameter is read-only.	-
	-200000.00… 200000.00	Process feedback.	1 = 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 the control chain diagram on page *499*. This parameter is read-only.	-
	-200000.00… 200000.00	Setpoint for process PID controller.	1 = 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 the control chain diagram on page *502*. This parameter is read-only.	-
	-200000.00… 200000.00	PID deviation.	1 = 1
40.05	*Process PID trim output act*	Displays the trimmed reference output. This parameter is read-only.	-
	-32768...32767	Trimmed reference.	1 = 1 unit

No.	Name/Value	Description	Def/FbEq16
40.06	*Process PID status word*	Displays status information on process PID control. This parameter is read-only.	0b0000

Bit	Name	Value
0	PID active	1 = Process PID control active.
1	Setpoint frozen	1 = Process PID setpoint frozen.
2	Output frozen	1 = Process PID controller output frozen.
3	PID sleep mode	1 = Sleep mode active.
4	Sleep boost	1 = Sleep boost active.
5	Trim mode	1 = Trim mode active
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 = Deadband active (see parameter *40.39*)
10	PID set	0 = Parameter set 1 in use. 1 = Parameter set 2 in use.
11	Reserved	
12	Internal setpoint active	1 = Internal setpoint active (see par. *40.16*…*40.23*)
13…15	Reserved	

No.	Name/Value	Description	Def/FbEq16
	0b0000…0b1111	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 *33*).	*Off*
	Off	Process PID control inactive.	0
	On	Process PID control active.	1
	On when drive running	Process PID control is active when the drive is running.	2
40.08	*Set 1 feedback 1 source*	Selects the primary source of process feedback. See the control chain diagram on page *499*.	*AI2 percent*
	Not selected	None.	0
	AI1 scaled	*12.12 AI1 scaled value* (see page *190*).	1
	AI2 scaled	*12.22 AI2 scaled value* (see page *191*).	2
	Freq in scaled	*11.39 Freq in 1 scaled value* (see page *187*).	3
	AI1 percent	*12.101 AI1 percent value* (see page *193*)	8
	AI2 percent	*12.102 AI2 percent value* (see page *193*)	9
	Feedback data storage	*40.91 Feedback data storage* (see page *311*),	10
	Other	Source selection (see *Terms and abbreviations* on page *162*).	-
40.09	*Set 1 feedback 2 source*	Selects the second source of process feedback. The second source is used only if the setpoint function requires two inputs. For the selections, see parameter *40.08 Set 1 feedback 1 source*.	*Not selected*
40.10	*Set 1 feedback function*	Defines how process feedback is calculated from the two feedback sources selected by parameters *40.08 Set 1 feedback 1 source* and *40.09 Set 1 feedback 2 source*.	*In1*
	In1	Source 1.	0

No.	Name/Value	Description	Def/FbEq16
	In1+In2	Sum of sources 1 and 2.	1
	In1-In2	Source 2 subtracted from source 1.	2
	In1*In2	Source 1 multiplied by source 2.	3
	In1/In2	Source 1 divided by source 2.	4
	MIN(In1,In2)	Smaller of the two sources.	5
	MAX(In1,In2)	Greater of the two sources.	6
	AVE(In1,In2)	Average of the two sources.	7
	sqrt(In1)	Square root of source 1.	8
	sqrt(In1-In2)	Square root of (source 1 - source 2).	9
	sqrt(In1+In2)	Square root of (source 1 + source 2).	10
	sqrt(In1)+sqrt(In2)	Square root of source 1 + square root of source 2.	11
40.11	*Set 1 feedback filter time*	Defines the filter time constant for process feedback.	0.000 s
	0.000…30.000 s	Feedback filter time.	1 = 1 s
40.14	*Set 1 setpoint scaling*	Defines, together with parameter *40.15* Set 1 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 *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 3.	0.00
	-200000.00... 200000.00	Process setpoint base.	1=1
40.15	*Set 1 output scaling*	See parameter *40.14 Set 1 setpoint scaling*	0.00
	-200000.00... 200000.00	Process PID controller output base.	1=1
40.16	*Set 1 setpoint 1 source*	Selects the primary source of process PID setpoint. See the control chain diagram on page *499*.	*AI1 percent*
	Not selected	None.	0
	Internal setpoint	Internal setpoint. See parameter *40.19 Set 1 internal setpoint sel1*.	2
	AI1 scaled	*12.12 AI1 scaled value* (see page *190*).	3
	AI2 scaled	*12.22 AI2 scaled value* (see page *191*).	4
	Motor potentiometer	*22.80 Motor potentiometer ref act* (output of the motor potentiometer).	8
	Freq in scaled	*11.39 Freq in 1 scaled value* (see page *187*).	10
	AI1 percent	*12.101 AI1 percent value* (see page *193*)	11
	AI2 percent	*12.102 AI2 percent value* (see page *193*)	12

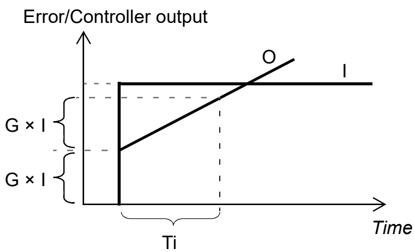
No.	Name/Value	Description	Def/FbEq16
	Control panel (ref saved)	Panel reference (*03.01 Panel reference*, see page *168*) saved by the control system for the location where the control returns is used as the reference. 	13
	Control panel (ref copied)	Panel reference (*03.01 Panel reference*, see page *168*) 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 *168*).	15
	FB A ref2	*03.06 FB A reference 2* (see page *168*).	16
	EFB ref1	*03.09 EFB reference 1* (see page *168*).	19
	EFB ref2	*03.10 EFB reference 2* (see page *168*).	20
	Setpoint data storage	*40.92 Setpoint data storage* (see page *311*)	24
	Other	Source selection (see *Terms and abbreviations* on page *162*).	-
40.17	*Set 1 setpoint 2 source*	Selects the second source of process setpoint. The second source is used only if the setpoint function requires two inputs. For the selections, see parameter *40.16 Set 1 setpoint 1 source*.	*Not selected*
40.18	*Set 1 setpoint function*	Selects a function between the setpoint sources selected by parameters *40.16 Set 1 setpoint 1 source* and *40.17 Set 1 setpoint 2 source*.	*In1*
	In1	Source 1.	0
	In1+In2	Sum of sources 1 and 2.	1
	In1-In2	Source 2 subtracted from source 1.	2
	In1*In2	Source 1 multiplied by source 2.	3
	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

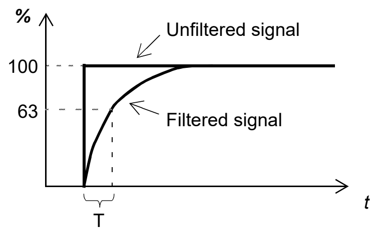
No.	Name/Value	Description	Def/FbEq16
	sqrt(In1)+sqrt(In2)	Square root of source 1 + square root of source 2.	11
40.19	*Set 1 internal setpoint sel1*	Selects together with *40.20 Set 1 internal setpoint sel2* the internal setpoint out of the presets defined by parameters *40.21*…*40.23*. **Note:** Parameters *40.16 Set 1 setpoint 1 source* and *40.17 Set 1 setpoint 2 source* must be set to *Internal setpoint*.	*Not selected*

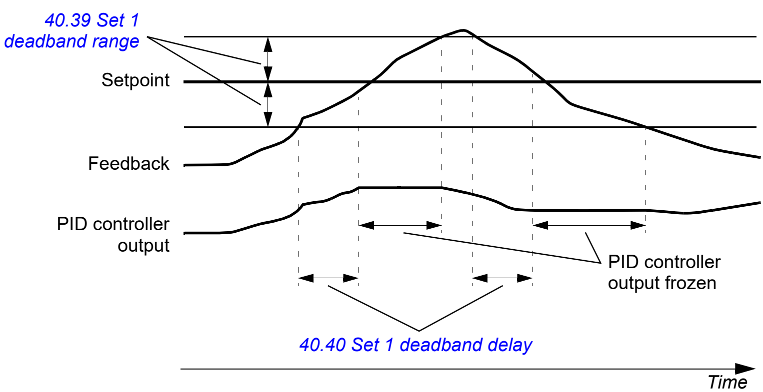
Source defined by par. *40.19*	Source defined by par. *40.20*	Setpoint preset active
0	0	Setpoint source
1	0	1 (par. ***40.21***)
0	1	2 (par. ***40.22***)
1	1	3 (par. ***40.23***)

No.	Name/Value	Description	Def/FbEq16
	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
	Timed function 1	Bit 0 of *34.01 Timed functions status* (see page *276*).	18
	Timed function 2	Bit 1 of *34.01 Timed functions status* (see page *276*).	19
	Timed function 3	Bit 2 of *34.01 Timed functions status* (see page *276*).	20
	Supervision 1	Bit 0 of *32.01 Supervision status* (see page *269*).	21
	Supervision 2	Bit 1 of *32.01 Supervision status* (see page *269*).	22
	Supervision 3	Bit 2 of *32.01 Supervision status* (see page *269*).	23
	Other [bit]	Source selection (see *Terms and abbreviations* on page *162*).	-
40.20	*Set 1 internal setpoint sel2*	Selects together with *40.19 Set 1 internal setpoint sel1* the internal setpoint used out of the three internal setpoints defined by parameters *40.21*…*40.23*. See table at *40.19 Set 1 internal setpoint sel1*.	*Not selected*
	Not selected	0.	0
	Selected	1.	1
	DI1	Digital input DI1 (*10.02 DI delayed status*, bit 0).	2
	DI2	Digital input DI2 (*10.02 DI delayed status*, bit 1).	3
	DI3	Digital input DI3 (*10.02 DI delayed status*, bit 2).	4
	DI4	Digital input DI4 (*10.02 DI delayed status*, bit 3).	5
	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 *276*).	18
	Timed function 2	Bit 1 of *34.01 Timed functions status* (see page *276*).	19
	Timed function 3	Bit 2 of *34.01 Timed functions status* (see page *276*).	20
	Supervision 1	Bit 0 of *32.01 Supervision status* (see page *269*).	21

No.	Name/Value	Description	Def/FbEq16
	Supervision 2	Bit 1 of *32.01 Supervision status* (see page *269*).	22
	Supervision 3	Bit 2 of *32.01 Supervision status* (see page *269*).	23
	Other [bit]	Source selection (see *Terms and abbreviations* on page *162*).	-
40.21	*Set 1 internal setpoint 1*	Internal process setpoint 1. See parameter *40.19 Set 1 internal setpoint sel1*.	0.00
	-200000.00... 200000.00	Internal process setpoint 1.	1 = 1
40.22	*Set 1 internal setpoint 2*	Internal process setpoint 2. See parameter *40.19 Set 1 internal setpoint sel1*.	0.00
	-200000.00... 200000.00	Internal process setpoint 2.	1 = 1
40.23	*Set 1 internal setpoint 3*	Internal process setpoint 3. See parameter *40.19 Set 1 internal setpoint sel1*.	0.00
	-200000.00... 200000.00	Internal process setpoint 3.	1 = 1
40.24	*Set 1 internal setpoint 0*	Internal process setpoint 0. See parameter *40.19 Set 1 internal setpoint sel1*.	0.00
	-200000.00... 200000.00	Internal process setpoint 0.	1 = 1
40.26	*Set 1 setpoint min*	Defines a minimum limit for the process PID controller setpoint.	0.00
	-200000.00... 200000.00	Minimum limit for process PID controller setpoint.	1 = 1
40.27	*Set 1 setpoint max*	Defines a maximum limit for the process PID controller setpoint.	200000.00
	-200000.00... 200000.00	Maximum limit for process PID controller setpoint.	1 = 1
40.28	*Set 1 setpoint increase time*	Defines the minimum time it takes for the setpoint to increase from 0% to 100%.	0.0 s
	0.0…1800.0 s	Setpoint increase time.	1 = 1
40.29	*Set 1 setpoint decrease time*	Defines the minimum time it takes for the setpoint to decrease from 100% to 0%.	0.0 s
	0.0…1800.0 s	Setpoint decrease time.	1 = 1
40.30	*Set 1 setpoint freeze enable*	Freezes, or defines a source that can be used to freeze, the setpoint of the process PID controller. This feature is useful when the reference is based on a process feedback connected to an analog input, and the sensor must be serviced without stopping the process. 1 = Process PID controller setpoint frozen See also parameter *40.38 Set 1 output freeze*.	*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

No.	Name/Value	Description	Def/FbEq16
	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 *276*).	18
	Timed function 2	Bit 1 of *34.01 Timed functions status* (see page *276*).	19
	Timed function 3	Bit 2 of *34.01 Timed functions status* (see page *276*).	20
	Supervision 1	Bit 0 of *32.01 Supervision status* (see page *269*).	21
	Supervision 2	Bit 1 of *32.01 Supervision status* (see page *269*).	22
	Supervision 3	Bit 2 of *32.01 Supervision status* (see page *269*).	23
	Other [bit]	Source selection (see *Terms and abbreviations* on page *162*).	-
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 *52*).	*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 *162*).	-
40.32	*Set 1 gain*	Defines the gain for the process PID controller. See parameter *40.33 Set 1 integration time*.	1.00
	0.01…100.00	Gain for PID controller.	100 = 1
40.33	*Set 1 integration time*	Defines the integration time for the process PID controller. This time needs to be set to the same order of magnitude as the reaction time of the process being controlled, otherwise instability will result.  I = controller input (error) O = controller output G = gain Ti = integration time **Note:** Setting this value to 0 disables the “I” part, turning the PID controller into a PD controller.	60.0 s
	0.0…9999.0 s	Integration time.	1 = 1 s

No.	Name/Value	Description	Def/FbEq16
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.  $O = I \times (1 - e^{-t/T})$ 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
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.	0.0
	-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*.	100.0
	-200000.00 …200000.00	Maximum limit for process PID controller output.	1 = 1
40.38	*Set 1 output freeze*	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

No.	Name/Value	Description	Def/FbEq16
	DI5	Digital input DI5 (*10.02 DI delayed status*, bit 4).	6
	DI6	Digital input DI6 (*10.02 DI delayed status*, bit 5).	7
	Timed function 1	Bit 0 of *34.01 Timed functions status* (see page *276*).	18
	Timed function 2	Bit 1 of *34.01 Timed functions status* (see page *276*).	19
	Timed function 3	Bit 2 of *34.01 Timed functions status* (see page *276*).	20
	Supervision 1	Bit 0 of *32.01 Supervision status* (see page *269*).	21
	Supervision 2	Bit 1 of *32.01 Supervision status* (see page *269*).	22
	Supervision 3	Bit 2 of *32.01 Supervision status* (see page *269*).	23
	Other [bit]	Source selection (see *Terms and abbreviations* on page *162*).	-
40.39	*Set 1 deadband range*	Defines a deadband around the setpoint. Whenever process feedback enters the deadband, a delay timer starts. If the feedback remains within the deadband longer than the delay (*40.40 Set 1 deadband delay*), the PID controller output is frozen. Normal operation resumes after the feedback value leaves the deadband.  	0.00
	00……200000.00	Deadband range.	1 = 1
40.40	*Set 1 deadband delay*	Delay for the deadband. See parameter *40.39 Set 1 deadband range*.	0.0
	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
	0.0…3600.0 s	Sleep start delay.	1 = 1

No.	Name/Value	Description	Def/FbEq16
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
	0.0…3600.0 s	Sleep boost time.	1 = 1
40.46	*Set 1 sleep boost step*	When the drive is entering sleep mode, the process setpoint is increased by this value for the time defined by parameter *40.45 Set 1 sleep boost time*. If active, sleep boost is aborted when the drive wakes up.	0.00
	0.00…200000.00	Sleep boost step.	1 = 1
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
	-200000.00… 200000.00	Wake-up level (as deviation between process setpoint and feedback).	1 = 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
	0.00…60.00 s	Wake-up delay.	1 = 1
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 *53*). 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
	Timed function 1	Bit 0 of *34.01 Timed functions status* (see page *276*).	18
	Timed function 2	Bit 1 of *34.01 Timed functions status* (see page *276*).	19
	Timed function 3	Bit 2 of *34.01 Timed functions status* (see page *276*).	20
	Supervision 1	Bit 0 of *32.01 Supervision status* (see page *269*).	21
	Supervision 2	Bit 1 of *32.01 Supervision status* (see page *269*).	22
	Supervision 3	Bit 2 of *32.01 Supervision status* (see page *269*).	23
	Other [bit]	Source selection (see *Terms and abbreviations* on page *162*).	-
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 *190*).	1

No.	Name/Value	Description	Def/FbEq16
	AI2 scaled	*12.22 AI2 scaled value* (see page *191*).	2
	FB A ref1	*03.05 FB A reference 1* (see page *168*).	3
	FB A ref2	*03.06 FB A reference 2* (see page *168*).	4
	Other	Source selection (see *Terms and abbreviations* on page *162*).	-
40.51	*Set 1 trim mode*	Activates the trim function and selects between direct and proportional trimming (or a combination of both). With trimming, it is possible to apply a corrective factor to the drive reference (setpoint). The output after trimming is available as parameter *40.05 Process PID trim output act* .	*Off*
	Off	The trim function is inactive.	0
	Direct	The trim function is active. The trimming factor is relative to the maximum speed, torque or frequency; the selection between these is made by parameter *40.52 Set 1 trim selection*.	1
	Proportional	The trim function is active. The trimming factor is relative to the reference selected by parameter *40.53 Set 1 trimmed ref pointer*.	2
	Combined	The trim function is active. The trimming factor is a combination of both *Direct* and *Proportional* modes; the proportions of each are defined by parameter *40.54 Set 1 trim mix*.	3
40.52	*Set 1 trim selection*	Selects whether trimming is used for correcting the speed, torque or frequency reference.	*Speed*
	Torque	Torque reference trimming.	1
	Speed	Speed reference trimming.	2
	Frequency	Frequency reference trimming.	3
40.53	*Set 1 trimmed ref pointer*	Selects the signal source for the trim reference.	*Not selected*
	Not selected	None.	0
	AI1 scaled	*12.12 AI1 scaled value* (see page *190*).	1
	AI2 scaled	*12.22 AI2 scaled value* (see page *191*).	2
	FBA ref1	*03.05 FB A reference 1* (see page *168*).	3
	FBA ref2	*03.06 FB A reference 2* (see page *168*).	4
	Other	Source selection (see *Terms and abbreviations*).	-
40.54	*Set 1 trim mix*	When parameter *40.51 Set 1 trim mode* is set to *Combined*, defines the effect of direct and proportional trim sources in the final trimming factor. 0.000 = 100% proportional 0.500 = 50% proportional, 50% direct 1.000 = 100% direct	0.000
	0.000...1.000	Trim mix.	1 = 1
40.55	*Set 1 trim adjust*	Defines a multiplier for the trimming factor. This value is multiplied by the result of parameter *40.51 Set 1 trim mode*. Consequently, the result of the multiplication is used to multiply the result of parameter *40.56 Set 1 trim adjust*.	1.000
	-100.000...100.000	Multiplier for trimming factor.	1 = 1
40.56	*Set 1 trim source*	Selects the reference to be trimmed.	*PID output*
	PID ref	PID setpoint.	1

No.	Name/Value	Description	Def/FbEq16
	PID output	PID controller output.	2
40.57	*PID set1/set2 selection*	Selects the source that determines whether process PID parameter set 1 (parameters *40.07*…*40.50*) or set 2 (group *41 Process PID set 2*) is used.	*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
	Timed function 1	Bit 0 of *34.01 Timed functions status* (see page *276*).	18
	Timed function 2	Bit 1 of *34.01 Timed functions status* (see page *276*).	19
	Timed function 3	Bit 2 of *34.01 Timed functions status* (see page *276*).	20
	Supervision 1	Bit 0 of *32.01 Supervision status* (see page *269*).	21
	Supervision 2	Bit 1 of *32.01 Supervision status* (see page *269*).	22
	Supervision 3	Bit 2 of *32.01 Supervision status* (see page *269*).	23
	Other [bit]	Source selection (see *Terms and abbreviations* on page *162*).	-
40.58	*Set 1 increase prevention*	Activates increase prevention of PID integration term for PID set 1.	*No*
	No	Increase prevention not in use.	0
	Limiting	The PID integration term is not increased.	1
	Other [bit]	Source selection (see *Terms and abbreviations* on page *162*).	-
40.59	*Set 1 decrease prevention*	Activates decrease prevention of PID integration term for PID set 1.	*No*
	No	Decrease prevention not in use.	0
	Limiting	The PID integration term is not decreased.	1
	Other [bit]	Source selection (see *Terms and abbreviations* on page *162*).	-
40.60	*Set 1 PID activation source*	Selects the source of process PID set 1 activation.	*On*
	Off	Set 1 PID activation source is Off.	0
	On	Set 1 PID activation source is On.	1
	Follow Ext1/Ext2 selection	Selection follows the value of parameter *19.11 Ext1/Ext2 selection*. By changing to Ext2 control location, Process PID set 1 is activated.	2
	DI1	Digital input DI1 (*10.02 DI delayed status*, bit 0).	3
	DI2	Digital input DI2 (*10.02 DI delayed status*, bit 1).	4
	DI3	Digital input DI3 (*10.02 DI delayed status*, bit 2).	5
	DI4	Digital input DI4 (*10.02 DI delayed status*, bit 3).	6
	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 *162*).	-

No.	Name/Value	Description	Def/FbEq16
40.61	*Setpoint scaling actual*	Actual setpoint scaling. See parameter *40.14 Set 1 setpoint scaling*.	0.00
	-200000.00… 200000.00 PID customer units	Scaling.	1 = 1 PID customer unit
40.62	*PID internal setpoint actual*	Displays the value of the internal setpoint. See the control chain diagram on page *502*. This parameter is read-only.	-
	-200000.00… 200000.00 %	Process PID internal setpoint.	1 = 1
40.65	*Trim auto connection*	Enable the PID trim auto connection and connects the *40.05 Process PID trim output act* to either speed, torque or frequency chains based on the trim selection parameter *40.52 Set 1 trim selection* or *41.52 Set 2 trim selection*.	*Disable*
	Disable	Trim auto connection disabled.	0
	Enable	Trim auto connection enabled.	1
40.79	*Set 1 units*	Selects the unit for process PID setpoint, feedback and deviation.	*°C*
	User text	User text	0
	%	%	1
	bar	bar	2
	kPa	kPa	3
	Pa	Pa	4
	psi	psi	5
	CFM	CFM	6
	inH_2O	inH_2O	7
	°C	°C	8
	°F	°F	9
	mbar	mbar	10
	m^3/h	m^3/h	11
	dm^3/h	dm^3/h	12
	l/s	l/s	13
	l/min	l/min	14
	l/h	l/h	15
	m^3/s	m^3/s	16
	m^3/m	m^3/m	17
	km^3/h	km^3/h	18
	gal/s	gal/s	19
	ft^3/s	ft^3/s	20
	ft^3/m	ft^3/m	21
	ft^3/h	ft^3/h	22
	ppm	ppm	23
	inHg	inHg	24
	kCFM	kCFM	25

No.	Name/Value	Description	Def/FbEq16
	inWC	inWC	26
	GPM	GPM	27
	gal/m	gal/m	28
	in wg	in wg	29
	MPa	MPa	30
	ftWC	ftWC	31
40.80	*Set 1 PID output min source*	Selects the source for set 1 PID output minimum.	*Set1 output min*
	None	None.	0
	Set1 output min	*40.36 Set 1 output min*.	1
	Other	Source selection (see *Terms and abbreviations* on page *162*).	-
40.81	*Set 1 PID output max source*	Selects the source for set 1 PID output maximum.	*Set1 output max*
	None	None.	0
	Set1 output max	*40.37 Set 1 output max*.	1
	Other	Source selection (see *Terms and abbreviations* on page *162*).	-
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.	-
40.90	*Set 1 feedback multiplier*	Defines the multiplier used in formulas of parameter *40.10 Set 1 feedback function*.	1.00
	-200000.00… 200000.00	Multiplier.	1 = 1
40.91	*Feedback data storage*	Storage parameter for receiving a process feedback value e.g. 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 e.g. 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*. Correct later.	0.00
	-100.00...100.00%	Percentage.	1=1
40.97	*Process PID feedback%*	Percentage scaled signal of parameter *40.02 Process PID feedback actual*.	0.00
	-100.00...100.00%	Percentage.	1=1

No.	Name/Value	Description	Def/FbEq16
40.98	*Process PID setpoint%*	Percentage scaled signal of parameter *40.03 Process PID setpoint actual*.	0.00
	-100.00...100.00%	Percentage.	1=1
40.99	*Process PID deviation%*	Percentage scaled signal of parameter *40.04 Process PID deviation actual*.	0.00
	-100.00...100.00%	Percentage.	1=1

41 Process PID set 2		A second set of parameter values for process PID control. The selection between this set and first set (parameter group *40 Process PID set 1*) is made by parameter *40.57 PID set1/set2 selection*. See also parameters *40.01*…*40.06*, and the control chain diagrams on pages *499* and *502*.	
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*
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 2 setpoint scaling*.	0.00
41.15	*Set 2 output scaling*	See parameter *40.15 Set 2 output scaling*.	0.00
41.16	*Set 2 setpoint 1 source*	See parameter *40.16 Set 1 setpoint 1 source*.	*AI1 percent*
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
41.22	*Set 2 internal setpoint 2*	See parameter *40.22 Set 1 internal setpoint 2*.	0.00
41.23	*Set 2 internal setpoint 3*	See parameter *40.23 Set 1 internal setpoint 3*.	0.00
41.24	*Set 2 internal setpoint 0*	See parameter *40.24 Set 1 internal setpoint 0*.	0.00
41.26	*Set 2 setpoint min*	See parameter *40.26 Set 1 setpoint min*.	0.00
41.27	*Set 2 setpoint max*	See parameter *40.27 Set 1 setpoint max*.	200000.00
41.28	*Set 2 setpoint increase time*	See parameter *40.28 Set 1 setpoint increase time*.	0.0 s
41.29	*Set 2 setpoint decrease time*	See parameter *40.29 Set 1 setpoint decrease time*.	0.0 s

No.	Name/Value	Description	Def/FbEq16
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*.	0.0
41.37	*Set 2 output max*	See parameter *40.37 Set 1 output max*.	100.0
41.38	*Set 2 output freeze*	See parameter *40.38 Set 1 output freeze*.	*Not selected*
41.39	*Set 2 deadband range*	See parameter *40.39 Set 1 deadband range*.	0.00
41.40	*Set 2 deadband delay*	See parameter *40.40 Set 1 deadband delay*.	0.0
41.43	*Set 2 sleep level*	See parameter *40.43 Set 1 sleep level*.	0.0
41.44	*Set 2 sleep delay*	See parameter *40.44 Set 1 sleep delay*.	60.0 s
41.45	*Set 2 sleep boost time*	See parameter *40.45 Set 1 sleep boost time*.	0.0 s
41.46	*Set 2 sleep boost step*	See parameter *40.46 Set 1 sleep boost step*.	0.00
41.47	*Set 2 wake-up deviation*	See parameter *40.47 Set 1 wake-up deviation*.	0.00
41.48	*Set 2 wake-up delay*	See parameter *40.48 Set 1 wake-up delay*.	0.50 s
41.49	*Set 2 tracking mode*	See parameter *40.49 Set 1 tracking mode*.	*Not selected*
41.50	*Set 2 tracking ref selection*	See parameter *40.50 Set 1 tracking ref selection*.	*Not selected*
41.51	*Set 2 trim mode*	See parameter *40.51 Set 1 trim mode*.	*Off*
41.52	*Set 2 trim selection*	See parameter *40.52 Set 1 trim selection*.	*Speed*
41.53	*Set 2 trimmed ref pointer*	See parameter *40.53 Set 1 trimmed ref pointer*.	*Not selected*
41.54	*Set 2 trim mix*	See parameter *40.54 Set 1 trim mix*.	0.000
41.55	*Set 2 trim adjust*	See parameter *40.55 Set 1 trim adjust*.	1.000
41.56	*Set 2 trim source*	See parameter *40.56 Set 1 trim source*.	*PID output*
41.58	*Set 2 increase prevention*	See parameter *40.58 Set 1 increase prevention*.	*No*
41.59	*Set 2 decrease prevention*	See parameter *40.59 Set 1 decrease prevention*.	*No*
41.60	*Set 2 PID activation source*	See parameter *40.60 Set 1 PID activation source*.	*On*
41.79	*Set 2 units*	See parameter *40.79 Set 1 units*.	*°C*
41.80	*Set 1 PID output min source*	Selects the source for set 2 PID output minimum.	*Set2 output min*

No.	Name/Value	Description	Def/FbEq16
	None	None.	0
	Set2 output min	*41.36 Set 2 output min*.	1
	Other	Source selection (see *Terms and abbreviations* on page *162*).	-
41.81	*Set 1 PID output max source*	Selects the source for set 2 PID output maximum.	*Set2 output max*
	None	None.	0
	Set2 output max	*41.37 Set 2 output max*.	1
	Other	Source selection (see *Terms and abbreviations* on page *162*).	-
41.89	*Set 2 setpoint multiplier*	See parameter *40.89 Set 1 feedback multiplier*	1.00
41.90	*Set 2 feedback multiplier*	Defines the multiplier used in formulas of parameter *41.10 Set 2 feedback function*.	1.00
	-100000.00… 100000.00	Multiplier.	1 = 1

43 Brake chopper		Settings for the internal brake chopper. This parameter group is applicable only for frames R0...R3	
43.01	*Braking resistor temperature*	Displays the estimated temperature of the brake resistor, or how close the brake resistor is to being too hot. The value is given in percent where 100% is the eventual temperature the resistor would reach when loaded long enough with its rated maximum load capacity (*43.09 Brake resistor Pmax cont*). The temperature calculation is based on the values of parameters *43.08*, *43.09* and *43.10*, and on the assumption that the resistor is installed as instructed by the manufacturer (ie it cools down as expected). This parameter is read-only.	0.0
	0.0…120.0%	Estimated brake resistor temperature.	1 = 1%
43.06	*Brake chopper enable*	Enables brake chopper control and selects the brake resistor overload protection method (calculation or measurement). **Note:** Before enabling brake chopper control, ensure that • a brake resistor is connected • overvoltage control is switched off (parameter *30.30 Overvoltage control*) • the supply voltage range (parameter *95.01 Supply voltage*) has been selected correctly.	*Disabled*
	Disabled	Brake chopper control disabled.	0
	Enabled with thermal model	Brake chopper control enabled with brake resistor protection based on the thermal model. If you select this, you must also specify the values needed by the model, ie. parameters *43.08*… *43.12*. See the resistor data sheet.	1
	Enabled without thermal model	Brake chopper control enabled without resistor overload protection based on the thermal model. This setting can be used, for example, if the resistor is equipped with a thermal switch that is wired to open the main contactor of the drive if the resistor overheats. For more information, see chapter *Resistor braking* in the *Hardware manual*.	2

No.	Name/Value	Description	Def/FbEq16
	Overvoltage peak protection	Brake chopper control enabled in an overvoltage condition. This setting is intended for situations where • the braking chopper is not needed for runtime operation, ie. to dissipate the inertial energy of the motor, • the motor is able to store a considerable amount magnetic energy in its windings, and • the motor might, deliberately or inadvertently, be stopped by coasting. In such a situation, the motor would potentially discharge enough magnetic energy towards the drive to cause damage. To protect the drive, the brake chopper can be used with a small resistor dimensioned merely to handle the magnetic energy (not the inertial energy) of the motor. With this setting, the brake chopper is activated only whenever the DC voltage exceeds the overvoltage limit. During normal use, the brake chopper is not operating.	3
43.07	*Brake chopper runtime enable*	Selects the source for quick brake chopper on/off control. 0 = Brake chopper IGBT pulses are cut off 1 = Normal brake chopper IGBT modulation allowed. This parameter can be used to enable chopper operation only when the supply is missing from a drive with a regenerative supply unit.	*On*
	Off	0.	0
	On	1.	1
	Other [bit]	Source selection (see *Terms and abbreviations* on page *162*).	-
43.08	*Brake resistor thermal tc*	Defines the thermal time constant for the brake resistor thermal model.	0 s
	0…10000 s	Brake resistor thermal time constant, ie the rated time to achieve 63% temperature.	1 = 1 s
43.09	*Brake resistor Pmax cont*	Defines the maximum continuous load of the brake resistor that will eventually raise the resistor temperature to the maximum allowed value (= continuous heat dissipation capacity of the resistor in kW) but not above it. The value is used in the resistor overload protection based on the thermal model. See parameter *43.06 Brake chopper enable* and the data sheet of the brake resistor used.	0.00 kW
	0.00… 10000.00 kW	Maximum continuous load of the brake resistor.	1 = 1 kW
43.10	*Brake resistance*	Defines the resistance value of the brake resistor. The value is used for the brake resistor protection based on the thermal model. See parameter *43.06 Brake chopper enable*.	0.0 ohm
	0.0…1000.0 ohm	Brake resistor resistance value.	1 = 1 ohm
43.11	*Brake resistor fault limit*	Selects the fault limit for the brake resistor protection based on the thermal model. See parameter *43.06 Brake chopper enable*. When the limit is exceeded, the drive trips on fault *7183 BR excess temperature*. The value is given in percent of the temperature the resistor reaches when loaded with the power defined by parameter *43.09 Brake resistor Pmax cont*.	105%
	0…150%	Brake resistor temperature fault limit.	1 = 1%

No.	Name/Value	Description	Def/FbEq16
43.12	*Brake resistor warning limit*	Selects the warning limit for the brake resistor protection based on the thermal model. See parameter *43.06 Brake chopper enable*. When the limit is exceeded, the drive generates a *A793 BR excess temperature* warning. The value is given in percent of the temperature the resistor reaches when loaded with the power defined by parameter *43.09 Brake resistor Pmax cont.*	95%
	0…150%	Brake resistor temperature warning limit.	1 = 1%
44 Mechanical brake control		Configuration of mechanical brake control. See also section *Mechanical brake control* (page *59*).	
44.01	*Brake control status*	Displays the mechanical brake control status word. This parameter is read-only.	0b0000

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

No.	Name/Value	Description	Def/FbEq16
	0b0000…0b1111	Mechanical brake control status word.	1 = 1
44.06	*Brake control enable*	Activates/deactivates (or selects a source that activates/deactivates) the mechanical brake control logic. 0 = Brake control inactive 1 = Brake control active	*Not selected*
	Not selected	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
	Timed function 1	Bit 0 of *34.01 Timed functions status* (see page *276*).	18
	Timed function 2	Bit 1 of *34.01 Timed functions status* (see page *276*).	19
	Timed function 3	Bit 2 of *34.01 Timed functions status* (see page *276*).	20
	Supervision 1	Bit 0 of *32.01 Supervision status* (see page *269*).	24
	Supervision 2	Bit 1 of *32.01 Supervision status* (see page *269*).	25
	Supervision 3	Bit 2 of *32.01 Supervision status* (see page *269*).	26

No.	Name/Value	Description	Def/FbEq16
	Other [bit]	Source selection (see *Terms and abbreviations* on page *162*).	-
44.08	*Brake open delay*	Defines the brake open delay, ie. the delay between the internal open brake command and the release of motor speed control. The delay timer starts when the drive has magnetized the motor. Simultaneously with the timer start, the brake control logic energizes the brake control output and the brake starts to open. Set this parameter to the value of mechanical opening delay specified by the brake manufacturer.	0.00 s
	0.00…5.00 s	Brake open delay.	100 = 1 s
44.13	*Brake close delay*	Specifies a delay between a close command (that is, when the brake control output is de-energized) and when the drive stops modulating. This is to keep the motor live and under control until the brake actually closes. Set this parameter equal to the value specified by the brake manufacturer as the mechanical wake-up time of the brake.	0.00 s
	0.00…60.00 s	Brake close delay.	100 = 1 s
44.14	*Brake close level*	Defines the brake close speed as an absolute value. After motor speed has decelerated to this level, a close command is given.	100.00 rpm
	0.00…1000.00 rpm	Brake close speed.	See par. *46.01*

45 Energy efficiency		Settings for the energy saving calculators. See also section *Energy saving calculators* (page *92*).	
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
	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
	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
	0.0…999.9 kWh	Energy savings in kWh.	10 = 1 kWh

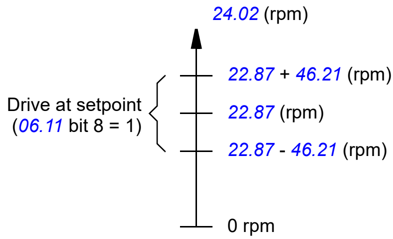
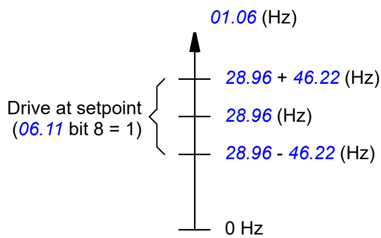
No.	Name/Value	Description	Def/FbEq16
45.04	*Saved energy*	Energy saved in kWh compared to direct-on-line motor connection. If the internal brake chopper of the drive is enabled, all energy fed by the motor to the drive is assumed to be converted into heat. This parameter is read-only (see parameter *45.21 Energy calculations reset*).	0.0
	0.0…214748364.0 kWh	Energy savings in kWh.	1 = 1 kWh
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. This parameter is read-only (see parameter *45.21 Energy calculations reset*).	0 INR
	0…4294967295 thousands	Monetary savings in thousands of units.	1 = 1 unit
45.06	*Saved money*	Monetary savings compared to direct-on-line motor connection. This value is a calculated by multiplying the saved energy in kWh by the currently active energy tariff (*45.14 Tariff selection*). When this parameter rolls over, parameter *45.05 Saved money x1000* is incremented. This parameter is read-only (see parameter *45.21 Energy calculations reset*).	0.00 INR
	0.00…999.99 units	Monetary savings.	1 = 1 unit
45.07	*Saved amount*	Monetary savings compared to direct-on-line motor connection. This value is a calculated by multiplying the saved energy in kWh by the currently active energy tariff (*45.14 Tariff selection*). This parameter is read-only (see parameter *45.21 Energy calculations reset*).	0.00 INR
	0.00… 21474830.08 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
	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
	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
	0.0…214748300.8 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.	*Disable*
	Disable	Energy optimization disabled.	0
	Enable	Energy optimization enabled.	1
45.12	*Energy tariff 1*	Defines energy tariff 1 (price of energy per kWh). Depending on the setting of parameter *45.14 Tariff selection*, either this value or *45.13 Energy tariff 2* is used for reference when monetary savings are calculated. **Note:** Tariffs are read only at the instant of selection, and are not applied retroactively.	5.000 INR
	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*.	6.000 INR
	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 *162*).	-
45.17	*Tariff currency unit*	Selects the currency unit based on which the values of parameters *45.05*, *45.06*, *45.07*, *45.12*, *45.13* are displayed.	*Local currency*
	Local currency	Displays the values of parameters *45.05*, *45.06*, *45.07*, *45.12*, *45.13* in Indian rupee.	100
	EUR	Displays the values of parameters *45.05*, *45.06*, *45.07*, *45.12*, *45.13* in euro.	101
	USD	Displays the values of parameters *45.05*, *45.06*, *45.07*, *45.12*, *45.13* in US dollars.	102

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.	0.00 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
	-3000.00 … 3000.00 kW	Peak power value.	10 = 1 kW
45.32	*Monthly peak power date*	Date of the peak power during the present month.	1/1/1980
	1/1/1980...6/5/2159	Date.	N/A
45.33	*Monthly peak power time*	Time of the peak power during the present month.	00:00:00
		Time.	N/A
45.34	*Monthly total energy (resettable)*	Total energy consumption from the beginning of the present month. You can reset the value by setting it to zero.	0.00 kWh
	-1000000.00 … 1000000.00 kWh	Total energy.	0.01 = 1 kWh
45.35	*Last month total energy*	Total energy consumption during the previous month, that is, between midnight of the first day or the previous month and midnight of the first day of the present month.	0.00 kWh
	-1000000.00 … 1000000.00 kWh		0.01 = 1 kWh
45.36	*Lifetime peak power value*	Value of the peak power over the drive lifetime.	0.00 kW
	-3000.00 … 3000.00 kW	Peak power value.	10 = 1 kW
45.37	*Lifetime peak power date*	Date of the peak power over the drive lifetime.	1/1/1980
		Date.	N/A
45.38	*Lifetime peak power time*	Time of the peak power over the drive lifetime.	00:00:00
		Time.	N/A
46 Monitoring/scaling settings		Speed supervision settings; actual signal filtering; general scaling settings.	
46.01	*Speed scaling*	Defines the maximum speed value used to define the acceleration ramp rate and the initial speed value used to define the deceleration ramp rate (see parameter group *23 Speed reference ramp*). The speed acceleration and deceleration ramp times are therefore related to this value (**not** to parameter *30.12 Maximum speed*). Also defines the 16-bit scaling of speed-related parameters. The value of this parameter corresponds to 20000 in e.g. fieldbus communication.	1500.00 rpm
	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 in e.g. fieldbus communication.	50.00 Hz
	0.10…1000.00 Hz	Acceleration/deceleration terminal/initial frequency.	10 = 1 Hz
46.03	*Torque scaling*	Defines the 16-bit scaling of torque parameters. The value of this parameter (in percent of nominal motor torque) corresponds to 10000 in e.g. fieldbus communication.	100.0%
	0.1…1000.0%	Torque corresponding to 10000 on fieldbus.	10 = 1%
46.04	*Power scaling*	Defines the output power value that corresponds to 10000 in e.g. fieldbus communication. The unit is selected by parameter *96.16 Unit selection*.	1000.00 kW
	0.10 …30000.00 kW or hp	Power corresponding to 10000 on fieldbus.	1 = 1 unit
46.05	*Current scaling*	Defines the 16-bit scaling of current parameters. The value of this parameter corresponds to 10000 in fieldbus communication.	10000 A
	0…30000 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 A or FBA B). For example, with a setting of 30, the fieldbus reference range of 0…20000 would correspond to a speed of 30…[*46.02*] Hz. **Note:** This parameter is effective only with the ABB Drives communication profile.	0.00 Hz
	0.00 … 1000.00 Hz	Speed corresponding to minimum fieldbus reference.	10 = 1 Hz
46.11	*Filter time motor speed*	Defines a filter time for signals *01.01 Motor speed used* and *01.02 Motor speed estimated*.	500 ms
	2…20000 ms	Motor speed signal filter time.	1 = 1 ms
46.12	*Filter time output frequency*	Defines a filter time for signal *01.06 Output frequency*.	500 ms
	2…20000 ms	Output frequency signal filter time.	1 = 1 ms
46.13	*Filter time motor torque*	Defines a filter time for signal *01.10 Motor torque*.	100 ms
	2…20000 ms	Motor torque signal filter time.	1 = 1 ms
46.14	*Filter time power*	Defines a filter time for signal *01.14 Output power*.	100 ms
	2…20000 ms	Output power signal filter time.	1 = 1 ms

No.	Name/Value	Description	Def/FbEq16
46.21	*At speed hysteresis*	Defines the “at setpoint” limits for speed control of the drive. When the difference between speed reference (*22.87 Speed reference act 7*) and the speed feedback (*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.	1500.00 rpm
	0.00…30000.00 rpm	“Above limit” indication trigger level for speed control.	See par. *46.01*
46.32	*Above frequency limit*	Defines the trigger level for “above limit” indication in frequency control. When actual frequency exceeds the limit, bit 10 of *06.17 Drive status word 2* is set.	50.00 Hz
	0.00…1000.00 Hz	“Above limit” indication trigger level for frequency control.	See par. *46.02*

No.	Name/Value	Description	Def/FbEq16
46.33	Above torque limit	Defines the trigger level for “above limit” indication in torque control. When actual torque exceeds the limit, bit 10 of 06.17 Drive status word 2 is set.	300.0%
	0.0…1600.0%	“Above limit” indication trigger level for torque control.	See par. 46.03
46.41	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 decimal places of power-related parameters.	2
	0...3	Number of decimal places of power parameters.	1 = 1
46.44	Current decimals	Defines the number of decimal places of current-related parameters.	1
	0...3	Number of decimal places of current parameters.	1 = 1

47 Data storage		Data storage parameters that can be written to and read from using other parameters’ source and target settings. Note that there are different storage parameters for different data types. See also section Data storage parameters (page 95).	
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.	-
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.	-

No.	Name/Value	Description	Def/FbEq16
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	Panel/PC tool communication timeout.	10 = 1 s
49.05	*Communication loss action*	Selects how the drive reacts to a control panel (or PC tool) communication break.	*Fault*
	No action	No action taken.	0
	Fault	Drive trips on *7081 Control panel loss*.	1
	Last speed	Drive generates an *A7EE Panel loss* warning and freezes the speed to the level the drive was operating at. The speed is determined on the basis of actual speed using 850 ms low-pass filtering. **WARNING!** Make sure that it is safe to continue operation in case of a communication break.	2

No.	Name/Value	Description	Def/FbEq16
	Speed ref safe	Drive generates an *A7EE Panel loss* warning and sets the speed to the speed defined by parameter *22.41 Speed ref safe* (or *28.41 Frequency ref safe* when frequency reference is being used). **WARNING!** Make sure that it is safe to continue operation in case of a communication break.	3
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 is shown in *Home view 1* of the Basic panel (ACS-BP-S) when the active external control location is EXT1. Home view 1 is toggled automatically between Home view 4 (parameter *49.01*) according to the active external control location EXT1 or EXT2, respectively	*Auto*
	Auto	*01.06 Output frequency* (page *165*) in scalar control mode, otherwise *01.01 Motor speed used* used (page *165*).	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
	Freq ref used	*28.02 Frequency ref ramp output*	14
	Process PID out	*40.01 Process PID output actual*	16
	Temp sensor 1 excitation	The output is used to feed an excitation current to the temperature sensor 1, see parameter *35.11 Temperature 1 source*. See also section *Motor thermal protection* (page *81*).	20
	Temp sensor 2 excitation	The output is used to feed an excitation current to the temperature sensor 2, see parameter *35.21 Temperature 2 source*. See also section *Motor thermal protection* (page *81*).	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
	AO1 data storage	*13.91 AO1 data storage*.	37

No.	Name/Value	Description	Def/FbEq16
	AO2 data storage	*13.92 AO2 data storage*.	38
	Other	Source selection (see *Terms and abbreviations* on page *162*).	-
49.20	*Basic panel home view 2*	Selects the parameters that is shown in *Home view 2* of the Basic panel (ACS-BP-S) when the active external control location is EXT1. Home view 2 is toggled automatically between Home view 5 (parameter *49.21*) according to the active external control location EXT1 or EXT2, respectively See parameter *49.19* for the other selections than Auto.	*Auto*
	Auto	*01.07 Motor current* (page *165*) .	0
49.21	*Basic panel home view 3*	Selects the parameters that is shown in *Home view 3* of the Basic panel (ACS-BP-S) when the active external control location is EXT1. Home view 3 is toggled automatically between Home view 6 (parameter *49.221*) according to the active external control location EXT1 or EXT2, respectively See parameter *49.19* for the other selections than Auto.	*Auto*
	Auto	*01.10 Motor torque* (page *165*)	0
49.21	*Basic panel home view 3*	Selects the parameters that is shown in *Home view 4* of the Basic panel (ACS-BP-S) when the active external control location is EXT2. Home view 1 is toggled automatically between Home view 4 (parameter *49.19*) according to the active external control location EXT1 or EXT2, respectively. See parameter *49.19* for the other selections than Auto.	*Auto*
	Auto	Selects the same parameter as selected by parameter *49.19 Basic panel home view 1* for external control location EXT 1.	0
49.21	*Basic panel home view 3*	Selects the parameters that is shown in *Home view 5* of the Basic panel (ACS-BP-S) when the active external control location is EXT2. Home view 2 is toggled automatically between Home view 5 (parameter *49.20*) according to the active external control location EXT1 or EXT2, respectively. See parameter *49.19* for the other selections than Auto.	*Auto*
	Auto	Selects the same parameter as selected by parameter *49.20 Basic panel home view 2* for external control location EXT 1.	0
49.221	*Basic panel home view 6*	Selects the parameters that is shown in *Home view 6* of the Basic panel (ACS-BP-S) when the active external control location is EXT2. Home view 3 is toggled automatically between Home view 6 (parameter *49.21*) according to the active external control location EXT1 or EXT2, respectively. See parameter *49.19* for the other selections than Auto.	*Auto*
	Auto	Selects the same parameter as selected by parameter *49.21 Basic panel home view 3* for external control location EXT 1.	0

No.	Name/Value	Description	Def/FbEq16
50 Fieldbus adapter (FBA)		Fieldbus communication configuration. See also chapter *Fieldbus control through a fieldbus adapter* (page *471*).	
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	Communication break detection active. Upon a communication break, the drive trips on a *7510 FBA A communication* fault and coasts to a stop.	1
	Last speed	Communication break detection active. Upon a communication break, the drive generates a warning (*A7C1 FBA A communication*) and freezes the speed to the level the drive was operating at. The speed is determined on the basis of actual speed using 850 ms low-pass filtering. **WARNING!** Make sure that it is safe to continue operation in case of a communication break.	2
	Speed ref safe	Communication break detection active. Upon a communication break, the drive generates a warning (*A7C1 FBA A communication*) and sets the speed to the value defined by parameter *22.41 Speed ref safe* (or *28.41 Frequency ref safe* when frequency reference is being used). **WARNING!** Make sure that it is safe to continue operation in case of a communication break.	3
	Fault always	Drive trips on *7510 FBA A communication*. This occurs even though no control is expected from the fieldbus.	4
	Warning	Drive generates an *A7C1 FBA A communication* warning. This occurs even though no control is expected from the fieldbus. **WARNING!** Make sure that it is safe to continue operation in case of a communication break.	5
50.03	*FBA A comm loss t out*	Defines the time delay before the action defined by parameter *50.02 FBA A comm loss func* is taken. Time count starts when the communication link fails to update the message.	0.3 s
	0.3…6553.5 s	Time delay.	1 = 1 s

<table>
<tr><th>No.</th><th>Name/Value</th><th>Description</th><th>Def/FbEq16</th></tr>
<tr><td>50.04</td><td>FBA A ref1 type</td><td>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.</td><td>Speed or frequency</td></tr>
<tr><td></td><td>Speed or frequency</td><td>Type and scaling is chosen automatically according to the currently active operation mode as follows:<table><tr><th>Operation mode
(see par. 19.01)</th><th>Reference 1 type</th></tr><tr><td>Speed control</td><td>Speed</td></tr><tr><td>Torque control</td><td>Speed</td></tr><tr><td>Frequency control</td><td>Frequency</td></tr></table></td><td>0</td></tr>
<tr><td></td><td>Transparent</td><td>No scaling is applied.</td><td>1</td></tr>
<tr><td></td><td>General</td><td>Generic reference without a specific unit.</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>50.05</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>Torque</td></tr><tr><td>Torque control</td><td>Torque</td></tr><tr><td>Frequency control</td><td>Torque</td></tr></table></td><td>0</td></tr>
<tr><td></td><td>Transparent</td><td>No scaling is applied.</td><td>1</td></tr>
<tr><td></td><td>General</td><td>Generic reference without a specific unit.</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>
</table>

<table>
<tr><th>No.</th><th>Name/Value</th><th>Description</th><th>Def/FbEq16</th></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 rowspan="2">Speed</td></tr>
<tr><td>Torque control</td></tr>
<tr><td>Frequency control</td><td>Frequency</td></tr>
</table></td><td>0</td></tr>
<tr><td></td><td>Transparent</td><td>No scaling is applied.</td><td>1</td></tr>
<tr><td></td><td>General</td><td>Generic reference without a specific unit.</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>50.08</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 rowspan="2">Speed</td></tr>
<tr><td>Torque control</td></tr>
<tr><td>Frequency control</td><td>Frequency</td></tr>
</table></td><td>0</td></tr>
<tr><td></td><td>Transparent</td><td>No scaling is applied.</td><td>1</td></tr>
<tr><td></td><td>General</td><td>Generic reference without a specific unit.</td><td>2</td></tr>
<tr><td></td><td>Torque</td><td>01.01 Motor speed used is sent as actual value 2. 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>50.09</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 162).</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 162).</td><td>-</td></tr>
</table>

No.	Name/Value	Description	Def/FbEq16
50.11	*FBA A act2 transparent source*	When parameter *50.08 FBA A actual 2 type* is set to *Transparent*, this parameter selects the source of actual value 2 transmitted to the fieldbus network through fieldbus adapter A.	*Not selected*
	Not selected	No source selected.	-
	Other	Source selection (see *Terms and abbreviations* on page *162*).	-
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.	0.0.0.0
	0.0.0.0.0...FF.FF.FF.FF	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.	0
	-2147483648…2147483647	Raw REF1 sent by master to fieldbus adapter A.	0
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.	0
	-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.	0.0.0.0
	0.0.0.0.0...FF.FF.FF.FF	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.	0
	-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.	0
	-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** = Module is not found or is not properly connected, or is disabled by parameter 50.01 FBA A enable; **0** = None; **1** = PROFIBUS-DP; **32** = CANopen; **128 =** Ethernet; **132** = PROFInet IO; **135** = EtherCAT; **485** = RS-485 comm. This parameter is read-only.	0
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
	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.	0x0000
	0x0000...0xffff	Parameter table revision of adapter module.	-
51.29	FBA A drive type code	Displays the drive type code in the fieldbus adapter module mapping file (stored in the memory of the drive). This parameter is read-only.	-
	0…65535	Drive type code stored in the mapping file.	1 = 1
51.30	FBA A mapping file ver	Displays the fieldbus adapter module mapping file revision stored in the memory of the drive in decimal format. This parameter is read-only.	-
	0…65535	Mapping file revision.	1 = 1
51.31	D2FBA A comm status	Displays the status of the fieldbus adapter module communication.	Not configured
	Not configured	Adapter is not configured.	0
	Initializing	Adapter is initializing.	1
	Time out	A timeout has occurred in the communication between the adapter and the drive.	2
	Configuration error	Adapter configuration error: mapping file not found in the file system of the drive, or mapping file upload has failed more than three times.	3
	Off-line	Fieldbus communication is off-line.	4

No.	Name/Value	Description	Def/FbEq16
	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.	0x0000
	0x0000...0xffff	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.	0x0000
	0x0000...0xffff	Application program version of adapter module.	-

52 FBA A data in		Selection of data to be transferred from drive to fieldbus controller through fieldbus adapter A. **Note:** 32-bit values require two consecutive parameters. Whenever a 32-bit value is selected in a data parameter, the next parameter is automatically reserved.	
52.01	*FBA A data in1*	Parameters *52.01*…*52.12* select data to be transferred from the drive to the fieldbus controller through fieldbus adapter A.	*None*
	None	None.	0
	CW 16bit	Control Word (16 bits)	1
	Ref1 16bit	Reference REF1 (16 bits)	2
	Ref2 16bit	Reference REF2 (16 bits)	3
	SW 16bit	Status Word (16 bits)	4
	Act1 16bit	Actual value ACT1 (16 bits)	5
	Act2 16bit	Actual value ACT2 (16 bits)	6
	CW 32bit	Control Word (32 bits)	11
	Ref1 32bit	Reference REF1 (32 bits)	12
	Ref2 32bit	Reference REF2 (32 bits)	13
	SW 32bit	Status Word (32 bits)	14
	Act1 32bit	Actual value ACT1 (32 bits)	15
	Act2 32bit	Actual value ACT2 (32 bits)	16
	SW2 16bit	Status Word 2 (16 bits)	24

No.	Name/Value	Description	Def/FbEq16
	Other	Source selection (see *Terms and abbreviations* on page *162*).	-
…	…	…	…
52.12	*FBA A data in12*	See parameter *52.01 FBA A data in1*.	*None*
53 FBA A data out		Selection of data to be transferred from fieldbus controller to drive through fieldbus adapter A. **Note:** 32-bit values require two consecutive parameters. Whenever a 32-bit value is selected in a data parameter, the next parameter is automatically reserved.	
53.01	*FBA A data out1*	Parameters *53.01*…*53.12* select data to be transferred from the fieldbus controller to the drive through fieldbus adapter A.	*None*
	None	None.	0
	CW 16bit	Control Word (16 bits)	1
	Ref1 16bit	Reference REF1 (16 bits)	2
	Ref2 16bit	Reference REF2 (16 bits)	3
	CW 32bit	Control Word (32 bits)	11
	Ref1 32bit	Reference REF1 (32 bits)	12
	Ref2 32bit	Reference REF2 (32 bits)	13
	CW2 16bit	Control Word 2 (16 bits)	21
	Other	Source selection (see *Terms and abbreviations* on page *162*).	-
…	…	…	…
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 *Fieldbus control through the embedded fieldbus interface (EFB)* (page *441*).	
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
58.02	*Protocol ID*	Displays the protocol ID and revision. This parameter is read-only.	-
		Protocol ID and revision.	1 = 1
58.03	*Node address*	Defines the node address of the drive on the fieldbus link. Values 1…247 are allowable. Two devices with the same address are not allowed on-line. Changes to this parameter take effect after the control unit is rebooted or the new settings validated by parameter *58.06 Communication control* (*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. 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*).	*19.2 kbps*
	Autodetect	Baud rate detected automatically	0
	4.8 kbps	4.8 kbit/s.	1
	9.6 kbps	9.6 kbit/s.	2

No.	Name/Value	Description	Def/FbEq16
	19.2 kbps	19.2 kbit/s.	3
	38.4 kbps	38.4 kbit/s.	4
	57.6 kbps	57.6 kbit/s.	5
	76.8 kbps	76.8 kbit/s.	6
	115.2 kbps	115.2 kbit/s.	7
58.05	*Parity*	Selects the type of parity bit and 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*).	*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	Reserved	
4	Wiring error	1 = Errors detected (A/B wires possibly swapped)
5	Parity error	1 = Error detected: check parameters *58.04* and *58.05*
6	Baud rate error	1 = Error detected: check parameters *58.05* and *58.04*
7	No bus activity	1 = 0 bytes received during last 5 seconds
8	No packets	1 = 0 packets (addressed to any device) detected during last 5 seconds
9	Noise or addressing error	1 = Errors detected (interference, or another device with the same address on line)
10	Comm loss	1 = 0 packets addressed to the drive received within timeout (*58.16*)
11	CW/Ref loss	1 = No control word or references received within timeout (*58.16*)
12	Not active	1 = Not active. EFB is not the active channel. Only used in redundant communication control.
13	Protocol 1	1 = Used for protocol-dependent statuses. See protocol documentation.
14	Protocol 2	See Bit *13*.
15	Internal error	1 = internal error. Problem with the communication to the drive software.

	0000h…FFFFh	EFB communication status.	1 = 1
58.08	*Received packets*	Displays a count of valid packets addressed to the drive. During normal operation, this number increases constantly. Can be reset from the control panel by keeping Reset down for over 3 seconds.	-
	0…4294967295	Number of received packets addressed to the drive.	1 = 1
58.09	*Transmitted packets*	Displays a count of valid packets transmitted by the drive. During normal operation, this number increases constantly. Can be reset from the control panel by keeping Reset down for over 3 seconds.	-
	0…4294967295	Number of transmitted packets.	1 = 1
58.10	*All packets*	Displays a count of valid packets addressed to any device on the bus. During normal operation, this number increases constantly. Can be reset from the control panel by keeping Reset down for over 3 seconds.	-
	0…4294967295	Number of all received packets.	1 = 1
58.11	*UART errors*	Displays a count of character errors received by the drive. An increasing count indicates a configuration problem on the bus. Can be reset from the control panel by keeping Reset down for over 3 seconds.	-
	0…4294967295	Number of UART errors.	1 = 1

No.	Name/Value	Description	Def/FbEq16
58.12	*CRC errors*	Displays a count of packets with a CRC error received by the drive. An increasing count indicates interference on the bus. Can be reset from the control panel by keeping Reset down for over 3 seconds.	-
	0…4294967295	Number of CRC errors.	1 = 1
58.14	*Communication loss action*	Selects how the drive reacts to an EFB communication break. Changes to this parameter take effect after the control unit is rebooted or the new settings validated by parameter *58.06 Communication control* (*Refresh settings*). See also parameters *58.15 Communication loss mode* and *58.16 Communication loss time*.	*Fault*
	No action	No action taken (monitoring disabled).	0
	Fault	The drive monitors communication loss when start/stop is expected from the EFB on the currently active control location. Drive trips on *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 an *A7CE EFB comm loss* warning and freezes the speed to the level the drive was operating at. The speed is determined on the basis of actual speed using 850 ms low-pass filtering. This occurs 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 an *A7CE EFB comm loss* warning and sets the speed to the speed defined by parameter *22.41 Speed ref safe* (or *28.41 Frequency ref safe* when frequency reference is being used). This occurs 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 *6681 EFB comm loss*. This happens even thought the drive is in a control location where the EFB start/stop or reference is not used.	4
	Warning	Drive generates an *A7CE EFB comm loss* warning. This occurs even though no control is expected from the EFB. ⚠ **WARNING!** Make sure that it is safe to continue operation in case of a communication break.	5
58.15	*Communication loss mode*	Defines which message types reset the timeout counter for detecting an EFB communication loss. Changes to this parameter take effect after the control unit is rebooted or the new settings validated by parameter *58.06 Communication control* (*Refresh settings*). See also parameters *58.14 Communication loss action* and *58.16 Communication loss time*.	*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

<table>
<tr><th>No.</th><th>Name/Value</th><th>Description</th><th>Def/FbEq16</th></tr>
<tr><td>58.16</td><td>Communication loss time</td><td>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.</td><td>3.0 s</td></tr>
<tr><td></td><td>0.0…6000.0 s</td><td>EFB communication timeout.</td><td>1 = 1</td></tr>
<tr><td>58.17</td><td>Transmit delay</td><td>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).</td><td>3.0 ms</td></tr>
<tr><td></td><td>0…65535 ms</td><td>Minimum response delay.</td><td>1 = 1</td></tr>
<tr><td>58.18</td><td>EFB control word</td><td>Displays the raw (unmodified) status word sent by the drive to the Modbus controller. For debugging purposes.
This parameter is read-only.</td><td>-</td></tr>
<tr><td></td><td>0000h…FFFFh</td><td>Control word sent by Modbus controller to the drive.</td><td>1 = 1</td></tr>
<tr><td>58.19</td><td>EFB status word</td><td>Displays the raw (unmodified) status word for debugging purposes.
This parameter is read-only.</td><td>-</td></tr>
<tr><td></td><td>0000h…FFFFh</td><td>Status word sent by the drive to the Modbus controller.</td><td>1 = 1</td></tr>
<tr><td>58.25</td><td>Control profile</td><td>Defines the communication profile used by the protocol.
Changes to this parameter take effect after the control unit is rebooted or the new settings validated by parameter 58.06 Communication control (Refresh settings).</td><td>ABB Drives</td></tr>
<tr><td></td><td>ABB Drives</td><td>ABB Drives control profile (with a 16-bit control word)</td><td>0</td></tr>
<tr><td></td><td>DCU Profile</td><td>DCU control profile (with a 16 or 32-bit control word)</td><td>5</td></tr>
<tr><td>58.26</td><td>EFB ref1 type</td><td>Selects the type and scaling of reference 1 received through the embedded fieldbus interface.
The scaled reference is displayed by 03.09 EFB reference 1.</td><td>Speed or frequency</td></tr>
<tr><td></td><td>Speed or frequency</td><td>Type and scaling is chosen automatically according to the currently active operation mode as follows.
<table>
<tr><th>Operation mode
(see par. 19.01)</th><th>Reference 1 type</th></tr>
<tr><td>Speed control</td><td>Speed</td></tr>
<tr><td>Torque control</td><td>Speed</td></tr>
<tr><td>Frequency control</td><td>Frequency</td></tr>
</table></td><td>0</td></tr>
<tr><td></td><td>Transparent</td><td>No scaling is applied.</td><td>1</td></tr>
<tr><td></td><td>General</td><td>Generic reference without a specific unit. Scaling: 1 = 100.</td><td>2</td></tr>
<tr><td></td><td>Torque</td><td>Torque reference. The scaling is defined by parameter 46.03 Torque scaling.</td><td>3</td></tr>
<tr><td></td><td>Speed</td><td>Speed reference. The scaling is defined by parameter 46.01 Speed scaling.</td><td>4</td></tr>
<tr><td></td><td>Frequency</td><td>Frequency reference. The scaling is defined by parameter 46.02 Frequency scaling.</td><td>5</td></tr>
</table>

No.	Name/Value	Description	Def/FbEq16
58.27	*EFB ref2 type*	Selects the type and scaling of reference 2 received through the embedded fieldbus interface. For the parameter selection, see *58.26 EFB ref1 type*. The scaled reference is displayed by *03.10 EFB reference 2*.	*Torque*
58.28	*EFB act1 type*	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* Torque 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
	Reserved		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*	Selects the type of actual value 2. For the selections, see parameter *58.28 EFB act1 type*.	*Transparent*
58.31	*EFB act1 transparent source*	Selects the source of actual value 1 when parameter *58.28 EFB act1 type* is set to *Transparent*.	*Not selected*
	Not selected	None.	0
	Other	Source selection (see *Terms and abbreviations* on page *162*).	-
58.32	*EFB act2 transparent source*	Selects the source of actual value 2 when parameter *58.29 EFB act2 type* is set to *Transparent*.	*Other* (par. *01.07 Motor current*)
	Not selected	None.	0
	Other	Source selection (see *Terms and abbreviations* on page *162*).	-
58.33	*Addressing mode*	Defines the mapping between parameters and holding registers in the 400101…465535 Modbus register range. Changes to this parameter take effect after the control unit is rebooted or the new settings validated by parameter *58.06 Communication control* (*Refresh settings*).	*Mode 0*
	Mode 0	<u>16-bit values (groups 1…99, indexes 1…99)</u>: Register address = 400000 + 100 × parameter group + parameter index. For example, parameter 22.80 would be mapped to register 400000 + 2200 + 80 = 402280. <u>32-bit values (groups 1…99, indexes 1…99)</u>: Register address = 420000 + 200 × parameter group + 2 × parameter index. For example, parameter 22.80 would be mapped to register 420000 + 4400 + 160 = 424560.	0
	Mode 1	<u>16-bit values (groups 1…255, indexes 1…255)</u>: Register address = 400000 + 256 × parameter group + parameter index. For example, parameter 22.80 would be mapped to register 400000 + 5632 + 80 = 405712.	1

No.	Name/Value	Description	Def/FbEq16
	Mode 2	32-bit values (groups 1…127, indexes 1…255): Register address = 400000 + 512 × parameter group + 2 × parameter index. For example, parameter 22.80 would be mapped to register 400000 + 11264 + 160 = 411424.	2
58.34	*Word order*	Selects in which order 16-bit registers of 32-bit parameters are transferred. For each register, the first byte contains the high order byte and the second byte contains the low order byte. Changes to this parameter take effect after the control unit is rebooted or the new settings validated by parameter *58.06 Communication control* (*Refresh settings*).	*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
58.101	*Data I/O 1*	Defines the address in the drive which the Modbus master accesses when it reads from or writes to the register address corresponding to Modbus register 1 (400001). The master defines the type of the data (input or output). The value is transmitted in a Modbus frame consisting of two 16-bit words. If the value is 16-bit, it is transmitted in the LSW (least significant word). If the value is 32-bit, the subsequent parameter is also reserved for it and must be set to *None*.	*CW 16bit*
	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 (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

No.	Name/Value	Description	Def/FbEq16
	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 *162*).	-
58.102	*Data I/O 2*	Defines the address in the drive which the Modbus master accesses when it reads from or writes to register address 400002. For the selections, see parameter *58.101 Data I/O 1*.	*Ref1 16bit*
58.103	*Data I/O 3*	Defines the address in the drive which the Modbus master accesses when it reads from or writes to register address 400003. For the selections, see parameter *58.101 Data I/O 1*.	*Ref2 16bit*
58.104	*Data I/O 4*	Defines the address in the drive which the Modbus master accesses when it reads from or writes to register address 400004. For the selections, see parameter *58.101 Data I/O 1*.	*SW 16bit*
58.105	*Data I/O 5*	Defines the address in the drive which the Modbus master accesses when it reads from or writes to register address 400005. For the selections, see parameter *58.101 Data I/O 1*.	*Act1 16bit*
58.106	*Data I/O 6*	Defines the address in the drive which the Modbus master accesses when it reads from or writes to register address 400006. For the selections, see parameter *58.101 Data I/O 1*.	*Act2 16bit*
58.107	*Data I/O 7*	Parameter selector for Modbus register address 400007. For the selections, see parameter *58.101 Data I/O 1*.	*None*
…	…	…	…
58.114	*Data I/O 14*	Parameter selector for Modbus register address 400014. For the selections, see parameter *58.101 Data I/O 1*.	*None*

No.	Name/Value	Description	Def/FbEq16
70 Override		Enabling/disabling of override function, override activation signal and override speed/frequency.	
70.01	Override status	Shows the override status. This parameter is read-only.	0b0000

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...11	Reserved	
12	Test mode active	0 = Test mode is inactive; 1 = Test mode is active
13...15	Reserved	

No.	Name/Value	Description	Def/FbEq16
	0b0000…0b1111		1=1
70.02	Override enable	Enables the override function.	Off
	Off	Override disabled.	0
	On	Override enabled.	1
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
	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
	Other [bit]	Source selection (see Terms and abbreviations on page 162).	-
70.04	Override reference source	Selects the source for the speed used in the override mode.	Override speed/freq
	Constant speed/freq	Constant speed used as the reference	0
	AI1	12.12 AI1 scaled value (page 190).	1
	AI2	12.22 AI2 scaled value (page 191).	2

No.	Name/Value	Description	Def/FbEq16
	Override speed/freq	Parameter *70.06 Override frequency*/ *70.07 Override speed* is used as the reference.	3
	Motor potentiometer	*22.80 Motor potentiometer ref act* (output of the Motor potentiometer)	4
	Stop	The output of the drive is shut off and the motor no longer runs. Override is displayed on the panel but the motor does not run. Drive follows the specified stop type.	5
	Process PID set 1	Output of the process PID Set 1 (*40.96*) is used as the reference.	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
	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 *162*).	-
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 as reference in 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 = 1 rpm
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*, *2340 Short circuit*, *3210 DC link overvoltage*, *4981 External temperature 1*, *4982 External temperature 2*, *5090 STO hardware failure*, *5091 Safe torque off*, *FA81 Safe torque off 1*, *FA81 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

No.	Name/Value	Description	Def/FbEq16
	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...60	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
	0.1...120.0 s	Auto reset delay time.	10 = 1 s

71 External PID1		Configuration of external PID. See the control chain diagrams on pages *501* and *504*.	
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 (see par. *71.39*)
10…11	Reserved	
12	Internal setpoint active	1 = Internal setpoint active (see par. *71.16*…*71.23*)
13…15	Reserved	

	0000h…FFFFh	Process PID control status word.	1 = 1
71.07	*PID operation mode*	See parameter *40.07 Process PID operation mode*.	*Off*
71.08	*Feedback 1 source*	See parameter *40.08 Set 1 feedback 1 source*.	*Not selected*
71.11	*Feedback filter time*	See parameter *40.11 Set 1 feedback filter time*.	0.000 s

No.	Name/Value	Description	Def/FbEq16
71.14	*Setpoint scaling*	Defines, together with parameter *71.15 Output scaling*, a general scaling factor for the external PID control chain. The scaling can be utilized when, for example, the process setpoint is input in Hz, and the output of the PID controller is used as an rpm value in speed control. In this case, this parameter might be set to 50, and parameter *71.15* to the nominal motor speed at 50 Hz. In effect, the output of the PID controller [*71.15*] when deviation (setpoint - feedback) = [*71.14*] and [*71.32*] = 1. **Note:** The scaling is based on the ratio between *71.14* and *71.15*. For example, the values 50 and 1500 would produce the same scaling as 1 and 3.	1500.00
	-200000.00… 200000.00	Process setpoint base.	1 = 1
71.15	*Output scaling*	See parameter *71.14 Setpoint scaling*.	1500.00
	-200000.00… 200000.00	Process PID controller output base.	1 = 1
71.16	*Setpoint 1 source*	See parameter *40.16 Set 1 setpoint 1 source*.	*Not selected*
71.19	*Internal setpoint sel1*	See parameter *40.19 Set 1 internal setpoint sel1*.	*Not selected*
71.20	*Internal setpoint sel2*	See parameter *40.20 Set 1 internal setpoint sel2*.	*Not selected*
71.21	*Internal setpoint 1*	See parameter *40.21 Set 1 internal setpoint 1*.	0.00 PID customer units
71.22	*Internal setpoint 2*	See parameter *40.22 Set 1 internal setpoint 2*.	0.00 PID customer units
71.23	*Internal setpoint 3*	See parameter *40.23 Set 1 internal setpoint 3*.	0.00 PID customer units
71.26	*Setpoint min*	See parameter *40.26 Set 1 setpoint min*.	0.00
71.27	*Setpoint max*	See parameter *40.27 Set 1 setpoint max*.	200000.00
71.31	*Deviation inversion*	See parameter *40.31 Set 1 deviation inversion*.	*Not inverted (Ref - Fbk)*
71.32	*Gain*	See parameter *40.32 Set 1 gain*.	1.00
71.33	*Integration time*	See parameter *40.33 Set 1 integration time*.	60.0 s
71.34	*Derivation time*	See parameter *40.34 Set 1 derivation time*.	0.000 s
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*.	*Not selected*

No.	Name/Value	Description	Def/FbEq16
71.39	*Deadband range*	The control program compares the absolute value of parameter *71.04 Deviation act value* to the deadband range defined by this parameter. If the absolute value is within the deadband range for the time period defined by parameter *71.40 Deadband delay*, PID's deadband mode is activated and *71.06 PID status word* bit 9 *Deadband active* is set. Then PID's output is frozen and *71.06 PID status word* bit 2 *Output frozen* is set. If the absolute value is equal or greater than the deadband range, PID's deadband mode is deactivated.	0.0
	0.0…200000.0	Range	1 = 1
71.40	*Deadband delay*	Defines the deadband delay for the deadband function. See parameter *71.39 Deadband range*.	0.0 s
	0.0…3600.0 s	Delay	1 = 1 s
71.58	*Increase prevention*	Activates increase prevention of PID integration term for Ext PID 1.	*No*
	No	Increase prevention not in use.	0
	Limiting	The Ext PID integration term is not increased.	1
	Process PID min lim	The Ext PID integration term is not increased when the output of the process PID has reached its minimum limit. In this setup, the external PID is used as a source for the process PID.	2
	Process PID max lim	The Ext PID integration term is not increased when the output of the process PID has reached its maximum limit. In this setup, the external PID is used as a source for the process PID.	3
	Other [bit]	Source selection (see *Terms and abbreviations* on page *162*).	-
71.59	*Decrease prevention*	Activates decrease prevention of PID integration term for Ext PID 1.	*No*
	No	Decrease prevention not in use.	0
	Limiting	The Ext PID integration term is not decreased	1
	Process PID min lim	The Ext PID integration term is not increased when the output of the process PID has reached its minimum limit. In this setup, the external PID is used as a source for the process PID.	2
	Process PID max lim	The Ext PID integration term is not increased when the output of the process PID has reached its maximum limit. In this setup, the external PID is used as a source for the process PID.	3
	Other [bit]	Source selection (see *Terms and abbreviations* on page *162*).	-
71.62	*Internal setpoint actual*	See parameter *40.62 PID internal setpoint actual*.	-
71.79	*External PID units*	Selects the unit for process PID setpoint, feedback and deviation.	*%*
	User text	User text	0
	%	%	1
	bar	bar	2
	kPa	kPa	3
	Pa	Pa	4
	psi	psi	5

No.	Name/Value	Description	Def/FbEq16
	CFM	CFM	6
	inH_2O	inH_2O	7
	°C	°C	8
	°F	°F	9
	mbar	mbar	10
	m^3/h	m^3/h	11
	dm^3/h	dm^3/h	12
	l/s	l/s	13
	l/min	l/min	14
	l/h	l/h	15
	m^3/s	m^3/s	16
	m^3/m	m^3/m	17
	km^3/h	km^3/h	18
	gal/s	gal/s	19
	ft^3/s	ft^3/s	20
	ft^3/m	ft^3/m	21
	ft^3/h	ft^3/h	22
	ppm	ppm	23
	inHg	inHg	24
	kCFM	kCFM	25
	inWC	inWC	26
	GPM	GPM	27
	gal/m	gal/m	28
	in wg	in wg	29
	MPa	MPa	30
	ftWC	ftWC	31

No.	Name/Value	Description	Def/FbEq16
76 PFC configuration		PFC (Pump and fan control) and Autochange configuration parameters. See also section *Pump and Fan Control (PFC) macro* on page *125*.	
76.01	*PFC status*	Displays the running/stopped status of the PFC motors. PFC1, PFC2, PFC3 and PFC4 always correspond to the 1st…4th 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.	0b0000

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…15	Reserved	

No.	Name/Value	Description	Def/FbEq16
	0b0000…0b1111	Status of the PFC relay outputs.	1 = 1
76.02	*PFC system status*	Displays the status of the PFC system in text form. Provides a quick PFC system overview, e.g. if the parameter is added to the Home view on the control panel.	*PFC disabled*
	PFC disabled	-	0
	PFC enabled (not started)	-	1
	SPFC enabled (not started)	-	2
	MPFC enabled	-	3
	Invalid configuration	-	4
	PFC inactive (local control)	-	5
	PFC inactive (invalid operation mode)	-	6
	Drive motor interlocked	-	7
	All motors interlocked	-	8
	inactive (ext1 active)	-	9
	Running with VSD	-	100
	Running with VSD + 1 Aux	-	101
	Running with VSD + 2 Aux	-	102
	Running with VSD + 3 Aux	-	103
	Starting Aux1	-	200

No.	Name/Value	Description	Def/FbEq16
	Starting Aux2	-	201
	Starting Aux3	-	202
	Stopping Aux1	-	300
	Stopping Aux2	-	301
	Stopping Aux3	-	302
	Autochange active	-	400
	No auxiliary motors available to be started	-	500
	Regulator bypass active	-	600
	MPFC connection ok	-	700
	PID sleep	-	800
	PID sleep boost	-	801
76.11	*Pump/fan status 1*	Shows the status of pump or fan 1.	0b0000

Bit	Name	Value
0	Ready	0 = False, 1 = True
2	Running	0 = False, 1 = True
5	In PFC control	0 = False, 1 = True
1, 3, 4, 6…10	Reserved	
11	Interlocked	0 = False, 1 = True
12…15	Reserved	

No.	Name/Value	Description	Def/FbEq16
	0b0000…0b1111	Status of pump or fan 1.	1 = 1
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*.	-
76.21	*PFC configuration*	Selects the multi-pump/fan control (PFC) mode.	*Off*
	Off	PFC 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. SPFC enabled. For more information, see *Pump and Fan Control (PFC) macro* on page.*125*	2
	SPFC	SPFC enabled. For more information, see *Soft Pump and Fan Control (SPFC) macro* on page.*134*	3
76.25	*Number of motors*	Total number of motors used in the application, including the motor connected directly to the drive.	1
	1…4	Number of motors.	1 = 1
76.26	*Min number of motors allowed*	Minimum number of motors running simultaneously.	1
	0…4	Minimum number of motors.	1 = 1

No.	Name/Value	Description	Def/FbEq16
76.27	*Max number of motors allowed*	Maximum number of motors running simultaneously.	1
	1…4	Maximum number of motors.	1 = 1
76.30	*Start point 1*	Defines the start speed (Hz/rpm) for the first auxiliary pump. As the motor speed or frequency exceeds the limit defined by this parameter, a new auxiliary pump is started. To avoid nuisance starts of the auxiliary pump, the speed of the variable speed pump 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 pump is not started. To maintain the process conditions during the start of the auxiliary pump, 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 auxiliary pump to a speed where it produces flow.	Vector: 1300 rpm; Scalar 48 Hz; 58 Hz (*95.20* b0)
	0…32767 rpm/Hz	Speed/frequency.	1 = 1 unit
76.31	*Start point 2*	Defines the start speed (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 (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)
76.41	*Stop point 1*	Defines the stop speed (Hz/rpm) for the first auxiliary motor. When the speed 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…32767 rpm/Hz	Speed/frequency	1 = 1 unit
76.42	*Stop point 2*	Defines the stop speed (Hz/rpm) for the second auxiliary motor. See parameter *76.31 Stop point 1*.	Vector: 800 rpm; Scalar 25 Hz; 30 Hz (*95.20* b0)
76.43	*Stop point 3*	Defines the stop speed (Hz/rpm) for the third auxiliary motor. See parameter *76.31 Stop point 1*.	Vector: 800 rpm; Scalar 25 Hz; 30 Hz (*95.20* b0)
76.55	*Start delay*	Defines a start delay for 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 a stop delay for auxiliary motors. See parameter *76.31 Stop point 1*.	10.00 s
	0.00…12600.00 s	Time delay.	1 = 1 s

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 *128*.	*Not selected*
	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 *276*)).	8
	Timed function 2	Autochange triggered by timed function 2 (bit 1 of *34.01 Timed functions status* (see page *276*)).	9
	Timed function 3	Autochange triggered by timed function 3 (bit 2 of *34.01 Timed functions status* (see page *276*)).	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 PFC maintenance and monitoring*.	13
	Other [bit]	Source selection (see *Terms and abbreviations* on page *162*).	-
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*e. **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 interlock 1*	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 *276*).	8
	Timed function 2	Bit 1 of *34.01 Timed functions status* (see page *276*).	9
	Timed function 3	Bit 2 of *34.01 Timed functions status* (see page *276*).	10
	Other [bit]	Source selection (see *Terms and abbreviations* on page *162*).	-
76.82	*PFC interlock 2*	See parameter *76.82 PFC interlock 1*.	*Available. PFC motor is available*
76.83	*PFC interlock 3*	See parameter *76.82 PFC interlock 1*.	*Available. PFC motor is available*
76.84	*PFC interlock 4*	See parameter *76.82 PFC interlock 1*.	*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*
	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 *162*).	-

No.	Name/Value	Description	Def/FbEq16
77 PFC maintenance and monitoring		PFC (Pump and fan control) maintenance and monitoring parameters.	
77.10	*PFC runtime change*	Enables the reset, or arbitrary setting, of *77.11 Pump/fan 1 running time* … *77.14 Pump/fan 4 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* … *77.14 Pump/fan 4 running time* to an arbitrary value.	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*.	5
77.11	*Pump/fan 1 running time*	Running time counter of pump/fan 1. Can be set or reset by parameter *77.10 Pump/fan 1 running time*.	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
90 Feedback selection		Load feedback configuration.	
90.03	*Load speed*	Displays the estimated load speed. Load speed = $\left(\frac{\text{90.62 Gear denominator}}{\text{90.61 Gear numerator}}\right) \times$ *01.01 Motor speed used*	
	-32768.00 … 32767.00 rpm	Load speed.	1 = 1 rpm
90.52	*LoadSpeed filter time*	Defines a filter time for load speed feedback (*90.03 Load speed*).	10 ms
	0...10000 ms	Load speed filter time.	1 = 1 ms
90.61	*Gear numerator*	Parameter *90.61* and *90.62* define a gear function between the motor and load speed. $\frac{\text{90.61 Gear numerator}}{\text{90.62 Gear denominator}} = \frac{\text{Motor speed}}{\text{Load speed}}$	1
	-2147483648… 2147483647	Gear numerator (motor-side).	-
90.62	*Gear denominator*	See parameter *90.61 Gear numerator*.	1

No.	Name/Value	Description	Def/FbEq16
	-2147483648… 2147483647	Gear denominator (load - side)	-
90.99	*Load speed unit*	Selects the unit for parameter *90.03 Load speed*.	*rpm*
	No unit	No unit	0
	rpm	rpm	7
	m/s	m/s	41
	m/min	m/min	42
	ft/s	ft/s	43
	ft/min	ft/min	45

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.	*380…415 V*
	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	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.	*Disable*
	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
	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. **Note:** The installation of the hardware specified by this parameter may require derating of drive output, or impose other limitations. Refer to the hardware manual of the drive.	0b0000

Bit	Name	Information
0	Reserved	
1	ABB Sine filter	1 = An ABB sine filter is connected to the output of the drive.
2…15	Reserved	

No.	Name/Value	Description	Def/FbEq16
	0b0000…0b1111	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.	0b0000

Bit	Name	Value
0	Supply frequency 60 Hz	If you change the value of this bit, you have to do a complete reset to the drive after the change. After reset you have to reselect the macro to be used. See section *Differences in the default values between 50 Hz and 60 Hz supply frequency settings* on page *374*.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…15	Reserved	

No.	Name/Value	Description	Def/FbEq16
	0b0000…0b1111	Hardware options configuration word.	1 = 1
95.21	*HW options word 2*	Specifies more hardware-related options that require differentiated parameter defaults. See parameter *95.20 HW options word 2*. **WARNING!** An incorrect setting may cause the motor to rush uncontrollably, or the brake chopper or resistor to overload.	0b0000

Bit	Name	Value
0...5	Reserved	
6	Cabinet drive	0 = Inactive, 1 = Active. Only for drive frames R6 or larger.
7	Reserved	0 = Inactive, 1 = Active. Only for drive frames R6 or larger.
8...15	Reserved	

No.	Name/Value	Description	Def/FbEq16
	0b0000…0b1111	Hardware options configuration word.	1 = 1

No.	Name/Value	Description	Def/FbEq16
95.26	*Motor disconnect switch*	Enables the use of the motor disconnect switch. When enabled, the drive does not trip to a fault when it detects the disconnection but remains operational and returns to normal operation after a reconnection. When this parameter is enabled, the drive will go through the following sequence: 1. Motor is disconnected: Drive detects the disconnection and indicates it with warning *A784*. The drive remains in operation and waits for motor reconnection. 2. Motor is reconnected: Drive detects the reconnection, removes the warning and returns to normal operation. The last active reference before the disconnection is in use. **Note:** This feature is only available in scalar mode. This parameter does not affect vector mode behavior.	*Disable*
	Disable	Motor disconnect switch disabled.	0
	Enable	Motor disconnect switch enabled.	1
95.200	*Cooling fan mode*	Selects the fan control type. The fan control functionality enables heat dissipation from the drive and avoids dust accumulation in the drive.	*Auto*
	Auto	Controls the fan automatically according to the temperature changes of the drive.	0
	Always on	Fan runs continuously with maximum speed (main fan nominal speed).	1

96 System		Language selection; access levels; macro selection; parameter save and restore; control unit reboot; user parameter sets; unit selection.	
96.01	*Language*	Selects the language of the parameter interface and other displayed information when viewed on the control panel. **Notes:** • Not all languages listed below are necessarily supported. • This parameter does not affect the languages visible in the Drive composer PC tool. (Those are specified under **View** – **Settings** – **Drive default language**.)	Not selected
	Not selected	None.	0
	English	English.	1033
	Hindi (India)	Hindi.	2052

No.	Name/Value	Description	Def/FbEq16
96.02	*Pass code*	Pass codes can be entered into this parameter to activate further access levels (see parameter *96.03 Access 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. **Note:** You must change the default user pass code to maintain a high level of cybersecurity. <u>Store the code in a safe place – the protection cannot be disabled even by ABB if the code is lost.</u> See also section *User lock* (page *95*).	0
	0…99999999	Pass code.	-
96.03	*Access level status*	Shows which access levels have been activated by pass codes entered into parameter *96.02 Pass code*.	0b0000
	0b0000...0b1111		1=1

Bit	Name
0	End user
1	Service
2	Advanced programmer
3	Reserved
4	Long menu
5...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
	0b0000…0b1111	Active access levels.	-
96.04	*Macro select*	Selects the control macro. See chapter *Control macros* (page *101*) for more information. After a selection is made, the parameter reverts automatically to *Done*.	*Done*
	Done	Macro selection complete; normal operation.	0
	ABB standard	Factory macro (see page *102*). For scalar motor control.	1
	ABB standard (vector)	ABB standard (vector) macro (see page *105*). For vector motor control.	17
	3-wire	3-wire macro (see page *108*)	
	Motor potentiometer	Motor potentiometer macro (see page *111*).	13
	PID	PID macro (see page *116*).	14
	Panel PID	Panel PID macro (see page *119*).	15

No.	Name/Value	Description	Def/FbEq16
	PFC	PFC macro (see page *125*).	16
	SPFC	SPFC macro (see page *134*).	18
	Pharma Application	Pharma application (see page *143*)	19
	Plastic Extrusion	Plastic extrusion (see page *146*)	20
	Torque control	Torque control (see page *122*)	28
	Jigar	Jigar macro (see page *149*)	30
96.05	*Macro active*	Shows which control macro is currently selected. See chapter *Control macros* (page *101*) for more information. To change the macro, use parameter *96.04 Macro select*.	*ABB standard*
	ABB standard	Factory macro (see page *102*). For scalar motor control.	1
	ABB standard (vector)	ABB standard (vector) macro (see page *105*). For vector motor control.	17
	3-wire	3-wire macro (see page *108*)	
	Motor potentiometer	Motor potentiometer macro (see page *111*).	13
	PID	PID macro (see page *116*).	14
	Panel PID	Panel PID macro (see page *119*).	15
	PFC	PFC macro (see page *125*).	16
	SPFC	SPFC macro (see page *134*)	18
	Pharma Application	Pharma application (see page *143*)	19
	Plastic Extrusion	Plastic extrusion (see page *146*)	20
	Torque control	Torque control (see page *122*)	28
	Jigar	Jigar macro (see page *149*)	30
96.06	*Parameter restore*	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*. **Note:** This parameter cannot be changed while the drive is running.	*Done*
	Done	Restoring is completed.	0
	Reset motor data	Restore all motor rating ID run results to default values	2
	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, and the drive name • control panel/PC communication settings • fieldbus adapter settings • control macro selection and the parameter defaults implemented by it • parameter *95.20 HW options word 1* and the differentiated defaults implemented by it.	8
	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

No.	Name/Value	Description	Def/FbEq16
	Clear all	Restores all editable parameter values to default values, except • end user texts, such as customized warnings and faults, and the drive name • control macro selection and the parameter defaults implemented by it • parameter *95.20 HW options word 1* and the differentiated defaults implemented by it • group *49 Panel port communication* parameters.	62
	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 drive name, contact info, customized fault and warning texts 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
	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
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 *User parameter sets* (page *94*).	*n/a*
	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

<table>
<tr><th>No.</th><th>Name/Value</th><th>Description</th><th>Def/FbEq16</th></tr>
<tr><td></td><td>User3 IO active</td><td>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.</td><td>6</td></tr>
<tr><td></td><td>User4 IO active</td><td>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.</td><td>7</td></tr>
<tr><td></td><td>Reserved</td><td></td><td>8…19</td></tr>
<tr><td></td><td>User1 backup</td><td>User set 1 has been saved or loaded.</td><td>20</td></tr>
<tr><td></td><td>User2 backup</td><td>User set 2 has been saved or loaded.</td><td>21</td></tr>
<tr><td></td><td>User3 backup</td><td>User set 3 has been saved or loaded.</td><td>22</td></tr>
<tr><td></td><td>User4 backup</td><td>User set 4 has been saved or loaded.</td><td>23</td></tr>
<tr><td>96.11</td><td>User set save/load</td><td>Enables the saving and restoring of up to four custom sets of parameter settings.
The set that was in use before powering down the drive is in use after the next power-up.
Notes:
• Some hardware configuration settings, such as I/O extension module and fieldbus configuration parameters (groups 14…16, 47, 50…58 and 92…93) are not included in user parameter sets.
• Parameter changes made after loading a set are not automatically stored – they must be saved using this parameter.
• This parameter cannot be changed while the drive is running</td><td>No action</td></tr>
<tr><td></td><td>No action</td><td>Load or save operation complete; normal operation.</td><td>0</td></tr>
<tr><td></td><td>User set I/O mode</td><td>Load user parameter set using parameters 96.12 User set I/O mode in1 and 96.13 User set I/O mode in2.</td><td>1</td></tr>
<tr><td></td><td>Load set 1</td><td>Load user parameter set 1.</td><td>2</td></tr>
<tr><td></td><td>Load set 2</td><td>Load user parameter set 2.</td><td>3</td></tr>
<tr><td></td><td>Load set 3</td><td>Load user parameter set 3.</td><td>4</td></tr>
<tr><td></td><td>Load set 4</td><td>Load user parameter set 4.</td><td>5</td></tr>
<tr><td></td><td>Save to set 1</td><td>Save user parameter set 1.</td><td>18</td></tr>
<tr><td></td><td>Save to set 2</td><td>Save user parameter set 2.</td><td>19</td></tr>
<tr><td></td><td>Save to set 3</td><td>Save user parameter set 3.</td><td>20</td></tr>
<tr><td></td><td>Save to set 4</td><td>Save user parameter set 4.</td><td>21</td></tr>
<tr><td>96.12</td><td>User set I/O mode in1</td><td>When parameter 96.11 User set save/load is set to User set I/O mode, selects the user parameter set together with parameter 96.13 User set I/O mode in2 as follows:
<table>
<tr><th>Status of source defined by par. 96.12</th><th>Status of source defined by par. 96.13</th><th>User parameter set selected</th></tr>
<tr><td>0</td><td>0</td><td>Set 1</td></tr>
<tr><td>1</td><td>0</td><td>Set 2</td></tr>
<tr><td>0</td><td>1</td><td>Set 3</td></tr>
<tr><td>1</td><td>1</td><td>Set 4</td></tr>
</table></td><td>Not selected</td></tr>
<tr><td></td><td>Not selected</td><td>0.</td><td>0</td></tr>
<tr><td></td><td>Selected</td><td>1.</td><td>1</td></tr>
</table>

No.	Name/Value	Description	Def/FbEq16
	DI1	Digital input DI1 (*10.02 DI delayed status*, bit 0).	2
	DI2	Digital input DI2 (*10.02 DI delayed status*, bit 1).	3
	DI3	Digital input DI3 (*10.02 DI delayed status*, bit 2).	4
	DI4	Digital input DI4 (*10.02 DI delayed status*, bit 3).	5
	DI5	Digital input DI5 (*10.02 DI delayed status*, bit 4).	6
	DI6	Digital input DI6 (*10.02 DI delayed status*, bit 5).	7
	Timed function 1	Bit 0 of *34.01 Timed functions status* (see page *276*).	18
	Timed function 2	Bit 1 of *34.01 Timed functions status* (see page *276*).	19
	Timed function 3	Bit 2 of *34.01 Timed functions status* (see page *276*).	20
	Supervision 1	Bit 0 of *32.01 Supervision status* (see page *269*).	24
	Supervision 2	Bit 1 of *32.01 Supervision status* (see page *269*).	25
	Supervision 3	Bit 2 of *32.01 Supervision status* (see page *269*).	26
	Other [bit]	Source selection (see *Terms and abbreviations* on page *162*).	-
96.13	*User set I/O mode in2*	See parameter *96.12 User set I/O mode in1*.	*Not selected*
96.16	*Unit selection*	Selects the unit of parameters indicating power, temperature and torque.	0b0000

Bit	Name	Information
0	Power unit	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	

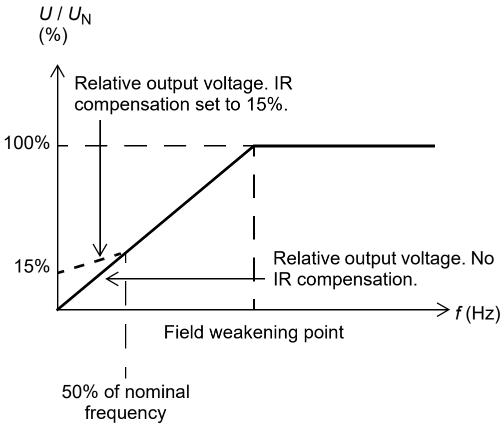
	0b0000…0b1111	Unit selection word.	1 = 1
96.20	*Time sync primary source*	Defines the 1st priority external source for synchronization of the drive's time and date.	*Panel link*
	Internal	No external source selected.	0
	Fieldbus A	FENA/FPNO can get the time from SNTP server and set it as time for the drive.	3
	Embedded FB	EFB BACnet MS/TP time-sync service can be used to set the time for the drive.	6
	Panel link	You can set the time using control panel, or Drive composer PC tool connected to the control panel.	8
	Ethernet tool link	You can set the time manually by using DCP over Ethernet. The time can be set in the same way when you do it with USB and panel.	9
96.51	*Clear fault and event logger*	Clears all events from the drive's fault and event logs.	*Done*
	Done	1 = No action	0
	Reset	1 = Resets (clears) fault and event logger.	1

No.	Name/Value	Description	Def/FbEq16
96.78	*550 compatibility mode*	Enables/disables a Modbus user to access a select set of parameters using 550 register numbering.	*Enable*
	Disable	Using 550 compatibility mode is disabled.	0
	Enable	Using 550 compatibility mode is enabled.	1
96.100	*Change user pass code*	*(Visible when user lock is open)* To change the current user pass code, enter a new code into this parameter as well as *96.101 Confirm user pass code*. A warning will be active until the new pass code is confirmed. To cancel changing the pass code, close the user lock without confirming. To close the lock, enter an invalid pass code in parameter *96.02 Pass code*, activate parameter *96.08 Control board boot*, or cycle the power. See also section *User lock* (page *95*).	10000000
	10000000… 99999999	New user pass code.	-
96.101	*Confirm user pass code*	*(Visible when user lock is open)* Confirms the new user pass code entered in *96.100 Change user pass code*.	
	10000000… 99999999	Confirmation of new user pass code.	-
96.102	*User lock functionality*	*(Visible when user lock is open)* Selects the actions or functionalities to be prevented by the user lock. Note that the changes made take effect only when the user lock is closed. See parameter *96.02 Pass code*. **Note:** We recommend you select all the actions and functionalities unless otherwise required by the application.	0000h

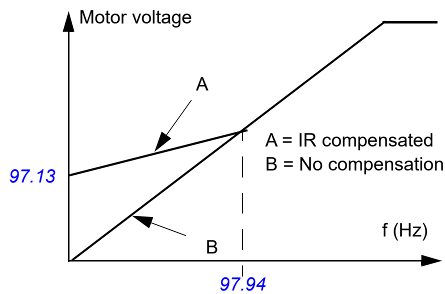
Bit	Name	Information
0	Disable ABB access levels	1 = ABB access levels (service, advanced programmer, etc.; see *96.03*) disabled
1	Freeze parameter lock state	1 = Changing the parameter lock state prevented, ie. pass code 358 has no effect
2	Disable file download	1 = Loading of files to drive prevented. This applies to • firmware upgrades • parameter restore • 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…5	Reserved	
6	Protect AP	1 = Creating a backup and restoring from a backup prevented.
7	Disable panel Bluetooth	1 = Bluetooth disabled on ACS-AP-W control panel. If the drive is part of a panel bus, Bluetooth is disabled on all panels.
8...10	Reserved	
11	Disable OEM access level 1	1 = OEM access level 1 disabled
12	Disable OEM access level 2	1 = OEM access level 2 disabled
13	Disable OEM access level 3	1 = OEM access level 3 disabled
14…15	Reserved	

No.	Name/Value	Description	Def/FbEq16
	0000h…FFFFh	Selection of actions to be prevented by user lock.	-
97 Motor control		Switching frequency; slip gain; voltage reserve; flux braking; anti-cogging (signal injection); IR compensation.	
97.01	Switching frequency reference	Defines the switching frequency of the drive that is used as long as the drive does not heat too much. See section *Switching frequency* on page *71*. Higher switching frequency results in lower acoustic noise- **Notes** • If you have a multimotor system, contact your local ABB representative. • 2 kHz option is not available in R0...R2 frames.	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 that is allowed. Depends on the frame size.	1.5 kHz
	1.5 kHz	1.5 kHz (available only in R0...R2 frames)	1.5
	2 kHz	2 kHz.	2
	4 kHz	4 kHz.	4
	8 kHz	8 kHz.	8
	12 kHz	12 kHz	12
97.03	Slip gain	Defines the slip gain which is used to improve the estimated motor slip. 100% means full slip gain; 0% means no slip gain. The default value is 100%. Other values can be used if a static speed error is detected despite having the setting at full slip gain. **Example** (with nominal load and nominal slip of 40 rpm): A 1000 rpm constant speed reference is given to the drive. Despite having full slip gain (= 100%), a manual tachometer measurement from the motor axis gives a speed value of 998 rpm. The static speed error is 1000 rpm - 998 rpm = 2 rpm. To compensate the error, the slip gain should be increased to 105% (2 rpm / 40 rpm = 5%).	100%
	0…200%	Slip gain.	1 = 1%
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%

No.	Name/Value	Description	Def/FbEq16
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*	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%

<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.


See also section IR compensation for scalar motor control on page 65.
Typical IR compensation values are shown below.
<table>
<tr><th colspan="9">3-phase 380…415V drives</th><th></th></tr>
<tr><td>P_N (kW)</td><td>0, 37</td><td>0, 75</td><td>1, 1</td><td>2, 2</td><td>4</td><td>7, 5</td><td>15</td><td>37</td><td>132</td></tr>
<tr><td>IR compen-sation (%)</td><td>3, 5</td><td>3, 5</td><td>3, 2</td><td>2, 5</td><td>2</td><td>1, 5</td><td>1.3</td><td>1.1</td><td>0.6</td></tr>
</table>
WARNING! Set IR compensation value as low as possible. Large IR compensation value can lead to overheating of the motor and damage to the drive, if operated for longer periods at low speed.</td><td>3.50%</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>97.20</td><td>U/F ratio</td><td>Selects the form for the U/f (voltage to frequency) ratio below field weakening point. For scalar control only.</td><td>Linear</td></tr>
<tr><td></td><td>Linear</td><td>Linear ratio for constant torque applications.</td><td>0</td></tr>
<tr><td></td><td>Squared</td><td>Squared ratio for centrifugal pump and fan applications. With squared U/f ratio the noise level is lower for most operating frequencies.</td><td>1</td></tr>
<tr><td>97.48</td><td>Udc stabilizer</td><td>Enables or disables the DC bus voltage stabilizer.</td><td>Disabled</td></tr>
<tr><td></td><td>Disabled</td><td>DC bus voltage stabilizer disabled.</td><td>0</td></tr>
<tr><td></td><td>Enabled min</td><td>DC bus voltage stabilizer enabled, minimum stabilization.</td><td>50</td></tr>
<tr><td></td><td>Enabled mild</td><td>DC bus voltage stabilizer enabled, mild stabilization.</td><td>100</td></tr>
<tr><td></td><td>Enabled medium</td><td>DC bus voltage stabilizer enabled, medium stabilization.</td><td>300</td></tr>
<tr><td></td><td>Enabled strong</td><td>DC bus voltage stabilizer enabled, strong stabilization.</td><td>500</td></tr>
<tr><td></td><td>Enabled max</td><td>DC bus voltage stabilizer enabled, maximum stabilization.</td><td>800</td></tr>
</table>

No.	Name/Value	Description	Def/FbEq16
97.49	*Slip gain for scalar*	Sets gain for slip compensation (in %) while drive is operating in scalar control mode. • A squirrel-cage motor slips under load. Increasing the frequency as the motor torque increases compensates for the slip. • Requires parameter *99.04 Motor control mode* = *Scalar*. 0 = No slip compensation. 1...200 = Increasing slip compensation. 100% means full slip compensation according to parameters *99.08 Motor nominal frequency* and *99.09 Motor nominal speed*.	0
	0...200 %	Slip compensation in %.	1 = 1%
97.94	*IR comp max frequency*	Sets the frequency at which IR compensation (set by parameter *97.13 IR compensation*) reaches 0 V. The unit is % of motor nominal frequency. IR compensation When enabled, IR compensation provides an extra voltage boost to the motor at low speeds. Use IR compensation, for example, in applications that require a high breakaway torque.  	80.0
	1.0...200.0 %	IR compensation maximum frequency in %.	1 = 1%
97.135	*UDC ripple*	Displays ripple voltage.	0.0 V
	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. **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.	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.	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.	0.00000 p.u.
	0.00000…1.00000 p.u.	Leakage inductance in per unit.	-
98.09	Rs user SI	Defines the stator resistance R_S of the motor model.	0.00000 ohm
	0.00000…100.00000 ohm	Stator resistance.	-
98.10	Rr user SI	Defines the rotor resistance R_R of the motor model.	0.00000 ohm
	0.00000…100.00000 ohm	Rotor resistance.	-
98.11	Lm user SI	Defines the main inductance L_M of the motor model.	0.00 mH
	0.00…100000.00 mH	Main inductance.	1 = 10000 mH
98.12	SigmaL user SI	Defines the leakage inductance σL_S.	0.00 mH
	0.00…100000.00 mH	Leakage inductance.	1 = 10000 mH

No.	Name/Value	Description	Def/FbEq16
99 Motor data		Motor configuration settings.	
99.03	*Motor type*	Selects the motor type. **Note:** This parameter cannot be changed while the drive is running.	*Asynchro-nous motor*
	Asynchronous motor	Standard squirrel cage AC induction motor (asynchronous induction motor).	0
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*. **Note:** In vector control the drive performs a standstill ID run at the first start if ID run has not been previously performed. A new start command is required after standstill ID run. **Note:** To achieve a better motor control performance, you can perform a normal ID run without load. See also section *Operating modes of the drive* (page *37*).	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 *Speed compensated stop* (page *75*), and section *Operating modes of the drive* (page *37*).	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.	4.7 A
	0.0...11.2 A	Nominal current of the motor. The allowable range: • vector control mode: 1/6…2 × I_N of the drive • scalar control mode: 0…2 × I_N with scalar control mode. **Note:** When using flying start in scalar control mode (see parameter *21.19 Scalar start mode*), the nominal current must be in the range allowed for vector control mode.	1 = 0.01 A See *46.05*

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:** • 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.	400.0 V
	0.0...32767.0 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.	1430 rpm
	0…30000 rpm	Nominal speed of the motor.	1 = 1 rpm
99.10	*Motor nominal power*	Defines the nominal motor power. The setting must match the value on the rating plate of the motor. If multiple motors are connected to the drive, enter the total power of the motors. The unit is selected by parameter *96.16 Unit selection*. **Note:** This parameter cannot be changed while the drive is running.	0.75 kW
	0.00… 10000.00 kW or 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. **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
99.12	*Motor nominal torque*	Defines the nominal motor shaft torque for a more accurate motor model. Not obligatory. The unit is selected by parameter *96.16 Unit selection*. **Note:** This parameter cannot be changed while the drive is running.	0.000 N·m or lb·ft
	0.000…4000000.000 N·m or 0.000…2950248.597 lb·ft	Nominal motor torque.	1 = 100 unit

No.	Name/Value	Description	Def/FbEq16
99.13	*ID run requested*	Selects the type of the motor identification routine (ID run) performed at the next start of the drive. During the ID run, the drive will identify the characteristics of the motor for optimum motor control. 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 e.g. 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. • 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
	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. Make sure that it is safe to run the motor before performing the ID run.	1

No.	Name/Value	Description	Def/FbEq16
	Reduced	Reduced ID run. This mode should be selected instead of the *Normal* or *Advanced* ID Run if • mechanical losses are higher than 20% (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. **Note:** This mode should be selected only if the *Normal*, *Reduced* or *Advanced* ID run is not possible due to the restrictions caused by the connected mechanics (e.g. with lift or crane applications).	3
	Advanced	Advanced ID run. Only for frames R6…R8. 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
	Adaptive	Adaptive ID run. Initially, drive runs in Standstill ID run mode and then refines the motor parameters during the normal operation. This helps to achieve more optimal performance. **Note:** This is applicable for R0...R5 frames only.	7
99.14	*Last ID run performed*	Shows the type of ID run that was performed last. For more information about the different modes, see the selections of parameter *99.13 ID run requested*.	*None*
	None	No ID run has been performed.	0
	Normal	*Normal* ID run.	1
	Reduced	*Reduced* ID run.	2
	Standstill	*Standstill* ID run.	3
	Advanced	*Advanced* ID run.	6
	Adative	*Adaptive* ID run.	7

No.	Name/Value	Description	Def/FbEq16
99.15	*Motor polepairs calculated*	Calculated number of pole pairs in the motor.	0
	0…1000	Number of pole pairs.	1 = 1
99.16	*Motor phase order*	Switches the rotation direction of motor. This parameter can be used if the motor turns in the wrong direction (for example, because of the wrong phase order in the motor cable), and correcting the cabling is considered impractical. **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
12.20	*AI1 scaled at AI1 max*	1500.000	1800.000
13.18	*AO1 source max*	1500.0	1800.0
22.26	*Constant speed 1*	300.00 rpm	360.00 rpm
22.27	*Constant speed 2*	600.00 rpm	720.00 rpm
22.28	*Constant speed 3*	900 .00 rpm	1080.00 rpm
22.29	*Constant speed 4*	1200.00 rpm	1440.00 rpm
22.30	*Constant speed 5*	1500.00 rpm	1800.00 rpm
22.30	*Constant speed 6*	2400.00 rpm	2880.00 rpm
22.31	*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
30.11	*Minimum speed*	-1500.00 rpm	-1800.00 rpm
30.12	*Maximum speed*	1500.00 rpm	1800.00 rpm
30.13	*Minimum frequency*	-50.00 Hz	-60.00 Hz
30.14	*Maximum frequency*	50.00 Hz	60.00 Hz
31.26	*Stall speed limit*	150.00 rpm	180.00 rpm
31.27	*Stall frequency limit*	15.00 Hz	18.00 Hz
31.30	*Overspeed trip margin*	500.00 rpm	500.00 rpm
46.01	*Speed scaling*	1500.00 rpm	1800.00 rpm
46.02	*Frequency scaling*	50.00 Hz	60.00 Hz

Parameters supported by Modbus backwards compatibility with 550

ACx550 compatibility mode is a way to communicate with an ACx580 drive in such a way that it looks like an ACx550 drive over Modbus RTU or Modbus TCP. This mode can be enabled by changing parameter *96.78 550 compatibility mode* to Enable.

In the 550 compatibility mode all supported parameters can be read as if the drive were an ACx550. Some parameters are read only and do not support writes. See the table below to see which parameters support writes.

ACx550 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
01.14	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
01.24	AO 1	Read only
01.25	AO 2	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

ACx550 parameter	Name	Read/Write
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
01.45	MOTOR TEMP	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

ACx550 parameter	Name	Read/Write
11.05	REF1 MAX	Read/Write
11.08	REF2 MAX	Read/Write
16.02	PARAMETER LOCK	Read/Write
20.01	MINIMUM SPEED	Read/Write
20.02	MAXIMUM SPEED	Read/Write
20.03	MAX CURRENT	Read/Write
20.07	MINIMUM FREQ	Read/Write
20.08	MAXIMUM FREQ	Read/Write
22.02	ACCELER TIME 1	Read/Write
22.03	DECELER TIME 1	Read/Write
30.05	MOT THERM POT	Read/Write
30.06	MOT THERM TIME	Read/Write
30.07	MOT LOAD CURVE	Read/Write
33.01	FIRMWARE	Read only
33.02	LOADING PACKAGE	Read only
33.03	TEST DATE	Read only

ACx550 parameter	Name	Read/Write
33.04	DRIVE RATING	Read only
40.01	GAIN	Read/Write
40.02	INTEGRATION TIME	Read/Write
40.03	DERIVATION TIME	Read/Write
40.04	PID DERIV FILTER	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
42.11	INTERNAL SETPNT	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

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 *161*).

The ACS560 parameter list uses long and short menu structure. ACS560 parameter list adopts long and short menu structure. The short menu displays common parameter list and the long menu displays complete parameter list. The long and short menus are adjusted by parameter 96.02 password. The default value is short menu.

Parameters	Input password	Long and short menu
96.02 password	1	Short menu
	2	Long menu

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.

Term	Definition
Binary src	Binary source: the value of the parameter can be taken from a specific bit in another parameter value (“Other”). Sometimes the value can be fixed to 0 (false) or 1 (true). In addition, the parameter may offer other pre-selected settings.
Data	Data parameter
FbEq32	32-bit fieldbus equivalent: The scaling between the value shown on the panel and the integer used in communication when a 32-bit value is selected for transmission to an external system. The corresponding 16-bit scalings are listed in chapter *Parameters* (page *161*).
List	Selection list.
No.	Parameter number.
PB	Packed Boolean (bit list).
Real	Real number.
Type	Parameter type. See *Analog src*, *Binary src*, *List*, *PB*, *Real*.

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 = 1 unit
01.15	Output power % of motor nom	*Real*	-300.00…300.00	%	100 = 1%
01.17	Motor shaft power	*Real*	-32768.00…32767.00	kW or hp	100 = 1 unit
01.18	Inverter GWh counter	*Real*	0…65535	GWh	1 = 1 GWh
01.19	Inverter MWh counter	*Real*	0…1000	MWh	1 = 1 MWh
01.20	Inverter kWh counter	*Real*	0…1000	kWh	1 = 1 kWh
01.24	Flux actual %	*Real*	0…200	%	1 = 1%
01.30	Nominal torque scale	*Real*	0.000…4000000	N·m	1000 = 1 unit
01.31	Ambient temperature	*Real*	-40...120	°C or °F	10 = 1 °
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	100 = 1 kWh
01.55	Inverter GWh counter (resettable)	*Real*	0…65535	GWh	1 = 1 GWh
01.56	Inverter MWh counter (resettable)	*Real*	0…1000	MWh	1 = 1 MWh
01.57	Inverter kWh counter (resettable)	*Real*	0…1000	kWh	1 = 1 kWh
01.58	Cumulative inverter energy (resettable)	*Real*	-200000000.0… 200000000.0	kWh	1 = 1 kWh
01.61	Abs motor speed used	*Real*	0.00…30000.00	rpm	100 = 1 rpm
01.62	Abs motor speed %	*Real*	0.00…1000.00%	%	100 = 1%
01.63	Abs output frequency	*Real*	0.00…500.00 Hz	Hz	100 = 1 Hz
01.64	Abs motor torque	*Real*	0.0…1600.0	%	10 = 1%
01.65	Abs output power	*Real*	0.00…32767.00	kW	100 = 1 kW
01.66	Abs output power % motor nom	*Real*	0.00…300.00	%	100 = 1%
01.67	Abs output power % drive nom	*Real*	0.00…300.00	%	100 = 1%

No.	Name	Type	Range	Unit	FbEq32
01.68	Abs motor shaft power	*Real*	0.00…32767.00	kW or hp	100 = 1 kW
03 Input references					
03.01	Panel reference	*Real*	-10000.00…100000.00	-	100 = 1
03.02	Panel reference remote	*Real*	-10000.00…100000.00	-	100 = 1
03.05	FB A reference 1	*Real*	-10000.00…100000.00	-	100 = 1
03.06	FB A reference 2	*Real*	-10000.00…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*	0x0000...0xffff	-	1 = 1
04.02	Active fault 2	*Data*	0x0000...0xffff	-	1 = 1
04.03	Active fault 3	*Data*	0x0000...0xffff	-	1 = 1
04.06	Active warning 1	*Data*	0x0000...0xffff	-	1 = 1
04.07	Active warning 2	*Data*	0x0000...0xffff	-	1 = 1
04.08	Active warning 3	*Data*	0x0000...0xffff	-	1 = 1
04.11	Latest fault	*Data*	0x0000...0xffff	-	1 = 1
04.12	2nd latest fault	*Data*	0x0000...0xffff	-	1 = 1
04.13	3rd latest fault	*Data*	0x0000...0xffff	-	1 = 1
04.16	Latest warning	*Data*	0x0000...0xffff	-	1 = 1
04.17	2nd latest warning	*Data*	0x0000...0xffff	-	1 = 1
04.18	3rd latest warning	*Data*	0x0000...0xffff	-	1 = 1
04.40	Event word 1	*PB*	0000h…FFFFh	-	1 = 1
04.40	Event word 1	*PB*	0000h…FFFFh	-	1 = 1
04.41	Event word 1 bit 0 code	*Data*	0x2310…FFFFh	-	1 = 1
04.43	Event word 1 bit 1 code	*Data*	0x3210…FFFFh	-	1 = 1
04.45, 04,47, 04,49, …	…	…	…	…	
04.71	Event word 1 bit 15 code	*Data*	0x2330…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	10 = 1 °
05.11	Inverter temperature	*Real*	-40.0…160.0	%	10 = 1%
05.20	Diagnostic word 1	*PB*	0b0000…0b1111	-	0b0000
05.21	Diagnostic word 2	*PB*	0b0000…0b1111	-	0b0000
05.22	Diagnostic word 3	*PB*	0b0000…0b1111	-	0b0000
05.80	Motor speed at fault	*Real*	-30000.00…30000.00	rpm	100 = 1 rpm
05.81	Output frequency at fault	*Real*	-500.00…500.00	Hz	100 = 1 Hz

No.	Name	Type	Range	Unit	FbEq32
05.82	DC voltage at fault	*Real*	0.00…2000.00	V	100 = 1 V
05.83	Motor current at fault	*Real*	0.00…30000.00	A	100 = 1 A
05.84	Motor torque at fault	*Real*	-1600.0…1600.0	%	10 = 1%
05.85	Main status word at fault	*PB*	0000h…FFFFh	-	1 = 1
05.86	DI delayed status at fault	*PB*	0b0000...0b1111	-	1 = 1
05.87	Inverter temperature at fault	*PB*	-40.0…160.0	°C	10 = 1°C
05.88	Reference used at fault	*Real*	-500.00...500.00 Hz/ -1600.0…1600.0%/ 30000.00...30000.00 rpm	Hz/ %/ rpm	100 = 1 Hz/ 10 = 1%/ 100 = 1 rpm
05.99	BIO-01 DIP switch status	*PB*	0000h...FFFh	-	1 = 1
06 Control and status words					
06.01	Main control word	*PB*	0x0000...0xffff	-	1 = 1
06.11	Main status word	*PB*	0x0000...0xffff	-	1 = 1
06.16	Drive status word 1	*PB*	0b0000...0b1111	-	1 = 1
06.17	Drive status word 2	*PB*	0b0000...0b1111	-	1 = 1
06.18	Start inhibit status word	*PB*	0b0000...0b1111	-	1 = 1
06.19	Speed control status word	*PB*	0b0000...0b1111	-	1 = 1
06.20	Constant speed status word	*PB*	0b0000...0b1111	-	1 = 1
06.21	Drive status word 3	*PB*	0b0000...0b1111	-	1 = 1
06.29	MSW bit 10 selection	*Binary src*	0...2	-	1 = 1
06.30	MSW bit 11 selection	*Binary src*	-	-	1 = 1
06.31	MSW bit 12 selection	*Binary src*	-	-	1 = 1
06.32	MSW bit 13 selection	*Binary src*	-	-	1 = 1
06.33	MSW bit 14 selection	*Binary src*	-	-	1 = 1
07 System info					
07.03	Drive rating id	*List*	-	-	1 = 1
07.04	Firmware name	*List*	-	-	1 = 1
07.05	Firmware version	*Data*	0.00.0.0...255.255.255.255	-	1 = 1
07.06	Loading package name	*List*	-	-	1 = 1
07.07	Loading package version	*Data*	0.00.0.0...255.255.255.255	-	1 = 1
07.11	Cpu usage	*Real*	0…100	%	1 = 1%
07.35	Drive configuration	*Binary src*	-	-	1=1
07.36	Drive configuration 2	*Binary src*	-	-	1=1

Parameter groups 10…99

No.	Name	Type	Range	Unit	FbEq32
10 Standard DI, RO					
10.01	DI status	*PB*	0b0000...0b1111	-	1 = 1
10.02	DI delayed status	*PB*	0b0000...0b1111	-	1 = 1
10.03	DI force selection	*PB*	0b0000...0b1111	-	1 = 1
10.04	DI forced data	*PB*	0b0000...0b1111	-	1 = 1
10.05	DI1 ON delay	*Real*	0.00...3000.00	s	10 = 1
10.06	DI1 OFF delay	*Real*	0.00...3000.00	s	10 = 1
10.07	DI2 ON delay	*Real*	0.00...3000.00	s	10 = 1
10.08	DI2 OFF delay	*Real*	0.00...3000.00	s	10 = 1
10.09	DI3 ON delay	*Real*	0.00...3000.00	s	10 = 1
10.10	DI3 OFF delay	*Real*	0.00...3000.00	s	10 = 1
10.11	DI4 ON delay	*Real*	0.00...3000.00	s	10 = 1
10.12	DI4 OFF delay	*Real*	0.00...3000.00	s	10 = 1
10.13	DI5 ON delay	*Real*	0.00...3000.00	s	10 = 1
10.14	DI5 OFF delay	*Real*	0.00...3000.00	s	10 = 1
10.15	DI6 ON delay	*Real*	0.00...3000.00	s	10 = 1
10.16	DI6 OFF delay	*Real*	0.00...3000.00	s	10 = 1
10.21	RO status	*PB*	0b0000...0b1111	-	1 = 1
10.22	RO force selection	*PB*	0b0000...0b1111	-	1 = 1
10.23	RO forced data	*PB*	0b0000...0b1111	-	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*	0b0000...0b1111	-	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*	0b000...0b1111	-	1 = 1
12.03	AI supervision function	*List*	0b000...0b1111	-	1 = 1
12.04	AI supervision selection	*PB*	0b000...0b1111	-	1 = 1
12.05	AI supervision force	*PB*	0b000...0b1111	-	1 = 1
12.11	AI1 actual value	*Real*	0.000…11.000 V	V	1000 = 1 unit
12.12	AI1 scaled value	*Real*	-32768.000…32767.000	-	1000 = 1
12.13	AI1 forced value	*Real*	0.000…11.000 V	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…11.000 V	V	1000 = 1 unit
12.18	AI1 max	*Real*	0.000…11.000 V	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	1000 = 1 unit
12.22	AI2 scaled value	*Real*	-32768.000…32767.000	-	1000 = 1
12.23	AI2 forced value	*Real*	0.000…22.000	mA	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…22.000	mA	1000 = 1 unit
12.28	AI2 max	*Real*	0.000…22.000	mA	1000 = 1 unit
12.29	AI2 scaled at AI2 min	*Real*	-32768.000…32767.000	-	1000 = 1
12.30	AI2 scaled at AI2 max	*Real*	-32768.000…32767.000	-	1000 = 1
12.101	AI1 percent value	*Real*	0.00…100.00	%	100 = 1%
12.102	AI2 percent value	*Real*	0.00…100.00	%	100 = 1%
12.110	AI dead band	*Real*	0.00...100.00	%	1 = 1%
13 Standard AO					
13.02	AO force selection	*PB*	0b0000…0b1111	-	1 = 1
13.11	AO1 actual value	*Real*	0.000…22.000 or 0.000…11000 V	mA	1000 = 1 mA
13.12	AO1 source	*Analog src*	-	-	1 = 1
13.13	AO1 forced value	*Real*	0.000…22.000 or 0.000…11000 V	mA	1000 = 1 mA
13.15	AO1 unit selection	*List*	2, 10	-	1 = 1
13.16	AO1 filter time	*Real*	0.000…30.000	s	1000 = 1 s
13.17	AO1 source min	*Real*	-32768.0…32767.0	-	10 = 1
13.18	AO1 source max	*Real*	-32768.0…32767.0	-	10 = 1

No.	Name	Type	Range	Unit	FbEq32
13.19	AO1 out at AO1 src min	*Real*	0.000…22.000 or 0.000…11000 V	mA	1000 = 1 mA
13.20	AO1 out at AO1 src max	*Real*	0.000…22.000 or 0.000…11000 V	mA	1000 = 1 mA
13.21	AO2 actual value	*Real*	0.000…22.000	mA	1000 = 1 mA
13.22	AO2 source	*Analog src*	-	-	1 = 1
13.23	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
19 Operation mode					
19.01	Actual operation mode	*List*	-	-	1 = 1
19.11	Ext1/Ext2 selection	*Binary src*	-	-	1 = 1
19.12	Ext1 control mode	*List*	1...5	-	1 = 1
19.14	Ext2 control mode	*List*	1…5	-	1 = 1
19.16	Local control mode	*List*	0, 1	-	1 = 1
19.17	Local control disable	*List*	0…1	-	1 = 1
20 Start/stop/direction					
20.01	Ext1 commands	*List*	0…6, 4, 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
20.05	Ext1 in3 source	*Binary src*	-	-	1 = 1
20.06	Ext2 commands	*List*	0…6, 4, 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
20.11	Run enable stop mode	*List*	0…2	-	1 = 1
20.12	Run enable 1 source	*Binary src*	-	-	1 = 1
20.19	Enable start command	*Binary src*	-	-	1 = 1

No.	Name	Type	Range	Unit	FbEq32
20.21	Direction	*List*	0…2	-	1 = 1
20.22	Enable to rotate	*Binary src*	-	-	1 = 1
20.25	Jogging enable	*Binary src*	-	-	1 = 1
20.26	Jogging 1 start source	*Binary src*	-	-	1 = 1
20.27	Jogging 2 start source	*Binary src*	-	-	1 = 1
20.30	Enable signal warning function	*PB*	0000h...FFFFh	-	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*	0b0000…0b1111	-	1 = 1
21.09	DC hold speed	*Real*	0.00…1000.00	rpm	100 = 1 rpm
21.10	DC current reference	*Real*	0.0…100.0	%	10 = 1%
21.11	Post magnetization time	*Real*	0…3000	s	1 = 1 s
21.14	Pre-heating input source	*Binary src*	-	-	1 = 1
21.15	Pre-heating time delay	*Real*	10...3000	s	1 = 1
21.16	Pre-heating current	*Real*	0.0…30.0	%	10 = 1%
21.18	Auto restart time	*Real*	0.0…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
21.26	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
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

No.	Name	Type	Range	Unit	FbEq32
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	0b0000…0b1111	-	1 = 1
22.22	Constant speed sel1	Binary src	-	-	1 = 1
22.23	Constant speed sel2	Binary src	-	-	1 = 1
22.24	Constant speed sel3	Binary src	-	-	1 = 1
22.26	Constant speed 1	Real	-30000.00…30000.00	rpm	100 = 1 rpm
22.27	Constant speed 2	Real	-30000.00…30000.00	rpm	100 = 1 rpm
22.28	Constant speed 3	Real	-30000.00…30000.00	rpm	100 = 1 rpm
22.29	Constant speed 4	Real	-30000.00…30000.00	rpm	100 = 1 rpm
22.30	Constant speed 5	Real	-30000.00…30000.00	rpm	100 = 1 rpm
22.31	Constant speed 6	Real	-30000.00…30000.00	rpm	100 = 1 rpm
22.32	Constant speed 7	Real	-30000.00…30000.00	rpm	100 = 1 rpm
22.41	Speed ref safe	Real	-30000.00…30000.00	rpm	100 = 1 rpm
22.42	Jogging 1 ref	Real	-30000.00…30000.00	rpm	100 = 1 rpm
22.43	Jogging 2 ref	Real	-30000.00…30000.00	rpm	100 = 1 rpm
22.51	Critical speed function	PB	0b0000…0b1111	-	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
22.71	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
22.76	Motor potentiometer min value	Real	-32768.00…32767.00	-	100 = 1
22.77	Motor potentiometer max value	Real	-32768.00…32767.00	-	100 = 1
22.78	Motor potentiometer ramp up	Real	0.0...3600.0	s	-
22.79	Motor potentiometer ramp down	Real	0.0...3600.0	s	-
22.80	Motor potentiometer ref act	Real	-32768.00…32767.00	-	100 = 1

No.	Name	Type	Range	Unit	FbEq32
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
23.20	Acc time jogging	*Real*	0.000…1800.000	s	1000 = 1 s
23.21	Dec time jogging	*Real*	0.000…1800.000	s	1000 = 1 s
23.23	Emergency stop time	*Real*	0.000…1800.000	s	1000 = 1 s
23.28	Variable slope	*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*	-30000.00…30000.00	rpm	100 = 1 rpm
24.12	Speed error filter time	*Real*	0...10000	ms	1 = 1ms
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
25.30	Flux adaptation enable	*List*	0...1	-	-
25.33	Speed controller autotune	*List*	-	-	1 = 1
25.34	Speed controller autotune mode	*List*	-	-	1 = 1
25.37	Mechanical time constant	*Real*	0.00...1000.00	s	100 = 1 s
25.38	Autotune torque step	*Real*	0.00...100.00	%	100 = 1%
25.39	Autotune speed step	*Real*	0.00...100.00	%	100 = 1%
25.40	Autotune repeat times	*Real*	1...10	-	1 = 1
25.53	Torque prop reference	*Real*	-30000.0…30000.0	%	10 = 1%
25.54	Torque integral reference	*Real*	-30000.0…30000.0	%	10 = 1%

No.	Name	Type	Range	Unit	FbEq32
25.55	Torque deriv reference	*Real*	-30000.0…30000.0	%	10 = 1%
25.56	Torque acc compensation	*Real*	-30000.0…30000.0	%	10 = 1%
26 Torque reference chain					
26.01	Torque reference to TC	*Real*	-1600.0…1600.0	%	10 = 1%
26.02	Torque reference used	*Real*	-1600.0…1600.0	%	10 = 1%
26.08	Minimum torque ref	*Real*	-1000.0…0.0	%	10 = 1%
26.09	Maximum torque ref	*Real*	0.0…1000.0	%	10 = 1%
26.11	Torque ref1 source	*Analog src*	-	-	1 = 1
26.12	Torque ref2 source	*Analog src*	-	-	1 = 1
26.13	Torque ref1 function	*List*	0…5	-	1 = 1
26.14	Torque ref1/2 selection	*Binary src*	-	-	1 = 1
26.17	Torque ref filter time	*Real*	0.000…30.000	s	1000 = 1 s
26.18	Torque ramp up time	*Real*	0.000…60.000	s	1000 = 1 s
26.19	Torque ramp down time	*Real*	0.000…60.000	s	1000 = 1 s
26.20	Torque reversal	*List*	-	-	1 = 1
26.70	Torque reference act 1	*Real*	-1600.0…1600.0	%	10 = 1%
26.71	Torque reference act 2	*Real*	-1600.0…1600.0	%	10 = 1%
26.72	Torque reference act 3	*Real*	-1600.0…1600.0	%	10 = 1%
26.73	Torque reference act 4	*Real*	-1600.0…1600.0	%	10 = 1%
26.74	Torque ref ramp out	*Real*	-1600.0…1600.0	%	10 = 1%
26.75	Torque reference act 5	*Real*	-1600.0…1600.0	%	10 = 1%
26.76	Torque reference act 6		-1600.0…1600.0	%	10 = 1%
26.81	Rush control gain	*Real*	0.0...10000.0	-	10=1
26.82	Rush control integration time	*Real*	0.0...10.0	s	10=1 s
28 Frequency reference chain					
28.01	Frequency ref ramp input	*Real*	-500.00…500.00	Hz	100 = 1 Hz
28.02	Frequency ref ramp output	*Real*	-500.00…500.00	Hz	100 = 1 Hz
28.11	Ext1 frequency ref1	*Analog src*	-	-	1 = 1
28.12	Ext1 frequency ref2	*Analog src*	0...5	-	1 = 1
28.13	Ext1 frequency function	*List*	0…5	-	1 = 1
28.15	Ext2 frequency ref1	*Analog src*	-	-	1 = 1
28.16	Ext2 frequency ref2	*Analog src*	-	-	1 = 1
28.17	Ext2 frequency function	*List*	0…5	-	1 = 1
28.21	Constant frequency function	*PB*	0b0000…0b1111	-	1 = 1
28.22	Constant frequency sel1	*Binary src*	-	-	1 = 1

No.	Name	Type	Range	Unit	FbEq32
28.23	Constant frequency sel2	*Binary src*	-	-	1 = 1
28.24	Constant frequency sel3	*Binary src*	-	-	1 = 1
28.26	Constant frequency 1	*Real*	-500.00…500.00	Hz	100 = 1 Hz
28.27	Constant frequency 2	*Real*	-500.00…500.00	Hz	100 = 1 Hz
28.28	Constant frequency 3	*Real*	-500.00…500.00	Hz	100 = 1 Hz
28.29	Constant frequency 4	*Real*	-500.00…500.00	Hz	100 = 1 Hz
28.30	Constant frequency 5	*Real*	-500.00…500.00	Hz	100 = 1 Hz
28.31	Constant frequency 6	*Real*	-500.00…500.00	Hz	100 = 1 Hz
28.32	Constant frequency 7	*Real*	-500.00…500.00	Hz	100 = 1 Hz
28.41	Frequency ref safe	*Real*	-500.00…500.00	Hz	100 = 1 Hz
28.42	Jogging 1 frequency ref	*Real*	-500.00…500.00	Hz	100 = 1 Hz
28.43	Jogging 2 frequency ref	*Real*	-500.00…500.00	Hz	100 = 1 Hz
28.51	Critical frequency function	*PB*	0b0000…0b1111	-	1 = 1
28.52	Critical frequency 1 low	*Real*	-500.00…500.00	Hz	100 = 1 Hz
28.53	Critical frequency 1 high	*Real*	-500.00…500.00	Hz	100 = 1 Hz
28.54	Critical frequency 2 low	*Real*	-500.00…500.00	Hz	100 = 1 Hz
28.55	Critical frequency 2 high	*Real*	-500.00…500.00	Hz	100 = 1 Hz
28.56	Critical frequency 3 low	*Real*	-500.00…500.00	Hz	100 = 1 Hz
28.57	Critical frequency 3 high	*Real*	-500.00…500.00	Hz	100 = 1 Hz
28.71	Freq ramp set selection	*Binary src*	-	-	1 = 1
28.72	Freq acceleration time 1	*Real*	0.000…1800.000	s	1000 = 1 s
28.73	Freq deceleration time 1	*Real*	0.000…1800.000	s	1000 = 1 s
28.74	Freq acceleration time 2	*Real*	0.000…1800.000	s	1000 = 1 s
28.75	Freq deceleration time 2	*Real*	0.000…1800.000	s	1000 = 1 s
28.76	Freq ramp in zero source	*Binary src*	-	-	1 = 1
28.82	Shape time 1	*Real*	0.000…1800.000	s	1000 = 1 s
28.83	Shape time 2	*Real*	0.000…1800.000	s	1000 = 1 s
28.92	Frequency ref act 3	*Real*	-500.00…500.00	Hz	100 = 1 Hz
28.96	Frequency ref act 7	*Real*	-500.00…500.00	Hz	100 = 1 Hz
28.97	Frequency ref unlimited	*Real*	-500.00…500.00	Hz	100 = 1 Hz
30 Limits					
30.01	Limit word 1	*PB*	0b0000…0b1111	-	1 = 1
30.02	Torque limit status	*PB*	0b0000…0b1111	-	1 = 1
30.09	Current limit monitor time	*Real*	0.00...120.00	s	-
30.10	Current limit actions	*List*	0...2	-	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

No.	Name	Type	Range	Unit	FbEq32
30.14	Maximum frequency	*Real*	-500.00…500.00	Hz	100 = 1 Hz
30.17	Maximum current	*Real*	0.00.3.24	A	100 = 1 A
30.18	Torq lim sel	*Binary src*	-	-	1 = 1
30.19	Minimum torque 1	*Real*	-1600.0…0.0	%	10 = 1%
30.20	Maximum torque 1	*Real*	0.0…1600.0	%	10 = 1%
30.21	Min torque 2 source	*Analog src*	-	-	1 = 1
30.22	Max torque 2 source	*Analog src*	-	-	1 = 1
30.23	Minimum torque 2	*Real*	-1600.0...0.0	%	10 = 1%
30.24	Maximum torque 2	*Real*	0.0...1600.0	%	10 = 1%
30.26	Power motoring limit	*Real*	0.00…600.00	%	100 = 1%
30.27	Power generating limit	*Real*	-600.00…0.00	%	100 = 1%
30.30	Overvoltage control	*List*	0…1	-	1 = 1
30.31	Undervoltage control	*List*	0…1	-	1 = 1
30.35	Thermal current limitation	*List*	0...1	-	1 = 1
30.36	Speed limit selection	*Binary src*	-	-	1 = 1
30.37	Min speed source	*Analog src*	-	-	1 = 1
30.38	Max speed source	*Analog src*	-	-	1 = 1
31 Fault functions					
31.01	External event 1 source	*Binary src*	-	-	1 = 1
31.02	External event 1 type	*List*	0…1	-	1 = 1
31.03	External event 2 source	*Binary src*	-	-	1 = 1
31.04	External event 2 type	*List*	0…1	-	1 = 1
31.05	External event 3 source	*Binary src*	-	-	1 = 1
31.06	External event 3 type	*List*	0…1	-	1 = 1
31.07	External event 4 source	*Binary src*	-	-	1 = 1
31.08	External event 4 type	*List*	0…1	-	1 = 1
31.09	External event 5 source	*Binary src*	-	-	1 = 1
31.10	External event 5 type	*List*	0…1	-	1 = 1
31.11	Fault reset selection	*Binary src*	-	-	1 = 1
31.12	Autoreset selection	*PB*	0x0000…0xffff	-	1 = 1
31.13	Selectable fault	*Real*	0x0000…0xffff	-	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

No.	Name	Type	Range	Unit	FbEq32
31.16	Delay time	*Real*	0.0…120.0	s	10 = 1 s
31.19	Motor 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
31.36	Aux fan fault function	*List*	0…1	-	1 = 1
31.40	Disable warning messages	*PB*	0000h...FFFFh	-	1 = 1
32 Supervision					
32.01	Supervision status	*PB*	0b0000…0b1111	-	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	-	-
32.10	Supervision 1 high	*Real*	-21474836.00… 21474836.00	-	-
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
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…6	-	1 = 1
32.26	Supervision 3 action	*List*	0…3	-	1 = 1
32.27	Supervision 3 signal	*Analog src*	0, 1, 3, 4, 6...10, 23...27	-	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

No.	Name	Type	Range	Unit	FbEq32
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
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*	0b0000…0b1111	-	1 = 1
34.02	Timer status	*PB*	0b0000…0b1111	-	1 = 1
34.04	Season/exception day status	*PB*	0b0000…0b1111	-	1 = 1
34.10	Timed functions enable	*Binary src*	0...7	-	1 = 1
34.11	Timer 1 configuration	*PB*	0b0000…0b1111	-	1 = 1
34.12	Timer 1 start time	Time	00:00:00…23:59:59	-	1 = 1
34.13	Timer 1 duration	Duration	00 00:00…07 00:00	-	1 = 1
34.14	Timer 2 configuration	*PB*	0b0000…0b1111	-	1 = 1
34.15	Timer 2 start time	Time	00:00:00…23:59:59	-	1 = 1
34.16	Timer 2 duration	Duration	00 00:00…07 00:00	-	1 = 1
34.17	Timer 3 configuration	*PB*	0b0000…0b1111	-	1 = 1

No.	Name	Type	Range	Unit	FbEq32
34.18	Timer 3 start time	Time	00:00:00…23:59:59	-	1 = 1
34.19	Timer 3 duration	Duration	00 00:00…07 00:00	-	1 = 1
34.20	Timer 4 configuration	*PB*	0b0000…0b1111	-	1 = 1
34.21	Timer 4 start time	Time	00:00:00…23:59:59	-	1 = 1
34.22	Timer 4 duration	Duration	00 00:00…07 00:00	-	1 = 1
34.23	Timer 5 configuration	*PB*	0b0000…0b1111	-	1 = 1
34.24	Timer 5 start time	Time	00:00:00…23:59:59	-	1 = 1
34.25	Timer 5 duration	Duration	00 00:00…07 00:00	-	1 = 1
34.26	Timer 6 configuration	*PB*	0b0000…0b1111	-	1 = 1
34.27	Timer 6 start time	Time	00:00:00…23:59:59	-	1 = 1
34.28	Timer 6 duration	Duration	00 00:00…07 00:00	-	1 = 1
34.29	Timer 7 configuration	*PB*	0b0000…0b1111	-	1 = 1
34.30	Timer 7 start time	Time	00:00:00…23:59:59	-	1 = 1
34.31	Timer 7 duration	Duration	00 00:00…07 00:00	-	1 = 1
34.32	Timer 8 configuration	*PB*	0b0000…0b1111	-	1 = 1
34.33	Timer 8 start time	Time	00:00:00…23:59:59	-	1 = 1
34.34	Timer 8 duration	Duration	00 00:00…07 00:00	-	1 = 1
34.35	Timer 9 configuration	*PB*	0b0000…0b1111	-	1 = 1
34.36	Timer 9 start time	Time	00:00:00…23:59:59	-	1 = 1
34.37	Timer 9 duration	Duration	00 00:00…07 00:00	-	1 = 1
34.38	Timer 10 configuration	*PB*	0b0000…0b1111	-	1 = 1
34.39	Timer 10 start time	Time	00:00:00…23:59:59	-	1 = 1
34.40	Timer 10 duration	Duration	00 00:00…07 00:00	-	1 = 1
34.41	Timer 11 configuration	*PB*	0b0000…0b1111	-	1 = 1
34.42	Timer 11 start time	Time	00:00:00…23:59:59	-	1 = 1
34.43	Timer 11 duration	Duration	00 00:00…07 00:00	-	1 = 1
34.44	Timer 12 configuration	*PB*	0b0000…0b1111	-	1 = 1
34.45	Timer 12 start time	Time	00:00:00…23:59:59	-	1 = 1
34.46	Timer 12 duration	Duration	00 00:00…07 00:00	-	1 = 1 -
34.60	Season 1 start date	Date	-	-	1 = 1
34.61	Season 2 start date	Date	-	-	1 = 1
34.62	Season 3 start date	Date	-	-	1 = 1
34.63	Season 4 start date	Date	-	-	1 = 1
34.70	Number of active exceptions	*Real*	0…16	-	1 = 1
34.71	Exception types	*PB*	0b0000…0b1111	-	1 = 1
34.72	Exception 1 start	Date	-	d	1 = 1 d
34.73	Exception 1 length	*Real*	0…60	d	1 = 1 d
34.74	Exception 2 start	Date	-	d	1 = 1 d
34.75	Exception 2 length	*Real*	0…60	d	1 = 1 d
34.76	Exception 3 start	Date	-	d	1 = 1 d
34.77	Exception 3 length	*Real*	0…60	d	1 = 1 d

No.	Name	Type	Range	Unit	FbEq32
34.78	Exception day 4	Date	-	d	1 = 1 d
34.79	Exception day 5	Date	-	d	1 = 1 d
34.80	Exception day 6	Date	-	d	1 = 1 d
34.81	Exception day 7	Date	-	d	1 = 1 d
34.82	Exception day 8	Date	-	d	1 = 1 d
34.83	Exception day 9	Date	-	d	1 = 1 d
34.84	Exception day 10	Date	-	d	1 = 1 d
34.85	Exception day 11	Date	-	d	1 = 1 d
34.86	Exception day 12	Date	-	d	1 = 1 d
34.87	Exception day 13	Date	-	d	1 = 1 d
34.88	Exception day 14	Date	-	d	1 = 1 d
34.89	Exception day 15	Date	-	d	1 = 1 d
34.90	Exception day 16	Date	-	d	1 = 1 d
34.100	Timed function 1	*PB*	0b0000…0b1111	-	1 = 1
34.101	Timed function 2	*PB*	0b0000…0b1111	-	1 = 1
34.102	Timed function 3	*PB*	0b0000…0b1111	-	1 = 1
34.110	Boost time function	*PB*	0b0000…0b1111	-	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 °
35.02	Measured temperature 1	*Real*	-60…5000 °C or -76…9032 °F	°C, °F	1 = 1 unit
35.03	Measured temperature 2	*Real*	-60…5000 °C or -76…9032 °F	°C, °F	1 = 1 unit
35.05	Motor overload level	*Real*	0.0...300.0	%	1 = 1unit
35.11	Temperature 1 source	*List*	-	-	1 = 1
35.12	Temperature 1 fault limit	*Real*	-60…5000 °C or -76…9032 °F	°C, °F	1 = 1 unit
35.13	Temperature 1 warning limit	*Real*	-60…5000 °C or -76…9032 °F	°C, °F	1 = 1 unit
35.14	Temperature 1 AI source	*Analog src*	-	-	1 = 1
35.21	Temperature 2 source	*List*	-	-	1 = 1
35.22	Temperature 2 fault limit	*Real*	-60…5000 °C or -76…9032 °F	°C, °F	1 = 1 unit
35.23	Temperature 2 warning limit	*Real*	-60…5000 °C or -76…9032 °F	°C, °F	1 = 1 unit
35.24	Temperature 2 AI source	*Analog src*	-	-	1 = 1
35.50	Motor ambient temperature	*Real*	-60…100 °C or -76 … 212 °F	°C, °F	1 = 1 °
35.51	Motor load curve	*Real*	50…150	%	1 = 1%

No.	Name	Type	Range	Unit	FbEq32
35.52	Zero speed load	*Real*	50…150	%	1 = 1%
35.53	Break point	*Real*	1.00 … 500.00	Hz	100 = 1 Hz
35.54	Motor nominal temperature rise	*Real*	0…300 °C or 32…572 °F	°C or °F	1 = 1 °
35.55	Motor thermal time const	*Real*	100…10000	s	1 = 1 s
35.56	Motor overload action	*List*	0...2	-	1 = 1
35.57	Motor overload class	*List*	0...4	-	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
36.09	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*	1/1/1980...6/5/2159	-	1 = 1
36.12	PVL peak time	*Data*	00:00:00...23:59:59	-	1 = 1
36.13	PVL current at peak	*Real*	-32768.00…32767.00	A	100 = 1 A
36.14	PVL DC voltage at peak	*Real*	0.00…2000.00	V	100 = 1 V
36.15	PVL speed at peak	*Real*	-30000.00-30000.00	rpm	100 = 1 rpm
36.16	PVL reset date	*Data*	1/1/1980...6/5/2159	-	1 = 1
36.17	PVL reset time	*Data*	00:00:00...23:59:59	-	1 = 1
37 User load curve					
37.01	ULC output status word	*PB*	0b0000…0b1111	-	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
37.21	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%

No.	Name	Type	Range	Unit	FbEq32
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 PID customer unit
40.02	Process PID feedback actual	*Real*	-200000.00...200000.00	PID customer units	100 = 1 PID customer unit
40.03	Process PID setpoint actual	*Real*	-200000.00...200000.00	PID customer units	100 = 1 PID customer unit
40.04	Process PID deviation actual	*Real*	-200000.00...200000.00	PID customer units	100 = 1 PID customer unit
40.05	Process PID trim output act	*Real*	-32768...32767	PID customer units	100 = 1 PID customer unit
40.06	Process PID status word	*PB*	0b0000…0b1111	-	1 = 1
40.07	Process PID operation mode	*List*	0…2	-	1 = 1
40.08	Set 1 feedback 1 source	*Analog src*	-	-	1 = 1
40.09	Set 1 feedback 2 source	*Analog src*	-	-	1 = 1
40.10	Set 1 feedback function	*List*	0…11	-	1 = 1
40.11	Set 1 feedback filter time	*Real*	0.000…30.000	s	1000 = 1 s
40.14	Set 1 setpoint scaling	*Real*	-200000.00...200000.00	-	-
40.15	Set 1 output scaling	*Real*	-200000.00...200000.00	-	-
40.16	Set 1 setpoint 1 source	*Analog src*	-	-	1 = 1
40.17	Set 1 setpoint 2 source	*Analog src*	-	-	1 = 1
40.18	Set 1 setpoint function	*List*	0…11	-	1 = 1
40.19	Set 1 internal setpoint sel1	*Binary src*	-	-	1 = 1
40.20	Set 1 internal setpoint sel2	*Binary src*	-	-	1 = 1
40.21	Set 1 internal setpoint 1	*Real*	-200000.00...200000.00	PID customer units	100 = 1 PID customer unit
40.22	Set 1 internal setpoint 2	*Real*	-200000.00...200000.00	PID customer units	100 = 1 PID customer unit
40.23	Set 1 internal setpoint 3	*Real*	-200000.00...200000.00	PID customer units	100 = 1 PID customer unit
40.24	Set 1 internal setpoint 0	*Real*	-200000.00...200000.00	PID customer units	100 = 1 PID customer unit
40.26	Set 1 setpoint min	*Real*	-200000.00...200000.00	-	100 = 1

No.	Name	Type	Range	Unit	FbEq32
40.27	Set 1 setpoint max	*Real*	-200000.00...200000.00	-	100 = 1
40.28	Set 1 setpoint increase time	*Real*	0.0…1800.0	s	10 = 1 s
40.29	Set 1 setpoint decrease time	*Real*	0.0…1800.0	s	10 = 1 s
40.30	Set 1 setpoint freeze enable	*Binary src*	-	-	1 = 1
40.31	Set 1 deviation inversion	*Binary src*	-	-	1 = 1
40.32	Set 1 gain	*Real*	0.01…100.00	-	100 = 1
40.33	Set 1 integration time	*Real*	0.0…9999.0	s	10 = 1 s
40.34	Set 1 derivation time	*Real*	0.000…10.000	s	1000 = 1 s
40.35	Set 1 derivation filter time	*Real*	0.0…10.0	s	10 = 1 s
40.36	Set 1 output min	*Real*	-200000.00…200000.00	-	10 = 1
40.37	Set 1 output max	*Real*	-200000.00…200000.00	-	10 = 1
40.38	Set 1 output freeze	*Binary src*	-	-	1 = 1
40.39	Set 1 deadband range	*Real*	0.00...3600.00	-	100 = 1
40.40	Set 1 deadband delay	*Real*	0.0...200000.0	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*	0.00…200000.00	PID customer units	100 = 1 PID customer unit
40.47	Set 1 wake-up deviation	*Real*	-20000000…200000.00	PID customer units	100 = 1 PID customer unit
40.48	Set 1 wake-up delay	*Real*	0.00…60.00	s	100 = 1 s
40.49	Set 1 tracking mode	*Binary src*	-	-	1 = 1
40.50	Set 1 tracking ref selection	*Analog src*	-	-	1 = 1
40.51	Set 1 trim mode	*List*	0...3	-	1 = 1
40.52	Set 1 trim selection	*List*	1...3	-	1 = 1
40.53	Set 1 trimmed ref pointer	*Analog src*	-	-	1 = 1
40.54	Set 1 trim mix	*Real*	0.000...1.000	-	1 = 1
40.55	Set 1 trim adjust	*Real*	-100.000...100.000	-	1 = 1
40.56	Set 1 trim source	*List*	1...2	-	1 = 1
40.57	PID set1/set2 selection	*Binary src*	0...7, 18...23	-	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

No.	Name	Type	Range	Unit	FbEq32
40.61	Setpoint scaling actual	*Real*	--200000.00…200000.00	-	100 = 1
40.62	PID internal setpoint actual	*Real*	-200000.00…200000.00	PID customer units	100 = 1 PID customer unit
40.65	Trim auto connection	TBD			
40.79	Set 1 units	*List*	0...31	Depends on selection	-
40.80	Set 1 PID output min source	*Analog src*	-	-	1 = 1
40.81	Set 1 PID output max source	*Analog src*	-	-	1 = 1
40.89	Set 1 setpoint multiplier	*Real*	-200000.00…200000.00	-	-
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	%	-
40.97	Process PID feedback%	*Real*	-100.00...100.00	%	-
40.98	Process PID setpoint%	*Real*	-100.00...100.00	%	-
40.99	Process PID deviation%	*Real*	-100.00...100.00	%	-
41 Process PID set 2					
41.08	Set 2 feedback 1 source	*Analog src*	-	-	1 = 1
41.09	Set 2 feedback 2 source	*Analog src*	-	-	1 = 1
41.10	Set 2 feedback function	*List*	0…11	-	1 = 1
41.11	Set 2 feedback filter time	*Real*	0.000…30.000	s	1000 = 1 s
41.14	Set 2 setpoint scaling	*Real*	-200000.00 … 200000.00	-	100=1
41.15	Set 2 output scaling	*Real*	-200000.00 … 200000.00	-	100=1
41.16	Set 2 setpoint 1 source	*Analog src*	-	-	1 = 1
41.17	Set 2 setpoint 2 source	*Analog src*	-	-	1 = 1
41.18	Set 2 setpoint function	*List*	0…11	-	1 = 1
41.19	Set 2 internal setpoint sel1	*Binary src*	-	-	1 = 1
41.20	Set 2 internal setpoint sel2	*Binary src*	-	-	1 = 1
41.21	Set 2 internal setpoint 1	*Real*	-200000.00 … 200000.00	PID customer unit	100 = 1 PID customer unit
41.22	Set 2 internal setpoint 2	*Real*	-200000.00 … 200000.00	PID customer units	100 = 1 PID customer unit

No.	Name	Type	Range	Unit	FbEq32
41.23	Set 2 internal setpoint 3	*Real*	-200000.00 … 200000.00	PID customer units	100 = 1 PID customer unit
41.24	Set 2 internal setpoint 0	*Real*	-200000.00 … 200000.00	PID customer units	100 = 1 PID customer unit
41.26	Set 2 setpoint min	*Real*	-200000.00 … 200000.00	-	100 = 1
41.27	Set 2 setpoint max	*Real*	-200000.00 … 200000.00	-	100 = 1
41.28	Set 2 setpoint increase time	*Real*	0.0…1800.0	s	10 = 1 s
41.29	Set 2 setpoint decrease time	*Real*	0.0…1800.0	s	10 = 1 s
41.30	Set 2 setpoint freeze enable	*Binary src*	-	-	1 = 1
41.31	Set 2 deviation inversion	*Binary src*	-	-	1 = 1
41.32	Set 2 gain	*Real*	0.01…100.00	-	100 = 1
41.33	Set 2 integration time	*Real*	0.0…9999.0	s	10 = 1 s
41.34	Set 2 derivation time	*Real*	0.000…10.000	s	1000 = 1 s
41.35	Set 2 derivation filter time	*Real*	0.0…10.0	s	10 = 1 s
41.36	Set 2 output min	*Real*	-200000.00 … 200000.00	-	10 = 1
41.37	Set 2 output max	*Real*	-200000.00 … 200000.00	-	10 = 1
41.38	Set 2 output freeze	*Binary src*	-	-	1 = 1
41.39	Set 2 deadband range	*Real*	0.00...3600.00	-	100 = 1
41.40	Set 2 deadband delay	*Real*	0.0...200000.0	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*	0.00…200000.00	PID customer units	100 = 1 PID customer unit
41.47	Set 2 wake-up deviation	*Real*	-200000.00 … 200000.00	PID customer units	100 = 1 PID customer unit
41.48	Set 2 wake-up delay	*Real*	0.00…60.00	s	100 = 1 s
41.49	Set 2 tracking mode	*Binary src*	-	-	1 = 1
41.50	Set 2 tracking ref selection	*Analog src*	-	-	1 = 1
41.51	Set 2 trim mode	*List*	0...3	-	1 = 1
41.52	Set 2 trim selection	*List*	1...3	-	1 = 1
41.53	Set 2 trimmed ref pointer	*Analog src*	-	-	1 = 1
41.54	Set 2 trim mix	*Real*	0.000...1.000	-	1 = 1
41.55	Set 2 trim adjust	*Real*	-100.000...100.000	-	1 = 1
41.56	Set 2 trim source	*List*	1...2	-	1 = 1

No.	Name	Type	Range	Unit	FbEq32
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
41.79	Set 2 units	*Real*	0...31	Depends on selection	-
41.80	Set 1 PID output min source	*Analog src*	-	-	1 = 1
41.81	Set 1 PID output max source	*Analog src*	-	-	1 = 1
41.89	Set 2 setpoint multiplier	*Real*	-100000.00…100000.00	-	100 = 1
41.90	Set 2 feedback multiplier	*Real*	-100000.00…100000.00	-	100 = 1
43 Brake chopper					
43.01	Braking resistor temperature	*Real*	0.0…120.0	%	10 = 1%
43.06	Brake chopper enable	*List*	0…3	-	1 = 1
43.07	Brake chopper runtime enable	*Binary src*	0…1	-	1 = 1
43.08	Brake resistor thermal tc	*Real*	0…10000	s	1 = 1 s
43.09	Brake resistor Pmax cont	*Real*	0.00…10000.00	kW	100 = 1 kW
43.10	Brake resistance	*Real*	0.0…1000.0	Ohm	10 = 1 ohm
43.11	Brake resistor fault limit	*Real*	0…150	%	1 = 1%
43.12	Brake resistor warning limit	*Real*	0…150	%	1 = 1%
44 Mechanical brake control					
44.01	Brake control status	*PB*	0b0000…0b1111	-	1 = 1
44.06	Brake control enable	*Binary src*	-	-	1 = 1
44.08	Brake open delay	*Real*	0.00…5.00	s	100 = 1 s
44.13	Brake close delay	*Real*	0.00…60.00	s	100 = 1 s
44.14	Brake close level	*Real*	0.00…1000.00	rpm	100 = 1 rpm
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	INR	1 = 1
45.06	Saved money	*Real*	0.00…999.99	INR	100 = 1
45.07	Saved amount	*Real*	0.00…21474830.00	INR	100 = 1
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

No.	Name	Type	Range	Unit	FbEq32
45.10	Total saved CO2	*Real*	0.0…214748300.0	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	INR	1000 = 1
45.13	Energy tariff 2	*Real*	0.000…4294966.296	INR	1000 = 1
45.14	Tariff selection	*Binary src*	-	-	1 = 1
45.17	Tariff currency unit	*List*	100, 101, 102	INR	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
45.31	Monthly peak power value (resettable)	*Real*	-3000.00 … 3000.00	kW	1 = 1 kW
45.32	Monthly peak power date	*Real*	1/1/1980...6/5/2159		N/A
45.33	Monthly peak power time	*Real*			N/A
45.34	Monthly total energy (resettable)	*Real*	-1000000.00 … 1000000.00	kWh	1 = 1 kWh
45.35	Last month total energy	*Real*	-1000000.00 … 1000000.00	kWh	1 = 1 kWh
45.36	Lifetime peak power value	*Real*	-3000.00 … 3000.00	kW	1 = 1 kW
45.37	Lifetime peak power date	*Real*	1/1/1980...6/5/2159		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 0.10…40200.00 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

No.	Name	Type	Range	Unit	FbEq32
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
46.33	Above torque limit	*Real*	0.0…1600.0	%	10 = 1%
46.41	kWh pulse scaling	*Real*	0.001…1000.000	kWh	1000 = 1 kWh
46.43	Power decimals	*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
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	*List*	-	-	1 = 1
49.20	Basic panel home view 2	*List*	-	-	1 = 1
49.21	Basic panel home view 3	*List*	-	-	1 = 1
49.219	Basic panel home view 4	*List*	-	-	1 = 1
49.220	Basic panel home view 5	*List*	-	-	1 = 1
49.221	Basic panel home view 6	*List*	-	-	1 = 1
50 Fieldbus adapter (FBA)					
50.01	FBA A enable	*List*	0…1	-	1 = 1

No.	Name	Type	Range	Unit	FbEq32
50.02	FBA A comm loss func	*List*	0…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...2, 4, 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*	0.0.0.0.0...FF.FF.FF.FF	-	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*	0.0.0.0.0...FF.FF.FF.FF	-	1 = 1
50.17	FBA A actual value 1	*Real*	-2147483648… 2147483647	-	1 = 1
50.18	FBA A actual value 2	*Real*	-2147483648… 2147483647	-	1 = 1
51 FBA A settings					
51.01	FBA A type	*List*	0, 1, 32, 37, 128, 132, 135, 136, 485, 101, 47808	-	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*	0x0000...0xffff	-	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*	0x0000...0xffff	-	1 = 1
51.33	FBA A appl SW ver	*Data*	0x0000...0xffff	-	1 = 1
52 FBA A data in					
52.01	FBA A data in1	*List*	0...6, 11...16, 24	-	1 = 1
…	…	…	…	…	
52.12	FBA A data in12	*List*	0...6, 11...16, 24	-	1 = 1

No.	Name	Type	Range	Unit	FbEq32
53 FBA A data out					
53.01	FBA A data out1	*List*	0...3, 11...13, 21	-	1 = 1
…	…	…	…	…	
53.12	FBA A data out12	*List*	0...3, 11...13, 21	-	1 = 1
58 Embedded fieldbus					
58.01	Protocol enable	*List*	0…1	-	1 = 1
58.02	Protocol ID	*Real*	0000h…FFFFh	-	1 = 1
58.03	Node address	*Real*	0…255	-	1 = 1
58.04	Baud rate	*List*	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
58.14	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*	0000h…FFFFh	-	1 = 1
58.19	EFB status word	*PB*	0000h…FFFFh	-	1 = 1
58.25	Control profile	*List*	0, 5	-	1 = 1
58.26	EFB ref1 type	*List*	0…5	-	1 = 1
58.27	EFB ref2 type	*List*	0…5	-	1 = 1
58.28	EFB act1 type	*List*	0…5	-	1 = 1
58.29	EFB act2 type	*List*	0…5	-	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
58.101	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

No.	Name	Type	Range	Unit	FbEq32
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*	0b0000…0b1111	-	1 = 1
70.02	Override enable	*List*	-	-	1 = 1
70.03	Override activation source	*List*	-	-	1 = 1
70.04	Override reference source	*List*	-	-	1 = 1
70.05	Override direction	*List*	-	-	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
70.20	Override fault handling	*List*	0...1	-	1 = 1
70.21	Override auto reset trials	*Real*	0...60	-	1 = 1
70.22	Override auto reset time	*Real*	0.1...120.0	s	10 = 1
71 External PID1					
71.01	External PID act value	*Real*	-200000.00…200000.00	%	100 = 1 PID customer unit
71.02	Feedback act value	*Real*	-200000.00…200000.00	PID customer units	100 = 1 PID customer unit
71.03	Setpoint act value	*Real*	-200000.00…200000.00	PID customer units	100 = 1 PID customer unit
71.04	Deviation act value	*Real*	-200000.00…200000.00	PID customer units	100 = 1 PID customer unit
71.06	PID status word	*PB*	0000h…FFFFh	-	1 = 1
71.07	PID operation mode	*List*	0…2	-	1 = 1
71.08	Feedback 1 source	*Analog src*	-	-	1 = 1
71.11	Feedback filter time	*Real*	0.000…30.000	s	1000 = 1 s
71.14	Setpoint scaling	*Real*	-200000.00…200000.00	-	100 = 1
71.15	Output scaling	*Real*	-200000.00…200000.00	-	100 = 1
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

No.	Name	Type	Range	Unit	FbEq32
71.21	Internal setpoint 1	*Real*	-200000.00…200000.00	PID customer units	100 = 1 PID customer unit
71.22	Internal setpoint 2	*Real*	-200000.00…200000.00	PID customer units	100 = 1 PID customer unit
71.23	Internal setpoint 3	*Real*	-200000.00…200000.00	PID customer units	100 = 1 PID customer unit
71.26	Setpoint min	*Real*	-200000.00…200000.00	-	100 = 1
71.27	Setpoint max	*Real*	-200000.00…200000.00	-	100 = 1
71.31	Deviation inversion	*Binary src*	-	-	1 = 1
71.32	Gain	*Real*	0.10…100.00	-	100 = 1
71.33	Integration time	*Real*	0.0…9999.0	s	10 = 1 s
71.34	Derivation time	*Real*	0.000…10.000	s	1000 = 1 s
71.35	Derivation filter time	*Real*	0.0…10.0	s	1000 = 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	1000 = 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 customer units	100 = 1 PID customer unit
71.79	External PID units	*List*	0...31	Depends on selection	-
76 PFC configuration					
76.01	PFC status	*PB*	0b0000...0b1111	-	1 = 1
76.02	PFC system status	*PB*	0...9, 100...103, 200...202, 300...302, 400, 500, 600, 700, 800, 801	-	1 = 1
76.11	Pump/fan status 1	*PB*	0b0000…0b1111	-	1 = 1
76.12	Pump/fan status 2	*PB*	0b0000…0b1111	-	1 = 1
76.13	Pump/fan status 3	*PB*	0b0000…0b1111	-	1 = 1
76.14	Pump/fan status 4	*PB*	0b0000…0b1111	-	1 = 1
76.21	PFC configuration	*List*	0, 2…3	-	1 = 1
76.25	Number of motors	*Real*	1…4	-	1 = 1
76.26	Min number of motors allowed	*Real*	0…4	-	1 = 1
76.27	Max number of motors allowed	*Real*	1…4	-	1 = 1

No.	Name	Type	Range	Unit	FbEq32
76.30	Start point 1	*Real*	0…32767	rpm/Hz	1 = 1 unit
76.31	Start point 2	*Real*	0…32767	rpm/Hz	1 = 1 unit
76.32	Start point 3	*Real*	0…32767	rpm/Hz	1 = 1 unit
76.41	Stop point 1	*Real*	0…32767	rpm/Hz	1 = 1 unit
76.42	Stop point 2	*Real*	0…32767	rpm/Hz	1 = 1 unit
76.43	Stop point 3	*Real*	0…32767	rpm/Hz	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 interlock 1	*List*	0…10	-	1 = 1
76.82	PFC interlock 2	*List*	0…10	-	1 = 1
76.83	PFC interlock 3	*List*	0…10	-	1 = 1
76.84	PFC interlock 4	*List*	0…10	-	1 = 1
76.95	Regulator bypass control	*Binary src*	-	-	-
77 PFC maintenance and monitoring					
77.10	PFC runtime change	*List*	0…5	-	1 = 1
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
90 Feedback selection					
90.03	Load speed	*Real*	-32768.00...32768.00	rpm	100 = 1 rpm
90.52	LoadSpeed filter time	*Real*	0...10000	ms	1 = 1 ms
90.61	Gear numerator	*Real*	-2147483648... 2147483648	-	1 = 1
90.62	Gear denominator	*Real*	-2147483648... 2147483648	-	1 = 1
90.99	Load speed unit	*List*	-	rpm	1 = 1
95 HW configuration					
95.01	Supply voltage	*List*	0, 2	-	1 = 1
95.02	Adaptive voltage limits	*List*	0…1	-	1 = 1
95.03	Estimated AC supply voltage	*Real*	0…65535	V	1 = 1 V

No.	Name	Type	Range	Unit	FbEq32
95.04	Control board supply	*List*	0…1	-	1 = 1
95.15	Special HW settings	*PB*	0b0000…0b1111	-	1 = 1
95.20	HW options word 1	*PB*	0b0000…0b1111	-	1 = 1
95.21	HW options word 2	*PB*	0b0000…0b1111	-	1 = 1
95.26	Motor disconnect switch	*List*	0...1	-	1 = 1
95.200	Cooling fan mode	*List*	0, 1	-	1 = 1
96 System					
96.01	Language	*List*	0, 1033, 2052	-	1 = 1
96.02	Pass code	*Data*	-	-	1 = 1
96.03	Access level status	*PB*	0b0000...0b1111	-	1 = 1
96.04	Macro select	*List*	-	-	1 = 1
96.05	Macro active	*List*	-	-	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...11	-	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*	-	-	1=1
96.13	User set I/O mode in2	*Binary src*	-	-	1=1
96.16	Unit selection	*PB*	0b0000...0b1111	-	1 = 1
96.20	Time sync primary source	*List*	-	-	1 = 1
96.51	Clear fault and event logger	*Real*	0…1	-	1 = 1
(Parameters 96.100…96.102 only visible when enabled by parameter 96.02)					
96.78	550 compatibility mode	*List*	0…1	-	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*	1.5, 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	%	1 = 1
97.13	IR compensation	*Real*	0.00…50.00	%	100 = 1%
97.20	U/F ratio	*List*	0…20	-	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	%	10 = 1%

No.	Name	Type	Range	Unit	FbEq32
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.
98.09	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
99 Motor data					
99.03	Motor type	*List*	0	-	1 = 1
99.04	Motor control mode	*List*	0…1	-	1 = 1
99.06	Motor nominal current	*Real*	0.0...32767.0	A	10 = 1 A
99.07	Motor nominal voltage	*Real*	0.0...32767.0	V	10 = 1 V
99.08	Motor nominal frequency	*Real*	0.00 … 500.00	Hz	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, 6, 7	-	1 = 1
99.14	Last ID run performed	*List*	0…3, 6	-	1 = 1
99.15	Motor polepairs calculated	*Real*	0…1000	-	1 = 1
99.16	Motor phase order	*List*	0…1	-	1 = 1

8

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 of active warnings and faults are displayed on the control panel of the drive as well as in the Drive composer PC tool with warning and fault names. Only the codes of warnings and faults are available over fieldbus.

Warnings do not need to be reset; they stop showing when the cause of the warning ceases. Warnings do not latch and the drive will continue to operate the motor.

Faults latch inside the drive and cause the drive to trip, and the motor stops. After the cause of a fault has been removed, the fault can be reset from a selectable source (parameter *31.11 Fault reset selection*) such as the control panel, Drive composer PC tool, the digital inputs of the drive, or fieldbus. 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*).

Editable messages

For external events, the action (fault or warning), name and the message text can be edited. To specify external events, use parameter *31 Fault functions*.

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

- 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*.

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 active faults and warnings, see

- **Menu ≡ - Diagnostics - Active faults** 0
- **Menu ≡ - Diagnostics - Active warnings** 0
- parameters in group *04 Warnings and faults* (page *169*).

For previously occurred faults, see

- **Menu ≡ - Diagnostics - Fault history**
- parameters in group *04 Warnings and faults* (page *169*).

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 (*aux code visible only on assistant control panel and drive composer*)	Cause	What to do
64FF	Fault reset	A fault has been reset from the panel, Drive composer PC tool, fieldbus or I/O.	Event. Informative only.
A2B1	Overcurrent	Output current has exceeded internal fault limit. In addition to an actual overcurrent situation, this warning may also be caused by an earth fault or supply phase loss.	Check motor load. Check acceleration times in parameter group *23 Speed reference ramp* (speed control), *26 Torque reference chain* (torque control) or *28 Frequency reference chain* (frequency control). Also check parameters *46.01 Speed scaling*, *46.02 Frequency scaling* and *46.03 Torque scaling*. Check motor and motor cable (including phasing and delta/star connection). Check for an earth fault in motor or motor cables by measuring the insulation resistances of motor and motor cable. See chapter *Electrical installation*, section *Checking the insulation of the assembly* in the *Hardware manual* of the drive. Check there are no contactors opening and closing in motor cable. Check that the start-up data in parameter group *99 Motor data* corresponds to the motor rating plate. Check that there are no power factor correction capacitors or surge absorbers in motor cable.
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.

Code (hex)	**Warning / Aux. code** (***aux code visible only on assistant control panel and drive composer***)	**Cause**	**What to do**
A2B4	Short circuit	Short-circuit in motor cable(s) or motor.	Check motor and motor cable for cabling errors. Check motor and motor cable (including phasing and delta/star connection). Check for an earth fault in motor or motor cables by measuring the insulation resistances of motor and motor cable. See chapter *Electrical installation*, section *Checking the insulation of the assembly* in the *Hardware manual* of the drive. Check there are no power factor correction capacitors or surge absorbers in motor cable.
A2BA	IGBT overload	Excessive IGBT junction to case temperature. This warning protects the IGBT(s) and can be activated by a short circuit in the motor cable.	Check motor cable. Check ambient conditions. Check air flow and fan operation. Check heatsink fins for dust pick-up. Check motor power against drive power.
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). See also section *DC undervoltage* (page 80).	
A3AA	DC not charged	The voltage of the intermediate DC circuit has not yet risen to operating level.	
A490	Incorrect temperature sensor setup	Sensor type mismatch	Check the settings of temperature source parameters *35.11* and *35.21* against *91.21* and *91.25.*
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 excessive. 1 – Sensor fault.	Check the sensor and change the control board.

Code (hex)	Warning / Aux. code (*aux code visible only on assistant control panel and drive composer*)	Cause	What to do
A4A1	IGBT overtemperature	Estimated drive IGBT temperature is excessive.	Check ambient conditions. Check air flow and fan operation. Check heatsink fins for dust pick-up. Check motor power against drive power.
A4A9	Cooling	Drive module temperature is excessive.	Check ambient temperature. If it exceeds 40%/104 °F (frames R4…R8) or if it exceeds 50% /122 °F (frames R0…R8), ensure that load current does not exceed derated load capacity of drive. See chapter *Technical data*, section *Derating* in the *Hardware manual* of the drive. Check drive module cooling air flow and fan operation. Check inside of cabinet and heatsink of drive module for dust pick-up. Clean whenever necessary.
A4B0	Excess temperature	Power unit module temperature is excessive.	Check ambient conditions. Check air flow and fan operation. Check heatsink fins for dust pick-up. Check motor power against drive power.
A4B1	Excess temperature difference	High temperature difference between the IGBTs of different phases.	Check the motor cabling. Check cooling of drive module(s).
A4F6	IGBT temperature	Drive IGBT temperature is excessive.	Check ambient conditions. Check air flow and fan operation. Check heatsink fins for dust pick-up. Check motor power against drive power.
A580	PU communication	Communication errors between drive control unit and power unit.	Check connections between drive control unit and power unit and value of parameter *95.04 Control board supply*.
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 (connected to the fan connectors on the control board) is stuck or disconnected.	Check the auxiliary code. Check auxiliary fan(s) and connection(s). 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, this warning will be generated even if the corresponding fault is defeated. See fault *5081 Auxiliary fan broken* (page *430*).
	0001	Auxiliary fan 1 missing.	
	0002	Auxiliary fan 2 missing.	

Code (hex)	**Warning / Aux. code** (***aux code visible only on assistant control panel and drive composer***)	**Cause**	**What to do**
A590	Drive HW initialization.	Drive hardware setup is initializing. 1 - Initializing HW settings for the first time.	See auxiliary code.
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.
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 *264*). 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 (format XXXY YYZZ). “Y YY” specifies through which BCU control unit channel the fault was received (“0 00” with a ZCU control unit). “ZZ” specifies the location: With control program version 2.8x and later: **1:** U-phase IGBT, **2:** V-phase IGBT, **3:** W-phase IGBT, **4:** Power supply board, **5:** Power unit xINT board, **6:** Brake chopper, **7:** Air inlet (TEMP3, X10), **8:** du/dt filter (TEMP2, X7), **9:** TEMP1 (X6). With control program version up to and including 2.7x: **1:** U-phase IGBT, **2:** V-phase IGBT, **3:** W-phase IGBT, **4:** Power unit INT board, **5:** Brake chopper, **6:** Air inlet, **7:** Power supply board, **8:** du/dt filter, FAh: Air in temp.
A5EB	PU board powerfail	Power unit power supply failure.	Contact your local ABB representative.
A5ED	Measurement circuit ADC	Measurement circuit fault.	Check the connections between the drive control unit and the power unit.
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.
A5F1	Redundant measurement	Duplicated measurements are beyond limits.	Contact your local ABB representative.

Code (hex)	Warning / Aux. code (*aux code visible only on assistant control panel and drive composer*)	Cause	What to do
A5F2	Overtemperature hw	Excessive hardware temperature.	Contact your local ABB representative.
A682	Flash erase speed	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 Parameter save manually* or cyclic parameter writes (such as user logger triggering through parameters). Check the auxiliary code (format XYYY YZZZ). "X" specifies the source of warning (1: generic flash erase supervision). "ZZZ" specifies the flash subsector number that generated the warning.
A6A4	Motor nominal value	The motor parameters are set incorrectly.	Check the auxiliary code. See actions for each code below.
		The drive is not dimensioned correctly.	
	1	Slip frequency is too small.	Check the settings of the motor configuration parameters in groups 98 and 99. Check that the drive is sized correctly for the motor.
	2	Synchronous and nominal speeds differ too much.	
	3	Nominal speed is higher than synchronous speed with 1 pole pair.	
	4	Nominal current is outside limits	
	5	Nominal voltage is outside limits.	
	6	Nominal power is higher than apparent power.	
	7	Nominal power not consistent with nominal speed and torque.	
A6A5	No motor data	Parameters in group 99 have not been set.	Check that all the required parameters in group 99 have been set. **Note:** It is normal for this warning to appear during the start-up and continue until the motor data is entered.
A6A6	Voltage category unselected	The voltage category has not been defined.	Set voltage category in parameter *95.01 Supply voltage*.
A6A7	System time not set	System time is not set.	
A6B0	User lock is open	The user lock is open, ie. user lock configuration parameters *96.100*…*96.102* are visible.	Close the user lock by entering an invalid pass code in parameter *96.02 Pass code*. See section *User lock* (page *95*).
A6B1	User pass code not confirmed	A new user pass code has been entered in parameter *96.100* but not confirmed in *96.101*.	Confirm the new pass code by entering the same code in *96.101*. To cancel, close the user lock without confirming the new code. See section *User lock* (page *95*).

Code (hex)	Warning / Aux. code (*aux code visible only on assistant control panel and drive composer*)	Cause	What to do
A6D1	FBA A parameter conflict	The drive does not have a functionality requested by a PLC, or requested functionality has not been activated.	Check PLC programming. Check settings of parameter groups *50 Fieldbus adapter (FBA)*.
A6E5	AI parametrization	The current/voltage hardware setting of an analog input does not correspond to parameter settings.	Check the event log for an auxiliary code. The code identifies the analog input whose settings are in conflict. Adjust either the hardware setting (on the drive control unit) or parameter *12.15*/*12.25*. **Note:** Control board reboot (either by cycling the power or through parameter *96.08 Control board boot*) is required to validate any changes in the hardware settings.
A6E6	ULC configuration	User load curve configuration error.	Check the auxiliary code (format XXXX ZZZZ). "ZZZZ" indicates the problem (see actions for each code below).
	0000	Speed points inconsistent.	Check that each speed point (parameters *37.11*…*37.15*) has a higher value than the previous point.
	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.	
AFFE	Override active	Override active warning.	Informative warning. See parameter *70.02 Override enable*.
A780	Motor stall (Programmable warning: *31.24 Stall function*)	Motor is operating in stall region.	Check motor load, drive ratings and 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*, *35.55*, *35.56*).
A784	Motor disconnect	All three output phases are disconnected from motor.	Check if parameter *95.26* enables the use of a motor disconnect switch. If not, check the following: • All switches between drive and motor are closed. • All cables between drive and motor are connected and secured. If no issue was detected and drive output was actually connected to motor, contact ABB.
A791	Brake resistor	Brake resistor fault.	Check brake resistor.
A792	Brake resistor wiring	Brake resistor short circuit or fault in brake chopper.	Check brake chopper and brake resistor connections.

Code (hex)	**Warning / Aux. code** (*aux code visible only on assistant control panel and drive composer*)	Cause	What to do
A793	BR excess temperature	Brake resistor temperature has exceeded warning limit defined by parameter *43.12 Brake resistor warning limit*.	Stop drive. Let resistor cool down. Check resistor overload protection function settings (parameter group *43 Brake chopper*). Check warning limit setting, parameter *43.12 Brake resistor warning limit*. Check that the resistor has been dimensioned correctly. Check that braking cycle meets allowed limits.
A794	BR data	Brake resistor data has not been given.	One or more of the resistor data settings (parameters *43.08*…*43.10*) is incorrect. The parameter is specified by the auxiliary code.
	0000 0001	Resistance value too low.	Check value of *43.10*.
	0000 0002	Thermal time constant not given.	Check value of *43.08*.
	0000 0003	Maximum continuous power not given.	Check value of *43.09*.
A79C	BC IGBT excess temperature	Brake chopper IGBT temperature has exceeded internal warning limit.	Let chopper cool down. Check for excessive ambient temperature. Check for cooling fan failure. Check for obstructions in the air flow. Check the dimensioning and cooling of the cabinet. Check resistor overload protection function settings (parameters *43.06*…*43.10*). Check minimum allowed resistor value for the chopper being used. Check that braking cycle meets allowed limits. Check that drive supply AC voltage is not excessive.
A7AB	Built in/Extension I/O configuration failure	The I/O built in/extension module is not connected to the device properly.	Make sure that the I/O built in/extension module is connected to the device.
A7AC	I/O Module internal error	Calibration data is not stored in the I/O module. Analog signals are not working with full accuracy.	Replace I/O module.
A7A1	Mechanical brake closing failed	Mechanical brake control warning.	Check mechanical brake connection. Check mechanical brake settings in parameter group *44 Mechanical brake control*. Check that acknowledgment signal matches the actual status of the brake.

Code (hex)	**Warning / Aux. code** (***aux code visible only on assistant control panel and drive composer***)	**Cause**	**What to do**
A7A2	Mechanical brake opening failed	Status of mechanical brake acknowledgment is not as expected during brake open.	Check mechanical brake connection. Check mechanical brake settings in parameter group *44 Mechanical brake control*. Check that acknowledgment signal matches the actual status of brake.
A7A5	Mechanical brake opening not allowed	Open conditions of mechanical brake cannot be fulfilled.	Check mechanical brake settings in parameter group *44 Mechanical brake control*. Check that the acknowledgment signal (if used) matches the actual status of the brake.
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.
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.	Replace the drive cooling fan. Parameter *05.04 Fan on-time counter* shows the running time of the cooling fan.
A8A0	AI supervision	Analog signal is beyond limits.	Check the signal level, input wiring, and the defined limits.
	0001 – AI1 less minimum	0003 – AI2 less minimum	
	0002 – AI1 greater maximum	0004 – AI2 greater maximum	
A8A1	RO life warning	The relay has changed states more than the recommended number of times.	Change the control board or stop using the relay output.
	0001	Relay output 1	Change the control board or stop using relay output 1.
	0002	Relay output 2	Change the control board or stop using relay output 2.

Code (hex)	**Warning / Aux. code** (*aux code visible only on assistant control panel and drive composer*)	Cause	What to do
	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, eg. if a fast changing frequency signal is connected to it. The relay lifetime will be exceeded shortly.	Replace the signal connected to the relay output source with a less frequently changing signal.
	0001	Relay output 1	Select a different signal with parameter *10.24 RO1 source*.
	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	Signal supervision 1 (Editable message text) Programmable warning: *32.06 Supervision 1 action*	Warning generated by the signal supervision function 1.	Check the source of the warning (parameter *32.07 Supervision 1 signal*).
A8B1	Signal supervision 2 (Editable message text) Programmable warning: *32.16 Supervision 2 action*	Warning generated by the signal supervision function 2.	Check the source of the warning (parameter *32.17 Supervision 2 signal*).
A8B2	Signal supervision 3 (Editable message text) Programmable warning: *32.26 Supervision 3 action*	Warning generated by the signal supervision function 3.	Check the source of the warning (parameter *32.27 Supervision 3 signal*).
A8B3	Signal supervision 4 (Editable message text) Programmable warning: *32.36 Supervision 4 action*	Warning generated by the signal supervision function 4.	Check the source of the warning (parameter *32.37 Supervision 4 signal*).
A8B4	Signal supervision 5 (Editable message text) Programmable warning: *32.46 Supervision 5 action*	Warning generated by the signal supervision function 5.	Check the source of the warning (parameter *32.47 Supervision 5 signal*).
A8B5	Signal supervision 6 (Editable message text) Programmable warning: *32.56 Supervision 6 action*	Warning generated by the signal supervision function 6.	Check the source of the warning (parameter *32.57 Supervision 6 signal*).
A8B6	Current limit	Motor actual current exceeded the limit defined in parameter *30.17 Maximum current*.	Reduce the motor load. Check for any jam or stall in motor.
A8BE	ULC overload warning	User load curve: Signal has been too long over the overload curve.	See parameter *37.03 ULC overload actions*.
	001	Overload occurred between speed point *37.11 ULC speed table point 1* and *37.12 ULC speed table point 2*.	Check the load.

Code (hex)	**Warning / Aux. code** (*aux code visible only on assistant control panel and drive composer*)	Cause	What to do
	002	Overload occurred between speed point *37.12 ULC speed table point 2* and *37.13 ULC speed table point 3*.	Check the load.
	003	Overload occurred between speed point *37.13 ULC speed table point 3* and *37.14 ULC speed table point 4*.	Check the load.
	004	Overload occurred between speed point *37.14 ULC speed table point 4* and *37.15 ULC speed table point 5*.	Check the load.
A8BF	ULC underload warning	User load curve: Signal has been too long under the underload curve.	See parameter *37.04 ULC underload actions*.
	001	Underload occurred between speed point *37.11 ULC speed table point 1* and *37.12 ULC speed table point 2*.	Check the load.
	002	Underload occurred between speed point *37.12 ULC speed table point 2* and *37.13 ULC speed table point 3*.	Check the load.
	003	Underload occurred between speed point *37.13 ULC speed table point 3* and *37.14 ULC speed table point 4*.	Check the load.
	004	Underload occurred between speed point *37.14 ULC speed table point 4* and *37.15 ULC speed table point 5*.	Check the load.
A8C0	ULC invalid speed table	User load curve: X-axis points (speed) are not valid.	Check that points fulfill conditions. See parameter *37.11 ULC speed table point 1*.
A8C5	ULC invalid underload table	User load curve: Underload curve points are not valid.	Check that points fulfill conditions. See parameter *37.21 ULC underload point 1*.
A8C6	ULC invalid overload table	User load curve: Overload curve points are not valid.	Check that points fulfill conditions. See parameter *37.31 ULC overload point 1*.
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*.

Code (hex)	Warning / Aux. code (*aux code visible only on assistant control panel and drive composer*)	Cause	What to do
A983	External warning 3 (Editable message text) Programmable warning: *31.05 External event 3 source* *31.06 External event 3 type*	Fault in external device 3.	Check the external device. Check setting of parameter *31.05 External event 3 source*.
A984	External warning 4 (Editable message text) Programmable warning: *31.07 External event 4 source* *31.08 External event 4 type*	Fault in external device 4.	Check the external device. Check setting of parameter *31.07 External event 4 source*.
A985	External warning 5 (Editable message text) Programmable warning: *31.09 External event 5 source* *31.10 External event 5 type*	Fault in external device 5.	Check the external device. Check setting of parameter *31.09 External event 5 source*.
A991	Safe motor temperature	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*.
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*.
AF90	Speed controller autotuning	The speed controller autotune routine did not complete successfully.	Check the auxiliary code (format XXXX YYYY). “YYYY” indicates the problem (see actions for each code below).
	0000	The drive was stopped before the autotune routine finished.	Repeat autotune until successful.
	0001	The drive was started but was not ready to follow the autotune command.	Make sure the prerequisites of the autotune run are fulfilled. See section *Before activating the autotune routine* (page *46*).
	0002	Required torque reference could not be reached before the drive reached maximum speed.	Decrease torque step (parameter *25.38*) or increase speed step (*25.39*).
	0003	Motor could not accelerate/decelerate to maximum/minimum speed.	Increase torque step (parameter *25.38*) or decrease speed step (*25.39*).
	0005	Motor could not decelerate with full autotune torque.	Decrease torque step (parameter *25.38*) or speed step (*25.39*).
AFAA	Autoreset	A fault is about to be autoreset.	Informative warning. See the settings in parameter group *31 Fault functions*.

Code (hex)	**Warning / Aux. code** (***aux code visible only on assistant control panel and drive composer***)	**Cause**	**What to do**
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.	
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*.
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.
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.
AFEB	Run enable missing	No run enable signal is received.	Check setting of parameter *20.12 Run enable 1 source*. Switch signal on (e.g. in the fieldbus Control Word) or check wiring of selected source.
AFEC	External power signal missing	*95.04 Control board supply* is set to *External 24V* but no voltage is connected to the control unit.	Check the external 24 V DC power supply to the control unit, or change the setting of parameter *95.04*.
AFED	Enable to rotate	Signal to rotate has not been received within a fixed time delay of 120 s.	Switch enable to rotate signal on (eg. in digital inputs). Check the setting of (and source selected by) parameter *20.22 Enable to rotate*.
AFF6	Identification run	Motor ID run will occur at next start.	Informative warning.
B5F6	Identification run	Motor ID run completed successfully.	Informative warning.
B5A0	STO event Programmable event: *31.22 STO indication run/stop*	Safe torque off function is active, ie. safety circuit signal(s) connected to connector STO is lost.	Check safety circuit connections. For more information, see chapter *The Safe torque off function* in the *Hardware manual* of the drive and description of parameter *31.22 STO indication run/stop* (page *264*).
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*.

Code (hex)	Warning / Aux. code (*aux code visible only on assistant control panel and drive composer*)	Cause	What to do
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*.
FA90	STO diagnostics failure	The software is not working properly.	Restart the control unit.

Fault messages

Code (hex)	**Fault / Aux. code** (*aux code visible only on assistant control panel and drive composer*)	Cause	What to do
1080	Backup/Restore timeout	Panel or PC tool has failed to communicate with the drive when backup was being made or restored.	Request backup or restore again.
1081	Rating ID fault	Drive software is not able to read the rating ID of the drive.	Reset the fault to make the drive try to reread the rating ID. If the fault reappears, cycle the power to the drive. You may have to be repeat this. If the fault persists, contact your local ABB representative.
2281	Calibration	Measured offset of output phase current measurement or difference between output phase U2 and W2 current measurement is too great (the values are updated during current calibration).	Try performing the current calibration again. If the fault persists, contact your local ABB representative.
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), *26 Torque reference chain* (torque control) or *28 Frequency reference chain* (frequency control). Also check parameters *46.01 Speed scaling*, *46.02 Frequency scaling* and *46.03 Torque scaling*. Check motor and motor cable (including phasing and delta/star connection). Check there are no contactors opening and closing in motor cable. Check that the start-up data in parameter group 99 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.
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.

Code (hex)	Fault / Aux. code (*aux code visible only on assistant control panel and drive composer*)	Cause	What to do
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	Total earth leakage of inverter modules is excessive.	Check there are no power factor correction capacitors or surge absorbers in motor cable. Measure insulation resistances of motor cables and motor. Contact your local ABB representative.
3130	Input phase loss	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.
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. See also section *DC undervoltage* (page *80*).	Check supply cabling, fuses and switchgear.
3291	BU DC link difference	Difference in DC voltages between parallel-connected inverter modules.	Check the auxiliary code (format XXXY YYZZ). “XXX” specifies the source of the first error (see “YYY”). “YYY” specifies the module through which BCU control unit channel the fault was received (**1**: Channel 1, **2**: Channel 2, **4**: Channel 3, **8**: Channel 4, …, **800:** Channel 12).

Code (hex)	**Fault / Aux. code** (***aux code visible only on assistant control panel and drive composer***)	**Cause**	**What to do**
3381	Output phase loss Programmable fault: *31.19 Motor phase loss*	Motor circuit fault due to missing motor connection (any of the three phases not connected). In scalar control mode, the drive detects fault only when the output frequency is above 10% of the motor nominal frequency.	Connect motor cable. If the drive is in scalar mode and nominal current of the motor is less than 1/6 of the nominal output current of the drive, set parameter *31.19 Motor phase loss* to *No action*.
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%/104 °F (frames R4…R8) or if it exceeds 50% /122 °F (frames R0…R8), ensure that load current does not exceed derated load capacity of drive. See chapter *Technical data*, section *Derating* in the *Hardware manual* of the drive. Check drive module cooling air flow and fan operation. Check inside of cabinet and heatsink of drive module for dust pick-up. Clean whenever necessary.
42F1	IGBT temperature	Drive IGBT temperature is excessive.	Check ambient conditions. Check air flow and fan operation. Check heatsink fins for dust pick-up. Check motor power against drive power.
4310	Excess temperature	Power unit module temperature is excessive.	Check ambient conditions. Check air flow and fan operation. Check heatsink fins for dust pick-up. Check motor power against drive power.
4380	Excess temperature difference	High temperature difference between the IGBTs of different phases.	Check the motor cabling. Check cooling of drive module(s).
4981	External temperature 1	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).
4982	External temperature 2	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).

Code (hex)	Fault / Aux. code (*aux code visible only on assistant control panel and drive composer*)	Cause	What to do
4991	Safe motor temperature	The CPTC-02 module indicates overtemperature: • motor temperature is too high, or • the thermistor is in shortcircuit.	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 is stuck or disconnected.	See *A581 Fan* (page 416).
5081	Auxiliary fan broken	An auxiliary cooling fan is stuck or disconnected.	Check auxiliary fan(s) and connection(s). Replace fan if faulty.
	0001	Auxiliary fan 1 broken.	
	0002	Auxiliary fan 2 broken.	
5089	SMT circuit malfunction	Safe motor temperature fault is generated and STO event/fault/warning is not generated.	Check connection between the relay output of the module and the STO terminal.
5090	STO hardware failure	STO hardware diagnostics has detected hardware failure.	Contact your local ABB representative, quoting the auxiliary code. The code contains location information, especially with parallel-connected inverter modules. When converted into a 32-bit binary number, the bits of the code indicate the following: 31…28: Number of faulty inverter module (0…11 decimal). 1111: STO_ACT states of control unit and inverter modules in conflict 27: STO_ACT state of inverter modules 26: STO_ACT state of control unit 25: STO1 of control unit 24: STO2 of control unit 23…12: STO1 of inverter modules 12…1 (Bits of non-existing modules set to 1) 11…0: STO2 of inverter modules 12…1 (Bits of non-existing modules set to 1)
5091	Safe torque off Programmable fault: *31.22 STO indication run/stop*	Safe torque off function is active, 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 264). Check the value of parameter *95.04 Control board supply*.
5092	PU logic error	Power unit memory has cleared.	Cycle the power to the drive. If the control unit is externally powered, also reboot the control unit (using parameter *96.08 Control board boot*) or by cycling its power. If the problem persists, contact your local ABB representative.

Code (hex)	**Fault / Aux. code** (*aux code visible only on assistant control panel and drive composer*)	Cause	What to do
5093	Rating ID mismatch	The hardware of the drive does not match the information stored in the memory. This may occur eg. 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.	See *A5EA Measurement circuit temperature* (page *417*).
5095	Redundant measurement	Duplicated measurements are beyond limits.	Contact ABB.
5096	Overtemperature hw	Excessive hardware temperature.	Contact your local ABB representative.
5098	I/O communication loss	Communication failure to standard I/O.	Try resetting the fault or cycle the power to the drive.
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.	If the control unit is externally powered, check the setting of parameter *95.04 Control board supply*. If the problem persists, contact your local ABB representative, quoting the auxiliary code.
5692	PU board powerfail	Power unit power supply failure.	Check the auxiliary code (format ZZZY YYXX). “YY Y” specifies the affected inverter module (**0…C**, always **0** for ZCU control units). “XX” specifies the affected power supply (**1**: Power supply 1, **2**: Power supply 2, **3**: both supplies).
5693	Measurement circuit DFF	Measurement circuit fault.	Contact your local ABB representative, quoting the auxiliary code.
5695	Reduced run	Configured power units not found.	Configure the power units.
5697	Charging feedback	Charging feedback signal missing.	Check the feedback signal coming from the charging system
5698	Unknown PU fault	The power unit logic generated a fault which is not known by software.	Check the logic and software compatibility.
50A0	Fan	Cooling fan stuck or disconnected.	Check fan operation and connection. Replace fan if faulty.
6181	FPGA version incompatible	Firmware and FPGA versions are incompatible.	Reboot the control unit (using parameter *96.08 Control board boot*) or by cycling power. If the problem persists, contact your local ABB representative

Code (hex)	**Fault / Aux. code** (*aux code visible only on assistant control panel and drive composer*)	Cause	What to do
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.
64A3	Application loading	Application file incompatible or corrupted.	Check the auxiliary code. See actions for each code below.
	8006	Not enough memory for the application.	Reduce the size of the application. Reduce the number of parameter mappings. See the drive-specific log generated by Automation Builder.
	8007	The application contains the wrong system library version.	Update the system library or reinstall Automation Builder. See the drive-specific log generated by Automation Builder.
	8008	The application is empty.	In Automation Builder, give a “Clean” command and reload the application.
	8009	The application contains invalid tasks.	In Automation Builder, check application task configuration, give a “Clean all” command, and reload the application.
	800A	The application contains an unknown target (system) library function.	Update the system library or reinstall Automation Builder. See the drive-specific log generated by Automation Builder.
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 ABB.
64A6	Adaptive program	Fault in adaptive program.	Check the fault code extension.
64B1	Internal SSW fault	A fatal error in the power-up phase of System Software (SSW).	SSW runs in partial functionality mode.
	1 – Starting OS time tick failed 2 – Creating system tasks failed 3 – Initializing file system failed 4 – Checking file system failed	5 – Initializing WoRm volumes failed 6 – Loading FPGA configuration failed 7 – Loading application program failed	

Code (hex)	**Fault / Aux. code** (***aux code visible only on assistant control panel and drive composer***)	**Cause**	**What to do**
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 parameterization failed, eg. Parameter default value that cannot be changed has been attempted to write.	
64E1	Kernel overload	Operating system error.	Reboot the control unit (using parameter *96.08 Control board boot*) or by cycling power. If the problem persists, contact your local ABB representative
6581	Parameter system	Parameter load or save failed.	Try forcing a save using parameter *96.07 Parameter save manually*. Retry.
6591	Backup/Restore timeout	During backup creating or restoring operation a panel or PC-tool has failed to communicate with the drive as part of this operation.	Check 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*.
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.	Contact your local ABB representative.
		Version mismatch between EFB protocol firmware and drive firmware.	
6685	EFB fault 2	Fault reserved for the EFB protocol application.	Check the documentation of the protocol.
6686	EFB fault 3	Fault reserved for the EFB protocol application.	Check the documentation of the protocol.
6882	Text 32-bit table overflow	Internal fault.	Reset the fault. Contact your local ABB representative if the fault persists.

Code (hex)	Fault / Aux. code (*aux code visible only on assistant control panel and drive composer*)	Cause	What to do
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 I/O module and drive is not working properly.	Check the I/O module installation.
7085	Incompatible option module	Fieldbus option module not supported.	Replace the module with a supported type.
7086	I/O module AI overvoltage	Overvoltage detected in AI. AI is changed to voltage mode from mA mode. AI will return automatically back to mA mode when the AI signal level is within acceptable limits.	Check AI signal levels.
7087	I/O module configuration	I/O module configuration not supported or illegal.	Check the auxiliary code. See actions for each code below.
	001	S1/S2 DIP switch position on BIO-01 has changed after power up.	Reboot control unit either by cycling the power or through parameter *96.08 Control board boot* to activate new DIP switch position.
	002	S1/S2 DIP switch positions are such that DO1 would be in both S1 and S2 pins. This is not a supported combination.	Change S1/S2 DIP switch positions to a supported combination, see parameter *05.99 BIO-01 DIP switch status*.
71A2	Mechanical brake closing failed	Mechanical brake control fault. Activated e.g., if brake acknowledgment is not as expected during brake closing.	Check mechanical brake connection. Check mechanical brake settings in parameter group *44 Mechanical brake control*. Check that the acknowledgment signal matches the actual status of the brake.
71A5	Mechanical brake opening not allowed	Open conditions of mechanical brake cannot be fulfilled.	Check mechanical brake settings in parameter group *44 Mechanical brake control*. Check that the acknowledgment signal (if used) matches the actual status of the brake.
7100	Excitation current	Excitation current feedback low or missing	Contact your local ABB representative.
7121	Motor stall Programmable fault: *31.24 Stall function*	Motor is operating in stall region because of e.g. excessive load or insufficient motor power.	Check motor load and drive ratings. Check fault function parameters.
7122	Motor overload	Motor current is too high.	Check for overloaded motor Adjust the parameters used for the motor overload function. (*35.51*…*35.53*, *35.55*, *35.56*)

Code (hex)	**Fault / Aux. code** (*aux code visible only on assistant control panel and drive composer*)	Cause	What to do
7181	Brake resistor	Brake resistor broken or not connected.	Check that a brake resistor has been connected. Check the condition of the brake resistor. Check the dimensioning of the brake resistor.
7183	BR excess temperature	Brake resistor temperature has exceeded fault limit defined by parameter *43.11 Brake resistor fault limit*.	Stop drive. Let resistor cool down. Check resistor overload protection function settings (parameter group *43 Brake chopper*). Check fault limit setting, parameter *43.11 Brake resistor fault limit*. Check that braking cycle meets allowed limits.
7184	Brake resistor wiring	Brake resistor short circuit or brake chopper control fault.	Check brake chopper and brake resistor connection. Ensure brake resistor is not damaged.
7191	BC short circuit	Short circuit in brake chopper IGBT.	Ensure brake resistor is connected and not damaged. Check the electrical specifications of the brake resistor against chapter *Resistor braking* in the *Hardware manual* of the drive. Replace brake chopper (if replaceable).
7192	BC IGBT excess temperature	Brake chopper IGBT temperature has exceeded internal fault limit.	Let chopper cool down. Check for excessive ambient temperature. Check for cooling fan failure. Check for obstructions in the air flow. Check resistor overload protection function settings (parameter group *43 Brake chopper*). Check that braking cycle meets allowed limits. Check that drive supply AC voltage is not excessive.
71A3	Mech brake opening failed	Mechanical brake control is faulty. Brake open acknowledgment is not matching the actual status.	Check connections, brake settings and brake acknowledgment signal.
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).
73B0	Emergency ramp failed	Emergency stop did not finish within expected time.	Check the predefined ramp times (*23.11*…*23.15*, *23.12*…*23.13* for mode Off1, *23.23* for mode Off3).
73F0	Overfrequency	Maximum allowed output frequency exceeded.	Check the auxiliary code.

Code (hex)	**Fault / Aux. code** (*aux code visible only on assistant control panel and drive composer*)	Cause	What to do
	00FA	Motor is turning faster than the highest allowed frequency due to incorrectly set minimum/maximum frequency or the motor rushes because of too high supply voltage or incorrect supply voltage selection in parameter *95.01 Supply voltage*.	Check minimum/maximum frequency settings, parameters *30.13 Minimum frequency* and *30.14 Maximum frequency*. Check used supply voltage and voltage selection parameter *95.01 Supply voltage*.
	Other	-	Contact your local ABB representative, quoting the auxiliary code.
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.
8000	Unicos system error	System fault.	Power cycle.
8001	ULC underload fault	User load curve: Signal has been too long under the underload curve.	See parameter *37.04 ULC underload actions*.
	001	Underload occurred between speed point *37.11 ULC speed table point 1* and *37.12 ULC speed table point 2*.	Check the load.
	002	Underload occurred between speed point *37.12 ULC speed table point 2* and *37.13 ULC speed table point 3*.	Check the load.
	003	Underload occurred between speed point *37.13 ULC speed table point 3* and *37.14 ULC speed table point 4*.	Check the load.
	004	Underload occurred between speed point *37.14 ULC speed table point 4* and *37.15 ULC speed table point 5*.	Check the load.
8002	ULC overload fault	User load curve: Signal has been too long over the overload curve.	See parameter *37.03 ULC overload actions*.
	001	Overload occurred between speed point *37.11 ULC speed table point 1* and *37.12 ULC speed table point 2*.	Check the load.
	002	Overload occurred between speed point *37.12 ULC speed table point 2* and *37.13 ULC speed table point 3*.	Check the load.

Code (hex)	Fault / Aux. code (*aux code visible only on assistant control panel and drive composer*)	Cause	What to do
	003	Overload occurred between speed point *37.13 ULC speed table point 3* and *37.14 ULC speed table point 4*.	Check the load.
	004	Overload occurred between speed point *37.14 ULC speed table point 4* and *37.15 ULC speed table point 5*.	Check the load.
8009	Current limit	Motor actual current exceeded the limit defined in parameter *30.17 Maximum current*.	Reduce the motor load. Check for any jam or stall in motor. See parameter *30.17 Maximum current*.
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*.
	1 – AI1LessMIN	3 – AI2LessMIN	
	2 – AI1GreaterMAX	4 – AI2GreaterMAX	
80B0	Signal supervision 1 (Editable message text) Programmable fault: *32.06 Supervision 1 action*	Fault generated 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 generated 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 generated 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 generated 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 generated 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 generated 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*.

Code (hex)	Fault / Aux. code (*aux code visible only on assistant control panel and drive composer*)	Cause	What to do
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*.
A2A1	Current calibration	Current offset and gain measurement calibration will occur at next start.	Informative warning. (See parameter *99.13 ID run requested*).
FA81	Safe torque off 1	Safe torque off function is active, ie. STO circuit 1 is broken.	Check safety circuit connections. For more information, see chapter *The Safe torque off function* in the *Hardware manual* of the drive and description of parameter *31.22 STO indication run/stop* (page *264*). Check the value of parameter *95.04 Control board supply*.
FA82	Safe torque off 2	Safe torque off function is active, ie. STO circuit 2 is broken.	
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.
	0001	Maximum current limit too low.	Check settings of parameters *99.06 Motor nominal current* and *30.17 Maximum current*. Make sure that *30.17* > *99.06*. Check that the drive is dimensioned correctly according to the motor.

Code (hex)	Fault / Aux. code (*aux code visible only on assistant control panel and drive composer*)	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.

Code (hex)	**Fault / Aux. code** (***aux code visible only on assistant control panel and drive composer***)	**Cause**	**What to do**
FF63	STO diagnostics failure.	SW internal malfunction.	Reboot the control unit (using parameter *96.08 Control board boot* or by cycling power.
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.

9

Fieldbus control through the embedded fieldbus interface (EFB)

What this chapter contains

The chapter describes how the drive can be controlled by external devices over a communication network (fieldbus) using the embedded fieldbus interface.

System overview

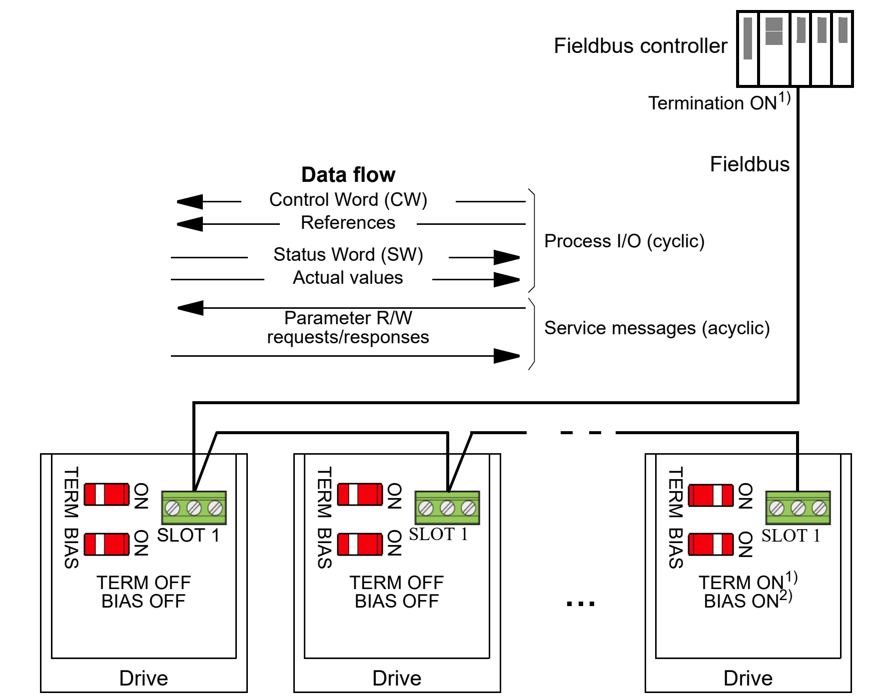
The drive can be connected to an external control system through a communication link using either a fieldbus adapter or the embedded fieldbus interface.

The embedded fieldbus interface supports the Modbus RTU protocol. The drive control program can handle 10 Modbus registers in a 10-millisecond time level. For example, if the drive receives a request to read 20 registers, it will start its response within 22 ms of receiving the request – 20 ms for processing the request and 2 ms overhead for handling the bus. The actual response time depends on other factors as well, such as the baud rate (a parameter setting in the drive).

The drive can be set to receive all of its control information through the fieldbus interface, or the control can be distributed between the embedded fieldbus interface and other available sources, for example, digital and analog inputs.

Connecting the fieldbus to the drive

Connect the fieldbus to terminal slot, which is attached on the control unit of the drive. The connection diagram is shown below.



1) The device at both ends on the fieldbus must have termination on.
2) One device, preferably at the end on the fieldbus must have bias on.

The AC500 PLC has a free version library called ‘PS553 drives’ which help user to communicate and control between PLC and drives easily.

Setting up the embedded fieldbus interface

To configure the parameters automatically

1. Navigate to **Main menu** ≡ → **Complete parameter list** and set parameter *96.04* to *Modbus RTU [21].*

The following parameters change automatically.

Parameter	Setting
20.01 Ext1 commands	*Embedded fieldbus* [1]
20.03 Ext1 in1 source	*Always off* [0]
20.04 Ext1 in2 source	*Always off* [0]
22.11 Ext1 speed ref1	*EFB ref1*[8]
22.22 Constant speed sel1	*Always off* [0]
22.23 Constant speed sel2	*Always off* [0]
23.11 Ramp set selection	*Acc/Dec time 1*[0]
28.11 Ext1 frequency ref1	*EFB ref1*[8]
28.22 Constant frequency sel1	*Always off* [0]
28.23 Constant frequency sel2	*Always off* [0]
28.71 Freq ramp set selection	*Acc/Dec time 1*[0]
31.11 Fault reset selection	*DI1*[2]
58.01 Protocol enable	*Modbus RTU* 1]

You can manually set the drive up for the embedded fieldbus communication with the parameters shown in the table below. The **Setting for fieldbus control** column gives either the value to use or the default value. The **Function/Information column** gives a description of the parameter.

Parameter		Setting for fieldbus control	Function/Information
COMMUNICATION INITIALIZATION			
58.01	*Protocol enable*	*Modbus RTU* [1]	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) [3]	Defines the communication speed of the link. Use the same setting as in the master station.
58.05	*Parity*	*8 EVEN 1* (default) [2]	Selects the parity and stop bit setting. Use the same setting as in the master station.
58.14	*Communication loss action*	*Fault* (default) [1]	Defines the action taken when a communication loss is detected.
58.15	*Communication loss mode*	*Cw / Ref1 / Ref2* (default) [2]	Enables/disables communication loss monitoring and defines the means for resetting the counter of the communication loss delay.

Parameter		Setting for fieldbus control	Function/Information
58.16	Communication loss time	3.0 s (default)	Defines the timeout limit for the communication monitoring.
58.17	Transmit delay	0 ms (default)	Defines a response delay for the drive.
58.25	Control profile	ABB Drives [0] (default)	Selects the control profile used by the drive. See section Basics of the embedded fieldbus interface (page 447).
58.26 58.27	EFB ref1 type EFB ref2 type	Speed or frequency (default for 58.26) [0], Transparent, General, Torque [3] (default for 58.27), Speed [4], Frequency [5]	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) [0], Transparent (default for 58.29) [1], General [2], Torque [3],Speed [4], Frequency [5]	Defines the types of actual values 1 and 2. The scaling for each actual value type is defined by parameters 46.01…46.03. With the Speed or frequency setting, the type is selected automatically according to the currently active drive control mode.
58.31 58.32	EFB act1 transparent source EFB act2 transparent source	Other	Defines the source of actual values 1 and 2 when the 58.26 EFB ref1 type (58.27 EFB ref2 type) is set to Transparent.
58.33	Addressing mode	Mode 0 (default) [0]	Defines the mapping between parameters and holding registers in the 400001…465536 (100…65535) Modbus register range.
58.34	Word order	LO-HI (default) [1]	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 [31], AO1 data storage [32], AO2 data storage [33], Feedback data storage [40], Setpoint data storage [41]	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.

Parameter	Setting for fieldbus control	Function/Information
58.06 Communication control	*Refresh settings*	Validates the settings of the configuration parameters.

The new settings will take effect when the drive is powered up the next time, or when they are validated by parameter *58.06 Communication control* (*Refresh settings*).

Setting the drive control parameters

After the embedded fieldbus interface has been set up, check and adjust the drive control parameters listed in the table below. The **Setting for fieldbus control** column gives the value or values to use when the embedded fieldbus signal is the desired source or destination for that particular drive control signal. The **Function/Information** column gives a description of the parameter.

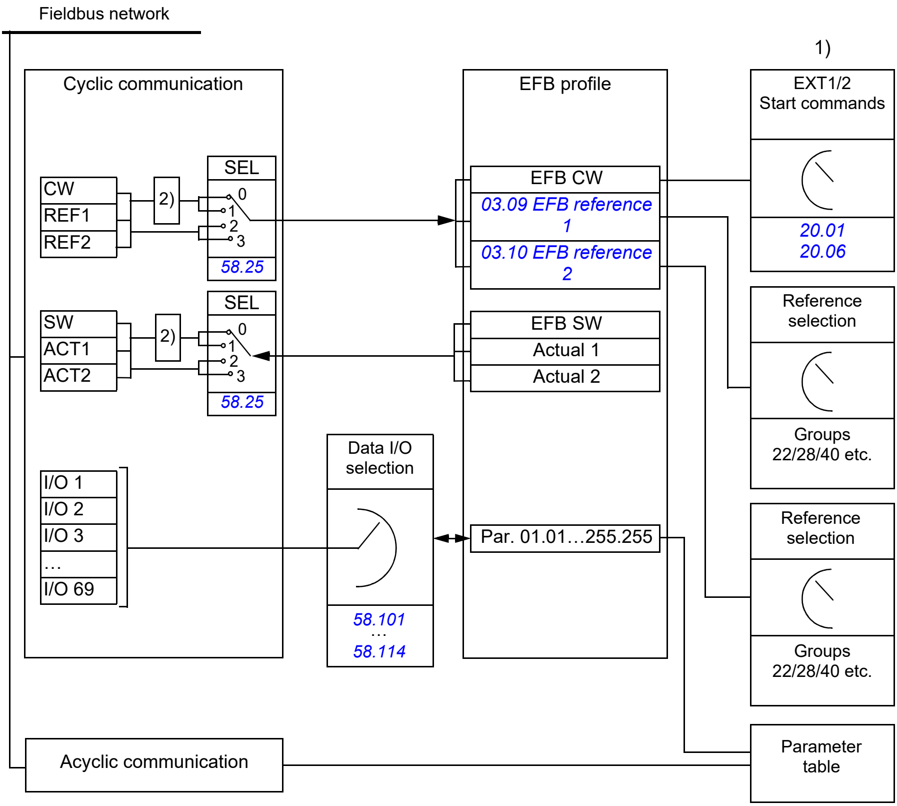
Parameter	Setting for fieldbus control	Function/Information
CONTROL COMMAND SOURCE SELECTION		
20.01 Ext1 commands	*Embedded fieldbus*	Selects fieldbus as the source for the start and stop commands when EXT1 is selected as the active control location.
20.06 Ext2 commands	*Embedded fieldbus*	Selects fieldbus 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.
TORQUE REFERENCE SELECTION		
26.11 Torque ref1 source	*EFB ref1*	Selects a reference received through the embedded fieldbus interface as torque reference 1.
26.12 Torque ref2 source	*EFB ref1*	Selects a reference received through the embedded fieldbus interface as torque reference 2.
FREQUENCY REFERENCE SELECTION		
28.11 Ext1 frequency ref1	*EFB ref1*	Selects a reference received through the embedded fieldbus interface as frequency reference 1.

Parameter	Setting for fieldbus control	Function/Information
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 *450*).

Control word and Status word

The Control Word (CW) is a 16-bit or 32-bit packed boolean word. It is the principal means of controlling the drive from a fieldbus system. The CW is sent by the fieldbus controller to the drive. With drive parameters, the user selects the EFB CW as the source of drive control commands (such as start/stop, emergency stop, selection between external control locations 1/2, or fault reset). The drive switches between its states according to the bit-coded instructions of the CW.

The fieldbus CW is either written to the drive as it is or the data is converted. See section *About the control profiles* (page *450*).

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 *450*).

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 *450*).

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 *450*).

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

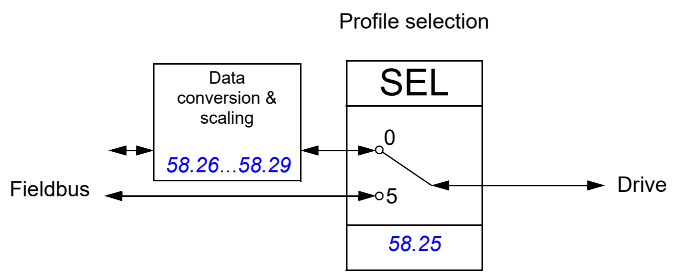
A control profile defines the rules for data transfer between the drive and the fieldbus master, for example:

- 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 *458*.

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 D**. **Note:** Run enable signal must be active; see the drive documentation. If the drive is set to receive the Run enable signal from the fieldbus, this bit activates the signal.
		0	Inhibit operation. Proceed to **OPERATION INHIBITED**.
4	RAMP_OUT_ ZERO	1	Normal operation. Proceed to **RAMP FUNCTION GENERATOR: OUTPUT D**.
		0	Force Ramp Function Generator output to zero. Drive ramps to stop (current and DC voltage limits in force).
5	RAMP_HOLD	1	ramp function. Proceed to **RAMP FUNCTION GENERATOR: ACCELERATOR D**.
		0	Halt ramping (Ramp Function Generator output held).
6	RAMP_IN_ ZERO	1	Normal operation. Proceed to **OPERATING**. **Note:** This bit is effective only if the fieldbus interface is set as the source for this signal by drive parameters.
		0	Force Ramp Function Generator input to zero.
7	RESET	0=>1	Fault reset if an active fault exists. Proceed to **SWITCH-ON INHIBITED**. **Note:** This bit is effective only if the fieldbus interface is set as the source for this signal by drive parameters.
		0	Continue normal operation.

Bit	Name	Value	STATE/Description
8	JOGGING_1	1	Request running at Jogging 1 speed. **Note:** This bit is effective only if the fieldbus interface is set as the source for this signal by drive parameters.
		0	Continue normal operation.
9	JOGGING_2	1	Request running at Jogging 2 speed. **Note:** This bit is effective only if the fieldbus interface is set as the source for this signal by drive parameters.
		0	Continue normal operation.
10	REMOTE_ CMD	1	Fieldbus control 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 (7…9).
		0	(no op)
1	START	1	Start the drive.
		0	(no op)

<table>
<tr><th>Bit</th><th>Name</th><th>Value</th><th>State/Description</th></tr>
<tr><td rowspan="2">2</td><td rowspan="2">REVERSE</td><td>1</td><td>Reverse direction of motor rotation. See in the table below how this bit and sign of the reference effect the direction of the motor direction.
<table>
<tr><th rowspan="2"></th><th colspan="2">Sign of the reference</th></tr>
<tr><th>Positive (+)</th><th>Negative (-)</th></tr>
<tr><td>Bit REVERSE = 0</td><td>Forward</td><td>Reverse</td></tr>
<tr><td>Bit REVERSE = 1</td><td>Reverse</td><td>Forward</td></tr>
</table></td></tr>
<tr><td>0</td><td>(no op)</td></tr>
<tr><td>3</td><td>Reserved</td><td></td><td></td></tr>
<tr><td rowspan="2">4</td><td rowspan="2">RESET</td><td>0=>1</td><td>Fault reset if an active fault exists.</td></tr>
<tr><td>0</td><td>(no op)</td></tr>
<tr><td rowspan="2">5</td><td rowspan="2">EXT2</td><td>1</td><td>Select External control location EXT2. Effective if the control location is parameterized to be selected from the fieldbus.</td></tr>
<tr><td>0</td><td>Select External control location EXT1. Effective if the control location is parameterized to be selected from the fieldbus.</td></tr>
<tr><td rowspan="2">6</td><td rowspan="2">RUN_DISABLE</td><td>1</td><td>Run disable. If the drive is set to receive the run enable signal from the fieldbus, this bit deactivates the signal.</td></tr>
<tr><td>0</td><td>Run enable. If the drive is set to receive the run enable signal from the fieldbus, this bit activates the signal.</td></tr>
<tr><td rowspan="2">7</td><td rowspan="2">STOPMODE_RAMP</td><td>1</td><td>Normal ramp stop mode</td></tr>
<tr><td>0</td><td>(no op) Default to parameter stop mode if bits 7…9 are all 0.</td></tr>
<tr><td rowspan="2">8</td><td rowspan="2">STOPMODE_EMERGENCY_RAMP</td><td>1</td><td>Emergency ramp stop mode.</td></tr>
<tr><td>0</td><td>(no op) Default to parameter stop mode if bits 7…9 are all 0.</td></tr>
<tr><td rowspan="2">9</td><td rowspan="2">STOPMODE_COAST</td><td>1</td><td>Coast stop mode.</td></tr>
<tr><td>0</td><td>(no op) Default to parameter stop mode if bits 7…9 are all 0.</td></tr>
<tr><td rowspan="2">10</td><td rowspan="2">RAMP_PAIR _2</td><td>1</td><td>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.</td></tr>
<tr><td>0</td><td>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.</td></tr>
<tr><td rowspan="2">11</td><td rowspan="2">RAMP_OUT_ZERO</td><td>1</td><td>Force Ramp Function Generator output to zero. Drive ramps to stop (current and DC voltage limits in force).</td></tr>
<tr><td>0</td><td>Normal operation.</td></tr>
<tr><td rowspan="2">12</td><td rowspan="2">RAMP_HOLD</td><td>1</td><td>Halt ramping (Ramp Function Generator output held).</td></tr>
<tr><td>0</td><td>Normal operation.</td></tr>
<tr><td rowspan="2">13</td><td rowspan="2">RAMP_IN_ZERO</td><td>1</td><td>Force Ramp Function Generator input to zero.</td></tr>
<tr><td>0</td><td>Normal operation.</td></tr>
</table>

Bit	Name	Value	State/Description
14	REQ_LOCAL_LOCK	1	Drive does not switch to local control mode (see parameter *19.17 Local control disable*).
		0	Drive can switch between local and remote control modes.
15	Reserved		
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.
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 *458*.

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 D**.
		0	**OPERATION INHIBITED**.
3	TRIPPED	1	**FAULT**.
		0	No fault.
4	OFF_2_STATUS	1	OFF2 inactive.
		0	**OFF2 ACTIVE**.
5	OFF_3_STATUS	1	OFF3 inactive.
		0	**OFF3 ACTIVE**.
6	SWC_ON_ INHIB	1	**SWITCH-ON INHIBITED**.
		0	–
7	ALARM	1	Warning/Alarm.
		0	No warning/alarm.
8	AT_ SETPOINT	1	**OPERATING**. Actual value equals Reference (is within tolerance limits, e.g. in speed control, speed error is 10% max. of nominal motor speed).
		0	Actual value differs from Reference (is outside tolerance limits).
9	REMOTE	1	Drive control location: REMOTE (EXT1 or EXT2).
		0	Drive control location: LOCAL.
10	ABOVE_ LIMIT	1	Actual frequency or speed equals or exceeds supervision limit (set by drive parameter). Valid in both directions of rotation.
		0	Actual frequency or speed within supervision limit.
11	USER_0		Status bits that can be combined with drive logic for application-specific functionality.
12	USER_1		
13	USER_2		
14	USER_3		
15	Reserved		

Status Word for the DCU Profile

The embedded fieldbus interface writes the drive Status Word bits 0 to 15 to the fieldbus Status Word as is. Bits 16 to 32 of the drive Status Word are not in use.

Bit	Name	Value	State/Description
0	READY	1	Drive is ready to receive the start command.
		0	Drive is not ready.
1	D	1	External run enable signal is active.
		0	External run enable signal is not active.
2	Reserved for D_TO_ROTATE		Not yet implemented.
3	RUNNING	1	Drive is modulating.
		0	Drive is not modulating.
4	ZERO_SPEED	1	Drive is at zero speed.
		0	Drive is not at zero speed.
5	ACCELERATING	1	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…46.33
		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
12	PANEL_LOCAL	1	Panel/keypad (or PC tool) is in local control mode.
		0	Panel/keypad (or PC tool) is not in local control mode.
13	FIELDBUS_LOCAL	1	Fieldbus is in local control mode.
		0	Fieldbus is not in local control mode.
14	EXT2_ACT	1	External control location EXT2 is active.
		0	External control location EXT1 is active.
15	FAULT	1	Drive is faulted.
		0	Drive is not faulted.

Bit	Name	Value	State/Description
16	ALARM	1	Warning/Alarm is active.
		0	No warning/alarm.
17	Reserved		
18	Reserved for DIRECTION_LOCK		Not yet implemented.
19	Reserved		
20	CTL_MODE	1	Vector motor control mode is active.
		0	Scalar motor control mode is active.
21	Reserved		
22	USER_0		Status bits that can be combined with drive logic for application-specific functionality.
23	USER_1		
24	USER_2		
25	USER_3		
26	REQ_CTL	1	Control is requested in this channel.
		0	Control is not requested in this channel.
27…31	Reserved		

State transition diagrams

State transition diagram for the ABB Drives profile

The diagram below shows the state transitions in the drive when the drive is using the ABB Drives profile and the drive is configured to follow the commands of the control word from the embedded fieldbus interface. The upper case texts refer to the states which are used in the tables representing the fieldbus Control and Status words. See sections *Control Word for the ABB Drives profile* on page *451* and *Status Word for the ABB Drives profile* on page *455*.

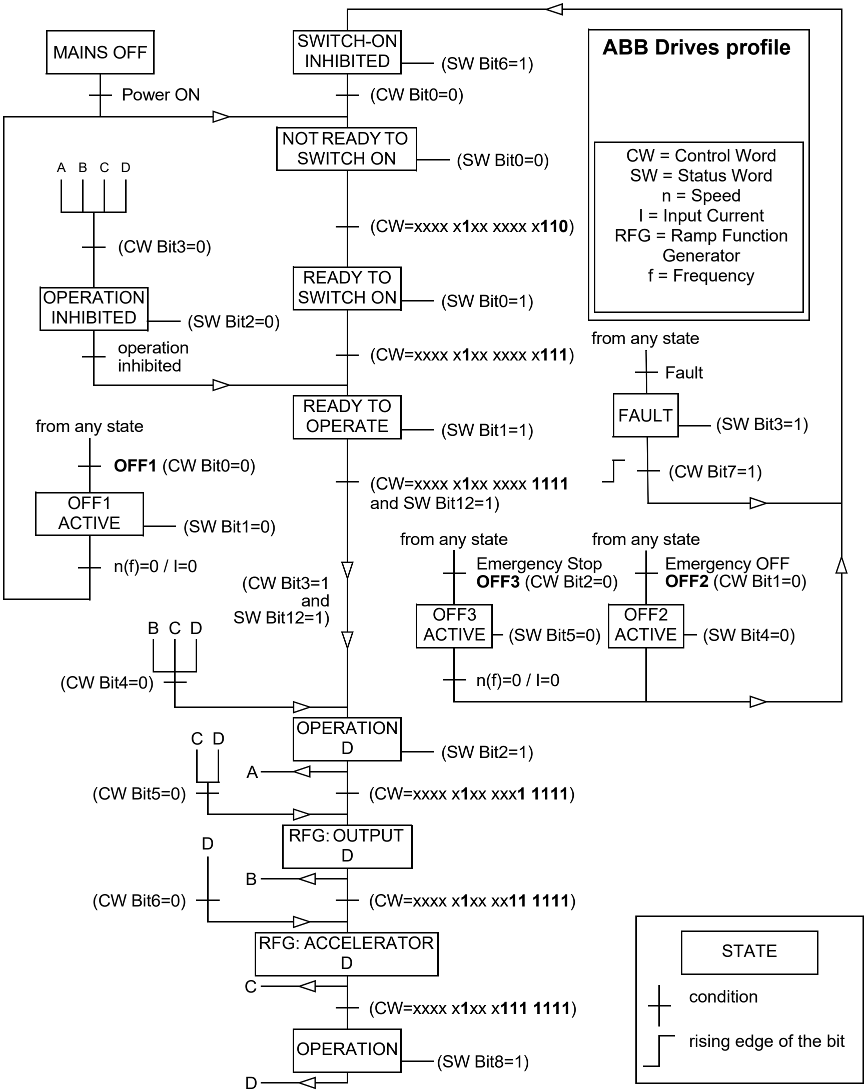


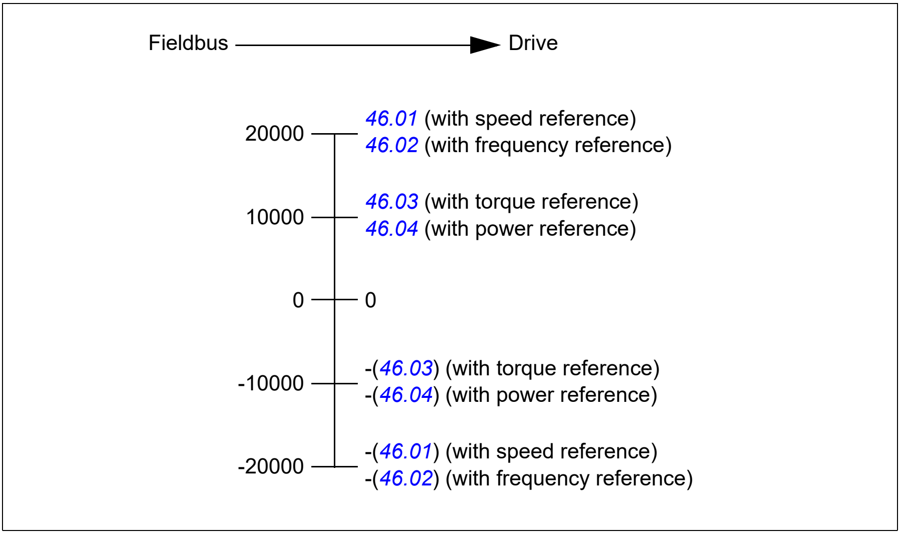
ABB Drives profile
CW = Control Word
SW = Status Word
n = Speed
I = Input Current
RFG = Ramp Function Generator
f = Frequency
MAINS OFF
Power ON
SWITCH-ON INHIBITED
(SW Bit6=1)
(CW Bit0=0)
NOT READY TO SWITCH ON
(SW Bit0=0)
A B C D
(CW Bit3=0)
(CW=xxxx x1xx xxxx x110)
READY TO SWITCH ON
(SW Bit0=1)
OPERATION INHIBITED
(SW Bit2=0)
operation inhibited
(CW=xxxx x1xx xxxx x111)
from any state
Fault
READY TO OPERATE
(SW Bit1=1)
FAULT
(SW Bit3=1)
from any state
OFF1 (CW Bit0=0)
(CW Bit7=1)
(CW=xxxx x1xx xxxx 1111 and SW Bit12=1)
OFF1 ACTIVE
(SW Bit1=0)
from any state
Emergency Stop
OFF3 (CW Bit2=0)
from any state
Emergency OFF
OFF2 (CW Bit1=0)
n(f)=0 / I=0
(CW Bit3=1 and SW Bit12=1)
OFF3 ACTIVE
(SW Bit5=0)
OFF2 ACTIVE
(SW Bit4=0)
B C D
(CW Bit4=0)
n(f)=0 / I=0
OPERATION D
(SW Bit2=1)
C D
A
(CW Bit5=0)
(CW=xxxx x1xx xxx1 1111)
RFG: OUTPUT D
D
B
(CW Bit6=0)
(CW=xxxx x1xx xx11 1111)
RFG: ACCELERATOR D
C
(CW=xxxx x1xx x111 1111)
OPERATION
(SW Bit8=1)
D
STATE
condition
rising edge of the bit

References

References for the ABB Drives profile and DCU Profile

The ABB Drives profile supports the use of two references, EFB reference 1 and EFB reference 2. The references are 16-bit words each containing a sign bit and a 15-bit integer. A negative reference is formed by calculating the two's complement from the corresponding positive reference.

The references are scaled as defined by parameters *46.01…46.04*; which scaling is in use depends on the setting of *58.26 EFB ref1 type* and *58.27 EFB ref2 type* (see page *338*).



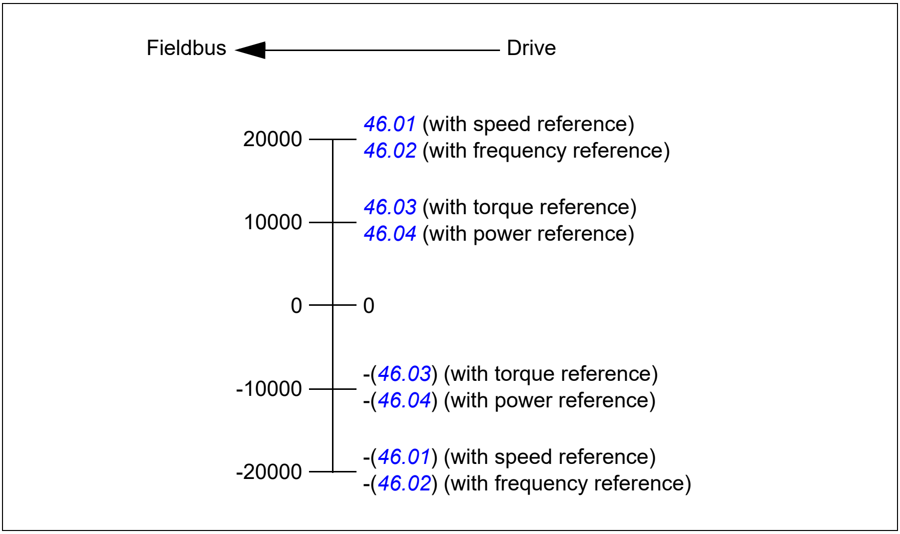
The scaled references are shown by parameters *03.09 EFB reference 1* and *03.10 EFB reference 2*.

Actual values

Actual values for the ABB Drives profile and DCU Profile

The ABB Drives profile supports the use of two fieldbus actual values, ACT1 and ACT2. The actual values are 16-bit words each containing a sign bit and a 15-bit integer. A negative value is formed by calculating the two's complement from the corresponding positive value.

The actual values are scaled as defined by parameters *46.01…46.04*; which scaling is in use depends on the setting of parameters *58.28 EFB act1 type* and *58.29 EFB act2 type* (see page *339*).



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 *451*) and *Control Word for the DCU Profile* (page *452*). 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 *58.104 Data I/O 4*.
400003	Default: Reference 2 (*Ref2 16bit*). The selection can be changed using parameter *58.104 Data I/O 4*.
400004	Default: Status Word (*SW 16bit*). See sections *Status Word for the ABB Drives profile* (page *455*) and *Status Word for the DCU Profile* (page *456*). 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 *469*).
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.
17h	Read/Write Multiple Registers	Writes the contents of a contiguous block of 4X registers, then reads the contents of another group of registers (the same or different than those written) in a server device.

Code	Function name	Description
2Bh / 0Eh	Encapsulated Interface Transport	Supported subcodes: • 0Eh Read Device Identification: Allows reading the identification and other information. Supported ID codes (access type): • 00h: Request to get the basic device identification (stream access) • 04h: Request to get one specific identification object (individual access) Supported Object IDs: • 00h: Vendor Name (“ABB”) • 01h: Product Code (for example, “ASCLx or ASCDx”) • 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: (“ACS560”).

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 *469*.

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	JOGGING_1	STOPMODE_EMERGENCY_RAMP
000010	JOGGING_2	STOPMODE_COAST
000011	REMOTE_CMD	Reserved
000012	EXT_CTRL_LOC	RAMP_OUT_ZERO
000013	USER_0	RAMP_HOLD
000014	USER_1	RAMP_IN_ZERO
000015	USER_2	Reserved
000016	USER_3	Reserved
000017	Reserved	FB_LOCAL_CTL
000018	Reserved	FB_LOCAL_REF
000019	Reserved	Reserved
000020	Reserved	Reserved
000021	Reserved	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)

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.

10

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

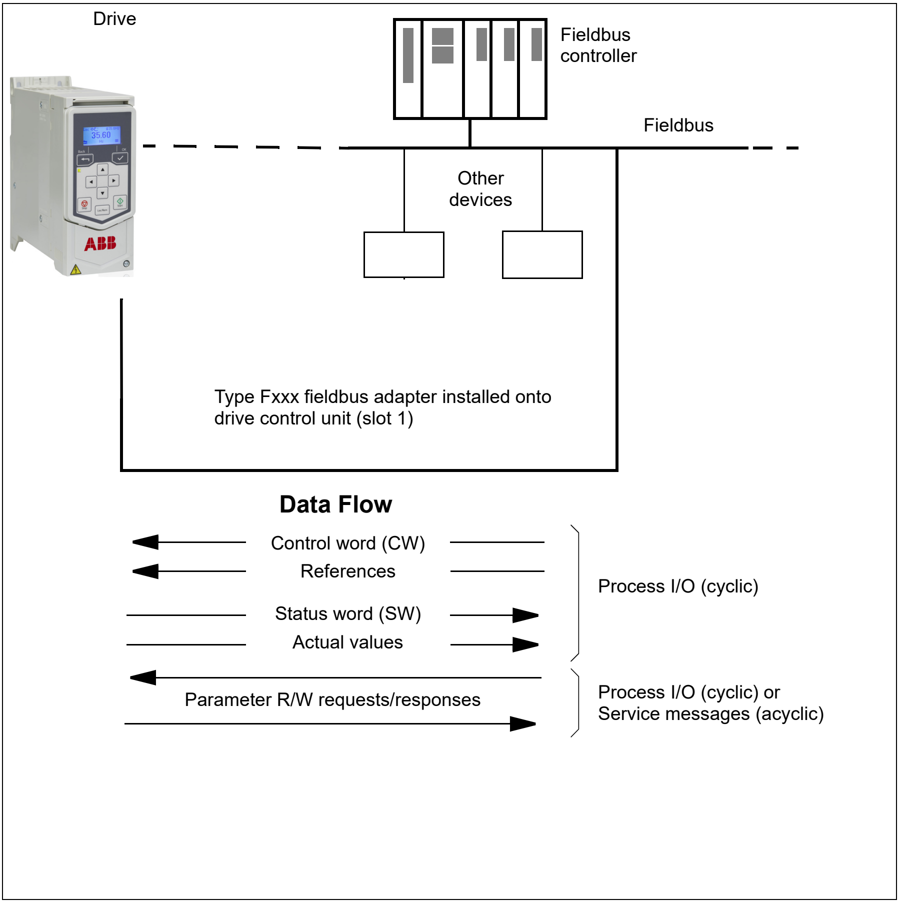
The drive can be connected to an external control system through an optional fieldbus adapter (“fieldbus adapter A” = FBA A) mounted onto the control unit of the drive. The drive can be configured to receive all of its control information through the fieldbus interface, or the control can be distributed 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:

- PROFIBUS DP (FPBA-01 adapter)
- PROFINET (FPNO-21)
- CANopen (FCAN-01 adapter)
- EtherCAT (FECA-01 adapter)
- EtherNet/IP (FEIP-21)
- Modbus/TCP (FMBT-21)
- EtherNet IP^{TM}/PROFINET IO/Modbus/TCP (FENA-11/-21)
- ModbusRTU (FSCA-01)

Notes:

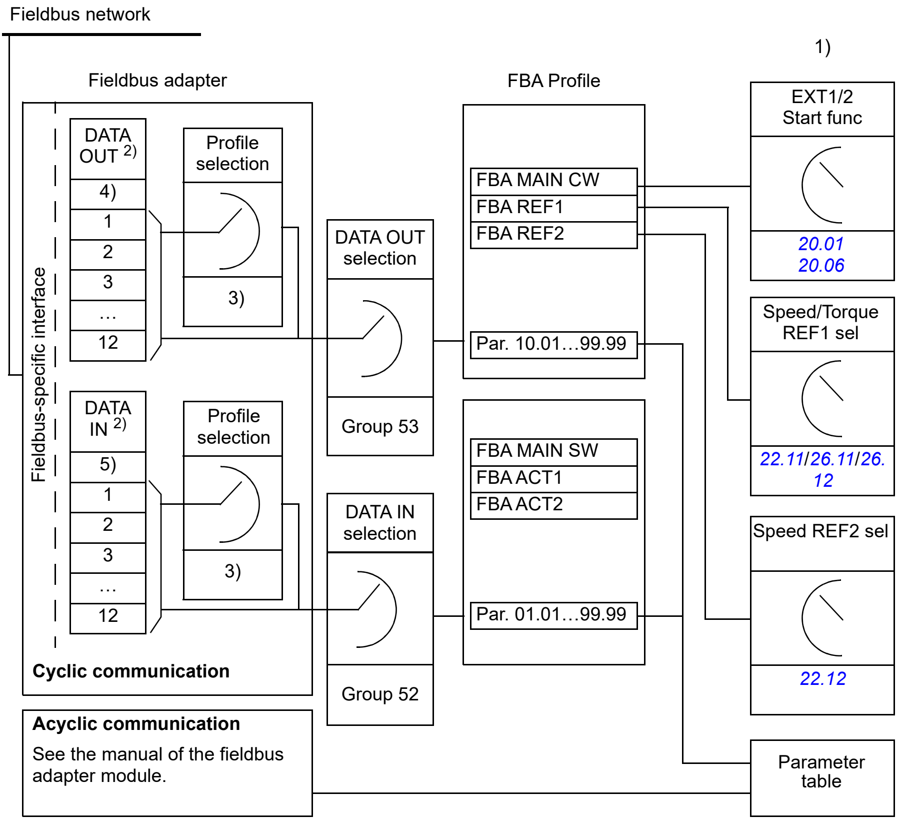
- The text and examples in this chapter describe the configuration of one fieldbus adapter (FBA A) by parameters *50.01*…*50.18* and parameter groups *51 FBA A settings*…*53 FBA A data out*.
- The AC 500 PLC has a free version library called PS553 drives which helps user to communicate and control between PLC and drives easily.



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.

Control word and Status word

The Control word is the principal means for controlling the drive from a fieldbus system. It is sent by the fieldbus master station to the drive through the adapter module. The drive switches between its states according to the bit-coded instructions in the Control word, and returns status information to the master in the Status word.

The contents of the Control word and the Status word are detailed on pages *478* and *480* respectively. The drive states are presented in the state diagram (page *481*).

Debugging the network words

If parameter *50.12 FBA A debug mode* is set to *Fast* [1], the Control word received from the fieldbus is shown by parameter *50.13 FBA A control word*, and the Status word transmitted to the fieldbus network by *50.16 FBA A status word*. This “raw” data is very useful to determine if the fieldbus master is transmitting the correct data before handing control to the fieldbus network.

References

References are 16-bit words containing a sign bit and a 15-bit integer. A negative reference (indicating reversed direction of rotation) is formed by calculating the two's complement from the corresponding positive reference.

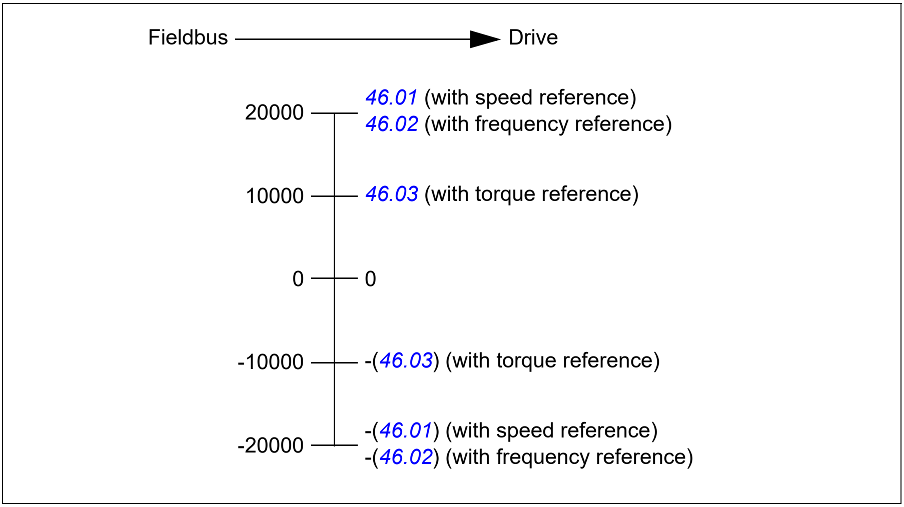
ABB drives can receive control information from multiple sources including analog and digital inputs, the drive control panel and a fieldbus adapter module. In order to have the drive controlled through the fieldbus, the module must be defined as the source for control information such as reference. This is done using the source selection parameters in groups *22 Speed reference selection*, *26 Torque reference chain* and *28 Frequency reference chain*.

Debugging the network words

If parameter *50.12 FBA A debug mode* is set to *Fast* [1], the references received from the fieldbus are displayed by *50.14 FBA A reference 1* and *50.15 FBA A reference 2*.

Scaling of references

The references are scaled as defined by parameters *46.01*…*46.04*; which scaling is in use depends on the setting of *50.04 FBA A ref1 type* and *50.05 FBA A ref2 type*.



The scaled references are shown by parameters *03.05 FB A reference 1* and *03.06 FB A reference 2*.

Actual values

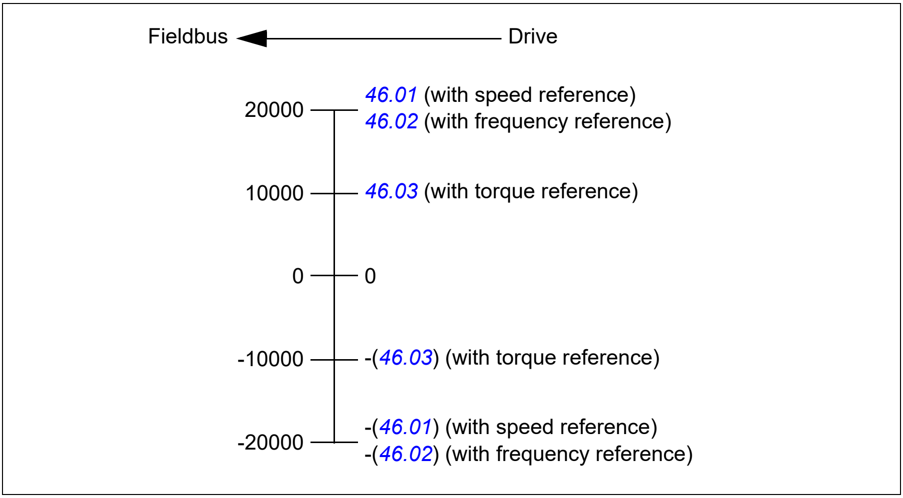
Actual values are 16-bit words containing information on the operation of the drive. The types of the monitored signals are selected by parameters *50.07 FBA A actual 1 type* and *50.08 FBA A actual 2 type*.

Debugging the network words

If parameter *50.12 FBA A debug mode* is set to *Fast* [1], 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

The upper case boldface text refers to the states shown in the state diagram (page 481).

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 D**. **Note:** Run enable signal must be active; see drive documentation. If the drive is set to receive the Run enable signal from the fieldbus, this bit activates the signal.
		0	Inhibit operation. Proceed to **OPERATION INHIBITED**.
4	Ramp out zero	1	Normal operation. Proceed to **RAMP FUNCTION GENERATOR: OUTPUT D**.
		0	Force Ramp function generator output to zero. The drive will immediately decelerate to zero speed (observing the torque limits).
5	Ramp hold	1	ramp function. Proceed to **RAMP FUNCTION GENERATOR: ACCELERATOR D**.
		0	Halt ramping (Ramp Function Generator output held).
6	Ramp in zero	1	Normal operation. Proceed to **OPERATING**. **Note:** This bit is effective only if the fieldbus interface is set as the source for this signal by drive parameters.
		0	Force Ramp function generator input to zero.
7	Reset	0=>1	Fault reset if an active fault exists. Proceed to **SWITCH-ON INHIBITED**. **Note:** This bit is effective only if the fieldbus interface is set as the source of the reset signal by drive parameters.
		0	Continue normal operation.
8	Inching 1	1	Accelerate to inching (jogging) setpoint 1. **Notes:** • Bits 4…6 must be 0. • See also section *Rush control* (page 72).
		0	Inching (jogging) 1 disabled.
9	Inching 2	1	Accelerate to inching (jogging) setpoint 2. See notes at bit 8.
		0	Inching (jogging) 2 disabled.
10	Remote cmd	1	Fieldbus control d.
		0	Control word and reference not getting through to the drive, except for bits 0…2.

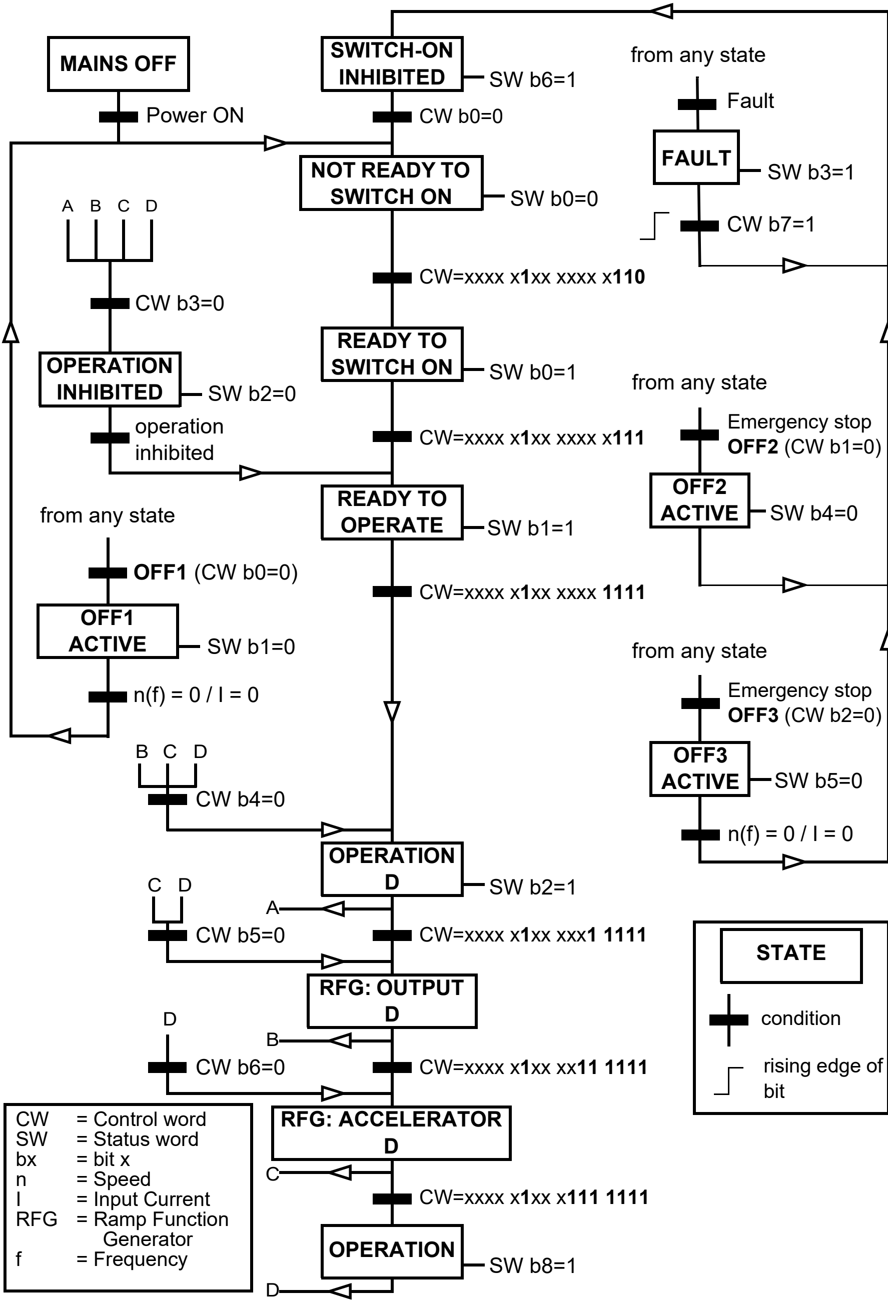
Bit	Name	Value	STATE/Description
11	Ext ctrl loc	1	Select External Control Location EXT2. Effective if control location is parameterized to be selected from fieldbus.
		0	Select External Control Location EXT1. Effective if control location is parameterized to be selected from fieldbus.
12	User bit 0	1	User configurable
		0	
13	User bit 1	1	
		0	
14	User bit 2	1	
		0	
15	User bit 3	1	
		0	

Contents of the fieldbus Status word

The upper case boldface text refers to the states shown in the state diagram (page 481).

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 D**.
		0	**OPERATION INHIBITED**.
3	Tripped	1	**FAULT**.
		0	No fault.
4	Off 2 inactive	1	OFF2 inactive.
		0	**OFF2 ACTIVE**.
5	Off 3 inactive	1	OFF3 inactive.
		0	**OFF3 ACTIVE**.
6	Switch-on inhibited	1	**SWITCH-ON INHIBITED**.
		0	–
7	Warning	1	Warning active.
		0	No warning active.
8	At setpoint	1	**OPERATING**. Actual value equals reference = is within tolerance limits (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



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*.

Notes:

- The optional modules BIO-01 and RIIO-01 are applicable only for frames R0...R2.
- No parameter changes are done for C-series modules. c-series modules are only supported in frames R3...R8.

Option	10.24 RO1 source	10.27 RO2 source	10.30 RO3 source	20.01 Ext1 commands	20.03 Ext1 in1 source	20.04 Ext1 in2 source
BIO-01	-	-	-	2 (In1 Start, In2 Dir)	2 (DI1)	3 (DI2)
RIIO-01	-	-	-	2 (In1 Start, In2 Dir)	2 (DI1)	3 (DI2)
FENA-21	-	-	-	-	-	-
FECA-01	-	-	-	-	-	-
FPBA-01	-	-	-	-	-	-
FCAN-01	-	-	-	-	-	-
FSCA-01	-	-	-	-	-	-
FEIP-21	-	-	-	-	-	-
FMBT-21	-	-	-	-	-	-
FPNO-21	-	-	-	-	-	-
FEPL-02	-	-	-	-	-	-
FDNA-01	-	-	-	-	-	-
FCNA-01	-	-	-	-	-	-

Option	22.11 Ext1 speed ref1	22.22 Constant speed sel1	22.23 Constant speed sel2
BIO-01	1 (AI1 scaled)	4 (DI3)	5 (DI4)
RIIO-01	1 (AI1 scaled)	4 (DI3)	5 (DI4)
FENA-21	-	-	-
FECA-01	-	-	-
FPBA-01	-	-	-
FCAN-01	-	-	-
FSCA-01	-	-	-
FEIP-21	-	-	-
FMBT-21	-	-	-
FPNO-21	-	-	-
FEPL-02	-	-	-
FDNA-01	-	-	-
FCNA-01	-	-	-

Option	23.11 Ramp set selection	28.11 Ext1 frequency ref1	28.22 Constant frequency sel1	28.23 Constant frequency sel2
BIO-01	6 (DI5)	1 (AI1 scaled)	4 (DI3)	5 (DI4)
RIIO-01	6 (DI5)	1 (AI1 scaled)	4 (DI3)	5 (DI4)
FENA-21	-	-	-	-
FECA-01	-	-	-	-
FPBA-01	-	-	-	-
FCAN-01	-	-	-	-
FSCA-01	-	-	-	-
FEIP-21	-	-	-	-
FMBT-21	-	-	-	-
FPNO-21	-	-	-	-
FEPL-02	-	-	-	-
FDNA-01	-	-	-	-
FCNA-01	-	-	-	-

Option	28.71 Freq ramp set selection	31.11 Fault reset selection
BIO-01	6 (DI5)	0
RIIO-01	6 (DI5)	0
FENA-21	-	-
FECA-01	-	-
FPBA-01	-	-
FCAN-01	-	-
FSCA-01	-	-
FEIP-21	-	-
FMBT-21	-	-
FPNO-21	-	-
FEPL-02	-	-
FDNA-01	-	-
FCNA-01	-	-

Option	50.01 FBA A enable	50.02 FBA A comm loss func	51.02 FBA A Par2	51.04 FBA A Par4
BIO-01	0	0	-	-
RIIO-01	0	0	-	-
FENA-21	1 (Enable)	0	11	0
FECA-01	1 (Enable)	0	0	-
FPBA-01	1 (Enable)	0	-	-
FCAN-01	1 (Enable)	0	-	-
FSCA-01	1 (Enable)	0	-	-

Option	50.01 FBA A enable	50.02 FBA A comm loss func	51.02 FBA A Par2	51.04 FBA A Par4
FEIP-21	1 (Enable)	0	100	0
FMBT-21	1 (Enable)	0	0	0
FPNO-21	1 (Enable)	0	11	0
FEPL-02	1 (Enable)	0	-	-
FDNA-01	1 (Enable)	0	-	-
FCNA-01	1 (Enable)	0	-	-

Option	51.05 FBA A Par5	51.06 FBA A Par6	51.07 FBA A Par7	51.08 FBA A Par8	51.09 FBA A Par9
BIO-01	-	-	-	-	-
RIIO-01	-	-	-	-	-
FENA-21	192	168	0	10	24
FECA-01	0	0	0	0	0
FPBA-01	1	-	-	-	0
FCAN-01	0	-	-	-	-
FSCA-01	-	10	1	-	-
FEIP-21	-	-	-	-	128
FMBT-21	-	-	-	1	-
FPNO-21	-	-	-	-	-
FEPL-02	-	-	-	-	-
FDNA-01	-	-	-	-	-
FCNA-01	-	-	-	-	-

Option	51.21 FBA A Par21	51.23 FBA A Par23	51.24 FBA A Par24
BIO-01	-	-	-
RIIO-01	-	-	-
FENA-21	-	-	-
FECA-01	-	-	-
FPBA-01	-	-	-
FCAN-01	-	-	-
FSCA-01	-	-	-
FEIP-21	-	128	128
FMBT-21	1	-	-
FPNO-21	-	-	-
FEPL-02	-	-	-
FDNA-01	-	-	-
FCNA-01	-	-	-

Option	52.01 FBA data in1	52.02 BA data in2	53.01 FBA data out1	53.02 FBA data out2	58.01 Protocol enable*
BIO-01	-	-	-	-	-
RIIO-01	-	-	-	-	-
FENA-21	4	5	1	2	0
FECA-01	-	-	-	-	0
FPBA-01	4	5	1	2	0
FCAN-01	-	-	-	-	0
FSCA-01	-				0
FEIP-21	-	-	-	-	0
FMBT-21	-	-	-	-	0
FPNO-21	4	5	1	2	0
FEPL-02	-	-	-	-	0
FDNA-01	-	-	-	-	0
FCNA-01	-	-	-	-	0
*Parameter 58.01 is set to 0 in frames R0...R2.					

Setting up the drive for fieldbus control manually

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)

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 ACS 560 drives**	**Description**
50.01 FBA A enable	**1** = [slot number]	Enables communication between the drive and the fieldbus adapter module.
50.04 FBA A ref1 type	**4** = *Speed*	Selects the fieldbus A reference 1 type and scaling.
50.07 FBA A actual 1 type	**0** = *Speed or frequency*	Selects the actual value type 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 data in1	**4** = SW 16bit[1)]	Status word
52.02 FBA data in2	**5** = Act1 16bit	Actual value 1
52.03 FBA data in3	01.07[2)]	Motor current
52.05 FBA data in5	01.11[2)]	DC voltage
53.01 FBA data out1	**1** = CW 16bit[1)]	Control word
53.02 FBA data out2	**2** = Ref1 16bit	Reference 1 (speed)
53.03 FBA data out3	23.12[2)]	Acceleration time 1

Drive parameter	Setting for ACS 560 drives	Description
53.05 FBA data out5	23.13[2)]	Deceleration time 1
51.27 FBA A par refresh	**1** = *Configure*	Validates the configuration parameter settings.
19.12 Ext1 control mode	**2** = *Speed*	Selects speed control as the control mode 1 for external control location EXT1.
20.01 Ext1 commands	**12** = *Fieldbus A*	Selects fieldbus adapter A as the source of the start and stop commands for external control location EXT1.
20.02 Ext1 start trigger type	**1** = *Level*	Selects a level-triggered start signal for external control location EXT1.
22.11 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 sequence for the parameter example above is given below.

Control word:

- 477h (1143 decimal) –> READY TO SWITCH ON
- 47Fh (1151 decimal) –> OPERATING (Speed mode)

11

Control chain diagrams

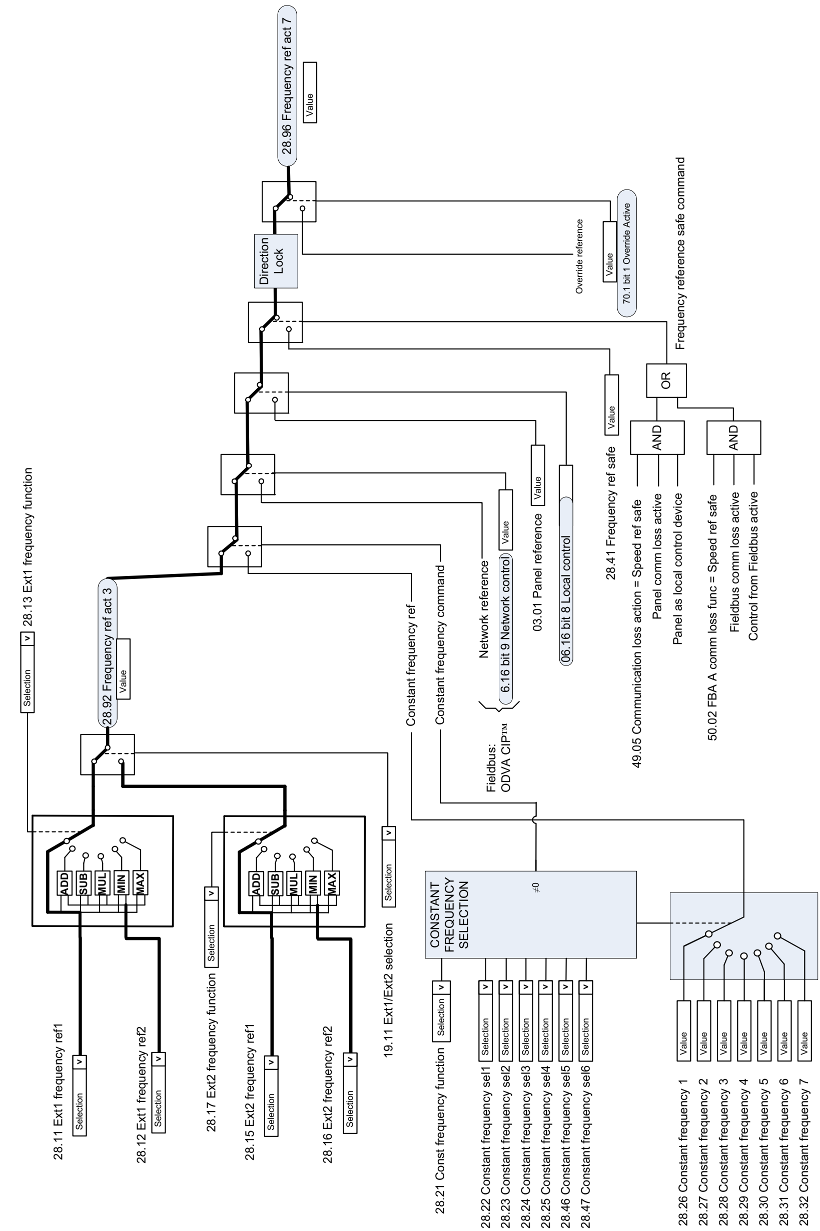
Contents of this chapter

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.

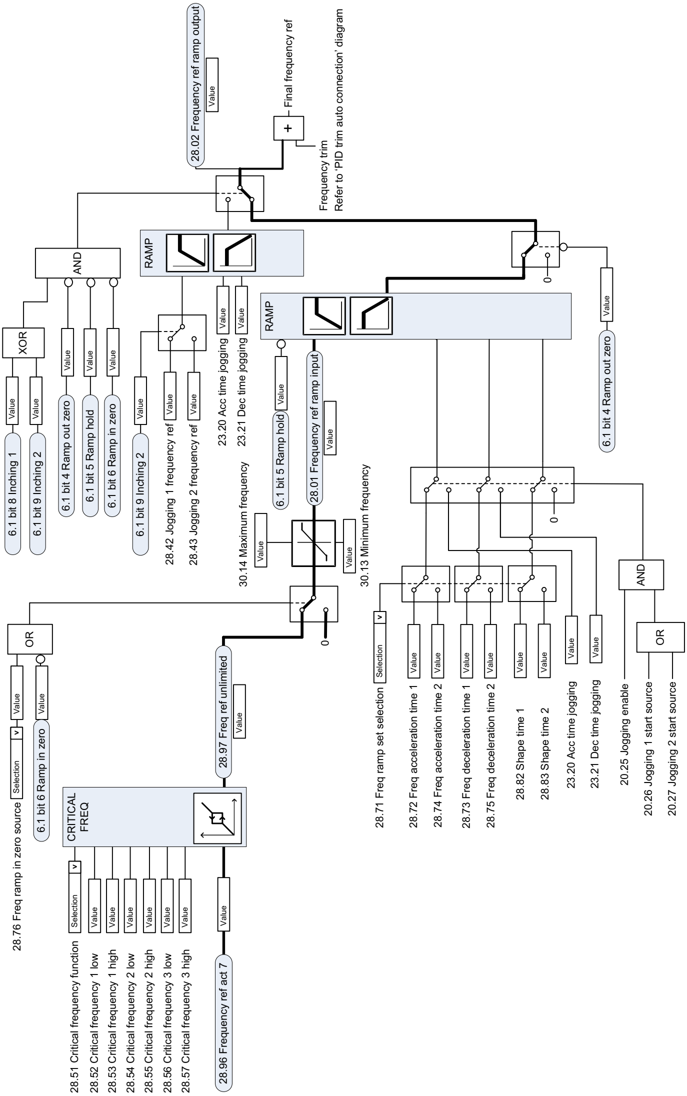
For a more general diagram, see section *Operating modes of the drive* (page *37*).

Note: The reference to group 24 parameters in control chain diagrams can be ignored. Group 24 Speed reference conditioning is not available in ACS560.

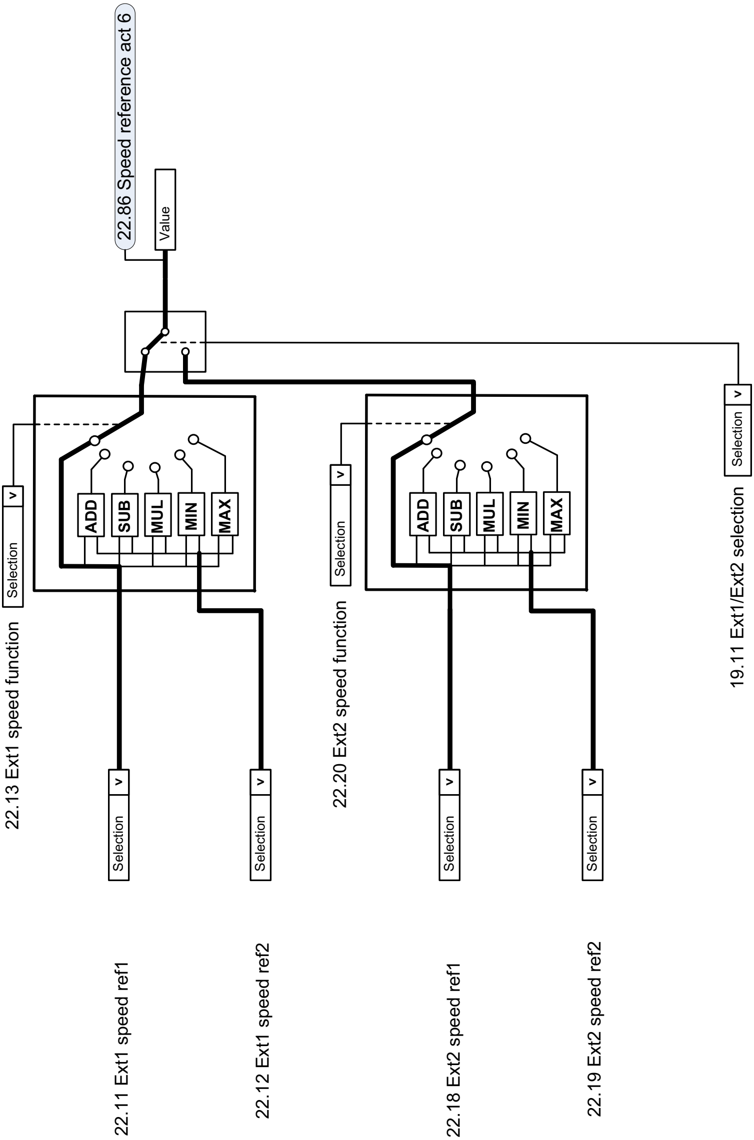
Frequency reference selection



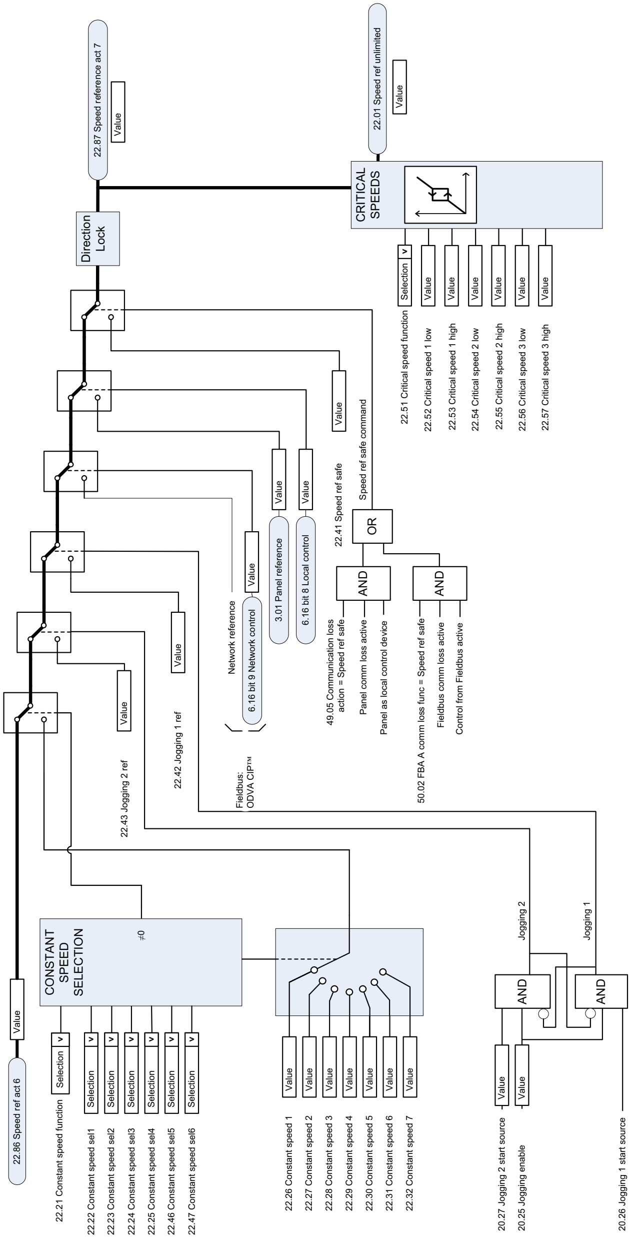
Frequency reference modification



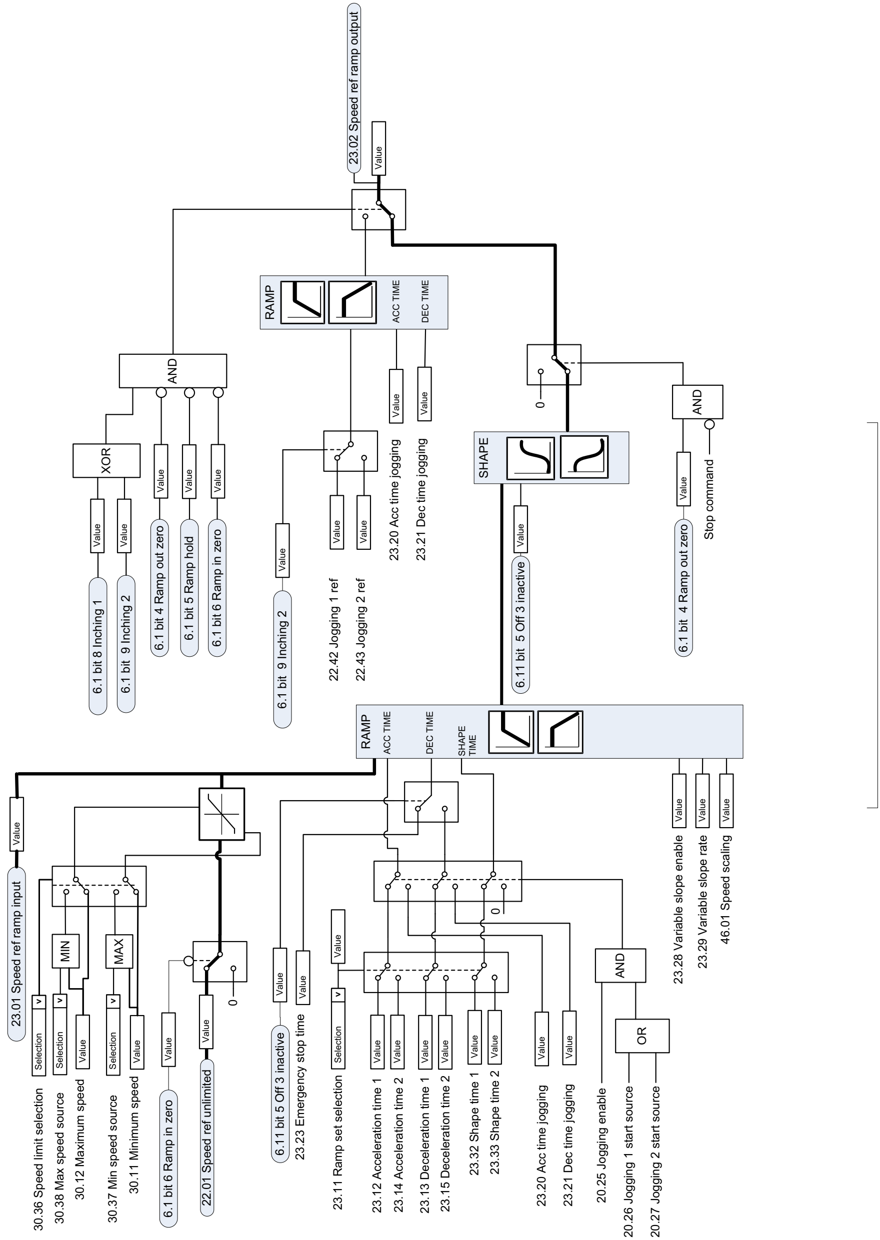
Speed reference source selection I



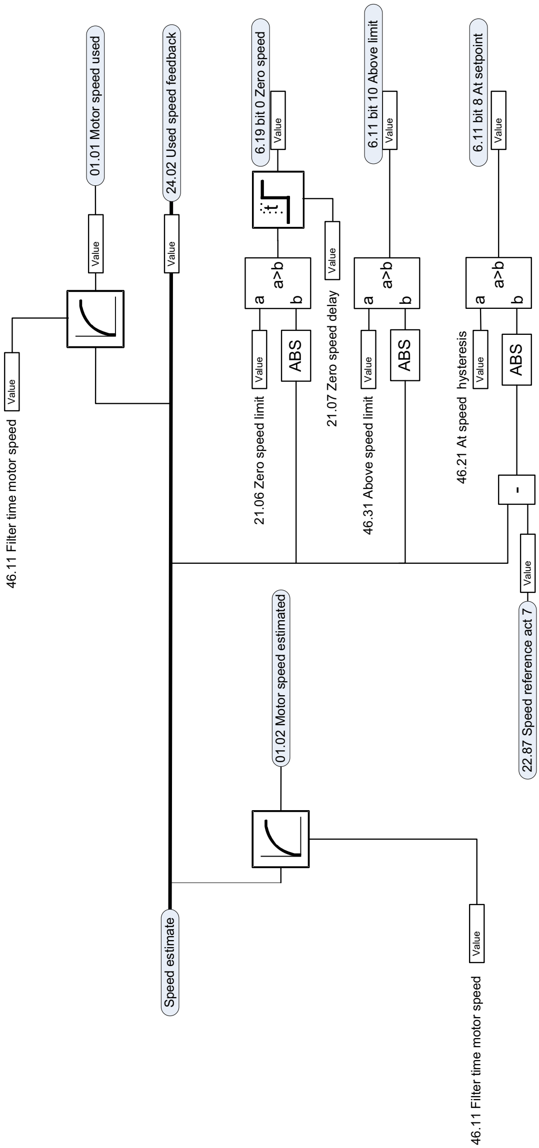
Speed reference source selection II



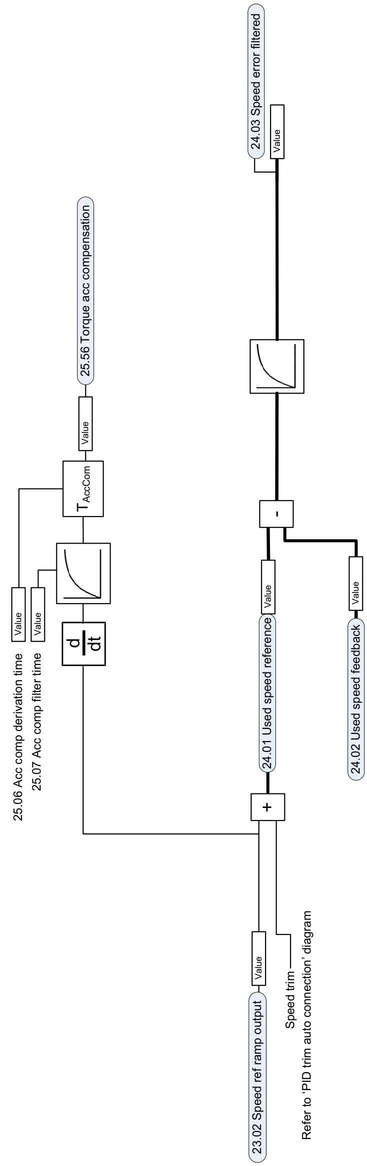
Speed reference ramping and shaping



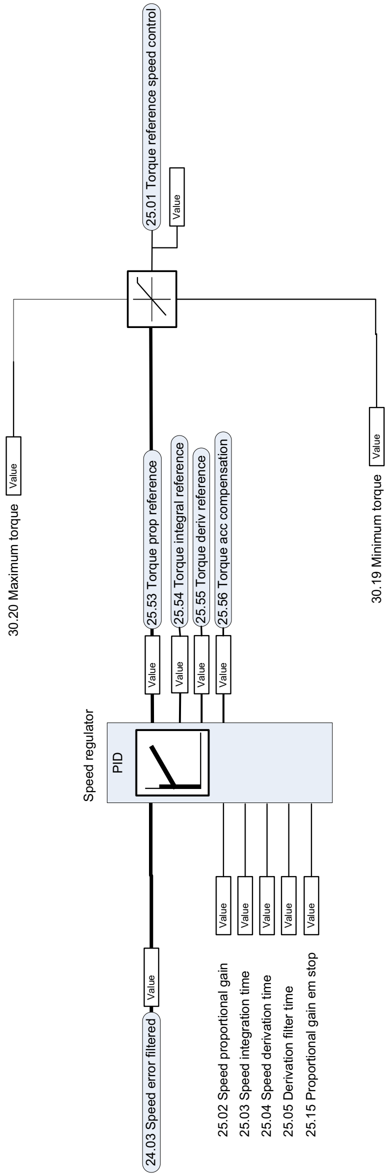
Speed feedback



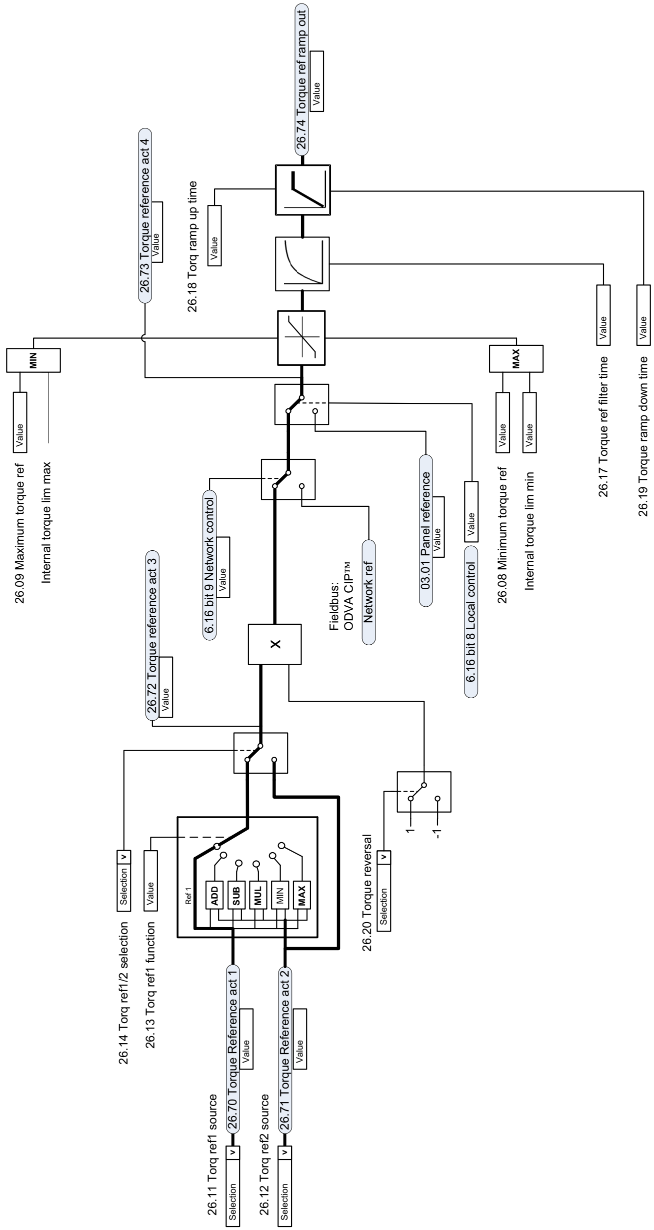
Speed error calculation



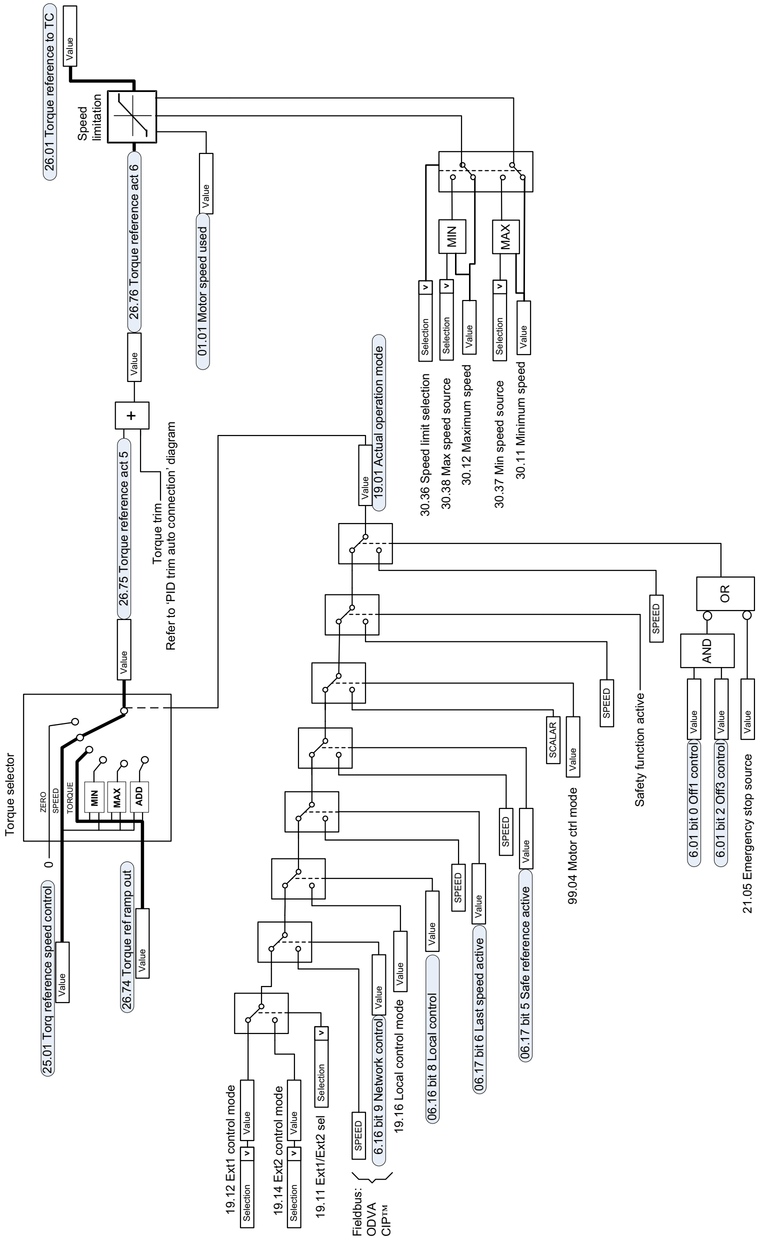
Speed controller



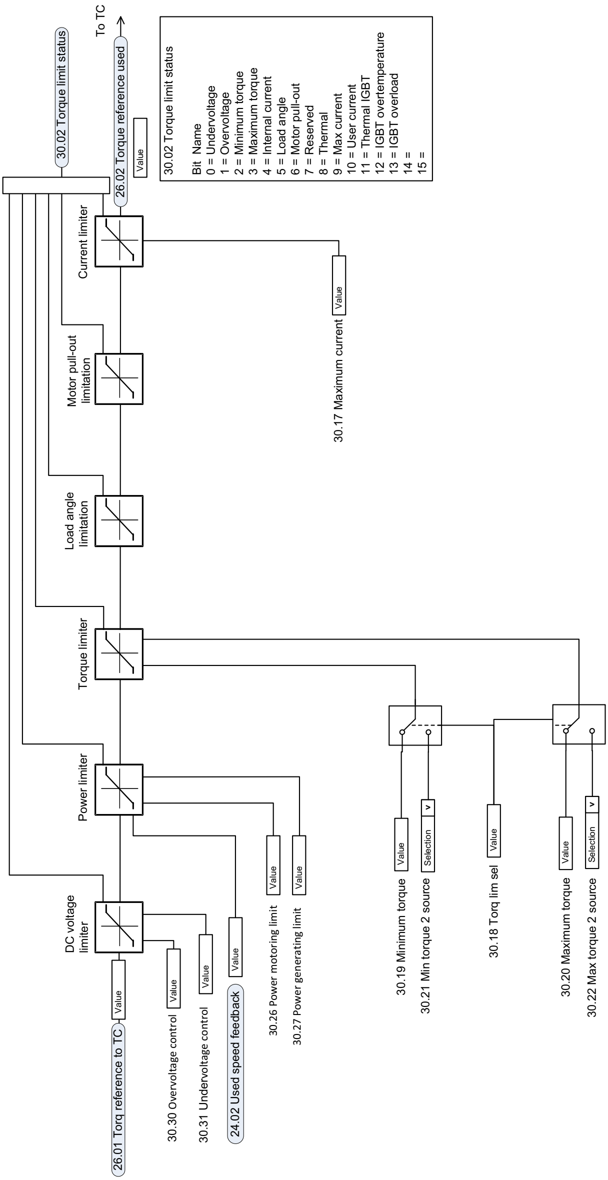
Torque reference source selection and modification



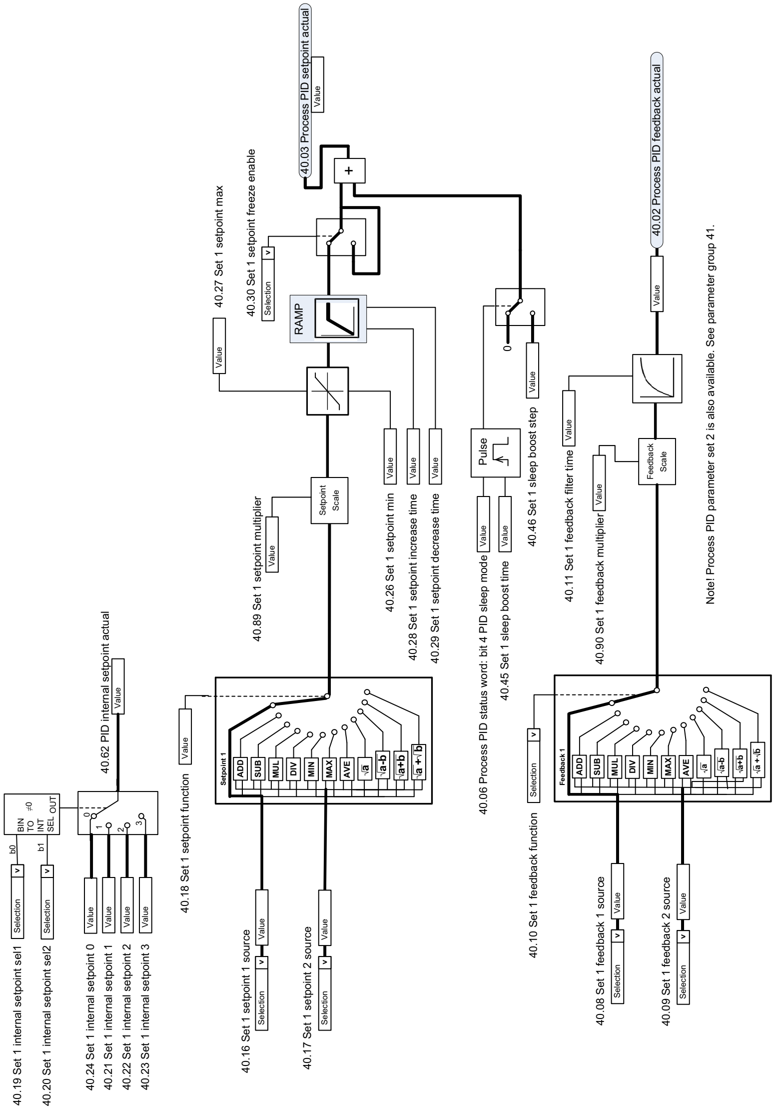
Reference selection for torque controller



Torque limitation

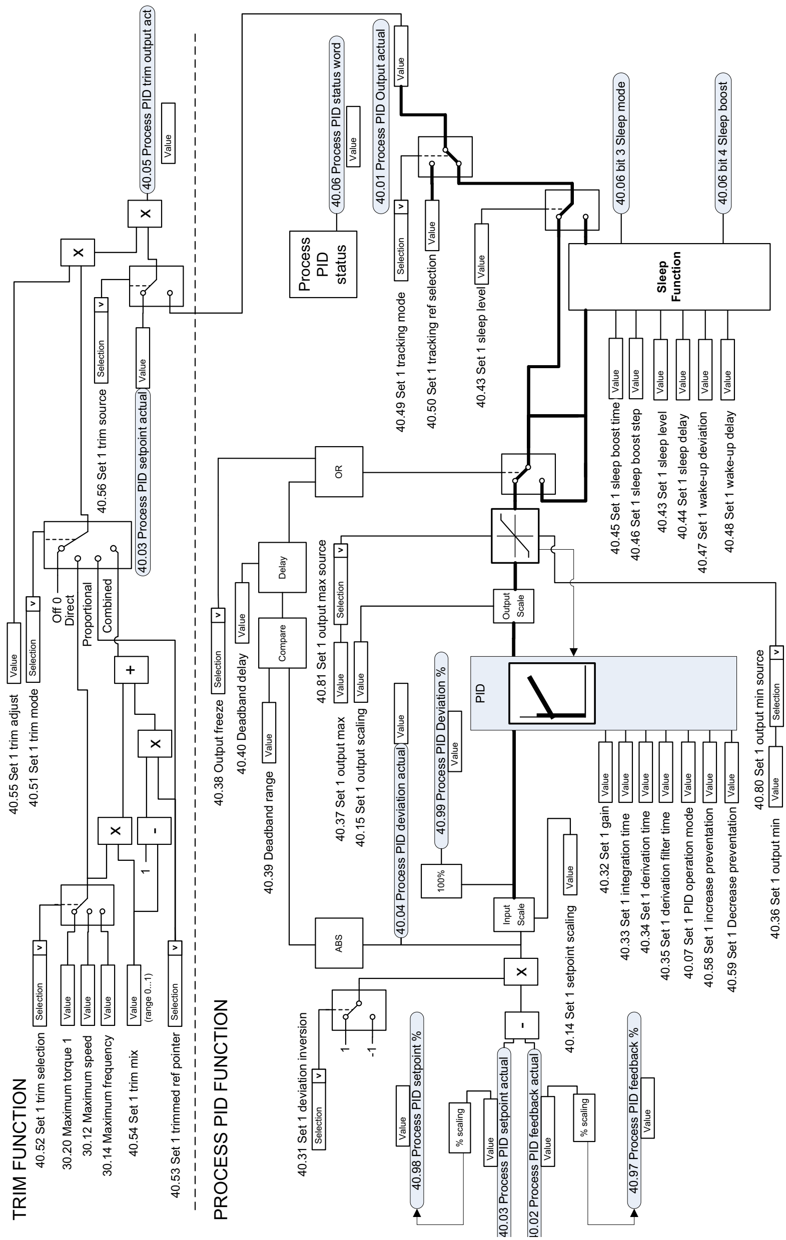


Process PID setpoint and feedback source selection

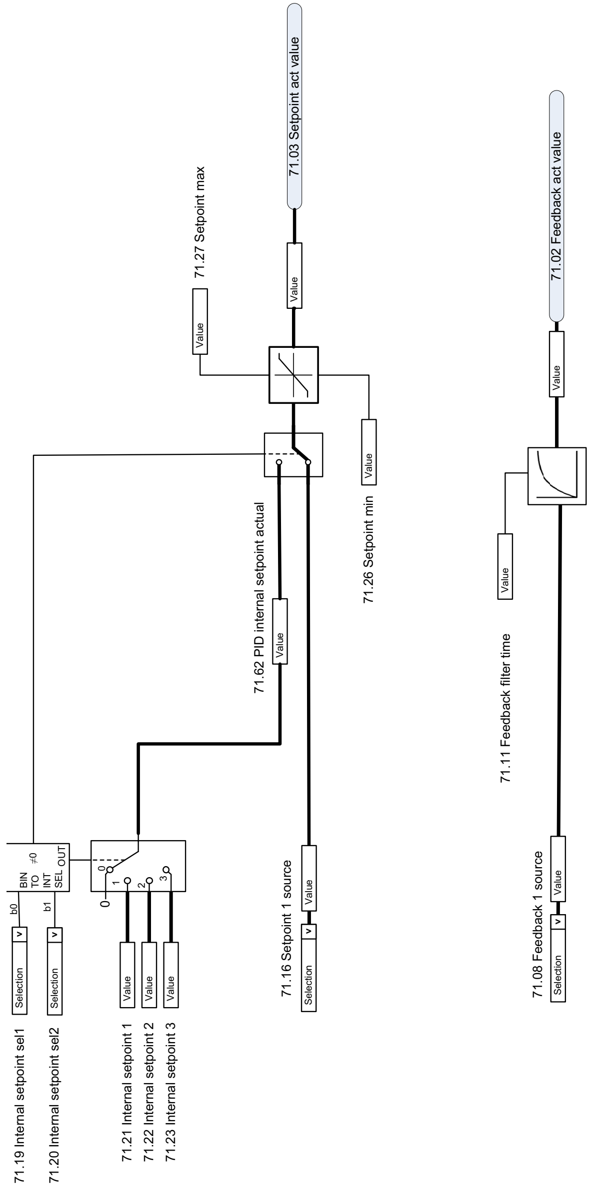


Note! Process PID parameter set 2 is also available. See parameter group 41.

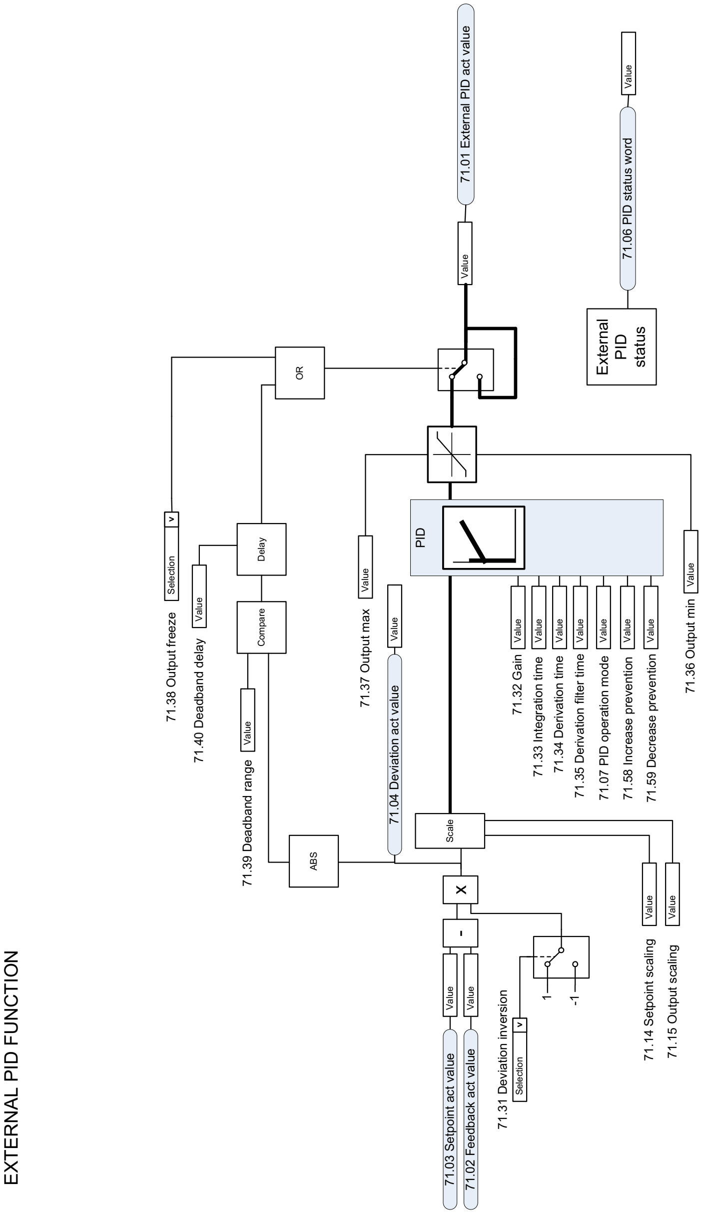
Process PID controller



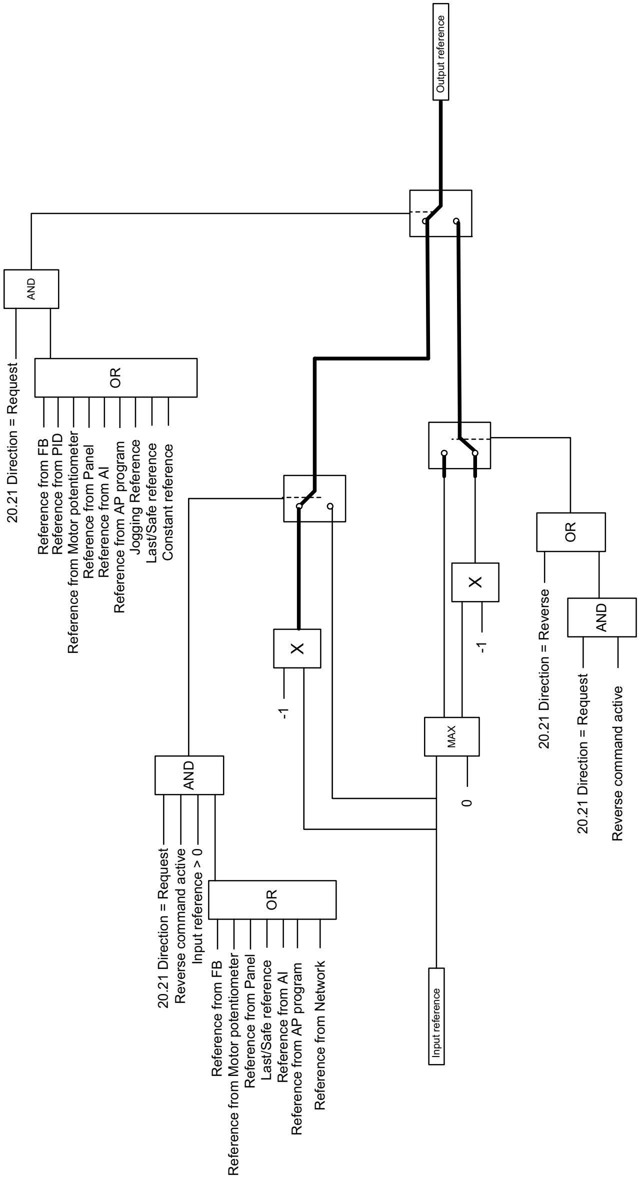
External PID setpoint and feedback source selection



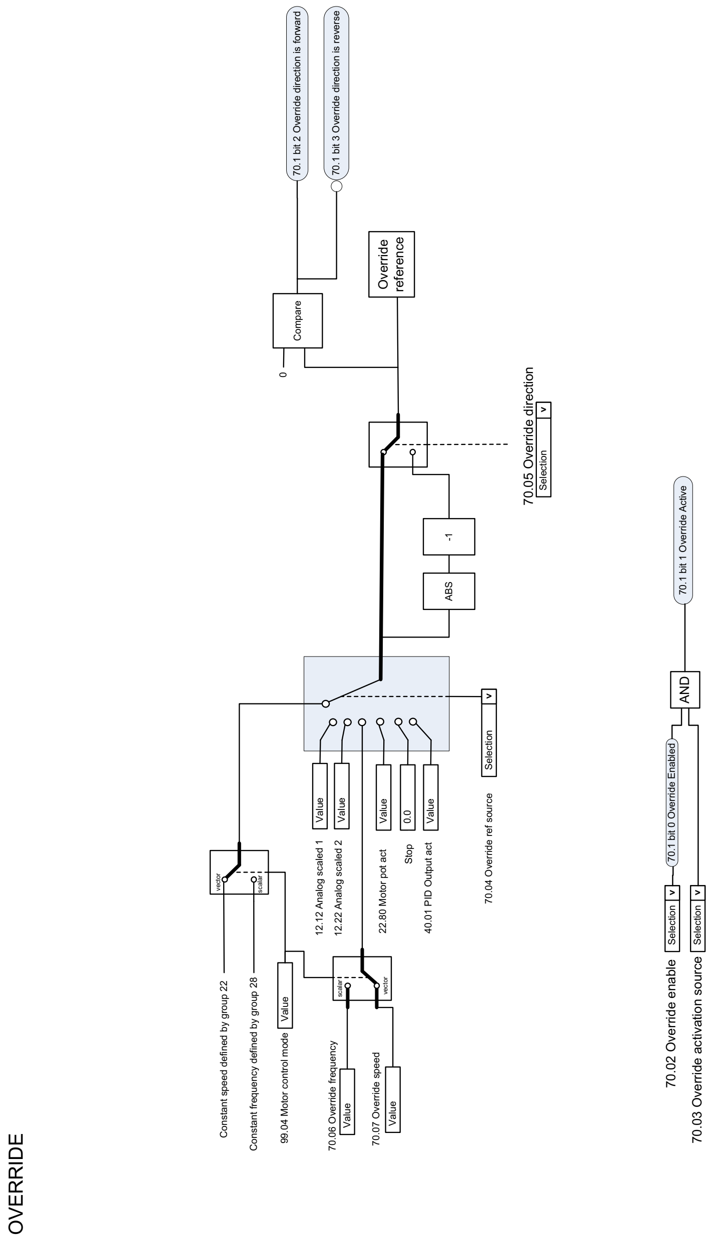
External PID controller



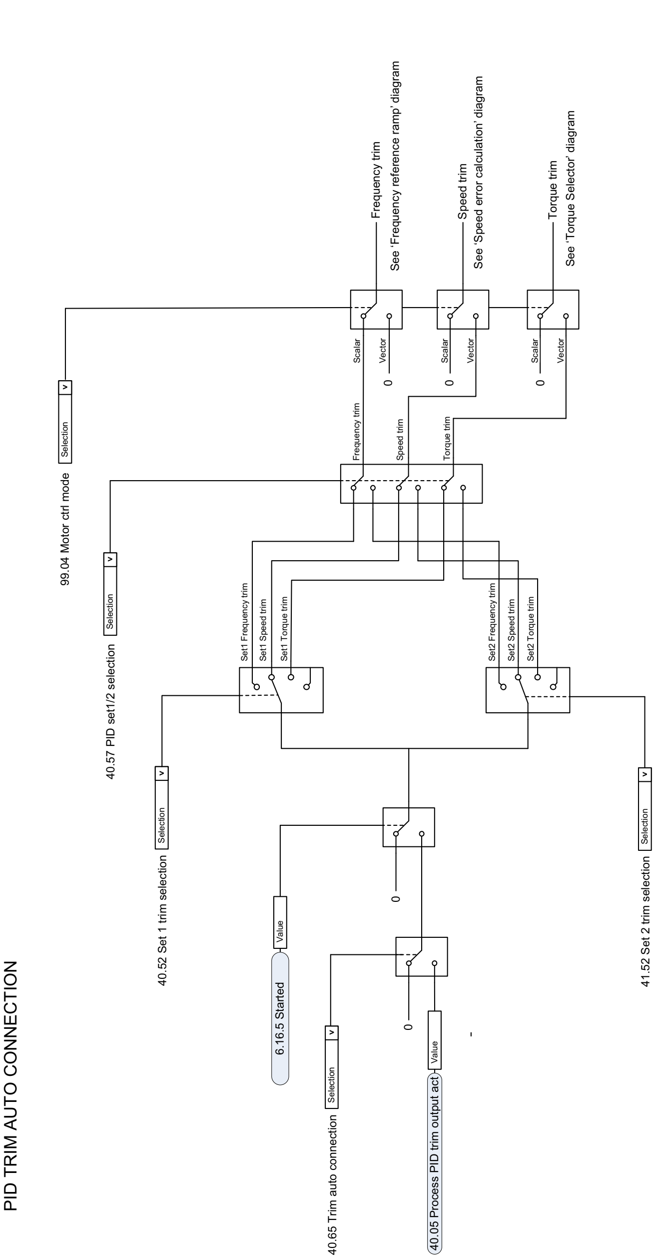
Direction lock



Override


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
-1
ABS
70.1 bit 1 Override Active
AND
Selection
70.04 Override ref source
Value
12.12 Analog scaled 1
12.22 Analog scaled 2
22.80 Motor pot act
Stop
0.0
40.01 PID Output act
vector
scalar
Constant speed defined by group 22
Constant frequency defined by group 28
99.04 Motor control mode
70.06 Override frequency
70.07 Override speed
70.1 bit 0 Override Enabled
70.02 Override enable
70.03 Override activation source

PID trim auto connection



12

Parameterization with drive composer

Contents of this chapter

The chapter describes about the drive composer application and how drive parameters can be managed with the drive composer.

Drive composer

Drive composer is a 32-bit PC tool used for commissioning and maintaining ABB common architecture drives.The drive composer can be connected to a drive that has assistant panel or a dummy panel. The full version is called Drive composer pro and the free version is called Drive composer entry. The drive composer free version is available for download from *ABB website*.

Note: The drive composer cannot be connected to the basic panel.

You can perform following actions with the drive composer:

- View and adjust drive parameters.
- Control a drive: start, stop, direction, speed/torque/frequency reference.
- Monitor the operation and status of a drive.
- Monitor signals in numerical and graphical (trending) format.
- Work simultaneously with multiple drives like master and follower drives (pro).
- Display control diagrams of a drive for parameter setting and diagnostic purposes (pro).
- Create user-specific workspaces by customizing parameter windows.
- Configure the optional FSO-11 and FSO-12 safety functions module (pro).
- Handle workspaces.
- Create and execute macro scripts (pro).

How to connect the drive composer

To establish a connection between the Drive composer and the drive you need to meet the following requirements:

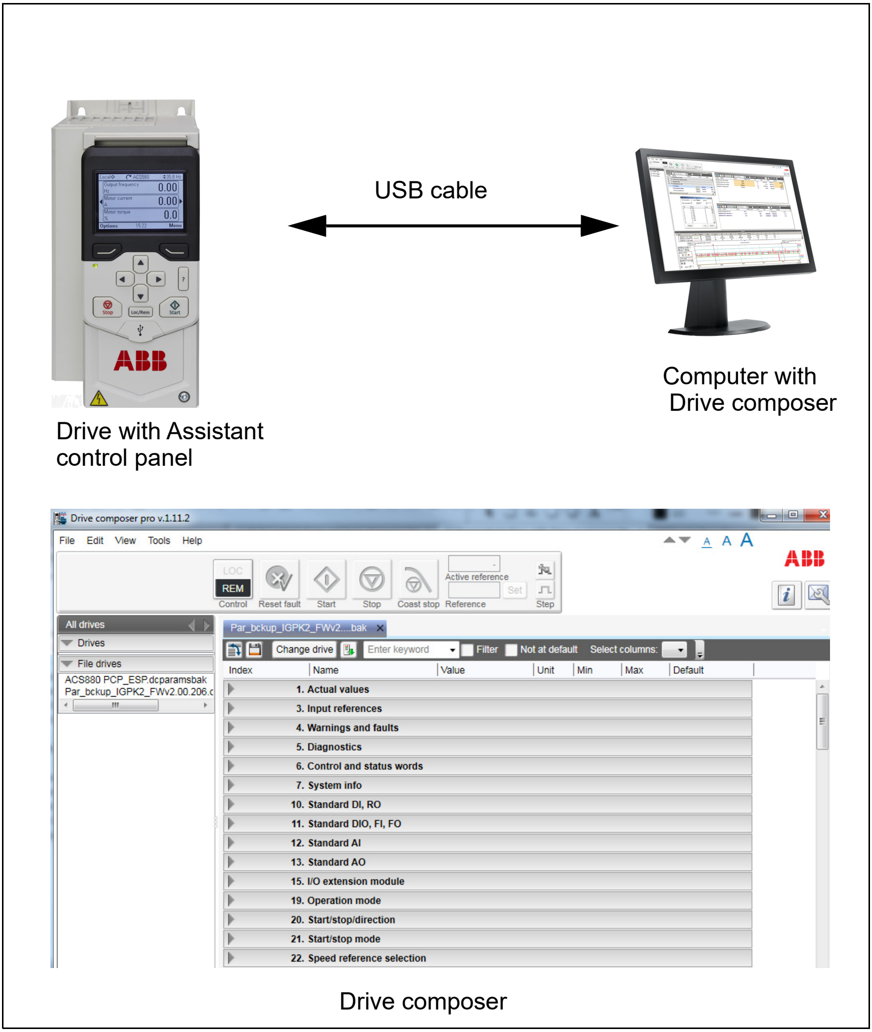
- Computer with drive composer installed
- Assistant control panel or Dummy panel
- Mini USB cable (assistant control panel) or BCBL-01 cable (dummy panel)

Communication Connection

- Use BCBL-01 cable to connect the drive with a dummy panel. Connect BCBL-01 cable to the RJ 45 port of the panel and the other end to the USB port of your computer. You can order the BCBL-01 with the order ID *3AXD50000032449.*
- Use a mini USB cable to connect the drive with an assistant panel.
- Use Ethernet-based fieldbus adapter modules for PC tool communication (one-wire solution, Profinet, Ethernet IP) (pro) or a drive-embedded Ethernet port
- Use an OPC-based commissioning and maintenance tool (pro).

Both versions include a demo that allows testing user interface functionality, edit parameter files offline (pro) or open and analyze saved monitored files without connecting to a physical drive.

Connection Diagram (with assistant panel)



For more information, see *Drive composer start-up and maintenance PC tool user's manual* (3AUA0000094606[English]).

13

Parameterization with automation builder drive manager

Contents of this chapter

The chapter describes about the automation builder drive manager application and how drive parameters can be managed with the automation builder drive manager.

Automation builder drive manager

Automation builder drive manager is a software tool that enables you to configure ABB drives connected to the PLC through PROFIBUS or PROFINET.

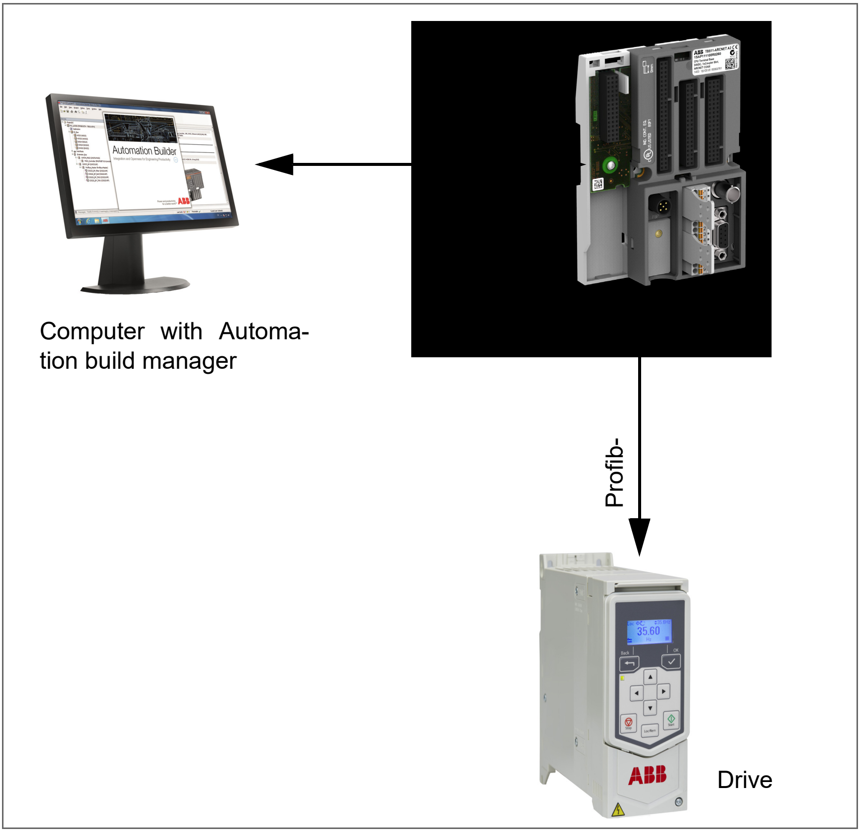
You can perform the following actions with the automation builder drive manager:

- Monitor the drive status like Running, Stopped, EXT1/EXT2 and Running direction.
- Monitor the drive parameter groups and parameters.
- Monitor the drive firmware version and properties.
- Monitor the drive parameter values along with the parameter attributes like parameter minimum and maximum settings, parameter units and parameter protection status.
- User can edit parameters in offline view and then copy to drive when online.
- Open the offline drive parameter settings (project view) and compare to the online drive parameters. The compare function shows the parameters with different

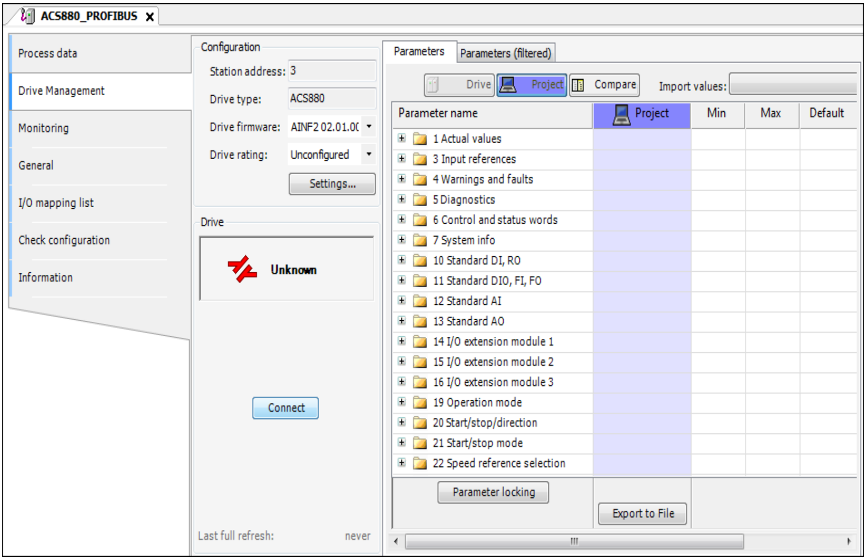
settings in offline and online mode.User can also download the parameter values which have differences in offline and online settings.

- Export the drive parameters from Drive Manager to the respective standalone drive tool parameter file formats (.dsp, mdwp, dcparamsbak).
- Import the drive parameters (.dsp, dwp, dcparamsbak) to the Drive Manager and compare the parameter values of the file with the project view file.
- Update and save a group or a single parameter to the drive.

Connection Diagram



Parameter view with drive manager



For more information on automation builder application download, purchase see *http://new.abb.com/plc/automationbuilder/platform/software*. The information about configuring automation builder with drive and other details are available in the online help of the application.

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