ABB DRIVES FOR HVAC

ACH180 HVAC control program

Firmware manual

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Firmware manual

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1

Introduction to the manual

Contents of this chapter

This chapter describes the applicability, the target audience and the 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 ACH180 HVAC control program (version 2.20.0.0 firmware AHVDC).

To check the firmware version of the control program in use, refer to parameter 07.05 Firmware version.

Safety instructions

Obey 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. Chapter Parameters (page 137) lists the relevant parameters and related warnings.

Target audience

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

Purpose of the manual

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

Related documents

You can find manuals on the Internet. See below for the relevant code/link. For more documentation, go to www.abb.com/drives/documents.

	ACH180 manuals link list

Terms and abbreviations

Term	Description
ACX-AP-x	Assistant control panel, with an advanced operator keypad for communication with the drive.
BACnet™	A network protocol (Building Automation and Control Networks)
BAS	Building automation system
BMS	Building management system
Brake chopper	Conducts the surplus energy from the intermediate circuit of the drive to the brake resistor when necessary. The chopper operates when the DC link voltage exceeds a certain maximum limit. The voltage rise is typically caused by deceleration (braking) of a high inertia motor.
Brake resistor	Dissipates the drive surplus braking energy conducted by the brake chopper to heat
CCA-01	Configuration adapter
Control unit	The part 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
Drive	Frequency converter for controlling AC motors
EFB	Embedded fieldbus
FBA	Fieldbus adapter
Frame, frame size	Physical size of the drive or power module
ID run	Motor identification run. During the identification run, the drive will identify the characteristics of the motor for optimum motor control.
Intermediate circuit	DC circuit between rectifier and inverter

Term	Description
Inverter	Converts direct current and voltage to alternating current and voltage.
IPC	Intelligent pump control
LSW	Least Significant Word
Macro	A pre-defined set of default values of parameters in a drive control program.
Network control	With fieldbus protocols based on the Common Industrial Protocol (CIP™), such as DeviceNet and Ethernet/IP, denotes the control of the drive using the Control Supervisor and AC/DC drive objects of the ODVA AC/DC Drive Profile. For more information, see www.odva.org.
Parameter	In the drive control program, user-adjustable operation instruction to the drive, or signal measured or calculated by the drive. In some (for example fieldbus) contexts, a value that can be accessed as an object. For example, variable, constant, or signal.
PFC	Single pump or fan control. One drive controls multiple pumps or fans with motors.
PID controller	Proportional–integral–derivative controller
PLC	Programmable logic controller
Rectifier	Converts alternating current and voltage to direct current and voltage
SPFC	Soft pump or fan control. One drive controls multiple pumps or fans with motors.
STO	Safe torque off (IEC/EN 61800-5-2)

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

Control panel

Contents of this chapter

This chapter describes how to use the integrated control panel.

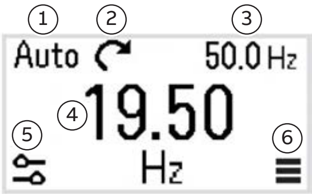
Control panel

By default, ACH180 has an integrated control panel. You can also use an external control panel. For more information, refer to ACS-AP-I, -S, -W and ACH-AP-H, -W Assistant control panel's user's manual (3AUA0000085685 [English]).

1. Display. Shows the **Home** view as default.
2. Status LED. Green and red colors indicate the state and potential problems.
3. **Back** key. Opens the **Options** view.
4. Arrow keys for menu navigation and setting values.
5. **OK** key. Opens the **Menu** in the **Home** view.
6. **Off** key. Stops the drive and switches to the Off mode.
7. **Auto/Hand** key. Opens a selection screen view that allows the user to select between Auto and Hand modes.

Home view and Message view

The **Home** view is the main view. You can open the main **Menu** and **Options** menu from the **Home** view.

Home view 	1. Control location - Hand, Off or Auto 2. Rotation direction - forward or reverse 3. Target frequency 4. Actual frequency 5. Options menu - quick access menu 6. Main menu - menu list

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

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

Message view: Fault 	Fault messages require your immediate attention. See section Warning, fault and pure event messages (page 408) to troubleshoot the problem.

Message view: Warning 	Warning messages show possible problems. See section Warning, fault and pure event messages (page 408) to troubleshoot the problem.

Options menu and Main menu

	1. Options menu To open: press the Back key in the **Home** view. 2. Main menu To open: press the OK key in the **Home** view.

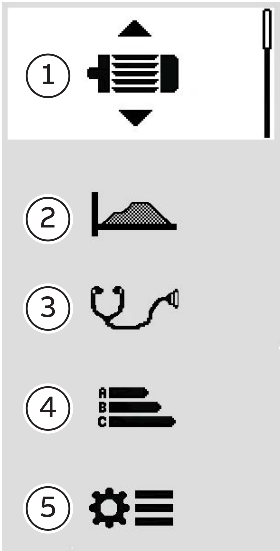
Options menu

The Options menu is a quick access menu.

	1. Reference value - set the reference value 2. Active faults - view possible faults 3. Active warnings - view possible warnings

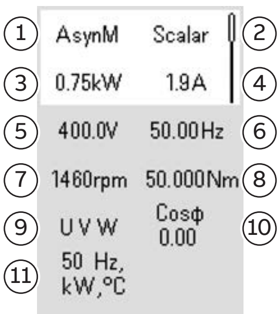
Main menu

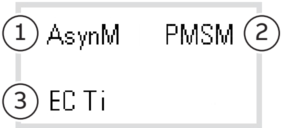
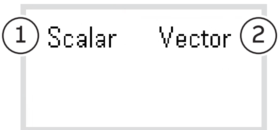
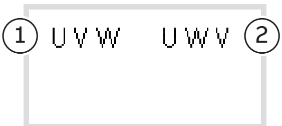
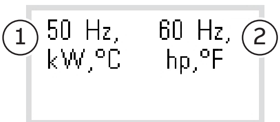
The Main menu is a scrolling menu. The menu icons represent specific groups. The groups have submenus.

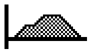
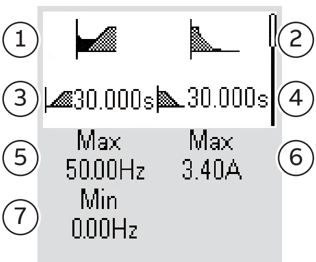
	1. Motor data - motor parameters 2. Motor control - motor settings 3. Diagnostics - faults, warnings, fault log and connection status 4. Energy efficiency 5. Parameters

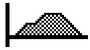
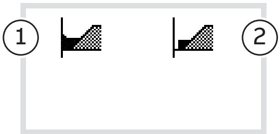
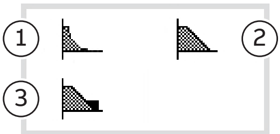
Submenus

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

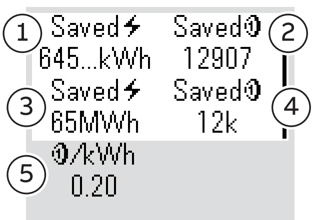
Motor data 	
	1. Motor type - AsynM, PMSM, EC Ti 2. Control mode - Scalar, Vector 3. Nominal power 4. Nominal current 5. Nominal voltage 6. Nominal frequency 7. Nominal speed 8. Nominal torque 9. Phase order - U V W, U W V 10. Nominal Cosphi 11. Unit selection - SI or US units

Motor data	
	
Motor type 	1. AsynM - Asynchronous motor 2. PMSM - Permanent magnet synchronous motor 3. EC Ti - Ferrite assisted synchronous reluctance motor
Control mode 	1. Scalar 2. Vector
Phase order 	1. U V W 2. U W V
Unit selection 	1. SI units 2. US units

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

<table>
<tr><th colspan="2">Motor control
</th></tr>
<tr><td>Start mode
</td><td>1. Const time
2. Automatic</td></tr>
<tr><td>Stop mode
</td><td>1. Coast
2. Ramp
3. DC hold</td></tr>
</table>

<table>
<tr><th colspan="2">Diagnostics
</th></tr>
<tr><td></td><td>1. Active Fault - shows the fault code
2. Fault History - list of latest fault codes (newest first)
3. Active Warnings - shows the warning code
4. Connection Status - Fieldbus and I/O signals</td></tr>
</table>

<table>
<tr><th colspan="2">Energy efficiency
</th></tr>
<tr><td></td><td>1. Saved energy in kWh
2. Saved money
3. Saved energy in MW
4. Saved money x 1000
5. Cost per kWh h</td></tr>
</table>

<table>
<tr><th colspan="2">Parameters
</th></tr>
<tr><td>
</td><td>1. Complete parameter list - groups menu with complete parameters and parameter levels
2. Modified parameter list
3. Parameter restore - resets the drive to the factory default parameters</td></tr>
</table>

3

Start-up, ID run and use

Contents of this chapter

This chapter describes how to use the integrated panel of the drive to do the start-up, ID run, and other actions. You can also use an external control panel or the Drive Composer PC tool.

Start-up the drive

Safety	
WARNING! Do not start-up the drive unless you are a qualified electrician. Read and obey the instructions in the Safety instructions chapter in the hardware manual of the drive. Ignoring the instructions can cause physical injury or death, or damage to the equipment.	
☐	Check the installation. Refer to Installation checklist in the hardware manual of the drive.
Start-up procedure	
☐	Have the motor name plate data at hand.
☐	Power up the drive.
☐	Select the unit with the left and right arrow key: international (1) or US (2). Press OK to confirm the selection.
☐	Go to **Motor data** view.
☐	Go to **Motor type** submenu. Set the motor type. • **AsynM**: Asynchronous induction motor • **PMSM**: Permanent magnet motor, or • **EC Ti**: Ferrite assisted synchronous reluctance motors.

☐	Go to **Control mode** submenu. Set the motor control mode.
	• **Vector**: Speed reference. The drive does an automatic stand-still ID run.
	• **Scalar**: Frequency reference. Use this mode when:
	  • The number of motors can change.
	  • The nominal motor current is less than 20% of the nominal drive current.
	Note: Scalar mode is not recommended for permanent magnet motors.

☐	Set the nominal power.
☐	Set the nominal current.
☐	Set the nominal voltage.
☐	Set the nominal frequency.
☐	Set the nominal speed.
☐	Set the nominal torque (optional).
☐	Set the nominal cosphi (optional).

☐	Go to **Motor control** view.
☐	Set the start mode.
☐	Set the stop mode.
☐	Set the acceleration time. **Note:** The speed acceleration ramp time is based on the values in parameters 46.01 Speed scaling / 46.02 Frequency scaling.
☐	Set the deceleration time. **Note:** The speed deceleration ramp time is based on the values in parameters 46.01 Speed scaling / 46.02 Frequency scaling.
☐	Set the maximum speed or frequency. For more information, refer to parameters 30.12 Maximum speed / 30.14 Maximum frequency.
☐	Set the minimum speed or frequency. For more information, refer to parameters 30.11 Minimum speed / 30.13 Minimum frequency.
☐	Tune the drive parameters to the application. You can also use the optional assistant control panel (ACH-AP-x) or the Drive Composer PC tool with the drive.

Do the identification (ID) run

The drive automatically estimates motor characteristics by using the Standstill ID run when the drive is started for the first time in vector control and after any motor parameter in parameter group 99 Motor data (page 390) is changed. This is valid when:

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

In most applications there is no need to perform a separate ID run. The ID run should be selected manually if:

- vector control mode is used (parameter 99.04 Motor control mode is set to Vector), and
- permanent magnet motor PMSM is used (parameter 99.03 Motor type is set to Permanent magnet motor), or
- the drive operates near zero speed references, or
- the motor has to be operated at torque range above the motor nominal torque, over a wide speed range.

Do the ID run with parameter 99.13 ID run requested.

Note: If motor parameters in parameter group 99 Motor data (page 390) are changed after the ID run, the ID run must be repeated.

Note: If you have already parameterized your application using the scalar motor control mode (parameter 99.04 Motor control mode is set to Scalar) and you need to change the motor control mode to Vector,

- set parameter 99.04 Motor control mode to Vector, and
- for I/O controlled drive, check parameters in parameter groups 22 Speed reference selection (page 210), 23 Speed reference ramp (page 223), 12 Standard AI (page 173), 30 Limits (page 249) and 46 Monitoring/scaling settings (page 343).

ID run procedure

Safety	
⚠ **WARNING!** Make sure it is safe to start the motor and run it in either direction.	
ID run procedure	
☐	Go to **Main menu**.
☐	Select the **Parameters** submenu.
☐	Select **All parameters**.
☐	Select 99 Motor data (page 390) and press OK.
☐	Make sure that the nominal motor values have been defined correctly.
☐	Select 99.13 ID run requested, select the wanted ID mode and press OK. An AFF6 Identification run warning message is shown before you press Auto/Hand. The panel LED starts to blink green to indicate an active warning.
☐	Press Auto/Hand to start the ID run. Do not press any control panel keys during the ID run. If you need to stop the ID run, press Stop.
☐	Examine the direction of the motor. If necessary, set the motor direction with the phase order setting or with the phase order of the motor cable.

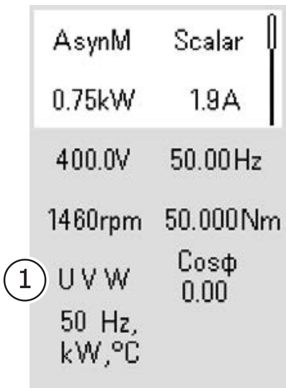
When the ID run is completed, the status light stops blinking.

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

Start and stop the drive in local control

	1. Press the Auto/Hand key to start the drive. 2. Press the Off key to stop the drive

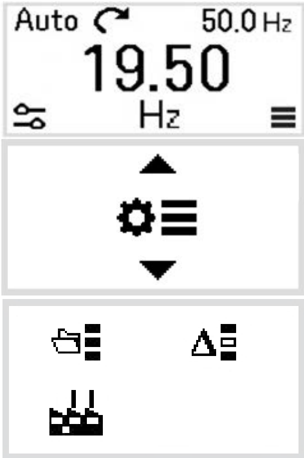
Change the rotation direction

	Start the motor and examine the actual rotation direction of the motor axis. If it is necessary, change the motor direction with the Phase order setting (1) in the Motor data view or change the phase order of the motor cable

Set the speed or frequency reference

	1. On **Home** view, press Back key to go to **Options** menu. 2. In the **Options** menu, move to the speed or frequency reference item and press OK. 3. Press the arrow keys to edit the value. 4. Press the OK key to confirm the new value.

Set the drive parameters



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

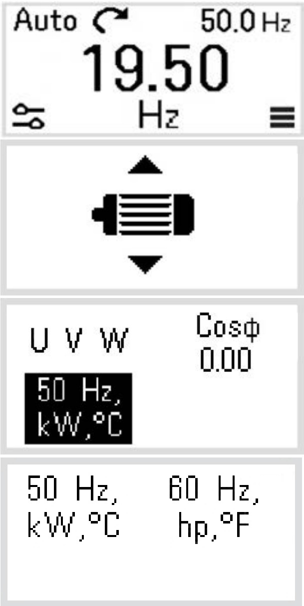
The parameters are shown in respective groups. The first two digits of the parameter number represent the parameter group. For example, parameters starting with 30 are in the Limits group.

See section Parameters (page 137) for more information.

Open Diagnostics

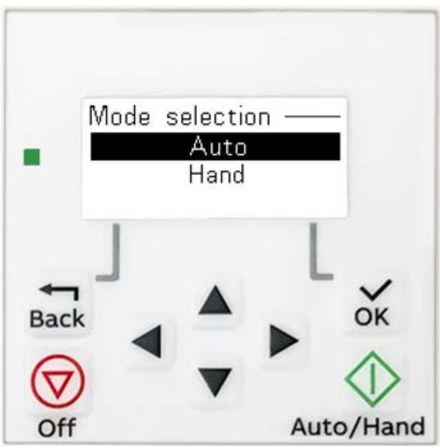
1. Select the **Main menu** from the **Home** view.
2. Go to **Diagnostics** and press the OK key to open the submenu.
3. Select the warning or fault with the arrow key and press the OK key.
4. See section Fault tracing (page 405) for more information.

Change the units



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

Switch between Auto and Hand modes



1. Press the Auto/Hand key in the **Home** view.
2. Select the correct mode with the arrow keys.
3. Press the OK key to confirm selection.

4

Default I/O configuration

Contents of this chapter

This chapter describes the intended use, operation and default control connections of the application.

HVAC default

This is the default configuration for HVAC (factory default). The HVAC default I/O control is used, for example, for typical I/O controlled BMS applications.

This configuration uses a direct speed reference in the Auto mode, with speed reference connected to analog input 1 (AI1). The start command is given with digital input 1 (DI1).

In the Hand/Off mode, the speed reference and start command are given through the control panel.

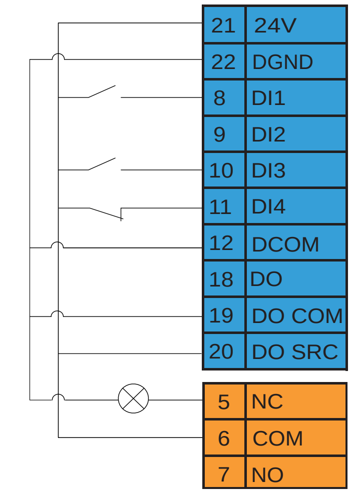
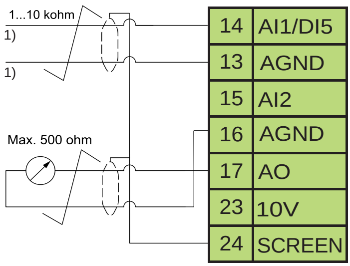
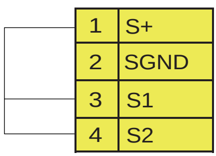
Input signals:

- AI1: Analog frequency/speed reference
- DI1: Start/stop selection
- DI3: Constant speed/frequency selection
- DI4: Start interlock 1

Output signals:

- AO1: Output frequency
- Relay output: Damper control

Default I/O connections for the HVAC default

Connection	Term.	Description
Digital I/O and relay output connections		
	24 V	Aux. +24 V DC, max 200 mA
	DGND	Aux. voltage output common
	DI1	Stop (0) / Start (1)
	DI2	Not configured
	DI3	Constant speed/frequency selection
	DI4	Start interlock 1 (1 = allow start)
	DCOM	Digital input common
	DO	Not energized
	DO COM	Digital output common
	DO SRC	Digital output auxiliary voltage
	NC	Damper control (Relay output 1)
	COM	
	NC	
Analog I/O		
	AI1/DI5	Speed/frequency reference (0…10V)
	AGND	Analog input circuit common
	AI2	Not used
	AGND	Analog output circuit common
	AO	Output frequency (0...20mA)
	10V	Ref. voltage +10 V DC
	SCREEN	Signal cable shield (screen)
Safe torque off (STO)		
	S+	Safe torque off function. Connected at the factory. Drive starts only when both circuits are closed.
	SGND	
	S1	
	S2	

Connection	Term.	Description
EIA-485		
25 B+	B+	Embedded fieldbus (EIA-485)
26 A-	A-	
27 DGND	DGND	
28 SHIELD	SHIELD	
Jumper		
J1 Termination	Termination	EIA-485 termination selection
1) Reference signal (0…10V) 2) Terminal sizes: 0.5 mm² … 1 mm² (22...16 AWG)		

5

Program features

Contents of this chapter

This chapter describes some of the 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.

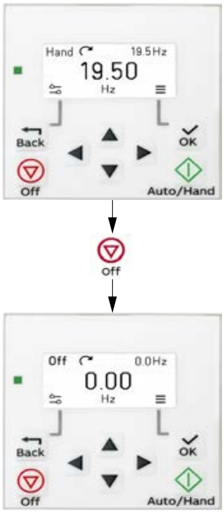
Local control vs. external control

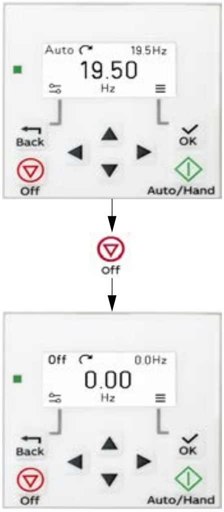
The ACH180 has two main control locations: local and external. In local control there are two different modes: Off and Hand.

In the Off mode, the drive is stopped. In the Hand mode, the drive is running. The initial reference in the Hand mode is copied from the drive reference.

The following diagrams show the state transitions when you press the Auto/Hand or Off key:

<table>
<tr><th>From Off mode to Auto mode</th><th>From Off mode to Hand mode</th></tr>
<tr><td></td><td></td></tr>
</table>

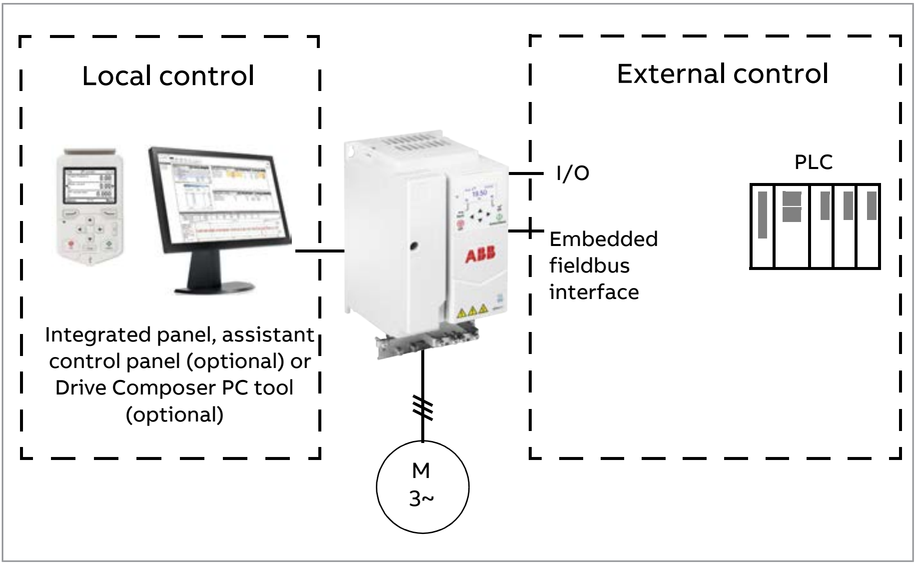
From Hand mode to Off mode	From Hand mode to Auto mode
	

From Auto mode to Off mode	From Auto mode to Hand mode
	

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

Note: If fault 7081 Control panel loss is active and the drive is powered down, the mode changes to Auto when power is reapplied.

Note: Override function overrides the actual running mode.



Local control

The control commands are given from the integrated or optional assistant control panel, or from a PC equipped with the Drive Composer PC tool when the drive is in local control. Local control is mainly used during commissioning and maintenance. The control panel always overrides the external control signal sources when used in local control. Changing the control location to local can be prevented by parameter 19.18 HAND/OFF disable source.

Use parameter 49.05 Communication loss action to specify how the drive reacts to a control panel or PC tool communication break (the parameter has no effect in external control).

External control

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

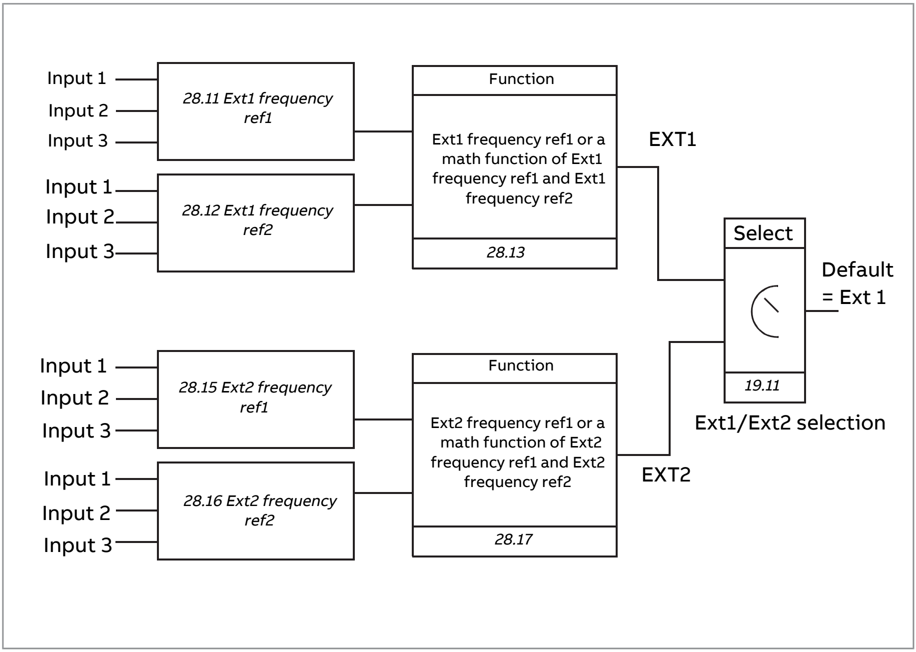
- the I/O terminals (digital and analog inputs)
- the fieldbus interface (via the embedded fieldbus interface)
- optional assistant control panel.

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

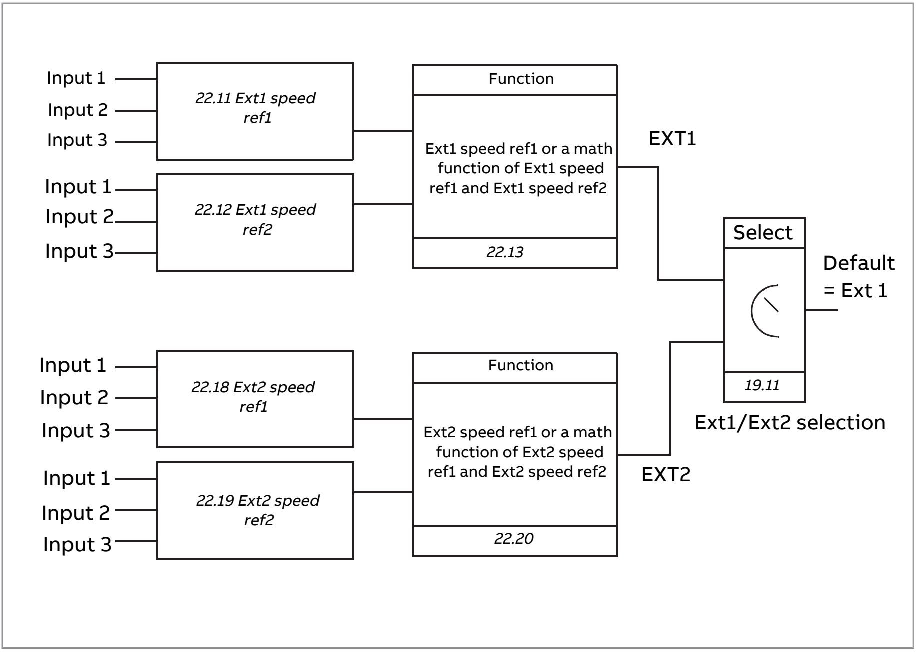
Communication fail functionality

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).

Block diagram: EXT1/EXT2 selection for frequency control



Block diagram: EXT1/EXT2 selection for speed control

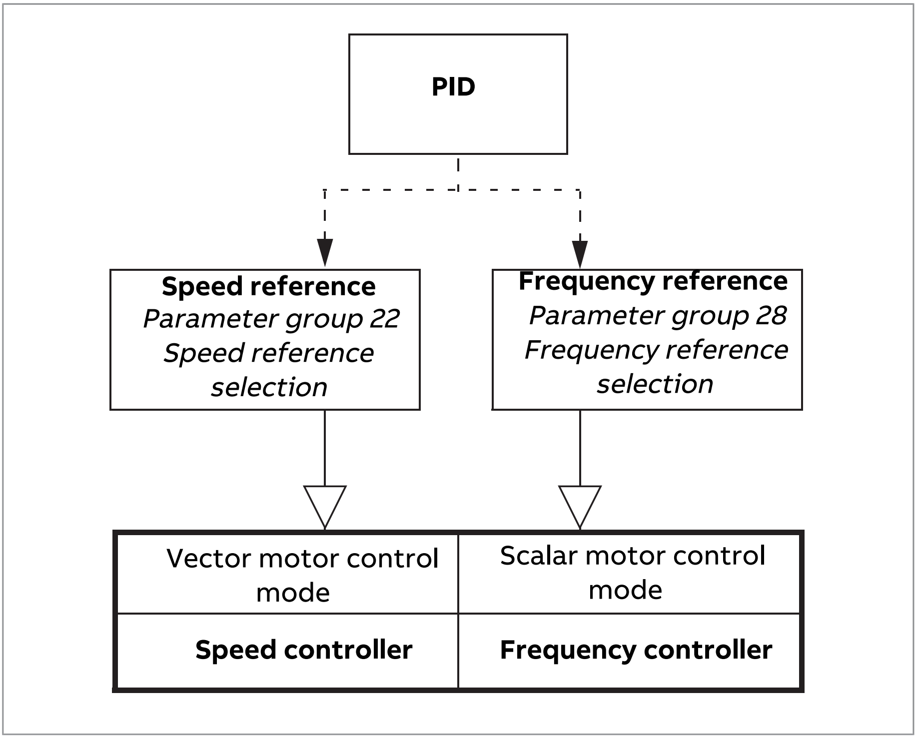


Settings

- Parameters: 19.11 Ext1/Ext2 selection; 20.01 Ext1 commands…20.10 Ext2 in3 source.
- Parameters: 22.11 Ext1 speed ref1…22.20 Ext2 speed function.
- Parameters: 28.11 Ext1 frequency ref1…28.17 Ext2 frequency function.

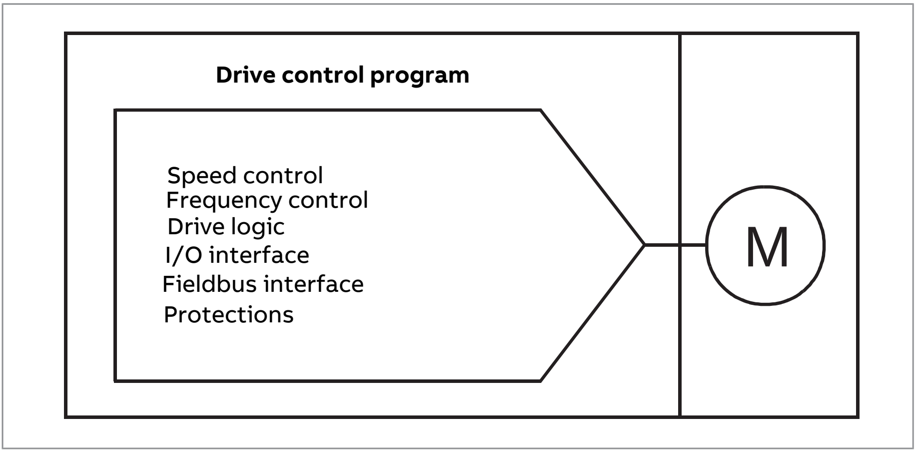
Operating modes of the drive

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 (page 184). An overview of the different reference types and control chains is shown below.



Drive configuration and programming

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



Configuring via default configurations

Default configurations are predefined I/O configurations. See chapter Default I/O configuration (page 35).

Configuring via parameters

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

- the integrated control panel or optional assistant control panel
- the Drive composer PC tool, as described in Drive composer user's manual (3AUA0000094606 [English]), or
- the fieldbus interface, as described in Modbus RTU control through the embedded fieldbus interface (EFB) (page 429).

All parameter settings are stored automatically to the permanent memory of the drive.

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

Settings and diagnostics

- Parameters: 96.06 Parameter restore…96.07 Parameter save manually
- Event: -.

Adaptive programming

Conventionally, the user can control the operation of the drive by parameters. However, the standard parameters have a fixed set of choices or a setting range. To further customize the operation of the drive, an adaptive program can be constructed out of a set of function blocks.

The Drive composer PC tool (available separately) has an Adaptive programming feature with a graphical user interface for building the custom program. The function blocks include the usual arithmetic and logical functions, as well as, for example, selection, comparison and timer blocks.

Note: Adaptive programming requires Drive Composer version 2.8 or newer.

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

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

Example:

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

The status of the adaptive program is shown by parameter 07.30 Adaptive program status. The adaptive program can be disabled by parameter 96.70 Disable adaptive program.

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

Inputs available to the adaptive program	
INPUT	SOURCE
I/O	
DI1	10.02 DI delayed status, bit 0
DI2	10.02 DI delayed status, bit 1
DI3	10.02 DI delayed status, bit 2
DI4	10.02 DI delayed status, bit 3
DI5	10.02 DI delayed status, bit 4

Inputs available to the adaptive program	
AI1	12.11 AI1 actual value
AI2	12.21 AI2 actual value
ACTUAL SIGNALS	
Motor speed	01.01 Motor speed used
Output frequency	01.06 Output frequency
Motor current	01.07 Motor current
Motor torque	01.10 Motor torque
Motor shaft power	01.17 Motor shaft power
STATUS	
Enabled	06.16 Drive status word 1, bit 0
Inhibited	06.16 Drive status word 1, bit 1
Ready to start	06.16 Drive status word 1, bit 3
Tripped	06.11 Main status word, bit 3
At setpoint	06.11 Main status word, bit 8
Limiting	06.16 Drive status word 1, bit 7
Ext1 active	06.16 Drive status word 1, bit 10
Ext2 active	06.16 Drive status word 1, bit 11
DATA STORAGE	
Data storage 1 real32	47.01 Data storage 1 real32
Data storage 2 real32	47.02 Data storage 2 real32
Data storage 3 real32	47.03 Data storage 3 real32
Data storage 4 real32	47.04 Data storage 4 real32

Outputs available to the adaptive program	
OUTPUT	TARGET

Outputs available to the adaptive program	
I/O	
RO1	10.24 RO1 source
AO1	13.12 AO1 source
DO1	
START CONTROL	
Ext1/Ext2 selection	19.11 Ext1/Ext2 selection
Ext1 in1 cmd	20.03 Ext1 in1 source
Ext1 in2 cmd	20.04 Ext1 in2 source
Ext1 in3 cmd	20.05 Ext1 in3 source
Ext2 in1 cmd	20.08 Ext2 in1 source
Ext2 in2 cmd	20.09 Ext2 in2 source
Ext2 in3 cmd	20.10 Ext2 in3 source
Fault reset	31.11 Fault reset selection
SPEED CONTROL	
Ext1 speed reference	22.11 Ext1 speed ref1
Speed proportional gain	25.02 Speed proportional gain
Speed integration time	25.03 Speed integration time
Acceleration time 1	23.12 Acceleration time 1
Deceleration time 1	23.13 Deceleration time 1
FREQUENCY CONTROL	
Ext1 frequency reference	28.11 Ext1 frequency ref1
LIMIT FUNCTION	
Minimum torque 2	30.21 Min torque 2 source
Maximum torque 2	30.22 Max torque 2 source
EVENTS	

Outputs available to the adaptive program	
External event 1	31.01 External event 1 source
External event 2	31.03 External event 2 source
External event 3	31.05 External event 3 source
External event 4	31.07 External event 4 source
External event 5	31.09 External event 5 source
DATA STORAGE	
Data storage 1 real32	47.01 Data storage 1 real32
Data storage 2 real32	47.02 Data storage 2 real32
Data storage 3 real32	47.03 Data storage 3 real32
Data storage 4 real32	47.04 Data storage 4 real32
PROCESS PID	
Set 1 setpoint 1	40.16 Set 1 setpoint 1 source
Set 1 setpoint 2	40.17 Set 1 setpoint 2 source
Set 1 feedback 1	40.08 Set 1 feedback 1 source
Set 1 feedback 2	40.09 Set 1 feedback 2 source
Set 1 gain	40.32 Set 1 gain
Set 1 integration time	40.33 Set 1 integration time
Set 1 tracking mode	40.49 Set 1 tracking mode
Set 1 track reference	40.50 Set 1 tracking ref selection

Adaptive program fault and aux code formats

The format of the aux code:

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

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

See fault 64A6 Adaptive program.

Sequence program

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

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

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

Settings and diagnostics

- Parameter groups: 01 Actual values (page 141), 06 Control and status words (page 153), 07 System info (page 159), 10 Standard DI, RO (page 160), 12 Standard AI (page 173), 13 Standard AO (page 179), 19 Operation mode (page 184), 20 Start/stop/direction (page 186), 23 Speed reference ramp (page 223), 25 Speed control (page 230), 30 Limits (page 249), 31 Fault functions (page 260), 40 Process PID set 1 (page 312), 47 Data storage (page 347), and 96 System (page 371)
- Event: 64A6 Adaptive program fault.

Control interfaces

Programmable analog inputs

There are 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 parameter. Each input can be filtered, inverted and scaled. AI1 can be configured as DI5 by parameter.

Settings

- Parameter group: 12 Standard AI (page 173)
- Parameter: 11.21 DI5 configuration.

Programmable analog outputs

There is one analog output voltage (0/2…10 V) or current (0/4…20 mA) output (can be set by parameter). The output can be filtered, inverted and scaled.

Settings

- Parameter group: 13 Standard AO (page 179).

Programmable digital inputs and outputs

There are four digital inputs, and one digital outputs. In addition, the analog input AI1 can be configured as digital input DI5 by a parameter.

Digital inputs DI3 and DI4 can be used as frequency input.

Settings

- Parameter groups: 10 Standard DI, RO (page 160) and 11 Standard DIO, FI, FO (page 168).

Programmable relay outputs

There is one relay output. The signal indicated by the output can be selected by a parameter.

Settings

- Parameters: 10.22 RO force selection...10.24 RO1 source.

Fieldbus control

The drive can be connected to an automation systems through its fieldbus interface. See chapter Modbus RTU control through the embedded fieldbus interface (EFB) (page 429).

Settings

- Parameter group: 58 Embedded fieldbus (page 350).

Pump and fan control features

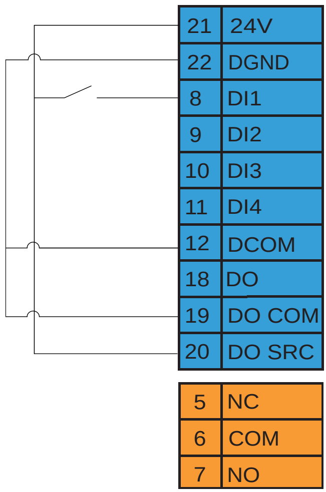
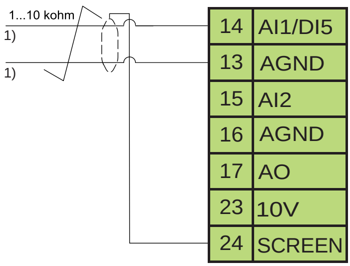
Application examples

Supply fan, basic speed follower

There are a variety of different inputs and control schemes that may be applied to a drive being used on a supply fan. The example below consists of one of the more basic configurations. The following pages will build upon this example and provide more advanced examples. The example below consists of:

- DI1: Start/stop contact closure from the building automation system (BAS)
- AI1: A 0…10 V DC analog speed command signal from the BAS
- No safeties to the drive and no status feedback to the BAS.

Wiring diagram

Connection	Term.2)	Description
Digital I/O and relay output connections		
	24 V	Aux. +24 V DC, max 200 mA
	DGND	Aux. voltage output common
	DI1	Stop (0) / Start (1)
	DI2	Not configured
	DI3	Not configured
	DI4	Not configured
	DCOM	Digital input common
	DO	Not energized
	DO COM	Digital output common
	DO SRC	Digital output auxiliary voltage
	NC	Not energized (Relay output 1)
	COM	
	NO	
Analog I/O		
	AI1/DI5	Speed reference (0…10V)
	AGND	Analog input circuit common
	AI2	Not used
	AGND	Analog output circuit common
	AO	Zero
	10V	Ref. voltage +10 V DC
	SCREEN	Signal cable shield (screen)

1) Reference signal (0…10 V)
2) Terminal sizes: 0.5 mm² … 1 mm² (22...16 AWG)

Required parameter adjustments

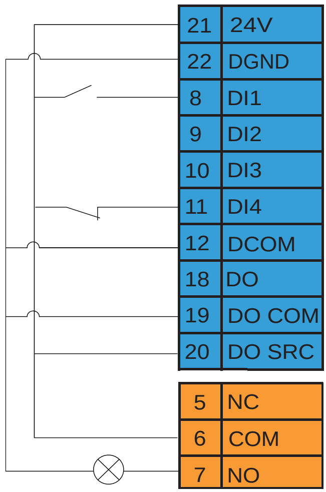
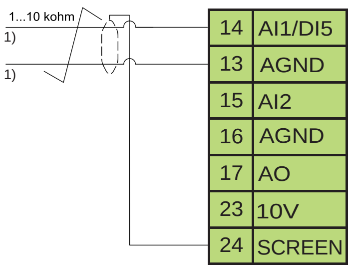
- Parameter 10.24 RO1 source = Not energized [0]
- Parameter 13.12 AO1 source = Zero [0]
- Parameter 20.41 Start interlock 1 = Not used [0]
- Parameter 22.22 Constant speed sel1 = Always off [0]
- Parameter 28.22 Constant frequency sel1 = Always off [0]

Supply fan, basic speed follower with interlock and status

There are a variety of different inputs and control schemes that may be applied to a drive being used as the controller for a supply fan. The example below consists of:

- DI1: Start/stop contact closure from the building automation system (BAS)
- AI1: A 0…10 V DC analog speed command signal from the BAS
- DI4: A duct high static pressure safety (Overpressure) contact wired to the drive
- RO1: A run/stop status feedback from the drive to the BAS.

Wiring diagram

Connection	Term.2)	Description
Digital I/O and relay output connections		
	24 V	Aux. +24 V DC, max 200 mA
	DGND	Aux. voltage output common
	DI1	Stop (0) / Start (1)
	DI2	Not configured
	DI3	Not configured
	DI4	Start interlock 1 (1 = allow start)
	DCOM	Digital input common
	DO	Not energized
	DO COM	Digital output common
	DO SRC	Digital output auxiliary voltage
	NC	Running (Relay output 1)
	COM	
	NO	
Analog I/O		
	AI1/DI5	Speed reference (0…10V)
	AGND	Analog input circuit common
	AI2	Not used
	AGND	Analog output circuit common
	AO	Output frequency (0...20mA)
	10V	Ref. voltage +10 V DC
	SCREEN	Signal cable shield (screen)

1) Reference signal (0…10 V)

2) Terminal sizes: 0.5 mm²…1 mm² (22...16 AWG)

Required parameter adjustments

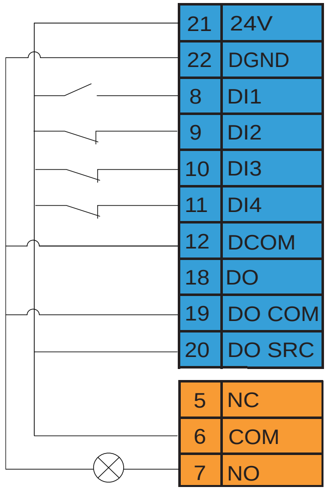
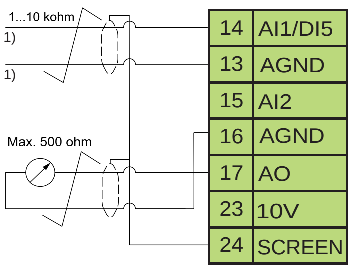
- Parameter 10.24 RO1 source = Running [7]
- Parameter 13.12 AO1 source = Zero [0]
- Parameter 20.47 Start interlock 1 text = Overpressure [4]
- Parameter 22.22 Constant speed sel1 = Always off [0]
- Parameter 28.22 Constant frequency sel1 = Always off [0]

Supply fan, speed follower complete integration

There are a variety of different inputs and control schemes that may be applied to a drive being used as the controller for a supply fan. The example below consists of:

- DI1: Start/stop contact closure from the building automation system (BAS)
- AI1: A 0…10 V DC analog speed command signal from the BAS
- DI2: A damper end-switch contact closure to the drive, to indicate the damper open/closed status
- DI3: A supply air smoke alarm safety contact wired to the drive
- DI4: A duct high static pressure safety (Overpressure) contact wired to the drive
- RO1: A relay output to the external, actuator control circuit to open an isolation damper
- AO1: A 0…10 V DC analog output signal from the drive, to indicate drive output frequency, to the BAS.

Wiring diagram

Connection	Term.2)	Description
Digital I/O and relay output connections		
	24 V	Aux. +24 V DC, max 200 mA
	DGND	Aux. voltage output common
	DI1	Stop (0) / Start (1)
	DI2	Run permissive (1 = allow start)
	DI3	Start interlock 2 (1 = allow start)
	DI4	Start interlock 1 (1 = allow start)
	DCOM	Digital input common
	DO	Not energized
	DO COM	Digital output common
	DO SRC	Digital output auxiliary voltage
	NC	Damper control (Relay output 1)
	COM	
	NO	
Analog I/O		
	AI1/DI5	Speed reference (0…10V)
	AGND	Analog input circuit common
	AI2	Not used
	AGND	Analog output circuit common
	AO	Output frequency (0...20mA)
	10V	Ref. voltage +10 V DC
	SCREEN	Signal cable shield (screen)
1) Reference signal (0…10 V) 2) Terminal sizes: 0.5 mm²…1 mm² (22...16 AWG)		

Required parameter adjustments

- Parameter 20.40 Run permissive = DI2 [3]
- Parameter 20.42 Start interlock 2 = DI3 [4]
- Parameter 20.46 Run permissive text = Damper end switch [1]
- Parameter 20.47 Start interlock 1 text = Overpressure [4]
- Parameter 20.48 Start interlock 2 text = Smoke alarm [6]

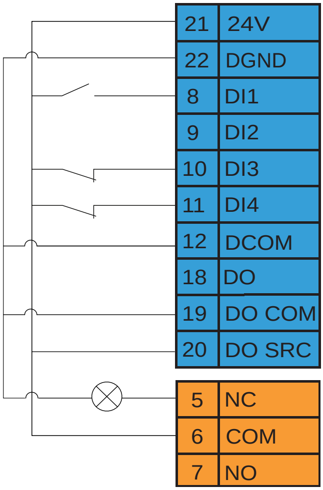
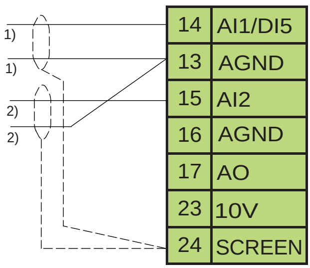
- Parameter 22.22 Constant speed sel1 = Always off [0]
- Parameter 28.22 Constant frequency sel1 = Always off [0]

Supply fan, PID control

The drive can be used with a supply fan to maintain static air duct pressure. The drive must speed up when the pressure is too low, and slow down when the pressure is too high. The example below consists of:

- DI1: Start/stop contact closure from the building automation system (BAS)
- AI1: A 4…20 mA setpoint command signal from the BAS
  - 4 mA = 0.0 kPa (or 0.0 inWC)
  - 20 mA = 0.5 kPa (or 2.0 inWC)
- AI2: A 4…20 mA analog pressure transducer feedback signal wired to the drive with a pressure range of 0…1.25 kPa (0…5 inWC)
  - 4 mA = 0.0 kPa (0.0 inWC)
  - 20 mA = 1.25 kPa (5.0 inWC)
- DI4: A duct high static pressure safety (Overpressure) contact wired to the drive
- DI3: A Freezestat safety contact wired to the drive
- RO1: A run/stop status feedback from the drive to the BAS

Wiring diagram

Connection	Term.[3)]	Description
Digital I/O and relay output connections		
	24 V	Aux. +24 V DC, max 200 mA
	DGND	Aux. voltage output common
	DI1	Stop (0) / Start (1)
	DI2	Not configured
	DI3	Start interlock 2 (1 = allow start)
	DI4	Start interlock 1 (1 = allow start)
	DCOM	Digital input common
	DO	Not energized
	DO COM	Digital output common
	DO SRC	Digital output auxiliary voltage
	NC	Running (Relay output 1)
	COM	
	NO	
Analog I/O		
	AI1/DI5	Set 1 setpoint (4…20mA)
	AGND	Analog input circuit common
	AI2	Set 1 feedback (4…20mA)
	AGND	Analog output circuit common
	AO	Zero
	10V	Ref. voltage +10 V DC
	SCREEN	Signal cable shield (screen)

1) BAS setpoint (4...20 mA)
2) Transducer feedback (4...20 mA)
3) Terminal sizes: 0.5 mm²…1 mm² (22...16 AWG)

Required parameter adjustments

- Parameter 10.24 RO1 source = Running [7]
- Parameter 12.15 AI1 unit selection = mA [10]
- Parameter 12.20 AI1 scaled at AI1 max = 2.000
- Parameter 12.30 AI2 scaled at AI2 max = 5.000

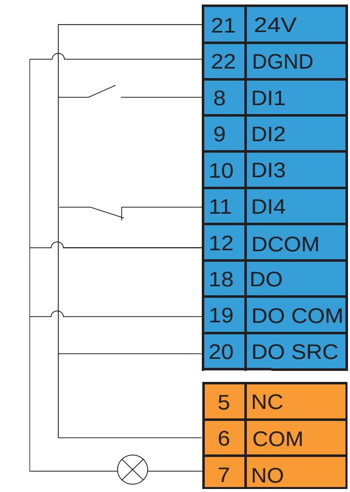
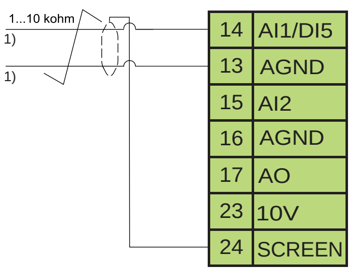
- Parameter 13.12 AO1 source = Zero [0]
- Parameter 19.11 Ext1/Ext2 selection = EXT2 [1]
- Parameter 20.06 Ext2 commands = In1 Start [1]
- Parameter 20.08 Ext2 in1 source = DI1 [2]
- Parameter 20.42 Start interlock 2 = DI3 [4]
- Parameter 20.47 Start interlock 1 text = Overpressure [4]
- Parameter 20.48 Start interlock 2 text = Freezestat [3]
- Parameter 22.22 Constant speed sel1 = Always off [0]
- Parameter 28.15 Ext2 frequency ref1 = PID [16]
- Parameter 28.22 Constant frequency sel1 = Always off [0]
- Parameter 40.07 Process PID operation mode = On when drive running [2]
- Parameter 40.16 Set 1 setpoint 1 source = AI1 scaled [3]
- Parameter 40.27 Set 1 setpoint max = 2.00
- Parameter 40.31 Set 1 deviation inversion = Not inverted (Ref - Fbk) [0]
- Parameter 40.79 Set 1 units = inWC [65]

Cooling tower fan, speed follower

There are a variety of different inputs and control schemes that may be applied to a drive being used as the controller for a cooling tower. The example below consists of:

- DI1: Start/stop contact closure from the building automation system (BAS)
- AI1: A 4…20 mA analog speed command signal from the BAS
- DI4: A vibration safety switch contact wired to the drive
- RO1: A run/stop status feedback from the drive to the BAS
- Minimum frequency programmed to 30 Hz due to lubrication needs of this particular fan's right angle gear box.

Wiring diagram

<table>
<tr><th>Connection</th><th>Term.2)</th><th>Description</th></tr>
<tr><td colspan="3">Digital I/O and relay output connections</td></tr>
<tr><td rowspan="13">
</td><td>24 V</td><td>Aux. +24 V DC, max 200 mA</td></tr>
<tr><td>DGND</td><td>Aux. voltage output common</td></tr>
<tr><td>DI1</td><td>Stop (0) / Start (1)</td></tr>
<tr><td>DI2</td><td>Not configured</td></tr>
<tr><td>DI3</td><td>Not configured</td></tr>
<tr><td>DI4</td><td>Start interlock 1 (1 = allow start)</td></tr>
<tr><td>DCOM</td><td>Digital input common</td></tr>
<tr><td>DO</td><td>Not energized</td></tr>
<tr><td>DO COM</td><td>Digital output common</td></tr>
<tr><td>DO SRC</td><td>Digital output auxiliary voltage</td></tr>
<tr><td>NC</td><td rowspan="3">Running
(Relay output 1)</td></tr>
<tr><td>COM</td></tr>
<tr><td>NO</td></tr>
<tr><td colspan="3">Analog I/O</td></tr>
<tr><td rowspan="7">
</td><td>AI1/DI5</td><td>Speed reference (4…20 mA)</td></tr>
<tr><td>AGND</td><td>Analog input circuit common</td></tr>
<tr><td>AI2</td><td>Not used</td></tr>
<tr><td>AGND</td><td>Analog output circuit common</td></tr>
<tr><td>AO</td><td>Output frequency (0…20mA)</td></tr>
<tr><td>10V</td><td>Ref. voltage +10 V DC</td></tr>
<tr><td>SCREEN</td><td>Signal cable shield (screen)</td></tr>
<tr><td colspan="3">1) Reference signal (4…20 mA)
2) Terminal sizes: 0.5 mm²…1 mm² (22...16 AWG)</td></tr>
</table>

Required parameter adjustments

- Parameter 10.24 RO1 source = Running [7]
- Parameter 12.15 AI1 unit selection = mA [10]
- Parameter 13.12 AO1 source = Zero [0]
- Parameter 20.47 Start interlock 1 text = Vibration switch [1]
- Parameter 22.22 Constant speed sel1 = Always off [0]

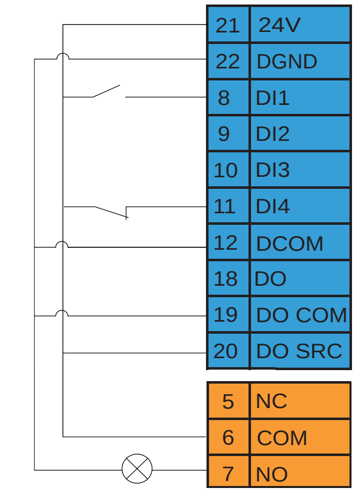
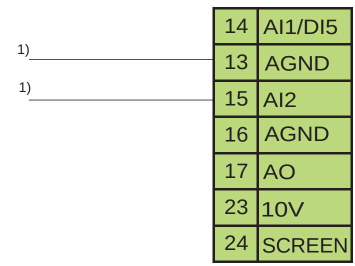
- Parameter 28.22 Constant frequency sel1 = Always off [0]
- Parameter 30.13 Minimum frequency = 30.00

Cooling tower, PID

There are a variety of different inputs and control schemes that may be applied to a drive being used as the controller for a Cooling tower. The example below consists of:

- DI1: Start/stop contact closure from the building automation system (BAS)
- Water temperature setpoint fixed at 24 °C (75 °F). The drive speeds up the fan when the temperature is too warm, and slows it down when the temperature is too cool
- AI2: A 4…20 mA analog water temperature transducer feedback signal wired directly to the drive with a temperature range of -30…50 °C (-22…122 °F)
  - 4 mA = -30 °C (-22 °F)
  - 20 mA = 50 °C (122 °F)
- DI4: A vibration safety switch contact wired to the drive
- RO1: A run/stop status feedback from the drive to the BAS
- Minimum frequency programmed to 20 Hz due to lubrication needs of this particular fan’s right angle gear box
- The drive stops the fan and enters sleep mode when the motor speed drops below 25 Hz for more than 30 seconds.
- The drive wakes up from sleep mode when the water temperature increases above 26 °C (79 °F), which is also a deviation of 2 °C (4 °F) above the setpoint of 24 °C (75 °F).

Wiring diagram

<table>
<tr><th>Connection</th><th>Term.2)</th><th>Description</th></tr>
<tr><td colspan="3">Digital I/O and relay output connections</td></tr>
<tr><td rowspan="13">
</td><td>24 V</td><td>Aux. +24 V DC, max 200 mA</td></tr>
<tr><td>DGND</td><td>Aux. voltage output common</td></tr>
<tr><td>DI1</td><td>Stop (0) / Start (1)</td></tr>
<tr><td>DI2</td><td>Not configured</td></tr>
<tr><td>DI3</td><td>Not configured</td></tr>
<tr><td>DI4</td><td>Start interlock 1 (1 = allow start)</td></tr>
<tr><td>DCOM</td><td>Digital input common</td></tr>
<tr><td>DO</td><td>Not energized</td></tr>
<tr><td>DO COM</td><td>Digital output common</td></tr>
<tr><td>DO SRC</td><td>Digital output auxiliary voltage</td></tr>
<tr><td>NC</td><td rowspan="3">Running
(Relay output 1)</td></tr>
<tr><td>COM</td></tr>
<tr><td>NO</td></tr>
<tr><td colspan="3">Analog I/O</td></tr>
<tr><td rowspan="7">
</td><td>AI1/DI5</td><td>Not used</td></tr>
<tr><td>AGND</td><td>Analog input circuit common</td></tr>
<tr><td>AI2</td><td>Set 1 feedback (4…20mA)</td></tr>
<tr><td>AGND</td><td>Analog output circuit common</td></tr>
<tr><td>AO</td><td>Output frequency (0...20mA)</td></tr>
<tr><td>10V</td><td>Ref. voltage +10 V DC</td></tr>
<tr><td>SCREEN</td><td>Signal cable shield (screen)</td></tr>
<tr><td colspan="3">1) Water temperature
2) Terminal sizes: 0.5 mm²…1 mm² (22...16 AWG)</td></tr>
</table>

Required parameter adjustments

- Parameter 10.24 RO1 source = Running [7]
- Parameter 12.15 AI1 unit selection = mA [10]
- Parameter 12.29 AI2 scaled at AI2 min = -30.00 (if °C) or -22.00 (if °F)
- Parameter 12.30 AI2 scaled at AI2 max = 50.00 (if °C) or 122.00 (if °F)
- Parameter 13.12 AO1 source = Zero [0]

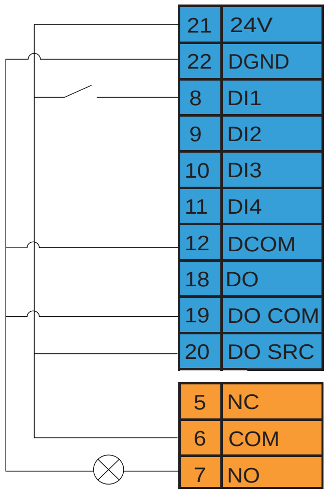
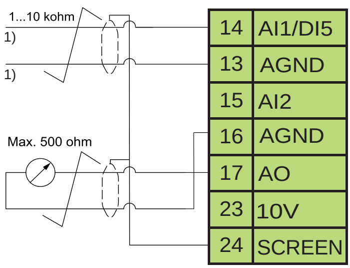
- Parameter 19.11 Ext1/Ext2 selection = EXT2 [1]
- Parameter 20.06 Ext2 commands = In1 Start [1]
- Parameter 20.08 Ext2 in1 source = DI1 [2]
- Parameter 20.47 Start interlock 1 text = Vibration switch [1]
- Parameter 22.22 Constant speed sel1 = Always off [0]
- Parameter 28.15 Ext2 frequency ref1 = PID [16]
- Parameter 28.22 Constant frequency sel1 = Always off [0]
- Parameter 30.13 Minimum frequency = 20.00
- Parameter 40.07 Process PID operation mode = On when drive running [2]
- Parameter 40.21 Set 1 internal setpoint 1 = 75.00
- Parameter 40.43 Set 1 sleep level = 25.0
- Parameter 40.44 Set 1 sleep delay = 30.0
- Parameter 40.47 Set 1 wake-up deviation = 2.00 (if °C) or 4.00 (if °F)
- Parameter 40.79 Set 1 units = °C [150] or °F [151]

Chilled water pump

There are a variety of different inputs and control schemes that may be applied to the drive being used on a chilled water pump. The example below consists of:

- DI1: Start/stop contact closure from the building automation system (BAS)
- AI1: A 0…10 V DC analog speed command signal from the BAS
- RO1: A run/stop status feedback from the drive to the BAS
- AO1: A 4…20 mA analog output signal from the drive, to indicate drive output current, to the BAS
- When a stop command is received, the drive shall ramp the motor to a stop to prevent water hammer.

Wiring diagram

Connection	Term. 2)	Description
Digital I/O and relay output connections		
	24 V	Aux. +24 V DC, max 200 mA
	DGND	Aux. voltage output common
	DI1	Stop (0) / Start (1)
	DI2	Not configured
	DI3	Not configured
	DI4	Not configured
	DCOM	Digital input common
	DO	Not energized
	DO COM	Digital output common
	DO SRC	Digital output auxiliary voltage
	NC	Running (Relay output 1)
	COM	
	NO	
Analog I/O		
	AI1/DI5	Speed reference (0…10V)
	AGND	Analog input circuit common
	AI2	Not used
	AGND	Analog output circuit common
	AO	Motor current (0...20mA)
	10V	Ref. voltage +10 V DC
	SCREEN	Signal cable shield (screen)
1) Reference signal (0…10 V) 2) Terminal sizes: 0.5 mm^2…1 mm^2 (22...16 AWG)		

Required parameter adjustments

- Parameter 13.18 AO1 source max = Recommend motor nameplate FLA
- Parameter 10.24 RO1 source = Running [7]
- Parameter 13.12 AO1 source = Motor current [4]
- Parameter 20.41 Start interlock 1 = Not used [0]
- Parameter 21.03 Stop mode = Ramp [1]

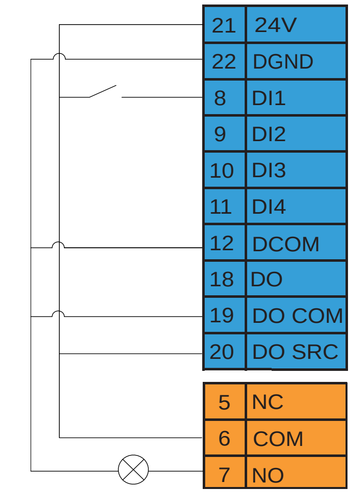
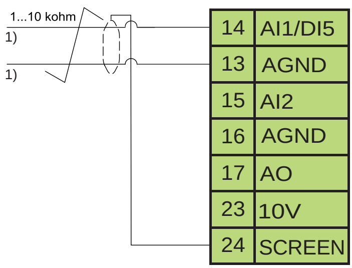
- Parameter 22.22 Constant speed sel1 = Always off [0]
- Parameter 28.22 Constant frequency sel1 = Always off [0]

Condenser water pump

There are a variety of different inputs and control schemes that may be applied to a drive being used on a condenser water pump. The example below consists of:

- DI1: Start/stop contact closure from the building automation system (BAS)
- AI1: A 4…20 mA analog speed command signal from the BAS
- RO1: A run/stop status feedback from the drive to the BAS
- When a stop command is received, the drive ramps the motor to a stop to prevent water hammer.
- Minimum frequency set to 20 Hz.

Wiring diagram

Connection	Term.2)	Description
Digital I/O and relay output connections		
	24 V	Aux. +24 V DC, max 200 mA
	DGND	Aux. voltage output common
	DI1	Stop (0) / Start (1)
	DI2	Not configured
	DI3	Not configured
	DI4	Not configured
	DCOM	Digital input common
	DO	Not energized
	DO COM	Digital output common
	DO SRC	Digital output auxiliary voltage
	NC	Running (Relay output 1)
	COM	
	NO	
Analog I/O		
	AI1/DI5	Speed reference (0…10V)
	AGND	Analog input circuit common
	AI2	Not used
	AGND	Analog output circuit common
	AO	Zero
	10V	Ref. voltage +10 V DC
	SCREEN	Signal cable shield (screen)

1) Reference signal (0…10 V)

2) Terminal sizes: 0.5 mm^2…1 mm^2 (22...16 AWG)

Required parameter adjustments

- Parameter 10.24 RO1 source = Running [7]
- Parameter 12.15 AI1 unit selection = mA [10]
- Parameter 13.12 AO1 source = Zero [0]
- Parameter 20.41 Start interlock 1 = Not used [0]
- Parameter 21.03 Stop mode = Ramp [1]

- Parameter 22.22 Constant speed sel1 = Always off [0]
- Parameter 28.22 Constant frequency sel1 = Always off [0]
- Parameter 30.13 Minimum frequency = 20.00

Automatic fault resets

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

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

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

Settings

- Parameters: 13.12 AO1 source…13.16 AO1 filter time.

External events

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

Settings

- Parameters: 31.01 External event 1 source…31.10 External event 5 type.

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 210) and 28 Frequency reference chain (page 236).

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 parameter 22.87 Speed reference act 7 enters a critical range, the output of the function parameter 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.

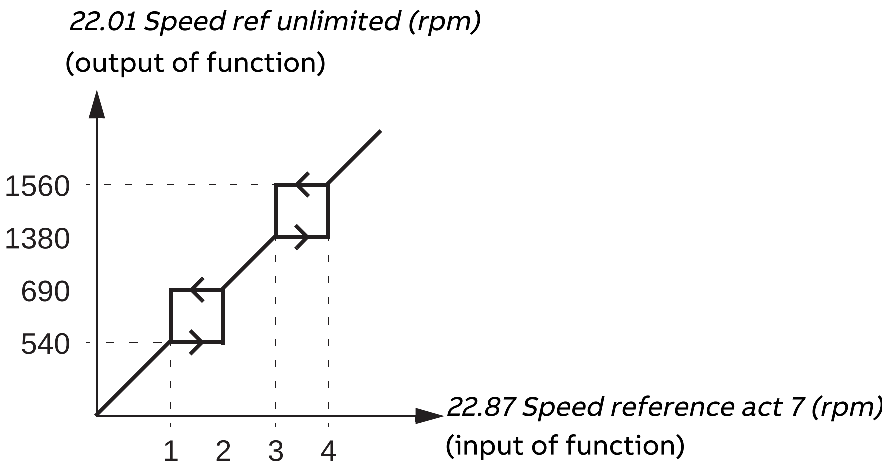
When the drive is limiting the allowed output speeds/frequencies, it limits to the absolutely lowest critical speed (critical speed low or critical frequency low) when accelerating from standstill, unless the speed reference is over the upper critical speed/ frequency limit.

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

Example for critical speeds

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

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

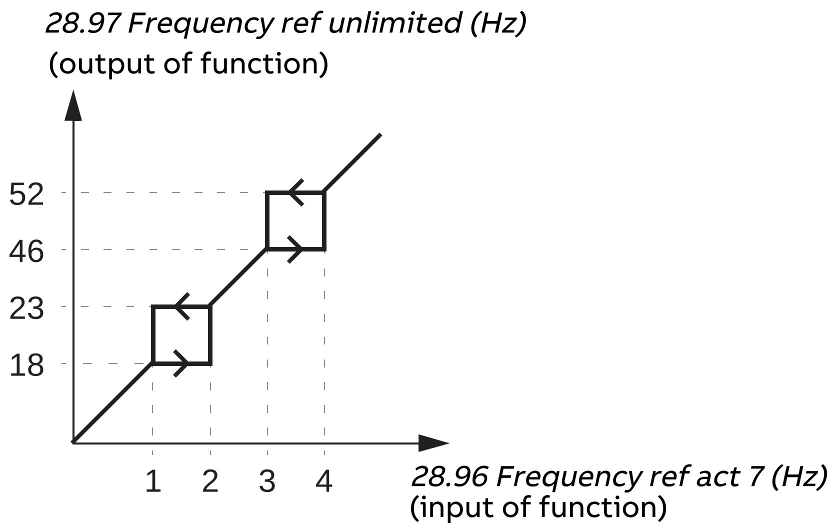


1	22.52 Critical speed 1 low = 540 rpm
2	22.53 Critical speed 1 high = 690 rpm
3	22.54 Critical speed 2 low = 1380 rpm
4	22.55 Critical speed 2 high = 1560 rpm

Example for critical frequencies

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

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



1	28.52 Critical frequency 1 low = 18 Hz
2	28.53 Critical frequency 1 high = 23 Hz
3	28.54 Critical frequency 2 low = 46 Hz
4	28.55 Critical frequency 2 high = 52 Hz

Settings

- Critical speed parameters: 22.51 Critical speed function…22.57 Critical speed 3 high
- Critical frequency parameters: 28.51 Critical frequency function…28.57 Critical frequency 3 high.

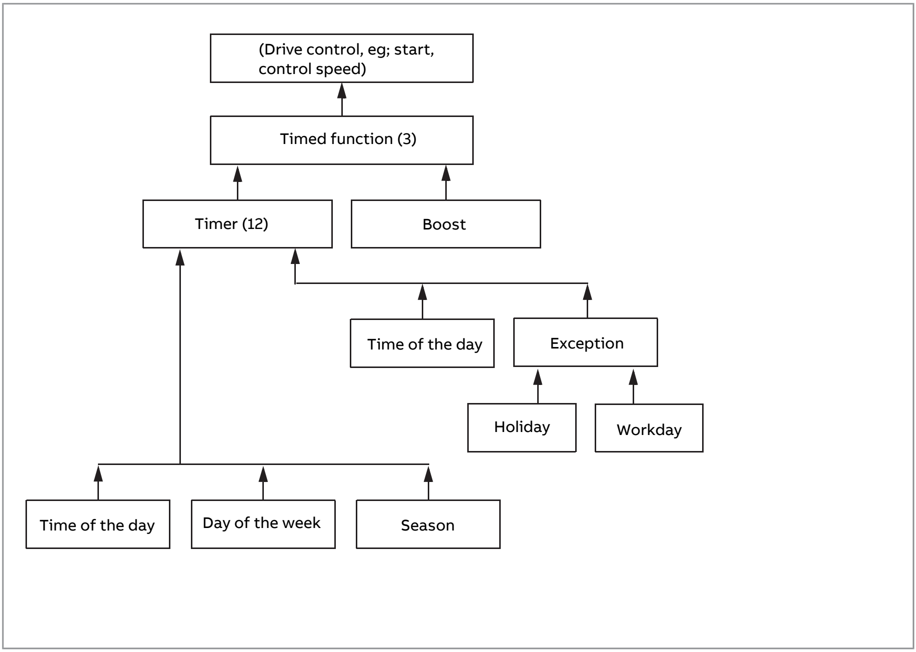
Timed functions

The base entity of the timed functions is called a timer. A timer can be active based on time of the day, day of the week and season of the year. In addition to these time related parameters, the timer activation can be influenced by so called days of exception (configurable as holiday or workday). For example, 25. 12. (Dec 25th) can be defined as holiday in many countries. A timer can be set to be active or inactive during the days of exception.

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

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

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



Settings

- Parameter group: 34 Timed functions (page 285).

Ramps

Overview

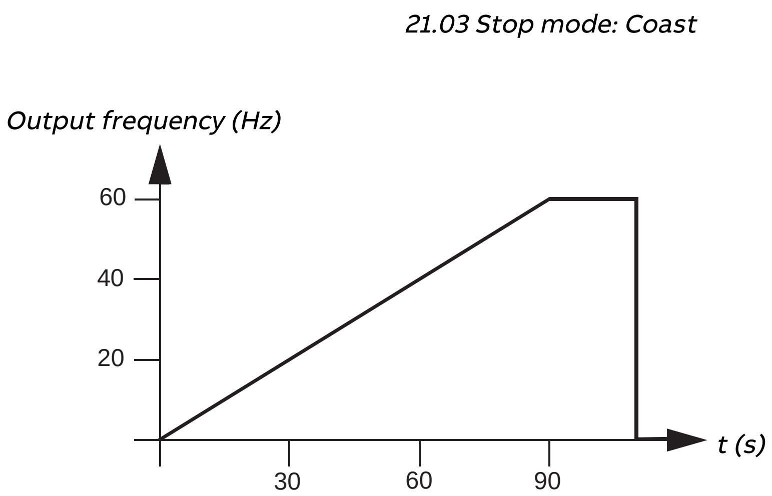
Ramps refer to acceleration and deceleration times. The ramps function adjusts the rate of how fast or slow a drive changes the motor speed with respect to the commanded speed. Ramps should be configured based on the specific application requirements.

Functionality

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

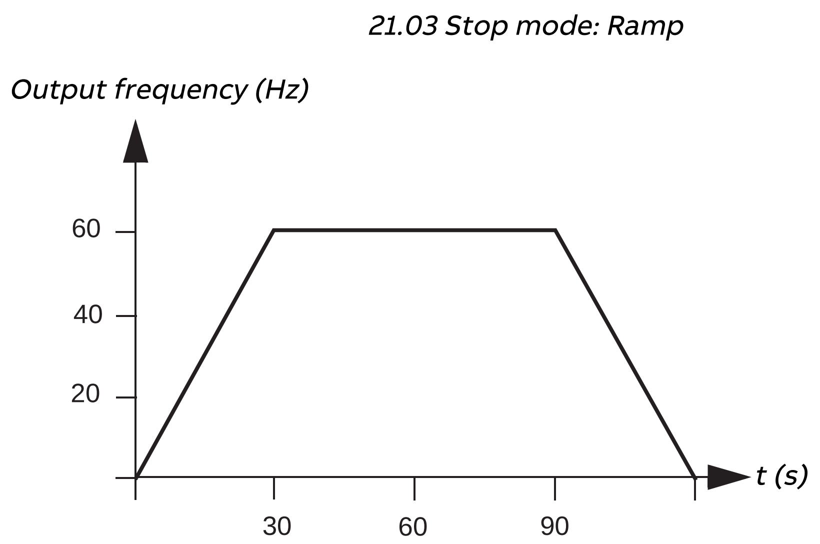
The deceleration ramp is the amount of time required for the drive to ramp down from the value set in parameter 46.02 Frequency scaling to 0 Hz. The most typical settings of parameter 46.02 Frequency scaling are 50 Hz outside of North America and 60 Hz for North America. Note that the ramps function is always active during operation and not just used for starting and stopping modes.

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



90-second acceleration and no decceleration ramp curve

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



30-second acceleration and decceleration ramp curve

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

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

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

Settings

- Speed reference ramping parameters: 23.11 Ramp set selection…23.15 Deceleration time 2
- Frequency reference ramping parameters: 28.71 Freq ramp set selection…28.75 Freq deceleration time 2 and 46.02 Frequency scaling
- Emergency stop ("Off3" mode) parameter: 23.23 Emergency stop time.

Application examples

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

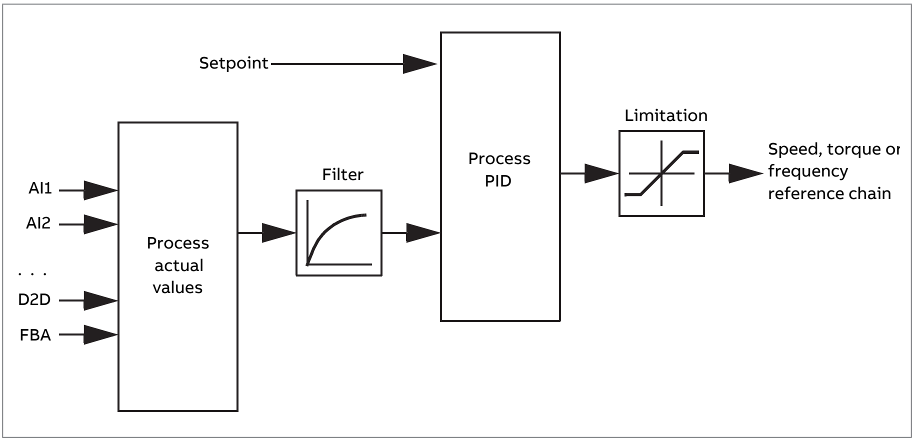
In the pump application examples, the fluid in the pipes can create enough force on the pump to cause the pump to come to a stop very quickly after the drive stops controlling the motor. This sudden stop will cause a pressure surge in the pipes, often known as water hammer. Water hammer problems include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

Process PID control

There are two built-in process PID controllers (PID set 1 and PID set 2) in the drive. The controller can be used to control process variables such as pressure or flow in the pipe or fluid level in the container.

In process PID control, a process reference (setpoint) is connected to the drive instead of a speed reference. An actual value (process feedback) is also brought back to the drive. The process PID control adjusts the drive speed in order to keep the measured process quantity (actual value) at the desired level (setpoint). This means that user does not need to set a frequency/speed 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 the Process PID controller (page 518) control chain diagram.



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

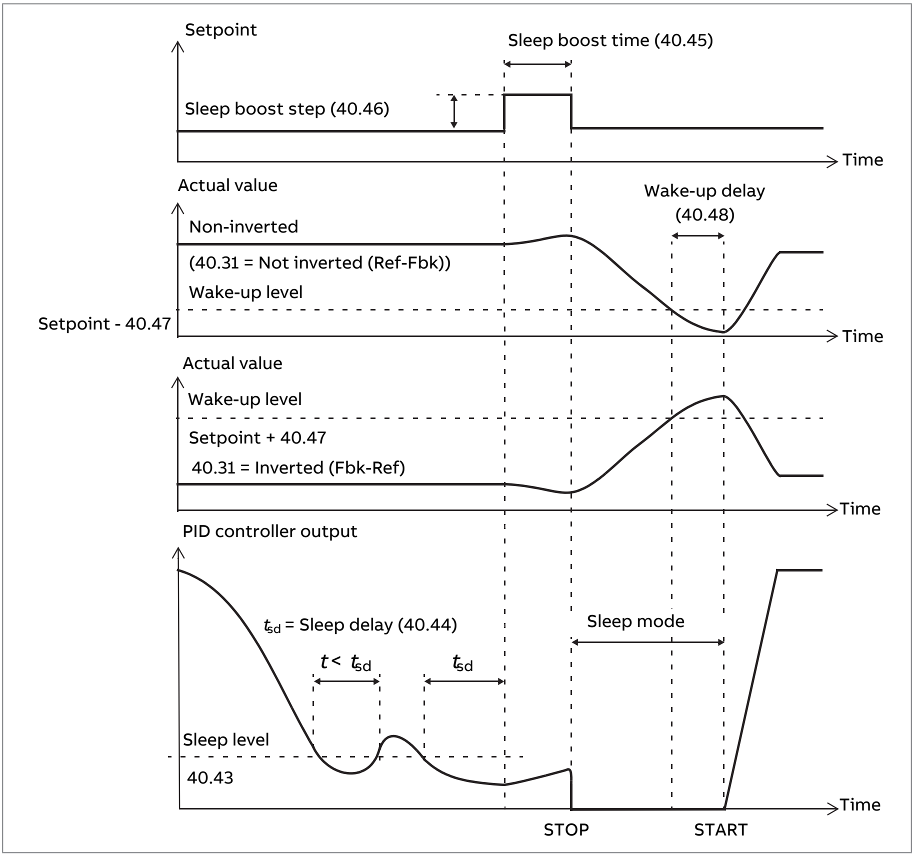
Note: Process PID control is only available in external control location EXT2; see section Local control vs. external control (page 39).

Sleep and boost functions for process PID control

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

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

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



Tracking

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

Settings

- Parameter groups: 40 Process PID set 1 (page 312) and 41 Process PID set 2 (page 331).

Limits

Limits overview

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

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

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

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

Settings

- Parameter group: 30 Limits (page 249).

Application examples

Referring to Application example: Cooling tower fan, speed follower and Application example: Cooling tower, PID, the minimum frequency is set based on limitations on the lubrication requirements of the fan's gearbox. In this case, the limit is based on information provided by the equipment manufacturer.

While the other application examples do not use limitations, there may be a benefit. For example, in the pumping application examples, a pump manufacturer may recommend a minimum flow of 25%. Flow is linearly related to motor speed. In this example, assuming a 60 Hz pump system, the drive's minimum frequency would be set to 15 Hz.

Override

Overview

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

Note: The following section details the operation of Override for a stand-alone drive in scalar mode. See section Scalar motor control (page 99).

Activating the Override mode

When Override is activated, the drive follows the programmed functionality defined in parameter group 70 Override (page 361). The Override mode is activated through an assigned digital input in the drive. The digital input also acts as the start command for the drive in Override mode.

It is important that the system will operate as programmed when the Override mode is triggered. Secure the Override settings so that they cannot be changed.

Steps to lock override mode once setup:

1. Parameter 96.02 Pass code (default 10000000) = enter
2. Parameter 96.102 User lock functionality = Set bit 5 (Enable override lock) to "1"
3. Parameter 96.02 Pass code = 00000000 (Locks out the security options).

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

Reference for Override frequency

You can configure the drive to run in seven different Override modes by adjusting parameter 70.04 Override reference source.

- Constant speed/freq allows you to select multiple, constant speeds/frequencies based on multiple digital inputs.
- AI1 or AI2 is the speed reference in the Override mode.
- Override speed/freq commands the drive speed/frequency to a single preprogrammed value.
- Motor potentiometer uses two defined digital inputs to increase or decrease the drive frequency. Initial values can be configured, as well as, minimum and maximum values and ramp times.
- Stop stops the drive following the defined stop mode.

- Process PID set 1 or Process PID set 2 controls the drive frequency using the output value of the process PID controller for PID parameter set 1 or 2.

Override mode features

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

- Once in Override, the drive ignores all fieldbus communication commands for start/stop and speed reference.
- In the Override mode the drive ignores all commands from the control panel: for example, Hand/Off/Auto requests and any parameters changes that would affect override are ignored. If a DriveWare tool is connected via the USB port, it will be ignored.
- Activating the Override mode also initiates a start command. There is no need for a secondary start command while in the Override mode.
- The run permissive signal and the signal source for the start interlock(s) that will be followed during the Override mode can be set up in parameter 70.10 Override enables selection.
- When Override is enabled, the drive ignores all inputs with the exception of the override activation/deactivation input, the digital inputs selecting the constant speed/frequency, or speeds/frequencies, and the safeties selected to be effective in the Override mode. Selecting which ones remain active is done in parameter 70.10 Override enables selection and they can be the run permissive signal and/or up to four start interlock(s).
- When the Override mode is active, the drive displays warning message Override active.
- The monitoring of parameters by fieldbus communication is still available during the Override mode. Pass through I/O points (analog outputs, relays outputs and digital inputs that are controlled through a fieldbus) will operate normally and pass data through the drive.
- Faults are grouped into high priority faults and low priority faults. High priority faults are displayed and they will stop the drive. See parameter group 70 Override (page 361) for fault handling. The following is a list of the high priority faults:

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

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

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

- The Override configuration is able to be locked through the drive's access level security. See section Activating the Override mode (page 85).
- The AI supervision function still operates for any Override modes that utilize an analog input. Thus if an analog input signal is lost, the drive will operate based on parameter group 12 Standard AI (page 173) configuration.
- If Safe Torque Off (STO) is triggered while the drive is in the Override mode, the drive exits override and follows the programming for STO alarm and fault configuration. A fault code is displayed to let the operator know the drive is in an STO condition. When STO is disabled, the drive does not go back into override operation.

Settings

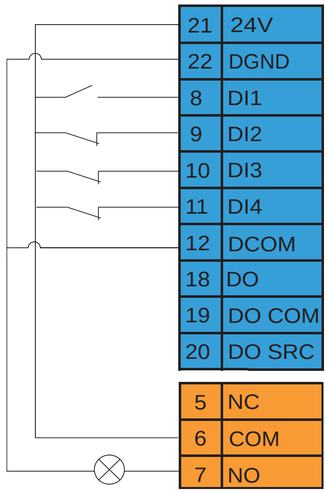
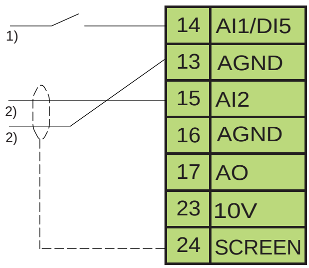
- Parameter group: 70 Override (page 361)
- Parameter group: 12 Standard AI (page 173)
- Parameter group: 96 System (page 371).

Application example: Override for single Override frequency control

The air handler unit (AHU) that normally provides conditioned air to the occupied zone may be switched into a smoke control mode by the fire alarm system. The AHU dampers are typically configured to full outside air and exhaust air paths, in smoke control mode. The supply fan and the return/exhaust fan are controlled to pre-determined speeds to provide the specified air flow and space pressurization. This example consists of:

- DI1: A start/stop command from the building automation system (BAS) for Normal mode operation
- AI2: A 0…10 V DC analog speed command signal from the BAS for Normal mode operation
- DI3: A Freezestat safety configured as a low priority safety interlock that will be ignored in the Override mode
- DI4: A duct high static pressure safety (Overpressure) configured as a high priority safety interlock that will operate in normal and Override modes
- DI2: A supply air smoke detector/alarm safety configured as a high priority safety interlock that will operate in normal and Override modes
- In the Override mode, the drive will operate at a single, predefined override frequency (air balance preset of 48 Hz)
- In the Override mode the high priority safeties will be reset as many times as required to ensure the system stays in operation
- DI5: Override mode is enabled by relay output from the fire alarm system to the drive
- RO1: A run/stop status feedback from the drive to the BAS.

Wiring diagram

Connection	Term.3)	Description
Digital I/O and relay output connections		
	24 V	Aux. +24 V DC, max 200 mA
	DGND	Aux. voltage output common
	DI1	Stop (0) / Start (1)
	DI2	Start interlock 3 (1 = allow start)
	DI3	Start interlock 2 (1 = allow start)
	DI4	Start interlock 1 (1 = allow start)
	DCOM	Digital input common
	DO	Not energized
	DO COM	Digital output common
	DO SRC	Digital output auxiliary voltage
	NC	Running (Relay output 1)
	COM	
	NO	
Analog I/O		
	AI1/DI5	Override
	AGND	Analog input circuit common
	AI2	Speed reference (0…10V)
	AGND	Analog output circuit common
	AO	Zero
	10V	Ref. voltage +10 V DC
	SCREEN	Signal cable shield (screen)

1) Connected to terminal 21
2) Speed reference (0…10 V)
3) Terminal sizes: 0.5 mm²…1 mm² (22...16 AWG)

Required parameter adjustments

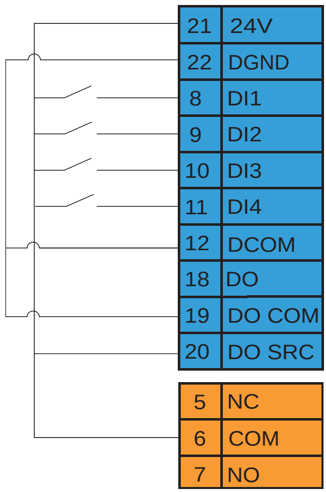
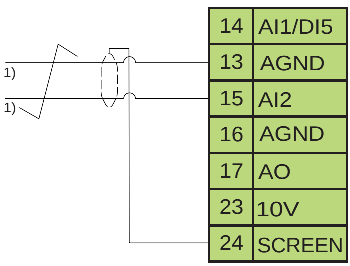
- Parameter 10.24 RO1 source = Running [7]
- Parameter 11.21 DI5 configuration = Digital input 5 [0]
- Parameter 12.25 AI2 unit selection = V [2]
- Parameter 13.12 AO1 source = Zero [0]
- Parameter 20.42 Start interlock 2 = DI3 [4]
- Parameter 20.43 Start interlock 3 = DI2 [3]
- Parameter 20.47 Start interlock 1 text = Overpressure [4]
- Parameter 20.48 Start interlock 2 text = Freezestat [2]
- Parameter 20.49 Start interlock 3 text = Smoke alarm [6]
- Parameter 22.22 Constant speed sel1 = Always off [0]
- Parameter 28.11 Ext1 frequency ref1 = AI2 scaled [2]
- Parameter 28.22 Constant frequency sel1 = Always off [0]
- Parameter 70.02 Override enable = On, critical [2]
- Parameter 70.03 Override activation source = DI5 [5]
- Parameter 70.04 Override reference source = Override speed/freq [3]
- Parameter 70.06 Override frequency = 48.0
- Parameter 70.10 Override enables selection = Start interlock 1 [1], Start interlock 2 [2] = 1
- Parameter 70.20 Override fault handling = Autoreset [1]

Application example: Override for PID control

In the Override for single Override frequency control application example above, the drive ran at a predetermined fixed frequency. In this example, the drive will use its internal PID loop to control based on a fixed pressure. A common application of the control scheme used in this application example is for the control of a dedicated stairwell pressurization fan in multi-story buildings during a fire or smoke event. The drive controls the stairwell pressurization fan speed to maintain a specific level of positive pressure in the stairwell. The positive pressure relative to the occupied space helps reduce the amount of smoke that enters the stairwell. This example consists of:

- The drive/fan only operates during a fire or smoke event
- AI2: An analog differential pressure sensor measuring the pressure differential between the stairwell and the occupied space
- DI1: An override input (Run) from the fire alarm system to start the drive and place it in the Override mode
- DI4: A dedicated "shutdown" command from the fire alarm system
- DI2: An isolation damper end-switch contact closure, wired from the damper to the drive, to indicate the damper open/close status. (The isolation damper has to be proven open for the fan to operate.)
- DI3: A High pressure static safety (Overpressure)
- Resetting of high priority faults is Normal with two resets. (This is not "run to destruction".)

Wiring diagram

<table>
<tr><th>Connection</th><th>Term.2)</th><th>Description</th></tr>
<tr><td colspan="3">Digital I/O and relay output connections</td></tr>
<tr><td rowspan="13"></td><td>24 V</td><td>Aux. +24 V DC, max 200 mA</td></tr>
<tr><td>DGND</td><td>Aux. voltage output common</td></tr>
<tr><td>DI1</td><td>Stop (0) / Start (1)</td></tr>
<tr><td>DI2</td><td>Run permissive (1 = allow start)</td></tr>
<tr><td>DI3</td><td>Start interlock 2 (1 = allow start)</td></tr>
<tr><td>DI4</td><td>Start interlock 1 (1 = allow start)</td></tr>
<tr><td>DCOM</td><td>Digital input common</td></tr>
<tr><td>DO</td><td>Not energized</td></tr>
<tr><td>DO COM</td><td>Digital output common</td></tr>
<tr><td>DO SRC</td><td>Digital output auxiliary voltage</td></tr>
<tr><td>NC</td><td rowspan="3">Not energized</td></tr>
<tr><td>COM</td></tr>
<tr><td>NO</td></tr>
<tr><td colspan="3">Analog I/O</td></tr>
<tr><td rowspan="7"></td><td>AI1/DI5</td><td>Override</td></tr>
<tr><td>AGND</td><td>Analog input circuit common</td></tr>
<tr><td>AI2</td><td>Not used</td></tr>
<tr><td>AGND</td><td>Analog output circuit common</td></tr>
<tr><td>AO</td><td>Zero</td></tr>
<tr><td>10V</td><td>Ref. voltage +10 V DC</td></tr>
<tr><td>SCREEN</td><td>Signal cable shield (screen)</td></tr>
<tr><td colspan="3">1) Pressure signal
2) Terminal sizes: 0.5 mm²…1 mm² (22...16 AWG)</td></tr>
</table>

Required parameter adjustments

- Parameter 10.24 RO1 source = Not energized [0]
- Parameter 13.12 AO1 source = Zero [0]
- Parameter 20.03 Ext1 in1 source = Always off [0]
- Parameter 20.40 Run permissive = DI2 [3]
- Parameter 20.42 Start interlock 2 = DI3 [4]
- Parameter 22.22 Constant speed sel1 = Always off [0]
- Parameter 28.22 Constant frequency sel1 = Always off [0]
- Parameter 70.02 Override enable = On [1]
- Parameter 70.03 Override activation source = DI1 [1]
- Parameter 70.04 Override reference source = Process PID set 1 [6]
- Parameter 70.10 Override enables selection = Run permissive [0], Start interlock 1 [1] and Start interlock 2 [2] = 1
- Parameter 70.21 Override auto reset trials = 2

Interlocks

Overview

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

Interlocks typically are wired to the drive's digital inputs (DI), DI1 through DI5. Certain fieldbus communications can also be used to control interlocks, although typically not recommended for most applications.

Configuration

You can configure interlocks via parameter group 20 Start/stop/direction (page 186).

Interlocks are configurable for normally open or normally closed functionality.

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

An unsatisfied interlock is indicated on the drive control panel display via a flashing green LED light, and a flashing warning on the display. With parameter 20.51 Start interlock condition you can configure the drive to indicate an unsatisfied interlock in one of two methods:

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

This setting applies to all the interlocks. With parameter 20.45 Start interlock stop mode you can configure the drive for either coast or ramp to a stop, when the interlock changes to an unsatisfied state.

Wiring connections

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

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

Functionality

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

Settings and diagnostics

- Parameter: 20.41 Start interlock 1
- Events: AFEE Start interlock 1, AFEF Start interlock 2, AFF0 Start interlock 3 and AFF2 Start interlock forced warning.

Application examples of interlocks

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

1. **Overpressure**. This interlock is typically used with air handlers for air duct protection. This interlock stops operation when the measured pressure exceeds a threshold, to prevent damage to ductwork. For integration examples, see application examples Supply fan, basic speed follower with interlock and status (page 55) and Supply fan, speed follower complete integration (page 57).

2. **Motor disconnect open**. This interlock is used in a variety of applications that have a disconnect switch between the drive and motor, to indicate the disconnect switch has been opened. This interlock prevents the drive from attempting to operate a motor while the disconnect switch is open. Note that without this interlock wired to the drive, under certain operating conditions, the motor will attempt to draw a high amount of inrush current once the disconnect switch is closed. This high amount of current may cause the drive to fault to protect itself.

3. **Vibration trip**. This interlock is typically used with cooling towers for vibration protection. This interlock stops operation when the measured vibration exceeds a threshold, to prevent damage to the tower.

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

   For integration examples, see application examples Cooling tower fan, speed follower (page 63) and Cooling tower, PID (page 66).

4. **Smoke alarm**. This interlock is typically used with air handlers to stop the propagation of smoke through air ducts. This interlock stops operation when the measured smoke exceeds a threshold, to limit the amount of smoke spread through the system. For an integration example, see application example Supply fan, speed follower complete integration (page 57).

5. **Freezestat**. This interlock is typically used with air handlers for coil protection. This interlock stops operation when the measured temperature is below a threshold, to prevent freezing and subsequent coil damage. For an integration example, see application example Supply fan, PID control (page 60).

6. **Firestat**. This interlock is typically used with air handlers. This interlock stops operation when the measured temperature is above a threshold, possibly indicating a fire in the building.

7. **Low suction or Low pressure**. This interlock is typically used with pumps for pump protection. This interlock stops operation when the measured pressure on the suction side of the pump is below a threshold, to prevent pump damage from having it run dry.

8. **Access door**. This interlock is used in a variety of applications that have an access door. This interlock stops operation when the access door is opened. Note that an interlock is not an acceptable alternative to following proper safety procedures.

9. **Auxiliary open**. This interlock text is a generic term used in a variety of applications that have auxiliary contacts that need to stop drive operation. This interlock stops operation when the auxiliary has been opened.

10. **Pressure relief**. This interlock is used in applications that have a pressure relief method, such as a pressure relief valve, that also has an interlock tied to this relief method. This interlock stops operation when pressure exceeds a threshold and pressure is being mechanically relieved.

11. **Start interlock 1**, **Start interlock 2**, **Start interlock 3**, and **Start interlock 4**. This interlock text is a generic term used in a variety of applications that have interlocks. This interlock stops operation when the interlock has been opened or closed depending on the setup. ABB recommends using the predefined Descriptive text and/or custom Label text whenever possible, as this will simplify any future interlock troubleshooting needs.

12. **Label text**. Provides up to 35 characters of free/custom text describing the interlock. This text will appear on the drive control panel when the interlock is no longer satisfied. This text can be used to better describe the interlock itself or its physical location. This text can also be used to enter a phone number for the local support of that equipment. Note that the Label text option is separate from the predefined text, thus the two can be used in conjunction with each other. For example, the predefined text can be selected for Overpressure, while the Label text may state “Reset switch located in control panel.”

Run permissive

Overview

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

Run permissive is different from start interlock:

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

The run permissive is typically wired to one of the drive’s digital inputs, DI1 through DI5. DI2 is most commonly used. Certain fieldbus communications can also be used to control run permissive, although typically not recommended for most applications.

Configuration

You can configure run permissive via parameter group 20 Start/stop/direction (page 186). Run permissive is configurable for normally open or normally closed functionality.

Wiring connections

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

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

Functionality

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

Run permissive features include the following:

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

Settings and diagnostics

- Parameter: 20.40 Run permissive
- Events: AFED Run permissive and AFF3 Run permissive forced warning.

Application example: Damper end switch

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

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

See the figure at parameter 10.24 RO1 source, selection Damper control and application example Supply fan, speed follower complete integration (page 57).

Application example: Valve opening

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

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

Motor control

Motor types

The drive supports asynchronous AC induction motor (AsynM), permanent magnet synchronous motor (PMSM) and ferrite assisted synchronous reluctance motor (PMaSynRM).

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.

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

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

Settings

- Parameter: 99.13 ID run requested
- Events: AFF6 Identification run and FF61 ID run.

Scalar motor control

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

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

- If the exact nominal motor values are not available or the drive needs to run different motor after the commissioning phase
- If a short commissioning time is needed or no ID run is wanted
- In multimotor systems: 1) if the load is not equally shared between the motors, 2) if the motors are of different sizes, or 3) if the motors are going to be changed after motor identification (ID run)
- If the nominal current of the motor is less than 1/6 of the nominal output current of the drive
- If the drive is used without a motor connected (for example, for test purposes)
- If the drive is equipped with a sine filter.

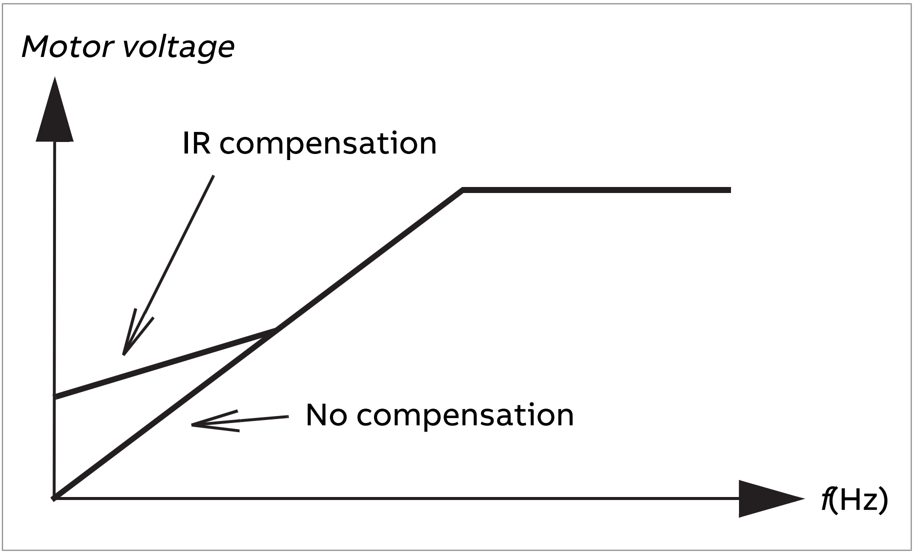
In scalar control, some standard features are not available.

See also section Operating modes of the drive (page 46).

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.

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



Settings and diagnostics

- Parameter group: 28 Frequency reference chain (page 236)
- Parameters: 97.13 IR compensation, 97.94 IR comp max frequency and 99.04 Motor control mode
- Events: -

Vector motor control

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

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

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

Settings and diagnostics

- Parameters: 99.04 Motor control mode and 99.13 ID run requested
- Events: -

Autophasing

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

The autophasing routine is performed with permanent magnet synchronous motors to determine the rotor angle at every start.

Note: The motor always turns when it is started as the shaft is turned towards the remanence flux.

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

U/f ratio

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

The function has two modes: linear and squared.

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

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

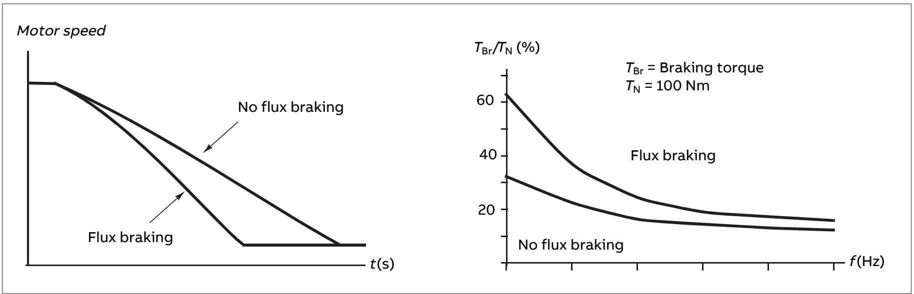
The U/f function cannot be used with energy optimization; if parameter 45.11 Energy optimizer is set to Enable, parameter 97.20 U/F Ratio is ignored.

Settings and diagnostics

- Parameters: 45.11 Energy optimizer and 97.20 U/F Ratio
- Events: -

Flux braking

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



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

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

Two braking power levels are available:

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

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

Settings and diagnostics

- Parameter: 97.05 Flux braking
- Events: -

DC magnetization

The drive has different magnetization functions for different phases of motor start/rotation/stop: pre-magnetization, DC hold, and 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 parameter 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 in parameter 21.02 Magnetization time, it is possible to synchronize the motor start and, for example, the release of a mechanical brake.

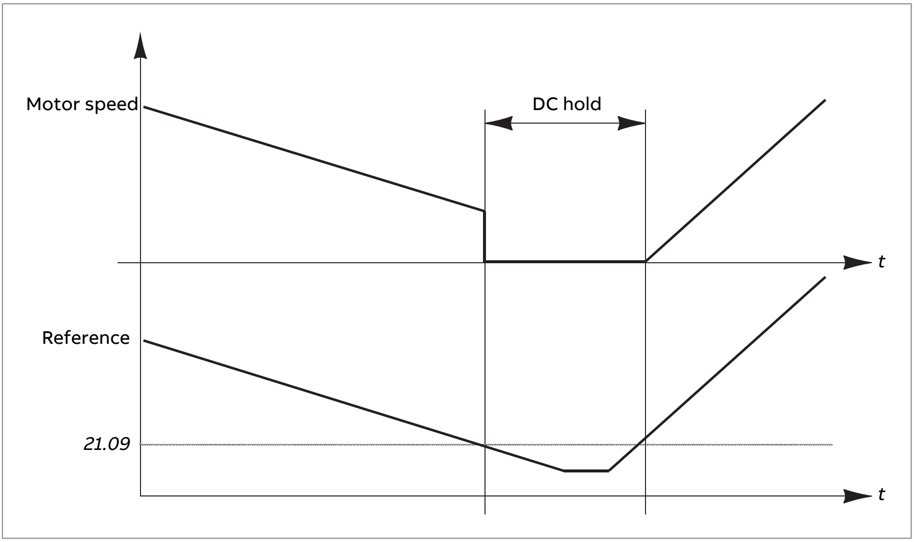
Settings and diagnostics

- Parameters: 21.01 Start mode, 21.19 Scalar start mode and 21.02 Magnetization time
- Events: -

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 and diagnostics

- Parameters: 21.08 DC current control and 21.09 DC hold speed
- Events: -

DC brake

This function enables DC injection braking after modulation has stopped for a certain period - parameter 21.11 Post magnetization time. DC injection braking can be used to quickly stop the motor without using a mechanical brake.

DC brake is activated by parameter 21.08 DC current control. The DC braking current is set by parameter 21.10 DC current reference.

Post-magnetization

The function keeps the motor magnetized for a certain period after stopping - see parameter 21.11 Post magnetization time. 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 and diagnostics

- Parameters: 21.03 Stop mode, 21.08 DC current control and 21.11 Post magnetization time

- Events: -

Pre-heating (Motor heating)

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

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

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

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

Notes

- In applications where the motor keeps rotating for a long time after the modulation is stopped, it is recommended to use ramp stop with pre-heating to prevent a sudden pull at the rotor when the pre-heating is activated.
- The heating function requires that the STO circuit is closed or not triggered open.
- The heating function requires that the drive is not faulted.
- The heating function is allowed even if Run permissive signal is missing.
- Pre-heating uses DC hold to produce current.
- The heating function is allowed even if Start enable signal is missing.

Settings and diagnostics

- Parameters: 21.14 Pre-heating input source, 21.15 Pre-heating time delay and 21.16 Pre-heating current
- Events: -

Energy optimization

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

Note: With a permanent magnet motor energy optimization is always enabled.

Settings and diagnostics

- Parameter: 45.11 Energy optimizer
- Events: -

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 ACH180 drives hardware manual (3AXD50000955862 [English]).

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

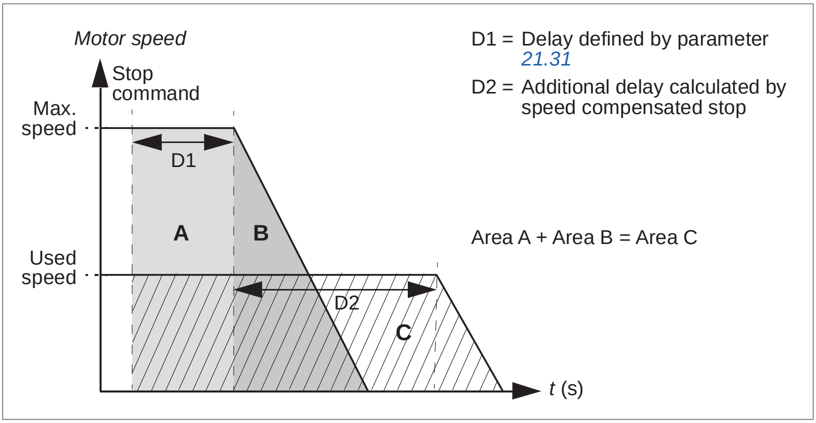
Example 2: If the reference switching frequency is set to 12 kHz and the minimum switching frequency is set to the smallest available value, the drive maintains the highest possible switching frequency to reduce motor noise and only when the drive heats will it decrease the switching frequency. This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

Settings and diagnostics

- Parameters: 97.01 Switching frequency reference and 97.02 Minimum switching frequency
- Events: -

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 and diagnostics

- Parameters: 21.30 Speed compensated stop mode, 21.31 Speed comp stop delay and 21.32 Speed comp stop threshold
- Events: -

Motor thermal protection

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

The motor temperature can be monitored using

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

Motor thermal protection model

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

1. When power is applied to the drive for the first time, the motor is assumed to be at ambient temperature - defined by parameter 35.50 Motor ambient

temperature. After this, when power is applied to the drive, the motor is assumed to be at the estimated temperature.

2. Motor temperature is calculated using the user-adjustable motor thermal time and motor load curve. The load curve should be adjusted in case the ambient temperature exceeds 30 °C.

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

Insulation

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

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

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

Temperature monitoring using Pt100 sensors

1…3 Pt100 sensors can be connected in series to an analog input and an analog output.

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

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

See section Insulation (page 108).

For the wiring of the sensor, see section AI1 and AI2 as Pt100, Pt1000, Ni1000, KTY83 and KTY84 sensor inputs (page 110).

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

See section Insulation (page 108).

For the wiring of the sensor, see section AI1 and AI2 as Pt100, Pt1000, Ni1000, KTY83 and KTY84 sensor inputs (page 110).

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

See section Insulation (page 108).

For the wiring of the sensor, see section AI1 and AI2 as Pt100, Pt1000, Ni1000, KTY83 and KTY84 sensor inputs (page 110).

Temperature monitoring using KTY83 sensors

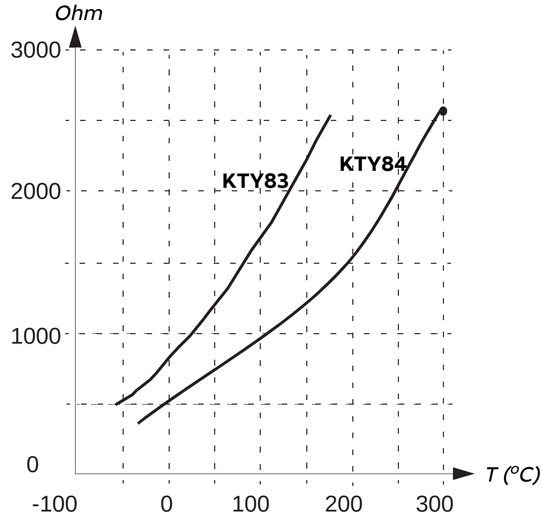
One KTY83 sensor can be connected to an analog input and an analog output on the control unit.

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
90	936	1569
110	1063	1774
130	1197	1993
150	1340	2225



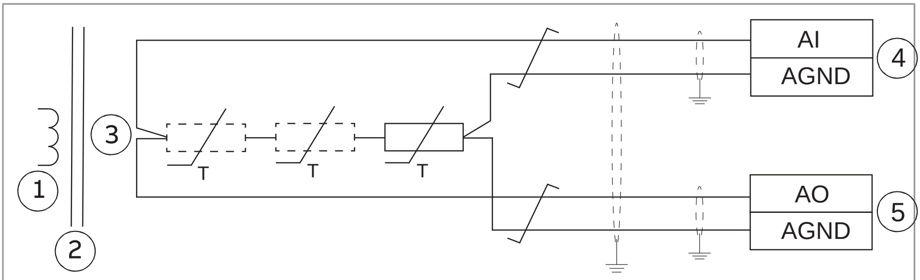
It is possible to adjust the motor temperature supervision limits and select how the drive reacts when overtemperature is detected.

See section Insulation (page 108).

For the wiring of the sensor, see section AI1 and AI2 as Pt100, Pt1000, Ni1000, KTY83 and KTY84 sensor inputs (page 110).

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

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



1	Motor winding

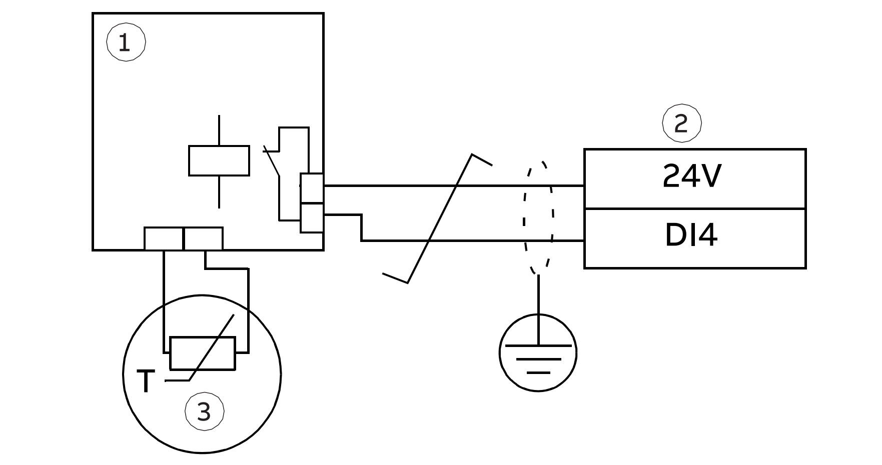
2	Double or reinforced insulation
3	1…3 × (Pt100 or Pt1000) or 1 × (Ni1000 or KTY83 or KTY84)
4	Select the input type to voltage for analog input AI1 or AI2 with parameters. Set the appropriate analog input unit to V (volt) in parameter group 12 Standard AI (page 173).
5	Select the excitation mode in parameter group 13 Standard AO (page 179).

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

Temperature monitoring using thermistor relays

A normally closed or a normally open thermistor relay can be connected to digital input DI4.

See section Insulation (page 108).



1	Thermistor relay
2	Control board
3	Motor

Settings

- Parameter group: 35 Motor thermal protection (page 296).

Motor overload protection

This section describes motor overload protection without using motor thermal protection model, either with estimated or measured temperature. For protection with the motor thermal protection model, see section Motor thermal protection (page 107).

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

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

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

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

Using class 20 satisfies the UL 508C requirements.

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

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

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

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

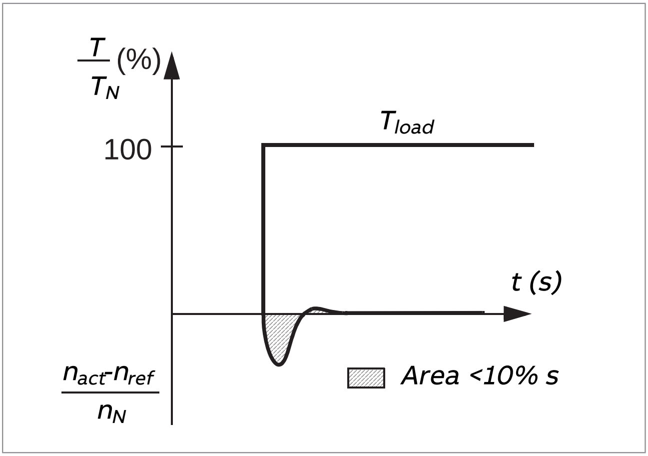
Settings

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

Speed control performance figures

The table below shows typical performance figures for speed control.

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



T_N = rated motor torque

n_N = rated motor speed

n_{act} = actual speed

n_{ref} = speed reference

Floating point control (Motor potentiometer)

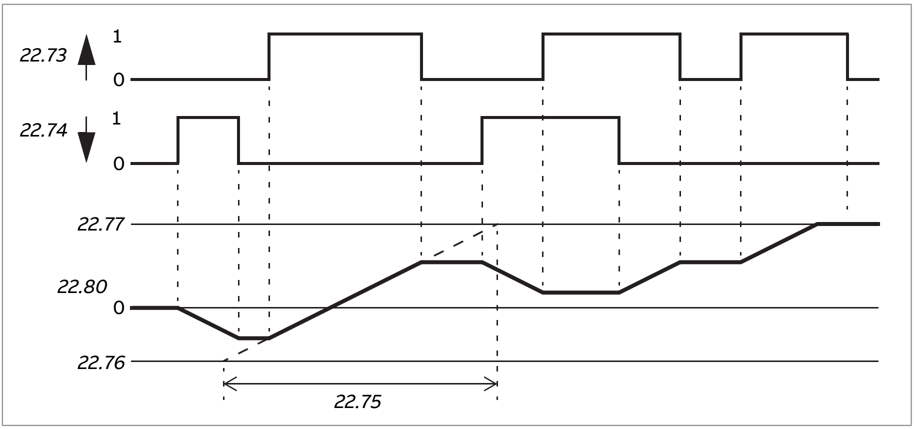
The Floating point control (parameters are named Motor potentiometer, however) is, in effect, a counter whose value can be adjusted up and down using two digital signals selected by parameters 22.73 Motor potentiometer up source and 22.74 Motor potentiometer down source.

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

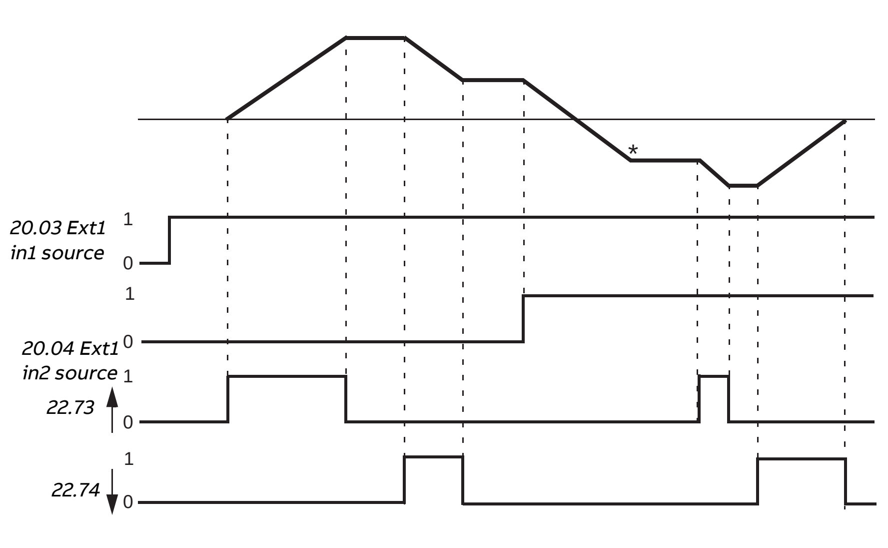
The change rate is defined in parameter 22.75 Motor potentiometer ramp time as the time it would take for the value to change from the minimum (parameter 22.76 Motor potentiometer min value) to the maximum (parameter 22.77 Motor potentiometer max value) or vice versa. If the up and down signals are simultaneously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

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

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



Parameters 22.73 Motor potentiometer up source and 22.74 Motor potentiometer down source control speed or frequency from zero to maximum speed or frequency. The running direction can be changed with parameter 20.04 Ext1 in2 source. See the following example.



*Output speed or frequency has reached the reference value.

Settings

- Parameters: 22.71 Motor potentiometer function…22.80 Motor potentiometer ref act.

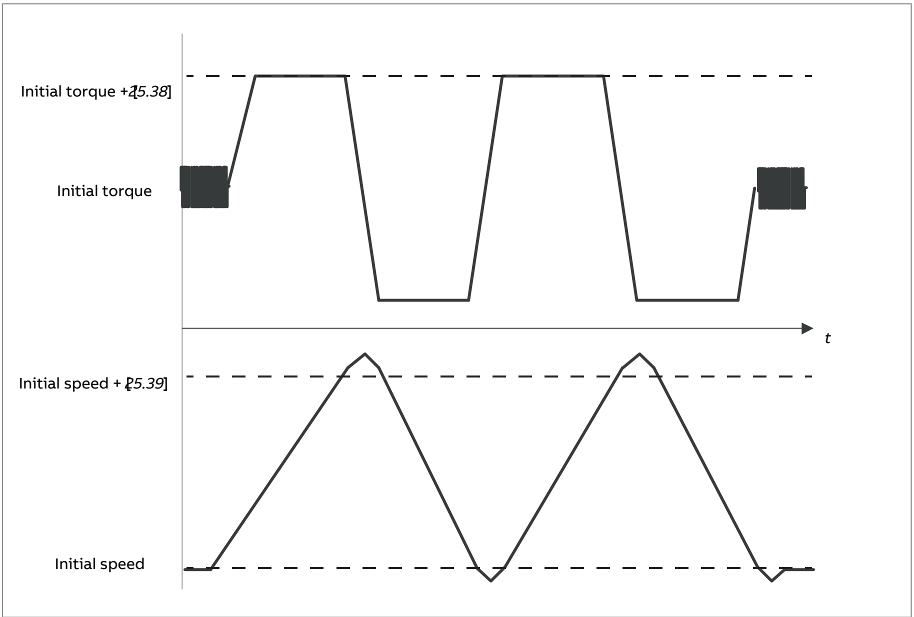
Speed controller autotune

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

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

The maximum torque reference used during autotuning will be the initial torque (i.e. torque when the routine is activated) plus the value of parameter 25.38 Autotune torque step, unless limited by the maximum torque limit (parameter group 30 Limits (page 249)) or the nominal motor torque (parameter group 99 Motor data (page 390)). The calculated maximum speed during the routine is the initial speed (ie.speed when the routine is activated) + the value of parameter 25.39 Autotune speed step, unless limited by parameter 30.12 Maximum speed or 99.09 Motor nominal speed.

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



Note:

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

Before activating the autotune routine

The prerequisites for performing the autotune routine are the following:

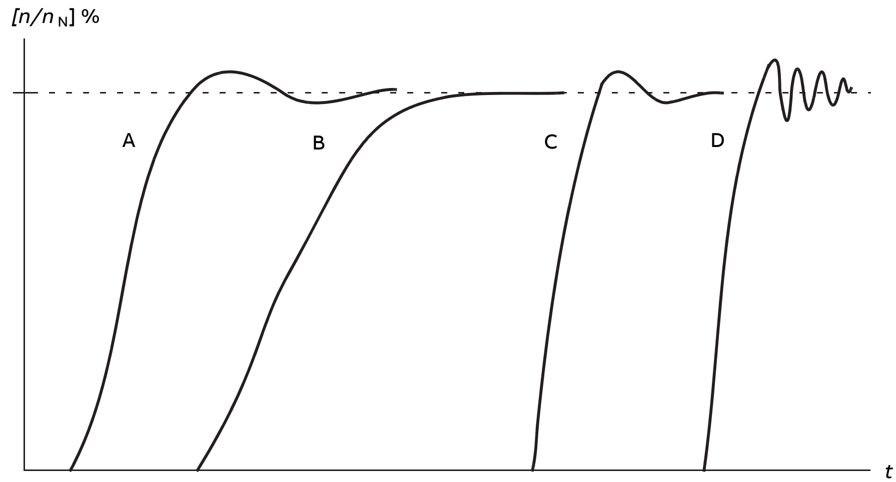
- The motor identification run (ID run) has been successfully completed
- Speed and torque limits (parameter group 30 Limits (page 249)) have been set, and
- speed error filtering (parameter group 24 Speed reference conditioning (page 228)) and zero speed (parameters 21.06 Zero speed limit and 21.07 Zero speed delay) have been set to eliminate these disturbances.
- The drive has been started and is running in speed control mode.

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

Autotune modes

Autotuning can be performed in three different ways depending on the setting of parameter 25.34 Speed controller autotune mode. 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

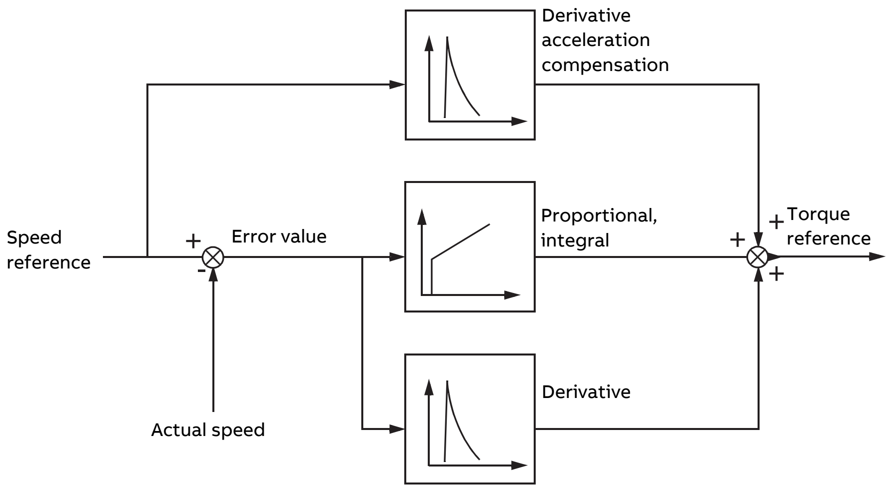
<u>Autotune results</u>

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

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

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

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



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

Warning indications

A warning message, AF90 Speed controller autotuning, will be generated if the autotune routine does not complete successfully. See chapter Fault tracing (page 405) for further information.

Settings and diagnostics

- Parameters: 25.33 Speed controller autotune…25.40 Autotune repeat times
- Event: AF90 Speed controller autotuning.

DC voltage control

Overvoltage control

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

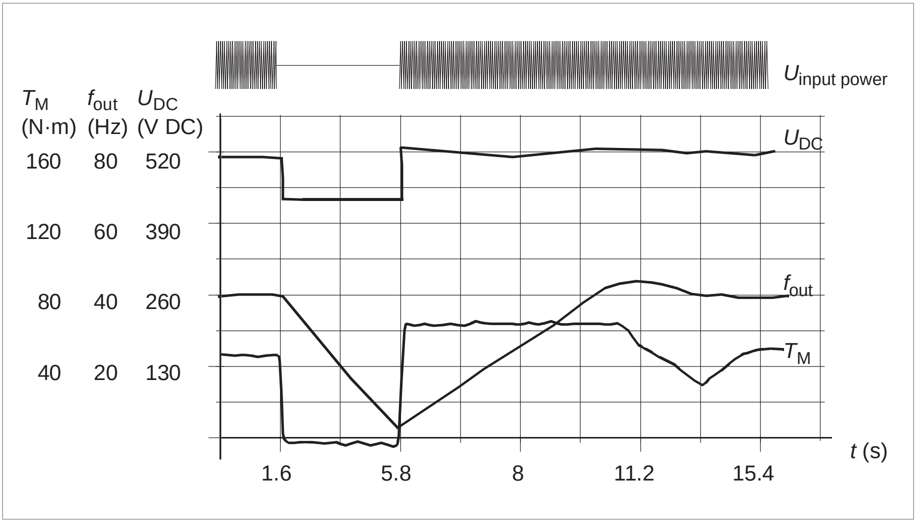
See also section Voltage control and trip limits (page 120).

Undervoltage control (power loss ride-through)

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

See also section Voltage control and trip limits (page 120).

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



U_{DC} = Intermediate circuit voltage of the drive

f_{out} = Output frequency of the drive

T_M = Motor torque

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

Implementing the undervoltage control (power loss ride-through)

Implement the undervoltage control function as follows:

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

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

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

Voltage control and trip limits

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

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

DC voltage levels

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

Adaptive voltage limit enabled by parameter 95.02 Adaptive voltage limits:

DC voltage level [V] **See parameter 95.01 Supply voltage.**	**95.01 Supply voltage**			
	AC supply voltage range [V] 208…240	**AC supply voltage range [V] 380…415**	**AC supply voltage range [V] 440…480**	**Automatic / Not selected**
Overvoltage fault limit	421	842	842	842
Overvoltage control limit	389	779	779	779
Internal brake chopper start limit	389	779	779	779
Internal brake chopper stop limit	379	759	759	759
Overvoltage warning limit	372	745	745	745
Undervoltage warning limit	0.85×1.41×par. 95.03 value	0.85×1.41×par. 95.03 value	0.85×1.41×par. 95.03 value	0.85×1.41×par. 95.03 value
Undervoltage control limit	0.78×1.41×par. 95.03 value	0.78×1.41×par. 95.03 value	0.78×1.41×par. 95.03 value	0.78×1.41×par. 95.03 value
Charging relay closing limit / charging deactivation	0.78×1.41×par. 95.03 value	0.78×1.41×par. 95.03 value	0.78×1.41×par. 95.03 value	0.78×1.41×par. 95.03 value
Charging relay opening limit / charging activation	0.73×1.41×par. 95.03 value	0.73×1.41×par. 95.03 value	0.73×1.41×par. 95.03 value	0.73×1.41×par. 95.03 value
DC voltage at upper bound of supply voltage range (*U*DCmax)	324	560	648	(variable)
DC voltage at lower bound of supply voltage range (*U*DCmin)	281	513	594	(variable)
Standby limit 3)	0.73×1.41×par. 95.03 value	0.73×1.41×par. 95.03 value	0.3×1.41×par. 95.03 value	0.73×1.41×par. 95.03 value

DC voltage level [V] See parameter 95.01 Supply voltage.	95.01 Supply voltage			
	AC supply voltage range [V] 208…240	AC supply voltage range [V] 380…415	AC supply voltage range [V] 440…480	Automatic / Not selected
Note: Parameter 95.03 Estimated AC supply voltage is the estimated AC supply voltage while powering up the drive and it will not be continuously updated during run time.				

Adaptive voltage limit disabled by parameter 95.02 Adaptive voltage limits:

DC voltage level [V] See parameter 95.01 Supply voltage.	95.01 Supply Voltage				
	AC supply voltage range [V] 208…240	AC supply voltage range [V] 380…415	AC supply voltage range [V] 440…480	Automatic / Not selected	
				if 95.03 < 456 V AC	if 95.03 > 456 V AC
Overvoltage fault limit	421	842	842	842	842
Overvoltage control limit	389	779	779	779	779
Internal brake chopper start limit	389	779	779	779	779
Internal brake chopper stop limit	379	759	759	759	759
Overvoltage warning limit	372	745	745	745	745
Undervoltage warning limit	0.85×1.35×208 = 239	0.85×1.35×380 = 436	0.85×1.35×440 = 504	0.85×1.35×380 = 436	0.85×1.35×440 = 505
Undervoltage control limit	0.78×1.35×208 = 219	0.78×1.35×380 = 400	0.78×1.35×440 = 463	0.78×1.35×380 = 400	0.78×1.35×440 = 463
Charging relay closing limit / charging deactivation	0.78×1.35×208 = 219	0.78×1.35×380 = 400	0.78×1.35×440 = 463	0.78×1.35×380 = 400	0.78×1.35×440 = 463

DC voltage level [V] **See parameter 95.01 Supply voltage.**	**95.01 Supply Voltage**				
	AC supply voltage range [V] 208…240	**AC supply voltage range [V] 380…415**	**AC supply voltage range [V] 440…480**	**Automatic / Not selected**	
				if 95.03 < 456 V AC	**if 95.03 > 456 V AC**
Charging relay opening limit / charging activation	0.73×1.35x208 = 205	0.73×1.35x380 = 374	0.73×1.35x440 = 433	0.73×1.35x380 = 374	0.73×1.35x440 = 433
DC voltage at upper bound of supply voltage range (*U*DCmax)	324	560	648	(variable)	(variable)
DC voltage at lower bound of supply voltage range (*U*DCmin)	281	513	594	(variable)	(variable)
Standby limit	0.73×1.35×208 = 205	0.73×1.35×380 = 374	0.73×1.35×440 = 433	0.73×1.35×380 = 374	0.73×1.35×440 = 433
Under-voltage fault limit 1)	0.73×1.35×208 = 205	0.73×1.35×380 = 374	0.73×1.35×440 = 433	0.73×1.35×380 = 374	0.73×1.35×440 = 433
1) See section Triggering the undervoltage fault (page 123).					

Triggering the undervoltage warning

The undervoltage warning A3A2 DC link undervoltage is triggered if the DC link voltage goes below the undervoltage warning limit when the drive is not modulating.

Triggering the undervoltage fault

The undervoltage fault 3220 DC link undervoltage is triggered if the drive is modulating and the DC link voltage goes below the undervoltage trip limit.

Settings

- Parameters: 01.11 DC voltage, 30.30 Overvoltage control, 30.31 Undervoltage control, 95.01 Supply voltage and 95.02 Adaptive voltage limits
- Events: A3A2 DC link undervoltage warning and 3220 DC link undervoltage fault.

Supervisory

Signal supervision

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

The supervised signal is low-pass filtered.

Settings

- Parameter group: 32 Supervision (page 272).

Application example: Dirty filter

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

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

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

Application example: High current

The supervisory function can be used to monitor motor current for increasing or excessive loading. This increase in loading may be due to mechanical failure/wear. A single "high current" threshold may be used with the supervisory function. Alternately, parameter group 37 User load curve (page 308) can be used to detect this scenario throughout the entire speed range, as shown under User load curve (page 125).

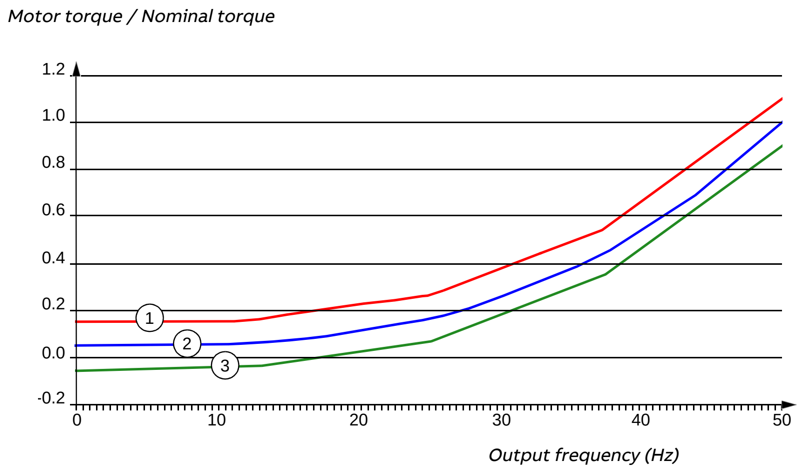
For example, a fan bearing is beginning to fail due to lack of lubrication. The bearing surfaces are beginning to bind, causing the motor current draw to exceed its normal level. The supervisory function indicates the load is drawing higher current than normal. As a result, service personnel can investigate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

User load curve

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

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

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



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

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

Overload can be, for example, used to monitor for fan load profiles becoming too high.

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

The load curve can be used as a trigger for the pump cleaning function. (Underload = blocked inlet on the pump, Overload = blockage in the pump impeller or output of the pump).

The user load curve can also, over a longer time period, be used to demonstrate when the efficiency of a pump system may be dropping so it can be used along with a maintenance trigger.

Settings

- Parameter group: 37 User load curve (page 308).

Application example: Proof of flow

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

For example, during commissioning of the fan, the motor torque is recorded with the belt installed and the fan operating at 50% speed. The drive control panel is capable of displaying the motor torque. See parameter 01.10 Motor torque.

Using this value as a reference point, a low torque threshold is determined to indicate a broken belt indication. This technique verifies that not only the drive is running the motor, but that the motor is also loaded by the application. A time delay value is available and configurable to allow for system variables. A relay output can be configured for the user load curve (proof of flow) status.

Energy efficiency

Energy optimization

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

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

Settings

- Parameter: 45.11 Energy optimizer.

Energy saving calculators

This feature consists of the following functionalities:

- An energy optimizer that adjusts the motor flux in such a way that the total system efficiency is maximized
- A counter that monitors used and saved energy by the motor and displays them in kWh, currency or volume of CO2 emissions, and
- A load analyzer showing the load profile of the drive.

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

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

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

Settings

- Parameter group: 45 Energy efficiency (page 338)
- Parameters: 01.50 Current hour kWh, 01.51 Previous hour kWh, 01.52 Current day kWh and 01.53 Previous day kWh
- Parameters: 01.55 Inverter GWh counter (resettable), 01.56 Inverter MWh counter (resettable), 01.57 Inverter kWh counter (resettable) and 01.58 Cumulative inverter energy (resettable).

Load analyzer

Peak value logger

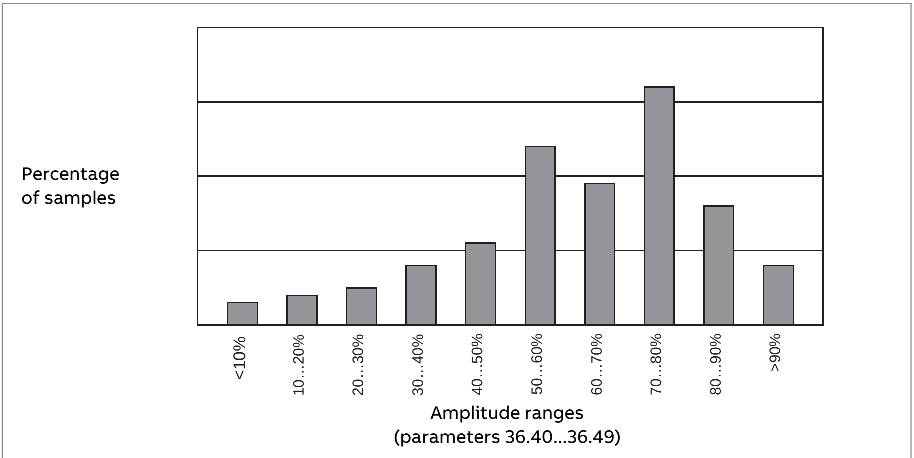
The user can select a signal to be monitored by a peak value logger. The logger records the peak value of the signal along with the time the peak occurred, as well as motor current, DC voltage and motor speed at the time of the peak. The peak value is sampled at 2 ms intervals.

Amplitude loggers

The control program has two amplitude loggers.

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

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



Amplitude logger 1 is fixed to monitor motor current, and cannot be reset. With amplitude logger 1, 100% corresponds to the maximum output current of the drive (*I*max), which is listed in the Hardware manual of the drive. The measured current is logged continuously. The distribution of samples is shown by parameters 36.20 AL1 0 to 10%…36.29 AL1 over 90%.

Settings

- Parameter group: 36 Load analyzer (page 304).

User parameter sets

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

A user parameter set contains all editable values in parameter groups 10 Standard DI, RO (page 160)…99 Motor data (page 390) except:

- forced I/O values such as 10.03 DI force selection and 10.04 DI forced data

- data storage parameters (parameter group 47 Data storage (page 347))
- Embedded fieldbus communication settings (parameter group 58 Embedded fieldbus (page 350))
- some hardware settings in parameter group 95 HW configuration (page 368) - for example parameter 95.01 Supply voltage
- user set selection parameters 96.11 User set save/load…96.13 User set I/O mode in2.

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

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

Settings and diagnostics

- Parameters: 10.03 DI force selection…10.04 DI forced data, 95.01 Supply voltage and 96.10 User set status…96.13 User set I/O mode in2
- Event: 64B2 User set fault.

System safety and protections

Fixed/Standard protections

Overcurrent

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

DC overvoltage

See section Overvoltage control (page 119).

DC undervoltage

See section Undervoltage control (power loss ride-through) (page 119).

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.

Programmable protection functions

Motor phase loss detection (parameter 31.19)

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

Supply phase loss detection (parameter 31.21)

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

Safe torque off detection (parameter 31.22)

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

Swapped supply and motor cabling (parameter 31.23)

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

Stall protection (parameters 31.24…31.28)

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

Overspeed protection (parameters 31.30…31.31)

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

AI supervision (parameters 12.03…12.04)

The parameters select how the drive reacts when an analog input signal moves out of the minimum and/or maximum limits specified for the input. This can be due to broken I/O wiring or sensor.

Emergency stop

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

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

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

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

Note:

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

Settings

- Parameters: 21.04 Emergency stop mode, 21.05 Emergency stop source, 23.23 Emergency stop time, 31.32 Emergency ramp supervision and 31.33 Emergency ramp supervision delay.

Miscellaneous

Backup and restore

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

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

Backup

Manual backup

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

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

Automatic backup

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

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

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

Restore

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

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

Settings and diagnostics

- Parameter: 96.07 Parameter save manually
- Event: -

Data storage parameters

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 347).

Parameter checksum calculation

Two parameter checksums, A and B, can be calculated from a set of parameters to monitor changes in the drive configuration. The sets are different for checksums

A and B. Each of these checksum is compared to the corresponding reference checksum; in case of a mismatch, an event (a pure event, warning or fault) is generated. The calculated checksum can be set as the new reference checksum.

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

The parameters included in the checksum A calculation are user editable parameters in parameter groups 10 Standard DI, RO…13 Standard AO, 19 Operation mode…25 Speed control, 28 Frequency reference chain, 30 Limits…32 Supervision, 34 Timed functions…37 User load curve, 40 Process PID set 1…41 Process PID set 2, 45 Energy efficiency…46 Monitoring/scaling settings, 70 Override, 95 HW configuration…99 Motor data.

The set of parameters for checksum B does not include

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

The parameters included in the checksum B calculation are user editable parameters in parameter groups 10 Standard DI, RO…13 Standard AO, 19 Operation mode…25 Speed control, 28 Frequency reference chain, 30 Limits…32 Supervision, 34 Timed functions…37 User load curve, 40 Process PID set 1…41 Process PID set 2, 46 Monitoring/scaling settings, 70 Override, 95 HW configuration…97 Motor control.

Settings

- Parameters: 96.54 Checksum action…96.69 Actual checksum B, 96.71 Approved checksum A…96.72 Approved checksum B.

User lock

User lock

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

WARNING!
ABB will not be liable for damages or losses caused by the failure to activate the user lock using a new pass code. See Cyber security disclaimer (page 17).

To activate the user lock for the first time:

- Enter the default pass code, 10000000, into parameter 96.02 Pass code. This will make parameters 96.100 Change user pass code…96.102 User lock functionality visible.
- Enter a new pass code into parameter 96.100 Change user pass code. Always use eight digits; if using Drive composer PC tool, finish with Enter.

- Confirm the new pass code in parameter 96.101 Confirm user pass code.

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

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

Settings

- Parameters: 96.02 Pass code and 96.100 Change user pass code…96.102 User lock functionality.

AI dead band

Users can define a dead band value for the analog input signals with parameter 12.110 AI dead band. The value is valid for analog inputs AI1 and AI2, and for the voltage and/or milliampere signals. A dead band value of 100% corresponds to 10 V for a voltage signal and 20 mA for a current signal.

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

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

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

Example: Parameter 12.110 AI dead band is set to 50%.

In case of voltage signal:

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

- AI dead band hysteresis negative value = 5 - 0.5 = 4.5 V

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

6

Parameters

Contents of this chapter

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

Terms and abbreviations

Term	Definition
Actual signal	Type of parameter that is the result of a measurement or calculation by the drive, or contains status information. Most actual signals are read-only, but some (especially counter-type actual signals) can be reset.
Def	(In the following table, shown on the same row as the parameter name) The default value of a parameter when used in the HVAC macro. **Note:** Certain configurations or optional equipment may require specific default values.
FbEq 16b / 32b	(In the following table, shown on the same row as the parameter range, or for each selection) The scaling between the integer used in communication and the value shown on the panel when a 16-bit value is selected for transmission to an external system. The scaling is indicated for both 16-bit and 32-bit values.
Other	The value is taken from another parameter. Choosing “Other” displays a parameter list in which the user can specify the source parameter.

Term	Definition
Other [bit]	The value is taken from a specific bit in another parameter. Choosing “Other” displays a parameter list in which the user can specify the source parameter and bit.
Parameter	Either a user-adjustable operating instruction for the drive, or an actual signal.
p.u.	Per unit
[parameter number in square brackets]	The value of the parameter.

Parameter group summary

Parameter listing

No.	Name / Range / Selection	Description	Def / Type FbEq 16b / 32b
01	Actual values	Basic signals for monitoring the drive. All parameters in this group are read-only. **Note:** Values of these actual signals are filtered with the filter time defined in parameter group 46 Monitoring/scaling settings (page 343). The selection lists for parameters in other parameter 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.	0.00 rpm / real32
	-30000.00 … 30000.00 rpm	Estimated motor speed. For scaling, see parameter 46.01 Speed scaling.	1 = 1 rpm / 100 = 1 rpm
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.	0.00 rpm / real32
	-30000.00 … 30000.00 rpm	Estimated motor speed.	1 = 1 rpm / 100 = 1 rpm
01.03	Motor speed %	Motor speed in percent of the synchronous motor speed.	0.00 percent / real32
	-1000.00 … 1000.00 %	Motor speed.	10 = 1 % / 100 = 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.	0.00 Hz / real32
	-500.00 … 500.00 Hz	Estimated output frequency.	10 = 1 Hz / 100 = 1 Hz
01.07	Motor current	Measured (absolute) motor current in A.	0.00 A / real32
	0.00 … 30000.00 A	Motor current.	1 = 1 A / 100 = 1 A
01.08	Motor current % of motor nom	Motor current (drive output current) in percent of the nominal motor current.	0.0 percent / real32
	0.0 … 1000.0 %	Motor current.	1 = 1 % / 10 = 1 %
01.09	Motor current % of drive nom	Motor current (drive output current) in percent of the nominal drive current.	0.0 percent / real32
	0.0 … 1000.0 %	Motor current.	1 = 1 % / 10 = 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.	0.0 percent / real32
	-1600.0 … 1600.0 %	Motor torque.	10 = 1 % / 10 = 1 %

No.	Name / Range / Selection	Description	Def / Type FbEq 16b / 32b
01.11	DC voltage	Measured DC link voltage.	0.00 V / real32
	0.00 … 2000.00 V	DC link voltage.	10 = 1 V / 100 = 1 V
01.13	Output voltage	Calculated motor voltage in V AC.	0 V / real32
	0…2000 V	Motor voltage.	1 = 1 V / 1 = 1 V
01.14	Output power	Drive output power. The unit is selected by parameter 96.16 Unit selection. A filter time constant for this signal can be defined by parameter 46.14 Filter time power.	0.00 kW or hp / real32
	-32768.00 … 32767.00 kW or hp	Output power.	1 = 1 kW or hp / 100 = 1 kW or hp
01.15	Output power % of motor nom	Output power in percent of the nominal motor power.	0.00 percent / real32
	-300.00 … 300.00 %	Output power.	10 = 1 % / 100 = 1 %
01.17	Motor shaft power	Estimated mechanical power at motor shaft.	0.00 kW or hp / real32
	-32768.00 … 32767.00 kW or hp	Motor shaft power.	1 = 1 kW or hp / 100 = 1 kW or hp
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 GWh / uint16
	0…65535 GWh	Energy in GWh.	1 = 1 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, parameter 01.18 Inverter GWh counter is incremented. The minimum value is zero.	0 MWh / uint16
	0…1000 MWh	Energy in MWh.	1 = 1 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, parameter 01.19 Inverter MWh counter is incremented. The minimum value is zero.	0 kWh / real32
	0…1000 kWh	Energy in kWh.	10 = 1 kWh / 1 = 1 kWh
01.24	Flux actual %	Used flux reference in percent of nominal flux of motor.	0 percent / real32
	0…200 %	Flux reference.	1 = 1 % / 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 Nm or lbft / uint32
	0.000 … 4000000.000 Nm or lbft	Nominal torque.	1 = 100 Nm or lbft / 100 = 1 Nm or lbft

No.	Name / Range / Selection	Description	Def / Type FbEq 16b / 32b
01.50	Current hour kWh	Current hour energy consumption. This is the energy of the last 60 minutes (not necessarily continuous) the drive has been running, not the energy of a calendar hour. If the power is cycled, after the drive is again up and running, the parameter value is set to the value it had before the power cycle.	0.00 kWh / real32
	0.00 … 1000000.00 kWh	Energy.	- / 100 = 1 kWh
01.51	Previous hour kWh	Previous hour energy consumption. The value of parameter 01.50 Current hour kWh is stored here when its values has been cumulated for 60 minutes. If the power is cycled, after the drive is again up and running, the parameter value is set to the value it had before the power cycle.	0.00 kWh / real32
	0.00 … 1000000.00 kWh	Energy.	- / 100 = 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. If the power is cycled, after the drive is again up and running, the parameter value is set to the value it had before the power cycle.	0.00 kWh / real32
	0.00 … 1000000.00 kWh	Energy.	- / 100 = 1 kWh
01.53	Previous day kWh	Previous day energy consumption. The value of parameter 01.52 Current day kWh is stored here when its value has been cumulated for 24 hours. If the power is cycled, after the drive is again up and running, the parameter value is set to the value it had before the power cycle.	0.00 kWh / real32
	0.00 … 1000000.00 kWh	Energy.	- / 100 = 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.	0.0 kWh / real32
	-200000000.0 … 200000000.0 kWh	Energy in kWh.	10 = 1 kWh / 1 = 1 kWh
01.55	Inverter GWh counter (resettable)	Amount of energy that has passed through the drive (in either direction) in full gigawatt-hours. The minimum value is zero. You can reset the value by setting it to zero or by pressing the Reset softkey for 3 seconds. Resetting any of parameters 01.55…01.58 resets all of them.	0 GWh / uint16
	0…65535 GWh	Energy in GWh.	1 = 1 GWh / 1 = 1 GWh

No.	Name / Range / Selection	Description	Def / Type FbEq 16b / 32b
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, parameter 01.55 Inverter GWh counter (resettable) is incremented. The minimum value is zero. You can reset the value by setting it to zero or by pressing the Reset softkey for 3 seconds. Resetting any of parameters 01.55…01.58 resets all of them.	0 MWh / uint16
	0...1000 MWh	Energy in MWh.	1 = 1 MWh / 1 = 1 MWh
01.57	Inverter kWh counter (resettable)	Amount of energy that has passed through the drive (in either direction) in full kilowatt-hours. Whenever the counter rolls over, parameter 01.56 Inverter MWh counter (resettable) is incremented. The minimum value is zero. You can reset the value by setting it to zero or by pressing the Reset softkey for 3 seconds. Resetting any of parameters 01.55…01.58 resets all of them.	0 kWh / real32
	0...1000 kWh	Energy in kWh.	10 = 1 kWh / 1 = 1 kWh
01.58	Cumulative inverter energy (resettable)	Amount of energy that has passed through the drive (in either direction) in full kilowatt-hours. The minimum value is zero. You can reset the value by setting it to zero or by pressing the Reset softkey for 3 seconds. Resetting any of parameters 01.55…01.58 resets all of them.	0.0 kWh / real32
	-200000000.0 ... 200000000.0 kWh	Energy in kWh.	10 = 1 kWh / 1 = 1 kWh
01.61	Abs motor speed used	Absolute value of parameter 01.01 Motor speed used.	0.00 rpm / real32
	0.00 ... 30000.00 rpm	Estimated motor speed.	1 = 1 rpm / 100 = 1 rpm
01.62	Abs motor speed %	Absolute value of parameter 01.03 Motor speed %.	0.00 percent / real32
	0.00 ... 1000.00 %	Estimated motor speed.	10 = 1 % / 100 = 1 %
01.63	Abs output frequency	Absolute value of parameter 01.06 Output frequency.	0.00 Hz / real32
	0.00 ... 500.00 Hz	Estimated output frequency.	10 = 1 Hz / 100 = 1 Hz
01.64	Abs motor torque	Absolute value of parameter 01.10 Motor torque.	0.00 percent / real32
	0.0 ... 1600.0 %	Motor torque.	10 = 1 % / 10 = 1 %
01.65	Abs output power	Absolute value of parameter 01.14 Output power.	0.00 kW / real32
	0.00 ... 32767.00 kW	Output power.	1 = 1 kW / 100 = 1 kW
01.66	Abs output power % motor nom	Absolute value of parameter 01.15 Output power % of motor nom.	0.00 percent / real32
	0.00 ... 300.00 %	Output power.	10 = 1 % / 1 = 1 %

No.	Name / Range / Selection	Description	Def / Type FbEq 16b / 32b
01.68	Abs motor shaft power	Absolute value of parameter 01.17 Motor shaft power.	0.00 kW or hp / real32
	0.00 … 32767.00 kW or hp	Motor shaft power.	1 = 1 kW or hp / 100 = 1 kW or hp

No.	Name / Range / Selection	Description	Def / Type FbEq 16b / 32b
03	Input references	Values of references received from various sources. All parameters in this group are read-only.	
03.01	Panel reference	Reference 1 given from the control panel or PC tool.	0.00 NoUnit / real32
	-100000.00 ... 100000.00	Control panel or PC tool reference.	1 = 10 / 100 = 1
03.02	Panel reference remote	Reference 2 given from the control panel or PC tool.	0.00 NoUnit / real32
	-100000.00 ... 100000.00	Control panel or PC tool reference.	1 = 10 / 100 = 1
03.09	EFB reference 1	Scaled reference 1 received through the embedded fieldbus interface.	0.00 NoUnit / real32
	-30000.00 ... 30000.00	Scaled reference 1 received through the embedded fieldbus interface.	1 = 10 / 100 = 1
03.10	EFB reference 2	Scaled reference 2 received through the embedded fieldbus interface.	0.00 NoUnit / real32
	-30000.00 ... 30000.00	Scaled reference 2 received through the embedded fieldbus interface.	1 = 10 / 100 = 1
03.17	Integrated Panel ref	Local mode reference given from the integrated control panel. The unit (rpm, Hz or %) is set from parameter.	0.00 NoUnit / real32
	-100000.00 ... 100000.00	Integrated control panel reference.	1 = 10 / 100 = 1
03.18	Integrated Panel ref remote	Remote mode reference given from the integrated control panel.	0.00 NoUnit / real32
	-100000.00 ... 100000.00	Integrated control panel reference.	1 = 10 / 100 = 1

No.	Name / Range / Selection	Description	Def / Type FbEq 16b / 32b
04	Warnings and faults	Information on warnings and faults that occurred last. For explanations of individual warning and fault codes, see chapter Fault tracing (page 405). All parameters in this group are read-only unless otherwise noted. Fault and event logs can be cleared with parameter 96.51 Clear fault and event logger.	
04.01	Tripping fault	Code of the 1st active fault (the fault that caused the current trip).	0000h / uint16
	0000h…FFFFh	1st active fault.	1 = 1
04.02	Active fault 2	Code of the 2nd active fault.	0000h / uint16
	0000h…FFFFh	2nd active fault.	1 = 1
04.03	Active fault 3	Code of the 3rd active fault.	0000h / uint16
	0000h…FFFFh	3rd active fault.	1 = 1
04.06	Active warning 1	Code of the 1st active warning.	0000h / uint16
	0000h…FFFFh	1st active warning.	1 = 1
04.07	Active warning 2	Code of the 2nd active warning.	0000h / uint16
	0000h…FFFFh	2nd active warning.	1 = 1
04.08	Active warning 3	Code of the 3rd active warning.	0000h / uint16
	0000h…FFFFh	3rd active warning.	1 = 1
04.11	Latest fault	Code of the 1st stored (non-active) fault.	0000h / uint16
	0000h…FFFFh	1st stored fault.	1 = 1
04.12	2nd latest fault	Code of the 2nd stored (non-active) fault.	0000h / uint16
	0000h…FFFFh	2nd stored fault.	1 = 1
04.13	3rd latest fault	Code of the 3rd stored (non-active) fault.	0000h / uint16
	0000h…FFFFh	3rd stored fault.	1 = 1
04.16	Latest warning	Code of the 1st stored (non-active) warning.	0000h / uint16
	0000h…FFFFh	1st stored warning.	1 = 1
04.17	2nd latest warning	Code of the 2nd stored (non-active) warning.	0000h / uint16
	0000h…FFFFh	2nd stored warning.	1 = 1
04.18	3rd latest warning	Code of the 3rd stored (non-active) warning.	0000h / uint16
	0000h…FFFFh	3rd stored warning.	1 = 1
04.40	Event word 1	User-defined event word. This word collects the status of the events (warnings, faults or pure events) selected by parameters 04.41…04.71.	0000h / uint16
b0	User bit 0	1 = Event selected by parameter 04.41 is active	
b1	User bit 1	1 = Event selected by parameter 04.43 is active	

No.	Name / Range / Selection	Description	Def / Type FbEq 16b / 32b
b15	User bit 15	1 = Event selected by parameter 04.71 is active	
	0000h…FFFFh		1 / 1
04.41	Event word 1 bit 0 code	Selects the hexadecimal code of an event (warning, fault or pure event) whose status is shown as bit 0 of parameter 04.40 Event word 1. The event codes are listed in chapter Fault tracing (page 405). This parameter is adjustable.	0000h / uint16
	0000h…FFFFh	Default fault 2310 Overcurrent.	1 = 1
04.43	Event word 1 bit 1 code	Selects the hexadecimal code of an event (warning, fault or pure event) whose status is shown as bit 1 of parameter 04.40 Event word 1. The event codes are listed in chapter Fault tracing (page 405). This parameter is adjustable.	0000h / uint16
	0000h…FFFFh	Default fault 3210 DC link overvoltage.	1 = 1
04.45	Event word 1 bit 2 code	Default fault 4310 Excess temperature. This parameter is adjustable.	0000h / uint16
	0000h…FFFFh		1 = 1
04.47	Event word 1 bit 3 code	Default fault 2340 Short circuit. This parameter is adjustable.	0000h / uint16
	0000h…FFFFh		1 = 1
04.49	Event word 1 bit 4 code	No default fault. This parameter is adjustable.	0000h / uint16
	0000h…FFFFh		1 = 1
04.51	Event word 1 bit 5 code	Default fault 3220 DC link undervoltage. This parameter is adjustable.	0000h / uint16
	0000h…FFFFh		1 = 1
04.53	Event word 1 bit 6 code	Default fault 80A0 AI supervision fault. This parameter is adjustable.	0000h / uint16
	0000h…FFFFh		1 = 1
04.55	Event word 1 bit 7 code	No default fault. This parameter is adjustable.	0000h / uint16
	0000h…FFFFh		1 = 1
04.57	Event word 1 bit 8 code	Default fault 7122 Motor overload. This parameter is adjustable.	0000h / uint16
	0000h…FFFFh		1 = 1

No.	Name / Range / Selection	Description	Def / Type FbEq 16b / 32b
04.59	Event word 1 bit 9 code	Default fault 7081 Control panel loss. This parameter is adjustable.	0000h / uint16
	0000h…FFFFh		1 = 1
04.61	Event word 1 bit 10 code	Default fault FF61 ID run. This parameter is adjustable.	0000h / uint16
	0000h…FFFFh		1 = 1
04.63	Event word 1 bit 11 code	Default fault 7121 Motor stall. This parameter is adjustable.	0000h / uint16
	0000h…FFFFh		1 = 1
04.65	Event word 1 bit 12 code	Default fault 4110 Control board temperature. This parameter is adjustable.	0000h / uint16
	0000h…FFFFh		1 = 1
04.67	Event word 1 bit 13 code	Default fault 9081 External event 1. This parameter is adjustable.	0000h / uint16
	0000h…FFFFh		1 = 1
04.69	Event word 1 bit 14 code	Default fault 9082 External event 2. This parameter is adjustable.	0000h / uint16
	0000h…FFFFh		1 = 1
04.71	Event word 1 bit 15 code	Selects the hexadecimal code of an event (warning, fault or pure event) whose status is shown as bit 15 of parameter 04.40 Event word 1. Default fault 2330 Earth leakage. The events are listed in chapter Fault tracing (page 405). This parameter is adjustable.	0000h / uint16
	0000h…FFFFh	Code of event.	1 = 1

No.	Name / Range / Selection	Description	Def / Type FbEq 16b / 32b
05	Diagnostics	Various run-time-type counters and measurements related to drive maintenance. All parameters in this group are read-only.	
05.01	On-time counter	On-time counter. The counter runs when the drive is powered.	0 days / uint16
	0…65535 days	On-time counter.	1 = 1 days / 1 = 1 days
05.02	Run-time counter	Motor run-time counter in full days. The counter runs when the inverter modulates.	0 days / uint16
	0…65535 days	Motor run-time counter.	1 = 1 days / 1 = 1 days
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 h / uint32
	0.0 … 429496729.5 h	Hours.	- / 10 = 1 h
05.04	Fan on-time counter	Running time of the drive cooling fan. Can be reset from the control panel by pressing the Reset softkey for 3 seconds.	0 days / uint16
	0…65535 days	Cooling fan run-time counter.	1 = 1 days / 1 = 1 days
05.10	Control board temperature	Measured temperature of the control board.	0 °C or °F / real32
	-100…300 °C or °F	Control board temperature in degrees Celsius or Fahrenheit.	1 = 1 °C or °F / 10 = 1 °C or °F
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	0.0 percent / real32
	-40.0 … 160.0 %	Drive temperature in percent.	1 = 1 % / 10 = 1 %
05.20	Diagnostic word 1	Diagnostic word 1. For possible causes and remedies, see chapter Fault tracing (page 405).	0000 0000 0000 0000 / uint16
b0	Any warning or fault	1 = Drive has generated a warning or tripped on a fault. 0 = No warning or fault active.	
b1	Any warning	1 = Drive has generated a warning. 0 = No warning active.	
b2	Any fault	1 = Drive has tripped on a fault. 0 = No fault active.	
b3	Reserved		
b4	Overcurrent flt	1 = Drive has tripped on fault 2310 Overcurrent.	
b5	Reserved		
b6	DC overvoltage	1 = Drive has tripped on fault 3210 DC link overvoltage.	
b7	DC undervoltage	1 = Drive has tripped on fault 3220 DC link undervoltage.	

No.	Name / Range / Selection	Description	Def / Type FbEq 16b / 32b
b8	Reserved		
b9	Device overtemp flt	1 = Drive has tripped on fault 4310 Excess temperature.	
b10…15	Reserved		
	0000h…FFFFh		1 = 1 / 1 = 1
05.21	Diagnostic word 2	Diagnostic word 2. For possible causes and remedies, see chapter Fault tracing (page 405).	0000 0000 0000 0000 / uint16
b0…9	Reserved		
b10	Motor overtemp flt	1 = Drive has tripped on fault 4981 External temperature 1.	
b11…15	Reserved		
	0000h…FFFFh		1 = 1 / 1 = 1
05.22	Diagnostic word 3	Diagnostic word 3.	0000 0000 0000 0000 / uint16
b0…8	Reserved		
b9	kWh pulse	1 = kWh pulse is active.	
b10	Reserved		
b11	Fan command	1 = Drive fan is rotating above idle speed.	
b12…15	Reserved		
	0000h…FFFFh		1 = 1 / 1 = 1
05.80	Motor speed at fault	Copy of parameter 01.01 Motor speed used at the occurrence of the latest fault. Parameters 05.80…05.89 are shown for each fault in the fault log.	0.00 rpm / real32
	-30000.00 … 30000.00 rpm	Estimated motor speed.	1 = 1 rpm / 100 = 1 rpm
05.81	Output frequency at fault	Shows the value of copy of parameter 01.06 Output frequency at the occurrence of the latest fault.	0.00 Hz / real32
	-500.00 … 500.00 Hz	Estimated output frequency.	1 = 1 Hz / 100 = 1 Hz
05.82	DC voltage at fault	Shows the value of copy of parameter 01.11 DC voltage at the occurrence of the latest fault.	0.00 V / real32
	0.00 … 2000.00 V	DC link voltage.	10 = 1 V / 100 = 1 V
05.83	Motor current at fault	Shows the value of copy of parameter 01.07 Motor current at the occurrence of the latest fault.	0.00 A / real32
	0.00 … 30000.00 A	Motor current.	1 = 1 A / 100 = 1 A
05.84	Motor torque at fault	Shows the value of copy of parameter 01.10 Motor torque at the occurrence of the latest fault.	0 percent / real32
	-1600…1600 %	Motor torque.	1 = 1 % / 10 = 1 %
05.85	Main status word at fault	Shows the value of copy of parameter 06.11 Main status word at the occurrence of the latest fault.	0000h / uint16
	0000h…FFFFh		1 = 1 / 1 = 1

No.	Name / Range / Selection	Description	Def / Type FbEq 16b / 32b
05.86	DI delayed status at fault	Shows the value of copy of parameter 10.02 DI delayed status at the occurrence of the latest fault.	0000h / uint16
	0000h…FFFFh		1 = 1 / 1 = 1
05.87	Inverter temperature at fault	Shows the value of copy of parameter 05.11 Inverter temperature at the occurrence of the latest fault.	0 °C or °F / real32
	-40...160 °C or °F	Drive temperature in Celsius or Farenheit.	1 = 1 °C or °F / 10 = 1 °C or °F
05.88	Reference used at fault	Shows the value of copy of parameter 28.01 Frequency ref ramp input (in scalar control mode) or 23.01 Speed ref ramp input (in speed control mode) at the occurrence of the latest fault.	0.00 NoUnit / real32
	-30000.00 ... 30000.00	Frequency or speed reference.	1 = 1 / 1 = 1
05.89	HVAC status word at fault	Shows the value of copy of parameter 06.22 HVAC status word at the occurrence of the latest fault.	0000h / uint16
	0000h…FFFFh		1 = 1 / 1 = 1

No.	Name / Range / Selection	Description	Def / Type FbEq 16b / 32b
06	Control and status words	Drive control and status words. All parameters in this group are read-only unless otherwise noted.	
06.01	Main control word	Shows the control signals as received from the selected sources (such as digital inputs, the fieldbus interfaces and the application program). The main control word of the drive. Refer to The ABB Drives profile (page 437) and The DCU profile (page 446) for the bit descriptions, the related status word and state diagram for the ABB drives profile. **Note:** When using fieldbus control, this parameter value is not same as the Control word value that the drive receives from PLC.	0000h / uint16
	0000h…FFFFh		1 / 1
06.11	Main status word	Main status word of the drive. Refer to The ABB Drives profile (page 437) and The DCU profile (page 446) for the bit descriptions, the related control word and state diagram for the ABB drives profile. **Note:** When using fieldbus control, this parameter value is not same as the Status word value that the drive sends to PLC.	0000h / uint16
	0000h…FFFFh		1 / 1
06.16	Drive status word 1	Drive status word 1.	0000 0000 0000 0000 / uint16
b0	Enabled	1 = If start interlock signals (parameters 20.41…20.44) are all present. **Note:** This bit is not affected by the presence of a fault.	
b1	Inhibited	1 = Start inhibited. To start the drive, the inhibiting signal (see parameter 06.18 Start inhibit status word) must be removed and the start signal cycled.	
b2	DC charged	1 = DC circuit has been charged.	
b3	Ready to start	1 = Drive is ready to receive a start command.	
b4	Following reference	1 = Drive is ready to follow given reference.	
b5	Started	1 = Drive has been started.	
b6	Modulating	1 = Drive is modulating (output stage is being controlled).	
b7	Limiting	1 = Any operating limit (speed, torque, etc.) is active.	
b8	Local control	1 = Drive is in local control.	
b9	Network control	1 = Drive is in Network control. See section Terms and abbreviations (page 16).	

No.	Name / Range / Selection	Description	Def / Type FbEq 16b / 32b
b10	Ext1 active	1 = Control location EXT1 active.	
b11	Ext2 active	1 = Control location EXT2 active.	
b12	Reserved		
b13	Start request	1 = If Start requested. 0 = When Run permissive signal (see parameter 20.40 Run permissive) is 0.	
b14	Running	1 = Drive is controlling speed or frequency, in PID sleep or pre-magnetization.	
b15	Reserved		
	0000h…FFFFh		1 / 1
06.17	Drive status word 2	Drive status word 2.	0000 0000 0000 0000 / uint16
b0	Identification run done	1 = Motor identification (ID) run has been performed.	
b1	Magnetized	1 = The motor has been magnetized	
b2	Reserved		
b3	Speed control	1 = Speed control mode active.	
b4	Reserved		
b5	Safe reference active	1 = A “safe” reference is applied by functions such as parameter 49.05 Communication loss action.	
b6	Last speed active	1 = A “last speed” reference is applied by functions such as parameter 49.05 Communication loss action.	
b7	Reserved		
b8	Emergency stop failed	1 = Emergency stop failed (see parameters 31.32 Emergency ramp supervision and 31.33 Emergency ramp supervision delay).	
b9	Reserved		
b10	Above limit	1 = Actual speed or frequency equals or exceeds limit (defined by parameters 46.31 Above speed limit and 46.32 Above frequency limit). Valid in both directions of rotation.	
b11	Emergency stop active	1 = An emergency stop command signal is active, or the drive is stopping after receiving an emergency stop command.	
b12	Reserved		
b13	Start delay active	1 = Start delay (parameter 21.22 Start delay) active.	
b14…15	Reserved		
	0000h…FFFFh		1 / 1

No.	Name / Range / Selection	Description	Def / Type FbEq 16b / 32b
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.	0000 0000 0000 0000 / uint16
b0	Not ready run	1 = DC voltage is missing or drive has not been parametrized correctly. Check the parameters in parameter groups 95 HW configuration (page 368) and 99 Motor data (page 390).	
b1	Ctrl location changed	* 1 = Control location has changed.	
b2	SSW inhibit	1 = Control program is keeping itself in inhibited state.	
b3	Fault reset	* 1 = A fault has been reset.	
b4	Start interlocked	1 = Start interlocked	
b5	Run permissive	1 = Run permissive signal missing	
b6	Reserved		
b7	STO	1 = Safe torque off function active.	
b8	Current calibration ended	* 1 = Current calibration routine has finished.	
b9	ID run ended	* 1 = Motor identification run has finished.	
b10	Reserved		
b11	Em Off1	1 = Emergency stop signal (mode off1).	
b12	Em Off2	1 = Emergency stop signal (mode off2).	
b13	Em Off3	1 = Emergency stop signal (mode off3).	
b14	Auto reset inhibit	1 = The autoreset function is inhibiting operation.	
b15	Reserved		
	0000h…FFFFh		1 / 1
06.19	Speed control status word	Speed control status word.	0000 0000 0000 0000 / uint16
b0	Zero speed	1 = Drive has been running below parameter 21.06 Zero speed limit for a time defined by parameter 21.07 Zero speed delay.	
b1	Forward	1 = Drive is running in forward direction above parameter 21.06 Zero speed limit.	
b2	Reverse	1 = Drive is running in reverse direction above parameter 21.06 Zero speed limit.	
b3…6	Reserved		
b7	Any constant speed request	1 = A constant speed or frequency has been selected; see parameter 06.20 Constant speed status word.	

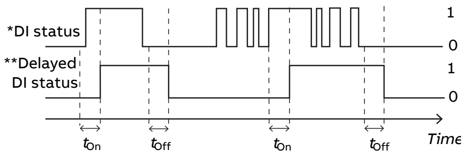
No.	Name / Range / Selection	Description	Def / Type FbEq 16b / 32b
b8…15	Reserved		
	0000h…FFFFh		1 / 1
06.20	Constant speed status word	Constant speed/frequency status word. Indicates which constant speed or frequency is active (if any). See also parameter 06.19 Speed control status word, bit 7, and section Constant speeds/frequencies (page 74).	0000 0000 0000 0000 / uint16
b0	Constant speed 1	1 = Constant speed or frequency 1 selected.	
b1	Constant speed 2	1 = Constant speed or frequency 2 selected.	
b2	Constant speed 3	1 = Constant speed or frequency 3 selected.	
b3	Constant speed 4	1 = Constant speed or frequency 4 selected.	
b4	Constant speed 5	1 = Constant speed or frequency 5 selected.	
b5	Constant speed 6	1 = Constant speed or frequency 6 selected.	
b6	Constant speed 7	1 = Constant speed or frequency 7 selected.	
b7…15	Reserved		
	0000h…FFFFh		1 / 1
06.21	Drive status word 3	Drive status word 3.	0000 0000 0000 0000 / uint16
b0	DC hold active	1 = DC hold is active.	
b1	Post-magnetizing active	1 = Post-magnetizing is active.	
b2	Motor pre-heating active	1 = Motor pre-heating is active.	
b3	PM smooth start active	1 = PM smooth start active.	
b4	Rotor position known	1 = Rotor position is known.	
b5	DC brake active	1 = Brake is active.	
b6…15	Reserved		
	0000h…FFFFh		1 / 1
06.22	HVAC status word	ACH180 specific status word.	0000 0000 0000 0000 / uint16
b0	Hand mode	0 = Drive is not operated from the control panel in the Hand mode. 1 = Drive is operated from the control panel in the Hand mode.	
b1	Off mode	0 = Drive is not in the Off mode. 1 = Drive is in the Off mode.	
b2	Auto mode	0 = Drive is not in the Auto mode. 1 = Drive is in the Auto mode.	

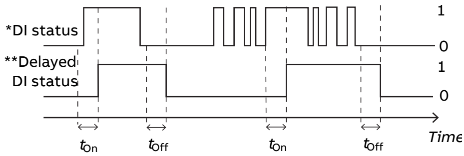
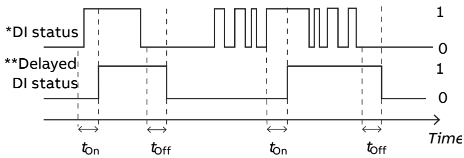
No.	Name / Range / Selection	Description	Def / Type FbEq 16b / 32b
b4	Pre-heating	0 = Motor pre-heating is not active. 1 = Motor pre-heating is active.	
b5	Damper control	0 = Damper control is not active. 1 = Damper control is active.	
b5…6	Reserved		
b7	Run permissive	0 = Run permissive is not present, drive is not allowed to run. 1 = Run permissive is present, drive is allowed to run.	
b8	Start interlock 1	0 = Start interlock 1 is not present, drive is not allowed to start. 1 = Start interlock 1 is present, drive is allowed to start.	
b9	Start interlock 2	0 = Start interlock 2 is not present, drive is not allowed to start. 1 = Start interlock 2 is present, drive is allowed to start.	
b10	Start interlock 3	0 = Start interlock 3 is not present, drive is not allowed to start. 1 = Start interlock 3 is present, drive is allowed to start.	
b11	Start interlock 4	0 = Start interlock 4 is not present, drive is not allowed to start. 1 = Start interlock 4 is present, drive is allowed to start.	
b12	All start interlocks	0 = One or more of Start interlock 1, Start interlock 2, Start interlock 3 or Start interlock 4 is not present, drive is not allowed to start. 1 = Start interlock 1 and Start interlock 2 and Start interlock 3 and Start interlock 4 are all present, drive is allowed to start.	
b13…15	Reserved		
	0000h…FFFFh		1 / 1
06.29	MSW bit 10 selection	Selects a binary source whose status is transmitted as bit 10 (User bit 0) of parameter 06.11 Main status word. This parameter is adjustable.	Above limit / uint32
	False	0.	0
	True	1.	1
	Above limit	Bit 10 of parameter 06.17 Drive status word 2.	2
	Other [bit]	See Terms and abbreviations (page 137).	-
06.30	MSW bit 11 selection	Selects a binary source whose status is transmitted as bit 11 (User bit 0) of parameter 06.11 Main status word. This parameter is adjustable.	Ext ctrl loc / uint32
	False	0.	0
	True	1.	1
	Ext ctrl loc	Bit 11 of parameter 06.01 Main control word.	2

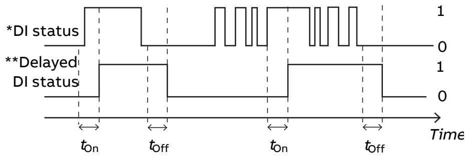
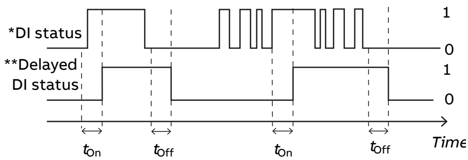
No.	Name / Range / Selection	Description	Def / Type FbEq 16b / 32b
	Other [bit]	See Terms and abbreviations (page 137).	-
06.31	MSW bit 12 selection	Selects a binary source whose status is transmitted as bit 12 (User bit 1) of parameter 06.11 Main status word. This parameter is adjustable.	Run permissive / uint32
	False	0.	0
	True	1.	1
	Run permissive	Bit 5 of parameter 06.18 Start inhibit status word.	3
	Other [bit]	See Terms and abbreviations (page 137).	-
06.32	MSW bit 13 selection	Selects a binary source whose status is transmitted as bit 13 (User bit 2) of parameter 06.11 Main status word. This parameter is adjustable.	False / uint32
	False	0.	0
	True	1.	1
	Other [bit]	See Terms and abbreviations (page 137).	-
06.33	MSW bit 14 selection	Selects a binary source whose status is transmitted as bit 14 (User bit 3) of parameter 06.11 Main status word. This parameter is adjustable.	False / uint32
	False	0.	0
	True	1.	1
	Other [bit]	See Terms and abbreviations (page 137).	-

No.	Name / Range / Selection	Description	Def / Type FbEq 16b / 32b
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.)	- / uint16
07.04	Firmware name	Firmware identification.	- / uint32
	-		1 = 1
07.05	Firmware version	Version number of the firmware.	0.00.0.0 / uint32
	-		1 = 1
07.06	Loading package name	Name of the firmware loading package.	0 / uint32
	-		1 = 1
07.07	Loading package version	Version number of the firmware loading package.	0.00.0.0 / uint32
	-		1 = 1
07.11	Cpu usage	Microprocessor load in percent.	0 percent / uint32
	0...100 %	Microprocessor load.	1 = 1 % / 1 = 1 %
07.30	Adaptive program status	Shows the status of the adaptive program. See section Adaptive programming (page 48).	0000h / uint16
b0	Initialized	1 = Adaptive program initialized.	
b1	Editing	1 = Adaptive program is being edited.	
b2	Edit done	1 = Editing of adaptive program finished.	
b3	Running	1 = Adaptive program running.	
b4…13	Reserved		
b14	State changing	1 = State change in progress in adaptive programming engine.	
b15	Faulted	1 = Error in adaptive program.	
	0000h…FFFFh		1 = 1 / 1 = 1
07.31	AP sequence state	Shows the number of the active state of the sequence program part of the adaptive program (AP). If adaptive programming is not running, or it does not contain a sequence program, the parameter is zero.	0 NoUnit / uint16
	0...20		1 = 1 / 1 = 1

No.	Name / Range / Selection	Description	Def / Type FbEq 16b / 32b
10	Standard DI, RO	Configuration of digital inputs and relay outputs.	
10.01	DI status	Displays the electrical status of digital inputs. This parameter is read-only.	0000h / uint16
b0	DI1	1 = Digital input 1 is ON.	
b1	DI2	1 = Digital input 2 is ON.	
b2	DI3	1 = Digital input 3 is ON.	
b3	DI4	1 = Digital input 4 is ON.	
b4	DI5	1 = Digital input 5 is ON.	
b5…15	Reserved		
	0000h…FFFFh		1 = 1 / 1 = 1
10.02	DI delayed status	Displays the delayed status of digital inputs. This word is updated only after activation / deactivation delays. This parameter is read-only.	0000h / uint16
b0	DI1	1 = Digital input 1 is ON.	
b1	DI2	1 = Digital input 2 is ON.	
b2	DI3	1 = Digital input 3 is ON.	
b3	DI4	1 = Digital input 4 is ON.	
b4	DI5	1 = Digital input 5 is ON.	
b5…14	Reserved		
	0000h…FFFFh		1 = 1 / 1 = 1
10.03	DI force selection	The electrical statuses of the digital inputs can be overridden, for example, for testing purposes. A bit in parameter 10.04 DI forced data is provided for each digital input, and its value is applied whenever the corresponding bit in this parameter is 1. **Note:** Boot and power cycle reset the force selections (parameters 10.03 and 10.04).	0000h / uint16
b0	DI1	1 = Force DI1 to value of bit 0 of parameter 10.04 DI forced data. (0 = Normal mode).	
b1	DI2	1 = Force DI2 to value of bit 1 of parameter 10.04 DI forced data. (0 = Normal mode).	
b2	DI3	1 = Force DI3 to value of bit 2 of parameter 10.04 DI forced data. (0 = Normal mode).	
b3	DI4	1 = Force DI4 to value of bit 3 of parameter 10.04 DI forced data. (0 = Normal mode).	
b4	DI5	1 = Force DI5 to value of bit 4 of parameter 10.04 DI forced data. (0 = Normal mode).	
b5…15	Reserved		

No.	Name / Range / Selection	Description	Def / Type FbEq 16b / 32b
	0000h…FFFFh		1 = 1 / 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 4 is the forced value for the DI5.	0000h / uint16
b0	DI1	Force the value of this bit to D1, if so defined in parameter 10.03 DI force selection.	
b1	DI2	Force the value of this bit to D2, if so defined in parameter 10.03 DI force selection.	
b2	DI3	Force the value of this bit to D3, if so defined in parameter 10.03 DI force selection.	
b3	DI4	Force the value of this bit to D4, if so defined in parameter 10.03 DI force selection.	
b4	DI5	Force the value of this bit to D5, if so defined in parameter 10.03 DI force selection.	
b5…14	Reserved		
	0000h…FFFFh		1 = 1 / 1 = 1
10.05	DI1 ON delay	Defines the activation delay for digital input DI1.  t_{On} = parameter 10.05 DI1 ON delay t_{Off} = parameter 10.06 DI1 OFF delay *Electrical status of digital input. Indicated by parameter 10.01 DI status. **Indicated by parameter 10.02 DI delayed status.	0.00 s / uint32
	0.00 ... 3000.00 s	Activation delay for DI1.	10 = 1 s / 100 = 1 s
10.06	DI1 OFF delay	Defines the deactivation delay for digital input DI1. See parameter 10.05 DI1 ON delay.	0.00 s / uint32
	0.00 ... 3000.00 s	Deactivation delay for DI1.	10 = 1 s / 100 = 1 s

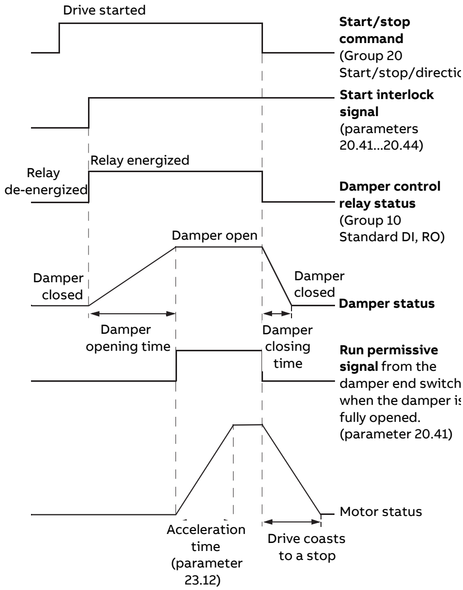
No.	Name / Range / Selection	Description	Def / Type FbEq 16b / 32b
10.07	DI2 ON delay	Defines the activation delay for digital input DI2.  t_{On} = parameter 10.07 DI2 ON delay t_{Off} = parameter 10.08 DI2 OFF delay *Electrical status of digital input. Indicated by parameter 10.01 DI status. **Indicated by parameter 10.02 DI delayed status.	0.00 s / uint32
	0.00 ... 3000.00 s	Activation delay for DI2.	10 = 1 s / 100 = 1 s
10.08	DI2 OFF delay	Defines the deactivation delay for digital input DI2. See parameter 10.07 DI2 ON delay.	0.00 s / uint32
	0.00 ... 3000.00 s	Deactivation delay for DI2.	10 = 1 s / 100 = 1 s
10.09	DI3 ON delay	Defines the activation delay for digital input DI3.  t_{On} = parameter 10.09 DI3 ON delay t_{Off} = parameter 10.10 DI3 OFF delay *Electrical status of digital input. Indicated by parameter 10.01 DI status. **Indicated by parameter 10.02 DI delayed status.	0.00 s / uint32
	0.00 ... 3000.00 s	Activation delay for DI3.	10 = 1 s / 100 = 1 s
10.10	DI3 OFF delay	Defines the deactivation delay for digital input DI3. See parameter 10.09 DI3 ON delay.	0.00 s / uint32
	0.00 ... 3000.00 s	Deactivation delay for DI3.	10 = 1 s / 100 = 1 s

No.	Name / Range / Selection	Description	Def / Type FbEq 16b / 32b
10.11	DI4 ON delay	Defines the activation delay for digital input DI4.  t_{On} = parameter 10.11 DI4 ON delay t_{Off} = parameter 10.12 DI4 OFF delay *Electrical status of digital input. Indicated by parameter 10.01 DI status. **Indicated by parameter 10.02 DI delayed status.	0.00 s / uint32
	0.00 ... 3000.00 s	Activation delay for DI4.	10 = 1 s / 100 = 1 s
10.12	DI4 OFF delay	Defines the deactivation delay for digital input DI4. See parameter 10.11 DI4 ON delay.	0.00 s / uint32
	0.00 ... 3000.00 s	Deactivation delay for DI4.	10 = 1 s / 100 = 1 s
10.13	DI5 ON delay	Defines the activation delay for digital input DI5.  t_{On} = parameter 10.13 DI5 ON delay t_{Off} = parameter 10.14 DI5 OFF delay *Electrical status of digital input. Indicated by parameter 10.01 DI status. **Indicated by parameter 10.02 DI delayed status.	0.00 s / uint32
	0.00 ... 3000.00 s	Activation delay for DI5.	10 = 1 s / 100 = 1 s
10.14	DI5 OFF delay	Defines the deactivation delay for digital input DI5. See parameter 10.13 DI5 ON delay.	0.00 s / uint32
	0.00 ... 3000.00 s	Deactivation delay for DI5.	10 = 1 s / 100 = 1 s
10.21	RO status	Status of relay output RO1.	0000h / uint16
b0	RO1	0 = De-energized. 1 = Energized.	
b1…15	Reserved		
	0000h…FFFFh		1 = 1 / 1 = 1

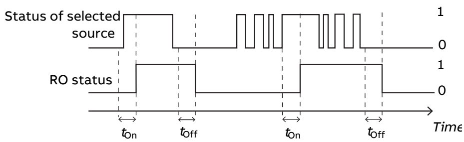
No.	Name / Range / Selection	Description	Def / Type FbEq 16b / 32b
10.22	RO force selection	The signals connected to the relay outputs can be overridden, for example, testing purposes. A bit in parameter 10.23 RO forced data is provided for each relay output, and its value is applied whenever the corresponding bit in this parameter is 1. **Note:** Boot and power cycle reset the force selections (parameters 10.22 and 10.23).	0000h / uint16
b0	RO1	1 = Force RO1 to value of bit 0 of parameter 10.23 RO forced data. (0 = Normal mode)	
b1…15	Reserved		
	0000h…FFFFh		1 = 1 / 1 = 1
10.23	RO forced data	Contains the values of relay outputs that are used instead of the connected signals if selected in parameter 10.22 RO force selection. Bit 0 is the forced value for RO1. **Note:** Boot and power cycle reset the force selections (parameters 10.22 and 10.23).	0000h / uint16
b0	RO1	1 = Force the value of this bit to RO1, if so defined in parameter 10.22 RO force selection.	
b1…15	Reserved		
	0000h…FFFFh		1 = 1 / 1 = 1
10.24	RO1 source	Selects a drive signal to be connected to relay output RO1.	Damper control / uint32
	Not energized	Output is not energized.	0
	Energized	Output is energized.	1
	Ready run	Bit 1 of parameter 06.11 Main status word.	2
	Enabled	Bit 0 of parameter 06.16 Drive status word 1.	4
	Started	Bit 5 of parameter 06.16 Drive status word 1.	5
	Magnetized	Bit 1 of parameter 06.17 Drive status word 2.	6
	Running	Bit 6 of parameter 06.16 Drive status word 1.	7
	Ready ref	Bit 2 of parameter 06.11 Main status word.	8
	At setpoint	Bit 8 of parameter 06.11 Main status word.	9
	Reverse	Bit 2 of parameter 06.19 Speed control status word.	10
	Zero speed	Bit 0 of parameter 06.19 Speed control status word.	11
	Above limit	Bit 10 of parameter 06.17 Drive status word 2.	12
	Warning	Bit 7 of parameter 06.11 Main status word.	13
	Fault	Bit 3 of parameter 06.11 Main status word.	14
	Fault (-1)	Inverted bit 3 of parameter 06.11 Main status word.	15
	Fault/Warning	Bit 3 OR bit 7 of parameter 06.11 Main status word.	16
	Overcurrent	Fault 2310 Overcurrent has occurred.	17

No.	Name / Range / Selection	Description	Def / Type FbEq 16b / 32b
	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 temp difference has occurred.	19
	Undervoltage	Fault 3220 DC link undervoltage has occurred.	20
	Motor temp	Fault 4981 External temperature 1 has occurred.	21
	Ext2 active	Bit 11 of parameter 06.16 Drive status word 1.	23
	Remote control	Bit 9 of parameter 06.11 Main status word.	24
	Timed function 1	Bit 0 of parameter 34.01 Timed functions status.	27
	Timed function 2	Bit 1 of parameter 34.01 Timed functions status.	28
	Timed function 3	Bit 2 of parameter 34.01 Timed functions status.	29
	Supervision 1	Bit 0 of parameter 32.01 Supervision status.	33
	Supervision 2	Bit 1 of parameter 32.01 Supervision status.	34
	Supervision 3	Bit 2 of parameter 32.01 Supervision status.	35
	Start delay	Bit 13 of parameter 06.17 Drive status word 2.	39
	RO/DIO control word bit0	Bit 0 of parameter 10.99 RO/DIO control word.	40
	Event word 1	Event word 1 = 1 if any bit of parameter 04.40 Event word 1 is 1, that is, if any warning, fault or pure event that has been defined with parameters 04.41…04.71 is on.	53

<table>
<tr><th>No.</th><th>Name / Range / Selection</th><th>Description</th><th>Def / Type
FbEq 16b / 32b</th></tr>
<tr><td></td><td>Damper control</td><td>See the figure below.



</td><td>54</td></tr>
<tr><td></td><td>Run permissive</td><td>Bit 7 of parameter 06.22 HVAC status word.</td><td>55</td></tr>
<tr><td></td><td>Start interlock 1</td><td>Bit 8 of parameter 06.22 HVAC status word.</td><td>56</td></tr>
<tr><td></td><td>Start interlock 2</td><td>Bit 9 of parameter 06.22 HVAC status word.</td><td>57</td></tr>
<tr><td></td><td>Start interlock 3</td><td>Bit 10 of parameter 06.22 HVAC status word.</td><td>58</td></tr>
<tr><td></td><td>Start interlock 4</td><td>Bit 11 of parameter 06.22 HVAC status word.</td><td>59</td></tr>
<tr><td></td><td>All start interlocks</td><td>Bit 12 of parameter 06.22 HVAC status word.</td><td>60</td></tr>
<tr><td></td><td>User load curve</td><td>Bit 3 of parameter 37.01 ULC output status word.</td><td>61</td></tr>
<tr><td></td><td>RO/DIO control word</td><td>Maps to corresponding bit in parameter 10.99 RO/DIO control word. For example, Bit 0 of parameter 10.99 RO/DIO control word controls RO1.</td><td>62</td></tr>
<tr><td></td><td>Other [bit]</td><td>See Terms and abbreviations (page 137).</td><td>-</td></tr>
<tr><td>10.25</td><td>RO1 ON delay</td><td>Defines the activation delay for relay output RO1.

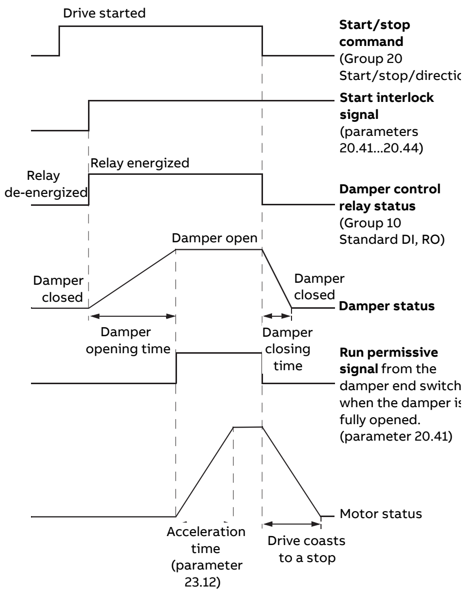


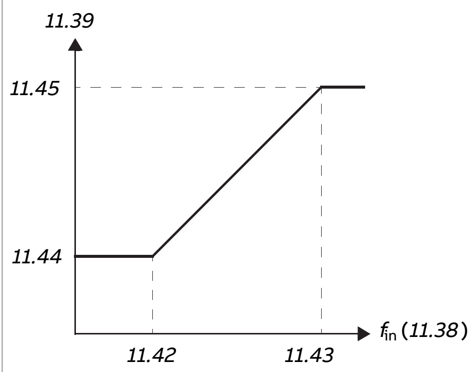
t_{On} = 10.25 RO1 ON delay
t_{Off} = 10.26 RO1 OFF delay</td><td>0.0 s / uint32</td></tr>
</table>

No.	Name / Range / Selection	Description	Def / Type FbEq 16b / 32b
	0.0 ... 3000.0 s	Activation delay for RO1.	10 = 1 s / 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 / uint32
	0.0 ... 3000.0 s	Deactivation delay for RO1.	10 = 1 s / 10 = 1 s
10.99	RO/DIO control word	Storage parameter for controlling the relay outputs, for example, through the embedded fieldbus interface. To control the relay outputs (RO) of the drive, send a control word with the bit assignments shown below as Modbus I/O data. Set the target selection parameter of that particular data (parameters 58.101…58.114) to AO1 data storage. In the source selection parameter of the desired output, select the appropriate bit of this word.	0000h / uint16
b0	RO1	Source bit for relay output RO1. See parameter 10.24 RO1 source.	
b1…7	Reserved		
b8	DIO1	Source bit for digital output DO1. See parameter 11.6 DO1 output source.	
b9…15	Reserved		
	0000h…FFFFh		1 = 1 / 1 = 1
10.101	RO1 toggle counter	Displays the number of times relay output RO1 has changed states. Can be reset from the control panel by keeping Reset down for over 3 seconds.	0 NoUnit / uint32
	0...4294967000	State change count.	- / 1 = 1

No.	Name / Range / Selection	Description	Def / Type FbEq 16b / 32b
11	Standard DIO, FI, FO	Configuration of the frequency input.	
11.02	DIO delayed status	Displays the delayed status of digital output DO1. This word is updated only after activation/deactivation delays (if any are specified). **Example:** 0001 = DO1 is on. This parameter is read-only.	0000h / uint16
b0	DO1	1 = Digital or frequency output DO1 is ON.	
b1…15	Reserved		
	0000h…FFFFh		1 = 1 / 1 = 1
11.03	DIO force selection	The signal connected to the digital output can be overridden for example, testing purposes. A bit in parameter 11.04 DIO force data is provided for digital output DO1, and its value is applied whenever the corresponding bit in this parameter is 1. **Note:** Boot and power cycle reset the force selections (parameters 11.03 and 11.04).	0000h / uint32
b0	DIO1	1 = Force DO1 to value of bit 0 of parameter 11.04 DIO force data. (0 = Normal mode)	
b1…15	Reserved		
	0000h…FFFFh		1 = 1 / 1 = 1
11.04	DIO force data	The signal connected to the digital output can be overridden for, for example, testing purposes. A bit in parameter 11.04 DIO force data is provided for digital output DO1, and its value is applied whenever the corresponding bit in this parameter is 1. **Note:** Boot and power cycle reset the force selections (parameters 11.02 and 11.03).	0000h / uint32
b0	DIO1	Set state of DO1.	
b1…15	Reserved		
	0000h…FFFFh		1 = 1 / 1 = 1
11.06	DO1 output source	Selects a drive signal to be connected to digital output DO1.	Not energized / uint32
	Not energized	Output is not energized.	0
	Energized	Output is energized.	1
	Ready run	Bit 1 of parameter 06.11 Main status word.	2
	Enabled	Bit 0 of parameter 06.16 Drive status word 1.	4
	Started	Bit 5 of parameter 06.16 Drive status word 1.	5
	Magnetized	Bit 1 of parameter 06.17 Drive status word 2.	6
	Running	Bit 6 of parameter 06.16 Drive status word 1.	7
	Ready ref	Bit 2 of parameter 06.11 Main status word.	8

No.	Name / Range / Selection	Description	Def / Type FbEq 16b / 32b
	At setpoint	Bit 8 of parameter 06.11 Main status word.	9
	Reverse	Bit 2 of parameter 06.19 Speed control status word.	10
	Zero speed	Bit 0 of parameter 06.19 Speed control status word.	11
	Above limit	Bit 10 of parameter 06.17 Drive status word 2.	12
	Warning	Bit 7 of parameter 06.11 Main status word.	13
	Fault	Bit 3 of parameter 06.11 Main status word.	14
	Fault (-1)	Inverted bit 3 of parameter 06.11 Main status word.	15
	Fault/Warning	Bit 3 OR bit 7 of parameter 06.11 Main status word.	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 temp difference has occurred.	19
	Undervoltage	Fault 3220 DC link undervoltage has occurred.	20
	Motor temp	Fault 4981 External temperature 1 has occurred.	21
	Ext2 active	Bit 11 of parameter 06.16 Drive status word 1.	23
	Remote control	Bit 9 of parameter 06.11 Main status word.	24
	Timed function 1	Bit 0 of parameter 34.01 Timed functions status.	27
	Timed function 2	Bit 1 of parameter 34.01 Timed functions status.	28
	Timed function 3	Bit 2 of parameter 34.01 Timed functions status.	29
	Supervision 1	Bit 0 of parameter 32.01 Supervision status.	33
	Supervision 2	Bit 1 of parameter 32.01 Supervision status.	34
	Supervision 3	Bit 2 of parameter 32.01 Supervision status.	35
	Start delay	Bit 13 of parameter 06.17 Drive status word 2.	39
	RO/DIO control word bit0	Bit 0 of parameter 10.99 RO/DIO control word.	40
	Event word 1	Event word 1 = 1 if any bit of parameter 04.40 Event word 1 is 1, that is, if any warning, fault or pure event that has been defined with parameters 04.41…04.71 is on.	53

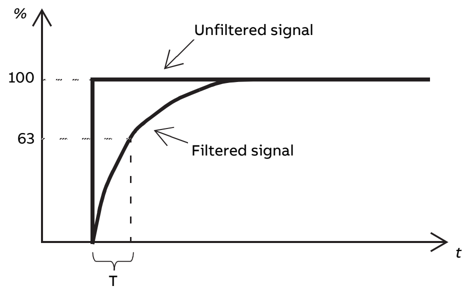
No.	Name / Range / Selection	Description	Def / Type FbEq 16b / 32b
	Damper control	See the figure below.  	54
	Run permissive	Bit 7 of parameter 06.22 HVAC status word.	55
	Start interlock 1	Bit 8 of parameter 06.22 HVAC status word.	56
	Start interlock 2	Bit 9 of parameter 06.22 HVAC status word.	57
	Start interlock 3	Bit 10 of parameter 06.22 HVAC status word.	58
	Start interlock 4	Bit 11 of parameter 06.22 HVAC status word.	59
	All start interlocks	Bit 12 of parameter 06.22 HVAC status word.	60
	User load curve	Bit 3 of parameter 37.01 ULC output status word.	61
	RO/DIO control word	For parameter 10.24 RO1 source: Bit 0 (RO1) of parameter 10.99 RO/DIO control word.	62
	Other [bit]	See Terms and abbreviations (page 137).	-
11.07	DO1 ON delay	Defines the on (activation) delay for DO1.	0.0 s / uint32
	0.0 ... 3000.0 s	Activation delay for DO1.	10 = 1 s / 10 = 1 s
11.08	DO1 OFF delay	Defines the deactivation delay for DO1.	0.0 s / uint32
	0.0 ... 3000.0 s	Deactivation delay for DO1.	10 = 1 s / 10 = 1 s
11.13	DI3 configuration	Selects the type of digital input DI3: normal digital input or frequency input.	Digital input / uint16
	Digital input	Digital input. See parameter 11.42 Freq in 1 min for more information.	0
	Frequency input	Frequency input.	1

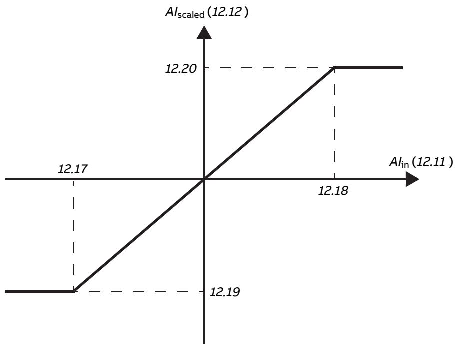
No.	Name / Range / Selection	Description	Def / Type FbEq 16b / 32b
11.17	DI4 configuration	Selects how digital input 4 is used.	Digital input / uint16
	Digital input	DI4 is used as a digital input.	0
	Frequency input	DI4 is used as a frequency input 1.	1
11.21	DI5 configuration	Selects how digital input 5 is used.	Analog input 1 / uint16
	Digital input 5	DI5 is used as a digital input.	0
	Analog input 1	DI5 is used as an analog output.	2
11.38	Freq in 1 actual value	Displays the value of frequency input 1 before scaling. See parameter 11.42 Freq in 1 min. This parameter is read-only.	0 Hz / real32
	0...16000 Hz	Unscaled value of frequency input 1.	1 = 1 Hz / 1 = 1 Hz
11.39	Freq in 1 scaled value	This parameter is read-only.	0.000 NoUnit / real32
	-32768.000 ... 32767.000	Scaled value of frequency input 1.	1 = 1 / 1000 = 1
11.42	Freq in 1 min	The incoming frequency signal (parameter 11.38 Freq in 1 actual value) is scaled into an internal signal (parameter 11.39 Freq in 1 scaled value) by parameters 11.42…11.45 as follows: 	0 Hz / real32
	0...16000 Hz	Minimum frequency of frequency input 1.	1 = 1 Hz / 1 = 1 Hz
11.43	Freq in 1 max	Defines the maximum value of the frequency signal actually arriving at frequency input 1. See parameter 11.42 Freq in 1 min.	16000 Hz / real32
	0...16000 Hz	Maximum frequency of frequency input 1.	1 = 1 Hz / 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 NoUnit / real32
	-32768.000 ... 32767.000	Value corresponding to minimum of frequency input 1.	1 = 1 / 1000 = 1

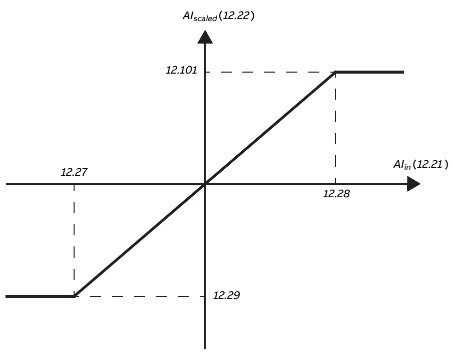
No.	Name / Range / Selection	Description	Def / Type FbEq 16b / 32b
11.45	Freq in 1 at scaled max	Defines the value that is required to correspond internally to the maximum input frequency defined by parameter 11.43 Freq in 1 max. See diagram at parameter 11.42 Freq in 1 min.	1500.000; 1800.000 (95.20 b0) NoUnit / real32
	-32768.000 ... 32767.000	Value corresponding to maximum of frequency input 1.	1 = 1 / 1000 = 1
11.46	Freq in 2 actual value	Displays the value of frequency input 2. See parameter 11.50 Freq in 2 min. This parameter is read-only.	0 Hz / real32
	0...16000 Hz	Unscaled value of frequency input 2.	1 = 1 Hz / 1 = 1 Hz
11.47	Freq in 2 scaled	Displays the value of frequency input 2. See parameter 11.50 Freq in 2 min. This parameter is read-only.	0.000 NoUnit / real32
	-32768.000 ... 32767.000	Scaled value of frequency input 2.	1 = 1 / 1000 = 1
11.50	Freq in 2 min	Defines the minimum value for frequency input 2.	0 Hz / real32
	0...16000 Hz	Minimum frequency of frequency input 2.	1 = 1 Hz / 1 = 1 Hz
11.51	Freq in 2 max	Defines the maximum value for frequency input 2.	16000 Hz / real32
	0...16000 Hz	Maximum frequency for frequency input 2.	1 = 1 Hz / 1 = 1 Hz
11.52	Freq in 2 at scaled min	Defines the real value that corresponds to the minimum frequency input 2 value defined by parameter 11.50 Freq in 2 min.	0.000 NoUnit / real32
	-32768.000 ... 32767.000	Value corresponding to minimum of frequency input 2.	1 = 1 / 1000 = 1
11.53	Freq in 2 at scaled max	Defines the real value that corresponds to the maximum frequency input 2 value defined by parameter 11.51 Freq in 2 max.	15000.000 NoUnit / real32
	-32768.000 ... 32767.000	Value corresponding to maximum of frequency input 2.	1 = 1 / 1000 = 1

No.	Name / Range / Selection	Description	Def / Type FbEq 16b / 32b
12	Standard AI	Configuration of standard analog inputs.	
12.02	AI force selection	The true readings of the analog inputs can be overridden, for example, for testing purposes. A forced value parameter is provided for each analog input, and its value is applied whenever the corresponding bit in this parameter is 1. **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). • Boot and power cycle reset the force selections (parameters 12.02 and 12.03).	0000h / uint16
b0	AI1	1 = Force AI1 to value of parameter 12.13 AI1 forced value.	
b1	AI2	1 = Force AI2 to value of parameter 12.23 AI2 forced value.	
b2…15	Reserved		
	0000h…FFFFh		1 = 1 / 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 / uint16
	No action	No action taken.	0
	Fault	Drive trips on 80A0 AI supervision fault.	1
	Warning	Drive generates an 80A0 AI supervision fault warning.	2
	Last speed	Drive generates a warning (80A0 AI supervision fault) 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 lowpass filtering. **WARNING!** Make sure that it is safe to continue operation in case of a communication break.	3

No.	Name / Range / Selection	Description	Def / Type FbEq 16b / 32b
	Speed ref safe	Drive generates a warning (80A0 AI supervision fault) and sets the speed to the speed defined by parameter 22.41 Speed ref safe (or parameter 28.41 Frequency ref safe when frequency reference is being used). **WARNING!** Make sure that it is safe to continue operation in case of a communication break.	4
12.04	AI supervision selection	Specifies the analog input limits to be supervised. See parameter 12.03 AI supervision function.	0000h / uint16
b0	AI1 < MIN	1 = Minimum limit supervision of AI1 active.	
b1	AI1 > MAX	1 = Maximum limit supervision of AI1 active.	
b2	AI2 < MIN	1 = Minimum limit supervision of AI2 active.	
b3	AI2 > MAX	1 = Maximum limit supervision of AI2 active.	
b4…15	Reserved		
	0000h…FFFFh		1 = 1 / 1 = 1
12.05	AI supervision force	Activates/deactivates analog input supervision for each control location (see section Local control vs. external control (page 39). When a control location does not utilize AI for referencing, you can use this parameter to deactivate AI supervision (12.04). This hides the AI supervision function (12.03) for the selected control location.	0000h / uint16
b0	AI1 Ext1	1 = AI1 supervision is active when EXT1 is used.	
b1	AI1 Ext2	1 = AI1 supervision is active when EXT2 is used.	
b2	AI1 Local	1 = AI1 supervision is active when local control is used.	
b3	Reserved		
b4	AI2 Ext1	1 = AI2 supervision is active when EXT1 is used.	
b5	AI2 Ext2	1 = AI2 supervision is active when EXT2 is used.	
b6	AI2 Local	1 = AI2 supervision is active when local control is used.	
b7…15	Reserved		
	0000h…FFFFh		1 = 1 / 1 = 1
12.11	AI1 actual value	Displays the value of analog input AI1 in mA or V (depending on whether the input is set to current or voltage by a hardware setting). This parameter is read-only.	0.000 V or mA / real32
	0.000 ... 11.000 (22.000) V or mA	Value of analog input AI1.	1000 = 1 V or mA / 1000 = 1 V or mA
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.	0.000 NoUnit / real32

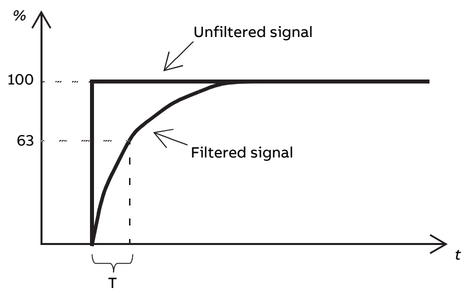
No.	Name / Range / Selection	Description	Def / Type FbEq 16b / 32b
	-32768.000 … 32767.000	Scaled value of analog input AI1.	1 = 1 / 1000 = 1
12.13	AI1 forced value	Forced value that can be used instead of the true reading of the input. See parameter 12.02 AI force selection.	0.000 V or mA / real32
	0.000 … 11.000 (22.000) V or mA	Forced value of analog input AI1.	1000 = 1 V or mA / 1000 = 1 V or mA
12.15	AI1 unit selection	Selects the unit for readings and settings related to analog input AI1.	V / uint16
	V	Volts.	2
	mA	Milliamperes.	10
12.16	AI1 filter time	Defines the filter time constant for analog input AI1.  $O = I \times (1 - e^{-t/T})$ I = filter input (step) O = filter output *t* = time T = filter time constant **Note:** The signal is also filtered due to the signal interface hardware (approximately 0.25 ms time constant). This cannot be changed by any parameter.	0.100 s / real32
	0.000 … 30.000 s	Filter time constant.	1000 = 1 s / 1000 = 1 s
12.17	AI1 min	Defines the minimum site value for analog input AI1. Set the value actually sent to the drive when the analog signal from plant is wound to its minimum setting. See also parameter 12.19 AI1 scaled at AI1 min.	0.000 V or mA / real32
	0.000 … 11.000 (22.000) V or mA	Minimum value of AI1.	1000 = 1 V or mA / 1000 = 1 V or mA

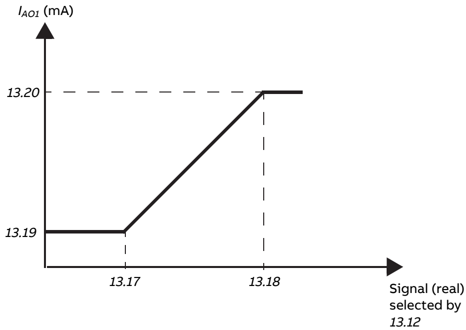
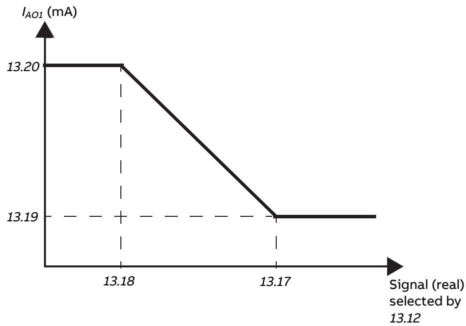
No.	Name / Range / Selection	Description	Def / Type FbEq 16b / 32b
12.18	AI1 max	Defines the maximum site value for analog input AI1. Set the value actually sent to the drive when the analog signal from plant is wound to its maximum setting. See also parameter 12.19 AI1 scaled at AI1 min.	10.000 V or mA / real32
	0.000 … 11.000 (22.000) V or mA	Maximum value of AI1.	1000 = 1 V or mA / 1000 = 1 V or mA
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 parameters 12.19 and 12.20 can effectively invert the analog input.)  	0.000 NoUnit / real32
	-32768.000 … 32767.000	Real value corresponding to minimum AI1 value.	1 = 1 / 1000 = 1
12.20	AI1 scaled at AI1 max	Defines the real internal value that corresponds to the maximum analog input AI1 value defined by parameter 12.18 AI1 max. See the drawing at parameter 12.19 AI1 scaled at AI1 min.	50.000; 60.000 (95.20 b0) NoUnit / real32
	-32768.000 … 32767.000	Real value corresponding to maximum AI1 value.	1 = 1 / 1000 = 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 V or mA / real32
	0.000 … 11.000 (22.000) V or mA	Value of analog input AI2.	1000 = 1 V or mA / 1000 = 1 V or mA
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 NoUnit / real32
	-32768.000 … 32767.000	Scaled value of analog input AI2.	1 = 1 / 1000 = 1

No.	Name / Range / Selection	Description	Def / Type FbEq 16b / 32b
12.23	AI2 forced value	Forced value that can be used instead of the true reading of the input. See parameter 12.02 AI force selection.	0.000 V or mA / real32
	0.000 … 11.000 (22.000) V or mA	Forced value of analog input AI2.	1000 = 1 V or mA / 1000 = 1 V or mA
12.25	AI2 unit selection	Selects the unit for readings and settings related to analog input AI2.	mA / uint16
	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 / real32
	0.000 … 30.000 s	Filter time constant.	1000 = 1 s / 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 V or mA / real32
	0.000 … 11.000 (22.000) V or mA	Minimum value of AI2.	1000 = 1 V or mA / 1000 = 1 V or mA
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 V or mA / real32
	0.000 … 11.000 (22.000) V or mA	Maximum value of AI2.	1000 = 1 V or mA / 1000 = 1 V or mA
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 parameters 12.29 and 12.101 can effectively invert the analog input.)  	0.000 NoUnit / real32
	-32768.000 … 32767.000	Real value corresponding to minimum AI2 value.	1 = 1 / 1000 = 1

No.	Name / Range / Selection	Description	Def / Type FbEq 16b / 32b
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 NoUnit / real32
	-32768.000 ... 32767.000	Real value corresponding to maximum AI2 value.	1 = 1 / 1000 = 1
12.101	AI1 percent value	Value of analog input AI1 in percent of AI1 scaling (12.18 AI1 max - 12.17 AI1 min).	0.00 percent / real32
	0.00 ... 100.00 %	AI1 value.	100 = 1 % / 100 = 1 %
12.102	AI2 percent value	Value of analog input AI2 in percent of AI2 scaling (12.28 AI2 max - 12.27 AI2 min).	0.00 percent / real32
	0.00 ... 100.00 %	AI2 value.	100 = 1 % / 100 = 1 %
12.110	AI dead band	AI dead band value in percentage where 100% = 10V in voltage mode and 100% = 20mA in current mode. Applicable for both AI1 and AI2. **Note:** 10% of AI dead band value is internally added in firmware as AI dead band hysteresis positive and negative. See section AI dead band (page 134).	0.40 percent / real32
	0.00 ... 100.00 %	AI dead band value.	100 = 1 % / 100 = 1 %

No.	Name / Range / Selection	Description	Def / Type FbEq 16b / 32b
13	Standard AO	Configuration of standard analog outputs.	
13.02	AO force selection	The source signals of the analog outputs can be overridden, for example, for testing purposes. A forced value parameter is provided for each analog output, and its value is applied whenever the corresponding bit in this parameter is 1. **Note:** Boot and power cycle reset the force selections (parameters 13.02 and 13.11).	0000h / uint16
b0	AO1	1 = Force AO1 to value of parameter 13.13 AO1 forced value. (0 = Normal mode)	
b1…15	Reserved		
	0000h…FFFFh		1 = 1 / 1 = 1
13.11	AO1 actual value	Displays the value of AO1 in mA or V. This parameter is read-only.	0.000 V or mA / real32
	0.000 ... 11.000 (22.000) V or mA	Value of AO1.	1000 = 1 V or mA / 1000 = 1 V or mA
13.12	AO1 source	Selects a signal to be connected to analog output AO1.	Output frequency / uint32
	Zero	None.	0
	Motor speed used	Parameter 01.01 Motor speed used.	1
	Output frequency	Parameter 01.06 Output frequency.	3
	Motor current	Parameter 01.07 Motor current.	4
	Motor current % of motor nominal	Parameter 01.08 Motor current % of motor nom.	5
	Motor torque	Parameter 01.10 Motor torque.	6
	DC voltage	Parameter 01.11 DC voltage.	7
	Output power	Parameter 01.14 Output power.	8
	Speed ref ramp in	Parameter 23.01 Speed ref ramp input.	10
	Speed ref ramp out	Parameter 23.02 Speed ref ramp output.	11
	Speed ref used	Parameter 24.01 Used speed reference.	12
	Freq ref used	Parameter 28.02 Frequency ref ramp output.	14
	Process PID out	Parameter 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 Programmable protection functions (page 130).	20
	Abs motor speed used	Parameter 01.61 Abs motor speed used.	26
	Abs motor speed %	Parameter 01.62 Abs motor speed %.	27
	Abs output frequency	Parameter 01.63 Abs output frequency.	28

No.	Name / Range / Selection	Description	Def / Type FbEq 16b / 32b
	Abs motor torque	Parameter 01.64 Abs motor torque.	30
	Abs output power	Parameter 01.65 Abs output power.	31
	Abs motor shaft power	Parameter 01.68 Abs motor shaft power.	32
	AO1 data storage	Parameter 13.91 AO1 data storage.	37
	Other [bit]	Source selection (see Terms and abbreviations (page 137)).	-
13.13	AO1 forced value	Forced value that can be used instead of the selected output signal. See parameter 13.02 AO force selection.	0.000 V or mA / real32
	0.000 … 11.000 (22.000) V or mA	Forced value for AO1.	1000 = 1 V or mA / 1000 = 1 V or mA
13.15	AO1 unit selection	Selects the unit for readings and settings related to analog input AO1.	V / uint16
	V	Volts.	2
	mA	Milliamperes.	10
13.16	AO1 filter time	Defines the filtering time constant for analog output AO1.  $O = I \times (1 - e^{-t/T})$ I = filter input (step) O = filter output *t* = time T = filter time constant	0.100 s / real32
	0.000 … 30.000 s	Filter time constant.	1000 = 1 s / 1000 = 1 s

No.	Name / Range / Selection	Description	Def / Type FbEq 16b / 32b
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 parameter 13.17 as the maximum value and parameter 13.18 as the minimum value inverts the output.  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.	0.0 NoUnit / real32

No.	Name / Range / Selection	Description	Def / Type FbEq 16b / 32b

	13.12 AO1 source	13.17 AO1 source min	13.18 AO1 source max
0	Zero	N/A (Output is constant zero.)	
1	Motor speed used	0	46.01 Speed scaling
3	Output frequency	0	46.02 Frequency scaling
4	Motor current	0	Max. value of 30.17 Maximum current
5	Motor current % of motor nominal	0%	100%
6	Motor torque	0	46.03 Torque scaling
7	DC voltage	Min. value of 01.11 DC voltage	Max. value of 01.11 DC voltage
8	Output power	0	46.04 Power scaling
10	Speed ref ramp in	0	46.01 Speed scaling
11	Speed ref ramp out	0	46.01 Speed scaling
12	Speed ref used	0	46.01 Speed scaling
14	Freq ref used	0	46.02 Frequency scaling
16	Process PID out	Min. value of 40.01 Process PID output actual	Max. value of 40.01 Process PID output actual
20	Temp sensor 1 excitation	N/A (Analog output is not scaled; it is determined by the sensor's triggering voltage.)	
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

<table>
<tr><th>No.</th><th>Name / Range / Selection</th><th>Description</th><th>Def / Type
FbEq 16b / 32b</th></tr>
<tr><td></td><td></td><td>
<table>
<tr><th></th><th>13.12 AO1 source</th><th>13.17 AO1 source min</th><th>13.18 AO1 source max</th></tr>
<tr><td>31</td><td>Abs output power</td><td>0</td><td>46.04 Power scaling</td></tr>
<tr><td>32</td><td>Abs motor shaft power</td><td>0</td><td>46.04 Power scaling</td></tr>
<tr><td></td><td>Other</td><td>Min. value of the selected parameter</td><td>Max. value of the selected parameter</td></tr>
</table>
</td><td></td></tr>
<tr><td></td><td>-32768.0 ... 32767.0</td><td>Real signal value corresponding to minimum AO1 output value.</td><td>1 = 1 / 10 = 1</td></tr>
<tr><td>13.18</td><td>AO1 source max</td><td>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.</td><td>50.0; 60.0 (95.20 b0)
NoUnit / real32</td></tr>
<tr><td></td><td>-32768.0 ... 32767.0</td><td>Real signal value corresponding to maximum AO1 output value.</td><td>1 = 1 / 10 = 1</td></tr>
<tr><td>13.19</td><td>AO1 out at AO1 src min</td><td>Defines the minimum output value for analog output AO1.
See also drawing at parameter 13.17 AO1 source min.</td><td>0.000 V or mA / real32</td></tr>
<tr><td></td><td>0.000 ... 11.000 (22.000) V or mA</td><td>Minimum AO1 output value.</td><td>1000 = 1 V or mA / 1000 = 1 V or mA</td></tr>
<tr><td>13.20</td><td>AO1 out at AO1 src max</td><td>Defines the maximum output value for analog output AO1.
See also drawing at parameter 13.17 AO1 source min.</td><td>10.000 V or mA / real32</td></tr>
<tr><td></td><td>0.000 ... 11.000 (22.000) V or mA</td><td>Maximum AO1 output value.</td><td>1000 = 1 V or mA / 1000 = 1 V or mA</td></tr>
<tr><td>13.91</td><td>AO1 data storage</td><td>Storage parameter for controlling analog output AO1, for example, through the embedded fieldbus interface.
In parameter 13.12 AO1 source, select AO1 data storage. Then set this parameter as the target of the incoming value data. With the embedded fieldbus interface, simply set the target selection parameter of that particular data (58.101…58.114) to AO1 data storage.</td><td>0.00 NoUnit / real32</td></tr>
<tr><td></td><td>-327.68 ... 327.67</td><td>Storage parameter for AO1.</td><td>100 = 1 / 100 = 1</td></tr>
</table>

No.	Name / Range / Selection	Description	Def / Type FbEq 16b / 32b
19	Operation mode	Selection of local and external control location sources and operating modes. See also section Operating modes of the drive (page 46).	
19.01	Actual operation mode	Displays the operating mode currently used. See parameter 19.11 Ext1/Ext2 selection. This parameter is read-only.	Scalar (Hz) / uint16
	Zero	None.	1
	Speed	Speed control (in vector motor control mode).	2
	Add	The speed controller output is added to the torque reference (in vector motor control mode).	6
	Scalar (Hz)	Frequency control in scalar motor control mode.	10
	Scalar (rpm)	Speed control in scalar motor control mode.	11
	Forced magn.	Motor is in magnetizing mode.	20
19.11	Ext1/Ext2 selection	Selects the source for external control location EXT1/EXT2 selection. 0 = EXT1 1 = EXT2	EXT1 / uint32
	EXT1	EXT1 (permanently selected).	0
	EXT2	EXT2 (permanently selected).	1
	DI1	Digital input DI1 (parameter 10.02 DI delayed status, bit 0).	3
	DI2	Digital input DI2 (parameter 10.02 DI delayed status, bit 1).	4
	DI3	Digital input DI3 (parameter 10.02 DI delayed status, bit 2).	5
	DI4	Digital input DI4 (parameter 10.02 DI delayed status, bit 3).	6
	DI5	Digital input DI5 (parameter 10.02 DI delayed status, bit 4).	7
	Timed function 1	Bit 0 of parameter 34.01 Timed functions status.	19
	Timed function 2	Bit 1 of parameter 34.01 Timed functions status.	20
	Timed function 3	Bit 2 of parameter 34.01 Timed functions status.	21
	Supervision 1	Bit 0 of parameter 32.01 Supervision status.	25
	Supervision 2	Bit 1 of parameter 32.01 Supervision status.	26
	Supervision 3	Bit 2 of parameter 32.01 Supervision status.	27
	EFB MCW bit 11	Control word bit 11 received through the embedded fieldbus interface.	32
	EFB connection loss	Detected communication loss of embedded fieldbus interface changes control mode to EXT2.	35
	Other [bit]	See Terms and abbreviations (page 137).	-

No.	Name / Range / Selection	Description	Def / Type FbEq 16b / 32b
19.18	HAND/OFF disable source	Selects the source for Hand/Off disable. 1 = Hand and/or Off buttons are disabled on the control panel and in Drive composer PC tool. Parameter 19.19 HAND/OFF disable action specifies which buttons are disabled or enabled. If the HAND/OFF disable is activated while the drive is in the Hand mode, the mode will be automatically switched to Off and the motor stops, and the user must start the motor again.	Not used / uint32
	Not used	0 = Hand and/or Off buttons are enabled and operational.	0
	Active	1 = Hand and/or Off buttons are disabled and not operational.	1
	DI1	Digital input DI1 (parameter 10.02 DI delayed status, bit 0).	2
	DI2	Digital input DI2 (parameter 10.02 DI delayed status, bit 1).	3
	DI3	Digital input DI3 (parameter 10.02 DI delayed status, bit 2).	4
	DI4	Digital input DI4 (parameter 10.02 DI delayed status, bit 3).	5
	DI5	Digital input DI5 (parameter 10.02 DI delayed status, bit 4).	6
	Comms	DCU profile control word bit 14 received through the embedded fieldbus interface. If a fieldbus adapter that supports transparent mode profiles is used, DCU control word bit 14 through the transparent mode profile is used.	8
	Other [bit]	See Terms and abbreviations (page 137).	-
19.19	HAND/OFF disable action	Selects which buttons are disabled on the control panel and in the Drive composer PC tool when parameter 19.18 HAND/OFF disable source is disabled.	HAND / uint16
	HAND	Hand button disabled.	0
	OFF and HAND	Both Off and Hand buttons disabled.	1
	OFF when Auto	Off button is disabled when the drive is in the Auto mode. Off button is again enabled after the Hand button has been pressed.	2

<table>
<tr><th>No.</th><th>Name / Range / Selection</th><th>Description</th><th>Def / Type
FbEq 16b / 32b</th></tr>
<tr><td>20</td><td>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 39).</td><td></td></tr>
<tr><td>20.01</td><td>Ext1 commands</td><td>Selects the source of start, stop and direction commands for external control location 1 (EXT1).
See parameter 20.21 Direction for the determination of the actual direction. See also parameters 20.02…20.05.</td><td>In1 Start / uint16</td></tr>
<tr><td></td><td>Not selected</td><td>No start or stop command sources selected.</td><td>0</td></tr>
<tr><td></td><td>In1 Start</td><td>The source of the start and stop commands is selected by parameter 20.03 Ext1 in1 source. The state transitions of the source bits are interpreted as follows:
<table>
<tr><th>State of source 1 (20.03)</th><th>Command</th></tr>
<tr><td>0 → 1 (20.02 = Edge)
1 (20.02 = Level)</td><td>Start</td></tr>
<tr><td>0</td><td>Stop</td></tr>
</table></td><td>1</td></tr>
<tr><td></td><td>In1 Start; In2 Dir</td><td>The source selected by parameter 20.03 Ext1 in1 source is the start signal; the source selected by parameter 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 forward</td></tr>
</table></td><td>2</td></tr>
</table>

<table>
<tr><th>No.</th><th>Name / Range / Selection</th><th>Description</th><th>Def / Type
FbEq 16b / 32b</th></tr>
<tr><td></td><td>In1 Start fwd; In2 Start rev</td><td>The source selected by parameter 20.03 Ext1 in1 source is the forward start signal; the source selected by parameter 20.04 Ext1 in2 source is the reverse start signal. The state transitions of the source bits are interpreted as follows:
<table>
<tr><th>State of source 1 (20.03)</th><th>State of source 2 (20.04)</th><th>Command</th></tr>
<tr><td>0</td><td>0</td><td>Stop</td></tr>
<tr><td>0 → 1 (20.02 = Edge)
1 (20.02 = Level)</td><td>0</td><td>Start forward</td></tr>
<tr><td>0</td><td>0 → 1 (20.02 = Edge)
1 (20.02 = Level)</td><td>Start reverse</td></tr>
<tr><td>1</td><td>1</td><td>Stop</td></tr>
</table></td><td>3</td></tr>
<tr><td></td><td>In1P Start; In2 Stop</td><td>The sources of the start and stop commands are selected by parameters 20.03 Ext1 in1 source and 20.04 Ext1 in2 source. The state transitions of the source bits are interpreted as follows:
<table>
<tr><th>State of source 1 (20.03)</th><th>State of source 2 (20.04)</th><th>Command</th></tr>
<tr><td>0 → 1</td><td>1</td><td>Start</td></tr>
<tr><td>Any</td><td>0</td><td>Stop</td></tr>
</table>
Note:

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

<table>
<tr><th>No.</th><th>Name / Range / Selection</th><th>Description</th><th>Def / Type
FbEq 16b / 32b</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 parameter 20.05 Ext1 in3 source determines the direction. The state transitions of the source bits are interpreted as follows:
<table>
<tr><th>State of source 1 (20.03)</th><th>State of source 2 (20.04)</th><th>State of source 3 (20.05)</th><th>Command</th></tr>
<tr><td>0 → 1</td><td>1</td><td>0</td><td>Start forward</td></tr>
<tr><td>0 → 1</td><td>1</td><td>1</td><td>Start reverse</td></tr>
<tr><td>Any</td><td>0</td><td>Any</td><td>Stop</td></tr>
</table>
Note:

Run permissive and Start interlock signals can be put ON before or after the start pulse has been given.
Parameter 20.02 Ext1 start trigger type has an effect only at startup of the drive with this setting. If the start input is ON and 20.02 = Level (1) when the drive is powered up, the motor will start.
</td><td>5</td></tr>
<tr><td></td><td>In1P Start fwd; In2P Start rev; In3 Stop</td><td>The sources of the start and stop commands are selected by parameters 20.03 Ext1 in1 source, 20.04 Ext1 in2 source and 20.05 Ext1 in3 source. The source selected by parameter 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:

Run permissive and Start interlock signals can be put ON before or after the start pulse has been given.
Parameter 20.02 Ext1 start trigger type has no effect with this setting.
</td><td>6</td></tr>
<tr><td></td><td>Control panel</td><td>The start and stop commands are taken from the control panel (or PC connected to the control panel connector).</td><td>11</td></tr>
</table>

No.	Name / Range / Selection	Description	Def / Type FbEq 16b / 32b
	Embedded fieldbus	The start and stop commands are taken from the embedded fieldbus interface. **Note:** Set also parameter 20.02 Ext1 start trigger type to Level.	14
20.02	Ext1 start trigger type	Defines whether the start signal for external control location EXT1 is edge-triggered or level-triggered. **Note:** If a pulse type start signal is selected, this parameter is only effective at drive startup. See the descriptions of the selections of parameter 20.01 Ext1 commands.	Level / uint16
	Edge	The start signal is edge-triggered.	0
	Level	The start signal is level-triggered.	1
20.03	Ext1 in1 source	Selects source 1 for parameter 20.01 Ext1 commands.	DI1 / uint32
	Always off	Always off.	0
	Always on	Always on.	1
	DI1	Digital input DI1 (parameter 10.02 DI delayed status, bit 0).	2
	DI2	Digital input DI2 (parameter 10.02 DI delayed status, bit 1).	3
	DI3	Digital input DI3 (parameter 10.02 DI delayed status, bit 2).	4
	DI4	Digital input DI4 (parameter 10.02 DI delayed status, bit 3).	5
	DI5	Digital input DI5 (parameter 10.02 DI delayed status, bit 4).	6
	Timed function 1	Bit 0 of parameter 34.01 Timed functions status.	18
	Timed function 2	Bit 1 of parameter 34.01 Timed functions status.	19
	Timed function 3	Bit 2 of parameter 34.01 Timed functions status.	20
	Supervision 1	Bit 0 of parameter 32.01 Supervision status.	24
	Supervision 2	Bit 1 of parameter 32.01 Supervision status.	25
	Supervision 3	Bit 2 of parameter 32.01 Supervision status.	26
	Constant speed	Bit 7 of parameter 06.19 Speed control status word.	40
	Other [bit]	See Terms and abbreviations (page 137).	-
20.04	Ext1 in2 source	Selects source 2 for parameter 20.01 Ext1 commands. For the available selections, see parameter 20.03 Ext1 in1 source.	Always off / uint32
20.05	Ext1 in3 source	Selects source 3 for parameter 20.01 Ext1 commands. For the available selections, see parameter 20.03 Ext1 in1 source.	Always off / uint32

<table>
<tr><th>No.</th><th>Name / Range / Selection</th><th>Description</th><th>Def / Type
FbEq 16b / 32b</th></tr>
<tr><td>20.06</td><td>Ext2 commands</td><td>Selects the source of start, stop and direction commands for external control location 2 (EXT2).
See parameter 20.21 Direction for the determination of the actual direction.
See also parameters 20.07…20.10.</td><td>Not selected / uint16</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 parameter 20.08 Ext2 in1 source is the start signal; the source selected by parameter 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 forward</td></tr>
</table></td><td>2</td></tr>
<tr><td></td><td>In1 Start fwd; In2 Start rev</td><td>The source selected by parameter 20.08 Ext2 in1 source is the forward start signal; the source selected by parameter 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>
</table>

<table>
<tr><th>No.</th><th>Name / Range / Selection</th><th>Description</th><th>Def / Type
FbEq 16b / 32b</th></tr>
<tr><td></td><td>In1P Start; In2 Stop</td><td>The sources of the start and stop commands are selected by parameters 20.08 Ext2 in1 source and 20.09 Ext2 in2 source. The state transitions of the source bits are interpreted as follows:
<table>
<tr><th>State of source 1 (20.08)</th><th>State of source 2 (20.09)</th><th>Command</th></tr>
<tr><td>0 → 1</td><td>1</td><td>Start</td></tr>
<tr><td>Any</td><td>0</td><td>Stop</td></tr>
</table>
Note:

Run permissive and Start interlock signals can be put ON before or after the start pulse has been given.
Parameter 20.07 Ext2 start trigger type has an effect only at startup of the drive with this setting. If the start input is ON and 20.07 = Level (1) when the drive is powered up, the motor will start.
</td><td>4</td></tr>
<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 parameter 20.10 Ext2 in3 source determines the direction. The state transitions of the source bits are interpreted as follows:
<table>
<tr><th>State of source 1 (20.08)</th><th>State of source 2 (20.09)</th><th>State of source 3 (20.10)</th><th>Command</th></tr>
<tr><td>0 → 1</td><td>1</td><td>0</td><td>Start forward</td></tr>
<tr><td>0 → 1</td><td>1</td><td>1</td><td>Start reverse</td></tr>
<tr><td>Any</td><td>0</td><td>Any</td><td>Stop</td></tr>
</table>
Note:

Run permissive and Start interlock signals can be put ON before or after the start pulse has been given.
Parameter 20.07 Ext2 start trigger type has an effect only at startup of the drive with this setting. If the start input is ON and 20.07 = Level (1) when the drive is powered up, the motor will start.
</td><td>5</td></tr>
</table>

<table>
<tr><th>No.</th><th>Name / Range / Selection</th><th>Description</th><th>Def / Type
FbEq 16b / 32b</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 parameter 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:
• Run permissive and Start interlock signals can be put ON before or after the start pulse has been given.
• Parameter 20.07 Ext2 start trigger type has no effect with this setting.</td><td>6</td></tr>
<tr><td></td><td>Control panel</td><td>The start and stop commands are taken from the control panel (or PC connected to the control panel connector).</td><td>11</td></tr>
<tr><td></td><td>Embedded fieldbus</td><td>The start and stop commands are taken from the embedded fieldbus interface.

Note: Set also parameter 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 / uint16</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 / uint32</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 / uint32</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 / uint32</td></tr>
</table>

<table>
<tr><th>No.</th><th>Name / Range / Selection</th><th>Description</th><th>Def / Type
FbEq 16b / 32b</th></tr>
<tr><td>20.21</td><td>Direction</td><td>Reference direction lock. Defines the direction of the drive rather than the sign of the reference, except in some cases.

In the table the actual drive rotation is shown as a function of parameter 20.21 Direction and Direction command (from parameter 20.01 Ext1 commands or 20.06 Ext2 commands).

<table>
<tr><th></th><th>Direction command = Forward</th><th>Direction command = Reverse</th><th>Direction command not defined</th></tr>
<tr><td>Par. 20.21 Direction = Forward</td><td>Forward</td><td>Forward</td><td>Forward</td></tr>
<tr><td>Par. 20.21 Direction = Reverse</td><td>Reverse</td><td>Reverse</td><td>Reverse</td></tr>
<tr><td>Par. 20.21 Direction = Request</td><td>Forward, but
- If reference from Constant, Motor potentiometer, PID, Safe speed, Last, Jogging or Panel reference, reference used as is.
- If reference from the network, reference used as is.</td><td>Reverse, but
- If reference from Constant, PID or Jogging reference, reference used as is.
- If reference from the network, Panel, Analog input, Motor potentiometer, Safe speed or Last reference, reference multiplied by -1.</td><td>Forward</td></tr>
</table>
</td><td>Forward / uint16</td></tr>
<tr><td></td><td>Request</td><td>In external control the direction is selected by a direction command (parameter 20.01 Ext1 commands or 20.06 Ext2 commands).

If the reference comes from Constant (constant speeds/frequencies), Floating point control (Motor potentiometer), PID, Speed ref safe, Last speed reference or Panel reference, the reference is used as is.

If the reference comes from a fieldbus:
• if the direction command is forward, the reference is used as is
• if the direction command is reverse, the reference is multiplied by -1.</td><td>0</td></tr>
</table>

No.	Name / Range / Selection	Description	Def / Type FbEq 16b / 32b
	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
20.30	Enable signals warning function	Selects enable signal warnings to be suppressed. This parameter can be used to prevent these warnings from flooding the event log. Whenever a bit of this parameter is set to 1, the corresponding warning is suppressed.	0000h / uint16
b0	Run permissive	1 = Warning AFED Run permissive.	
b1	Start interlocks	1 = Following warnings are suppressed: • AFEE Start interlock 1 • AFEF Start interlock 2 • AFF0 Start interlock 3 • AFF1 Start interlock 4.	
b2…15	Reserved		
	0000h…FFFFh		1 = 1 / 1 = 1
20.40	Run permissive	Selects the source of the Run permissive signal. Value 0 of the source deactivates the Run permissive and prevents running. Value 1 of the source activates the Run permissive and permits running.	Not used / uint32
	Not used	0.	0
	Not used	1.	1
	DI1	Digital input DI1 (parameter 10.02 DI delayed status, bit 0).	2
	DI2	Digital input DI2 (parameter 10.02 DI delayed status, bit 1).	3
	DI3	Digital input DI3 (parameter 10.02 DI delayed status, bit 2).	4
	DI4	Digital input DI4 (parameter 10.02 DI delayed status, bit 3).	5
	DI5	Digital input DI5 (parameter 10.02 DI delayed status, bit 4).	6
	-DI1	Digital input DI1 (parameter 10.02 DI delayed status, bit 0).	8
	-DI2	Digital input DI2 (parameter 10.02 DI delayed status, bit 1).	9
	-DI3	Digital input DI3 (parameter 10.02 DI delayed status, bit 2).	10
	-DI4	Digital input DI4 (parameter 10.02 DI delayed status, bit 3).	11

No.	Name / Range / Selection	Description	Def / Type FbEq 16b / 32b
	-DI5	Digital input DI5 (parameter 10.02 DI delayed status, bit 4).	12
	Embedded fieldbus	ABB Drives profile: Control word bit 3 received through the embedded fieldbus interface. DCU profile: Inverse of control word bit 6 received through the embedded fieldbus interface.	15
	Other [bit]	See Terms and abbreviations (page 137).	-
20.41	Start interlock 1	Selects the source of the Start interlock 1 signal. Value 0 of the source deactivates the Start interlock 1 signal and inhibits starting. Value 1 of the source activates the Start interlock 1 signal and allows starting.	DI4 / uint32
	Not used	1.	0
	Not used	1.	1
	DI1	Digital input DI1 (parameter 10.02 DI delayed status, bit 0).	2
	DI2	Digital input DI2 (parameter 10.02 DI delayed status, bit 1).	3
	DI3	Digital input DI3 (parameter 10.02 DI delayed status, bit 2).	4
	DI4	Digital input DI4 (parameter 10.02 DI delayed status, bit 3).	5
	DI5	Digital input DI5 (parameter 10.02 DI delayed status, bit 4).	6
	-DI1	Digital input DI1 (parameter 10.02 DI delayed status, bit 0).	8
	-DI2	Digital input DI2 (parameter 10.02 DI delayed status, bit 1).	9
	-DI3	Digital input DI3 (parameter 10.02 DI delayed status, bit 2).	10
	-DI4	Digital input DI4 (parameter 10.02 DI delayed status, bit 3).	11
	-DI5	Digital input DI5 (parameter 10.02 DI delayed status, bit 4).	12
	Embedded fieldbus	Start interlock 1: DCU profile: Inverse of control word bit 18 received through the embedded fieldbus interface. Start interlock 2: Inverse of bit 19. This selection is only available for parameters 20.41 Start interlock 1 and 20.42 Start interlock 2.	15
	Other [bit]	See Terms and abbreviations (page 137).	-
20.42	Start interlock 2	Selects the source of the Start interlock 2 signal. For the selections, see parameter 20.41 Start interlock 1.	Not used / uint32

No.	Name / Range / Selection	Description	Def / Type FbEq 16b / 32b
20.43	Start interlock 3	Selects the source of the Start interlock 3 signal. Start interlock 3 is not supported over the Embedded fieldbus. For the other selections than 15, see parameter 20.41 Start interlock 1.	Not used / uint32
20.44	Start interlock 4	Selects the source of the Start interlock 4 signal. Start interlock 4 is not supported over the Embedded fieldbus. For the other selections than 15, see parameter 20.41 Start interlock 1.	Not used / uint32
20.45	Start interlock stop mode	Follows motor stop mode selection, see parameter 21.03 Stop mode.	Not used / uint16
	Not used	Not in use.	0
	Coast	The motor coasts to a stop.	1
	Ramp	Stop along the active deceleration ramp.	2
20.46	Run permissive text	Alternative alarm texts for the run permissive. There is also label text (free text) for the run permissive. The control panel display will display the text when the run permissive becomes unsatisfied.	Run permissive / uint16
	Run permissive		0
	Damper end switch		1
	Valve opening		2
	Pre-lube cycle		3
	Interlock open		5
20.47	Start interlock 1 text	Alternative alarm texts for the start interlock 1. There is also label text (free text) for each start interlock. The control panel display will display that specific text when the interlock becomes unsatisfied.	Start interlock 1 / uint16
	Start interlock 1		0
	Vibration switch		1
	Firestat		2
	Freezestat		3
	Overpressure		4
	Vibration trip		5
	Smoke alarm		6
	Auxiliary open		7
	Low suction		8
	Low pressure		9
	Access door		10
	Pressure relief		11

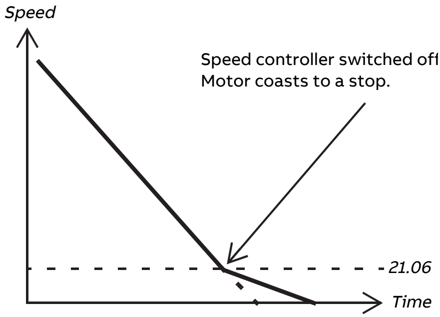
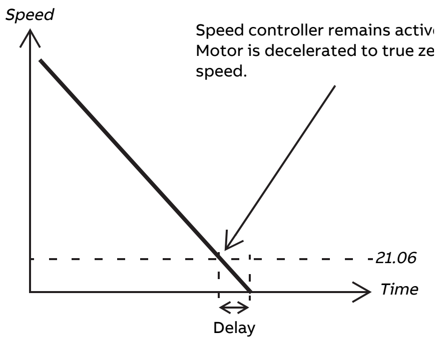
No.	Name / Range / Selection	Description	Def / Type FbEq 16b / 32b
	Motor disconnect open		12
	High static		13
	Safety open		14
	Interlock open		15
20.48	Start interlock 2 text	Alternative alarm texts for the start interlock 2. See parameter 20.47 Start interlock 1 text.	Start interlock 2 / uint16
	Start interlock 2	For other selections, see parameter 20.47 Start interlock 1 text.	0
20.49	Start interlock 3 text	Alternative alarm texts for the start interlock 3. See parameter 20.47 Start interlock 1 text.	Start interlock 3 / uint16
	Start interlock 3	For other selections, see parameter 20.47 Start interlock 1 text.	0
20.50	Start interlock 4 text	Alternative alarm texts for the start interlock 4. See parameter 20.47 Start interlock 1 text.	Start interlock 4 / uint16
	Start interlock 4	For other selections, see parameter 20.47 Start interlock 1 text.	0
20.51	Start interlock condition	Selects the condition for start interlock function. This parameter determines if the start command is needed before start interlock warnings are displayed.	Start command ignored / uint16
	Start command ignored	Start interlock warnings are displayed if the interlocks are missing.	0
	Start command required	Start command must be present before the start interlock warnings are displayed if the interlocks are missing.	1

No.	Name / Range / Selection	Description	Def / Type FbEq 16b / 32b
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 parameter 99.04 Motor control mode is set to Vector. **Note:** • The start function for the scalar motor control mode is selected by parameter 21.19 Scalar start mode. • Starting into a rotating motor is not possible when DC magnetizing is selected (Fast or Const time). • With permanent magnet motors, Automatic start mode must be used. • This parameter cannot be changed while the drive is running. See also section DC magnetization (page 103).	Automatic / uint16
	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 premagnetizing 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.	2

<table>
<tr><th>No.</th><th>Name / Range / Selection</th><th>Description</th><th>Def / Type
FbEq 16b / 32b</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 DTC motor control mode), or
parameter 21.19 Scalar start mode is set to Const time (in scalar motor control mode).
After the start command, the drive automatically pre-magnetizes the motor for the set time. To ensure full magnetizing, set this parameter to the same value as, or higher than, the rotor time constant. If not known, use the rule-of-thumb value given in the table below:
<table>
<tr><th>Motor rated power</th><th>Constant magnetizing time</th></tr>
<tr><td>< 1 kW</td><td>≥ 50 to 100 ms</td></tr>
<tr><td>1 to 10 kW</td><td>≥ 100 to 200 ms</td></tr>
<tr><td>10 to 200 kW</td><td>≥ 200 to 1000 ms</td></tr>
<tr><td>200 to 1000 kW</td><td>≥ 1000 to 2000 ms</td></tr>
</table>
Note: This parameter cannot be changed while the drive is running.</td><td>500 ms / uint16</td></tr>
<tr><td></td><td>0…10000 ms</td><td>Constant DC magnetizing time.</td><td>1 = 1 ms / 1 = 1 ms</td></tr>
<tr><td>21.03</td><td>Stop mode</td><td>Selects the way the motor is stopped when a stop command is received.
Additional braking is possible by selecting flux braking (see parameter 97.05 Flux braking).</td><td>Coast / uint16</td></tr>
<tr><td></td><td>Coast</td><td>Stop by switching off the output semiconductors of the drive.
The motor coasts to a stop.
WARNING!
If a mechanical brake is used, ensure it is safe to stop the drive by coasting.</td><td>0</td></tr>
<tr><td></td><td>Ramp</td><td>Stop along the active deceleration ramp. See parameter group 23 Speed reference ramp (page 223) or 28 Frequency reference chain (page 236).</td><td>1</td></tr>
<tr><td></td><td>Torque limit</td><td>Stop according to torque limits (parameters 30.19 Minimum torque 1 and 30.20 Maximum torque 1).
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) / uint16</td></tr>
</table>

No.	Name / Range / Selection	Description	Def / Type FbEq 16b / 32b
	Ramp stop (Off1)	With the drive running: • 1 = Normal operation. • 0 = Normal stop along the standard deceleration ramp defined for the particular reference type. After the drive has stopped, it can be restarted by removing the emergency stop signal and switching the start signal from 0 to 1. With the drive stopped: • 1 = Starting allowed. • 0 = Starting not allowed.	0
	Coast stop (Off2)	With the drive running: • 1 = Normal operation. • 0 = Stop by coasting. The drive can be restarted by restoring the start interlock signal and switching the start signal from 0 to 1. With the drive stopped: • 1 = Starting allowed. • 0 = Starting not allowed.	1
	Eme ramp stop (Off3)	With the drive running: • 1 = Normal operation. • 0 = Stop by ramping along emergency stop ramp defined by parameter 23.23 Emergency stop time. After the drive has stopped, it can be restarted by removing the emergency stop signal and switching the start signal from 0 to 1. With the drive stopped: • 1 = Starting allowed. • 0 = Starting not allowed.	2
21.05	Emergency stop source	Selects the source of the emergency stop signal. The stop mode is selected by parameter 21.04 Emergency stop mode. 0 = Emergency stop active. 1 = Normal operation. **Note:** This parameter cannot be changed while the drive is running.	Inactive (true) / uint32
	Active (false)	0.	0
	Inactive (true)	1.	1
	DI1	Digital input DI1 (parameter 10.02 DI delayed status, bit 0).	3
	DI2	Digital input DI2 (parameter 10.02 DI delayed status, bit 1).	4
	DI3	Digital input DI3 (parameter 10.02 DI delayed status, bit 2).	5
	DI4	Digital input DI4 (parameter 10.02 DI delayed status, bit 3).	6
	DI5	Digital input DI5 (parameter 10.02 DI delayed status, bit 4).	7

No.	Name / Range / Selection	Description	Def / Type FbEq 16b / 32b
	Other [bit]	See Terms and abbreviations (page 137).	-
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 / real32
	0.00 … 30000.00 rpm	Zero speed limit. For scaling, see parameter 46.01 Speed scaling.	1 = 1 rpm / 100 = 1 rpm

No.	Name / Range / Selection	Description	Def / Type FbEq 16b / 32b
21.07	Zero speed delay	Defines the delay for the zero speed delay function. The function is useful in applications where a smooth and quick restarting is essential. During the delay, the drive knows the rotor position accurately. <u>Without zero speed delay:</u> The drive receives a stop command and decelerates along a ramp. When actual motor speed falls below the value of parameter 21.06 Zero speed limit, inverter modulation is stopped and the motor coasts to a standstill.  <u>With zero speed delay:</u> The drive receives a stop command and decelerates along a ramp. When actual motor speed falls below the value of parameter 21.06 Zero speed limit, the zero speed delay function activates. During the delay the function keeps the speed controller live: the inverter modulates, motor is magnetized and the drive is ready for a quick restart.  	0 ms / real32
	0…30000 ms	Zero speed delay.	1 = 1 ms / 1 = 1 ms

No.	Name / Range / Selection	Description	Def / Type FbEq 16b / 32b
21.08	DC current control	Activates/deactivates the DC hold and post-magnetization functions. See section DC magnetization (page 103). **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.	0000h / uint16
b0	DC hold	1 = Enable DC hold. See section DC magnetization (page 103). **Note:** The DC hold function has no effect if the start signal is switched off.	
b1	Post magnetization	1 = Enable post-magnetization. See section DC magnetization (page 103). **Note:** Post-magnetization is only available when ramping is the selected stop mode (see parameter 21.03 Stop mode).	
b2	DC brake	1 = Enables DC injection braking after modulation has stopped. **Note:** • To enable DC brake, parameter 21.03 Stop mode has to be set to Coast. • DC braking current can be set with parameter 21.10 DC current reference. • DC braking time can be set with parameter 21.11 Post magnetization time.	
b3…15	Reserved		
	0000h…FFFFh		1 = 1 / 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 magnetization (page 103).	5.00 rpm / real32
	0.00 ... 1000.00 rpm	DC hold speed. For scaling, see parameter 46.01 Speed scaling.	1 = 1 rpm / 100 = 1 rpm
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 103). After 100 s post-magnetization time, the maximum magnetization current is limited to the magnetization current corresponding to the actual flux reference.	30.0 percent / real32
	0.0 ... 100.0 %	DC hold current.	1 = 1 % / 10 = 1 %

No.	Name / Range / Selection	Description	Def / Type FbEq 16b / 32b
21.11	Post magnetization time	Defines the length of time for which post-magnetization is active after stopping the motor. The magnetization current is defined by parameter 21.10 DC current reference. See parameter 21.08 DC current control.	0 s / uint32
	0…3000 s	Post-magnetization time.	1 = 1 s / 1 = 1 s
21.14	Pre-heating input source	Selects the source for controlling pre-heating for the motor. The status of the pre-heating is shown as bit 2 of parameter 06.21 Drive status word 3. **Note:** • The heating function requires that STO is not triggered. • The heating function requires that the drive is not faulted.	Off / uint32
	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 (parameter 10.02 DI delayed status, bit 0).	2
	DI2	Digital input DI2 (parameter 10.02 DI delayed status, bit 1).	3
	DI3	Digital input DI3 (parameter 10.02 DI delayed status, bit 2).	4
	DI4	Digital input DI4 (parameter 10.02 DI delayed status, bit 3).	5
	DI5	Digital input DI5 (parameter 10.02 DI delayed status, bit 4).	6
	Supervision 1	Bit 0 of parameter 32.01 Supervision status.	8
	Supervision 2	Bit 1 of parameter 32.01 Supervision status.	9
	Supervision 3	Bit 2 of parameter 32.01 Supervision status.	10
	Timed function 1	Bit 0 of parameter 34.01 Timed functions status.	11
	Timed function 2	Bit 1 of parameter 34.01 Timed functions status.	12
	Timed function 3	Bit 2 of parameter 34.01 Timed functions status.	13
	MCW user bit 0	Bit 12 of parameter 06.01 Main control word.	16
	MCW user bit 1	Bit 13 of parameter 06.01 Main control word.	17
	MCW user bit 2	Bit 14 of parameter 06.01 Main control word.	18
	MCW user bit 3	Bit 15 of parameter 06.01 Main control word.	19
	Other [bit]	See Terms and abbreviations (page 137).	-
21.15	Pre-heating time delay	Defines the time delay before pre-heating starts after the drive is stopped.	60 s / real32
	10…3000 s	Pre-heating time delay.	1 = 1 s / 1 = 1 s

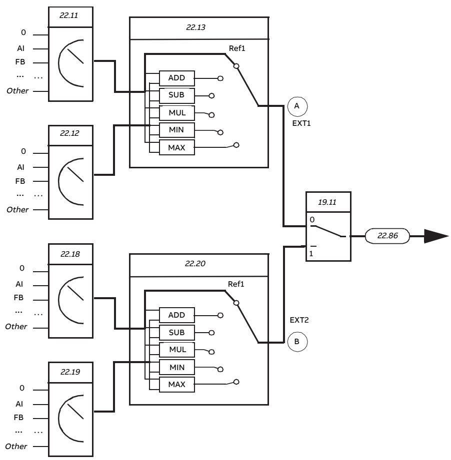
No.	Name / Range / Selection	Description	Def / Type FbEq 16b / 32b
21.16	Pre-heating current	Defines the DC current used to heat the motor. The value is in percent of the nominal motor current.	0.0 percent / real32
	0.0 … 30.0 %	Pre-heating current.	1 = 1 % / 10 = 1 %
21.19	Scalar start mode	Selects the motor start function for the scalar motor control mode, ie. when parameter 99.04 Motor control mode is set to Scalar. **Note:** • The start function for the vector motor control mode is selected by parameter 21.01 Start mode. • With permanent magnet motors, Automatic start mode must be used. • This parameter cannot be changed while the drive is running. See also section DC magnetization (page 103).	Automatic / uint16
	Normal	Immediate start from zero speed.	0
	Const time	The drive pre-magnetizes the motor before start. The pre-magnetizing time is defined by parameter 21.02 Magnetization time. This mode should be selected if constant pre-magnetizing time is required (for example, if the motor start must be synchronized with the release of a mechanical brake). This setting also guarantees the highest possible break-away torque when the pre-magnetizing time is set long enough. **Note:** This mode cannot be used to start into a rotating motor. **WARNING!** The drive will start after the set pre-magnetizing time has passed even if motor magnetization is not completed. In applications where a full break-away torque is essential, ensure that the constant magnetizing time is long enough to allow generation of full magnetization and torque.	1
	Automatic	The drive automatically selects the correct output frequency to start a rotating motor. This is useful for flying starts: if the motor is already rotating, the drive will start smoothly at the current frequency. **Note:** Cannot be used in multimotor systems.	2

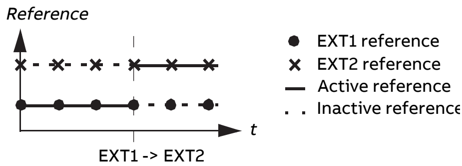
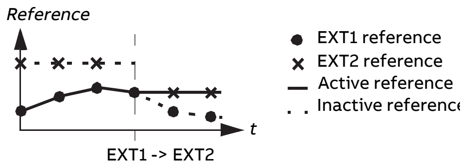
No.	Name / Range / Selection	Description	Def / Type FbEq 16b / 32b
	Torque boost	The drive pre-magnetizes the motor before the start. The pre-magnetizing time is defined by parameter 21.02 Magnetization time. Torque boost is applied at start. Torque boost is stopped when output frequency exceeds 40% of nominal frequency or when it is equal to the reference value. See parameter 21.26 Torque boost current. This mode should be 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.	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 magnetization (page 103).	5.00 Hz / real32
	0.00 … 1000.00 Hz	DC hold frequency.	1 = 1 Hz / 100 = 1 Hz

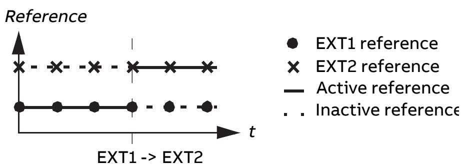
No.	Name / Range / Selection	Description	Def / Type FbEq 16b / 32b
21.22	Start delay	Defines the start delay. After the conditions for start have been fulfilled, the drive waits until the delay has elapsed and then starts the motor. During the delay, warning AFE9 Start delay is shown. Start delay can be used with all start modes.	0.00 s / real32
	0.00 … 60.00 s	Start delay	1 = 1 s / 100 = 1 s
21.23	Smooth start	Selects the forced current vector rotation mode at low speeds. When the smooth start mode is selected, the rate of acceleration is limited by the acceleration and deceleration ramp times. If the process driven by the permanent magnet synchronous motor has high inertia, slow ramp times are recommended. Can be used for permanent magnet synchronous motors only.	Disabled / uint16
	Disabled	Smooth start is disabled.	0
	Enabled always	Enabled always.	1
	Start only	Enabled when starting the motor.	2
21.24	Smooth start current	Current used in the current vector rotation at low speeds. Increase the smooth start current if the application requires motor shaft swinging needs to be minimized. Note that accurate torque control is not possible in the current vector rotation mode. Can be used for permanent magnet synchronous motors only.	50.0 percent / real32
	10.0 … 200.0 %	Value in percent of the nominal motor current.	1 = 1 % / 10 = 1 %
21.25	Smooth start speed	Output frequency up to which the current vector rotation is used. See parameter 21.19 Scalar start mode. Can be used for permanent magnet synchronous motors only.	10.0 percent / real32
	2.0 … 100.0 %	Value as a percentage of the nominal motor frequency.	1 = 1 % / 10 = 1 %
21.26	Torque boost current	Defines the maximum supplied current to motor when parameter 21.19 Scalar start mode is set to Torque boost (page 206). Parameter value is in percent of the motor nominal current. Nominal value of the parameter is 100.0%. Torque boost is only applied at start, ending when output frequency exceeds 40% of nominal frequency or when output frequency is equal to reference. Can be used in scalar motor control mode only.	100.0 percent / real32
	15.0 … 300.0 %	Value in percent of the nominal motor current.	1 = 1 % / 10 = 1 %

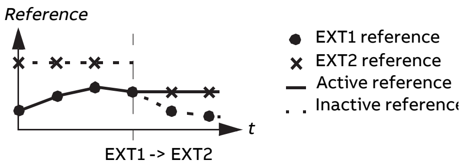
No.	Name / Range / Selection	Description	Def / Type FbEq 16b / 32b
21.27	Torque boost time	Defines the minimum and maximum torque boost time. If torque boost time is less than 40% of frequency acceleration time (see parameters 28.72 Freq acceleration time 1 and 28.74 Freq acceleration time 2), then torque boost time is set at 40% of frequency acceleration time.	20.0 s / real32
	0.0 ... 60.0 s	Nominal motor time.	1 = 1 s / 10 = 1 s
21.30	Speed compensated stop mode	Selects the method used to stop the drive. Speed compensated stop is active only if • the operation mode is not torque, and • parameter 21.03 Stop mode is Ramp.	Off / uint16
	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.	0.0 s / real32
	0.0 ... 1000.0 s	Speed delay.	1 = 1 s / 10 = 1 s
21.32	Speed comp stop threshold	This parameter sets a speed threshold below which the Speed compensated stop feature is disabled. In this speed region, the speed compensated stop is not attempted and the drive stops as it would, using the ramp option.	10 percent / real32
	10...100 %	Speed threshold as a percent of the motor nominal speed.	1 = 1 % / 1 = 1 %
21.35	Preheating power	Defines the power used to heat the motor.	0.00 kW / real32

No.	Name / Range / Selection	Description	Def / Type FbEq 16b / 32b
	0.00 ... 10.00 kW	Preheating power.	100 = 1 kW / 100 = 1 kW
21.36	Preheating unit	Defines if preheating is specified as current or power.	Current / uint16
	Current	Preheating specified as current.	0
	Power	Preheating specified as power.	1

No.	Name / Range / Selection	Description	Def / Type FbEq 16b / 32b
22	Speed reference selection	Speed reference selection; Floating point control (Motor potentiometer) settings. See the control chain diagrams Speed reference source selection I (page 512)…Speed controller (page 516).	
22.01	Speed ref unlimited	Displays the output of the speed reference selection block. See the control chain diagram Speed reference source selection II (page 513). This parameter is read-only.	0.00 rpm / real32
	-30000.00 … 30000.00 rpm	Value of the selected speed reference. For scaling, see parameter 46.01 Speed scaling.	1 = 1 rpm / 100 = 1 rpm
22.11	Ext1 speed ref1	Selects EXT1 speed reference source 1. Two signal sources can be defined by this parameter and parameter 22.12 Ext1 speed ref2. A mathematical function (parameter 22.13 Ext1 speed function) applied to the two signals creates an EXT1 reference (A in the figure below). A digital source selected by parameter 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 / uint32
	Zero	None.	0
	AI1 scaled	Parameter 12.12 AI1 scaled value.	1
	AI2 scaled	Parameter 12.22 AI2 scaled value.	2
	EFB ref1	Parameter 03.09 EFB reference 1.	8
	EFB ref2	Parameter 03.10 EFB reference 2.	9

No.	Name / Range / Selection	Description	Def / Type FbEq 16b / 32b
	Motor potentiometer	Parameter 22.80 Motor potentiometer ref act (output of the Floating point control (Motor potentiometer)).	15
	PID	Parameter 40.01 Process PID output actual (output of the process PID controller).	16
	Frequency input 1	Parameter 11.38 Freq in 1 actual value (when DI5 is used as a frequency input).	17
	Control panel (ref saved)	Control panel reference (parameter 03.01 Panel reference) saved by the control system for the location where the control returns is used as the reference. 	18
	Control panel (ref copied)	Control panel reference (parameter 03.01 Panel reference) for the previous control location is used as the reference when the control location changes if the references for the two locations are of the same type (eg frequency/speed/torque/PID); otherwise, the actual signal is used as the new reference. 	19
	Integrated panel (ref saved)	See above Control panel (ref saved).	20
	Integrated panel (ref copied)	See above Control panel (ref copied).	21
	Frequency input 2	Parameter 11.46 Freq in 2 actual value (when DI3 or DI4 is used as a frequency input).	22
	Other [bit]	See Terms and abbreviations (page 137).	-
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 / uint32
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 parameter 22.11 Ext1 speed ref1.	Ref1 / uint16
	Ref1	Signal selected by parameter 22.11 Ext1 speed ref1 is used as speed reference 1 as such (no function applied).	0

No.	Name / Range / Selection	Description	Def / Type FbEq 16b / 32b
	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 x 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
22.18	Ext2 speed ref1	Selects EXT2 speed reference source 1. Two signal sources can be defined by this parameter and parameter 22.19 Ext2 speed ref2. A mathematical function (parameter 22.20 Ext2 speed function) applied to the two signals creates an EXT2 reference. See diagram at parameter 22.11 Ext1 speed ref1.	Zero / uint32
	Zero	None.	0
	AI1 scaled	Parameter 12.12 AI1 scaled value.	1
	AI2 scaled	Parameter 12.22 AI2 scaled value.	2
	EFB ref1	Parameter 03.09 EFB reference 1.	8
	EFB ref2	Parameter 03.10 EFB reference 2.	9
	Motor potentiometer	Parameter 22.80 Motor potentiometer ref act (output of the Floating point control (Motor potentiometer)).	15
	PID	Parameter 40.01 Process PID output actual (output of the process PID controller).	16
	Frequency input 1	Parameter 11.38 Freq in 1 actual value (when DI5 is used as a frequency input).	17
	Control panel (ref saved)	Control panel reference (parameter 03.01 Panel reference) saved by the control system for the location where the control returns is used as the reference.  	18

No.	Name / Range / Selection	Description	Def / Type FbEq 16b / 32b
	Control panel (ref copied)	Control panel reference (parameter 03.01 Panel reference) for the previous control location is used as the reference when the control location changes if the references for the two locations are of the same type (eg frequency/speed/torque/PID); otherwise, the actual signal is used as the new reference.  	19
	Integrated panel (ref saved)	See above Control panel (ref saved).	20
	Integrated panel (ref copied)	See above Control panel (ref copied).	21
	Frequency input 2	Parameter 11.46 Freq in 2 actual value (when DI3 or DI4 is used as a frequency input).	22
	Other [bit]	See Terms and abbreviations (page 137).	-
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 / uint32
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 parameter 22.18 Ext2 speed ref1.	Ref1 / uint16
	Ref1	Signal selected by parameter 22.18 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 x 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.	0000h / uint16

No.	Name / Range / Selection	Description	Def / Type FbEq 16b / 32b
b0	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.	
b1	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 parameters 22.26…22.32 are positive. **WARNING!** If the direction signal is reverse and the active constant speed is negative, the drive will run in the forward direction. 0 = According to Par: The running direction for the constant speed is determined by the sign of the constant speed setting (parameters 22.26…22.32).	
b2…15	Reserved		
	0000h…FFFFh		1 = 1 / 1 = 1

No.	Name / Range / Selection	Description	Def / Type FbEq 16b / 32b
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 / uint32

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 / Range / Selection	Description	Def / Type FbEq 16b / 32b
	Always off	0.	0
	Always on	1.	1
	DI1	Digital input DI1 (parameter 10.02 DI delayed status, bit 0).	2
	DI2	Digital input DI2 (parameter 10.02 DI delayed status, bit 1).	3
	DI3	Digital input DI3 (parameter 10.02 DI delayed status, bit 2).	4
	DI4	Digital input DI4 (parameter 10.02 DI delayed status, bit 3).	5
	DI5	Digital input DI5 (parameter 10.02 DI delayed status, bit 4).	6
	Timed function 1	Bit 0 of parameter 34.01 Timed functions status.	18
	Timed function 2	Bit 1 of parameter 34.01 Timed functions status.	19
	Timed function 3	Bit 2 of parameter 34.01 Timed functions status.	20
	Supervision 1	Bit 0 of parameter 32.01 Supervision status.	24
	Supervision 2	Bit 1 of parameter 32.01 Supervision status.	25

No.	Name / Range / Selection	Description	Def / Type FbEq 16b / 32b
	Supervision 3	Bit 2 of parameter 32.01 Supervision status.	26
	EFB MCW bit 7	Control word bit 7 received through the embedded fieldbus interface.	32
	Other [bit]	See Terms and abbreviations (page 137).	-
22.23	Constant speed sel2	When bit 0 of parameter 22.21 Constant speed function is 0 (Separate), selects a source that activates constant speed 2. When bit 0 of parameter 22.21 Constant speed function is 1 (Packed), this parameter and parameters 22.22 Constant speed sel1 and 22.24 Constant speed sel3 select three sources that are used to activate constant speeds. See table at parameter 22.22 Constant speed sel1. For the selections, see parameter 22.22 Constant speed sel1.	Always off / uint32
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 / uint32
22.25	Constant speed sel4	When bit 0 of parameter 22.21 Constant speed function is 0 (Separate), selects a source that activates constant speed 4. For the selections, see parameter 22.22 Constant speed sel1.	Always off / uint32
22.26	Constant speed 1	Defines constant speed 1 (the speed the motor will turn when constant speed 1 is selected).	300.00; 360.00 (95.20 b0) rpm / real32
	-30000.00 … 30000.00 rpm	Constant speed 1. For scaling, see parameter 46.01 Speed scaling.	1 = 1 rpm / 100 = 1 rpm
22.27	Constant speed 2	Defines constant speed 2.	600.00; 720.00 (95.20 b0) rpm / real32
	-30000.00 … 30000.00 rpm	Constant speed 2. For scaling, see parameter 46.01 Speed scaling.	1 = 1 rpm / 100 = 1 rpm
22.28	Constant speed 3	Defines constant speed 3.	900.00; 1080.00 (95.20 b0) rpm / real32
	-30000.00 … 30000.00 rpm	Constant speed 3. For scaling, see parameter 46.01 Speed scaling.	1 = 1 rpm / 100 = 1 rpm

No.	Name / Range / Selection	Description	Def / Type FbEq 16b / 32b
22.29	Constant speed 4	Defines constant speed 4.	1200.00; 1440.00 (95.20 b0) rpm / real32
	-30000.00 ... 30000.00 rpm	Constant speed 4. For scaling, see parameter 46.01 Speed scaling.	1 = 1 rpm / 100 = 1 rpm
22.30	Constant speed 5	Defines constant speed 5.	1500.00; 1800.00 (95.20 b0) rpm / real32
	-30000.00 ... 30000.00 rpm	Constant speed 5. For scaling, see parameter 46.01 Speed scaling.	1 = 1 rpm / 100 = 1 rpm
22.31	Constant speed 6	Defines constant speed 6.	2400.00; 2880.00 (95.20 b0) rpm / real32
	-30000.00 ... 30000.00 rpm	Constant speed 6. For scaling, see parameter 46.01 Speed scaling.	1 = 1 rpm / 100 = 1 rpm
22.32	Constant speed 7	Defines constant speed 7.	3000.00; 3600.00 (95.20 b0) rpm / real32
	-30000.00 ... 30000.00 rpm	Constant speed 7. For scaling, see parameter 46.01 Speed scaling.	1 = 1 rpm / 100 = 1 rpm
22.41	Speed ref safe	Defines a safe speed reference value that is used with supervision functions such as • parameter 12.03 AI supervision function • parameter 49.05 Communication loss action.	0.00 rpm / real32
	-30000.00 ... 30000.00 rpm	Safe speed reference. For scaling, see parameter 46.01 Speed scaling.	1 = 1 rpm / 100 = 1 rpm
22.46	Constant speed sel5	When bit 0 of parameter 22.21 Constant speed function is 0 (Separate), selects a source that activates constant speed 5. For the selections, see parameter 22.22 Constant speed sel1.	Always off / uint32
22.47	Constant speed sel6	When bit 0 of parameter 22.21 Constant speed function is 0 (Separate), selects a source that activates constant speed 6. For the selections, see parameter 22.22 Constant speed sel1.	Always off / uint32
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 Constant speeds/frequencies (page 74).	0000h / uint16
b0	Enable	1 = Enable: Critical speeds enabled. 0 = Disable: Critical speeds disabled.	

No.	Name / Range / Selection	Description	Def / Type FbEq 16b / 32b
b1	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.	
b2…15	Reserved		
	0000h…FFFFh		1 = 1 / 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 parameter 22.53 Critical speed 1 high.	0.00 rpm / real32
	-30000.00 … 30000.00 rpm	Low limit for critical speed 1. For scaling, see parameter 46.01 Speed scaling.	1 = 1 rpm / 100 = 1 rpm
22.53	Critical speed 1 high	Defines the high limit for critical speed range 1. **Note:** This value must be less than or equal to the value of parameter 22.52 Critical speed 1 low.	0.00 rpm / real32
	-30000.00 … 30000.00 rpm	High limit for critical speed 1. For scaling, see parameter 46.01 Speed scaling.	1 = 1 rpm / 100 = 1 rpm
22.54	Critical speed 2 low	Defines the low limit for critical speed range 2. **Note:** This value must be less than or equal to the value of parameter 22.55 Critical speed 2 high.	0.00 rpm / real32
	-30000.00 … 30000.00 rpm	Low limit for critical speed 2. For scaling, see parameter 46.01 Speed scaling.	1 = 1 rpm / 100 = 1 rpm
22.55	Critical speed 2 high	Defines the high limit for critical speed range 2. **Note:** This value must be greater than or equal to the value of parameter 22.54 Critical speed 2 low.	0.00 rpm / real32
	-30000.00 … 30000.00 rpm	High limit for critical speed 2. For scaling, see parameter 46.01 Speed scaling.	1 = 1 rpm / 100 = 1 rpm
22.56	Critical speed 3 low	Defines the low limit for critical speed range 3. **Note:** This value must be less than or equal to the value of parameter 22.57 Critical speed 3 high.	0.00 rpm / real32
	-30000.00 … 30000.00 rpm	Low limit for critical speed 3. For scaling, see parameter 46.01 Speed scaling.	1 = 1 rpm / 100 = 1 rpm
22.57	Critical speed 3 high	Defines the high limit for critical speed range 3. **Note:** This value must be greater than or equal to the value of parameter 22.56 Critical speed 3 low.	0.00 rpm / real32
	-30000.00 … 30000.00 rpm	High limit for critical speed 3. For scaling, see parameter 46.01 Speed scaling.	1 = 1 rpm / 100 = 1 rpm
22.70	Motor potentiometer reference enable	Determines when parameters 22.73 Motor potentiometer up source and 22.74 Motor potentiometer down source may change parameter 22.80 Motor potentiometer ref act.	Selected / uint32

No.	Name / Range / Selection	Description	Def / Type FbEq 16b / 32b
	Not selected	Motor potentiometer up and down sources (parameters 22.73 and 22.74) are disabled.	0
	Selected	Motor potentiometer up and down sources (parameters 22.73 and 22.74) are enabled.	1
	While running	Motor potentiometer reference enable follows bit 4 Following reference of parameter 06.16 Drive status word 1.	2
	Other [bit]	See Terms and abbreviations (page 137).	-
22.71	Motor potentiometer function	Activates and selects the mode of the Floating point control (Motor potentiometer).	Disabled / uint16
	Disabled	Floating point control (Motor potentiometer) is disabled and its value set to 0.	0
	Enabled (init at stop/power-up)	When enabled, the Floating point control (Motor potentiometer) counter first adopts the value defined by parameter 22.72 Motor potentiometer initial value. The value can then be adjusted from the up and down sources defined by parameters 22.73 Motor potentiometer up source and 22.74 Motor potentiometer down source. A stop or a power cycle will reset the counter to parameter 22.72 Motor potentiometer initial value.	1
	Enabled (resume always)	As Enabled (init at stop/power-up), but the Floating point control (Motor potentiometer) counter value is retained over a power cycle.	2
	Enabled (init to actual)	Whenever another reference source is selected, the value of the Floating point control (Motor potentiometer) counter follows that reference. After the source of reference returns to the Floating point control (Motor potentiometer) counter, its value can again be changed by the motor potentiometer up and down sources (parameters 22.73 and 22.74).	3
	Enabled (resume/init to actual)	As Enabled (init to actual), but the motor potentiometer ref act value is retained over power cycle.	4
22.72	Motor potentiometer initial value	Defines an initial value (starting point) for the Floating point control (Motor potentiometer) counter. See the selections of parameter 22.71 Motor potentiometer function.	0.00 NoUnit / real32
	-32768.00 ... 32767.00	Initial value for motor potentiometer.	1 = 1 / 100 = 1

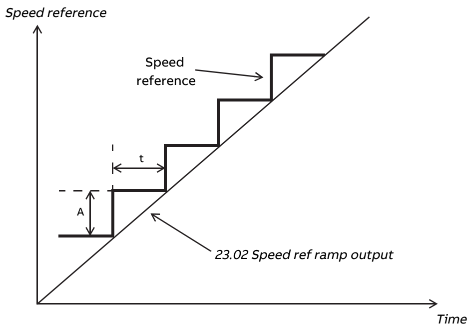
No.	Name / Range / Selection	Description	Def / Type FbEq 16b / 32b
22.73	Motor potentiometer up source	Selects the source of Floating point control (Motor potentiometer) counter up signal. 0 = No change. 1 = Increase Floating point control (Motor potentiometer) counter value. (If both the up and down sources are on, the potentiometer value will not change.) **Note:** Floating point control (Motor potentiometer) function up/down source control speed or frequency from zero to maximum speed or frequency. The running direction can be changed with parameter 20.04 Ext1 in2 source. See the figure in section Floating point control (Motor potentiometer) (page 114).	Not used / uint32
	Not used	0.	0
	Not used	1.	1
	DI1	Digital input DI1 (parameter 10.02 DI delayed status, bit 0).	2
	DI2	Digital input DI2 (parameter 10.02 DI delayed status, bit 1).	3
	DI3	Digital input DI3 (parameter 10.02 DI delayed status, bit 2).	4
	DI4	Digital input DI4 (parameter 10.02 DI delayed status, bit 3).	5
	DI5	Digital input DI5 (parameter 10.02 DI delayed status, bit 4).	6
	Timed function 1	Bit 0 of parameter 34.01 Timed functions status.	18
	Timed function 2	Bit 1 of parameter 34.01 Timed functions status.	19
	Timed function 3	Bit 2 of parameter 34.01 Timed functions status.	20
	Supervision 1	Bit 0 of parameter 32.01 Supervision status.	24
	Supervision 2	Bit 1 of parameter 32.01 Supervision status.	25
	Supervision 3	Bit 2 of parameter 32.01 Supervision status.	26
	EFB MCW bit 7	Control word bit 7 received through the embedded fieldbus interface.	32
	Other [bit]	See Terms and abbreviations (page 137).	-

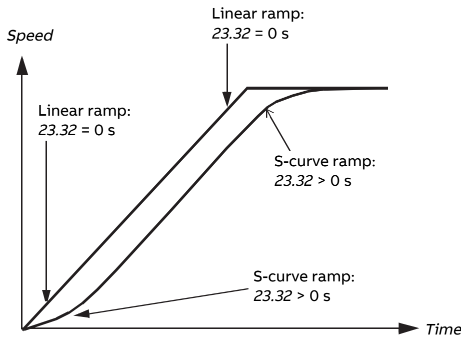
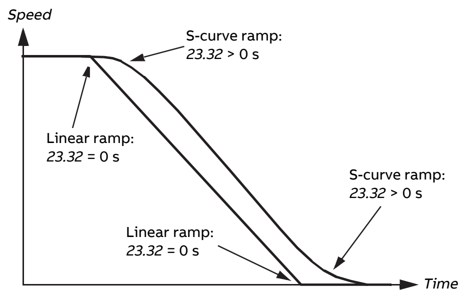
No.	Name / Range / Selection	Description	Def / Type FbEq 16b / 32b
22.74	Motor potentiometer down source	Selects the source of Floating point control (Motor potentiometer) counter down signal. 0 = No change. 1 = Decrease Increase Floating point control (Motor potentiometer) counter value. (If both the up and down sources are on, the potentiometer value will not change.) **Note:** Floating point control (Motor potentiometer) function up/down source control speed or frequency from zero to maximum speed or frequency. The running direction can be changed with parameter 20.04 Ext1 in2 source. See the figure in section Floating point control (Motor potentiometer) (page 114). For the selections, see parameter 22.73 Motor potentiometer up source.	Not used / uint32
22.75	Motor potentiometer ramp time	Defines the change rate of the Floating point control (Motor potentiometer) counter. This parameter specifies the time required for the Floating point control (Motor potentiometer) to change from minimum (parameter 22.76) to maximum (parameter 22.77). The same change rate applies in both directions.	40.0 s / real32
	0.0 ... 3600.0 s	Counter change time.	1 = 1 s / 10 = 1 s
22.76	Motor potentiometer min value	Defines the minimum value of the Floating point control (Motor potentiometer) counter. **Note:** If vector control mode is used, value of this parameter must be changed.	-50.00 NoUnit / real32
	-32768.00 ... 32767.00	Counter minimum.	1 = 1 / 100 = 1
22.77	Motor potentiometer max value	Defines the maximum value of the Floating point control (Motor potentiometer) counter. **Note:** If vector control mode is used, value of this parameter must be changed.	50.00 NoUnit / real32
	-32768.00 ... 32767.00	Counter maximum.	1 = 1 / 100 = 1
22.80	Motor potentiometer ref act	Shows the output of the Floating point control (Motor potentiometer) function. (The motor potentiometer is configured using parameters 22.71…22.74.) This parameter is read-only.	0 NoUnit / real32
	-32768.00 ... 32767.00	Value of the Floating point control (Motor potentiometer) counter.	1 = 1 / 100 = 1
22.86	Speed reference act 6	Displays the value of the speed reference (EXT1 or EXT2) that has been selected by parameter 19.11 Ext1/Ext2 selection. See diagram at parameter 22.11 Ext1 speed ref1 or the control chain diagram Speed reference source selection I (page 512). This parameter is read-only.	0 rpm / real32

No.	Name / Range / Selection	Description	Def / Type FbEq 16b / 32b
	-30000.00 … 30000.00 rpm	Speed reference after additive 2. For scaling, see parameter 46.01 Speed scaling.	1 = 1 rpm / 100 = 1 rpm
22.87	Speed reference act 7	Displays the value of speed reference before application of critical speeds. See the control chain diagram on page 511. The value is received from parameter 22.86 Speed reference act 6 unless overridden by • any constant speed • Network control reference (see section Terms and abbreviations (page 16)) • control panel reference • safe speed reference. This parameter is read-only.	0 rpm / real32
	-30000.00 … 30000.00 rpm	Speed reference before application of critical speeds. For scaling, see parameter 46.01 Speed scaling.	1 = 1 rpm / 100 = 1 rpm

No.	Name / Range / Selection	Description	Def / Type FbEq 16b / 32b
23	Speed reference ramp	Speed reference ramp settings (programming of the acceleration and deceleration rates for the drive). See the control chain diagram Speed reference ramping and shaping (page 514).	
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 Speed reference ramping and shaping (page 514). This parameter is read-only.	0 rpm / real32
	-30000.00 … 30000.00 rpm	Speed reference before ramping and shaping. For scaling, see parameter 46.01 Speed scaling.	1 = 1 rpm / 100 = 1 rpm
23.02	Speed ref ramp output	Displays the ramped and shaped speed reference in rpm. See the control chain diagram Speed reference ramping and shaping (page 514). This parameter is read-only.	0 rpm / real32
	-30000.00 … 30000.00 rpm	Speed reference after ramping and shaping. For scaling, see parameter 46.01 Speed scaling.	1 = 1 rpm / 100 = 1 rpm
23.11	Ramp set selection	Selects the source that switches between the two sets of acceleration/deceleration ramp times defined by parameters 23.12…23.15. 0 = Acceleration time 1 and deceleration time 1 are active. 1 = Acceleration time 2 and deceleration time 2 are active.	Acc/Dec time 1 / uint32
	Acc/Dec time 1	0.	0
	Acc/Dec time 2	1.	1
	DI1	Digital input DI1 (parameter 10.02 DI delayed status, bit 0).	2
	DI2	Digital input DI2 (parameter 10.02 DI delayed status, bit 1).	3
	DI3	Digital input DI3 (parameter 10.02 DI delayed status, bit 2).	4
	DI4	Digital input DI4 (parameter 10.02 DI delayed status, bit 3).	5
	DI5	Digital input DI5 (parameter 10.02 DI delayed status, bit 4).	6
	EFB DCU CW bit 10	Only for the DCU profile. DCU control word bit 10 received through the embedded fieldbus interface.	20
	Other [bit]	See Terms and abbreviations (page 137).	-

No.	Name / Range / Selection	Description	Def / Type FbEq 16b / 32b
23.12	Acceleration time 1	Defines acceleration time 1 as the time required for the speed to change from zero to the speed defined by parameter 46.01 Speed scaling (not to parameter 30.12 Maximum speed). If the speed reference increases faster than the set acceleration rate, the motor speed will follow the acceleration rate. If the speed reference increases slower than the set acceleration rate, the motor speed will follow the reference. If the acceleration time is set too short, the drive will automatically prolong the acceleration in order not to exceed the drive torque limits.	20.000 s / real32
	0.000 ... 1800.000 s	Acceleration time 1.	10 = 1 s / 1000 = 1 s
23.13	Deceleration time 1	Defines deceleration time 1 as the time required for the speed to change from the speed defined by parameter 46.01 Speed scaling (not from parameter 30.12 Maximum speed) to zero. If the speed reference decreases slower than the set deceleration rate, the motor speed will follow the reference. If the reference changes faster than the set deceleration rate, the motor speed will follow the deceleration rate. If the deceleration rate is set too short, the drive will automatically prolong the deceleration in order not to exceed drive torque limits (or not to exceed a safe DC link voltage). If there is any doubt about the deceleration time being too short, ensure that DC overvoltage control is on (parameter 30.30 Overvoltage control). **Note:** If a short deceleration time is needed for a high inertia application, the drive should be equipped with braking equipment such as a brake chopper and brake resistor.	20.000 s / real32
	0.000 ... 1800.000 s	Deceleration time 1.	10 = 1 s / 1000 = 1 s
23.14	Acceleration time 2	Defines acceleration time 2. See parameter 23.12 Acceleration time 1.	60.000 s / real32
	0.000 ... 1800.000 s	Acceleration time 2.	10 = 1 s / 1000 = 1 s
23.15	Deceleration time 2	Defines deceleration time 2. See parameter 23.13 Deceleration time 1.	60.000 s / real32
	0.000 ... 1800.000 s	Deceleration time 2.	10 = 1 s / 1000 = 1 s

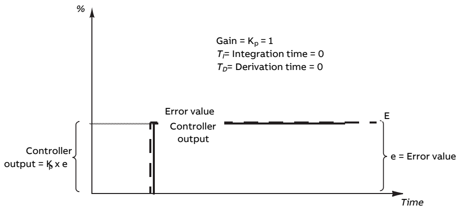
No.	Name / Range / Selection	Description	Def / Type FbEq 16b / 32b
23.23	Emergency stop time	Defines the time inside which the drive is stopped if an emergency stop Off3 is activated (that is, the time required for the speed to change from the speed value defined by parameter 46.01 Speed scaling or parameter 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…23.15. • The same parameter value is also used in frequency control mode (ramp parameters 28.71…28.75).	3.000 s / real32
	0.000 ... 1800.000 s	Emergency stop Off3 deceleration time.	10 = 1 s / 1000 = 1 s
23.28	Variable slope enable	Activates the variable slope function, which controls the slope of the speed ramp during a speed reference change. This allows for a constantly variable ramp rate to be generated, instead of just the standard two ramps normally available. If the update interval of the signal from an external control system and the variable slope rate (parameter 23.29 Variable slope rate) are equal, speed reference (parameter 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 control.	Off / uint16
	Off	Variable slope disabled.	0
	On	Variable slope enabled (not available in local control).	1

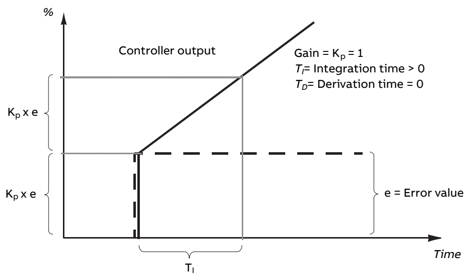
No.	Name / Range / Selection	Description	Def / Type FbEq 16b / 32b
23.29	Variable slope rate	Defines the rate of the speed reference change when variable slope is enabled by parameter 23.28 Variable slope enable. For the best result, enter the reference update interval into this parameter.	50 ms / real32
	2…30000 ms	Variable slope rate.	1 = 1 ms / 1 = 1 ms
23.32	Shape time 1	Defines the shape of the acceleration and deceleration ramps used with the set 1. 0.000 s: Linear ramp. Suitable for steady acceleration or deceleration and for slow ramps. 0.001…1000.000 s: S-curve ramp. S-curve ramps are ideal for lifting applications. The S-curve consists of symmetrical curves at both ends of the ramp and a linear part in between. **Acceleration:**  **Deceleration:** 	0.000 s / real32
	0.000 … 1800.000 s	Ramp shape at start and end of acceleration and deceleration.	10 = 1 s / 1000 = 1 s
23.33	Shape time 2	Defines the shape of the acceleration and deceleration ramps used with the set 2. See parameter 23.32 Shape time 1.	0.000 s / real32

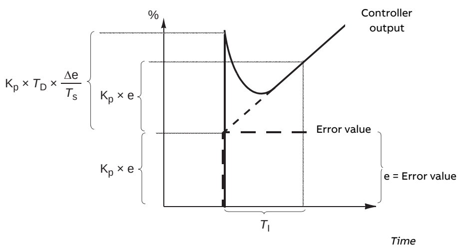
No.	Name / Range / Selection	Description	Def / Type FbEq 16b / 32b
	0.000 … 1800.000 s	Ramp shape at start and end of acceleration and deceleration.	10 = 1 s / 1000 = 1 s

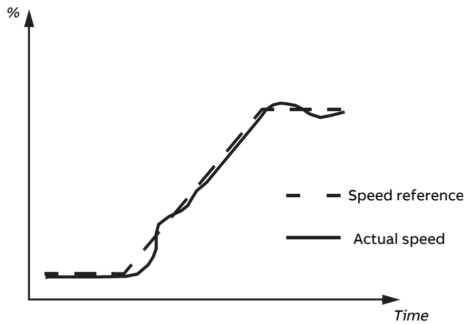
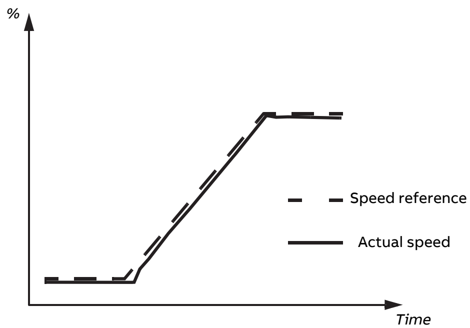
No.	Name / Range / Selection	Description	Def / Type FbEq 16b / 32b
24	Speed reference conditioning	Speed error calculation; speed error window control configuration; speed error step. See the control chain diagram Speed error calculation (page 515).	
24.01	Used speed reference	Displays the ramped and corrected speed reference (before speed error calculation). See the control chain diagram Speed error calculation (page 515). This parameter is read-only.	0.00 rpm / real32
	-30000.00 ... 30000.00 rpm	Speed reference used for speed error calculation. For scaling, see parameter 46.01 Speed scaling.	1 = 1 rpm / 100 = 1 rpm
24.02	Used speed feedback	Displays the speed feedback used for speed error calculation. See the control chain diagram Speed error calculation (page 515). This parameter is read-only.	0.00 rpm / real32
	-30000.00 ... 30000.00 rpm	Speed feedback used for speed error calculation. For scaling, see parameter 46.01 Speed scaling.	1 = 1 rpm / 100 = 1 rpm
24.03	Speed error filtered	Displays the filtered speed error. See the control chain diagram Speed error calculation (page 515). This parameter is read-only.	0.00 rpm / real32
	-30000.00 ... 30000.00 rpm	Filtered speed error. For scaling, see parameter 46.01 Speed scaling.	1 = 1 rpm / 1 = 1 rpm
24.04	Speed error inverted	Displays the inverted (unfiltered) speed error. See the control chain diagram Speed error calculation (page 515). This parameter is read-only.	0.00 rpm / real32
	-30000.00 ... 30000.00 rpm	Inverted speed error. For scaling, see parameter 46.01 Speed scaling.	1 = 1 rpm / 100 = 1 rpm
24.11	Speed correction	Defines a speed reference correction, ie. a value added to the existing reference between ramping and limitation. This is useful to trim the speed if necessary, for example to adjust draw between sections of a paper machine. See the control chain diagram Speed error calculation (page 515).	0.00 rpm / real32
	-10000.00 ... 10000.00 rpm	Speed reference correction. For scaling, see parameter 46.01 Speed scaling.	1 = 1 rpm / 100 = 1 rpm
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 / real32

No.	Name / Range / Selection	Description	Def / Type FbEq 16b / 32b
	0…10000 ms	Speed error filtering time constant. 0 = filtering disabled.	1 = 1 ms / 1 = 1 ms

No.	Name / Range / Selection	Description	Def / Type FbEq 16b / 32b
25	Speed control	Speed controller settings. See the control chain diagram Speed controller (page 516).	
25.01	Torque reference speed control	Displays the speed controller output that is transferred to the torque controller. See the control chain diagram Speed controller (page 516). This parameter is read-only.	0.0 percent / real32
	-1600.0 ... 1600.0 %	Limited speed controller output torque. For scaling, see parameter 46.03 Torque scaling.	10 = 1 % / 10 = 1 %
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%, that is, the output value is input × gain.	5.00 NoUnit / real32
	0.00 ... 250.00	Proportional gain for speed controller.	100 = 1 / 100 = 1

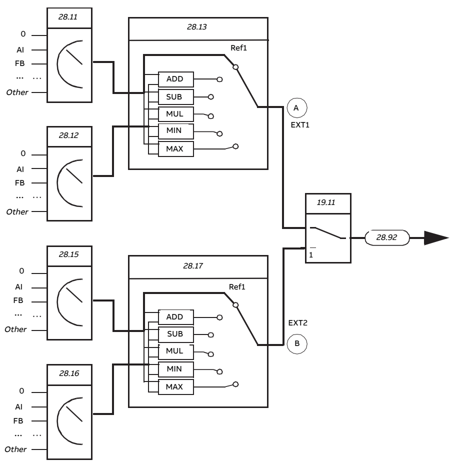
No.	Name / Range / Selection	Description	Def / Type FbEq 16b / 32b
25.03	Speed integration time	Defines the integration time of the speed controller. The integration time defines the rate at which the controller output changes when the error value is constant and the proportional gain of the speed controller is 1. The shorter the integration time, the faster the continuous error value is corrected. This time constant must be set to the same order of magnitude as the time constant (time to respond) of the actual mechanical system being controlled, otherwise instability will result. Setting the integration time to zero disables the I-part of the controller. This is useful to do when tuning the proportional gain; adjust the proportional gain first, then return the integration time. Anti-windup (the integrator just integrates up to 100%) stops the integrator if the controller output is limited. The figure below shows the speed controller output after an error step when the error remains constant.  	2.50 s / real32
	0.00 … 1000.00 s	Integration time for speed controller.	10 = 1 s / 100 = 1 s

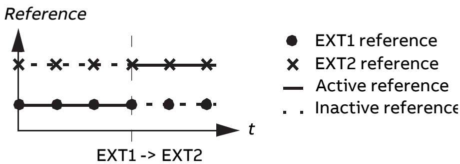
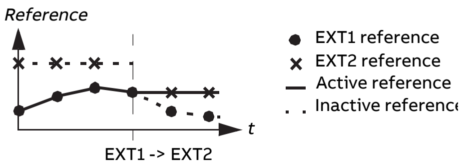
No.	Name / Range / Selection	Description	Def / Type FbEq 16b / 32b
25.04	Speed derivation time	Defines the derivation time of the speed controller. Derivative action boosts the controller output if the error value changes. The longer the derivation time, the more the speed controller output is boosted during the change. If the derivation time is set to zero, the controller works as a PI controller, otherwise as a PID controller. The derivation makes the control more responsive for disturbances. For simple applications, derivative time is not normally required and should be left at zero. The speed error derivative must be filtered with a low pass filter to eliminate disturbances. The figure below shows the speed controller output after an error step when the error remains constant.  Gain = K_p = 1 T_I = Integration time > 0 T_D= Derivation time > 0 T_s= Sample time period = 250 µs Δe = Error value change between two samples	0.000 s / real32
	0.000 … 10.000 s	Derivation time for speed controller.	1000 = 1 s / 1000 = 1 s
25.05	Derivation filter time	Defines the derivation filter time constant. See parameter 25.04 Speed derivation time.	8 ms / real32
	0…10000 ms	Derivation filter time constant.	1 = 1 ms / 1 = 1 ms

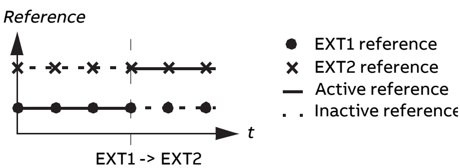
No.	Name / Range / Selection	Description	Def / Type FbEq 16b / 32b
25.06	Acc comp derivation time	Defines the derivation time for acceleration(/deceleration) compensation. In order to compensate for a high inertia load during acceleration, a derivative of the reference is added to the output of the speed controller. The principle of a derivative action is described under parameter 25.04 Speed derivation time. **Note:** As a general rule, set this parameter to the value between 50 and 100% of the sum of the mechanical time constants of the motor and the driven machine. The figure below shows the speed responses when a high inertia load is accelerated along a ramp. **No acceleration compensation:**  **Acceleration compensation:** 	0.00 s / real32
	0.00 … 1000.00 s	Acceleration compensation derivation time.	10 = 1 s / 100 = 1 s
25.07	Acc comp filter time	Defines the acceleration (or deceleration) compensation filter time constant. See parameters 25.04 Speed derivation time and 25.06 Acc comp derivation time.	8.0 ms / real32
	0.0 … 1000.0 ms	Acceleration/deceleration compensation filter time.	10 = 1 ms / 10 = 1 ms
25.15	Proportional gain em stop	Defines the proportional gain for the speed controller when an emergency stop is active. See parameter 25.02 Speed proportional gain.	10.00 NoUnit / real32

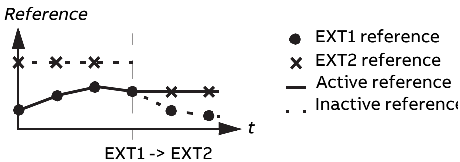
No.	Name / Range / Selection	Description	Def / Type FbEq 16b / 32b
	1.00 ... 250.00	Proportional gain upon an emergency stop.	100 = 1 / 100 = 1
25.30	Flux adaptation enable	Enables/disables speed controller adaptation based on motor flux reference (parameter 01.24 Flux actual %). The proportional gain of the speed controller is multiplied by a coefficient of 0…1 between 0…100% flux reference respectively.	Enable / uint16
	Disable	Speed controller adaptation based on flux reference disabled.	0
	Enable	Speed controller adaptation based on flux reference enabled.	1
25.33	Speed controller autotune	Activates (or selects a source that activates) the speed controller autotune function. See section Speed controller autotune (page 115).	Off / uint16
	Off	Not activated.	0
	On	Activated.	1
	Other [bit]	See Terms and abbreviations (page 137).	-
25.34	Speed controller autotune mode	Defines a control preset for the speed controller auto tune function. The setting affects the way the torque reference will respond to a speed reference step.	Normal / uint16
	Smooth	Slow yet robust response.	0
	Normal	Normal response.	1
	Tight	Fast response which can produce high gain value.	2
25.37	Mechanical time constant	Mechanical time constant of the drive and the machinery as determined by the speed controller autotune function. The value can be adjusted manually.	0.00 s / real32
	0.00 ... 1000.00 s	Mechanical time constant.	10 = 1 s / 100 = 1 s
25.38	Autotune torque step	Defines an added torque value used by the auto tune function. This value is scaled to the motor nominal torque. **Note:** The torque used by the auto tune function can also be limited by the torque limits (in parameter group 30 Limits (page 249)) and the nominal motor torque.	10.00 percent / real32
	0.00 ... 20.00 %	Torque step.	100 = 1 % / 100 = 1 %
25.39	Autotune speed step	Defines a speed value added to the initial speed for the auto tune function. The initial speed (speed used when auto tune is activated) plus the value of this parameter is the calculated maximum speed used by the auto tune routine. The maximum speed can also be limited by the speed limits (in parameter group 30 Limits (page 249)) and nominal motor speed. The value is scaled to the motor nominal speed. **Note:** The motor will exceed the calculated maximum speed slightly at the end of each acceleration stage.	10.00 percent / real32

No.	Name / Range / Selection	Description	Def / Type FbEq 16b / 32b
	0.00 … 20.00 %	Speed step.	100 = 1 % / 100 = 1 %
25.40	Autotune repeat times	Determines how many acceleration/deceleration cycles are performed during the auto tune routine. Increasing the value will improve the accuracy of the auto tune function, and allow the use of smaller torque or speed step values.	5 NoUnit / uint16
	1...10	Number of steps for auto tune.	1 = 1 / 1 = 1
25.53	Torque prop reference	Displays the output of the proportional (P) part of the speed controller. See the control chain diagram Speed controller (page 516). This parameter is read-only.	0.0 percent / real32
	-30000.0 … 30000.0 %	P-part output of speed controller. For scaling, see parameter 46.03 Torque scaling.	10 = 1 % / 10 = 1 %
25.54	Torque integral reference	Displays the output of the integral (I) part of the speed controller. See the control chain diagram Speed controller (page 516). This parameter is read-only.	0.0 percent / real32
	-30000.0 … 30000.0 %	I-part output of speed controller. For scaling, see parameter 46.03 Torque scaling.	10 = 1 % / 10 = 1 %
25.55	Torque deriv reference	Displays the output of the derivative (D) part of the speed controller. See the control chain diagram Speed controller (page 516). This parameter is read-only.	0.0 percent / real32
	-30000.0 … 30000.0 %	D-part output of speed controller. For scaling, see parameter 46.03 Torque scaling.	10 = 1 % / 10 = 1 %
25.56	Torque acc compensation	Displays the output of the acceleration compensation function. See the control chain diagram Speed controller (page 516). This parameter is read-only.	0.0 percent / real32
	-30000.0 … 30000.0 %	Output of acceleration compensation function. For scaling, see parameter 46.03 Torque scaling.	10 = 1 % / 10 = 1 %

No.	Name / Range / Selection	Description	Def / Type FbEq 16b / 32b
28	Frequency reference chain	Settings for the frequency reference chain. See chapter Control chain diagrams (page 509).	
28.01	Frequency ref ramp input	Displays the used frequency reference before ramping. See the control chain diagrams Frequency reference selection (page 510) and Frequency reference modification (page 511). This parameter is read-only.	0.00 Hz / real32
	-500.00 ... 500.00 Hz	Frequency reference before ramping. For scaling, see parameter 46.02 Frequency scaling.	10 = 1 Hz / 100 = 1 Hz
28.02	Frequency ref ramp output	Displays the final frequency reference (after selection, limitation and ramping). See the control chain diagram Frequency reference selection (page 510). This parameter is read-only.	0.00 Hz / real32
	-500.00 ... 500.00 Hz	Final frequency reference. For scaling, see parameter 46.02 Frequency scaling.	10 = 1 Hz / 100 = 1 Hz
28.11	Ext1 frequency ref1	Selects EXT1 frequency reference source 1. Two signal sources can be defined by this parameter and parameter 28.12 Ext1 frequency ref2. A mathematical function (parameter 28.13 Ext1 frequency function) applied to the two signals creates an EXT1 reference (A in the figure below). A digital source selected by parameter 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 / uint32
	Zero	None.	0

No.	Name / Range / Selection	Description	Def / Type FbEq 16b / 32b
	AI1 scaled	Parameter 12.12 AI1 scaled value.	1
	AI2 scaled	Parameter 12.22 AI2 scaled value.	2
	EFB ref1	Parameter 03.09 EFB reference 1.	8
	EFB ref2	Parameter 03.10 EFB reference 2.	9
	Motor potentiometer	Parameter 22.80 Motor potentiometer ref act (output of the Floating point control (Motor potentiometer)).	15
	PID	Parameter 40.01 Process PID output actual (output of the process PID controller).	16
	Frequency input 1	Parameter 11.38 Freq in 1 actual value (when DI5 is used as a frequency input).	17
	Control panel (ref saved)	Control panel reference (parameter 03.01 Panel reference) saved by the control system for the location where the control returns is used as the reference. 	18
	Control panel (ref copied)	Control panel reference (parameter 03.01 Panel reference) for the previous control location is used as the reference when the control location changes if the references for the two locations are of the same type (eg frequency/speed/torque/PID); otherwise, the actual signal is used as the new reference. 	19
	Integrated panel (ref saved)	See above Control panel (ref saved).	20
	Integrated panel (ref copied)	See above Control panel (ref copied).	21
	Frequency input 2	Parameter 11.46 Freq in 2 actual value (when DI3 or DI4 is used as a frequency input).	22
	Other [bit]	See Terms and abbreviations (page 137).	-
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 / uint32

No.	Name / Range / Selection	Description	Def / Type FbEq 16b / 32b
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 parameter 28.11 Ext1 frequency ref1.	Ref1 / uint16
	Ref1	Signal selected by parameter 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 ([parameter 28.11 Ext1 frequency ref1] - [parameter 28.12 Ext1 frequency ref2]) of the reference sources is used as frequency reference 1.	2
	Mul (ref1 x 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 parameter 28.16 Ext2 frequency ref2. A mathematical function (parameter 28.17 Ext2 frequency function) applied to the two signals creates an EXT2 reference. See diagram at parameter 28.11 Ext1 frequency ref1.	Zero / uint32
	Zero	Zero.	0
	AI1 scaled	Parameter 12.12 AI1 scaled value.	1
	AI2 scaled	Parameter 12.22 AI2 scaled value.	2
	EFB ref1	Parameter 03.09 EFB reference 1.	8
	EFB ref2	Parameter 03.10 EFB reference 2.	9
	Motor potentiometer	Parameter 22.80 Motor potentiometer ref act (output of the Floating point control (Motor potentiometer)).	15
	PID	Parameter 40.01 Process PID output actual (output of the process PID controller).	16
	Frequency input 1	Parameter 11.38 Freq in 1 actual value (when DI5 is used as a frequency input).	17
	Control panel (ref saved)	Control panel reference (parameter 03.01 Panel reference) saved by the control system for the location where the control returns is used as the reference. 	18

No.	Name / Range / Selection	Description	Def / Type FbEq 16b / 32b
	Control panel (ref copied)	Control panel reference (parameter 03.01 Panel reference) for the previous control location is used as the reference when the control location changes if the references for the two locations are of the same type (eg frequency/speed/torque/PID); otherwise, the actual signal is used as the new reference. 	19
	Integrated panel (ref saved)	See above Control panel (ref saved).	20
	Integrated panel (ref copied)	See above Control panel (ref copied).	21
	Frequency input 2	Parameter 11.46 Freq in 2 actual value (when DI3 or DI4 is used as a frequency input).	22
	Other [bit]	See Terms and abbreviations (page 137).	-
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 / uint32
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 parameter28.15 Ext2 frequency ref1.	Ref1 / uint16
	Ref1	Signal selected by parameter 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 ([parameter 28.15 Ext2 frequency ref1] - [parameter 28.16 Ext2 frequency ref2]) of the reference sources is used as frequency reference 1.	2
	Mul (ref1 x 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.	0000h / uint16

No.	Name / Range / Selection	Description	Def / Type FbEq 16b / 32b
b0	Constant 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.	
b1	Direction enable	1 = Start dir: To determine running direction for a constant speed, the sign of the constant speed setting (parameters 28.26…28.32) is multiplied by the direction signal (forward: +1, reverse: -1). This effectively allows the drive to have 14 (7 forward, 7 reverse) constant speeds if all values in parameters 28.26…28.32 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 28.26…28.32).	
b2…15	Reserved		
	0000h…FFFFh		1 = 1 / 1 = 1

<table>
<tr><th>No.</th><th>Name / Range / Selection</th><th>Description</th><th>Def / Type
FbEq 16b / 32b</th></tr>
<tr><td>28.22</td><td>Constant frequency sel1</td><td>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:
<table>
<tr><th>Source defined by par. 28.22</th><th>Source defined by par. 28.23</th><th>Source defined by par. 28.24</th><th>Constant frequency active</th></tr>
<tr><td>0</td><td>0</td><td>0</td><td>None</td></tr>
<tr><td>1</td><td>0</td><td>0</td><td>Constant frequency 1</td></tr>
<tr><td>0</td><td>1</td><td>0</td><td>Constant frequency 2</td></tr>
<tr><td>1</td><td>1</td><td>0</td><td>Constant frequency 3</td></tr>
<tr><td>0</td><td>0</td><td>1</td><td>Constant frequency 4</td></tr>
<tr><td>1</td><td>0</td><td>1</td><td>Constant frequency 5</td></tr>
<tr><td>0</td><td>1</td><td>1</td><td>Constant frequency 6</td></tr>
<tr><td>1</td><td>1</td><td>1</td><td>Constant frequency 7</td></tr>
</table></td><td>DI3 / uint32</td></tr>
<tr><td></td><td>Always off</td><td>Always off.</td><td>0</td></tr>
<tr><td></td><td>Always on</td><td>Always on.</td><td>1</td></tr>
<tr><td></td><td>DI1</td><td>Digital input DI1 (parameter 10.02 DI delayed status, bit 0).</td><td>2</td></tr>
<tr><td></td><td>DI2</td><td>Digital input DI2 (parameter 10.02 DI delayed status, bit 1).</td><td>3</td></tr>
<tr><td></td><td>DI3</td><td>Digital input DI3 (parameter 10.02 DI delayed status, bit 2).</td><td>4</td></tr>
<tr><td></td><td>DI4</td><td>Digital input DI4 (parameter 10.02 DI delayed status, bit 3).</td><td>5</td></tr>
<tr><td></td><td>DI5</td><td>Digital input DI5 (parameter 10.02 DI delayed status, bit 4).</td><td>6</td></tr>
<tr><td></td><td>Timed function 1</td><td>Bit 0 of parameter 34.01 Timed functions status.</td><td>18</td></tr>
<tr><td></td><td>Timed function 2</td><td>Bit 1 of parameter 34.01 Timed functions status.</td><td>19</td></tr>
<tr><td></td><td>Timed function 3</td><td>Bit 2 of parameter 34.01 Timed functions status.</td><td>20</td></tr>
<tr><td></td><td>Supervision 1</td><td>Bit 0 of parameter 32.01 Supervision status.</td><td>24</td></tr>
<tr><td></td><td>Supervision 2</td><td>Bit 1 of parameter 32.01 Supervision status.</td><td>25</td></tr>
</table>

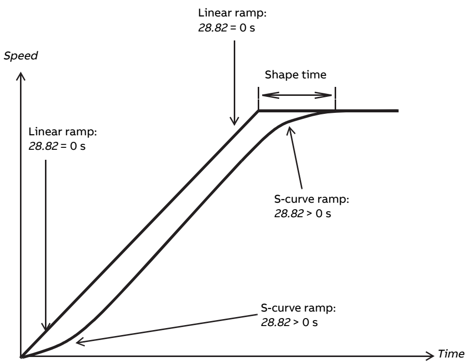
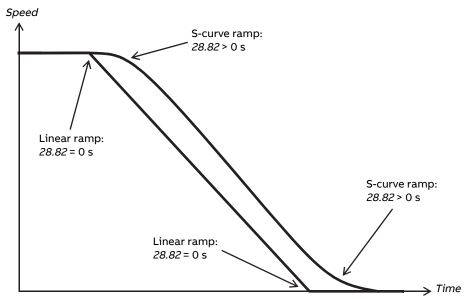
No.	Name / Range / Selection	Description	Def / Type FbEq 16b / 32b
	Supervision 3	Bit 2 of parameter 32.01 Supervision status.	26
	EFB MCW bit 7	Control word bit 7 received through the embedded fieldbus interface.	32
	Other [bit]	See Terms and abbreviations (page 137).	-
28.23	Constant frequency sel2	When bit 0 of parameter 28.21 Constant frequency function is 0 (Separate), selects a source that activates constant frequency 2. When bit 0 of parameter 28.21 Constant frequency function is 1 (Packed), this parameter and parameters 28.22 Constant frequency sel1 and 28.24 Constant frequency sel3 select three sources that are used to activate constant frequencies. See table at parameter 28.22 Constant frequency sel1. For the selections, see parameter 28.22 Constant frequency sel1.	Always off / uint32
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 / uint32
28.25	Constant frequency sel4	When bit 0 of parameter 28.21 Constant frequency function is 0 (Separate), selects a source that activates constant frequency 4. For the selections, see parameter 28.22 Constant frequency sel1.	Always off / uint32
28.26	Constant frequency 1	Defines constant frequency 1 (the frequency the motor will turn when constant frequency 1 is selected).	5.00; 6.00 (95.20 b0) Hz / real32
	-500.00 ... 500.00 Hz	Constant frequency 1. For scaling, see parameter 46.02 Frequency scaling.	10 = 1 Hz / 100 = 1 Hz
28.27	Constant frequency 2	Defines constant frequency 2.	10.00; 12.00 (95.20 b0) Hz / real32
	-500.00 ... 500.00 Hz	Constant frequency 2. For scaling, see parameter 46.02 Frequency scaling.	10 = 1 Hz / 100 = 1 Hz
28.28	Constant frequency 3	Defines constant frequency 3.	15.00; 18.00 (95.20 b0) Hz / real32
	-500.00 ... 500.00 Hz	Constant frequency 3. For scaling, see parameter 46.02 Frequency scaling.	10 = 1 Hz / 100 = 1 Hz
28.29	Constant frequency 4	Defines constant frequency 4.	20.00; 24.00 (95.20 b0) Hz / real32
	-500.00 ... 500.00 Hz	Constant frequency 4. For scaling, see parameter 46.02 Frequency scaling.	10 = 1 Hz / 100 = 1 Hz

No.	Name / Range / Selection	Description	Def / Type FbEq 16b / 32b
28.30	Constant frequency 5	Defines constant frequency 5.	25.00; 30.00 Hz (95.20 b0) Hz / real32
	-500.00 ... 500.00 Hz	Constant frequency 5. For scaling, see parameter 46.02 Frequency scaling.	10 = 1 Hz / 100 = 1 Hz
28.31	Constant frequency 6	Defines constant frequency 6.	40.00; 48.00 (95.20 b0) Hz / real32
	-500.00 ... 500.00 Hz	Constant frequency 6. For scaling, see parameter 46.02 Frequency scaling.	10 = 1 Hz / 100 = 1 Hz
28.32	Constant frequency 7	Defines constant frequency 7.	50.00; 60.00 (95.20 b0) Hz / real32
	-500.00 ... 500.00 Hz	Constant frequency 7. For scaling, see parameter 46.02 Frequency scaling.	10 = 1 Hz / 100 = 1 Hz
28.41	Frequency ref safe	Defines a safe frequency reference value that is used with supervision functions such as • parameter 12.03 AI supervision function • parameter 49.05 Communication loss action.	0.00 Hz / real32
	-500.00 ... 500.00 Hz	Safe frequency reference. For scaling, see parameter 46.02 Frequency scaling.	10 = 1 Hz / 100 = 1 Hz
28.46	Constant frequency sel5	When bit 0 of parameter 28.21 Constant frequency function is 0 (Separate), selects a source that activates constant frequency 4. For the selections, see parameter 28.22 Constant frequency sel1.	Always off / uint32
28.47	Constant frequency sel6	When bit 0 of parameter 28.21 Constant frequency function is 0 (Separate), selects a source that activates constant frequency 4. For the selections, see parameter 28.22 Constant frequency sel1.	Always off / uint32
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 75).	0000h / uint16
b0	Crit freq	1 = Enable: Critical frequencies enabled. 0 = Disable: Critical frequencies disabled.	
b1	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.	
b2…15	Reserved		
	0000h…FFFFh		1 = 1 / 1 = 1

No.	Name / Range / Selection	Description	Def / Type FbEq 16b / 32b
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 parameter 28.53 Critical frequency 1 high.	0.00 Hz / real32
	-500.00 ... 500.00 Hz	Low limit for critical frequency 1. For scaling, see parameter 46.02 Frequency scaling.	10 = 1 Hz / 100 = 1 Hz
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 parameter 28.52 Critical frequency 1 low.	0.00 Hz / real32
	-500.00 ... 500.00 Hz	High limit for critical frequency 1. For scaling, see parameter 46.02 Frequency scaling.	10 = 1 Hz / 100 = 1 Hz
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 parameter 28.55 Critical frequency 2 high.	0.00 Hz / real32
	-500.00 ... 500.00 Hz	Low limit for critical frequency 2. For scaling, see parameter 46.02 Frequency scaling.	10 = 1 Hz / 100 = 1 Hz
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 parameter 28.54 Critical frequency 2 low.	0.00 Hz / real32
	-500.00 ... 500.00 Hz	High limit for critical frequency 2. For scaling, see parameter 46.02 Frequency scaling.	10 = 1 Hz / 100 = 1 Hz
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 parameter 28.57 Critical frequency 3 high.	0.00 Hz / real32
	-500.00 ... 500.00 Hz	Low limit for critical frequency 3. For scaling, see parameter 46.02 Frequency scaling.	10 = 1 Hz / 100 = 1 Hz
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 parameter 28.56 Critical frequency 3 low.	0.00 Hz / real32
	-500.00 ... 500.00 Hz	High limit for critical frequency 3. For scaling, see parameter 46.02 Frequency scaling.	10 = 1 Hz / 100 = 1 Hz
28.71	Freq ramp set selection	Selects a source that switches between the two sets of acceleration/deceleration times defined by parameters 28.72…28.75. 0 = Acceleration time 1 and deceleration time 1 are in force 1 = Acceleration time 2 and deceleration time 2 are in force	Acc/Dec time 1 / uint32
	Acc/Dec time 1	0.	0
	Acc/Dec time 2	1.	1
	DI1	Digital input DI1 (parameter 10.02 DI delayed status, bit 0).	2

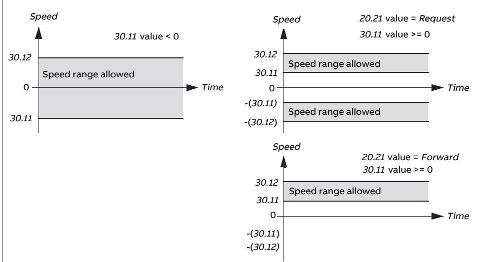
No.	Name / Range / Selection	Description	Def / Type FbEq 16b / 32b
	DI2	Digital input DI2 (parameter 10.02 DI delayed status, bit 1).	3
	DI3	Digital input DI3 (parameter 10.02 DI delayed status, bit 2).	4
	DI4	Digital input DI4 (parameter 10.02 DI delayed status, bit 3).	5
	DI5	Digital input DI5 (parameter 10.02 DI delayed status, bit 4).	6
	EFB DCU CW bit 10	Only for the DCU profile. DCU control word bit 10 received through the embedded fieldbus interface.	20
	Other [bit]	See Terms and abbreviations (page 137).	-
28.72	Freq acceleration time 1	Defines acceleration time 1 as the time required for the frequency to change from zero to the frequency defined by parameter 46.02 Frequency scaling. After this frequency has been reached, the acceleration continues with the same rate to the value defined by parameter 30.14 Maximum frequency. If the reference increases faster than the set acceleration rate, the motor will follow the acceleration rate. If the reference increases slower than the set acceleration rate, the motor frequency will follow the reference. If the acceleration time is set too short, the drive will automatically prolong the acceleration in order not to exceed the drive torque limits.	30.000 s / real32
	0.000 ... 1800.000 s	Acceleration time 1.	10 = 1 s / 1000 = 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 (parameter 30.30 Overvoltage control) is on. **Note:** If a short deceleration time is needed for a high inertia application, the drive should be equipped with braking equipment such as a brake chopper and brake resistor.	30.000 s / real32
	0.000 ... 1800.000 s	Deceleration time 1.	10 = 1 s / 1000 = 1 s
28.74	Freq acceleration time 2	Defines acceleration time 2. See parameter 28.72 Freq acceleration time 1.	60.000 s / real32
	0.000 ... 1800.000 s	Acceleration time 2.	10 = 1 s / 1000 = 1 s
28.75	Freq deceleration time 2	Defines deceleration time 2. See parameter 28.73 Freq deceleration time 1.	60.000 s / real32
	0.000 ... 1800.000 s	Deceleration time 2.	10 = 1 s / 1000 = 1 s

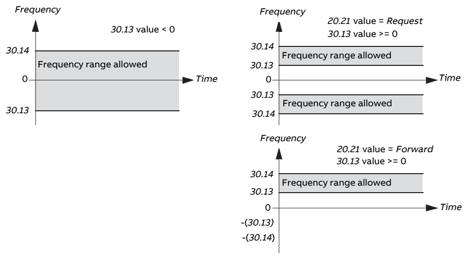
No.	Name / Range / Selection	Description	Def / Type FbEq 16b / 32b
28.76	Freq ramp in zero source	Selects a source that forces the frequency reference to zero. 0 = Force frequency reference to zero. 1 = Normal operation.	Inactive / uint32
	Active	0.	0
	Inactive	1.	1
	DI1	Digital input DI1 (parameter 10.02 DI delayed status, bit 0).	2
	DI2	Digital input DI2 (parameter 10.02 DI delayed status, bit 1).	3
	DI3	Digital input DI3 (parameter 10.02 DI delayed status, bit 2).	4
	DI4	Digital input DI4 (parameter 10.02 DI delayed status, bit 3).	5
	DI5	Digital input DI5 (parameter 10.02 DI delayed status, bit 4).	6
	Other [bit]	See Terms and abbreviations (page 137).	-

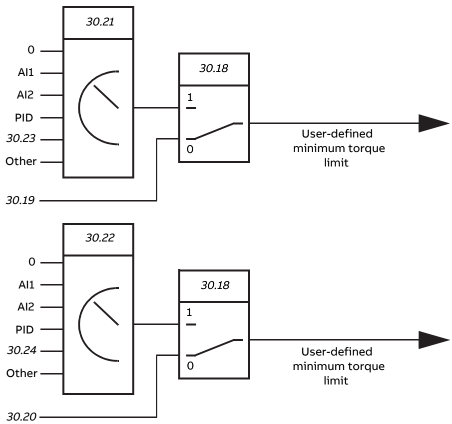
No.	Name / Range / Selection	Description	Def / Type FbEq 16b / 32b
28.82	Shape time 1	Defines the shape of the acceleration and deceleration ramps used with the set 1. 0.000 s: Linear ramp. Suitable for steady acceleration or deceleration and for slow ramps. 0.001…1000.000 s: S-curve ramp. S-curve ramps 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 / real32
	0.000 ... 1800.000 s	Ramp shape at start and end of acceleration and deceleration.	10 = 1 s / 1000 = 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 / real32
	0.000 ... 1800.000 s	Ramp shape at start and end of acceleration and deceleration.	10 = 1 s / 1000 = 1 s

No.	Name / Range / Selection	Description	Def / Type FbEq 16b / 32b
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 (parameter 19.11 Ext1/Ext2 selection). See the control chain diagram Frequency reference selection (page 510). This parameter is read-only.	0.00 Hz / real32
	-500.00 ... 500.00 Hz	Frequency reference after selection. For scaling, see parameter 46.02 Frequency scaling.	10 = 1 Hz / 100 = 1 Hz
28.96	Frequency ref act 7	Displays the frequency reference after application of constant frequencies, control panel reference, etc. See the control chain diagram Frequency reference selection (page 510). This parameter is read-only.	0.00 Hz / real32
	-500.00 ... 500.00 Hz	Frequency reference 7. For scaling, see parameter 46.02 Frequency scaling.	10 = 1 Hz / 100 = 1 Hz
28.97	Frequency ref unlimited	Displays the frequency reference after application of critical frequencies, but before ramping and limiting. See the control chain diagram Frequency reference modification (page 511). This parameter is read-only.	0.00 Hz / real32
	-500.00 ... 500.00 Hz	Frequency reference before ramping and limiting. For scaling, see parameter 46.02 Frequency scaling.	10 = 1 Hz / 100 = 1 Hz

No.	Name / Range / Selection	Description	Def / Type FbEq 16b / 32b
30	Limits	Drive operation limits.	
30.01	Limit word 1	Displays limit word 1. This parameter is read-only.	0000 0000 0000 0000 / uint16
b0	Torq lim	1 = Drive torque is being limited by the motor control (undervoltage control, current control, load angle control or pull-out control), or by the torque limits defined by parameters.	
b1…6	Reserved		
b7	Max speed ref lim	1 = Speed reference is being limited by parameter 30.12 Maximum speed.	
b8	Min speed ref lim	1 = Speed reference is being limited by parameter 30.11 Minimum speed.	
b9	Max freq ref lim	1 = Frequency reference is being limited by parameter 30.14 Maximum frequency.	
b10	Min freq ref lim	1 = Frequency reference is being limited by parameter 30.13 Minimum frequency.	
b11…15	Reserved		
	0000h…FFFFh		1 = 1 / 1 = 1
30.02	Torque limit status	Displays the torque controller limitation status word. This parameter is read-only. *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.	0000 0000 0000 0000 / uint16
b0	Undervoltage	*1 = Intermediate DC circuit undervoltage.	
b1	Overvoltage	*1 = Intermediate DC circuit overvoltage.	
b2	Minimum torque	*1 = Torque is being limited by parameter 30.19 Minimum torque 1, 30.26 Power motoring limit or 30.27 Power generating limit.	
b3	Maximum torque	*1 = Torque is being limited by parameter 30.20 Maximum torque 1, 30.26 Power motoring limit or 30.27 Power generating limit.	
b4	Internal current	1 = An inverter current limit (identified by bits 8…11) is active.	
b5	Load angle	With permanent magnet motors and reluctance motors only. 1 = Load angle limit is active, ie, the motor cannot produce any more torque.	
b6	Motor pullout	With asynchronous motors only. Motor pull-out limit is active, ie, the motor cannot produce any more torque.	
b7	Reserved		
b8	Thermal	1 = Input current is being limited by the main circuit thermal limit.	

No.	Name / Range / Selection	Description	Def / Type FbEq 16b / 32b
b9	Max current	*1 = Maximum output current (IMAX) is being limited.	
b10	User current	*1 = Output current is being limited by parameter 30.17 Maximum current.	
b11	Thermal IGBT	*1 = Output current is being limited by a calculated thermal current value.	
b12	IGBT overtemperat-ure	*1 = Output current is being limited because of estim-ated IGBT temperature.	
b13	IGBT overload	*1 = Output current is being limited because of IGBT junction to case temperature.	
b14…15	Reserved		
	0000h…FFFFh		1 = 1 / 1 = 1
30.11	Minimum speed	Defines together with parameter 30.12 Maximum speed the allowed speed range. See the figure below. A positive or zero minimum speed value defines two ranges, one positive and one negative. A negative minimum speed value defines one range. **WARNING!** The absolute value of parameter 30.11 Minimum speed must not be higher than the absolute value of parameter 30.12 Maximum speed. **WARNING!** In speed control mode only. In frequency control mode, use parameters 30.13 Minimum frequency and 30.14 Maximum frequency.  	0.00 rpm / real32
	-30000.00 … 30000.00 rpm	Minimum allowed speed. For scaling, see parameter 46.01 Speed scaling.	1 = 1 rpm / 100 = 1 rpm
30.12	Maximum speed	Defines together with parameter 30.11 Minimum speed the allowed speed range. See parameter 30.11 Minim-um speed. **Note:** This parameter does not affect the speed acceler-ation and deceleration ramp times. See parameter 46.01 Speed scaling.	1500.00; 1800.00 (95.20 b0) rpm / real32

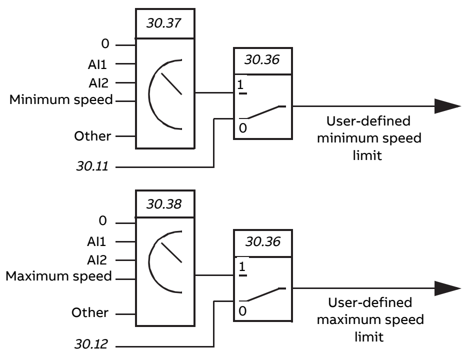
No.	Name / Range / Selection	Description	Def / Type FbEq 16b / 32b
	-30000.00 … 30000.00 rpm	Maximum speed. For scaling, see parameter 46.01 Speed scaling.	1 = 1 rpm / 100 = 1 rpm
30.13	Minimum frequency	Defines together with parameter 30.14 Maximum frequency the allowed frequency range. See the figure below. A positive or zero minimum frequency value defines two ranges, one positive and one negative. **WARNING!** The absolute value of parameter 30.13 Minimum frequency must not be higher than the absolute value of parameter 30.14 Maximum frequency. **WARNING!** In frequency control mode only. In speed control mode use parameters 30.11 Minimum speed and 30.12 Maximum speed. 	0.00 Hz / real32
	-500.00 … 500.00 Hz	Minimum frequency. For scaling, see parameter 46.02 Frequency scaling.	10 = 1 Hz / 100 = 1 Hz
30.14	Maximum frequency	Defines together with parameter 30.13 Minimum frequency the allowed frequency range. See parameter 30.13 Minimum frequency. **Note:** This parameter does not affect the frequency acceleration and deceleration ramp times. See parameter 46.02 Frequency scaling.	50.00; 60.00 (95.20 b0) Hz / real32
	-500.00 … 500.00 Hz	Maximum frequency. For scaling, see parameter 46.02 Frequency scaling.	10 = 1 Hz / 100 = 1 Hz
30.17	Maximum current	Defines the maximum allowed motor current. This depends on the drive type; it is automatically determined on the basis of the rating. The system sets the default value to 90% of the rated current so you can increase the parameter value by 10% if needed.	Drive dependant A / real32
	0.00 … Drive dependant A	Maximum motor current.	1 = 1 A / 100 = 1 A

No.	Name / Range / Selection	Description	Def / Type FbEq 16b / 32b
30.18	Torq lim sel	Selects a source that switches between two different predefined minimum torque limit sets. 0 = minimum torque limit defined by parameter 30.19 and maximum torque limit defined by parameter 30.20 are active. 1 = minimum torque limit selected by parameter 30.21 and maximum torque limit defined by parameter 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).	Torque limit set 1 / uint32
	Torque limit set 1	0 (minimum torque limit defined by parameter 30.19 and maximum torque limit defined by parameter 30.20 are active).	0
	Torque limit set 2	1 (minimum torque limit selected by parameter 30.21 and maximum torque limit defined by parameter 30.22 are active).	1
	DI1	Digital input DI1 (parameter 10.02 DI delayed status, bit 0).	2
	DI2	Digital input DI2 (parameter 10.02 DI delayed status, bit 1).	3
	DI3	Digital input DI3 (parameter 10.02 DI delayed status, bit 2).	4

No.	Name / Range / Selection	Description	Def / Type FbEq 16b / 32b
	DI4	Digital input DI4 (parameter 10.02 DI delayed status, bit 3).	5
	DI5	Digital input DI5 (parameter 10.02 DI delayed status, bit 4).	6
	EFB	Only for the DCU profile. DCU control word bit 15 received through the embedded fieldbus interface.	11
	Other [bit]	See Terms and abbreviations (page 137).	-
30.19	Minimum torque 1	Defines a minimum torque limit for the drive (in percent of nominal motor torque). See diagram at parameter 30.18 Torq lim sel. The limit is effective when • the source selected by parameter 30.18 Torq lim sel is 0, or • parameter 30.18 Torq lim sel is set to Torque limit set 1. **Note:** If your application, for example a pump or a fan, requires that the motor must rotate in one direction only, use speed/frequency limit (parameters 30.11 Minimum speed/30.13 Minimum frequency), or direction limit (parameter 20.21 Direction) to achieve this. Do not set parameter 30.19 Minimum torque 1 or 30.27 Power generating limit to 0%, as the drive is then not able to stop correctly.	-300.0 percent / real32
	-1600.0 ... 0.0 %	Minimum torque limit 1. For scaling, see parameter 46.03 Torque scaling.	10 = 1 % / 10 = 1 %
30.20	Maximum torque 1	Defines a maximum torque limit for the drive (in percent of nominal motor torque). See diagram at parameter 30.18 Torq lim sel. The limit is effective when • the source selected by parameter 30.18 Torq lim sel is 0, or • parameter 30.18 Torq lim sel is set to Torque limit set 1.	300.0 percent / real32
	0.0 ... 1600.0 %	Maximum torque 1. For scaling, see parameter 46.03 Torque scaling.	10 = 1 % / 10 = 1 %
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 • parameter 30.18 Torq lim sel is set to Torque limit set 2. See diagram at parameter 30.18 Torq lim sel. **Note:** Any positive values received from the selected source are inverted.	Minimum torque 2 / uint32
	Zero	None.	0
	AI1 scaled	Parameter 12.12 AI1 scaled value.	1

No.	Name / Range / Selection	Description	Def / Type FbEq 16b / 32b
	AI2 scaled	Parameter 12.22 AI2 scaled value.	2
	PID	Parameter 40.01 Process PID output actual (output of the process PID controller).	15
	Minimum torque 2	Parameter 30.23 Minimum torque 2.	16
	Other [bit]	See Terms and abbreviations (page 137).	-
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 • parameter 30.18 Torq lim sel is set to Torque limit set 2. See diagram at parameter 30.18 Torq lim sel. **Note:** Any negative values received from the selected source are inverted.	Maximum torque 2 / uint32
	Zero	None.	0
	AI1 scaled	Parameter 12.12 AI1 scaled value.	1
	AI2 scaled	Parameter 12.22 AI2 scaled value.	2
	PID	Parameter 40.01 Process PID output actual (output of the process PID controller).	15
	Maximum torque 2	Parameter 30.24 Maximum torque 2.	16
	Other [bit]	See Terms and abbreviations (page 137).	-
30.23	Minimum torque 2	Defines the minimum torque limit for the drive (in percent of nominal motor torque) when • the source selected by parameter 30.18 Torq lim sel is 1, or • parameter 30.18 Torq lim sel is set to Torque limit set 2, and • parameter 30.21 Min torque 2 source is set to Minimum torque 2. See diagram at parameter 30.18 Torq lim sel.	-300.0 percent / real32
	-1600.0 ... 0.0 %	Minimum torque limit 2. For scaling, see parameter 46.03 Torque scaling.	10 = 1 % / 10 = 1 %
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 parameter 30.18 Torq lim sel is 1, or • parameter 30.18 Torq lim sel is set to Torque limit set 2, and • parameter 30.22 Max torque 2 source is set to Maximum torque 2. See diagram at parameter 30.18 Torq lim sel.	300.0 percent / real32
	0.0 ... 1600.0 %	Maximum torque limit 2. For scaling, see parameter 46.03 Torque scaling.	10 = 1 % / 10 = 1 %

No.	Name / Range / Selection	Description	Def / Type FbEq 16b / 32b
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 percent / real32
	0.00 … 600.00 %	Maximum motoring power.	1 = 1 % / 100 = 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, for example a pump or a fan, requires that the motor must rotate in one direction only, use speed/frequency limit (parameter 30.11 Minimum speed/30.13 Minimum frequency), or direction limit (parameter 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 percent / real32
	-600.00 … 0.00 %	Maximum generating power.	1 = 1 % / 100 = 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 / uint16
	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 / uint16
	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 / uint16
	Disable	Thermal current limitation disabled.	0
	Enable	Thermal current limitation enabled.	1

No.	Name / Range / Selection	Description	Def / Type FbEq 16b / 32b
30.36	Speed limit selection	Selects a source that switches between two different predefined adjustable speed limit sets. 0 = minimum speed limit defined by parameter 30.11 Minimum speed and maximum speed limit defined by parameter 30.12 Maximum speed are active. 1 = minimum speed limit selected by parameter 30.37 Min speed source defined by parameter 30.38 Max speed source are active. The user can define two sets of speed limits, and switch between the sets using a binary source such as a digital input. The first set of limits is defined by parameters 30.11 Minimum speed and 30.12 Maximum speed. The second set has selector parameters for both the minimum (30.37 Min speed source) and maximum (30.38 Max speed source) limits that allows the use of a selectable analog source (such as an analog input). 	Not selected / uint32
	Not selected	Adjustable speed limits are disabled. (Minimum speed limit defined by parameter 30.11 Minimum speed and maximum speed limit defined by parameter 30.12 Maximum speed are active).	0
	Selected	Adjustable speed limits are enabled. (Minimum speed limit defined by parameter 30.37 Min speed source and maximum speed limit defined by parameter 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
	DI1	Digital input DI1 (parameter 10.02 DI delayed status, bit 0).	5
	DI2	Digital input DI2 (parameter 10.02 DI delayed status, bit 1).	6

No.	Name / Range / Selection	Description	Def / Type FbEq 16b / 32b
	DI3	Digital input DI3 (parameter 10.02 DI delayed status, bit 2).	7
	DI4	Digital input DI4 (parameter 10.02 DI delayed status, bit 3).	8
	DI5	Digital input DI5 (parameter 10.02 DI delayed status, bit 4).	9
	Other [bit]	See Terms and abbreviations (page 137).	-
30.37	Min speed source	Defines the source of a minimum speed limit for the drive when the source is selected by parameter 30.36 Speed limit selection. **Note:** In vector motor control mode only. In scalar motor control mode, use parameters 30.13 Minimum frequency and 30.14 Maximum frequency.	Minimum speed / uint32
	Zero	None.	0
	AI1 scaled	Parameter 12.12 AI1 scaled value.	1
	AI2 scaled	Parameter 12.22 AI2 scaled value.	2
	Minimum speed	Parameter 30.11 Minimum speed.	11
	Other [bit]	See Terms and abbreviations (page 137).	-
30.38	Max speed source	Defines the source of a maximum speed limit for the drive when the source is selected by 30.36 Speed limit selection. **Note:** In vector motor control mode only. In scalar motor control mode, use parameters 30.13 Minimum frequency and 30.14 Maximum frequency.	Maximum speed / uint32
	Zero	None.	0
	AI1 scaled	Parameter 12.12 AI1 scaled value.	1
	AI2 scaled	Parameter 12.22 AI2 scaled value.	2
	Maximum speed	Parameter 30.12 Maximum speed.	12
	Other [bit]	See Terms and abbreviations (page 137).	-
30.39	Limit word event type	Determines if parameter 30.01 Limit word 1 notifies the user when a trigger event has occurred. See 30.41 Limit word 1 event selection and 30.42 Torque limit event selection for further details.	Warning / uint16
	No indication	No event is triggered if the selected limit becomes active.	0
	Pure event	A pure event is triggered if the selected limit becomes active.	1
	Warning	A warning is triggered if the selected limit becomes active.	2
30.40	Limit word event delay	Sets the time an event needs to persist before triggering a warning.	3.0 s / real32
	0.0 ... 60.0 s	Event trigger delay time.	10 = 1 s / 1 = 1 s

No.	Name / Range / Selection	Description	Def / Type FbEq 16b / 32b
30.41	Limit word 1 event selection	Enables/disables if a warning is generated.	0000 0000 0000 0000 / uint16
b0	Torq lim	0 = Disabled; 1 = Enabled. See parameter 30.01 Limit word 1 for more information.	
b1…2	Reserved		
b3	Torq ref max	0 = Disabled; 1 = Enabled. See parameters 30.20 Maximum torque 1, 30.26 Power motoring limit and 30.27 Power generating limit for more information.	
b4	Torq ref min	0 = Disabled; 1 = Enabled. See parameters 30.19 Minimum torque 1, 30.26 Power motoring limit and 30.27 Power generating limit for more information.	
b5	Tlim max speed	0 = Disabled; 1 = Enabled. See parameter 30.12 Maximum speed for more information.	
b6	Tlim min speed	0 = Disabled; 1 = Enabled. See parameter 30.11 Minimum speed for more information.	
b7	Max speed ref lim	0 = Disabled; 1 = Enabled. See parameter 30.01 Limit word 1 for more information.	
b8	Min speed ref lim	0 = Disabled; 1 = Enabled. See parameter 30.01 Limit word 1 for more information.	
b9	Max freq ref lim	0 = Disabled; 1 = Enabled. See parameter 30.01 Limit word 1 for more information.	
b10	Min freq ref lim	0 = Disabled; 1 = Enabled. See parameter 30.01 Limit word 1 for more information.	
b11…15	Reserved		
	0000h…FFFFh		1 = 1 / 1 = 1
30.42	Torque limit event selection	Selects which bits of parameter 30.02 Torque limit status trigger a warning.	0x3f7f / uint16
b0	Undervoltage	0 = Disabled; 1 = Enabled. See parameter 30.02 Torque limit status for more information.	
b1	Overvoltage	0 = Disabled; 1 = Enabled. See parameter 30.02 Torque limit status for more information.	
b2	Minimum torque	0 = Disabled; 1 = Enabled. See parameter 30.02 Torque limit status for more information.	
b3	Maximum torque	0 = Disabled; 1 = Enabled. See parameter 30.02 Torque limit status for more information.	
b4	Internal current	0 = Disabled; 1 = Enabled. See parameter 30.02 Torque limit status for more information.	
b5	Load angle	0 = Disabled; 1 = Enabled. See parameter 30.02 Torque limit status for more information.	
b6	Motor pullout	0 = Disabled; 1 = Enabled. See parameter 30.02 Torque limit status for more information.	
b7	Reserved		
b8	Thermal	0 = Disabled; 1 = Enabled. See parameter 30.02 Torque limit status for more information.	

No.	Name / Range / Selection	Description	Def / Type FbEq 16b / 32b
b9	Max current	0 = Disabled; 1 = Enabled. See parameter 30.02 Torque limit status for more information.	
b10	User current	0 = Disabled; 1 = Enabled. See parameter 30.02 Torque limit status for more information.	
b11	Thermal IGBT	0 = Disabled; 1 = Enabled. See parameter 30.02 Torque limit status for more information.	
b12	IGBT overtemperat-ure	0 = Disabled; 1 = Enabled. See parameter 30.02 Torque limit status for more information.	
b13	IGBT overload	0 = Disabled; 1 = Enabled. See parameter 30.02 Torque limit status for more information.	
b14…15	Reserved		
	0000h…FFFFh		1 = 1 / 1 = 1

No.	Name / Range / Selection	Description	Def / Type FbEq 16b / 32b
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) / uint32
	Active (false)	0.	0
	Inactive (true)	1.	1
	DI1	Digital input DI1 (parameter 10.02 DI delayed status, bit 0).	3
	DI2	Digital input DI2 (parameter 10.02 DI delayed status, bit 1).	4
	DI3	Digital input DI3 (parameter 10.02 DI delayed status, bit 2).	5
	DI4	Digital input DI4 (parameter 10.02 DI delayed status, bit 3).	6
	DI5	Digital input DI5 (parameter 10.02 DI delayed status, bit 4).	7
	Other [bit]	See Terms and abbreviations (page 137).	-
31.02	External event 1 type	Selects the type of external event 1.	Fault / uint16
	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) / uint32
31.04	External event 2 type	Selects the type of external event 2.	Fault / uint16
	Fault	The external event generates a fault.	0
	Warning	The external event generates a warning.	1
31.05	External event 3 source	Defines the source of external event 3. See also parameter 31.06 External event 3 type. For the selections, see parameter 31.01 External event 1 source.	Inactive (true) / uint32
31.06	External event 3 type	Selects the type of external event 3.	Fault / uint16
	Fault	The external event generates a fault.	0
	Warning	The external event generates a warning.	1

No.	Name / Range / Selection	Description	Def / Type FbEq 16b / 32b
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) / uint32
31.08	External event 4 type	Selects the type of external event 4.	Fault / uint16
	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) / uint32
31.10	External event 5 type	Selects the type of external event 5.	Fault / uint16
	Fault	The external event generates a fault.	0
	Warning	The external event generates a warning.	1
31.11	Fault reset selection	Selects the source of an external fault reset signal. The signal resets the drive after a fault trip if the cause of the fault no longer exists. 0 → 1 = Reset **Note:** • When the start and stop command is through digital inputs (parameter 20.01 Ext1 commands or 20.06 Ext2 commands) or from local control, and you want to use fault reset from the fieldbus, selection EFB MCW bit 7 can be used. • Whenever the drive is in external control through fieldbus (start and stop command and reference are received through fieldbus), the fault can be reset from the fieldbus regardless of the selection of this parameter.	Not used / uint32
	Not used	0.	0
	Not used	1.	1
	DI1	Digital input DI1 (parameter 10.02 DI delayed status, bit 0).	2
	DI2	Digital input DI2 (parameter 10.02 DI delayed status, bit 1).	3
	DI3	Digital input DI3 (parameter 10.02 DI delayed status, bit 2).	4
	DI4	Digital input DI4 (parameter 10.02 DI delayed status, bit 3).	5
	DI5	Digital input DI5 (parameter 10.02 DI delayed status, bit 4).	6
	Timed function 1	Bit 0 of parameter 34.01 Timed functions status.	18

No.	Name / Range / Selection	Description	Def / Type FbEq 16b / 32b
	Timed function 2	Bit 1 of parameter 34.01 Timed functions status.	19
	Timed function 3	Bit 2 of parameter 34.01 Timed functions status.	20
	Supervision 1	Bit 0 of parameter 32.01 Supervision status.	24
	Supervision 2	Bit 1 of parameter 32.01 Supervision status.	25
	Supervision 3	Bit 2 of parameter 32.01 Supervision status.	26
	EFB MCW bit 7	Control word bit 7 received through the embedded fieldbus interface.	32
	Other [bit]	See Terms and abbreviations (page 137).	-
31.12	Autoreset selection	Selects faults that are automatically reset. The parameter is a 16-bit word with each bit corresponding to a fault type. Whenever a bit is set to 1, the corresponding fault is automatically reset. **Note:** Infinite reset trials are executed if parameter 70.02 Override enable is set to value On, critical. **WARNING!** Before you activate the function, make sure that no dangerous situations can occur. The function restarts the drive automatically and continues operation after a fault. The bits of this binary number correspond to the following faults:	000Ch / uint16
b0	Overcurrent	Overcurrent.	
b1	Overvoltage	Overvoltage.	
b2	Undervoltage	Undervoltage.	
b3	AI supervision fault	AI supervision fault.	
b4	Reserved		
b5	Overfrequency / Overspeed	Overfrequency/overspeed.	
b6	Earth fault	Earth fault.	
b7	Short circuit	Short circuit.	
b8…9	Reserved		
b10	Selectable fault	Selectable fault (see parameter 31.13 Selectable fault).	
b11	External fault 1	External fault 1 (from source selected by parameter 31.01 External event 1 source).	
b12	External fault 2	External fault 2 (from source selected by parameter 31.03 External event 2 source).	
b13	External fault 3	External fault 3 (from source selected by parameter 31.05 External event 3 source).	
b14	External fault 4	External fault 4 (from source selected by parameter 31.07 External event 4 source).	

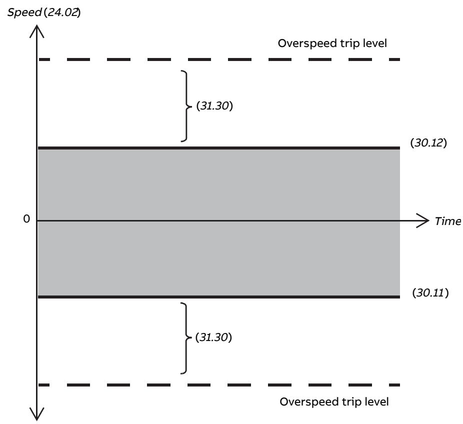
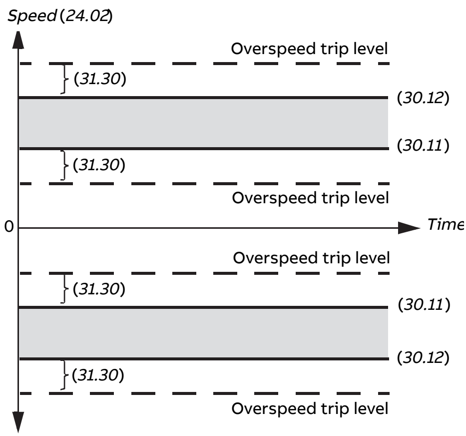
No.	Name / Range / Selection	Description	Def / Type FbEq 16b / 32b
b15	External fault 5	External fault 5 (from source selected by parameter 31.09 External event 5 source).	
	0000h…FFFFh		1 / 1
31.13	Selectable fault	Defines the fault that can be automatically reset using parameter 31.12 Autoreset selection, bit 10. Faults are listed in chapter Fault tracing (page 405).	0 / uint32
	0000…FFFFh	Fault code.	1 = 1
31.14	Number of trials	Defines the maximum number of automatic resets that the drive is allowed to attempt within the time specified by parameter 31.15 Total trials time. If the fault persists, subsequent reset attempts will be made at intervals defined by parameter 31.16 Delay time. The faults to be automatically reset are defined by parameter 31.12 Autoreset selection.	5 NoUnit / uint32
	0...5	Number of automatic resets.	1 = 1 / 1 = 1
31.15	Total trials time	Defines a time window for automatic fault resets. The maximum number of attempts made during any period of this length is defined by parameter 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 (parameter 31.14) at specified intervals (parameter 31.16) take longer than the value of parameter 31.15 Total trials time, the drive will continue to attempt resetting the fault until the cause is eventually removed.	30.0 s / real32
	1.0 ... 600.0 s	Time for automatic resets.	10 = 1 s / 10 = 1 s
31.16	Delay time	Defines the time that the drive will wait after a fault before attempting an automatic reset. See parameter 31.12 Autoreset selection.	5.0 s / real32
	0.0 ... 120.0 s	Autoreset delay.	10 = 1 s / 10 = 1 s
31.19	Motor phase loss	Selects how the drive reacts when a motor phase loss is detected. In scalar motor control mode: • The supervision activates above 10% of the motor nominal frequency. If any of the phase currents stays very small for a certain time limit, the output phase loss fault is given. • If the motor nominal current is below 1/6 of the drive nominal current or there is no motor connected, ABB recommends to disable the motor output phase loss function.	Fault / uint16
	No action	No action taken.	0
	Fault	The drive trips on fault 3381 Output phase loss.	1

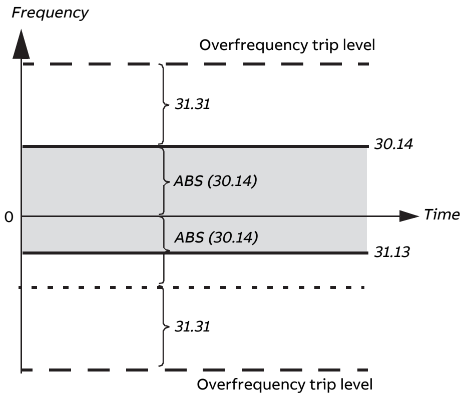
No.	Name / Range / Selection	Description	Def / Type FbEq 16b / 32b
31.20	Earth fault	Selects how the drive reacts when an earth fault or current unbalance is detected in the motor or the motor cable.	Fault / uint16
	No action	No action taken.	0
	Warning	The drive generates an A2B3 Earth leakage warning.	1
	Fault	The drive trips on fault 2330 Earth leakage.	2
31.21	Supply phase loss	Selects how the drive reacts when a supply phase loss is detected.	Fault / uint16
	Power derating	No action taken.	0
	Fault	The drive trips on fault 3130 Input phase loss.	1
31.22	STO indication run/stop	Selects which indications are given when one or both Safe torque off (STO) signals are switched off or lost. The indications also depend on whether the drive is running or stopped when this occurs. The tables at each selection below show the indications generated with that particular setting. **Note:** • 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. **WARNING!** The drive cannot detect or memorize any changes in the STO circuitry when the drive control unit is not powered or when the main power to the drive is off. If both STO circuits are closed and a level-type start signal is active when the power is restored, it is possible that the drive starts without a fresh start command. Take this into account in the risk assessment of the system. For more information on the STO, see chapter *The Safe torque off function* in the Hardware manual of the drive.	Fault/Fault / uint16

<table>
<tr><th>No.</th><th>Name / Range / Selection</th><th>Description</th><th>Def / Type
FbEq 16b / 32b</th></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 off and FA81 Safe torque off 1</td></tr>
<tr><td>1</td><td>0</td><td>Faults 5091 Safe torque off and FA82 Safe torque off 2</td></tr>
<tr><td>1</td><td>1</td><td>(Normal operation)</td></tr>
</table>
</td><td>0</td></tr>
<tr><td></td><td>Fault/Warning</td><td>
<table>
<tr><th colspan="2">Inputs</th><th colspan="2">Indication</th></tr>
<tr><th>IN1</th><th>IN2</th><th>Running</th><th>Stopped</th></tr>
<tr><td>0</td><td>0</td><td>Fault 5091 Safe torque off</td><td>Warning A5A0 Safe torque off</td></tr>
<tr><td>0</td><td>1</td><td>Faults 5091 Safe torque off and FA81 Safe torque off 1</td><td>Warning A5A0 Safe torque off and fault FA81 Safe torque off 1</td></tr>
<tr><td>1</td><td>0</td><td>Faults 5091 Safe torque off and FA82 Safe torque off 2</td><td>Warning A5A0 Safe torque off and fault FA82 Safe torque off 2</td></tr>
<tr><td>1</td><td>1</td><td colspan="2">(Normal operation)</td></tr>
</table>
</td><td>1</td></tr>
<tr><td></td><td>Fault/Event</td><td>
<table>
<tr><th colspan="2">Inputs</th><th colspan="2">Indication</th></tr>
<tr><th>IN1</th><th>IN2</th><th>Running</th><th>Stopped</th></tr>
<tr><td>0</td><td>0</td><td>Fault 5091 Safe torque off</td><td>Event B5A0 STO event</td></tr>
<tr><td>0</td><td>1</td><td>Faults 5091 Safe torque off and FA81 Safe torque off 1</td><td>Event B5A0 STO event and fault FA81 Safe torque off 1</td></tr>
<tr><td>1</td><td>0</td><td>Faults 5091 Safe torque off and FA82 Safe torque off 2</td><td>Event B5A0 STO event and fault FA82 Safe torque off 2</td></tr>
<tr><td>1</td><td>1</td><td colspan="2">(Normal operation)</td></tr>
</table>
</td><td>2</td></tr>
</table>

<table>
<tr><th>No.</th><th>Name / Range / Selection</th><th>Description</th><th>Def / Type
FbEq 16b / 32b</th></tr>
<tr><td></td><td>Warning/Warning</td><td>
<table>
<tr><th colspan="2">Inputs</th><th rowspan="2">Indication (running or stopped)</th></tr>
<tr><th>IN1</th><th>IN2</th></tr>
<tr><td>0</td><td>0</td><td>Warning A5A0 Safe torque off</td></tr>
<tr><td>0</td><td>1</td><td>Warning A5A0 Safe torque off and fault FA81 Safe torque off 1</td></tr>
<tr><td>1</td><td>0</td><td>Warning A5A0 Safe torque off and fault FA82 Safe torque off 2</td></tr>
<tr><td>1</td><td>1</td><td>(Normal operation)</td></tr>
</table>
</td><td>3</td></tr>
<tr><td></td><td>Event/Event</td><td>
<table>
<tr><th colspan="2">Inputs</th><th rowspan="2">Indication (running or stopped)</th></tr>
<tr><th>IN1</th><th>IN2</th></tr>
<tr><td>0</td><td>0</td><td>Event B5A0 STO event</td></tr>
<tr><td>0</td><td>1</td><td>Event B5A0 STO event and fault FA81 Safe torque off 1</td></tr>
<tr><td>1</td><td>0</td><td>Event B5A0 STO event and fault FA82 Safe torque off 2</td></tr>
<tr><td>1</td><td>1</td><td>(Normal operation)</td></tr>
</table>
</td><td>4</td></tr>
<tr><td></td><td>No indication/No indication</td><td>
<table>
<tr><th colspan="2">Inputs</th><th rowspan="2">Indication (running or stopped)</th></tr>
<tr><th>IN1</th><th>IN2</th></tr>
<tr><td>0</td><td>0</td><td>None</td></tr>
<tr><td>0</td><td>1</td><td>Fault FA81 Safe torque off 1</td></tr>
<tr><td>1</td><td>0</td><td>Fault FA82 Safe torque off 2</td></tr>
<tr><td>1</td><td>1</td><td>(Normal operation)</td></tr>
</table>
</td><td>5</td></tr>
<tr><td>31.23</td><td>Wiring or earth fault</td><td>Selects how the drive reacts to incorrect input power and motor cable connection (ie. input power cable is connected to drive motor connection).</td><td>Fault / uint16</td></tr>
<tr><td></td><td>No action</td><td>No action taken.</td><td>0</td></tr>
<tr><td></td><td>Fault</td><td>The drive trips on fault 3181 Wiring or earth fault.</td><td>1</td></tr>
<tr><td>31.24</td><td>Stall function</td><td>Selects how the drive reacts to a motor stall condition.
A stall condition is defined as follows:
• The drive exceeds the stall current limit (parameter 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 / uint16</td></tr>
<tr><td></td><td>No action</td><td>None (stall supervision disabled).</td><td>0</td></tr>
</table>

No.	Name / Range / Selection	Description	Def / Type FbEq 16b / 32b
	Warning	The drive generates an A780 Motor stall warning.	1
	Fault	The drive trips on fault 7121 Motor stall.	2
31.25	Stall current limit	Stall current limit in percent of the nominal current of the motor. See parameter 31.24 Stall function.	200.0 percent / real32
	0.0 … 1600.0 %	Stall current limit.	10 = 1 % / 10 = 1 %
31.26	Stall speed limit	Stall speed limit in rpm. See parameter 31.24 Stall function.	150.00; 180.00 (95.20 b0) rpm / real32
	0.00 … 10000.00 rpm	Stall speed limit. For scaling, see parameter 46.01 Speed scaling.	1 = 1 rpm / 100 = 1 rpm
31.27	Stall frequency limit	Stall frequency limit. See parameter 31.24 Stall function. **Note:** Setting the limit below 10 Hz is not recommended.	15.00; 18.00 (95.20 b0) Hz / real32
	0.00 … 1000.00 Hz	Stall frequency limit. For scaling, see parameter 46.01 Speed scaling.	10 = 1 Hz / 100 = 1 Hz
31.28	Stall time	Stall time. See parameter 31.24 Stall function.	20 s / real32
	0…3600 s	Stall time.	1 = 1 s / 1 = 1 s

No.	Name / Range / Selection	Description	Def / Type FbEq 16b / 32b
31.30	Overspeed trip margin	Defines, together with parameters 30.11 Minimum speed and 30.12 Maximum speed, the maximum allowed speed of the motor (overspeed protection). If the speed (parameter 24.02 Used speed feedback) exceeds the speed limit defined by parameter 30.11 Minimum speed or 30.12 Maximum speed 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 / real32

No.	Name / Range / Selection	Description	Def / Type FbEq 16b / 32b
	0.00 … 10000.00 rpm	Overspeed trip margin. For scaling, see parameter 46.01 Speed scaling.	1 = 1 rpm / 100 = 1 rpm
31.31	Frequency trip margin	Defines, together with parameters 30.13 Minimum frequency and 30.14 Maximum frequency, the maximum allowed frequency of the motor (overfrequency protection). The absolute value of this overfrequency trip level is calculated by adding the value of this parameter to the higher of the absolute values of parameters30.13 Minimum frequency and 30.14 Maximum frequency. If parameter 01.06 Output frequency exceeds the overfrequency trip level (ie. the absolute value of the output frequency exceeds the absolute value of the overfrequency trip level), the drive trips on the 73F0 Overfrequency fault.  	15.00 Hz / real32
	0.00 … 10000.00 Hz	Overfrequency trip margin.	1 = 1 Hz / 100 = 1 Hz

No.	Name / Range / Selection	Description	Def / Type FbEq 16b / 32b
31.32	Emergency ramp supervision	Parameters 31.32 Emergency ramp supervision and 31.33 Emergency ramp supervision delay, together with the derivative of parameter 24.02 Used speed feedback, provide a supervision function for emergency stop modes Off1 and Off3. The supervision is based on either • observing the time within which the motor stops, or • comparing the actual and expected deceleration rates. If this parameter is set to 0%, the maximum stop time is directly set in parameter 31.33 Emergency ramp supervision delay. Otherwise, parameter 31.32 Emergency ramp supervision defines the maximum allowed deviation from the expected deceleration rate, which is calculated from parameters 23.11…23.15 (Off1) or 23.23 Emergency stop time (Off3). If the actual deceleration rate (24.02) deviates too much from the expected rate, the drive trips on fault 73B0 Emergency ramp failed, sets bit 8 of parameter 06.17 Drive status word 2, and coasts to a stop. If parameter 31.32 Emergency ramp supervision is set to 0% and parameter 31.33 Emergency ramp supervision delay is set to 0 s, the emergency stop ramp supervision is disabled. See also parameter 21.04 Emergency stop mode.	0 percent / real32
	0...300 %	Maximum deviation from expected deceleration rate.	1 = 1 % / 1 = 1 %
31.33	Emergency ramp supervision delay	If parameter 31.32 Emergency ramp supervision is set to 0%, this parameter defines the maximum time an emergency stop (mode Off1 or Off3) is allowed to take. If the motor has not stopped when the time elapses, the drive trips on 73B0 Emergency ramp failed, sets bit 8 of parameter 06.17 Drive status word 2, and coasts to a stop. If 31.32 Emergency ramp supervision is set to a value other than 0%, this parameter defines a delay between the receipt of the emergency stop command and the activation of the supervision. ABB recommends to specify a short delay to allow the speed change rate to stabilize.	0 s / real32
	0...100 s	Maximum ramp-down time, or supervision activation delay.	1 = 1 s / 1 = 1 s
31.40	Disable warning messages	Selects warnings to be suppressed. This parameter is a 16-bit word with each bit corresponding to a warning. Whenever a bit is set to 1, the corresponding warning is suppressed.	0000 0000 0000 0000 / uint16
b0	Reserved		
b1	DC link undervoltage	1 = Warning A3A2 DC link undervoltage is suppressed.	
b2…4	Reserved		

No.	Name / Range / Selection	Description	Def / Type FbEq 16b / 32b
b5	Emergency stop (off2)	1 = Warning AFE1 Emergency stop (off2) is suppressed.	
b6	Emergency stop (off1 or off3)	1 = Warning AFE2 Emergency stop (off1 or off3) is suppressed.	
b7…15	Reserved		
	0000h…FFFFh		1 / 1
31.54	Fault action	Selects the stop mode when a non-critical fault occurs.	Coast / uint16
	Coast	Drive coasts to a stop.	0
	Emergency ramp	Drive follows the ramp specified for an emergency stop in parameter 23.23 Emergency stop time.	1

No.	Name / Range / Selection	Description	Def / Type FbEq 16b / 32b
32	Supervision	Configuration of signal supervision functions 1…3. Three values can be chosen to be monitored; a warning or fault is generated whenever predefined limits are exceeded. See also section Supervisory (page 124).	
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.	0000 0000 0000 0000 / uint16
b0	Supervision 1 active	1 = Signal selected by parameter 32.07 is outside its limits.	
b1	Supervision 2 active	1 = Signal selected by parameter 32.17 is outside its limits.	
b2	Supervision 3 active	1 = Signal selected by parameter 32.27 is outside its limits.	
b3	Supervision 4 active	1 = Signal selected by parameter 32.37 is outside its limits.	
b4	Supervision 5 active	1 = Signal selected by parameter 32.47 is outside its limits.	
b5	Supervision 6 active	1 = Signal selected by parameter 32.57 is outside its limits.	
b6…15	Reserved		
	0000h…FFFFh		1 / 1
32.05	Supervision 1 function	Selects the mode of signal supervision function 1. Determines how the monitored signal (see parameter 32.07 Supervision 1 signal) is compared to its lower and upper limits (parameters 32.09 Supervision 1 low and 32.10 Supervision 1 high respectively). The action to be taken when the condition is fulfilled is selected by parameter 32.06 Supervision 1 action.	Disabled / uint16
	Disabled	Signal supervision 1 not in use.	0
	Low	Action is taken whenever the signal falls below its lower limit.	1
	High	Action is taken whenever the signal rises above its upper limit.	2
	Abs low	Action is taken whenever the absolute value of the signal falls below its (absolute) lower limit.	3
	Abs high	Action is taken whenever the absolute value of the signal rises above its (absolute) upper limit.	4
	Both	Action is taken whenever the signal falls below its low limit or rises above its high limit.	5

No.	Name / Range / Selection	Description	Def / Type FbEq 16b / 32b
	Abs both	Action is taken whenever the absolute value of the signal falls below its (absolute) low limit or rises above its (absolute) high limit.	6
	Hysteresis	Action is taken whenever the signal rises above the value defined by the upper limit + 0.5 * hysteresis. The action is deactivated when the signal falls below the value defined by the lower limit - 0.5 * hysteresis.	7
	Low falling	Action taken whenever the signal falls from a value higher than 'Supervision low' limit + 0.5 * hysteresis to a value which is lower than 'Supervision low' limit - 0.5 * hysteresis. Action is deactivated when the signal rises to higher than 'Supervision low' limit + 0.5 * hysteresis.	8
	High rising	Action taken whenever the signal rises from a value lower than 'Supervision high' limit - 0.5 * hysteresis to a value which is higher than 'Supervision high' limit + 0.5 * hysteresis. Action is deactivated when the signal falls to lower than 'Supervision high' limit - 0.5 * hysteresis.	9
32.06	Supervision 1 action	Selects whether the drive generates a fault, warning or neither when the value monitored by signal supervision 1 exceeds its limits. **Note:** This parameter does not affect the status indicated by parameter 32.01 Supervision status.	No action / uint16
	No action	No warning or fault generated.	0
	Warning	Warning A8B0 Signal supervision 1 is generated.	1
	Fault	Drive trips on fault A8B0 Signal supervision 1.	2
	Fault if running	If running, the drive trips on fault A8B0 Signal supervision 1.	3
32.07	Supervision 1 signal	Selects the signal to be monitored by signal supervision function 1.	Frequency / uint32
	Zero	None.	0
	Speed	Parameter 01.01 Motor speed used.	1
	Frequency	Parameter 01.06 Output frequency.	3
	Current	Parameter 01.07 Motor current.	4
	Torque	Parameter 01.10 Motor torque.	6
	DC voltage	Parameter 01.11 DC voltage.	7
	Output power	Parameter 01.14 Output power.	8
	AI1	Parameter 12.11 AI1 actual value.	9
	AI2	Parameter 12.21 AI2 actual value.	10
	Speed ref ramp in	Parameter 23.01 Speed ref ramp input.	18
	Speed ref ramp out	Parameter 23.02 Speed ref ramp output.	19
	Speed ref used	Parameter 24.01 Used speed reference.	20

No.	Name / Range / Selection	Description	Def / Type FbEq 16b / 32b
	Freq ref used	Parameter 28.02 Frequency ref ramp output.	22
	Inverter temperature	Parameter 05.11 Inverter temperature.	23
	Process PID output	Parameter 40.01 Process PID output actual.	24
	Process PID feedback	Parameter 40.02 Process PID feedback actual.	25
	Process PID setpoint	Parameter 40.03 Process PID setpoint actual.	26
	Process PID deviation	Parameter 40.04 Process PID deviation actual.	27
	Other [bit]	See Terms and abbreviations (page 137).	-
32.08	Supervision 1 filter time	Defines a filter time constant for the signal monitored by signal supervision 1.	0.000 s / real32
	0.000 ... 30.000 s	Signal filter time.	1000 = 1 s / 1000 = 1 s
32.09	Supervision 1 low	Defines the lower limit for signal supervision 1.	0.00 NoUnit / real32
	-21474836.00 ... 21474836.00	Low limit.	1 = 1 / 1 = 1
32.10	Supervision 1 high	Defines the upper limit for signal supervision 1.	0.00 NoUnit / real32
	-21474836.00 ... 21474836.00	Upper limit.	1 = 1 / 1 = 1
32.11	Supervision 1 hysteresis	Defines the hysteresis for the signal monitored by signal supervision 1. This parameter applies to all selections for parameter 32.05 Supervision 1 function, not just selection Hysteresis (7). Action is taken whenever the signal rises above the value defined by the upper limit + 0.5 * hysteresis. The action is deactivated when the signal falls below the value defined by the lower limit - 0.5 * hysteresis.	0.00 null / real32
	0.00 ... 100000.00	Hysteresis.	- / 100 = 1
32.15	Supervision 2 function	Selects the mode of signal supervision function 2. Determines how the monitored signal (see parameter 32.17 Supervision 2 signal) is compared to its lower and upper limits (parameters 32.19 Supervision 2 low and 32.20 Supervision 2 high respectively). The action to be taken when the condition is fulfilled is selected by parameter 32.16 Supervision 2 action.	Disabled / uint16
	Disabled	Signal supervision 2 not in use.	0
	Low	Action is taken whenever the signal falls below its lower limit.	1
	High	Action is taken whenever the signal rises above its upper limit.	2
	Abs low	Action is taken whenever the absolute value of the signal falls below its (absolute) lower limit.	3

No.	Name / Range / Selection	Description	Def / Type FbEq 16b / 32b
	Abs high	Action is taken whenever the absolute value of the signal rises above its (absolute) upper limit.	4
	Both	Action is taken whenever the signal falls below its low limit or rises above its high limit.	5
	Abs both	Action is taken whenever the absolute value of the signal falls below its (absolute) low limit or rises above its (absolute) high limit.	6
	Hysteresis	Action is taken whenever the signal rises above the value defined by the upper limit + 0.5 * hysteresis. The action is deactivated when the signal falls below the value defined by the lower limit - 0.5 * hysteresis.	7
	Low falling	Action taken whenever the signal falls from a value higher than 'Supervision low' limit + 0.5 * hysteresis to a value which is lower than 'Supervision low' limit - 0.5 * hysteresis. Action is deactivated when the signal rises to higher than 'Supervision low' limit + 0.5 * hysteresis.	8
	High rising	Action taken whenever the signal rises from a value lower than 'Supervision high' limit - 0.5 * hysteresis to a value which is higher than 'Supervision high' limit + 0.5 * hysteresis. Action is deactivated when the signal falls to lower than 'Supervision high' limit - 0.5 * hysteresis.	9
32.16	Supervision 2 action	Selects whether the drive generates a fault, warning or neither when the value monitored by signal supervision 2 exceeds its limits. **Note:** This parameter does not affect the status indicated by parameter 32.01 Supervision status.	No action / uint16
	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 80B1 Signal supervision 2.	3
32.17	Supervision 2 signal	Selects the signal to be monitored by signal supervision function 2. For the available selections, see parameter 32.07 Supervision 1 signal.	Current / uint32
32.18	Supervision 2 filter time	Defines a filter time constant for the signal monitored by signal supervision 2.	0.000 s / real32
	0.000 ... 30.000 s	Signal filter time.	1000 = 1 s / 1000 = 1 s
32.19	Supervision 2 low	Defines the lower limit for signal supervision 2.	0.00 NoUnit / real32
	-21474836.00 ... 21474836.00	Low limit.	1 = 1 / 1 = 1
32.20	Supervision 2 high	Defines the upper limit for signal supervision 2.	0.00 NoUnit / real32

No.	Name / Range / Selection	Description	Def / Type FbEq 16b / 32b
	-21474836.00 … 21474836.00	Upper limit.	1 = 1 / 1 = 1
32.21	Supervision 2 hysteresis	Defines the hysteresis for the signal monitored by signal supervision 2. This parameter applies to all selections for parameter 32.15 Supervision 2 function, not just selection Hysteresis (7). Action is taken whenever the signal rises above the value defined by the upper limit + 0.5 * hysteresis. The action is deactivated when the signal falls below the value defined by the lower limit - 0.5 * hysteresis.	0.00 null / real32
	0.00 … 100000.00	Hysteresis.	- / 100 = 1
32.25	Supervision 3 function	Selects the mode of signal supervision function 3. Determines how the monitored signal (see parameter 32.27 Supervision 3 signal) is compared to its lower and upper limits (parameters 32.29 Supervision 3 low and 32.30 Supervision 3 high respectively). The action to be taken when the condition is fulfilled is selected by parameter 32.26 Supervision 3 action.	Disabled / uint16
	Disabled	Signal supervision 3 not in use.	0
	Low	Action is taken whenever signal is below 'Supervision low' limit - 0.5 * hysteresis. Action is deactivated whenever signal is above 'Supervision low' limit + 0.5 * hysteresis.	1
	High	Action is taken whenever signal is above 'Supervision High' limit + 0.5 * hysteresis. Action is deactivated whenever signal is below 'Supervision High' limit - 0.5 * hysteresis.	2
	Abs low	Action is taken whenever absolute value of signal is below absolute value of 'Supervision Low' limit - 0.5 * hysteresis. Action is deactivated whenever absolute value of signal is above absolute value of 'Supervision Low' limit + 0.5 * hysteresis.	3
	Abs high	Action is taken whenever absolute value of signal is above absolute value of 'Supervision High' limit + 0.5 * hysteresis. Action is deactivated whenever absolute value of signal is below absolute value of 'Supervision High' limit - 0.5 * hysteresis.	4
	Both	Action is taken whenever signal is above 'Supervision High' limit + 0.5 * hysteresis or below 'Supervision Low' limit - 0.5 * hysteresis. Action is deactivated whenever signal is in between 'Supervision High' limit - 0.5 * hysteresis and 'Supervision Low' limit + 0.5 * hysteresis.	5

No.	Name / Range / Selection	Description	Def / Type FbEq 16b / 32b
	Abs both	Action is taken whenever absolute value of signal is above absolute value of 'Supervision High' limit + 0.5 * hysteresis or below absolute value of 'Supervision Low' limit - 0.5 * hysteresis. Action is deactivated whenever absolute value of signal is in between absolute value of 'Supervision High' limit - 0.5 * hysteresis and absolute value of 'Supervision Low' limit + 0.5 * hysteresis.	6
	Hysteresis	Action is taken whenever signal is above 'Supervision High' limit + 0.5 * hysteresis. Action is deactivated whenever signal is below 'Supervision Low' limit - 0.5 * hysteresis. The status is unchanged when signal value is in between 'Supervision High' limit + 0.5 * hysteresis and 'Supervision Low' limit - 0.5 * hysteresis.	7
	Low falling	Action taken whenever the signal falls from a value higher than 'Supervision low' limit + 0.5 * hysteresis to a value which is lower than 'Supervision low' limit - 0.5 * hysteresis. Action is deactivated when the signal rises to higher than 'Supervision low' limit + 0.5 * hysteresis.	8
	High rising	Action taken whenever the signal rises from a value lower than 'Supervision high' limit - 0.5 * hysteresis to a value which is higher than 'Supervision high' limit + 0.5 * hysteresis. Action is deactivated when the signal falls to lower than 'Supervision high' limit - 0.5 * hysteresis.	9
32.26	Supervision 3 action	Selects whether the drive generates a fault, warning or neither when the value monitored by signal supervision 3 exceeds its limits. **Note:** This parameter does not affect the status indicated by parameter 32.01 Supervision status.	No action / uint16
	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 80B2 Signal supervision 3.	3
32.27	Supervision 3 signal	Selects the signal to be monitored by signal supervision function 3. For the available selections, see parameter 32.07 Supervision 1 signal.	Torque / uint32
32.28	Supervision 3 filter time	Defines a filter time constant for the signal monitored by signal supervision 3.	0.000 s / real32
	0.000 … 30.000 s	Signal filter time.	1000 = 1 s / 1000 = 1 s
32.29	Supervision 3 low	Defines the lower limit for signal supervision 3.	0.00 NoUnit / real32

No.	Name / Range / Selection	Description	Def / Type FbEq 16b / 32b
	-21474836.00 ... 21474836.00	Low limit.	1 = 1 / 1 = 1
32.30	Supervision 3 high	Defines the upper limit for signal supervision 3.	0.00 NoUnit / real32
	-21474836.00 ... 21474836.00	Upper limit.	1 = 1 / 1 = 1
32.31	Supervision 3 hysteresis	Defines the hysteresis for the signal monitored by signal supervision 3. This parameter applies to all selections for parameter 32.25 Supervision 3 function, not just selection Hysteresis (7). Action is taken whenever the signal rises above the value defined by the upper limit + 0.5 * hysteresis. The action is deactivated when the signal falls below the value defined by the lower limit - 0.5 * hysteresis.	0.00 null / real32
	0.00 ... 100000.00	Hysteresis.	- / 100 = 1
32.35	Supervision 4 function	Selects the mode of signal supervision function 4. Determines how the monitored signal (see parameter 32.37 Supervision 4 signal) is compared to its lower and upper limits (parameters 32.39 Supervision 4 low and 32.40 Supervision 4 high respectively). The action to be taken when the condition is fulfilled is selected by parameter 32.36 Supervision 4 action.	Disabled / uint16
	Disabled	Signal supervision 4 not in use.	0
	Low	Action is taken whenever signal is below 'Supervision low' limit - 0.5 * hysteresis. Action is deactivated whenever signal is above 'Supervision low' limit + 0.5 * hysteresis.	1
	High	Action is taken whenever signal is above 'Supervision High' limit + 0.5 * hysteresis. Action is deactivated whenever signal is below 'Supervision High' limit - 0.5 * hysteresis.	2
	Abs low	Action is taken whenever absolute value of signal is below absolute value of 'Supervision Low' limit - 0.5 * hysteresis. Action is deactivated whenever absolute value of signal is above absolute value of 'Supervision Low' limit + 0.5 * hysteresis.	3
	Abs high	Action is taken whenever absolute value of signal is above absolute value of 'Supervision High' limit + 0.5 * hysteresis. Action is deactivated whenever absolute value of signal is below absolute value of 'Supervision High' limit - 0.5 * hysteresis.	4
	Both	Action is taken whenever signal is above 'Supervision High' limit + 0.5 * hysteresis or below 'Supervision Low' limit - 0.5 * hysteresis. Action is deactivated whenever signal is in between 'Supervision High' limit - 0.5 * hysteresis and 'Supervision Low' limit + 0.5 * hysteresis.	5

No.	Name / Range / Selection	Description	Def / Type FbEq 16b / 32b
	Abs both	Action is taken whenever absolute value of signal is above absolute value of 'Supervision High' limit + 0.5 * hysteresis or below absolute value of 'Supervision Low' limit - 0.5 * hysteresis. Action is deactivated whenever absolute value of signal is in between absolute value of 'Supervision High' limit - 0.5 * hysteresis and absolute value of 'Supervision Low' limit + 0.5 * hysteresis.	6
	Hysteresis	Action is taken whenever signal is above 'Supervision High' limit + 0.5 * hysteresis. Action is deactivated whenever signal is below 'Supervision Low' limit - 0.5 * hysteresis. The status is unchanged when signal value is in between 'Supervision High' limit + 0.5 * hysteresis and 'Supervision Low' limit - 0.5 * hysteresis.	7
	Low falling	Action taken whenever the signal falls from a value higher than 'Supervision low' limit + 0.5 * hysteresis to a value which is lower than 'Supervision low' limit - 0.5 * hysteresis. Action is deactivated when the signal rises to higher than 'Supervision low' limit + 0.5 * hysteresis.	8
	High rising	Action taken whenever the signal rises from a value lower than 'Supervision high' limit - 0.5 * hysteresis to a value which is higher than 'Supervision high' limit + 0.5 * hysteresis. Action is deactivated when the signal falls to lower than 'Supervision high' limit - 0.5 * hysteresis.	9
32.36	Supervision 4 action	Selects whether the drive generates a fault, warning or neither when the value monitored by signal supervision 4 exceeds its limits. **Note:** This parameter does not affect the status indicated by parameter 32.01 Supervision status.	No action / uint16
	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 80B3 Signal supervision 4 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 / uint32
32.38	Supervision 4 filter time	Defines a filter time constant for the signal monitored by signal supervision 4.	0.000 s / real32
	0.000 … 30.000 s	Signal filter time.	1000 = 1 s / 1000 = 1 s
32.39	Supervision 4 low	Defines the lower limit for signal supervision 4.	0.00 NoUnit / real32

No.	Name / Range / Selection	Description	Def / Type FbEq 16b / 32b
	-21474836.00 ... 21474836.00	Low limit.	1 = 1 / 1 = 1
32.40	Supervision 4 high	Defines the upper limit for signal supervision 4.	0.00 NoUnit / real32
	-21474836.00 ... 21474836.00	Upper limit.	1 = 1 / 1 = 1
32.41	Supervision 4 hysteresis	Defines the hysteresis for the signal monitored by signal supervision 4. This parameter applies to all selections for parameter 32.35 Supervision 4 function, not just selection Hysteresis (7). Action is taken whenever the signal rises above the value defined by the upper limit + 0.5 * hysteresis. The action is deactivated when the signal falls below the value defined by the lower limit - 0.5 * hysteresis.	0.00 null / real32
	0.00 ... 100000.00	Hysteresis.	- / 100 = 1
32.45	Supervision 5 function	Selects the mode of signal supervision function 5. Determines how the monitored signal (see parameter 32.47 Supervision 5 signal) is compared to its lower and upper limits (parameters 32.49 Supervision 5 low and 32.50 Supervision 5 high respectively). The action to be taken when the condition is fulfilled is selected by parameter 32.46 Supervision 5 action.	Disabled / uint16
	Disabled	Signal supervision 5 not in use.	0
	Low	Action is taken whenever signal is below 'Supervision low' limit - 0.5 * hysteresis. Action is deactivated whenever signal is above 'Supervision low' limit + 0.5 * hysteresis.	1
	High	Action is taken whenever signal is above 'Supervision High' limit + 0.5 * hysteresis. Action is deactivated whenever signal is below 'Supervision High' limit - 0.5 * hysteresis.	2
	Abs low	Action is taken whenever absolute value of signal is below absolute value of 'Supervision Low' limit - 0.5 * hysteresis. Action is deactivated whenever absolute value of signal is above absolute value of 'Supervision Low' limit + 0.5 * hysteresis.	3
	Abs high	Action is taken whenever absolute value of signal is above absolute value of 'Supervision High' limit + 0.5 * hysteresis. Action is deactivated whenever absolute value of signal is below absolute value of 'Supervision High' limit - 0.5 * hysteresis.	4
	Both	Action is taken whenever signal is above 'Supervision High' limit + 0.5 * hysteresis or below 'Supervision Low' limit - 0.5 * hysteresis. Action is deactivated whenever signal is in between 'Supervision High' limit - 0.5 * hysteresis and 'Supervision Low' limit + 0.5 * hysteresis.	5

No.	Name / Range / Selection	Description	Def / Type FbEq 16b / 32b
	Abs both	Action is taken whenever absolute value of signal is above absolute value of 'Supervision High' limit + 0.5 * hysteresis or below absolute value of 'Supervision Low' limit - 0.5 * hysteresis. Action is deactivated whenever absolute value of signal is in between absolute value of 'Supervision High' limit - 0.5 * hysteresis and absolute value of 'Supervision Low' limit + 0.5 * hysteresis.	6
	Hysteresis	Action is taken whenever signal is above 'Supervision High' limit + 0.5 * hysteresis. Action is deactivated whenever signal is below 'Supervision Low' limit - 0.5 * hysteresis. The status is unchanged when signal value is in between 'Supervision High' limit + 0.5 * hysteresis and 'Supervision Low' limit - 0.5 * hysteresis.	7
	Low falling	Action taken whenever the signal falls from a value higher than 'Supervision low' limit + 0.5 * hysteresis to a value which is lower than 'Supervision low' limit - 0.5 * hysteresis. Action is deactivated when the signal rises to higher than 'Supervision low' limit + 0.5 * hysteresis.	8
	High rising	Action taken whenever the signal rises from a value lower than 'Supervision high' limit - 0.5 * hysteresis to a value which is higher than 'Supervision high' limit + 0.5 * hysteresis. Action is deactivated when the signal falls to lower than 'Supervision high' limit - 0.5 * hysteresis.	9
32.46	Supervision 5 action	Selects whether the drive generates a fault, warning or neither when the value monitored by signal supervision 5 exceeds its limits. **Note:** This parameter does not affect the status indicated by parameter 32.01 Supervision status.	No action / uint16
	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 80B4 Signal supervision 5 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 / uint32
32.48	Supervision 5 filter time	Defines a filter time constant for the signal monitored by signal supervision 5.	0.000 s / real32
	0.000 … 30.000 s	Signal filter time.	1000 = 1 s / 1000 = 1 s
32.49	Supervision 5 low	Defines the lower limit for signal supervision 5.	0.00 NoUnit / real32

No.	Name / Range / Selection	Description	Def / Type FbEq 16b / 32b
	-21474836.00 ... 21474836.00	Low limit.	1 = 1 / 1 = 1
32.50	Supervision 5 high	Defines the upper limit for signal supervision 5.	0.00 NoUnit / real32
	-21474836.00 ... 21474836.00	Upper limit.	1 = 1 / 1 = 1
32.51	Supervision 5 hysteresis	Defines the hysteresis for the signal monitored by signal supervision 5. This parameter applies to all selections for parameter 32.45 Supervision 5 function, not just selection Hysteresis (7). Action is taken whenever the signal rises above the value defined by the upper limit + 0.5 * hysteresis. The action is deactivated when the signal falls below the value defined by the lower limit - 0.5 * hysteresis.	0.00 null / real32
	0.00 ... 100000.00	Hysteresis.	- / 100 = 1
32.55	Supervision 6 function	Selects the mode of signal supervision function 6. Determines how the monitored signal (see parameter 32.57 Supervision 6 signal) is compared to its lower and upper limits (parameters 32.59 Supervision 6 low and 32.60 Supervision 6 high respectively). The action to be taken when the condition is fulfilled is selected by parameter 32.56 Supervision 6 action.	Disabled / uint16
	Disabled	Signal supervision 6 not in use.	0
	Low	Action is taken whenever signal is below 'Supervision low' limit - 0.5 * hysteresis. Action is deactivated whenever signal is above 'Supervision low' limit + 0.5 * hysteresis.	1
	High	Action is taken whenever signal is above 'Supervision High' limit + 0.5 * hysteresis. Action is deactivated whenever signal is below 'Supervision High' limit - 0.5 * hysteresis.	2
	Abs low	Action is taken whenever absolute value of signal is below absolute value of 'Supervision Low' limit - 0.5 * hysteresis. Action is deactivated whenever absolute value of signal is above absolute value of 'Supervision Low' limit + 0.5 * hysteresis.	3
	Abs high	Action is taken whenever absolute value of signal is above absolute value of 'Supervision High' limit + 0.5 * hysteresis. Action is deactivated whenever absolute value of signal is below absolute value of 'Supervision High' limit - 0.5 * hysteresis.	4
	Both	Action is taken whenever signal is above 'Supervision High' limit + 0.5 * hysteresis or below 'Supervision Low' limit - 0.5 * hysteresis. Action is deactivated whenever signal is in between 'Supervision High' limit - 0.5 * hysteresis and 'Supervision Low' limit + 0.5 * hysteresis.	5

No.	Name / Range / Selection	Description	Def / Type FbEq 16b / 32b
	Abs both	Action is taken whenever absolute value of signal is above absolute value of 'Supervision High' limit + 0.5 * hysteresis or below absolute value of 'Supervision Low' limit - 0.5 * hysteresis. Action is deactivated whenever absolute value of signal is in between absolute value of 'Supervision High' limit - 0.5 * hysteresis and absolute value of 'Supervision Low' limit + 0.5 * hysteresis.	6
	Hysteresis	Action is taken whenever signal is above 'Supervision High' limit + 0.5 * hysteresis. Action is deactivated whenever signal is below 'Supervision Low' limit - 0.5 * hysteresis. The status is unchanged when signal value is in between 'Supervision High' limit + 0.5 * hysteresis and 'Supervision Low' limit - 0.5 * hysteresis.	7
	Low falling	Action taken whenever the signal falls from a value higher than 'Supervision low' limit + 0.5 * hysteresis to a value which is lower than 'Supervision low' limit - 0.5 * hysteresis. Action is deactivated when the signal rises to higher than 'Supervision low' limit + 0.5 * hysteresis.	8
	High rising	Action taken whenever the signal rises from a value lower than 'Supervision high' limit - 0.5 * hysteresis to a value which is higher than 'Supervision high' limit + 0.5 * hysteresis. Action is deactivated when the signal falls to lower than 'Supervision high' limit - 0.5 * hysteresis.	9
32.56	Supervision 6 action	Selects whether the drive generates a fault, warning or neither when the value monitored by signal supervision 6 exceeds its limits. **Note:** This parameter does not affect the status indicated by parameter 32.01 Supervision status.	No action / uint16
	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 80B5 Signal supervision 6 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 / uint32
32.58	Supervision 6 filter time	Defines a filter time constant for the signal monitored by signal supervision 6.	0.000 s / real32
	0.000 … 30.000 s	Signal filter time.	1000 = 1 s / 1000 = 1 s
32.59	Supervision 6 low	Defines the lower limit for signal supervision 6.	0.00 NoUnit / real32

No.	Name / Range / Selection	Description	Def / Type FbEq 16b / 32b
	-21474836.00 … 21474836.00	Low limit.	1 = 1 / 1 = 1
32.60	Supervision 6 high	Defines the upper limit for signal supervision 6.	0.00 NoUnit / real32
	-21474836.00 … 21474836.00	Upper limit.	1 = 1 / 1 = 1
32.61	Supervision 6 hysteresis	Defines the hysteresis for the signal monitored by signal supervision 6. This parameter applies to all selections for parameter 32.55 Supervision 6 function, not just selection Hysteresis (7). Action is taken whenever the signal rises above the value defined by the upper limit + 0.5 * hysteresis. The action is deactivated when the signal falls below the value defined by the lower limit - 0.5 * hysteresis.	0.00 null / real32
	0.00 … 100000.00	Hysteresis.	- / 100 = 1

No.	Name / Range / Selection	Description	Def / Type FbEq 16b / 32b
34	Timed functions	Configuration of the timed functions. See also section Timed functions (page 77).	
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.	0000 0000 0000 0000 / uint16
b0	Timed function 1	1 = Active.	
b1	Timed function 2	1 = Active.	
b2	Timed function 3	1 = Active.	
b3…15	Reserved		
	0000h…FFFFh		1 / 1
34.02	Timer status	Status of timers 1…12. This parameter is read-only.	0000 0000 0000 0000 / uint16
b0	Timer 1	1 = Active.	
b1	Timer 2	1 = Active.	
b2	Timer 3	1 = Active.	
b3	Timer 4	1 = Active.	
b4	Timer 5	1 = Active.	
b5	Timer 6	1 = Active.	
b6	Timer 7	1 = Active.	
b7	Timer 8	1 = Active.	
b8	Timer 9	1 = Active.	
b9	Timer 10	1 = Active.	
b10	Timer 11	1 = Active.	
b11	Timer 12	1 = Active.	
b12…15	Reserved		
	0000h…FFFFh		1 / 1
34.04	Season/exception day status	Status of seasons 1…4, exception weekday and exception holiday. Only one season can be active at a time. A day can be a workday and a holiday at the same time. This parameter is read-only.	0000 0000 0000 0000 / uint16
b0	Season 1	1 = Active.	
b1	Season 2	1 = Active.	
b2	Season 3	1 = Active.	
b3	Season 4	1 = Active.	
b4…9	Reserved		

No.	Name / Range / Selection	Description	Def / Type FbEq 16b / 32b
b10	Exception workday	1 = Active.	
b11	Exception holiday	1 = Active.	
b12…15	Reserved		
	0000h…FFFFh		1 / 1
34.10	Timed functions enable	Selects the source for the timed functions enable signal. 0 = Disabled. 1 = Enabled.	Disabled / uint32
	Disabled	0.	0
	Enabled	1.	1
	DI1	Digital input DI1 (parameter 10.02 DI delayed status, bit 0).	2
	DI2	Digital input DI2 (parameter 10.02 DI delayed status, bit 1).	3
	DI3	Digital input DI3 (parameter 10.02 DI delayed status, bit 2).	4
	DI4	Digital input DI4 (parameter 10.02 DI delayed status, bit 3).	5
	DI5	Digital input DI5 (parameter 10.02 DI delayed status, bit 4).	6
	Other [bit]	See Terms and abbreviations (page 137).	-

No.	Name / Range / Selection	Description	Def / Type FbEq 16b / 32b
34.11	Timer 1 configuration	Defines when timer 1 is active.	0000 0111 1000 0000 / uint16

Bits of parameter 34.11 Timer 1 configuration

Monday	Tuesday	Wednesday	Thursday	Friday	Saturday	Sunday	Season1	Season2	Season3	Season4	Exceptions	Holidays	Workdays	
1	1	1	1	1	1	1	1	1	1	1	0	0	0	1)
1	1	1	1	1	0	0	1	1	1	1	0	0	0	2)
1	1	1	1	1	0	0	0	0	1	0	0	0	0	3)
1	1	1	1	1	0	0	1	1	1	1	1	1	0	4)
1	0	1	0	1	0	1	1	1	0	0	1	0	1	5)
1	1	1	1	1	1	1	1	1	1	1	1	0	0	6)

1) **Example 1:** Timer is active during the times of the day defined by other parameters every Weekday and every Season.
Exception day settings (parameters 34.70…34.90) do not have any effect on the Timer.

2) **Example 2:** Timer is active during the times of the day defined by other parameters from Mon to Fri, every Season.
Exception day settings (parameters 34.70…34.90) do not have any effect on the Timer.

3) **Example 3:** Timer is active during the times of the day defined by other parameters from Mon to Fri, only during Season 3 (can be configured as, eg, summer).
Exception day settings (parameters 34.70…34.90) do not have any effect on the Timer.

4) **Example 4:** Timer is active during the times of the day defined by other parameters from Mon to Fri, every Season.
In addition, the Timer is active every Exception day Holidays, regardless what is the day or season.

5) **Example 5:** Timer is active during the times of the day defined by other parameters on Mon, Wed, Fri and Sun, during Season1 and Season 2.
In addition, the Timer is active every Exception day Workdays, regardless what is the day or season.

6) **Example 6:** Timer is active during the times of the day defined by other parameters every Weekday and every Season.
The Timer is inactive during all Exception days.

b0	Monday	1 = Monday is an active start day.	
b1	Tuesday	1 = Tuesday is an active start day.	
b2	Wednesday	1 = Wednesday is an active start day.	
b3	Thursday	1 = Thursday is an active start day.	

No.	Name / Range / Selection	Description	Def / Type FbEq 16b / 32b
b4	Friday	1 = Friday is an active start day.	
b5	Saturday	1 = Saturday is an active start day.	
b6	Sunday	1 = Sunday is an active start day.	
b7	Season 1	1 = Timer is active in season 1.	
b8	Season 2	1 = Timer is active in season 2.	
b9	Season 3	1 = Timer is active in season 3.	
b10	Season 4	1 = Timer is active in season 4.	
b11	Exceptions	0 = Exceptions days are disabled. The timer follows only weekday and season settings (bits 0…10 in the timer configuration) and the start time and duration of the timer (see parameters 34.12 and 34.13). Exception day settings, parameters 34.70…34.90, do not have any effect on this timer. 1 = Exception days are enabled. The timer is active during the weekdays and seasons defined with bits 0…10 and the times defined by parameters 34.12 and 34.13. In addition, the timer is active during the exception days defined with bit 12, bit 13 and parameters 34.70…34.90. If bit 12 and bit 13 are both zero, the timer is inactive during the exception days.	
b12	Holidays	This bit has no effect unless bit 11 = 1 (Exceptions days are enabled). When bits 11 and 12 are both 1, the timer is active during the weekdays and seasons defined with bits 0…10 and times defined by parameters 34.12 and 34.13. In addition, the timer is active when the ongoing day is defined as Exception day Holiday by parameters 34.70…34.90 and the current time matches with the time range defined by parameters 34.12 and 34.13. During Exception days, weekday and season bits are ignored.	
b13	Workdays	This bit has no effect unless bit 11 = 1 (Exceptions enabled). When bits 11 and 13 are both 1, the Timer is active during the weekdays and seasons defined with bits 0…10 and the times defined by parameters 34.12 and 34.13. In addition, the timer is active when the ongoing day is defined as Exception day Workday by parameters 34.70…34.90 and the current time matches with the time range defined by parameters 34.12 and 34.13. During Exception days, weekday and season bits are ignored.	
b14…15	Reserved		
	0000h…FFFFh		1 / 1

No.	Name / Range / Selection	Description	Def / Type FbEq 16b / 32b
34.12	Timer 1 start time	Defines the daily start time of timer 1. The time can be changed in second steps. The timer can be started at an other time than the start time. For example, if the timer's duration is more than one day and the active session starts during the time, the timer is started at 00:00 and stopped when there is no duration left.	00:00:00 / uint32
	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 / uint16
	00 00:00…07 00:00	Timer duration.	1 = 1
34.14	Timer 2 configuration	See parameter 34.11 Timer 1 configuration.	0000 0111 1000 0000 / uint16
	0000h…FFFFh		1 / 1
34.15	Timer 2 start time	See parameter 34.12 Timer 1 start time.	00:00:00 / uint32
	00:00:00…23:59:59		1 = 1
34.16	Timer 2 duration	See parameter 34.13 Timer 1 duration.	00 00:00 / uint16
	00 00:00…07 00:00		1 = 1
34.17	Timer 3 configuration	See parameter 34.11 Timer 1 configuration.	0000 0111 1000 0000 / uint16
	0000h…FFFFh		1 / 1
34.18	Timer 3 start time	See parameter 34.12 Timer 1 start time.	00:00:00 / uint32
	00:00:00…23:59:59		1 = 1
34.19	Timer 3 duration	See parameter 34.13 Timer 1 duration.	00 00:00 / uint16
	00 00:00…07 00:00		1 = 1
34.20	Timer 4 configuration	See parameter 34.11 Timer 1 configuration.	0000 0111 1000 0000 / uint16
	0000h…FFFFh		1 / 1
34.21	Timer 4 start time	See parameter 34.12 Timer 1 start time.	00:00:00 / uint32
	00:00:00…23:59:59		1 = 1
34.22	Timer 4 duration	See parameter 34.13 Timer 1 duration.	00 00:00 / uint16
	00 00:00…07 00:00		1 = 1
34.23	Timer 5 configuration	See parameter 34.11 Timer 1 configuration.	0000 0111 1000 0000 / uint16
	0000h…FFFFh		1 / 1

No.	Name / Range / Selection	Description	Def / Type FbEq 16b / 32b
34.24	Timer 5 start time	See parameter 34.12 Timer 1 start time.	00:00:00 / uint32
	00:00:00…23:59:59		1 = 1
34.25	Timer 5 duration	See parameter 34.13 Timer 1 duration.	00 00:00 / uint16
	00 00:00…07 00:00		1 = 1
34.26	Timer 6 configuration	See parameter 34.11 Timer 1 configuration.	0000 0111 1000 0000 / uint16
	0000h…FFFFh		1 / 1
34.27	Timer 6 start time	See parameter 34.12 Timer 1 start time.	00:00:00 / uint32
	00:00:00…23:59:59		1 = 1
34.28	Timer 6 duration	See parameter 34.13 Timer 1 duration.	00 00:00 / uint16
	00 00:00…07 00:00		1 = 1
34.29	Timer 7 configuration	See parameter 34.11 Timer 1 configuration.	0000 0111 1000 0000 / uint16
	0000h…FFFFh		1 / 1
34.30	Timer 7 start time	See parameter 34.12 Timer 1 start time.	00:00:00 / uint32
	00:00:00…23:59:59		1 = 1
34.31	Timer 7 duration	See parameter 34.13 Timer 1 duration.	00 00:00 / uint16
	00 00:00…07 00:00		1 = 1
34.32	Timer 8 configuration	See parameter 34.11 Timer 1 configuration.	0000 0111 1000 0000 / uint16
	0000h…FFFFh		1 / 1
34.33	Timer 8 start time	See parameter 34.12 Timer 1 start time.	00:00:00 / uint32
	00:00:00…23:59:59		1 = 1
34.34	Timer 8 duration	See parameter 34.13 Timer 1 duration.	00 00:00 / uint16
	00 00:00…07 00:00		1 = 1
34.35	Timer 9 configuration	See parameter 34.11 Timer 1 configuration.	0000 0111 1000 0000 / uint16
	0000h…FFFFh		1 / 1
34.36	Timer 9 start time	See parameter 34.12 Timer 1 start time.	00:00:00 / uint32
	00:00:00…23:59:59		1 = 1
34.37	Timer 9 duration	See parameter 34.13 Timer 1 duration.	00 00:00 / uint16
	00 00:00…07 00:00		1 = 1
34.38	Timer 10 configuration	See parameter 34.11 Timer 1 configuration.	0000 0111 1000 0000 / uint16
	0000h…FFFFh		1 / 1
34.39	Timer 10 start time	See parameter 34.12 Timer 1 start time.	00:00:00 / uint32
	00:00:00…23:59:59		1 = 1

No.	Name / Range / Selection	Description	Def / Type FbEq 16b / 32b
34.40	Timer 10 duration	See parameter 34.13 Timer 1 duration.	00 00:00 / uint16
	00 00:00…07 00:00		1 = 1
34.41	Timer 11 configuration	See parameter 34.11 Timer 1 configuration.	0000 0111 1000 0000 / uint16
	0000h…FFFFh		1 / 1
34.42	Timer 11 start time	See parameter 34.12 Timer 1 start time.	00:00:00 / uint32
	00:00:00…23:59:59		1 = 1
34.43	Timer 11 duration	See parameter 34.13 Timer 1 duration.	00 00:00 / uint16
	00 00:00…07 00:00		1 = 1
34.44	Timer 12 configuration	See parameter 34.11 Timer 1 configuration.	0000 0111 1000 0000 / uint16
	0000h…FFFFh		1 / 1
34.45	Timer 12 start time	See parameter 34.12 Timer 1 start time.	00:00:00 / uint32
	00:00:00…23:59:59		1 = 1
34.46	Timer 12 duration	See parameter 34.13 Timer 1 duration.	00 00:00 / uint16
	00 00:00…07 00:00		1 = 1
34.60	Season 1 start date	Defines the start date of season 1 in format dd.mm, where dd is the number of the day and mm is the number of the month. The season changes at midnight. One season can be active at a time. Timers are started on exception days even if they are not inside the active season. The season start dates (1…4) must be given in increasing order to use all seasons. The default value is interpreted that the season is not configured. If the season start dates are not in increasing order and the value is something else than the default value, a season configuration warning is given.	01.01 / uint16
	01.01…12.31	Season start date.	1 = 1
34.61	Season 2 start date	Defines the start date of season 2. See parameter 34.60 Season 1 start date.	01.01 / uint16
	01.01…12.31		1 = 1
34.62	Season 3 start date	Defines the start date of season 3. See parameter 34.60 Season 1 start date.	01.01 / uint16
	01.01…12.31		1 = 1
34.63	Season 4 start date	Defines the start date of season 4. See parameter 34.60 Season 1 start date.	01.01 / uint16
	01.01…12.31		1 = 1

No.	Name / Range / Selection	Description	Def / Type FbEq 16b / 32b
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 NoUnit / uint16
	0...16	Number of active exception periods or days.	1 = 1 / 1 = 1
34.71	Exception types	Defines the types of exceptions 1…16 as workday or holiday. Exceptions 1…3 are periods (duration can be defined) and exceptions 4…16 are days (duration is always 24 hours).	0000 0000 0000 0000 / uint16
b0	Exception 1	0 = Workday. 1 = Holiday.	
b1	Exception 2	0 = Workday. 1 = Holiday.	
b2	Exception 3	0 = Workday. 1 = Holiday.	
b3	Exception 4	0 = Workday. 1 = Holiday.	
b4	Exception 5	0 = Workday. 1 = Holiday.	
b5	Exception 6	0 = Workday. 1 = Holiday.	
b6	Exception 7	0 = Workday. 1 = Holiday.	
b7	Exception 8	0 = Workday. 1 = Holiday.	
b8	Exception 9	0 = Workday. 1 = Holiday.	
b9	Exception 10	0 = Workday. 1 = Holiday.	
b10	Exception 11	0 = Workday. 1 = Holiday.	
b11	Exception 12	0 = Workday. 1 = Holiday.	
b12	Exception 13	0 = Workday. 1 = Holiday.	
b13	Exception 14	0 = Workday. 1 = Holiday.	
b14	Exception 15	0 = Workday. 1 = Holiday.	
b15	Exception 16	0 = Workday. 1 = Holiday.	
	0000h…FFFFh		1 / 1
34.72	Exception 1 start	Defines the start date of the exception period in format dd.mm, where dd is the number of the day and mm is the number of the month. The timer started on an exception day is always stopped at 23:59:59 even if it has duration left. The same date can be configured to be holiday and workday. The date is active if any of exception days are active.	01.01 / uint16
	01.01…31.12	Start date of exception period 1.	1 = 1

No.	Name / Range / Selection	Description	Def / Type FbEq 16b / 32b
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 days / uint16
	0...60 days	Length of exception period 1.	1 = 1 days / 1 = 1 days
34.74	Exception 2 start	See parameter 34.72 Exception 1 start.	01.01 / uint16
	-		1 = 1
34.75	Exception 2 length	See parameter 34.73 Exception 1 length.	0 days / uint16
	days		1 = 1 days / 1 = 1 days
34.76	Exception 3 start	See parameter 34.72 Exception 1 start.	01.01 / uint16
	-		1 = 1
34.77	Exception 3 length	See parameter 34.73 Exception 1 length.	0 days / uint16
	days		1 = 1 days / 1 = 1 days
34.78	Exception day 4	Defines the date of exception day 4.	01.01 / uint16
	01.01…12.31	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.	1 = 1
34.79	Exception day 5	See parameter 34.78 Exception day 4.	01.01 / uint16
	-		1 = 1
34.80	Exception day 6	See parameter 34.78 Exception day 4.	01.01 / uint16
	-		1 = 1
34.81	Exception day 7	See parameter 34.78 Exception day 4.	01.01 / uint16
	-		1 = 1
34.82	Exception day 8	See parameter 34.78 Exception day 4.	01.01 / uint16
	-		1 = 1
34.83	Exception day 9	See parameter 34.78 Exception day 4.	01.01 / uint16
	-		1 = 1
34.84	Exception day 10	See parameter 34.78 Exception day 4.	01.01 / uint16
	-		1 = 1
34.85	Exception day 11	See parameter 34.78 Exception day 4.	01.01 / uint16
	-		1 = 1
34.86	Exception day 12	See parameter 34.78 Exception day 4.	01.01 / uint16
	-		1 = 1
34.87	Exception day 13	See parameter 34.78 Exception day 4.	01.01 / uint16
	-		1 = 1
34.88	Exception day 14	See parameter 34.78 Exception day 4.	01.01 / uint16

No.	Name / Range / Selection	Description	Def / Type FbEq 16b / 32b
	-		1 = 1
34.89	Exception day 15	See parameter 34.78 Exception day 4.	01.01 / uint16
	-		1 = 1
34.90	Exception day 16	See parameter 34.78 Exception day 4.	01.01 / uint16
	-		1 = 1
34.100	Timed function 1	Defines which timers are connected to combined timer 1. 0 = Not connected. 1 = Connected. See parameter 34.01 Timed functions status.	0000 0000 0000 0000 / uint16
b0	Timer 1	0 = Inactive. 1 = Active.	
b1	Timer 2	0 = Inactive. 1 = Active.	
b2	Timer 3	0 = Inactive. 1 = Active.	
b3	Timer 4	0 = Inactive. 1 = Active.	
b4	Timer 5	0 = Inactive. 1 = Active.	
b5	Timer 6	0 = Inactive. 1 = Active.	
b6	Timer 7	0 = Inactive. 1 = Active.	
b7	Timer 8	0 = Inactive. 1 = Active.	
b8	Timer 9	0 = Inactive. 1 = Active.	
b9	Timer 10	0 = Inactive. 1 = Active.	
b10	Timer 11	0 = Inactive. 1 = Active.	
b11	Timer 12	0 = Inactive. 1 = Active.	
b12…15	Reserved		
	0000h…FFFFh		1 / 1
34.101	Timed function 2	Defines which timers are connected to combined timer 2. See parameter 34.01 Timed functions status.	0000 0000 0000 0000 / uint16
	0000h…FFFFh		1 / 1
34.102	Timed function 3	Defines which timers are connected to combined timer 3. See parameter 34.01 Timed functions status.	0000 0000 0000 0000 / uint16
	0000h…FFFFh		1 / 1
34.110	Boost time function	Defines which combined timers (that is, timers that are connected to the combined timers) are activated with the extra time function.	0000 0000 0000 0000 / uint16
b0	Timed function 1	0 = Inactive. 1 = Active.	
b1	Timed function 2	0 = Inactive. 1 = Active.	

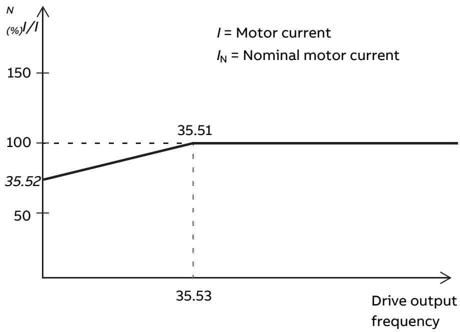
No.	Name / Range / Selection	Description	Def / Type FbEq 16b / 32b
b2	Timed function 3	0 = Inactive. 1 = Active.	
b3…15	Reserved		
	0000h…FFFFh		1 / 1
34.111	Boost time activation source	Selects the source of extra time activation signal. 0 = Disabled. 1 = Enabled.	Off / uint32
	Off	0.	0
	On	1.	1
	DI1	Digital input DI1 (parameter 10.02 DI delayed status, bit 0).	2
	DI2	Digital input DI2 (parameter 10.02 DI delayed status, bit 1).	3
	DI3	Digital input DI3 (parameter 10.02 DI delayed status, bit 2).	4
	DI4	Digital input DI4 (parameter 10.02 DI delayed status, bit 3).	5
	DI5	Digital input DI5 (parameter 10.02 DI delayed status, bit 4).	6
	Other [bit]	See Terms and abbreviations (page 137).	-
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 parameter 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 / uint16
	00 00:00…07 00:00	Extra time duration.	1 = 1

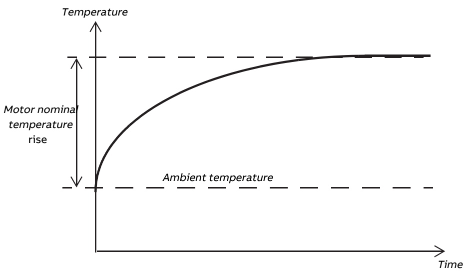
No.	Name / Range / Selection	Description	Def / Type FbEq 16b / 32b
35	Motor thermal protection	Motor thermal protection settings such as temperature measurement configuration, load curve definition and motor fan control configuration; motor overload protection. See also section Programmable protection functions (page 130).	
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 / 0 celsius / real32
	-60 / -76...1000 / 1832C	Estimated motor temperature.	1 = 1 °C / 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 / 0 / 0 celsius / real32
	-60 / -76 / 0 ... 5000 / 9032 / [35.12]C	Measured temperature 1.	1 = 1 °C / 1 = 1 °C
35.05	Motor overload level	Shows the motor overload level as a percent of the motor overload fault limit. See section Motor overload protection (page 112).	0.0 percent / real32
	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 % / 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 / uint32
	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 parameter 35.50 Motor ambient temperature.	1

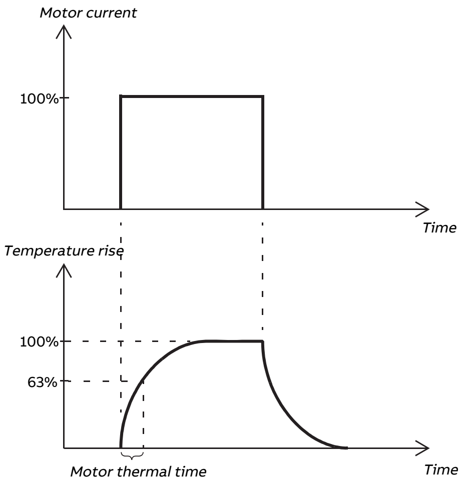
No.	Name / Range / Selection	Description	Def / Type FbEq 16b / 32b
	KTY84 analog I/O	KTY84 sensor connected to the analog input selected by parameter 35.14 Temperature 1 AI source and an analog output. The analog input can be from the standard I/O or from an extension module. The following settings are required: • Set the hardware jumper or switch related to the analog input to U (voltage). Any change must be validated by a control unit reboot. • Set the appropriate analog input unit selection parameter in parameter group 12 Standard AI (page 173) to V (volt). • In parameter group 13 Standard AO (page 179), 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
	1 x Pt100 analog I/O	Pt100 sensor connected to a standard analog input selected by parameter 35.14 Temperature 1 AI source and an analog output. The following settings are required: • Set the hardware jumper or switch related to the analog input to U (voltage). Any change must be validated by a control unit reboot. • Set the appropriate analog input unit selection parameter in parameter group 12 Standard AI (page 173) to V (volt). • In parameter group 13 Standard AO (page 179), set the source selection parameter of the analog output to Temp sensor 1 excitation. The analog output feeds a constant current through the sensor. As the resistance of the sensor increases along with its temperature, the voltage over the sensor increases. The voltage is read by the analog input and converted into degrees.	5
	2 x Pt100 analog I/O	As selection 1 x Pt100 analog I/O, but with two sensors connected in series. Using multiple sensors improves measurement accuracy significantly.	6
	3 x Pt100 analog I/O	As selection 1 x Pt100 analog I/O, but with three sensors connected in series. Using multiple sensors improves measurement accuracy significantly.	7

No.	Name / Range / Selection	Description	Def / Type FbEq 16b / 32b
	PTC analog I/O	PTC sensor connected to 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. **Note:** With this selection, the control program converts the analog signal to PTC resistance value in ohms and shows it in parameter 35.02 Measured temperature 1. The parameter name and unit still refer to temperature.	20
	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 appropriate analog input unit selection parameter in parameter group 12 Standard AI (page 173) to V (volt). • In parameter group 13 Standard AO (page 179), 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 x 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 appropriate analog input unit selection parameter in parameter group 12 Standard AI (page 173) to V (volt). • In parameter group 13 Standard AO (page 179), 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 x Pt1000 analog I/O	As selection 1 x Pt1000 analog I/O, but with two sensors connected in series. Using multiple sensors improves measurement accuracy significantly.	14
	3 x Pt1000 analog I/O	As selection 1 x Pt1000 analog I/O, but with three sensors connected in series. Using multiple sensors improves measurement accuracy significantly.	15

No.	Name / Range / Selection	Description	Def / Type FbEq 16b / 32b
	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 appropriate analog input unit selection parameter in parameter group 12 Standard AI (page 173) to V (volt). • In parameter group 13 Standard AO (page 179), 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
	Other [bit]	See Terms and abbreviations (page 137).	-
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.	130 / 266 celsius / real32
	-60 / -76...5000 / 9032C	Fault limit for temperature monitoring function 1.	1 = 1 °C / 1 = 1 °C
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.	110 / 230 °C or °F / real32
	-60 / -76...5000 / 9032 °C or °F	Warning limit for temperature monitoring function 1.	1 = 1 °C or °F / 1 = 1 °C or °F
35.14	Temperature 1 AI source	Specifies the analog input when the setting of parameter 35.11 Temperature 1 source requires measurement through an analog input. **Note:** If parameter 35.11 Temperature 1 source is set to Direct temperature, use selection Other here, and point to parameter 12.12 AI1 scaled value.	Not selected / uint32
	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 [bit]	Source selection (see Terms and abbreviations (page 137)).	-

No.	Name / Range / Selection	Description	Def / Type FbEq 16b / 32b
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 / 68 °C or °F / real32
	-60 / -76...100 / 212 °C or °F	Ambient temperature.	1 = 1 °C or °F / 1 = 1 °C or °F
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 and by the overload protection to specify the overload tripping level. 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 parameter 35.50 Motor ambient temperature. 	110 percent / uint16
	50...150 %	Maximum load for the motor load curve.	1 = 1 % / 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 percent / uint16

No.	Name / Range / Selection	Description	Def / Type FbEq 16b / 32b
	25...150 %	Zero speed load for the motor load curve.	1 = 1 % / 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 / uint16
	1.00 ... 500.00 Hz	Break point for the motor load curve. For scaling, see parameter 46.02 Frequency scaling.	10 = 1 Hz / 100 = 1 Hz
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 / 176 °C or °F / real32
	0 / 0...300 / 572 °C or °F	Temperature rise.	1 = 1 °C or °F / 1 = 1 °C or °F

No.	Name / Range / Selection	Description	Def / Type FbEq 16b / 32b
35.55	Motor thermal time constant	Defines the thermal time constant for use with the motor thermal protection model, defined as the time to reach 63% of the nominal motor temperature. See the motor manufacturer's recommendations. 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 / uint16
	100...10000 s	Motor thermal time constant.	1 = 1 s / 1 = 1 s
35.56	Motor overload action	Selects the action taken when the system detects the motor overload specified by parameter 35.57. See section Motor overload protection (page 112).	Warning and fault / uint16
	No action	No action taken.	0
	Warning only	Drive generates warning A783 Motor overload when the motor is overloaded to the warning level, that is, parameter 35.05 Motor overload level reaches value 88.0%.	1
	Warning and fault	Drive generates warning A783 Motor overload when the motor is overloaded to the warning level, that is, parameter 35.05 Motor overload level reaches value 88.0%. Drive trips on fault 7122 Motor overload when the motor is overloaded to the fault level, that is, parameter 35.05 Motor overload level reaches value 100.0%.	2

No.	Name / Range / Selection	Description	Def / Type FbEq 16b / 32b
35.57	Motor overload class	Defines the motor overload class to be used. The class of protection is specified by the user as the time for tripping at 7.2 times (IEC 60947-4-1) or 6 times (NEMA ICS) the tripping level current. See section Motor overload protection (page 112).	Class 20 / uint16
	Class 5	Motor overload class 5.	0
	Class 10	Motor overload class 10.	1
	Class 20	Motor overload class 20.	2
	Class 30	Motor overload class 30.	3
	Class 40	Motor overload class 40.	4

No.	Name / Range / Selection	Description	Def / Type FbEq 16b / 32b
36	Load analyzer	Peak value and amplitude logger settings. See also section Load analyzer (page 127).	
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 PVL reset date and 36.17 PVL reset time respectively.	Output power / uint32
	Not selected	None (peak value logger disabled).	0
	Motor speed used	Parameter 01.01 Motor speed used.	1
	Output frequency	Parameter 01.06 Output frequency.	3
	Motor current	Parameter 01.07 Motor current.	4
	Motor torque	Parameter 01.10 Motor torque.	6
	DC voltage	Parameter 01.11 DC voltage.	7
	Output power	Parameter 01.14 Output power.	8
	Speed ref ramp in	Parameter 23.01 Speed ref ramp input.	10
	Speed ref ramp out	Parameter 23.02 Speed ref ramp output.	11
	Speed ref used	Parameter 24.01 Used speed reference.	12
	Freq ref used	Parameter 28.02 Frequency ref ramp output.	14
	Process PID out	Parameter 40.01 Process PID output actual.	16
	Other [bit]	See Terms and abbreviations (page 137).	-
36.02	PVL filter time	Peak value logger filtering time. See parameter 36.01 PVL signal source.	2.00 s / real32
	0.00 … 120.00 s	Peak value logger filtering time.	100 = 1 s / 1 = 1 s

No.	Name / Range / Selection	Description	Def / Type FbEq 16b / 32b
36.06	AL2 signal source	Selects the signal to be monitored by amplitude logger 2. The signal is sampled at 200 ms intervals. The results are displayed by parameters 36.40…36.49. Each parameter represents an amplitude range, and shows what portion of the samples fall within that range. The signal value corresponding to 100% is defined by parameter 36.07 AL2 signal scaling. Amplitude logger 2 can be reset using parameter 36.09 Reset loggers. The logger is also reset whenever the signal. source or scaling is changed. The date and time of the last reset are stored into parameters 36.50 AL2 reset date and 36.51 AL2 reset time respectively. For the selections, see parameter 36.01 PVL signal source.	Motor torque / uint32
36.07	AL2 signal scaling	Defines the signal value that corresponds to 100% amplitude.	100.00 NoUnit / real32
	0.00 ... 32767.00	Signal value corresponding to 100%.	1 = 1 / 100 = 1
36.09	Reset loggers	Resets the peak value logger and/or amplitude logger 2. (Amplitude logger 1 cannot be reset.)	Done / uint16
	Done	Reset completed or not requested (normal operation).	0
	All	Reset both the peak value logger and amplitude logger 2.	1
	PVL	Reset the peak value logger.	2
	AL2	Reset amplitude logger 2.	3
36.10	PVL peak value	Peak value recorded by the peak value logger.	0.00 null / real32
	-32768.00 ... 32767.00	Peak value.	1 = 1 / 100 = 1
36.11	PVL peak date	The date on which the peak value was recorded.	0 / uint16
	-	Peak occurrence date.	1 = 1
36.12	PVL peak time	The time at which the peak value was recorded.	0 / uint32
	00:00:00…23:59:59	Peak occurrence time.	1 = 1
36.13	PVL current at peak	Motor current at the moment the peak value was recorded.	0.00 A / real32
	-32768.00 ... 32767.00 A	Motor current at peak.	1 = 1 A / 100 = 1 A
36.14	PVL DC voltage at peak	Voltage in the intermediate DC circuit of the drive at the moment the peak value was recorded.	0.00 V / real32
	0.00 ... 2000.00 V	DC voltage at peak.	10 = 1 V / 100 = 1 V
36.15	PVL speed at peak	Motor speed at the moment the peak value was recorded.	- / real32

No.	Name / Range / Selection	Description	Def / Type FbEq 16b / 32b
	-30000.00 ... 30000.00 rpm	Motor speed at peak. For scaling, see parameter 46.01 Speed scaling.	1 = 1 rpm / 1 = 1 rpm
36.16	PVL reset date	The date on which the peak value logger was last reset.	01.01.1980 / uint16
	-	Last reset date of the peak value logger.	1 = 1
36.17	PVL reset time	The time at which the peak value logger was last reset.	00:00:00 / uint32
	00:00:00…23:59:59	Last reset time of the peak value logger.	1 = 1
36.20	AL1 0 to 10%	Percentage of samples recorded by amplitude logger 1 that fall between 0 and 10%. 100% corresponds to the I_{max} value given in the ratings table in chapter Technical data in the *Hardware manual* of the drive.	0.00 percent / real32
	0.00 ... 100.00 %	Amplitude logger 1 samples between 0 and 10%.	1 = 1 % / 100 = 1 %
36.21	AL1 10 to 20%	Percentage of samples recorded by amplitude logger 1 that fall between 10 and 20%.	0.00 percent / real32
	0.00 ... 100.00 %	Amplitude logger 1 samples between 10 and 20%.	1 = 1 % / 100 = 1 %
36.22	AL1 20 to 30%	Percentage of samples recorded by amplitude logger 1 that fall between 20 and 30%.	0.00 percent / real32
	0.00 ... 100.00 %	Amplitude logger 1 samples between 20 and 30%.	1 = 1 % / 100 = 1 %
36.23	AL1 30 to 40%	Percentage of samples recorded by amplitude logger 1 that fall between 30 and 40%.	0.00 percent / real32
	0.00 ... 100.00 %	Amplitude logger 1 samples between 30 and 40%.	1 = 1 % / 100 = 1 %
36.24	AL1 40 to 50%	Percentage of samples recorded by amplitude logger 1 that fall between 40 and 50%.	0.00 percent / real32
	0.00 ... 100.00 %	Amplitude logger 1 samples between 40 and 50%.	1 = 1 % / 100 = 1 %
36.25	AL1 50 to 60%	Percentage of samples recorded by amplitude logger 1 that fall between 50 and 60%.	0.00 percent / real32
	0.00 ... 100.00 %	Amplitude logger 1 samples between 50 and 60%.	1 = 1 % / 100 = 1 %
36.26	AL1 60 to 70%	Percentage of samples recorded by amplitude logger 1 that fall between 60 and 70%.	0.00 percent / real32
	0.00 ... 100.00 %	Amplitude logger 1 samples between 60 and 70%.	1 = 1 % / 100 = 1 %
36.27	AL1 70 to 80%	Percentage of samples recorded by amplitude logger 1 that fall between 70 and 80%.	0.00 percent / real32
	0.00 ... 100.00 %	Amplitude logger 1 samples between 70 and 80%.	1 = 1 % / 100 = 1 %
36.28	AL1 80 to 90%	Percentage of samples recorded by amplitude logger 1 that fall between 80 and 90%.	0.00 percent / real32
	0.00 ... 100.00 %	Amplitude logger 1 samples between 80 and 90%.	1 = 1 % / 100 = 1 %
36.29	AL1 over 90%	Percentage of samples recorded by amplitude logger 1 that exceed 90%.	0.00 percent / real32
	0.00 ... 100.00 %	Amplitude logger 1 samples over 90%.	1 = 1 % / 100 = 1 %
36.40	AL2 0 to 10%	Percentage of samples recorded by amplitude logger 2 that fall between 0 and 10%.	0.00 percent / real32
	0.00 ... 100.00 %	Amplitude logger 2 samples between 0 and 10%.	1 = 1 % / 100 = 1 %

No.	Name / Range / Selection	Description	Def / Type FbEq 16b / 32b
36.41	AL2 10 to 20%	Percentage of samples recorded by amplitude logger 2 that fall between 10 and 20%.	0.00 percent / real32
	0.00 … 100.00 %	Amplitude logger 2 samples between 10 and 20%.	1 = 1 % / 100 = 1 %
36.42	AL2 20 to 30%	Percentage of samples recorded by amplitude logger 2 that fall between 20 and 30%.	0.00 percent / real32
	0.00 … 100.00 %	Amplitude logger 2 samples between 20 and 30%.	1 = 1 % / 100 = 1 %
36.43	AL2 30 to 40%	Percentage of samples recorded by amplitude logger 2 that fall between 30 and 40%.	0.00 percent / real32
	0.00 … 100.00 %	Amplitude logger 2 samples between 30 and 40%.	1 = 1 % / 100 = 1 %
36.44	AL2 40 to 50%	Percentage of samples recorded by amplitude logger 2 that fall between 40 and 50%.	0.00 percent / real32
	0.00 … 100.00 %	Amplitude logger 2 samples between 40 and 50%.	1 = 1 % / 100 = 1 %
36.45	AL2 50 to 60%	Percentage of samples recorded by amplitude logger 2 that fall between 50 and 60%.	0.00 percent / real32
	0.00 … 100.00 %	Amplitude logger 2 samples between 50 and 60%.	1 = 1 % / 100 = 1 %
36.46	AL2 60 to 70%	Percentage of samples recorded by amplitude logger 2 that fall between 60 and 70%.	0.00 percent / real32
	0.00 … 100.00 %	Amplitude logger 2 samples between 60 and 70%.	1 = 1 % / 100 = 1 %
36.47	AL2 70 to 80%	Percentage of samples recorded by amplitude logger 2 that fall between 70 and 80%.	0.00 percent / real32
	0.00 … 100.00 %	Amplitude logger 2 samples between 70 and 80%.	1 = 1 % / 100 = 1 %
36.48	AL2 80 to 90%	Percentage of samples recorded by amplitude logger 2 that fall between 80 and 90%.	0.00 percent / real32
	0.00 … 100.00 %	Amplitude logger 2 samples between 80 and 90%.	1 = 1 % / 100 = 1 %
36.49	AL2 over 90%	Percentage of samples recorded by amplitude logger 2 that exceed 90%.	0.00 percent / real32
	0.00 … 100.00 %	Amplitude logger 2 samples over 90%.	1 = 1 % / 100 = 1 %
36.50	AL2 reset date	The date on which amplitude logger 2 was last reset.	01.01.1980 / uint16
	-	Last reset date of amplitude logger 2.	1 = 1
36.51	AL2 reset time	The time at which amplitude logger 2 was last reset.	00:00:00 / uint32
	00:00:00…23:59:59	Last reset time of amplitude logger 2.	1 = 1

No.	Name / Range / Selection	Description	Def / Type FbEq 16b / 32b
37	User load curve	Settings for user load curve. See also section User load curve (page 125).	
37.01	ULC output status word	Displays the status of the monitored signal. The status is shown only while the drive is running. (The status word is independent of the actions and delays selected by parameters 37.03, 37.04, 37.41 and 37.42.) This parameter is read-only.	0000 0000 0000 0000 / uint16
b0	Under load limit	1 = Signal lower than the underload curve.	
b1	Within load range	1 = Signal between the underload and overload curve.	
b2	Over load limit	1 = Signal higher than the overload curve.	
b3	Outside load limit	1 = Signal lower than the underload curve or higher than the overload curve.	
b4…15	Reserved		
	0000h…FFFFh		1 / 1
37.02	ULC supervision signal	Selects the signal to be monitored. The function compares the absolute value of the signal against the load curve.	Motor torque % / uint32
	Not selected	No signal selected (monitoring disabled).	0
	Motor speed %	Parameter 01.03 Motor speed %.	1
	Motor current %	Parameter 01.08 Motor current % of motor nom.	2
	Motor torque %	Parameter 01.10 Motor torque.	3
	Output power % of motor nominal	Parameter 01.15 Output power % of motor nom.	4
	Other [bit]	Source selection (see Terms and abbreviations (page 137)).	-
37.03	ULC overload actions	Selects how the drive reacts if the absolute value of the monitored signal stays continuously above the overload curve for longer than the value of parameter 37.41 ULC overload timer.	Disabled / uint16
	Disabled	No action taken.	0
	Warning	The drive generates a warning (8002 ULC overload).	1
	Fault	The drive trips on 8002 ULC overload fault.	2
	Warning/Fault	The drive generates a warning (8002 ULC overload) if the signal stays continuously above the overload curve for half of the time defined by parameter 37.41 ULC overload timer. The drive trips on 8002 ULC overload fault if the signal stays continuously above the overload curve for a time defined by parameter 37.41 ULC overload timer.	3
37.04	ULC underload actions	Selects how the drive reacts if the absolute value of the monitored signal stays continuously above the overload curve for longer than the value of parameter 37.42 ULC underload timer.	Disabled / uint16

No.	Name / Range / Selection	Description	Def / Type FbEq 16b / 32b
	Disabled	No action taken.	0
	Warning	The drive generates a warning (A8BF ULC underload warning).	1
	Fault	The drive trips on 8001 ULC underload fault.	2
	Warning/Fault	The drive generates a warning (A8BF ULC underload warning) if the signal stays continuously below the underload curve for half of the time defined by parameter 37.41 ULC overload timer. The drive trips on 8001 ULC underload fault if the signal stays continuously below the underload curve for a time defined by parameter 37.42 ULC underload timer.	3
37.11	ULC speed table point 1	Defines the first of the five speed points on the X-axis of the user load curve. Speed points are used if parameter 99.04 Motor control mode is set to Vector or if parameter 99.04 Motor control mode is set to Scalar and the reference unit is rpm. The five points must be in order from lowest to highest. The points are defined as positive values, but the range is symmetrically effective also in the negative direction. The monitoring is not active outside these two areas.	150.0 rpm / real32
	-30000.0 ... 30000.0 rpm	Speed.	1 = 1 rpm / 10 = 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 / real32
	-30000.0 ... 30000.0 rpm	Speed.	1 = 1 rpm / 10 = 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 / real32
	-30000.0 ... 30000.0 rpm	Speed.	1 = 1 rpm / 10 = 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 / real32
	-30000.0 ... 30000.0 rpm	Speed.	1 = 1 rpm / 10 = 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 / real32
	-30000.0 ... 30000.0 rpm	Speed.	1 = 1 rpm / 10 = 1 rpm

No.	Name / Range / Selection	Description	Def / Type FbEq 16b / 32b
37.16	ULC frequency table point 1	Defines the first of the five frequency points on the X-axis of the user load curve. Frequency points are used if parameter 99.04 Motor control mode is set to Scalar and the reference unit is Hz. The five points must be in order from lowest to highest. The points are defined as positive values, but the range is symmetrically effective also in the negative direction. The monitoring is not active outside these two areas.	5.0 Hz / real32
	-500.0 ... 500.0 Hz	Frequency.	1 = 1 Hz / 10 = 1 Hz
37.17	ULC frequency table point 2	Defines the second frequency point. See parameter 37.16 ULC frequency table point 1.	25.0 Hz / real32
	-500.0 ... 500.0 Hz	Frequency.	1 = 1 Hz / 10 = 1 Hz
37.18	ULC frequency table point 3	Defines the third frequency point. See parameter 37.16 ULC frequency table point 1.	43.0 Hz / real32
	-500.0 ... 500.0 Hz	Frequency.	1 = 1 Hz / 10 = 1 Hz
37.19	ULC frequency table point 4	Defines the fourth frequency point. See parameter 37.16 ULC frequency table point 1.	50.0 Hz / real32
	-500.0 ... 500.0 Hz	Frequency.	1 = 1 Hz / 10 = 1 Hz
37.20	ULC frequency table point 5	Defines the fifth frequency point. See parameter 37.16 ULC frequency table point 1.	60.0 Hz / real32
	-500.0 ... 500.0 Hz	Frequency.	1 = 1 Hz / 10 = 1 Hz
37.21	ULC underload point 1	Defines the first of the five points on the Y-axis that together with the corresponding point on the X-axis (37.11 ULC speed table point 1…37.15 ULC speed table point 5 or 37.15 ULC speed table point 5…37.20 ULC frequency table point 5) define the underload (lower) curve. Each point of the underload curve must have a lower value than the corresponding overload point.	10.0 percent / real32
	-1600.0 ... 1600.0 %	Underload point.	1 = 1 % / 10 = 1 %
37.22	ULC underload point 2	Defines the second underload point. See parameter 37.21 ULC underload point 1.	15.0 percent / real32
	-1600.0 ... 1600.0 %	Underload point.	1 = 1 % / 10 = 1 %
37.23	ULC underload point 3	Defines the third underload point. See parameter 37.21 ULC underload point 1.	25.0 percent / real32
	-1600.0 ... 1600.0 %	Underload point.	1 = 1 % / 10 = 1 %
37.24	ULC underload point 4	Defines the fourth underload point. See parameter 37.21 ULC underload point 1.	30.0 percent / real32
	-1600.0 ... 1600.0 %	Underload point.	1 = 1 % / 10 = 1 %

No.	Name / Range / Selection	Description	Def / Type FbEq 16b / 32b
37.25	ULC underload point 5	Defines the fifth underload point. See parameter 37.21 ULC underload point 1.	30.0 percent / real32
	-1600.0 ... 1600.0 %	Underload point.	1 = 1 % / 10 = 1 %
37.31	ULC overload point 1	Defines the first of the five points on the Y-axis that together with the corresponding point on the X-axis (37.11 ULC speed table point 1…37.15 ULC speed table point 5 or 37.15 ULC speed table point 5…37.20 ULC frequency table point 5) define the overload (higher) curve. Each point of the overload curve must have a higher value than the corresponding underload point.	300.0 percent / real32
	-1600.0 ... 1600.0 %	Overload point.	1 = 1 % / 10 = 1 %
37.32	ULC overload point 2	Defines the second overload point. See parameter 37.31 ULC overload point 1.	300.0 percent / real32
	-1600.0 ... 1600.0 %	Overload point.	1 = 1 % / 10 = 1 %
37.33	ULC overload point 3	Defines the third overload point. See parameter 37.31 ULC overload point 1.	300.0 percent / real32
	-1600.0 ... 1600.0 %	Overload point.	1 = 1 % / 10 = 1 %
37.34	ULC overload point 4	Defines the fourth overload point. See parameter 37.31 ULC overload point 1.	300.0 percent / real32
	-1600.0 ... 1600.0 %	Overload point.	1 = 1 % / 10 = 1 %
37.35	ULC overload point 5	Defines the fifth overload point. See parameter 37.31 ULC overload point 1.	300.0 percent / real32
	-1600.0 ... 1600.0 %	Overload point.	1 = 1 % / 10 = 1 %
37.41	ULC overload timer	Defines the time for which the monitored signal must continuously stay above the overload curve before the drive takes the action selected by parameter 37.03 ULC overload actions.	20.0 s / real32
	0.0 ... 10000.0 s	Overload timer.	1 = 1 s / 10 = 1 s
37.42	ULC underload timer	Defines the time for which the monitored signal must continuously stay below the underload curve before the drive takes the action selected by parameter 37.04 ULC underload actions.	20.0 s / real32
	0.0 ... 10000.0 s	Underload timer.	1 = 1 s / 10 = 1 s

No.	Name / Range / Selection	Description	Def / Type FbEq 16b / 32b
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 parameter group 41 Process PID set 2 (page 331). The binary source that defines which set is used is selected by parameter 40.57 PID set1/set2 selection. See also the PID control chain diagrams in chapter Control chain diagrams (page 509).	
40.01	Process PID output actual	Displays the output of the process PID controller. See the control chain diagram Process PID controller (page 518). This parameter is read-only.	0.00 percent / real32
	-200000.00 ... 200000.00 %	Process PID controller output.	1 = 1 % / 100 = 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. This parameter is read-only.	0.00 Set 1 units / real32
	-200000.00 ... 200000.00 Set 1 units	Process feedback.	1 = 1 Set 1 units / 100 = 1 Set 1 units
40.03	Process PID setpoint actual	Displays the value of process PID setpoint after source selection, mathematical function (parameter 40.18 Set 1 setpoint function), limitation and ramping. This parameter is read-only.	0.00 Set 1 units / real32
	-200000.00 ... 200000.00 Set 1 units	Setpoint for process PID controller.	1 = 1 Set 1 units / 100 = 1 Set 1 units
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 Process PID controller (page 518). This parameter is read-only.	0.00 Set 1 units / real32
	-200000.00 ... 200000.00 Set 1 units	PID deviation.	1 = 1 Set 1 units / 100 = 1 Set 1 units
40.06	Process PID status word	Displays status information on process PID control. This parameter is read-only.	0000 0000 0000 0000 / uint16
b0	PID active	1 = Process PID control active.	
b1	Setpoint frozen	1 = Process PID setpoint frozen.	

No.	Name / Range / Selection	Description	Def / Type FbEq 16b / 32b
b2	Output frozen	1 = Process PID controller output frozen.	
b3	PID sleep mode	1 = Sleep mode active.	
b4	Sleep boost	1 = Sleep boost active.	
b5	Trim mode	1 = Trim mode active.	
b6	Tracking mode	1 = Tracking function active.	
b7	Output limit high	1 = PID output is being limited by parameter 40.37 Set 1 output max.	
b8	Output limit low	1 = PID output is being limited by parameter 40.36 Set 1 output min.	
b9	Deadband active	1 = Deadband active (see parameter 40.39 Set 1 deadband range).	
b10	PID set	0 = Parameter set 1 in use. 1 = Parameter set 2 in use.	
b11	Reserved		
b12	Internal setpoint active	1 = Internal setpoint active (see parameters 40.16…40.23).	
b13…15	Reserved		
	0000h…FFFFh		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 39).	Off / uint16
	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.	AI2 percent / uint32
	Not selected	None.	0
	AI1 scaled	Parameter 12.12 AI1 scaled value.	1
	AI2 scaled	Parameter 12.22 AI2 scaled value.	2
	Freq in scaled	Parameter 11.39 Freq in 1 scaled value.	3
	AI1 percent	Parameter 12.101 AI1 percent value.	8
	AI2 percent	Parameter 12.102 AI2 percent value.	9
	Feedback data storage	Parameter 40.91 Feedback data storage.	10
	Other [bit]	Source selection (see Terms and abbreviations (page 137)).	-

No.	Name / Range / Selection	Description	Def / Type FbEq 16b / 32b
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 / uint32
40.10	Set 1 feedback function	Defines how process feedback is calculated from the two feedback sources selected by parameters 40.08 Set 1 feedback 1 source and 40.09 Set 1 feedback 2 source. The result of the function (for any selection) is multiplied by parameter 40.90 Set 1 feedback multiplier. (That is why in selections 12 and 13, the multiplier k is constant 1.)	In1 / uint16
	In1	Source 1.	0
	In1+In2	Sum of sources 1 and 2.	1
	In1-In2	Source 2 subtracted from source 1.	2
	In1*In2	Source 1 multiplied by source 2.	3
	In1/In2	Source 1 divided by source 2.	4
	MIN(In1,In2)	Smaller of the two sources.	5
	MAX(In1,In2)	Greater of the two sources.	6
	AVE(In1,In2)	Average of the two sources.	7
	sqrt(In1)	Square root of source 1.	8
	sqrt(In1-In2)	Square root of (source 1 - source 2).	9
	sqrt(In1+In2)	Square root of (source 1 + source 2).	10
	sqrt(In1)+sqrt(In2)	Square root of source 1 + square root of source 2.	11
40.11	Set 1 feedback filter time	Defines the filter time constant for process feedback.	0.000 s / real32
	0.000 … 30.000 s	Feedback filter time.	1 = 1 s / 1000 = 1 s

<table>
<tr><th>No.</th><th>Name / Range / Selection</th><th>Description</th><th>Def / Type
FbEq 16b / 32b</th></tr>
<tr><td>40.14</td><td>Set 1 setpoint scaling</td><td>Defines, together with parameter 40.15 Set 1 output scaling, a general scaling factor for the process PID control chain.

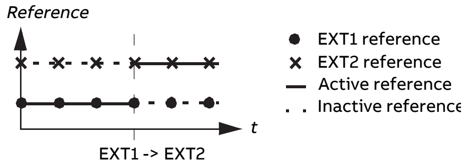
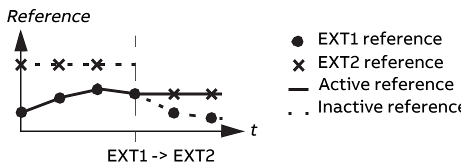
If the parameter is set to zero, automatic setpoint scaling is activated, where suitable setpoint scale is calculated according to selected setpoint source. Actual setpoint scale is shown in parameter 40.61 Setpoint scaling actual.

The scaling can be utilized when, for example, the process setpoint is input in Hz, and the output of the PID controller is used as an rpm value in speed control. In this case, this parameter might be set to 50, and parameter 40.15 to the nominal motor speed at 50 Hz.

In effect, the output of the PID controller = [40.15] when deviation (setpoint - feedback) = [40.14] and [40.32] = 1.

Note: The scaling is based on the ratio between 40.14 and 40.15. For example, the values 50 and 1500 would produce the same scaling as 1 and 30.</td><td>0.00 NoUnit / real32</td></tr>
<tr><td></td><td>-200000.00 ... 200000.00</td><td>Scaling.</td><td>1 = 1 / 100 = 1</td></tr>
<tr><td>40.15</td><td>Set 1 output scaling</td><td>See parameter 40.14 Set 1 setpoint scaling.

If the parameter is set to zero, scaling is automatic, and according to column Scaling:
<table><tr><th>Operation mode
(see par. 19.01)</th><th>Scaling</th></tr><tr><td>Speed control</td><td>40.01 Process PID output actual</td></tr><tr><td>Frequency control</td><td>40.02 Process PID feedback actual</td></tr></table></td><td>0.00 NoUnit / real32</td></tr>
<tr><td></td><td>-200000.00 ... 200000.00</td><td>Process PID controller output base.</td><td>1 = 1 / 100 = 1</td></tr>
<tr><td>40.16</td><td>Set 1 setpoint 1 source</td><td>Selects the primary source of process PID setpoint. See chapter Control chain diagrams (page 509).</td><td>Internal setpoint / uint32</td></tr>
<tr><td></td><td>Not selected</td><td>None.</td><td>0</td></tr>
<tr><td></td><td>Internal setpoint</td><td>Internal setpoint. See parameter 40.19 Set 1 internal setpoint sel1.</td><td>2</td></tr>
<tr><td></td><td>AI1 scaled</td><td>Parameter 12.12 AI1 scaled value.</td><td>3</td></tr>
<tr><td></td><td>AI2 scaled</td><td>Parameter 12.22 AI2 scaled value.</td><td>4</td></tr>
<tr><td></td><td>Motor potentiometer</td><td>Parameter 22.80 Motor potentiometer ref act (output of the Floating point control (Motor potentiometer)).</td><td>8</td></tr>
<tr><td></td><td>Freq in scaled</td><td>Parameter 11.39 Freq in 1 scaled value.</td><td>10</td></tr>
<tr><td></td><td>AI1 percent</td><td>Parameter 12.101 AI1 percent value.</td><td>11</td></tr>
<tr><td></td><td>AI2 percent</td><td>Parameter 12.102 AI2 percent value.</td><td>12</td></tr>
</table>

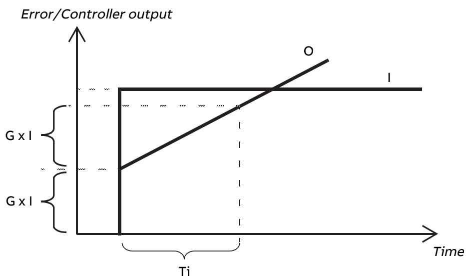
No.	Name / Range / Selection	Description	Def / Type FbEq 16b / 32b
	Control panel (ref saved)	Control panel reference (parameter 03.01 Panel reference) saved by the control system for the location where the control returns is used as the reference.  	13
	Control panel (ref copied)	Control panel reference (parameter 03.01 Panel reference) for the previous control location is used as the reference when the control location changes if the references for the two locations are of the same type (for example, frequency/speed/torque/PID); otherwise, the actual signal is used as the new reference  	14
	EFB ref1	Parameter 03.09 EFB reference 1.	19
	EFB ref2	Parameter 03.10 EFB reference 2.	20
	Setpoint data storage	Parameter 40.92 Setpoint data storage.	24
	Compensated setpoint	Parameter 40.70 Compensated setpoint.	25
	Integrated panel (ref saved)	See above Control panel (ref saved).	26
	Integrated panel (ref copied)	See above Control panel (ref copied).	27
	Other [bit]	See Terms and abbreviations (page 137).	-
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 / uint32
40.18	Set 1 setpoint function	Selects a function between the setpoint sources selected by parameters 40.16 Set 1 setpoint 1 source and 40.17 Set 1 setpoint 2 source. The result of the function (for any selection) is multiplied by parameter 40.89 Set 1 setpoint multiplier.	In1 / uint16
	In1	Source 1.	0

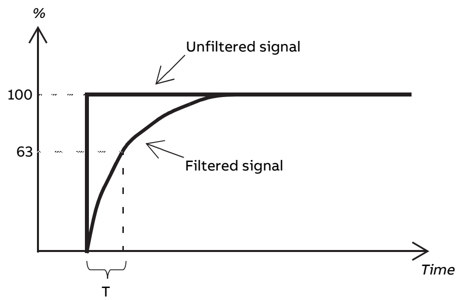
<table>
<tr><th>No.</th><th>Name / Range / Selection</th><th>Description</th><th>Def / Type
FbEq 16b / 32b</th></tr>
<tr><td></td><td>In1+In2</td><td>Sum of sources 1 and 2.</td><td>1</td></tr>
<tr><td></td><td>In1-In2</td><td>Source 2 subtracted from source 1.</td><td>2</td></tr>
<tr><td></td><td>In1*In2</td><td>Source 1 multiplied by source 2.</td><td>3</td></tr>
<tr><td></td><td>In1/In2</td><td>Source 1 divided by source 2.</td><td>4</td></tr>
<tr><td></td><td>MIN(In1,In2)</td><td>Smaller of the two sources.</td><td>5</td></tr>
<tr><td></td><td>MAX(In1,In2)</td><td>Greater of the two sources.</td><td>6</td></tr>
<tr><td></td><td>AVE(In1,In2)</td><td>Average of the two sources.</td><td>7</td></tr>
<tr><td></td><td>sqrt(In1)</td><td>Square root of source 1.</td><td>8</td></tr>
<tr><td></td><td>sqrt(In1-In2)</td><td>Square root of (source 1 - source 2).</td><td>9</td></tr>
<tr><td></td><td>sqrt(In1+In2)</td><td>Square root of (source 1 + source 2).</td><td>10</td></tr>
<tr><td></td><td>sqrt(In1)+sqrt(In2)</td><td>Square root of source 1 + square root of source 2.</td><td>11</td></tr>
<tr><td>40.19</td><td>Set 1 internal setpoint sel1</td><td>Selects together with parameter 40.20 Set 1 internal setpoint sel2 the internal setpoint out of the presets defined by parameters 40.21…40.24.

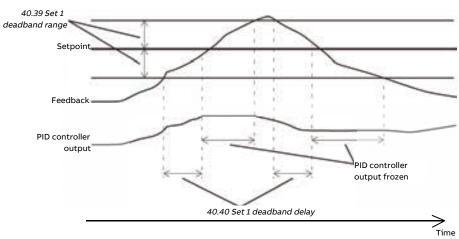
Note: Parameters 40.16 Set 1 setpoint 1 source and 40.17 Set 1 setpoint 2 source must be set to Internal setpoint.
<table>
<tr><th>Source defined by par. 40.19</th><th>Source defined by par. 40.20</th><th>Setpoint preset active</th></tr>
<tr><td>0</td><td>0</td><td>0 (par. 40.24)</td></tr>
<tr><td>1</td><td>0</td><td>1 (par. 40.21)</td></tr>
<tr><td>0</td><td>1</td><td>2 (par. 40.22)</td></tr>
<tr><td>1</td><td>1</td><td>3 (par. 40.23)</td></tr>
</table></td><td>Not selected / uint32</td></tr>
<tr><td></td><td>Not selected</td><td>0.</td><td>0</td></tr>
<tr><td></td><td>Selected</td><td>1.</td><td>1</td></tr>
<tr><td></td><td>DI1</td><td>Digital input DI1 (parameter 10.02 DI delayed status, bit 0).</td><td>2</td></tr>
<tr><td></td><td>DI2</td><td>Digital input DI2 (parameter 10.02 DI delayed status, bit 1).</td><td>3</td></tr>
<tr><td></td><td>DI3</td><td>Digital input DI3 (parameter 10.02 DI delayed status, bit 2).</td><td>4</td></tr>
<tr><td></td><td>DI4</td><td>Digital input DI4 (parameter 10.02 DI delayed status, bit 3).</td><td>5</td></tr>
<tr><td></td><td>DI5</td><td>Digital input DI5 (parameter 10.02 DI delayed status, bit 4).</td><td>6</td></tr>
<tr><td></td><td>Timed function 1</td><td>Bit 0 of parameter 34.01 Timed functions status.</td><td>18</td></tr>
<tr><td></td><td>Timed function 2</td><td>Bit 1 of parameter 34.01 Timed functions status.</td><td>19</td></tr>
<tr><td></td><td>Timed function 3</td><td>Bit 2 of parameter 34.01 Timed functions status.</td><td>20</td></tr>
<tr><td></td><td>Supervision 1</td><td>Bit 0 of parameter 32.01 Supervision status.</td><td>21</td></tr>
<tr><td></td><td>Supervision 2</td><td>Bit 1 of parameter 32.01 Supervision status.</td><td>22</td></tr>
</table>

No.	Name / Range / Selection	Description	Def / Type FbEq 16b / 32b
	Supervision 3	Bit 2 of parameter 32.01 Supervision status.	23
	Other [bit]	See Terms and abbreviations (page 137).	-
40.20	Set 1 internal set-point sel2	Selects together with parameter 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 parameter 40.19 Set 1 internal setpoint sel1.	Not selected / uint32
	Not selected	0.	0
	Selected	1.	1
	DI1	Digital input DI1 (parameter 10.02 DI delayed status, bit 0).	2
	DI2	Digital input DI2 (parameter 10.02 DI delayed status, bit 1).	3
	DI3	Digital input DI3 (parameter 10.02 DI delayed status, bit 2).	4
	DI4	Digital input DI4 (parameter 10.02 DI delayed status, bit 3).	5
	DI5	Digital input DI5 (parameter 10.02 DI delayed status, bit 4).	6
	Timed function 1	Bit 0 of parameter 34.01 Timed functions status.	18
	Timed function 2	Bit 1 of parameter 34.01 Timed functions status.	19
	Timed function 3	Bit 2 of parameter 34.01 Timed functions status.	20
	Supervision 1	Bit 0 of parameter 32.01 Supervision status.	21
	Supervision 2	Bit 1 of parameter 32.01 Supervision status.	22
	Supervision 3	Bit 2 of parameter 32.01 Supervision status.	23
	Other [bit]	See Terms and abbreviations (page 137).	-
40.21	Set 1 internal set-point 1	Internal process setpoint 1. See parameter 40.19 Set 1 internal setpoint sel1.	0.00 Set 1 units / real32
	-200000.00 ... 200000.00 Set 1 units	Internal process setpoint 1.	1 = 1 Set 1 units / 100 = 1 Set 1 units
40.22	Set 1 internal set-point 2	Internal process setpoint 2. See parameter 40.19 Set 1 internal setpoint sel1.	- / real32
	-200000.00 ... 200000.00 Set 1 units	Internal process setpoint 2.	1 = 1 Set 1 units / 100 = 1 Set 1 units
40.23	Set 1 internal set-point 3	Internal process setpoint 3. See parameter 40.19 Set 1 internal setpoint sel1.	- / real32
	-200000.00 ... 200000.00 Set 1 units	Internal process setpoint 3.	1 = 1 Set 1 units / 100 = 1 Set 1 units
40.24	Set 1 internal set-point 0	Internal process setpoint 0. See parameter 40.19 Set 1 internal setpoint sel1.	- / real32

No.	Name / Range / Selection	Description	Def / Type FbEq 16b / 32b
	-200000.00 ... 200000.00 Set 1 units	Internal process setpoint 0.	1 = 1 Set 1 units / 100 = 1 Set 1 units
40.26	Set 1 setpoint min	Defines a minimum limit for the process PID controller setpoint.	0.00 Set 1 units / real32
	-200000.00 ... 200000.00 Set 1 units	Minimum limit for process PID controller setpoint.	1 = 1 Set 1 units / 100 = 1 Set 1 units
40.27	Set 1 setpoint max	Defines a maximum limit for the process PID controller setpoint.	200000.00 Set 1 units / real32
	-200000.00 ... 200000.00 Set 1 units	Maximum limit for process PID controller setpoint.	1 = 1 Set 1 units / 100 = 1 Set 1 units
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 / real32
	0.0 ... 1800.0 s	Setpoint increase time.	1 = 1 s / 10 = 1 s
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 / real32
	0.0 ... 1800.0 s	Setpoint decrease time.	1 = 1 s / 10 = 1 s
40.30	Set 1 setpoint freeze enable	Freezes, or defines a source that can be used to freeze, the setpoint of the process PID controller. This feature is useful when the reference is based on a process feedback connected to an analog input, and the sensor must be serviced without stopping the process. 1 = Process PID controller setpoint frozen. See also parameter 40.38 Set 1 output freeze enable.	Not selected / uint32
	Not selected	Process PID controller setpoint not frozen.	0
	Selected	Process PID controller setpoint frozen.	1
	DI1	Digital input DI1 (parameter 10.02 DI delayed status, bit 0).	2
	DI2	Digital input DI2 (parameter 10.02 DI delayed status, bit 1).	3
	DI3	Digital input DI3 (parameter 10.02 DI delayed status, bit 2).	4
	DI4	Digital input DI4 (parameter 10.02 DI delayed status, bit 3).	5
	DI5	Digital input DI5 (parameter 10.02 DI delayed status, bit 4).	6
	DI6	Digital input DI6 (parameter 10.02 DI delayed status, bit 5).	7
	Timed function 1	Bit 0 of parameter 34.01 Timed functions status.	18
	Timed function 2	Bit 1 of parameter 34.01 Timed functions status.	19
	Timed function 3	Bit 2 of parameter 34.01 Timed functions status.	20
	Supervision 1	Bit 0 of parameter 32.01 Supervision status.	21

No.	Name / Range / Selection	Description	Def / Type FbEq 16b / 32b
	Supervision 2	Bit 1 of parameter 32.01 Supervision status.	22
	Supervision 3	Bit 2 of parameter 32.01 Supervision status.	23
	Other [bit]	See Terms and abbreviations (page 137).	-
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 82).	Not inverted (Ref - Fbk) / uint32
	Not inverted (Ref - Fbk)	0.	0
	Inverted (Fbk - Ref)	1.	1
	Other [bit]	See Terms and abbreviations (page 137).	-
40.32	Set 1 gain	Defines the gain for the process PID controller. See parameter 40.33 Set 1 integration time.	1.00 NoUnit / real32
	0.01 … 100.00	Gain for PID controller.	100 = 1 / 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.	10.0 s / real32
	0.0 … 9999.0 s	Integration time.	1 = 1 s / 10 = 1 s

No.	Name / Range / Selection	Description	Def / Type FbEq 16b / 32b
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 / real32
	0.000 … 10.000 s	Derivation time.	1000 = 1 s / 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 / real32
	0.0 … 10.0 s	Filter time constant.	10 = 1 s / 10 = 1 s
40.36	Set 1 output min	Defines the minimum limit for the process PID controller output. Using the minimum and maximum limits, it is possible to restrict the operation range.	0.00 percent / real32
	-200000.00 … 200000.00 %	Minimum limit for process PID controller output.	1 = 1 % / 100 = 1 %
40.37	Set 1 output max	Defines the maximum limit for the process PID controller output. See parameter 40.36 Set 1 output min.	100.00 percent / real32
	-200000.00 … 200000.00 %	Maximum limit for process PID controller output.	1 = 1 % / 100 = 1 %

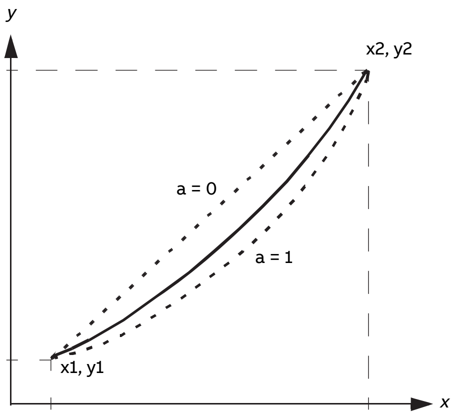
No.	Name / Range / Selection	Description	Def / Type FbEq 16b / 32b
40.38	Set 1 output freeze enable	Freezes (or defines a source that can be used to freeze) the output of the process PID controller, keeping the output at the value it was before freeze was enabled. This feature can be used when, for example, a sensor providing process feedback must to be serviced without stopping the process. 1 = Process PID controller output frozen. See also parameter 40.30 Set 1 setpoint freeze enable.	Not selected / uint32
	Not selected	Process PID controller output not frozen.	0
	Selected	Process PID controller output frozen.	1
	DI1	Digital input DI1 (parameter 10.02 DI delayed status, bit 0).	2
	DI2	Digital input DI2 (parameter 10.02 DI delayed status, bit 1).	3
	DI3	Digital input DI3 (parameter 10.02 DI delayed status, bit 2).	4
	DI4	Digital input DI4 (parameter 10.02 DI delayed status, bit 3).	5
	DI5	Digital input DI5 (parameter 10.02 DI delayed status, bit 4).	6
	Timed function 1	Bit 0 of parameter 34.01 Timed functions status.	18
	Timed function 2	Bit 1 of parameter 34.01 Timed functions status.	19
	Timed function 3	Bit 2 of parameter 34.01 Timed functions status.	20
	Supervision 1	Bit 0 of parameter 32.01 Supervision status.	21
	Supervision 2	Bit 1 of parameter 32.01 Supervision status.	22
	Supervision 3	Bit 2 of parameter 32.01 Supervision status.	23
	Other [bit]	See Terms and abbreviations (page 137).	-
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 (parameter 40.40 Set 1 deadband delay), the PID controller output is frozen. Normal operation resumes after the feedback value leaves the deadband.  	0.00 Set 1 units / real32

No.	Name / Range / Selection	Description	Def / Type FbEq 16b / 32b
	0.00 … 200000.00 Set 1 units	Deadband range.	1 = 1 Set 1 units / 100 = 1 Set 1 units
40.40	Set 1 deadband delay	Delay for the deadband. See parameter 40.39 Set 1 deadband range.	0.0 s / real32
	0.0 … 3600.0 s	Delay for deadband area.	1 = 1 s / 10 = 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 parameter 40.44 Set 1 sleep delay, the drive enters the sleep mode and stops the motor.	0.0 percent / real32
	0.0 … 200000.0 %	Sleep start level.	1 = 1 % / 10 = 1 %
40.44	Set 1 sleep delay	Defines a delay before the sleep function actually becomes enabled, to prevent nuisance sleeping. The delay timer starts when the sleep mode is enabled by parameter 40.43 Set 1 sleep level, and resets when the sleep mode is disabled.	60.0 s / real32
	0.0 … 3600.0 s	Sleep start delay.	1 = 1 s / 10 = 1 s
40.45	Set 1 sleep boost time	Defines a boost time for the sleep boost step. See parameter 40.46 Set 1 sleep boost step.	0.0 s / real32
	0.0 … 3600.0 s	Sleep boost time.	1 = 1 s / 10 = 1 s
40.46	Set 1 sleep boost step	When the drive is entering sleep mode, the process setpoint is increased by this value for the time defined by parameter 40.45 Set 1 sleep boost time. If active, sleep boost is aborted when the drive wakes up.	0.00 Set 1 units / real32
	0.00 … 200000.00 Set 1 units	Sleep boost step.	1 = 1 Set 1 units / 100 = 1 Set 1 units
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 (parameter 40.48 Set 1 wake-up delay), the drive wakes up. See also parameter 40.31 Set 1 deviation inversion.	- / real32
	-200000.00 … 200000.00 Set 1 units	Wake-up level (as deviation between process setpoint and feedback).	1 = 1 Set 1 units / 100 = 1 Set 1 units

No.	Name / Range / Selection	Description	Def / Type FbEq 16b / 32b
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 (parameter 40.47 Set 1 wake-up deviation), and resets if the deviation falls below the wake-up level.	0.50 s / real32
	0.00 ... 60.00 s	Wake-up delay.	1 = 1 s / 100 = 1 s
40.49	Set 1 tracking mode	Activates (or selects a source that activates) tracking mode. In tracking mode, the value selected by parameter 40.50 Set 1 tracking ref selection is substituted for the PID controller output. See also section Tracking (page 83). 1 = Tracking mode enabled.	Not selected / uint32
	Not selected	0.	0
	Selected	1.	1
	DI1	Digital input DI1 (parameter 10.02 DI delayed status, bit 0).	2
	DI2	Digital input DI2 (parameter 10.02 DI delayed status, bit 1).	3
	DI3	Digital input DI3 (parameter 10.02 DI delayed status, bit 2).	4
	DI4	Digital input DI4 (parameter 10.02 DI delayed status, bit 3).	5
	DI5	Digital input DI5 (parameter 10.02 DI delayed status, bit 4).	6
	Timed function 1	Bit 0 of parameter 34.01 Timed functions status.	18
	Timed function 2	Bit 1 of parameter 34.01 Timed functions status.	19
	Timed function 3	Bit 2 of parameter 34.01 Timed functions status.	20
	Supervision 1	Bit 0 of parameter 32.01 Supervision status.	21
	Supervision 2	Bit 1 of parameter 32.01 Supervision status.	22
	Supervision 3	Bit 2 of parameter 32.01 Supervision status.	23
	Other [bit]	See Terms and abbreviations (page 137).	-
40.50	Set 1 tracking ref selection	Selects the value source for tracking mode. See parameter 40.49 Set 1 tracking mode.	Not selected / uint32
	Not selected	None.	0
	AI1 scaled	Parameter 12.12 AI1 scaled value.	1
	AI2 scaled	Parameter 12.22 AI2 scaled value.	2
	Other [bit]	See Terms and abbreviations (page 137).	-
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 (parameter group 41 Process PID set 2 (page 331)) is used.	PID set 1 / uint32

No.	Name / Range / Selection	Description	Def / Type FbEq 16b / 32b
	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 (parameter 10.02 DI delayed status, bit 0).	2
	DI2	Digital input DI2 (parameter 10.02 DI delayed status, bit 1).	3
	DI3	Digital input DI3 (parameter 10.02 DI delayed status, bit 2).	4
	DI4	Digital input DI4 (parameter 10.02 DI delayed status, bit 3).	5
	DI5	Digital input DI5 (parameter 10.02 DI delayed status, bit 4).	6
	Timed function 1	Bit 0 of parameter 34.01 Timed functions status.	18
	Timed function 2	Bit 1 of parameter 34.01 Timed functions status.	19
	Timed function 3	Bit 2 of parameter 34.01 Timed functions status.	20
	Supervision 1	Bit 0 of parameter 32.01 Supervision status.	21
	Supervision 2	Bit 1 of parameter 32.01 Supervision status.	22
	Supervision 3	Bit 2 of parameter 32.01 Supervision status.	23
	Other [bit]	See Terms and abbreviations (page 137).	-
40.58	Set 1 increase prevention	Prevention of PID integration term increase for PID set 1.	No / uint32
	No	Increase prevention not in use.	0
	Limiting	The PID integration term is not increased if the maximum value for the PID output is reached. This parameter is valid for the PID set 1.	1
	Other [bit]	See Terms and abbreviations (page 137).	-
40.59	Set 1 decrease prevention	Prevention of PID integration term decrease for PID set 1.	No / uint32
	No	Decrease prevention not in use.	0
	Limiting	The PID integration term is not decreased if the minimum value for the PID output is reached. This parameter is valid for the PID set 1.	1
	Other [bit]	See Terms and abbreviations (page 137).	-
40.60	Set 1 PID activation source	Selects a source that enables/disables process PID control. See also parameter 40.07 Process PID operation mode. 0 = Process PID control disabled. 1 = Process PID control enabled.	On / uint32
	Off	0.	0
	On	1.	1

No.	Name / Range / Selection	Description	Def / Type FbEq 16b / 32b
	Follow Ext1/Ext2 selection	Process PID control is disabled when external control location EXT1 is active, and enabled when external control location EXT2 is active. See also parameter 19.11 Ext1/Ext2 selection.	2
	DI1	Digital input DI1 (parameter 10.02 DI delayed status, bit 0).	3
	DI2	Digital input DI2 (parameter 10.02 DI delayed status, bit 1).	4
	DI3	Digital input DI3 (parameter 10.02 DI delayed status, bit 2).	5
	DI4	Digital input DI4 (parameter 10.02 DI delayed status, bit 3).	6
	DI5	Digital input DI5 (parameter 10.02 DI delayed status, bit 4).	7
	Other [bit]	See Terms and abbreviations (page 137).	-
40.61	Setpoint scaling actual	Actual setpoint scaling. See parameter 40.14 Set 1 setpoint scaling.	0.00 NoUnit / real32
	-200000.00 ... 200000.00	Scaling.	1 = 1 / 100 = 1
40.62	PID internal setpoint actual	Displays the value of the internal setpoint. See the control chain diagram Process PID setpoint and feedback source selection (page 517). This parameter is read-only.	- / real32
	-200000.00 ... 200000.00 Set 1 units	Process PID internal setpoint.	1 = 1 Set 1 units / 100 = 1 Set 1 units

No.	Name / Range / Selection	Description	Def / Type FbEq 16b / 32b
40.70	Compensated set-point	Compensated setpoint determined for the input specified by parameter 40.71 Set 1 compensation input source. The determination of the compensated setpoint is based on the curve specified by points (x1, y1), (x2, y2) and the non-linearity of the curve specified with parameters 40.71…40.76. The compensated setpoint curve will be a mixture of a straight line between the points and a squared line between the points.  x = value from 40.71 Set 1 compensation input source y = 40.70 Compensated setpoint a = 40.76 Set 1 compensation non-linearity Compensated setpoint curve = a * squared function + (1 - a) * linear function	0.00 Set 1 units / real32
	-21474836.00 … 21474836.00 Set 1 units	Compensated setpoint value.	- / 100 = 1 Set 1 units
40.71	Set 1 compensation input source	Selects the source for set 1 compensation input.	Not selected / uint32
	Not selected	None.	0
	Internal setpoint	Internal setpoint. See parameter 40.19 Set 1 internal setpoint sel1.	2
	AI1 scaled	Parameter 12.12 AI1 scaled value.	3
	AI2 scaled	Parameter 12.22 AI2 scaled value.	4
	Motor potentiometer	Parameter 22.80 Motor potentiometer ref act (output of the Floating point control (Motor potentiometer)).	8
	Freq in scaled	Parameter 11.39 Freq in 1 scaled value.	10
	AI1 percent	Parameter 12.101 AI1 percent value.	11

No.	Name / Range / Selection	Description	Def / Type FbEq 16b / 32b
	AI2 percent	Parameter 12.102 AI2 percent value.	12
	EFB ref1	Parameter 03.09 EFB reference 1.	19
	EFB ref2	Parameter 03.10 EFB reference 2.	20
	Setpoint data storage	Parameter 40.92 Setpoint data storage.	24
	Other [bit]	See Terms and abbreviations (page 137).	-
40.72	Set 1 compensation input 1	Point x1 on the setpoint compensation curve, see parameter 40.71 Set 1 compensation input source.	0.00 NoUnit / real32
	-200000.00 ... 200000.00	Setpoint value.	1 = 1 / 100 = 1
40.73	Set 1 compensated output 1	Point y1 (= the compensated output of parameter 40.72 Set 1 compensation input 1) on the setpoint compensation curve, see parameter 40.70 Compensated setpoint.	0.00 Set 1 units / real32
	-200000.00 ... 200000.00 Set 1 units	Compensated setpoint value.	1 = 1 Set 1 units / 100 = 1 Set 1 units
40.74	Set 1 compensation input 2	Point x2 on the setpoint compensation curve, see parameter 40.71 Set 1 compensation input source.	0.00 NoUnit / real32
	-200000.00 ... 200000.00	Setpoint value.	1 = 1 / 100 = 1
40.75	Set 1 compensated output 2	Point y2 (= the compensated output of parameter 40.74 Set 1 compensation input 2) on the setpoint compensation curve, see parameter 40.70 Compensated setpoint.	0.00 Set 1 units / real32
	-200000.00 ... 200000.00 Set 1 units	Compensated setpoint value.	1 = 1 Set 1 units / 100 = 1 Set 1 units
40.76	Set 1 compensation non-linearity	Describes the non-linearity of the setpoint compensation curve, see parameter 40.70 Compensated setpoint.	0 percent / real32
	0...100 %	Percentage.	1 = 1 % / 1 = 1 %
40.79	Set 1 units	Unit used for PID set 1.	°C / uint16
	User text	User editable text.	0
	%	Percent.	4
	bar	Bar.	74
	kPa	Kilo pascal.	75
	Pa	Pascal.	77
	psi	Pound per square inch.	76
	CFM	Cubic feet per minute.	26
	inH_2O	Inch of water.	58
	°C	Degree Celsius.	150
	°F	Degree Fahrenheit.	151

No.	Name / Range / Selection	Description	Def / Type FbEq 16b / 32b
	mbar	Millibar.	44
	m^3/h	Cubic meter per hour.	78
	dm^3/h	Cubic decimeter per hour.	21
	l/s	Liter per second.	79
	l/min	Liter per minute.	37
	l/h	Liter per hour.	38
	m^3/s	Cubic meter per second.	88
	m^3/min	Cubic meter per minute.	40
	km^3/h	Cubic kilometer per minute.	131
	gal/s	Gallon per second.	47
	ft^3/s	Cubic feet per second.	50
	ft^3/min	Cubic feet per minute.	51
	ft^3/h	Cubic feet per hour.	52
	ppm	Parts per million.	34
	inHg	Inch of mercury.	29
	kCFM	Cubic kilo feet per minute.	126
	inWC	Inch of water.	65
	gpm	Gallon per minute.	80
	gal/min	Gallon per minute.	48
	in wg	Inch water gauge.	59
	MPa	Megapascal.	94
	ftWC	Feet of water.	125
40.80	Set 1 PID output min source	Selects the source for set 1 PID output minimum.	Set1 output min / uint32
	None	Not selected.	0
	Set1 output min	Parameter 40.36 Set 1 output min.	1
	Other [bit]	See Terms and abbreviations (page 137).	-
40.81	Set 1 PID output max source	Selects the source for set 1 PID output maximum.	Set1 output max / uint32
	None	Not selected.	0
	Set1 output max	Parameter 40.37 Set 1 output max.	1
	Other [bit]	See Terms and abbreviations (page 137).	-
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 null / real32
	-200000.00 ... 200000.00	Multiplier.	1 = 1 / 100 = 1

No.	Name / Range / Selection	Description	Def / Type FbEq 16b / 32b
40.90	Set 1 feedback multiplier	Defines the multiplier with which the result of the function specified by parameter 40.10 Set 1 feedback function is multiplied.	1.00 null / real32
	-200000.00 ... 200000.00	Multiplier.	1 = 1 / 100 = 1
40.91	Feedback data storage	Storage parameter for receiving a process feedback value, for example, through the embedded fieldbus interface. The value can be sent to the drive as Modbus I/O data. Set the target selection parameter of that particular data (parameters 58.101…58.114) to Feedback data storage. In parameter 40.08 Set 1 feedback 1 source (or 40.09 Set 1 feedback 2 source), select Feedback data storage.	0.00 NoUnit / real32
	-327.68 ... 327.67	Storage parameter for process feedback.	100 = 1 / 100 = 1
40.92	Setpoint data storage	Storage parameter for receiving a process setpoint value, for example, through the embedded fieldbus interface. The value can be sent to the drive as Modbus I/O data. Set the target selection parameter of that particular data (parameters 58.101…58.114) to Setpoint data storage. In parameter 40.16 Set 1 setpoint 1 source (or 40.17 Set 1 setpoint 2 source), select Setpoint data storage.	0.00 NoUnit / real32
	-327.68 ... 327.67	Storage parameter for process setpoint.	100 = 1 / 100 = 1
40.96	Process PID output %	Percentage scaled signal of parameter 40.01 Process PID output actual.	0.00 percent / real32
	-100.00 ... 100.00 %	Percentage.	100 = 1 % / 100 = 1 %
40.97	Process PID feedback %	Percentage scaled signal of parameter 40.02 Process PID feedback actual.	0.00 percent / real32
	-100.00 ... 100.00 %	Percentage.	100 = 1 % / 100 = 1 %
40.98	Process PID setpoint %	Percentage scaled signal of parameter 40.03 Process PID setpoint actual.	0.00 percent / real32
	-100.00 ... 100.00 %	Percentage.	100 = 1 % / 100 = 1 %
40.99	Process PID deviation %	Percentage scaled signal of parameter 40.04 Process PID deviation actual.	0.00 percent / real32
	-100.00 ... 100.00 %	Percentage.	100 = 1 % / 100 = 1 %

No.	Name / Range / Selection	Description	Def / Type FbEq 16b / 32b
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 (page 312)) is made by parameter 40.57 PID set1/set2 selection. See also parameters 40.01…40.06, and the control chain diagram Process PID setpoint and feedback source selection (page 517) and Direction lock (page 519).	
41.08	Set 2 feedback 1 source	See parameter 40.08 Set 1 feedback 1 source.	AI2 percent / uint32
41.09	Set 2 feedback 2 source	See parameter 40.09 Set 1 feedback 2 source.	Not selected / uint32
41.10	Set 2 feedback function	See parameter 40.10 Set 1 feedback function.	In1 / uint16
41.11	Set 2 feedback filter time	See parameter 40.11 Set 1 feedback filter time.	0.000 s / real32
	s		1 = 1 s / 1 = 1 s
41.14	Set 2 setpoint scaling	See parameter 40.14 Set 1 setpoint scaling.	0.00 NoUnit / real32
			1 = 1 / 1 = 1
41.15	Set 2 output scaling	See parameter 40.15 Set 1 output scaling.	0.00 NoUnit / real32
			1 = 1 / 1 = 1
41.16	Set 2 setpoint 1 source	See parameter 40.16 Set 1 setpoint 1 source.	Internal setpoint / uint32
41.17	Set 2 setpoint 2 source	See parameter 40.17 Set 1 setpoint 2 source.	Not selected / uint32
41.18	Set 2 setpoint function	See parameter 40.18 Set 1 setpoint function.	In1 / uint16
41.19	Set 2 internal setpoint sel1	See parameter 40.19 Set 1 internal setpoint sel1.	Not selected / uint32
41.20	Set 2 internal setpoint sel2	See parameter 40.20 Set 1 internal setpoint sel2.	Not selected / uint32
41.21	Set 2 internal setpoint 1	See parameter 40.21 Set 1 internal setpoint 1.	0.00 PID_CustomUnit / real32
	PID_CustomUnit		1 = 1 PID_CustomUnit / 1 = 1 PID_CustomUnit
41.22	Set 2 internal setpoint 2	See parameter 40.22 Set 1 internal setpoint 2.	0.00 PID_CustomUnit / real32
	PID_CustomUnit		1 = 1 PID_CustomUnit / 1 = 1 PID_CustomUnit
41.23	Set 2 internal setpoint 3	See parameter 40.23 Set 1 internal setpoint 3.	0.00 PID_CustomUnit / real32

No.	Name / Range / Selection	Description	Def / Type FbEq 16b / 32b
	PID_CustomUnit		1 = 1 PID_CustomUnit / 1 = 1 PID_CustomUnit
41.24	Set 2 internal setpoint 0	See parameter 40.24 Set 1 internal setpoint 0.	0.00 PID_CustomUnit / real32
	PID_CustomUnit		1 = 1 PID_CustomUnit / 1 = 1 PID_CustomUnit
41.26	Set 2 setpoint min	See parameter 40.26 Set 1 setpoint min.	0.00 Set 1 units / real32
	Set 1 units		1 = 1 Set 1 units / 1 = 1 Set 1 units
41.27	Set 2 setpoint max	See parameter 40.27 Set 1 setpoint max.	200000.00 Set 1 units / real32
	Set 1 units		1 = 1 Set 1 units / 1 = 1 Set 1 units
41.28	Set 2 setpoint increase time	See parameter 40.28 Set 1 setpoint increase time.	0.0 s / real32
	s		1 = 1 s / 1 = 1 s
41.29	Set 2 setpoint decrease time	See parameter 40.29 Set 1 setpoint decrease time.	0.0 s / real32
	s		1 = 1 s / 1 = 1 s
41.30	Set 2 setpoint freeze enable	See parameter 40.30 Set 1 setpoint freeze enable.	Not selected / uint32
41.31	Set 2 deviation inversion	See parameter 40.31 Set 1 deviation inversion.	Not inverted (Ref - Fbk) / uint32
41.32	Set 2 gain	See parameter 40.32 Set 1 gain.	1.00 NoUnit / real32
			- / -
41.33	Set 2 integration time	See parameter 40.33 Set 1 integration time.	10.0 s / real32
	s		1 = 1 s / 1 = 1 s
41.34	Set 2 derivation time	See parameter 40.34 Set 1 derivation time.	0.000 s / real32
	s		1000 = 1 s / 1 = 1 s
41.35	Set 2 derivation filter time	See parameter 40.35 Set 1 derivation filter time.	0.0 s / real32
	s		10 = 1 s / 1 = 1 s
41.36	Set 2 output min	See parameter 40.36 Set 1 output min.	0.00 percent / real32
	%		1 = 1 % / 1 = 1 %
41.37	Set 2 output max	See parameter 40.37 Set 1 output max.	100.00 percent / real32
	%		1 = 1 % / 1 = 1 %

No.	Name / Range / Selection	Description	Def / Type FbEq 16b / 32b
41.38	Set 2 output freeze enable	See parameter 40.38 Set 1 output freeze enable.	Not selected / uint32
41.39	Set 2 deadband range	See parameter 40.39 Set 1 deadband range.	0.00 Set 1 units / real32
	Set 1 units		1 = 1 Set 1 units / 1 = 1 Set 1 units
41.40	Set 2 deadband delay	See parameter 40.40 Set 1 deadband delay.	0.0 s / real32
	s		1 = 1 s / 1 = 1 s
41.43	Set 2 sleep level	See parameter 40.43 Set 1 sleep level.	0.0 percent / real32
	%		1 = 1 % / 1 = 1 %
41.44	Set 2 sleep delay	See parameter 40.44 Set 1 sleep delay.	60.0 s / real32
	s		1 = 1 s / 1 = 1 s
41.45	Set 2 sleep boost time	See parameter 40.45 Set 1 sleep boost time.	0.0 s / real32
	s		1 = 1 s / 1 = 1 s
41.46	Set 2 sleep boost step	See parameter 40.46 Set 1 sleep boost step.	0.00 Set 1 units / real32
	Set 1 units		1 = 1 Set 1 units / 1 = 1 Set 1 units
41.47	Set 2 wake-up deviation	See parameter 40.47 Set 1 wake-up deviation.	- / real32
	PID_CustomUnit		1 = 1 PID_CustomUnit / 1 = 1 PID_CustomUnit
41.48	Set 2 wake-up delay	See parameter 40.48 Set 1 wake-up delay.	0.50 s / real32
	s		1 = 1 s / 1 = 1 s
41.49	Set 2 tracking mode	See parameter 40.49 Set 1 tracking mode.	Not selected / uint32
41.50	Set 2 tracking ref selection	See parameter 40.50 Set 1 tracking ref selection.	Not selected / uint32
41.58	Set 2 increase prevention	See parameter 40.58 Set 1 increase prevention.	No / uint32
41.59	Set 2 decrease prevention	See parameter 40.59 Set 1 decrease prevention.	No / uint32
41.60	Set 2 PID activation source	See parameter 40.60 Set 1 PID activation source.	On / uint32
41.71	Set 2 compensation input source	See parameter 40.71 Set 1 compensation input source.	Not selected / uint32
41.72	Set 2 compensation input 1	See parameter 40.72 Set 1 compensation input 1.	0.00 NoUnit / real32
			1 = 1 / 1 = 1

No.	Name / Range / Selection	Description	Def / Type FbEq 16b / 32b
41.73	Set 2 compensated output 1	See parameter 40.73 Set 1 compensated output 1.	0.00 PID_Custom-Unit / real32
	PID_CustomUnit		1 = 1 PID_Custom-Unit / 1 = 1 PID_Cus-tomUnit
41.74	Set 2 compensation input 2	See parameter 40.74 Set 1 compensation input 2.	0.00 NoUnit / real32
			1 = 1 / 1 = 1
41.75	Set 2 compensated output 2	See parameter 40.75 Set 1 compensated output 2.	0.00 PID_Custom-Unit / real32
	PID_CustomUnit		1 = 1 PID_Custom-Unit / 1 = 1 PID_Cus-tomUnit
41.76	Set 2 compensation non-linearity	See parameter 40.76 Set 1 compensation non-linearity.	0.00 percent / real32
	%		1 = 1 % / 1 = 1 %
41.79	Set 2 units	See parameter 40.79 Set 1 units.	°C / uint16
41.80	Set 2 PID output min source	Selects the source for set 2 PID output minimum.	Set2 output min / uint32
	None	None.	0
	Set2 output min	Parameter 40.36 Set 1 output min.	1
	Other [bit]	See Terms and abbreviations (page 137).	-
41.81	Set 2 PID output max source	Selects the source for set 2 PID output maximum.	Set2 output max / uint32
	None	None.	0
	Set2 output max	Parameter 40.37 Set 1 output max.	1
	Other [bit]	See Terms and abbreviations (page 137).	-
41.89	Set 2 setpoint multi-plier	See parameter 40.89 Set 1 setpoint multiplier.	1.00 null / real32
			1 = 1 / 1 = 1
41.90	Set 2 feedback mul-tiplier	Defines the multiplier k used in formulas of parameter 40.10 Set 1 feedback function. See parameter 40.90 Set 1 feedback multiplier.	1.00 null / real32
			1 = 1 / 1 = 1

No.	Name / Range / Selection	Description	Def / Type FbEq 16b / 32b
43	Brake chopper	Settings for the internal brake chopper. **Note:** These parameters apply to internal brake chopper only. When using external brake, you must disable brake chopper function by setting parameter 43.06 Brake chopper function to value Disabled.	
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 (parameter 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.	- / real32
	0.0 ... 120.0 %	Estimated brake resistor temperature.	1 = 1 % / 100 = 1 %
43.06	Brake chopper function	Enables brake chopper control and selects the brake resistor overload protection method (calculation or measurement). **Note:** Before enabling brake chopper control, ensure that • a brake resistor is connected • overvoltage control is switched off (parameter 30.30 Overvoltage control) • the supply voltage range (parameter 95.01 Supply voltage) has been selected correctly. **Note:** When using external brake chopper, set this parameter to value Disabled.	Disabled / uint16
	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 of the drive.	2

No.	Name / Range / Selection	Description	Def / Type FbEq 16b / 32b
	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 run enable	Selects the source for quick brake chopper on/off control. 0 = Brake chopper IGBT pulses are cut off. 1 = Normal brake chopper IGBT modulation allowed.	On / uint32
	Off	0.	0
	On	1.	1
	Other [bit]	See Terms and abbreviations (page 137).	-
43.08	Brake resistor thermal tc	Defines the thermal time constant for the brake resistor thermal model.	0 s / real32
	0...10000 s	Brake resistor thermal time constant, ie, the rated time to achieve 63% temperature.	1 = 1 s / 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 function and the data sheet of the brake resistor used.	0.00 kW / real32
	0.00 ... 10000.00 kW	Maximum continuous load of the brake resistor.	1000 = 1 kW / 1000 = 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 function.	0.0 Ohm / real32
	0.0 ... 1000.0 Ohm	Brake resistor resistance value.	1000 = 1 Ohm / 1000 = 1 Ohm

No.	Name / Range / Selection	Description	Def / Type FbEq 16b / 32b
43.11	Brake resistor fault limit	Selects the fault limit for the brake resistor protection based on the thermal model. See parameter 43.06 Brake chopper function. When the limit is exceeded, the drive trips on fault 7183 BR excess temperature. The value is given in percent of the temperature the resistor reaches when loaded with the power defined by parameter 43.09 Brake resistor Pmax cont.	105 percent / real32
	0…150 %	Brake resistor temperature fault limit.	100 = 1 % / 100 = 1 %
43.12	Brake resistor warning limit	Selects the warning limit for the brake resistor protection based on the thermal model. See parameter 43.06 Brake chopper function. When the limit is exceeded, the drive generates a A793 BR excess temperature. 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 percent / real32
	0…150 %	Brake resistor temperature warning limit.	100 = 1 % / 100 = 1 %

No.	Name / Range / Selection	Description	Def / Type FbEq 16b / 32b
45	Energy efficiency	Settings for the energy saving calculators as well as peak and energy loggers. See also section Supervisory (page 124).	
45.01	Saved GW hours	Energy saved in GWh compared to direct-on-line motor connection. This parameter is incremented when parameter 45.02 Saved MW hours rolls over. This parameter is read-only (see parameter 45.21 Energy calculations reset).	0 GWh / uint16
	0…65535 GWh	Energy savings in GWh.	1 = 1 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 parameter 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 MWh / uint16
	0…999 MWh	Energy savings in MWh.	1 = 1 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 kWh / uint16
	0.0 … 999.9 kWh	Energy savings in kWh.	10 = 1 kWh / 10 = 1 kWh
45.04	Saved energy	Energy saved in kWh compared to direct-on-line motor connection. If the internal brake chopper of the drive is enabled, all energy fed by the motor to the drive is assumed to be converted into heat. This parameter is read-only (see parameter 45.21 Energy calculations reset).	0.0 kWh / real32
	0.0 … 214748368.0 kWh	Energy savings in kWh.	- / 10 = 1 kWh
45.05	Saved money x1000	Monetary savings in thousands compared to direct-on-line motor connection. This parameter is incremented when parameter 45.06 Saved money rolls over. This parameter is read-only (see parameter 45.21 Energy calculations reset).	0 unit x 1000 / uint32

No.	Name / Range / Selection	Description	Def / Type FbEq 16b / 32b
	0...4294967295 unit x 1000	Monetary savings in thousands of units.	- / 1 = 1 unit x 1000
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 (parameter 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 unit / uint32
	0.00 ... 999.99 unit	Monetary savings.	1 = 1 unit / 100 = 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 (parameter 45.14 Tariff selection). This parameter is read-only (see parameter 45.21 Energy calculations reset).	0.00 unit / real32
	0.00 ... 21474830.00 unit	Monetary savings.	1 = 1 unit / 100 = 1 unit
45.08	CO2 reduction in kilotons	Reduction in CO2 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 metric kiloton / uint16
	0...65535 metric kiloton	Reduction in CO2 emissions in metric kilotons.	1 = 1 metric kiloton / 1 = 1 metric kiloton
45.09	CO2 reduction in tons	Reduction in CO2 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 metric ton / uint16
	0.0 ... 999.9 metric ton	Reduction in CO2 emissions in metric tons.	1 = 1 metric ton / 10 = 1 metric ton
45.10	Total saved CO2	Reduction in CO2 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 metric ton / real32

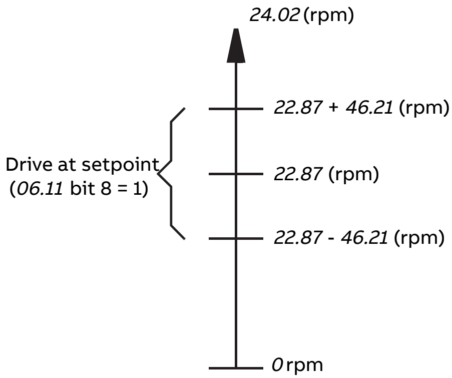
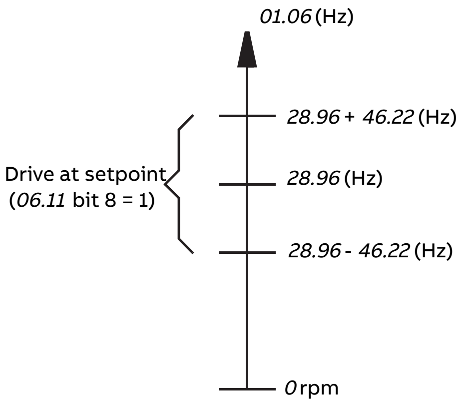
No.	Name / Range / Selection	Description	Def / Type FbEq 16b / 32b
	0.0 … 214748304.0 metric ton	Reduction in CO2 emissions in metric tons.	- / 10 = 1 metric ton
45.11	Energy optimizer	Enables/disables the energy optimization function. The function optimizes the motor flux so that total energy consumption and motor noise level are reduced when the drive operates below the nominal load. The total efficiency (motor and drive) can be improved by 1…20% depending on load torque and speed. **Note:** With a permanent magnet motor energy optimization is always enabled regardless of this parameter.	Disable / uint16
	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 parameter 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.	0.100 EUR / uint32
	EUR	Energy tariff 1.	1 = 1 EUR / 1 = 1 EUR
45.13	Energy tariff 2	Defines energy tariff 2 (price of energy per kWh). See parameter 45.12 Energy tariff 1.	0.200 EUR / uint32
	EUR	Energy tariff 2.	1 = 1 EUR / 1 = 1 EUR
45.14	Tariff selection	Selects (or defines a source that selects) which predefined energy tariff is used. 0 = 45.12 Energy tariff 1. 1 = 45.13 Energy tariff 2.	Energy tariff 1 / uint32
	Energy tariff 1	0.	0
	Energy tariff 2	1.	1
	DI1	Digital input DI1 (parameter 10.02 DI delayed status, bit 0).	2
	DI2	Digital input DI2 (parameter 10.02 DI delayed status, bit 1).	3
	DI3	Digital input DI3 (parameter 10.02 DI delayed status, bit 2).	4
	DI4	Digital input DI4 (parameter 10.02 DI delayed status, bit 3).	5
	DI5	Digital input DI5 (parameter 10.02 DI delayed status, bit 4).	6
	Other [bit]	See Terms and abbreviations (page 137).	-
45.18	CO2 conversion factor	Defines a factor for conversion of saved energy into CO2 emissions (kg/kWh or tn/MWh).	0.500 tn_MWh / uint16

No.	Name / Range / Selection	Description	Def / Type FbEq 16b / 32b
	tn_MWh	Factor for conversion of saved energy into CO2 emissions.	1 = 1 tn_MWh / 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 / real32
	0.00 … 10000000.00 kW	Motor power.	1 = 1 kW / 1 = 1 kW
45.21	Energy calculations reset	Resets the savings counter parameters 45.01…45.10.	Done / uint16
	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.	- / real32
	-3000.00 … 3000.00 kW	Peak power value.	10 = 1 kW / 1 = 1 kW
45.25	Hourly peak power time	Time of the peak power value during the last hour.	0 / uint32
	00:00:00…23:59:59	Time.	1 = 1
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.	- / real32
	-3000.00 … 3000.00 kWh	Total energy.	10 = 1 kWh / 1 = 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.	- / real32
	-3000.00 … 3000.00 kW	Peak power value.	10 = 1 kW / 1 = 1 kW
45.28	Daily peak power time	Time of the peak power since midnight of the present day.	0 / uint32
	00:00:00…23:59:59	Time.	1 = 1

No.	Name / Range / Selection	Description	Def / Type FbEq 16b / 32b
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.	- / real32
	-30000.00 … 30000.00 kWh	Total energy.	1 = 1 kWh / 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.	- / real32
	-30000.00 … 30000.00 kWh	Total energy.	1 = 1 kWh / 1 = 1 kWh
45.31	Monthly peak power value (resettable)	Value of the peak power during the present month, that is, since midnight of the first day of the present month. You can reset the value by setting it to zero.	- / real32
	-3000.00 … 3000.00 kW	Peak power value.	10 = 1 kW / 1 = 1 kW
45.32	Monthly peak power date	Date of the peak power during the present month.	0 / uint16
	-	Date.	1 = 1
45.33	Monthly peak power time	Time of the peak power during the present month.	0 / uint32
	00:00:00…23:59:59	Time.	1 = 1
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.	- / real32
	-1000000.00 … 1000000.00 kWh	Total energy.	1 = 100 kWh / 1 = 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.	- / real32
	-1000000.00 … 1000000.00 kWh		1 = 100 kWh / 1 = 1 kWh
45.36	Lifetime peak power value	Value of the peak power over the drive lifetime.	- / real32
	-3000.00 … 3000.00 kW	Peak power value.	10 = 1 kW / 1 = 1 kW
45.37	Lifetime peak power date	Date of the peak power over the drive lifetime.	0 / uint16
	-	Date.	1 = 1
45.38	Lifetime peak power time	Time of the peak power over the drive lifetime.	0 / uint32
	00:00:00…23:59:59	Time.	1 = 1

No.	Name / Range / Selection	Description	Def / Type FbEq 16b / 32b
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 (page 223)). The speed acceleration and deceleration ramp times are therefore related to this value (not to parameter 30.12 Maximum speed). Also defines the 16-bit scaling of speed-related parameters. The value of this parameter corresponds to 20000, for example, in fieldbus communication.	1500.00; 1800.00 (95.20 b0) rpm / real32
	0.10 ... 30000.00 rpm	Acceleration/deceleration terminal/initial speed.	1 = 1 rpm / 100 = 1 rpm
46.02	Frequency scaling	Defines the maximum frequency value used to define the acceleration ramp rate and the initial frequency value used to define deceleration ramp rate (see parameter group 28 Frequency reference chain (page 236)). The frequency acceleration and deceleration ramp times are therefore related to this value (not to parameter 30.14 Maximum frequency). Also defines the 16-bit scaling of frequency-related parameters. The value of this parameter corresponds to 20000, for example, in fieldbus communication.	50.00; 60.00 (95.20 b0) Hz / real32
	0.10 ... 1000.00 Hz	Acceleration/deceleration terminal/initial frequency.	10 = 1 Hz / 100 = 1 Hz
46.03	Torque scaling	Defines the 16-bit scaling of torque parameters. The value of this parameter (in percent of nominal motor torque) corresponds to 10000, for example, in fieldbus communication.	100.0 percent / real32
	0.1 ... 1000.0 %	Torque corresponding to 10000 on fieldbus.	10 = 1 % / 10 = 1 %
46.04	Power scaling	Defines the 16-bit scaling of power parameters. The value of this parameter corresponds to 10000, for example, in fieldbus communication. The unit is selected by parameter 96.16 Unit selection. For 32-bit scaling see parameter 46.43 Power decimals.	1000.0 NoUnit / real32
	0.1 ... 30000.0	Power corresponding to 10000 on fieldbus.	1 = 1 / 10 = 1
46.05	Current scaling	Defines the 16-bit scaling of current parameters. The value of this parameter corresponds to 10000, for example, in fieldbus communication. For 32-bit scaling see parameter 46.44 Current decimals.	10000 A / real32
	0...30000 A	Current corresponding to 10000 on fieldbus.	1 = 1 A / 1 = 1 A

No.	Name / Range / Selection	Description	Def / Type FbEq 16b / 32b
46.06	Speed ref zero scaling	Defines a speed corresponding to a zero reference received from the embedded fieldbus interface. 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 / real32
	0.00 … 30000.00 rpm	Speed corresponding to minimum fieldbus reference.	1 = 1 rpm / 100 = 1 rpm
46.07	Frequency ref zero scaling	Defines a frequency corresponding to a zero reference received from fieldbus (either the embedded fieldbus interface, or interface FBA). For example, with a setting of 30, the fieldbus reference range of 0…20000 would correspond to a speed of 30…[46.02] Hz. **Note:** This parameter is effective only with the ABB Drives communication profile.	0.00 Hz / real32
	0.00 … 1000.00 Hz	Frequency corresponding to minimum fieldbus reference.	10 = 1 Hz / 1 = 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 / real32
	2...20000 ms	Motor speed signal filter time.	1 = 1 ms / 1 = 1 ms
46.12	Filter time output frequency	Defines a filter time for signal 01.06 Output frequency.	500 ms / real32
	2...20000 ms	Output frequency signal filter time.	1 = 1 ms / 1 = 1 ms
46.13	Filter time motor torque	Defines a filter time for signal 01.10 Motor torque.	100 ms / real32
	2...20000 ms	Motor torque signal filter time.	1 = 1 ms / 1 = 1 ms
46.14	Filter time power	Defines a filter time for signal 01.14 Output power.	100 ms / real32
	2...20000 ms	Output power signal filter time.	1 = 1 ms / 1 = 1 ms

No.	Name / Range / Selection	Description	Def / Type FbEq 16b / 32b
46.21	At speed hysteresis	Defines the “at setpoint” limits for speed control of the drive. When the difference between reference (parameter 22.87 Speed reference act 7) and the speed (parameter 24.02 Used speed feedback) is smaller than parameter 46.21 At speed hysteresis, the drive is considered to be “at setpoint”. This is indicated by bit 8 of parameter 06.11 Main status word.  	50.00 rpm / real32
	0.00 … 30000.00 rpm	Limit for “at setpoint” indication in speed control. For scaling, see parameter 46.01 Speed scaling.	1 = 1 rpm / 100 = 1 rpm
46.22	At frequency hysteresis	Defines the “at setpoint” limits for frequency control of the drive. When the absolute difference between reference (parameter 28.96 Frequency ref act 7) and actual frequency (parameter 01.06 Output frequency) is smaller than parameter46.22 At frequency hysteresis, the drive is considered to be “at setpoint”. This is indicated by bit 8 of parameter 06.11 Main status word.  	2.00 Hz / real32

No.	Name / Range / Selection	Description	Def / Type FbEq 16b / 32b
	0.00 … 1000.00 Hz	Limit for “at setpoint” indication in frequency control. For scaling, see parameter 46.02 Frequency scaling.	10 = 1 Hz / 100 = 1 Hz
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 parameter 06.17 Drive status word 2 is set. This is also indicated by bit 10 in parameter 06.11 Main status word.	1500.00; 1800.00 (95.20 b0) rpm / real32
	0.00 … 30000.00 rpm	“Above limit” indication trigger level for speed control. For scaling, see parameter 46.01 Speed scaling.	1 = 1 rpm / 100 = 1 rpm
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 parameter 06.17 Drive status word 2 is set. This is also indicated by bit 10 in parameter 06.11 Main status word.	50.00; 60.00 (90.20 b0) Hz / real32
	0.00 … 1000.00 Hz	“Above limit” indication trigger level for frequency control. For scaling, see parameter 46.02 Frequency scaling.	10 = 1 Hz / 100 = 1 Hz
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 parameter 05.22 Diagnostic word 3.	1.000 kWh / real32
	0.001 … 1000.000 kWh	“kWh pulse” on trigger level.	1 = 1 kWh / 1000 = 1 kWh
46.43	Power decimals	Defines the number of decimals shown for parameter 99.10 Motor nominal power on the control panel and Drive composer PC tool. It also defines 32-bit scaling of power parameters. The value of this parameter corresponds to the number of decimals assumed in the 32-bit integer fieldbus communication. For 16-bit scaling, see parameter 46.04 Power scaling.	2 NoUnit / uint16
	0…3	Number of decimals.	1 = 1 / 1 = 1
46.44	Current decimals	Defines the number of decimals shown for parameter 99.06 Motor nominal current on the control panel and Drive composer PC tool. It also defines 32-bit scaling of current parameters. The value of this parameter corresponds to the number of decimals assumed in the 32-bit integer fieldbus communication. For 16-bit scaling, see parameter 46.04 Power scaling.	1 NoUnit / uint16
	0…3	Number of decimals.	1 = 1 / 1 = 1

No.	Name / Range / Selection	Description	Def / Type FbEq 16b / 32b
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 132).	
47.01	Data storage 1 real32	Data storage parameter 1.	0.000 NoUnit / real32
	-2147483.000 ... 2147483.000	32-bit data.	- / 1000 = 1
47.02	Data storage 2 real32	Data storage parameter 2.	0.000 NoUnit / real32
	-2147483.000 ... 2147483.000	32-bit data.	- / 1000 = 1
47.03	Data storage 3 real32	Data storage parameter 3.	0.000 NoUnit / real32
	-2147483.000 ... 2147483.000	32-bit data.	- / 1000 = 1
47.04	Data storage 4 real32	Data storage parameter 4.	0.000 NoUnit / real32
	-2147483.000 ... 2147483.000	32-bit data.	- / 1000 = 1
47.11	Data storage 1 int32	Data storage parameter 9.	0 NoUnit / int32
	-2147483648...2147483647	32-bit data.	- / 1 = 1
47.12	Data storage 2 int32	Data storage parameter 10.	0 NoUnit / int32
	-2147483648...2147483647	32-bit data.	- / 1 = 1
47.13	Data storage 3 int32	Data storage parameter 11.	0 NoUnit / int32
	-2147483648...2147483647	32-bit data.	- / 1 = 1
47.14	Data storage 4 int32	Data storage parameter 12.	0 NoUnit / int32
	-2147483648...2147483647	32-bit data.	- / 1 = 1
47.21	Data storage 1 int16	Data storage parameter 17.	0 NoUnit / int16
	-32768...32767	16-bit data.	1 = 1 / -
47.22	Data storage 2 int16	Data storage parameter 18.	0 NoUnit / int16
	-32768...32767	16-bit data.	1 = 1 / -
47.23	Data storage 3 int16	Data storage parameter 19.	0 NoUnit / int16
	-32768...32767	16-bit data.	1 = 1 / -
47.24	Data storage 4 int16	Data storage parameter 20.	0 NoUnit / int16
	-32768...32767	16-bit data.	1 = 1 / -

No.	Name / Range / Selection	Description	Def / Type FbEq 16b / 32b
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 NoUnit / uint32
	1...32	Node ID.	1 = 1 / 1 = 1
49.03	Baud rate	Defines the transfer rate of the link.	115.2 kbps / uint32
	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 / uint32
	0.3 ... 3000.0 s	Control panel/PC tool communication timeout.	10 = 1 s / 10 = 1 s
49.05	Communication loss action	Selects how the drive reacts to a control panel (or PC tool) communication break.	Fault / uint16
	No action	No action taken.	0
	Fault	Drive trips on 7081 Control panel loss.	1
	Last speed	Drive generates an A7EE Control panel loss warning and freezes the speed to the level the drive was operating at. The speed is determined on the basis of actual speed using 850 ms low-pass filtering. **WARNING!** Make sure that it is safe to continue operation in case of a communication break.	2
	Speed ref safe	Drive generates an A7EE Control panel loss warning and sets the speed to the speed defined by parameter 22.41 Speed ref safe (or parameter 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 / uint16
	Done	Refresh done or not requested.	0

No.	Name / Range / Selection	Description	Def / Type FbEq 16b / 32b
	Configure	Refresh parameters 49.01…49.05. The value reverts automatically to Done.	1

No.	Name / Range / Selection	Description	Def / Type FbEq 16b / 32b
58	Embedded fieldbus	Configuration of the embedded fieldbus (EFB) interface. See also Modbus RTU control through the embedded fieldbus interface (EFB) (page 429).	
58.01	Protocol enable	Enables/disables the embedded fieldbus interface and selects the protocol to use.	None / uint16
	None	None (communication disabled).	0
	Modbus RTU	Embedded fieldbus interface is enabled and uses the Modbus RTU protocol.	1
	BACnet MSTP	Embedded fieldbus interface is enabled and uses the BACnet MS/TP protocol.	2
	N2	Embedded fieldbus interface is enabled and uses the N2 protocol.	5
	GP1	Generic Protocol 1. Contact ABB technical support for details.	7
58.02	Protocol ID	Displays the protocol ID and revision. First 4 bits specify the protocol ID and last 12 bits specify the revision. This parameter is read-only.	0000h / uint16
	0000h…FFFFh	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. Also called Station ID, MAC Address or Device Address. Two devices with the same address are not allowed on-line. Changes to this parameter take effect after the control unit is rebooted or the new settings validated by parameter 58.06 Communication control (Refresh settings).	0 NoUnit / uint16
	0...255	Node address (values 1…247 are allowed).	1 = 1 / 1 = 1
58.04	Baud rate	Selects the transfer rate of the fieldbus link. When using selection Autodetect, the parity setting of the bus must be known and configured in parameter 58.05 Parity. When parameter 58.04 Baud rate is set to Autodetect, the EFB settings must be refreshed with parameter 58.06. The bus is monitored for a period of time and the detected baud rate is set as the value of this parameter. Changes to this parameter take effect after the control unit is rebooted or the new settings validated by parameter 58.06 Communication control (Refresh settings).	19.2 kbps / uint16
	Autodetect	Baud rate detected automatically.	0
	4.8 kbps	4.8 kbit/s.	1
	9.6 kbps	9.6 kbit/s.	2
	19.2 kbps	19.2 kbit/s.	3

No.	Name / Range / Selection	Description	Def / Type FbEq 16b / 32b
	38.4 kbps	38.4 kbit/s.	4
	57.6 kbps	57.6 kbit/s.	5
	76.8 kbps	76.8 kbit/s.	6
	115.2 kbps	115.2 kbit/s.	7
58.05	Parity	Modbus RTU, N2 only: Selects the type of parity bit and number of stop bits. Changes to this parameter take effect after the control unit is rebooted or the new settings validated by parameter 58.06 Communication control (Refresh settings). **Note:** For BACnet MS/TP, the BACnet standard defines the parity as 8 NONE 1.	8 EVEN 1 / uint16
	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 / uint16
	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
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).	0000 0000 0000 0000 / uint16
b0	Init failed	1 = EFB initialization failed.	
b1	Addr config err	1 = Node address not allowed by protocol.	
b2	Silent mode	1 = Drive not allowed to transmit. 0 = Drive allowed to transmit.	
b3	Autobauding	1 = Automatic detection of baud rate is in use (see parameter 58.04 Baud rate).	
b4	Wiring error	1 = Errors detected (A/B wires possibly swapped).	
b5	Parity error	1 = Error detected: check parameters 58.04 Baud rate and 58.05 Parity.	
b6	Baud rate error	1 = Error detected: check parameters 58.04 Baud rate and 58.05 Parity.	

No.	Name / Range / Selection	Description	Def / Type FbEq 16b / 32b
b7	No bus activity	1 = 0 bytes received during last 5 seconds.	
b8	No packets	1 = 0 packets (addressed to any device) detected during last 5 seconds.	
b9	Noise or addressing error	1 = Errors detected (interference, or another device with the same address on line).	
b10	Comm loss	1 = 0 packets addressed to the drive received within timeout (58.16 Communication loss time).	
b11	CW/Ref loss	1 = No control word or references received within timeout (58.16 Communication loss time).	
b12	Reserved		
b13	Protocol 1	1 = Duplicate ID detected on the network. Used for BACnet.	
b14	Reserved		
b15	Internal error	1 = Internal error occurred. Contact your local ABB representative.	
	0000h…FFFFh		1 / 1
58.08	Received packets	Displays a count of valid packets addressed to the drive. During normal operation, this number increases constantly. Can be reset from the control panel by pressing the Reset softkey for 3 seconds.	0 NoUnit / uint32
	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 pressing the Reset softkey for 3 seconds.	0 NoUnit / uint32
	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 pressing the Reset softkey for 3 seconds.	0 NoUnit / uint32
	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 pressing the Reset softkey for 3 seconds.	0 NoUnit / uint32
	0...4294967295	Number of UART errors.	- / 1 = 1

No.	Name / Range / Selection	Description	Def / Type FbEq 16b / 32b
58.12	CRC errors	Displays a count of packets with a CRC error received by the drive. An increasing count indicates interference on the bus. Can be reset from the control panel by pressing the Reset softkey for 3 seconds.	0 NoUnit / uint32
	0...4294967295	Number of CRC errors.	- / 1 = 1
58.13	Token counter	BACnet MS/TP only: Contains a count of the number of times this device has received the token. Used for diagnostic purposes.	0 NoUnit / uint32
	0...4294967295	Counter.	- / 1 = 1
58.14	Communication loss action	Selects how the drive reacts to an EFB communication break. Changes to this parameter take effect after the control unit is rebooted or the new settings validated by parameter 58.06 Communication control (Refresh settings). See also parameters 58.15 Communication loss mode and 58.16 Communication loss time.	No action / uint16
	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. The drive trips on 6681 EFB communication 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 parameter 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 communication loss. This happens even though the drive is in a control location where the EFB start/stop or reference is not used.	4

No.	Name / Range / Selection	Description	Def / Type FbEq 16b / 32b
	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.	Any message / uint16
	Any message	Any message addressed to the drive resets the timeout.	1
	Cw / Ref1 / Ref2	A write of the control word or a reference resets the timeout.	2
58.16	Communication loss time	Sets a timeout for EFB communication. If a communication break lasts longer than the timeout, the action specified by parameter 58.14 Communication loss action is taken. Changes to this parameter take effect after the control unit is rebooted or the new settings validated by parameter 58.06 Communication control (Refresh settings). See also parameter 58.15 Communication loss mode. **Note:** There is a 30-second boot-up delay immediately after power-up.	30.0 s / uint16
	0.0 ... 6000.0 s	EFB communication timeout.	1 = 1 s / 10 = 1 s
58.17	Transmit delay	<u>Modbus RTU, N2 only</u>: Defines a minimum response delay in addition to any fixed delay imposed by the protocol. Changes to this parameter take effect after the control unit is rebooted or the new settings validated by parameter 58.06 Communication control (Refresh settings).	0 ms / uint16
	0...65535 ms	Minimum response delay.	1 = 1 ms / 1 = 1 ms
58.18	EFB control word	<u>Modbus RTU, BACnet MS/TP only</u>: Displays the raw (unmodified) control word sent by the Modbus controller to the drive. For debugging purposes. This parameter is read-only.	0.0.0.0 / uint32
	0.0.0.0…FF.FF.FF.FF	Control word sent by Modbus controller to the drive.	1 = 1

<table>
<tr><th>No.</th><th>Name / Range / Selection</th><th>Description</th><th>Def / Type
FbEq 16b / 32b</th></tr>
<tr><td>58.19</td><td>EFB status word</td><td>Modbus RTU, BACnet MS/TP only: Displays the raw (unmodified) status word for debugging purposes.
This parameter is read-only.</td><td>0.0.0.0 / uint32</td></tr>
<tr><td></td><td>0.0.0.0…FF.FF.FF.FF</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>Modbus RTU only: Defines the communication profile used by the Modbus protocol.
Changes to this parameter take effect after the control unit is rebooted or the new settings validated by parameter 58.06 Communication control (Refresh settings).

Note: If you want to use the ABB drives limited profile, set parameter 96.79 Legacy control profile accordingly (supported in firmware revisions 2.15 or later).</td><td>ABB Drives / uint16</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>Modbus RTU only: Selects the type and scaling of reference 1 received through the embedded fieldbus interface.
The scaled reference is displayed by parameter 03.09 EFB reference 1.</td><td>Speed or frequency / uint16</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>Frequency control</td><td>Frequency</td></tr></table></td><td>0</td></tr>
<tr><td></td><td>Transparent</td><td>No scaling is applied.</td><td>1</td></tr>
<tr><td></td><td>General</td><td>Generic reference without a specific unit. Scaling: 1 = 100.</td><td>2</td></tr>
<tr><td></td><td>Torque</td><td>Torque reference. The scaling is defined by parameter 46.03 Torque scaling.</td><td>3</td></tr>
<tr><td></td><td>Speed</td><td>Speed reference. The scaling is defined by parameter 46.01 Speed scaling.</td><td>4</td></tr>
<tr><td></td><td>Frequency</td><td>Frequency reference. The scaling is defined by parameter 46.02 Frequency scaling.</td><td>5</td></tr>
<tr><td>58.27</td><td>EFB ref2 type</td><td>Modbus RTU only: Selects the type and scaling of reference 2 received through the embedded fieldbus interface.
The scaled reference is displayed by parameter 03.10 EFB reference 2.</td><td>Speed or frequency / uint16</td></tr>
<tr><td>58.28</td><td>EFB act1 type</td><td>Modbus RTU only: Selects the type of actual value 1.</td><td>Speed or frequency / uint16</td></tr>
</table>

<table>
<tr><th>No.</th><th>Name / Range / Selection</th><th>Description</th><th>Def / Type
FbEq 16b / 32b</th></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 1 type</th></tr><tr><td>Speed control</td><td>Speed</td></tr><tr><td>Frequency control</td><td>Frequency</td></tr></table></td><td>0</td></tr>
<tr><td></td><td>Transparent</td><td>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>Scaling is defined by parameter 46.03 Torque scaling.</td><td>3</td></tr>
<tr><td></td><td>Speed</td><td>Scaling is defined by parameter 46.01 Speed scaling.</td><td>4</td></tr>
<tr><td></td><td>Frequency</td><td>Scaling is defined by parameter 46.02 Frequency scaling.</td><td>5</td></tr>
<tr><td>58.29</td><td>EFB act2 type</td><td>Modbus RTU only: Selects the type of actual value 2.
For the selections, see parameter 58.28 EFB act1 type.</td><td>Speed or frequency / uint16</td></tr>
<tr><td>58.30</td><td>EFB status word transparent source</td><td>N2 only: Selects the source of actual value 1 when parameter 58.28 EFB act1 type is set to Transparent.</td><td>Not selected / uint32</td></tr>
<tr><td></td><td>Not selected</td><td>None.</td><td>0</td></tr>
<tr><td></td><td>Other [bit]</td><td>Source selection (see Terms and abbreviations (page 137)).</td><td>-</td></tr>
<tr><td>58.31</td><td>EFB act1 transparent source</td><td>Modbus RTU only: Selects the source of actual value 1 when parameter 58.28 EFB act1 type is set to Transparent.</td><td>Not selected / uint32</td></tr>
<tr><td></td><td>Not selected</td><td>None.</td><td>0</td></tr>
<tr><td></td><td>Other [bit]</td><td>Source selection (see Terms and abbreviations (page 137)).</td><td>-</td></tr>
<tr><td>58.32</td><td>EFB act2 transparent source</td><td>Modbus RTU, N2 only: Selects the source of actual value 2 when parameter 58.29 EFB act2 type is set to Transparent.</td><td>Not selected / uint32</td></tr>
<tr><td></td><td>Not selected</td><td>None.</td><td>0</td></tr>
<tr><td></td><td>Other [bit]</td><td>Source selection (see Terms and abbreviations (page 137)).</td><td>-</td></tr>
<tr><td>58.33</td><td>Addressing mode</td><td>Modbus RTU only: Defines the mapping between parameters and holding registers in the 400101…465535 Modbus register range.
Changes to this parameter take effect after the control unit is rebooted or the new settings validated by parameter 58.06 Communication control (Refresh settings).</td><td>Mode 0 / uint16</td></tr>
</table>

No.	Name / Range / Selection	Description	Def / Type FbEq 16b / 32b
	Mode 0	16-bit values (groups 1…99, indexes 1…99): Register address = 400000 + 100 × parameter group + parameter index. For example, parameter 22.80 would be mapped to register 400000 + 2200 + 80 = 402280. 32-bit values (groups 1…99, indexes 1…99): Register address = 420000 + 200 × parameter group + 2 × parameter index. For example, parameter 22.80 would be mapped to register 420000 + 4400 + 160 = 424560.	0
	Mode 1	16-bit values (groups 1…255, indexes 1…255): Register address = 400000 + 256 × parameter group + parameter index. For example, parameter 22.80 would be mapped to register 400000 + 5632 + 80 = 405712.	1
	Mode 2	32-bit values (groups 1…127, indexes 1…255): Register address = 400000 + 512 × parameter group + 2 × parameter index. For example, parameter 22.80 would be mapped to register 400000 + 11264 + 160 = 411424.	2
58.34	Word order	Modbus RTU only: Selects in which order 16-bit registers of 32-bit parameters are transferred. For each register, the first byte contains the high order byte and the second byte contains the low order byte. Changes to this parameter take effect after the control unit is rebooted or the new settings validated by parameter 58.06 Communication control (Refresh settings).	LO-HI / uint16
	HI-LO	The first register contains the high order word, the second contains the low order word.	0
	LO-HI	The first register contains the low order word, the second contains the high order word.	1
58.40	Device object ID	BACnet MS/TP only: The Device object ID must be unique across all BACnet devices in the building network. Valid values are in range 0…4194303. The default Device object ID (4194303) indicates that the Device object ID is uninitialized per the BACnet specification and it must be set to a unique value in the valid range. Changes to this parameter take effect after the control unit is rebooted or the new settings validated by parameter 58.06 Communication control (Refresh settings).	- / uint32
	0...4194303	ID.	- / 1 = 1

No.	Name / Range / Selection	Description	Def / Type FbEq 16b / 32b
58.41	Max master	BACnet MS/TP only: The highest master address for devices on the BACnet MS/TP bus. Changes to this parameter take effect after the control unit is rebooted or the new settings validated by parameter 58.06 Communication control (Refresh settings).	0 NoUnit / uint16
	0…127	Address.	1 = 1 / 1 = 1
58.42	Max info frames	BACnet MS/TP only: The maximum number of information frames the device may transmit before it must pass the token. Changes to this parameter take effect after the control unit is rebooted or the new settings validated by parameter 58.06 Communication control (Refresh settings).	0 NoUnit / uint16
	0…10	Maximum number information frames.	1 = 1 / 1 = 1
58.43	Max APDU retries	BACnet MS/TP only: Number of retries to send when no response is seen to confirmed requests. Changes to this parameter take effect after the control unit is rebooted or the new settings validated by parameter 58.06 Communication control (Refresh settings).	0 NoUnit / uint16
	0…10	Number of retries.	1 = 1 / 1 = 1
58.44	APDU timeout	BACnet MS/TP only: The amount of time in seconds between retransmissions when an expected acknowledgement has not been received. 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).	10 s / uint16
	1…60 s	Timeout.	1 = 1 s / 1 = 1 s
58.101	Data I/O 1	Modbus RTU, BACnet MS/TP only: Defines the address in the drive which the Modbus master accesses when it reads from or writes to the register address corresponding to Modbus register 1 (400001). The master defines the type of the data (input or output). The value is transmitted in a Modbus frame consisting of two 16-bit words. If the value is 16-bit, it is transmitted in the LSW (least significant word). If the value is 32-bit, the subsequent parameter is also reserved for it and must be set to None.	CW 16bit / uint32
	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

No.	Name / Range / Selection	Description	Def / Type FbEq 16b / 32b
	Act1 16bit	Actual value ACT1 (16 bits).	5
	Act2 16bit	Actual value ACT2 (16 bits).	6
	CW 32bit	Control Word (32 bits).	11
	Ref1 32bit	Reference REF1 (32 bits).	12
	Ref2 32bit	Reference REF2 (32 bits).	13
	SW 32bit	Status Word (32 bits).	14
	Act1 32bit	Actual value ACT1 (32 bits).	15
	Act2 32bit	Actual value ACT2 (32 bits).	16
	CW2 16bit	ABB Drives profile: 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
	RO/DIO control word	Parameter 10.99 RO/DIO control word.	31
	AO1 data storage	Parameter 13.91 AO1 data storage.	32
	Feedback data storage	Parameter 40.91 Feedback data storage.	40
	Setpoint data storage	Parameter 40.91 Feedback data storage.	41
	Other [bit]	Source selection (see Terms and abbreviations (page 137)).	-
58.102	Data I/O 2	Modbus RTU, BACnet MS/TP only: Defines the address in the drive which the Modbus master accesses when it reads from or writes to register address 400002. For the selections, see parameter 58.101 Data I/O 1.	Ref1 16bit / uint32
58.103	Data I/O 3	Modbus RTU, BACnet MS/TP only: Defines the address in the drive which the Modbus master accesses when it reads from or writes to register address 400003. For the selections, see parameter 58.101 Data I/O 1.	Ref2 16bit / uint32
58.104	Data I/O 4	Modbus RTU, BACnet MS/TP only: Defines the address in the drive which the Modbus master accesses when it reads from or writes to register address 400004. For the selections, see parameter 58.101 Data I/O 1.	SW 16bit / uint32
58.105	Data I/O 5	Modbus RTU, BACnet MS/TP only: Defines the address in the drive which the Modbus master accesses when it reads from or writes to register address 400005. For the selections, see parameter 58.101 Data I/O 1.	Act1 16bit / uint32
58.106	Data I/O 6	Modbus RTU, BACnet MS/TP only: Defines the address in the drive which the Modbus master accesses when it reads from or writes to register address 400006. For the selections, see parameter 58.101 Data I/O 1.	Act2 16bit / uint32

No.	Name / Range / Selection	Description	Def / Type FbEq 16b / 32b
58.107	Data I/O 7	Modbus RTU, BACnet MS/TP only: Parameter selector for Modbus register address 400007. For the selections, see parameter 58.101 Data I/O 1.	None / uint32
58.114	Data I/O 14	Modbus RTU, BACnet MS/TP only: Parameter selector for Modbus register address 4000014. For the selections, see parameter 58.101 Data I/O 1.	None / uint32

No.	Name / Range / Selection	Description	Def / Type FbEq 16b / 32b
70	Override	Enabling/disabling of override function, override activation signal and override speed/frequency and pass code. See control chain diagram Override (page 520).	
70.01	Override status	Shows the override status. This parameter is read-only.	0000 0000 0000 0000 / uint16
b0	Override enabled	0 = Override is disabled; 1 = Override is enabled.	
b1	Override active	0 = Override is inactive; 1 = Drive is active.	
b2	Override direction is forward	0 = Override direction is not forward; 1 = Override direction is forward.	
b3	Override direction is reverse	0 = Override direction is not reverse; 1 = Override direction is reverse.	
b4	Override stop mode is active	0 = Override stop mode is not active; 1 = Override stop mode is active.	
b5	Override passcode has been set	0 = Override passcode has not been set; 1 = Override passcode has been set	
b6	Reserved		
b7	Run permissive	0 = Prevents running; 1 = Permits running.	
b8	Start interlock 1	0 = Prevents starting; 1 = Permits starting.	
b9	Start interlock 2	0 = Prevents starting; 1 = Permits starting.	
b10	Start interlock 3	0 = Prevents starting; 1 = Permits starting.	
b11	Start interlock 4	0 = Prevents starting; 1 = Permits starting.	
b12	Test mode active	0 = Override test mode is not active; 1 = Override test mode is active.	
b13…15	Reserved		
	0000h…FFFFh		1 / 1
70.02	Override enable	Enables the override function.	Off / uint16
	Off	Override disabled.	0
	On	Override enabled.	1
	On, critical	Allows for an infinite number of fault resets. To be able use this selection, first set parameter 70.20 Override fault handling to value Autoreset.	2
70.03	Override activation source	Selects the source of the override activation. Value 0 of the source deactivates the override. Value 1 of the source activates the override.	Not Used / uint32
	Not Used	0.	0
	DI1	Digital input DI1 (parameter 10.02 DI delayed status, bit 0).	1
	DI2	Digital input DI2 (parameter 10.02 DI delayed status, bit 1).	2

No.	Name / Range / Selection	Description	Def / Type FbEq 16b / 32b
	DI3	Digital input DI3 (parameter 10.02 DI delayed status, bit 2).	3
	DI4	Digital input DI4 (parameter 10.02 DI delayed status, bit 3).	4
	DI5	Digital input DI5 (parameter 10.02 DI delayed status, bit 4).	5
	-DI1	Digital input DI1 (parameter 10.02 DI delayed status, bit 0).	7
	-DI2	Digital input DI2 (parameter 10.02 DI delayed status, bit 1).	8
	-DI3	Digital input DI3 (parameter 10.02 DI delayed status, bit 2).	9
	-DI4	Digital input DI4 (parameter 10.02 DI delayed status, bit 3).	10
	-DI5	Digital input DI5 (parameter 10.02 DI delayed status, bit 4).	11
	Constant speed	Bit 7 of parameter 06.19 Speed control status word.	13
	Other [bit]	See Terms and abbreviations (page 137).	-
70.04	Override reference source	Selects the source for the speed used in the override mode.	- / uint16
	Constant speed/freq	Constant speed used as the reference.	0
	AI1	Parameter 12.12 AI1 scaled value.	1
	AI2	Parameter 12.22 AI2 scaled value.	2
	Override speed/freq	Parameter 70.06 Override frequency or parameter 70.07 Override speed is used as the reference.	3
	Motor potentiometer	Parameter 22.80 Motor potentiometer ref act (output of the Floating point control (Motor potentiometer)).	4
	Stop	The output of the drive is shut off and the motor no longer runs. Override is displayed on the control panel but the motor does not run. Drive follows the specified stop type.	5
	Process PID set 1	Parameter 40.01 Process PID output actual.	6
	Process PID set 2	Parameter 40.01 Process PID output actual.	7
70.05	Override direction	Selects the source of the motor direction used in the override mode.	Forward / uint32
	Forward	Direction is forward.	0
	Reverse	Direction is reverse.	1
	DI1	Digital input DI1 (parameter 10.02 DI delayed status, bit 0).	2
	DI2	Digital input DI2 (parameter 10.02 DI delayed status, bit 1).	3

No.	Name / Range / Selection	Description	Def / Type FbEq 16b / 32b
	DI3	Digital input DI3 (parameter 10.02 DI delayed status, bit 2).	4
	DI4	Digital input DI4 (parameter 10.02 DI delayed status, bit 3).	5
	DI5	Digital input DI5 (parameter 10.02 DI delayed status, bit 4).	6
	-DI1	Digital input DI1 (parameter 10.02 DI delayed status, bit 0).	8
	-DI2	Digital input DI2 (parameter 10.02 DI delayed status, bit 1).	9
	-DI3	Digital input DI3 (parameter 10.02 DI delayed status, bit 2).	10
	-DI4	Digital input DI4 (parameter 10.02 DI delayed status, bit 3).	11
	-DI5	Digital input DI5 (parameter 10.02 DI delayed status, bit 4).	12
	Other [bit]	See Terms and abbreviations (page 137).	-
70.06	Override frequency	Defines the frequency used as reference in the override mode if parameter 70.04 Override reference source is set to Override speed/freq and the drive is in frequency mode.	0.0 Hz / real32
	-500.0 … 500.0 Hz	Override frequency.	10 = 1 Hz / 10 = 1 Hz
70.07	Override speed	Defines the speed used in as reference the override mode if parameter 70.04 Override reference source is set to Override speed/freq and the drive is in speed mode.	0.0 rpm / real32
	-30000.0 … 30000.0 rpm	Override speed.	1 = 1 rpm / 10 = 1 rpm
70.10	Override enables selection	Selects which start interlock and run permissive input signals configured in the drive parameters will not allow the override function to run the motor or will stop running the motor. The drive remains in override mode nevertheless.	0000h / uint16
b0	Run permissive	1 = The override is not allowed to run the motor or the motor will be stopped, if the source defined by parameter 20.40 Run permissive is 0.	
b1	Start interlock 1	1 = The override is not allowed to start the motor or the motor will be stopped, if the source defined by parameter 20.41 Start interlock 1 is 0.	
b2	Start interlock 2	1 = The override is not allowed to start the motor or the motor will be stopped, if the source defined by parameter 20.42 Start interlock 2 is 0.	
b3	Start interlock 3	1 = The override is not allowed to start the motor or the motor will be stopped, if the source defined by parameter 20.43 Start interlock 3 is 0.	

No.	Name / Range / Selection	Description	Def / Type FbEq 16b / 32b
b4	Start interlock 4	1 = The override is not allowed to start the motor or the motor will be stopped, if the source defined by parameter 20.44 Start interlock 4 is 0.	
b5…15	Reserved		
	0000h…FFFFh		1 / 1
70.20	Override fault handling	Faults are grouped into high priority faults and low priority faults. The following faults are high priority, and they are displayed and they will stop the drive: 2310 Overcurrent, 2330 Earth leakage, 2340 Short circuit, 3210 DC link overvoltage, 5090 STO hardware failure, 5091 Safe torque off, FA81 Safe torque off 1, FA82 Safe torque off 2. Other faults are low priority faults. Active low priority faults are reset when the drive enters override mode. Low priority faults are ignored when the drive is in override mode.	Fault on high priority / uint16
	Fault on high priority	Fault on high priority faults. The fault must be reset from the control panel or from a digital input.	0
	Autoreset	Fault on high priority faults (except STO related faults) with automatic fault reset and run. See the list of high priority faults above. See parameter 70.21 Override auto reset trials.	1
70.21	Override auto reset trials	Defines the number of automatic fault resets the drive performs during override operation. When the parameter is set to 0, reset trials are made continuously during the override operation. A value of 1…5 defines a specific number of automatic reset trials.	5 null / uint16
	0...5	Number of automatic reset trials.	1 = 1 / 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 / uint32
	5.0 ... 120.0 s	Auto reset delay time.	10 = 1 s / 10 = 1 s
70.40	Override log 1 start date	Displays the start date of the last Override activation.	01.01.1980 / uint16
	-	Start date.	1 = 1
70.41	Override log 1 start time	Displays the start time of the last Override activation.	00:00:00 / uint32
	00:00:00…23:59:59	Start time.	1 = 1
70.42	Override log 1 end date	Displays the end date of the last Override situation. If the drive is in Override mode, the parameter shows the current date.	01.01.1980 / uint16
	-	End date.	1 = 1

No.	Name / Range / Selection	Description	Def / Type FbEq 16b / 32b
70.43	Override log 1 end time	Displays the end time of the last Override situation. If the drive is in Override mode, the parameter shows the current time.	00:00:00 / uint32
	00:00:00…23:59:59	End time.	1 = 1
70.44	Override log 1 fault 1	Displays the last fault, if any, that occurred during the last operation of override.	0000h / uint16
	0000h…FFFFh	Fault description.	1 = 1
70.45	Override log 1 fault 2	Displays the second last fault, if any, that occurred during the last operation of override.	0000h / uint16
	0000h…FFFFh	Fault description.	1 = 1
70.46	Override log 1 fault 3	Displays the third last fault, if any, that occurred during the last operation of override.	0000h / uint16
	0000h…FFFFh	Fault description.	1 = 1
70.47	Override log 1 warning 1	Displays the last warning, if any, that occurred during the last operation of override.	0000h / uint16
	0000h…FFFFh	Warning description.	1 = 1
70.48	Override log 1 warning 2	Displays the second last warning, if any, that occurred during the last operation of override.	0000h / uint16
	0000h…FFFFh	Warning description.	1 = 1
70.49	Override log 1 warning 3	Displays the third last warning, if any, that occurred during the last operation of override.	0000h / uint16
	0000h…FFFFh	Warning description.	1 = 1
70.50	Override log 2 start date	Displays the start date of the second last Override activation.	0 / uint16
	-	Start date.	1 = 1
70.51	Override log 2 start time	Displays the start time of the second last Override activation.	00:00:00 / uint32
	00:00:00…23:59:59	Start time.	1 = 1
70.52	Override log 2 end date	Displays the end date of the second last Override situation.	0 / uint16
	-	End date.	1 = 1
70.53	Override log 2 end time	Displays the end time of the second last Override situation.	00:00:00 / uint32
	00:00:00…23:59:59	End time.	1 = 1
70.54	Override log 2 fault 1	Displays the last fault, if any, that occurred during the second last operation of override.	0000h / uint16
	0000h…FFFFh	Fault description.	1 = 1
70.55	Override log 2 fault 2	Displays the second last fault, if any, that occurred during the second last operation of override.	0000h / uint16
	0000h…FFFFh	Fault description	1 = 1

No.	Name / Range / Selection	Description	Def / Type FbEq 16b / 32b
70.56	Override log 2 fault 3	Displays the third last fault, if any, that occurred during the second last operation of override.	0000h / uint16
	0000h…FFFFh	Fault description.	1 = 1
70.57	Override log 2 warning 1	Displays the last warning, if any, that occurred during the second last operation of override.	0000h / uint16
	0000h…FFFFh	Warning description.	1 = 1
70.58	Override log 2 warning 2	Displays the second last warning, if any, that occurred during second the last operation of override.	0000h / uint16
	0000h…FFFFh	Warning description.	1 = 1
70.59	Override log 2 warning 3	Displays the third last warning, if any, that occurred during the second last operation of override.	0000h / uint16
	0000h…FFFFh	Warning description.	1 = 1
70.60	Override log 3 start date	Displays the start date of the third last Override activation.	0 / uint16
	-	Start date.	1 = 1
70.61	Override log 3 start time	Displays the start time of the third last Override activation.	00:00:00 / uint32
	00:00:00…23:59:59	Start time.	1 = 1
70.62	Override log 3 end date	Displays the end date of the third last Override situation.	01.01.1980 / uint16
	-	End date.	1 = 1
70.63	Override log 3 end time	Displays the end time of the third last Override situation.	00:00:00 / uint32
	00:00:00…23:59:59	End time.	1 = 1
70.64	Override log 3 fault 1	Displays the last fault, if any, that occurred during the third last operation of override.	0000h / uint16
	0000h…FFFFh	Fault description.	1 = 1
70.65	Override log 3 fault 2	Displays the second last fault, if any, that occurred during the third last operation of override.	0000h / uint16
	0000h…FFFFh	Fault description.	1 = 1
70.66	Override log 3 fault 3	Displays the third last fault, if any, that occurred during the third last operation of override.	0000h / uint16
	0000h…FFFFh	Fault description.	1 = 1
70.67	Override log 3 warning 1	Displays the last warning, if any, that occurred during the third last operation of override.	0000h / uint16
	0000h…FFFFh	Warning description.	1 = 1
70.68	Override log 3 warning 2	Displays the second last warning, if any, that occurred during third the last operation of override.	0000h / uint16
	0000h…FFFFh	Warning description.	1 = 1

No.	Name / Range / Selection	Description	Def / Type FbEq 16b / 32b
70.69	Override log 3 warning 3	Displays the third last warning, if any, that occurred during the third last operation of override.	0000h / uint16
	0000h…FFFFh	Warning description.	1 = 1

No.	Name / Range / Selection	Description	Def / Type FbEq 16b / 32b
95	HW configuration	Various hardware-related settings.	
95.01	Supply voltage	Selects the supply voltage range. This parameter is used by the drive to determine the nominal voltage of the supply network. The parameter also affects the current ratings and the DC voltage control functions (trip and brake chopper activation limits) of the drive. **WARNING!** An incorrect setting may cause the motor to rush uncontrollably, or the brake chopper or resistor to overload. **Note:** The selections shown depend on the hardware of the drive. If only one voltage range is valid for the drive in question, it is selected by default.	Automatic / not selected / uint16
	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
	208...240 V	208…240 V.	1
	380...415 V	380…415 V.	2
	440...480 V	440…480 V.	3
95.02	Adaptive voltage limits	Enables adaptive voltage limits. Adaptive voltage limits can be used if, for example, an IGBT supply unit is used to raise the DC voltage level. If the communication between the inverter and IGBT supply unit is active, the voltage limits are related to the DC voltage reference from the IGBT supply unit. Otherwise the limits are calculated based on the measured DC voltage at the end of the pre-charging sequence. This function is also useful if the AC supply voltage to the drive is high, as the warning levels are raised accordingly.	Enable / uint16
	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 V / uint16
	0...65535 V	Voltage.	10 = 1 V / 1 = 1 V

No.	Name / Range / Selection	Description	Def / Type FbEq 16b / 32b
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. See the *Hardware manual* of the drive.	0000 0000 0000 0000 / uint16
b0	Reserved		
b1	ABB Sine filter	1 = An ABB sine filter is connected to the output of the drive.	
b2…15	Reserved		
	0000h…FFFFh		1 = 1 / 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.	0000 0000 0000 0000 / uint16
b0	Supply frequency 60 Hz	See section Differences in default values between 50 Hz and 60 Hz supply frequency settings (page 396). 0 = 50 Hz. 1 = 60 Hz.	
b1…12	Reserved		
b13	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.	
b14	Output contactor	1 = Output contactor present. Affects parameter 10.24 RO1 source.	
b15	Reserved		
	0000h…FFFFh		1 = 1 / 1 = 1

No.	Name / Range / Selection	Description	Def / Type FbEq 16b / 32b
95.26	Motor disconnect detection	Detects if motor is disconnected and shows a warning of disconnected motor. When this parameter is enabled, the drive will do the following: 1. The drive detects if the motor is disconnected from the drive (all three phases). 2. When a motor disconnection is detected, the drive will stay running and waits for the motor to be connected again. The drive shows warning A784 Motor disconnect on the control panel. 3. When motor connection is again detected, the motor returns back to the last active reference before the disconnection was detected. 4. The warning message disappears from the panel. **Note:** This feature is only available in scalar control mode. This parameter does not affect vector control mode behavior.	Disable / uint16
	Disable	Detecting of disconnecting motor disabled.	0
	Enable	Detecting of disconnecting motor enabled.	1
95.200	Cooling fan mode	Cooling fan operation mode.	Auto / uint16
	Auto	Fan runs normally: Fan on/off, fan speed reference can autochange according to the drive state.	0
	Always on	Fan always runs at 100% speed reference.	1

No.	Name / Range / Selection	Description	Def / Type FbEq 16b / 32b
96	System	Language selection; access levels; macro selection; parameter save and restore; control unit reboot; user parameter sets; unit selection; parameter checksum calculation; user lock.	
96.01	Language	Selects the language of the parameter interface and other displayed information when viewed on the control panel.	Not selected / uint16
	Not selected	None.	0
	English	English.	1033
	Deutsch	German.	1031
	Italiano	Italian.	1040
	Español	Spanish.	3082
	Portugues	Portuguese.	2070
	Nederlands	Dutch.	1043
	Français	French.	1036
	Dansk	Danish.	1030
	Suomi	Finnish.	1035
	Svenska	Swedish.	1053
	Russki	Russian.	1049
	Polski	Polish.	1045
	Türkçe	Turkish.	1055
	Chinese (Simplified, PRC)	Simplified Chinese.	2052
96.02	Pass code	Pass codes can be entered into this parameter to activate further access levels (see parameter 96.03 Access level status) or to configure the user lock. Entering “358” toggles the parameter lock, which prevents the changing of all other parameters through the control panel or the Drive composer PC tool. Entering the user pass code (by default, “10000000”) enables parameters 96.100…96.102, which can be used to define a new user pass code and to select the actions that are to be prevented. Entering an invalid pass code will close the user lock if open, ie. hide parameters 96.100…96.102. After entering the code, check that the parameters are in fact hidden. If they are not, enter another (random) pass code. **Note:** You must change the default user pass code to maintain a high level of cybersecurity. Store the code in a safe place – **THE PROTECTION CANNOT BE DISABLED EVEN BY ABB** if the code is lost. See also section User lock (page 133).	- / uint32

No.	Name / Range / Selection	Description	Def / Type FbEq 16b / 32b
	0…99999999	Pass code.	1 = 1
96.03	Access level status	Shows which access levels have been activated by pass codes entered into parameter 96.02 Pass code.	0000h / uint16
b0	End user		
b1	Service		
b2…10	Reserved		
b10	Override parameter lock		
b11	OEM access level 1		
b12	OEM access level 2		
b13	OEM access level 3		
b14	Parameter lock		
b15	Reserved		
	0000h…FFFFh		1 = 1 / 1 = 1
96.04	Macro select	Selects the control macro. See chapter Default I/O configuration (page 35) for more information. After a selection is made, the parameter reverts automatically to Done.	HVAC default / uint16
	Done	Macro selection complete; normal operation.	0
	HVAC default	See chapter HVAC default (page 35).	1
96.05	Macro active	Shows which control macro is currently selected. See chapter Default I/O configuration (page 35) for more information. To change the macro, use parameter 96.04 Macro select.	HVAC default / uint16
96.06	Parameter restore	Restores the original settings of the control program, ie, parameter default values. **Note:** This parameter cannot be changed while the drive is running.	Done / uint16
	Done	Restoring is completed.	0

No.	Name / Range / Selection	Description	Def / Type FbEq 16b / 32b
	Restore defaults	Restores all editable parameter values to default values, except • motor data and ID run results • I/O extension module settings • end user texts, such as customized warnings and faults • control panel/PC communication settings • fieldbus adapter settings • control macro selection and the parameter defaults implemented by it • parameter 95.01 Supply voltage • differentiated defaults implemented by parameter 95.20 HW options word 1 • user lock configuration parameters 96.100…96.102.	8
	Clear all	Restores all editable parameter values to default values, except • end user texts, such as customized warnings and faults • control panel/PC communication settings • parameter 95.01 Supply voltage • differentiated defaults implemented by parameters 95.20 HW options word 1 • user lock configuration parameters 96.100…96.102. • parameter group 49 Panel port communication (page 348) parameters.	62
	Reset all fieldbus settings	Restores all fieldbus and communication related settings to default values. **Note:** Fieldbus, control panel and PC tool communication are interrupted during the restore.	32
	Reset home view	Restores the home view layout back to show the values of the default parameters defined by the control macro in use.	512
	Reset end user texts	Restores all end user texts to default values, including the contact info, customized fault and warning texts, PID unit and currency unit. **Note:** PID unit is reset only if it is user editable text, that is, parameter 40.79 Set 1 units is set to User text.	1024
	Reset motor data	Restores all motor nominal values and motor ID run results to default values.	2
	All to factory defaults	Restores settings and all editable parameters back to initial factory values, except differentiated defaults implemented by parameter 95.20 HW options word 1.	34560

No.	Name / Range / Selection	Description	Def / Type FbEq 16b / 32b
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 / uint16
	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 / uint16
	No action	1 = No action.	0
	Reboot	1 = Reboot the control unit.	1
96.10	User set status	Shows the status of the user parameter sets. This parameter is read-only. See also section Data storage parameters (page 132).	n/a / uint16
	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
	User set 1 I/O 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
	User set 2 I/O 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
	User set 3 I/O active	User set 3 has been selected by parameters 96.12 User set I/O mode in1 and 96.13 User set I/O mode in2.	6
	User set 4 I/O active	User set 4 has been selected by parameters 96.12 User set I/O mode in1 and 96.13 User set I/O mode in2.	7
	User set 1 backup	User set 1 has been saved or loaded.	8
	User set 2 backup	User set 2 has been saved or loaded.	9
	User set 3 backup	User set 3 has been saved or loaded.	10
	User set 4 backup	User set 4 has been saved or loaded.	11

<table>
<tr><th>No.</th><th>Name / Range / Selection</th><th>Description</th><th>Def / Type
FbEq 16b / 32b</th></tr>
<tr><td>96.11</td><td>User set save/load</td><td>Enables the saving and restoring of up to four custom sets of parameter settings. See section User parameter sets (page 128).

The set that was in use before powering down the drive is in use after the next power-up.

Note:
• Some hardware configuration settings, such as parameter groups 47 Data storage (page 347) and 58 Embedded fieldbus (page 350), and forced input/output values (such as parameters 10.03 DI force selection and 10.04 DI forced data) are not included in user parameter sets.
• Parameter changes made after loading a set are not automatically stored – they must be saved using this parameter.
• If no sets have been saved, attempting to load a set will create all sets from the currently active parameter settings.
• Switching between sets is only possible with the drive stopped.</td><td>No action / uint16</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 / uint32</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 / Range / Selection	Description	Def / Type FbEq 16b / 32b
	DI1	Digital input DI1 (parameter 10.02 DI delayed status, bit 0).	2
	DI2	Digital input DI2 (parameter 10.02 DI delayed status, bit 1).	3
	DI3	Digital input DI3 (parameter 10.02 DI delayed status, bit 2).	4
	DI4	Digital input DI4 (parameter 10.02 DI delayed status, bit 3).	5
	DI5	Digital input DI5 (parameter 10.02 DI delayed status, bit 4).	6
	Timed function 1	Bit 0 of parameter 34.01 Timed functions status.	18
	Timed function 2	Bit 1 of parameter 34.01 Timed functions status.	19
	Timed function 3	Bit 2 of parameter 34.01 Timed functions status.	20
	Supervision 1	Bit 0 of parameter 32.01 Supervision status.	24
	Supervision 2	Bit 1 of parameter 32.01 Supervision status.	25
	Supervision 3	Bit 2 of parameter 32.01 Supervision status.	26
	EFB MCW bit 7	Control word bit 7 received through the embedded fieldbus interface.	32
	Other [bit]	See Terms and abbreviations (page 137).	-
96.13	User set I/O mode in2	See parameter 96.12 User set I/O mode in1.	Not selected / uint32
96.16	Unit selection	Selects the unit of parameters indicating power, temperature and torque.	0000 0000 0000 0000 / uint16
b0	Power unit	0 = kW; 1 = hp.	
b1	Reserved		
b2	Temperature unit	0 = °C; 1 = °F.	
b3	Reserved		
b4	Torque unit	0 = Nm (N·m); 1 = lbft (lb·ft).	
b5…15	Reserved		
	0000h…FFFFh		1 = 1 / 1 = 1
96.20	Time sync primary source	Defines the first priority external source for synchronization of the drive's time and date.	Embedded FB / uint16
	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 Timesync service can be used for setting 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 using DCP over Ethernet. The time can be set in the same way when you do it with USB and panel.	9

No.	Name / Range / Selection	Description	Def / Type FbEq 16b / 32b
96.24	Full days since 1st Jan 1980	The number of full days passed since beginning of the year 1980. This parameter, together with parameters 96.25 Time in minutes within 24 h and 96.26 Time in ms within one minute makes it possible to set the date and time in the drive via the parameter interface from a fieldbus or application program. This may be necessary if the fieldbus protocol does not support time synchronization.	12055 days / uint16
	1…59999 days	Days since beginning of 1980.	1 = 1 days / 1 = 1 days
96.25	Time in minutes within 24 h	The number of full minutes passed since midnight. For example, the value 860 corresponds to 2:20 pm. See parameter 96.24 Full days since 1st Jan 1980.	0 min / uint16
	0…1439 min	Minutes since midnight.	1 = 1 min / 1 = 1 min
96.26	Time in ms within one minute	The number of milliseconds passed since the previous minute. See parameter 96.24 Full days since 1st Jan 1980.	0 ms / uint16
	0…59999 ms	Number of milliseconds since last minute.	1 = 1 ms / 1 = 1 ms
96.39	Event configuration	Selects the events that will be logged in the event logger.	0000 0000 1111 1111 / uint16
b0	Power applied	1 = Enabled = Event B5A2 Power applied will be logged. 0 = Disabled = Event will not be logged.	
b1	Hand mode selected	1 = Enabled = Event B681 Hand mode selected will be logged. 0 = Disabled = Event will not be logged.	
b2	Off mode selected	1 = Enabled = Event B682 Off mode selected will be logged. 0 = Disabled = Event will not be logged.	
b3	Auto mode selected	1 = Enabled = Event B683 Auto mode selected will be logged. 0 = Disabled = Event will not be logged.	
b4	Auto start command	1 = Enabled = Event B687 Auto start command will be logged. 0 = Disabled = Event will not be logged.	
b5	Auto stop command	1 = Enabled = Event B688 Auto stop command will be logged. 0 = Disabled = Event will not be logged.	
b6	Modulating started	1 = Enabled = Event B689 Modulating started will be logged. 0 = Disabled = Event will not be logged.	
b7	Modulating stopped	1 = Enabled = Event B68A Modulating stopped will be logged. 0 = Disabled = Event will not be logged.	
b8…15	Reserved		

No.	Name / Range / Selection	Description	Def / Type FbEq 16b / 32b
	0000h…FFFFh		1 = 1 / 1 = 1
96.51	Clear fault and event logger	Clears all events from the drive's fault and event logs. See section Warning/fault history (page 406).	Done / uint16
	Done	0 = No action.	0
	Reset	1 = Clear the loggers.	1
96.54	Checksum action	Selects how the drive reacts • when parameter 96.55 Checksum control word, bit 8 = 1 (Approved checksum A): if the parameter checksum 96.68 Actual checksum A does not match parameter 96.71 Approved checksum A, and/or • when parameter 96.55 Checksum control word, bit 9 = 1 (Approved checksum B): if the parameter checksum 96.69 Actual checksum B does not match parameter 96.72 Approved checksum B.	No action / uint16
	No action	No action taken. (The checksum feature is not in use.)	0
	Pure event	The drive generates an event log entry B686 Checksum mismatch.	1
	Warning	The drive generates a warning A686 Checksum mismatch.	2
	Warning and prevent start	The drive generates a warning A686 Checksum mismatch. Starting the drive is prevented.	3
	Fault	The drive trips on 6200 Checksum mismatch.	4
96.55	Checksum control word	Bits 8…9 select which comparison(s) are made: • Bit 8 = 1 (Approved checksum A): parameter 96.68 Actual checksum A is compared to parameter 96.71 Approved checksum A, and/or • Bit 9 = 1 (Approved checksum A): if parameter 96.69 Actual checksum B is compared to parameter 96.72 Approved checksum B. Bits 12…13 select approved (reference) checksum parameter(s) into which the actual checksum(s) from parameter(s) are copied: • Bit 12 = 1 (Set approved checksum A): Value of parameter 96.68 Actual checksum A is copied into parameter 96.71 Approved checksum A, and/or • Bit 13 = 1 (Set approved checksum B): Value of parameter 96.69 Actual checksum B is copied into parameter 96.72 Approved checksum B.	0000 0000 0000 0000 / uint16
b0…7	Reserved		
b8	Approved checksum A	1 = Enabled: Checksum A (96.71) is observed. 0 = Disabled.	
b9	Approved checksum B	1 = Enabled: Checksum B (96.72) is observed. 0 = Disabled.	
b10…11	Reserved		

No.	Name / Range / Selection	Description	Def / Type FbEq 16b / 32b
b12	Set approved checksum A	1 = Set: Copy value of 96.68 into 96.71. 0 = Done (copy has been made).	
b13	Set approved checksum B	1 = Set: Copy value of 96.69 into 96.72. 0 = Done (copy has been made).	
b14…15	Reserved		
	0000h…FFFFh		1 = 1 / 1 = 1
96.68	Actual checksum A	Displays the actual parameter configuration checksum A. Checksum A calculation does not include "fieldbus settings". The parameters included in the calculation are user editable parameters in parameter groups 10, 11, 12, 13, 19, 20, 21, 22, 23, 24, 25, 28, 30, 31, 32, 34, 35, 36, 37, 40, 41, 43, 45, 46, 70, 95, 96, 97, 98 and 99. See also section Parameter checksum calculation (page 132).	0000 0000h / uint32
	0000 0000h…FFFF FFFFh	Actual checksum.	1 = 1
96.69	Actual checksum B	Displays the actual parameter configuration checksum B. Checksum B calculation does not include • fieldbus settings • motor data settings, and • energy data settings parameters. The parameters included in the calculation are user editable parameters in parameter groups 10, 11, 12, 13, 19, 20, 21, 22, 23, 24, 25, 28, 30, 31, 32, 34, 35, 36, 37, 40, 41, 43, 45, 46, 70, 95, 96 and 97. See also section Parameter checksum calculation (page 132).	0000 0000h / uint32
	0000 0000h…FFFF FFFFh	Actual checksum.	1 = 1
96.70	Disable adaptive program	Enables/disables the adaptive program (if present). See also section Adaptive programming (page 48).	Yes / uint16
	No	Adaptive program enabled.	0
	Yes	Adaptive program disabled.	1
96.71	Approved checksum A	Approved (reference) checksum A.	0000 0000h / uint32
	0000 0000h…FFFF FFFFh	Approved checksum A.	1 = 1
96.72	Approved checksum B	Approved (reference) checksum B.	0000 0000h / uint32
	0000 0000h…FFFF FFFFh	Approved checksum B.	1 = 1

No.	Name / Range / Selection	Description	Def / Type FbEq 16b / 32b
96.78	Legacy Modbus mapping	Enables a Modbus user to access a select set of parameters using legacy register numbering. See the supported parameters in section Parameters supported by Modbus backwards compatibility with legacy drives (page 398). Parameter *96.78 550 Compatibility mode* will be replaced by parameters 96.78 Legacy Modbus mapping and 96.79 Legacy control profile in firmware versions 2.15 or later.	Disable / uint16
	Disable	Using legacy register numbering disabled.	0
	Enable	Using legacy register numbering enabled. This selection sets parameter 58.33 Addressing mode. Only 16-bit addressing is used, and only 16-bit data is used for reading and writing. <u>16-bit values (groups 1…99, indexes 1…99)</u>: Register address = 40000 + 100 × parameter group + parameter index. For example, parameter 22.80 would be mapped to register 40000 + 2200 + 80 = 42280.	1
96.79	Legacy control profile	Enables using a legacy control profile. **Note:** Parameter *96.78 550 Compatibility mode* will be replaced by parameters 96.78 Legacy Modbus mapping and 96.79 Legacy control profile in firmware versions 2.15 or later.	Not selected / uint16
	Not selected	EFB: Control profile selected with parameter 58.25 Control profile.	0
	DCU profile	Legacy DCU profile used.	1
	ABB drives	ABB drives profile used.	2
	ABB drives limited	Legacy ABB drives limited profile used.	3
96.100	Change user pass code	*(Visible when user lock is open)* To change the current user pass code, enter a new code into this parameter as well as parameter 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 133).	10000000 / uint32
	10000000…99999999	New user pass code.	1 = 1
96.101	Confirm user pass code	*(Visible when user lock is open)* Confirms the new user pass code entered in parameter 96.100 Change user pass code.	10000000 / uint32
	10000000…99999999	Confirmation of new user pass code.	1 = 1

No.	Name / Range / Selection	Description	Def / Type FbEq 16b / 32b
96.102	User lock functionality	*(Visible when user lock is open)* Selects the actions or functionalities to be prevented by the user lock. Parameter 96.03 Access level status shows which access are selected. **Note:** • The changes made take effect only when the user lock is closed. See parameter 96.02 Pass code. • ABB recommends you select all the actions and functionalities unless otherwise required by the application.	0000 0000 0000 0000 / uint16
b0	Disable ABB access levels	1 = ABB access levels (service, advanced programmer, etc.; see parameter 96.03 Access level status) disabled.	
b1	Freeze parameter lock state	1 = Changing the parameter lock state prevented, ie, pass code 358 has no effect.	
b2	Disable file download	1 = Loading of files to drive prevented. This applies to: • firmware upgrades • parameter restore • loading an adaptive program • changing home view of control panel • editing drive texts • editing the favorite parameters list on control panel • configuration settings made through control panel such as time/date formats and enabling/disabling clock display.	
b3	Reserved		
b4	Disable backups	0 = Backups are enabled. 1 = Backups are disabled.	
b5	Enable override lock	1 = Override locked. Parameter group 70 Override (page 361) parameters and reference or control chain parameters that have been selected to be used for override are write protected.	
b6	Protect AP	1 = Creating a backup and restoring from a backup prevented.	
b	Reserved		
b7	Disable panel bluetooth	1 = Bluetooth disabled on ACH-AP-W control panel. If the drive is part of a panel bus, Bluetooth is disabled on all control panels.	
b8…10	Reserved		
b11	Disable OEM access level 1	1 = OEM access level 1 disabled.	
b12	Disable OEM access level 2	1 = OEM access level 2 disabled.	
b13	Disable OEM access level 3	1 = OEM access level 3 disabled.	
b14…15	Reserved		
	0000h…FFFFh		1 / 1

No.	Name / Range / Selection	Description	Def / Type FbEq 16b / 32b
97	Motor control	Switching frequency; slip gain; voltage reserve; flux braking; anti-cogging (signal injection); IR compensation.	
97.01	Switching frequency reference	Defines the switching frequency of the drive that is used as long as the drive stays below the thermal limit. See section Switching frequency (page 106). Higher switching frequency results in lower acoustic motor noise. Lower switching frequency generates less switching losses and reduce EMC emissions. **Note:** If you have a multimotor system, contact your local ABB representative. **Note:** With an ABB EX motor, follow the instructions given in the ABB EX motor documentation.	4 kHz / uint32
	4 kHz	4 kHz.	4
	8 kHz	8 kHz.	8
	12 kHz	12 kHz.	12
97.02	Minimum switching frequency	Lowest switching frequency value that is allowed. Depends on the frame size. When drive is reaching the thermal limit, it will automatically start to reduce the switching frequency until the minimum allowed value is reached. Once the minimum has been reached, the drive will automatically start limiting the output current to keep the temperature below the thermal limit. Inverter temperature is shown by parameter 05.11 Inverter temperature. **Note:** With an ABB EX motor, follow the instructions given in the ABB EX motor documentation.	1.5 kHz / uint32
	1.5 kHz	1.5 kHz. Not for all frame sizes.	1
	2 kHz	2 kHz.	2
	4 kHz	4 kHz.	4
	8 kHz	8 kHz.	8
	12 kHz	12 kHz.	12

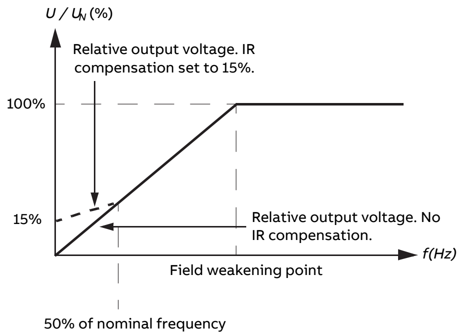
No.	Name / Range / Selection	Description	Def / Type FbEq 16b / 32b
97.03	Slip gain	Defines the slip gain which is used to improve the estimated motor slip. 100% means full slip gain; 0% means no slip gain. The default value is 100%. Other values can be used if a static speed error is detected despite 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 percent / real32
	0…200 %	Slip gain.	1 = 1 % / 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 percent / real32
	-5…50 %	Voltage reserve.	1 = 1 % / 1 = 1 %
97.05	Flux braking	Defines the level of flux braking power. (Other stopping and braking modes can be configured in parameter group 21 Start/stop mode (page 198)). **Note:** This is an expert level parameter and should not be adjusted without appropriate skill.	Disabled / uint16
	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

<table>
<tr><th>No.</th><th>Name / Range / Selection</th><th>Description</th><th>Def / Type
FbEq 16b / 32b</th></tr>
<tr><td>97.08</td><td>Optimizer minimum torque</td><td>This parameter can be used to improve the control dynamics of a synchronous reluctance motor or a salient permanent magnet synchronous motor.

As a rule of thumb, define a level to which the output torque must rise with minimum delay. This will increase the motor current and improve the torque response at low speeds.</td><td>0.0 percent / real32</td></tr>
<tr><td></td><td>0.0 ... 1600.0 %</td><td>Optimizer torque limit.</td><td>10 = 1 % / 10 = 1 %</td></tr>
<tr><td>97.11</td><td>TR tuning</td><td>Rotor time constant tuning.

This parameter can be used to improve torque accuracy in closed-loop control of an induction motor. Normally, the motor identification run provides sufficient torque accuracy, but manual fine-tuning can be applied in exceptionally demanding applications to achieve optimal performance.

Note: This is an expert level parameter and should not be adjusted without appropriate skill.</td><td>100 percent / real32</td></tr>
<tr><td></td><td>25...400 %</td><td>Rotor time constant tuning.</td><td>1 = 1 % / 1 = 1 %</td></tr>
<tr><td>97.13</td><td>IR compensation</td><td>Defines the relative output voltage boost at zero speed (IR compensation). The function is useful in applications with a high break-away torque where vector control cannot be applied.



Typical IR compensation values are shown below.

<table>
<tr><th colspan="6">3-phase U_N = 400 V (380…415 V) drives</th></tr>
<tr><td>P_N (kW)</td><td>3</td><td>7.5</td><td>15</td><td>37</td><td>132</td></tr>
<tr><td>IR compensation (%)</td><td>2.3</td><td>1.7</td><td>1.3</td><td>1.1</td><td>0.6</td></tr>
</table>
See also section IR compensation for scalar motor control (page 99).</td><td>1.95 percent / real32</td></tr>
</table>

No.	Name / Range / Selection	Description	Def / Type FbEq 16b / 32b
	0.00 ... 50.00 %	Voltage boost at zero speed in percent of nominal motor voltage.	1 = 1 % / 100 = 1 %
97.15	Motor model temperature adaptation	Enables the motor model temperature adaptation. Either estimated or measured motor temperature can be used to adapt temperature dependent parameters (for example, resistances) of motor model.	Disabled / uint16
	Disabled	Temperature adaptation disabled.	0
	Estimated temperature	Temperature adaptation with motor temperature estimate (parameter 35.01 Motor estimated temperature).	1
97.16	Stator temperature factor	Tunes the motor temperature dependence of stator parameters (stator resistance).	50 percent / real32
	0...200 %	Tuning factor.	1 = 1 % / 1 = 1 %
97.17	Rotor temperature factor	Tunes the motor temperature dependence of rotor parameters (eg. rotor resistance).	100 percent / real32
	0...200 %	Tuning factor.	1 = 1 % / 1 = 1 %
97.20	U/F Ratio	Selects the form for the U/f (voltage to frequency) ratio below field weakening point. For scalar control only. **Note:** 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.	Squared / uint32
	Linear	Linear ratio for constant torque applications.	0
	Squared	Squared ratio for centrifugal pump and fan applications. With squared U/f ratio the noise level is lower for most operating frequencies. Not recommended for permanent magnet motors.	1
97.48	Udc stabilizer	Enables or disables the DC bus voltage stabilizer.	Disabled / int16
	Disabled	DC bus voltage stabilizer disabled.	0
	Enabled min	DC bus voltage stabilizer enabled, minimum stabilization.	50
	Enabled mild	DC bus voltage stabilizer enabled, mild stabilization.	100
	Enabled medium	DC bus voltage stabilizer enabled, medium stabilization.	300
	Enabled strong	DC bus voltage stabilizer enabled, strong stabilization.	500
	Enabled max	DC bus voltage stabilizer enabled, maximum stabilization.	800

No.	Name / Range / Selection	Description	Def / Type FbEq 16b / 32b
97.49	Slip gain for scalar	Sets gain for slip compensation in percent when the drive is operating in scalar control mode. A squirrel-cage motor slips under load. Increasing the frequency as the motor torque increases compensates for the slip. **Note:** This parameter is only effective in scalar motor control mode (parameter 99.04 Motor control mode is set to Scalar).	0 percent / real32
	0...200 %	0% = No slip compensation. 0 … 200% = Increasing slip compensation. 100% means full slip compensation according to parameters 99.08 Motor nominal frequency and 99.09 Motor nominal speed.	1 = 1 % / 100 = 1 %
97.94	IR comp max frequency	Sets the frequency at which IR compensation set by parameter 97.13 IR compensation reaches 0 V. Unit is percent of the motor nominal frequency.	50.0 percent / real32
	1.0 ... 200.0 %	IR compensation maximum frequency in %.	1 = 1 % / 10 = 1 %
97.135	Udc ripple	Calculates ripple voltage.	0.0 V / real32
	0.0 ... 200.0 V	Voltage.	1 = 1 V / 10 = 1 V

No.	Name / Range / Selection	Description	Def / Type FbEq 16b / 32b
98	User motor parameters	Motor values supplied by the user that are used in the motor model. These parameters are useful for non-standard motors, or to just get more accurate motor control of the motor on site. A better motor model always improves the shaft performance.	
98.01	User motor model mode	Activates the motor model parameters 98.02…98.12 and 98.14. **Note:** • 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 / uint16
	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 pu / real32
	0.00000 ... 0.50000 pu	Stator resistance in per unit.	100000 = 1 pu / 100000 = 1 pu
98.03	Rr user	Defines the rotor resistance R_R of the motor model. **Note:** This parameter is valid only for asynchronous motors.	0.00000 pu / real32
	0.00000 ... 0.50000 pu	Rotor resistance in per unit.	100000 = 1 pu / 100000 = 1 pu
98.04	Lm user	Defines the main inductance L_M of the motor model. **Note:** This parameter is valid only for asynchronous motors.	0.00000 pu / real32
	0.00000 ... 10.00000 pu	Main inductance in per unit.	100000 = 1 pu / 100000 = 1 pu
98.05	SigmaL user	Defines the leakage inductance σL_S. **Note:** This parameter is valid only for asynchronous motors.	0.00000 pu / real32
	0.00000 ... 1.00000 pu	Leakage inductance in per unit.	100000 = 1 pu / 100000 = 1 pu

No.	Name / Range / Selection	Description	Def / Type FbEq 16b / 32b
98.06	Ld user	Defines the direct axis (synchronous) inductance. **Note:** This parameter is valid only for permanent magnet motors.	0.00000 pu / real32
	0.00000 … 10.00000 pu	Direct axis inductance in per unit.	100000 = 1 pu / 100000 = 1 pu
98.07	Lq user	Defines the quadrature axis (synchronous) inductance. **Note:** This parameter is valid only for permanent magnet motors.	0.00000 pu / real32
	0.00000 … 10.00000 pu	Quadrature axis inductance in per unit.	100000 = 1 pu / 100000 = 1 pu
98.08	PM flux user	Defines the permanent magnet flux. **Note:** This parameter is valid only for permanent magnet motors.	0.00000 pu / real32
	0.00000 … 2.00000 pu	Permanent magnet flux in per unit.	100000 = 1 pu / 100000 = 1 pu
98.09	Rs user SI	Defines the stator resistance R_S of the motor model.	0.00000 Ohm / real32
	0.00000 … 100.00000 Ohm	Stator resistance.	100 = 1 Ohm / 100000 = 1 Ohm
98.10	Rr user SI	Defines the rotor resistance R_R of the motor model. **Note:** This parameter is valid only for asynchronous motors.	0.00000 Ohm / real32
	0.00000 … 100.00000 Ohm	Rotor resistance.	100 = 1 Ohm / 100000 = 1 Ohm
98.11	Lm user SI	Defines the main inductance L_M of the motor model. **Note:** This parameter is valid only for asynchronous motors.	0.00 mH / real32
	0.00 … 100000.01 mH	Main inductance.	1 = 1 mH / 100 = 1 mH
98.12	SigmaL user SI	Defines the leakage inductance бLS. **Note:** This parameter is valid only for asynchronous motors.	0.00 mH / real32
	0.00 … 100000.01 mH	Leakage inductance.	1 = 1 mH / 100 = 1 mH
98.13	Ld user SI	Defines the direct axis (synchronous) inductance. **Note:** This parameter is valid only for permanent magnet motors.	0.00 mH / real32
	0.00 … 100000.01 mH	Direct axis inductance.	1 = 1 mH / 100 = 1 mH

No.	Name / Range / Selection	Description	Def / Type FbEq 16b / 32b
98.14	Lq user SI	Defines the quadrature axis (synchronous) inductance. **Note:** This parameter is valid only for permanent magnet motors.	0.00 mH / real32
	0.00 … 100000.01 mH	Quadrature axis inductance.	1 = 1 mH / 100 = 1 mH

No.	Name / Range / Selection	Description	Def / Type FbEq 16b / 32b
99	Motor data	Motor configuration settings.	
99.03	Motor type	Selects the motor type. **Note:** This parameter cannot be changed while the drive is running.	Asynchronous motor / uint16
	Asynchronous motor	Standard squirrel cage AC induction motor (asynchronous induction motor).	0
	Permanent magnet motor	Permanent magnet motor. Three-phase AC synchronous motor with permanent magnet rotor and sinusoidal BackEMF voltage. **Note:** With permanent magnet motors special attention must be paid on setting the motor nominal values correctly in parameter group 99 Motor data (page 390). You must use vector control. If the nominal BackEMF voltage of the motor is not available, a full ID run should be performed for improving performance.	1
	PMaSynRM	Permanent Magnet Assisted Synchronous Reluctance Motor.	3
99.04	Motor control mode	Selects the motor control mode.	Scalar / uint16
	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. • In vector control the drive performs a standstill ID run at the first start if ID run has not been previously performed. A new start command is required after standstill ID run. • To achieve a better motor control performance, you can perform a normal ID run without load. See also section Operating modes of the drive (page 46).	0

No.	Name / Range / Selection	Description	Def / Type FbEq 16b / 32b
	Scalar	Scalar control. Suitable for most applications, if top performance is not required. Motor identification run is not required. **Note:** Scalar control must be used in the following situations: • with multimotor systems 1) if the load is not equally shared between the motors, 2) if the motors are of different sizes, or 3) if the motors are going to be changed after the motor identification (ID run) • if the nominal current of the motor is less than 1/6 of the nominal output current of the drive • if the drive is used with no motor connected (for example, for test purposes). **Note:** Correct motor operation requires that the magnetizing current of the motor does not exceed 90% of the nominal current of the inverter. See also section Operating modes of the drive (page 46).	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. **Note:** • Correct motor operation requires that the magnetizing current of the motor does not exceed 90% of the nominal current of the drive. • This parameter cannot be changed while the drive is running. For 16-bit scaling, see parameter 46.05 Current scaling.	14.3 A / real32
	0.0 ... 50.0 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.	1 = 1 A / 10 = 1 A
99.07	Motor nominal voltage	Defines the nominal motor voltage supplied to the motor. This setting must match the value on the rating plate of the motor. **Note:** • With permanent magnet motors, the nominal voltage is the BackEMF voltage at nominal speed of the motor. If the voltage is given as voltage per rpm, for example, 60 V per 1000 rpm, the voltage for a nominal speed of 3000 rpm is 3 × 60 V = 180 V. • The stress on the motor insulation is always dependent on the drive supply voltage. This also applies to the case where the motor voltage rating is lower than that of the drive and the supply. • This parameter cannot be changed while the drive is running.	230.0 V / real32

No.	Name / Range / Selection	Description	Def / Type FbEq 16b / 32b
	40.0 … 480.0 V	Nominal voltage of the motor.	10 = 1 V / 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 / real32
	0.00 … 500.00 Hz	Nominal frequency of the motor.	10 = 1 Hz / 100 = 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.	1445 rpm / real32
	0…30000 rpm	Nominal speed of the motor.	1 = 1 rpm / 1 = 1 rpm
99.10	Motor nominal power	Defines the nominal motor power. The setting must match the value on the rating plate of the motor. If multiple motors are connected to the drive, enter the total power of the motors. The unit is selected by parameter 96.16 Unit selection. **Note:** This parameter cannot be changed while the drive is running. For 16-bit scaling, see parameter 46.04 Power scaling.	4.00 kW or hp / real32
	0.00 … 10000.00 kW or hp	Nominal power of the motor.	1 = 1 kW or hp / 100 = 1 kW or hp
99.11	Motor nominal cos Φ	Defines the cosphi of the motor for a more accurate motor model. The value is not obligatory, but is useful with an asynchronous motor, especially when performing a standstill identification run. With a permanent magnet or synchronous reluctance motor, this value is not needed. **Note:** • 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 NoUnit / real32
	0.00 … 1.00	Cosphi of the motor.	100 = 1 / 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 Nm or lbft / uint32
	0.000 … 4000000.000 Nm or lbft	Nominal motor torque.	1 = 100 Nm or lbft / 1000 = 1 Nm or lbft

No.	Name / Range / Selection	Description	Def / Type FbEq 16b / 32b
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. **Note:** • To ensure that the ID run can work properly, the drive limits in parameter group 30 Limits (page 249) (maximum speed and minimum speed, and maximum torque and minimum torque) must to be large enough (the range specified by the limits must be wide enough. If, for example, speed limits are less than the motor nominal speed, the ID run cannot be completed. • With a permanent magnet or synchronous reluctance motor, a Normal, Reduced or Standstill ID run requires that the motor shaft is NOT locked and the load torque is less than 10%. • With scalar control mode (parameter 99.04 Motor control mode = Scalar), the ID run is not requested automatically. However, an ID run can be performed for more accurate torque estimation. • Once the ID run is activated, it can be canceled by stopping the drive. • The ID run must be performed every time any of the motor parameters (99.04, 99.06…99.12) have been changed. • Ensure that the Safe Torque Off and emergency stop circuits (if any) are closed during the ID run. • Mechanical brake (if present) is not opened by the logic for the ID run. • This parameter cannot be changed while the drive is running.	None / uint16
	None	No motor ID run is requested. This mode can be selected only if the ID run (Normal, Reduced or Standstill) has already been performed once.	0

No.	Name / Range / Selection	Description	Def / Type FbEq 16b / 32b
	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. **Note:** • If the load torque will be higher than 20% of motor nominal torque, or if the machinery is not able to withstand the nominal torque transient during the ID run, then the driven machinery must be de-coupled from the motor during a Normal ID run. • Check the direction of rotation of the motor before starting the ID run. During the run, the motor will rotate in the forward direction. **WARNING!** The motor will run at up to approximately 50…100% of the nominal speed during the ID run. ENSURE THAT IT IS SAFE TO RUN THE MOTOR BEFORE PERFORMING THE ID RUN!	1
	Reduced	Reduced ID run. This mode should be selected instead of the Normal ID run if • mechanical losses are higher than 20% (ie. the motor cannot be de-coupled from the driven equipment), or if • flux reduction is not allowed while the motor is running (ie. in case of a motor with an integrated brake supplied from the motor terminals). With this ID run mode, the resultant motor control in the field weakening area or at high torques is not necessarily as accurate as motor control following a Normal ID run. Reduced ID run is completed faster than the Normal ID run (< 90 seconds). **Note:** Check the direction of rotation of the motor before starting the ID run. During the run, the motor will rotate in the forward direction. **WARNING!** The motor will run at up to approximately 50…100% of the nominal speed during the ID run. ENSURE THAT IT IS SAFE TO RUN THE MOTOR BEFORE PERFORMING THE ID RUN!	2
	Standstill	Standstill ID run. The motor is injected with DC current. With an AC induction (asynchronous) motor, the motor shaft is not rotated. With a permanent magnet motor, the shaft can rotate up to half a revolution. **Note:** This mode should be selected only if the Normal, or Reduced ID run is not possible due to the restrictions caused by the connected mechanics (for example, with lift or crane applications).	3

No.	Name / Range / Selection	Description	Def / Type FbEq 16b / 32b
	Adaptive	Adaptive ID run. Improves the motor model accuracy during normal operation of the drive. The drive performs a Standstill ID run first. Motor parameters are then updated with better accuracy during an adaptation sequence when following user's driving profile. When the adaptation is complete, parameter 99.14 Last ID run performed changes from Standstill to Adaptive. Motor parameters are updated automatically and the user is not required to update any other parameter. **Note:** For vector control only.	8
99.14	Last ID run performed	Shows the type of ID run that was performed last. For more information about the different modes, see the selections of parameter 99.13 ID run requested.	None / uint16
	None	No ID run has been performed.	0
	Normal	Normal ID run.	1
	Reduced	Reduced ID run.	2
	Standstill	Standstill ID run.	3
	Adaptive	Adaptive ID run.	8
99.15	Motor polepairs calculated	Calculated number of pole pairs in the motor.	0 NoUnit / uint16
	0...1000	Number of pole pairs.	1 = 1 / 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 / uint16
	U V W	Normal.	0
	U W V	Reversed rotation direction.	1

Differences in 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 with parameter 96.06 Parameter restore.

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 parameter group 99 Motor data (page 390) parameter values though these parameters are not listed in the table.

Parameter	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	50.000	60.000
13.18 AO1 source max	50.0	60.0
22.26 Constant speed 1	300.00 rpm	360.00 rpm
22.27 Constant speed 2	600.00 rpm	720.00 rpm
22.28 Constant speed 3	900 .00 rpm	1080.00 rpm
22.29 Constant speed 4	1200.00 rpm	1440.00 rpm
22.30 Constant speed 5	1500.00 rpm	1800.00 rpm
22.31 Constant speed 6	2400.00 rpm	2880.00 rpm
22.32 Constant speed 7	3000.00 rpm	3600.00 rpm
28.26 Constant frequency 1	5.00 Hz	6.00 Hz
28.27 Constant frequency 2	10.00 Hz	12.00 Hz
28.28 Constant frequency 3	15.00 Hz	18.00 Hz
28.29 Constant frequency 4	20.00 Hz	24.00 Hz
28.30 Constant frequency 5	25.00 Hz	30.00 Hz
28.31 Constant frequency 6	40.00 Hz	48.00 Hz
28.32 Constant frequency 7	50.00 Hz	60.00 Hz
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

Parameter	**95.20 HW options word 1 bit Supply frequency 60 Hz = 50 Hz**	**95.20 HW options word 1 bit Supply frequency 60 Hz = 60 Hz**
30.14 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 legacy drives

ACx310/320/355 compatibility mode is a way to communicate with an ACxx80 drive in such a way that it looks like an ACx310/320/355 drive over Modbus RTU or Modbus TCP. This mode can be enabled by changing parameter 96.78 Legacy Modbus mapping to Enable.

In the ACx310/320/355 compatibility mode all supported parameters can be read as if the drive were an ACx310/320/355. Some parameters are read only and do not support writes. See the table below to see which parameters support writes.

ACx310/320/355 parameter	Name	Read/Write
01.01	SPEED & DIR	Read only
01.02	SPEED	Read only
01.03	OUTPUT FREQ	Read only
01.04	CURRENT	Read only
01.05	TORQUE	Read only
01.06	POWER	Read only
01.07	DC BUS VOLTAGE	Read only
01.09	OUTPUT VOLTAGE	Read only
01.10	DRIVE TEMP	Read only
01.11	EXTERNAL REF 1	Read only
01.13	CTRL LOCATION	Read only
01.14	RUN TIME	Read only
01.15	KWH COUNTER	Read only
01.18	DI 1-3 STATUS	Read only
01.19	DI 4-6 STATUS	Read only
01.20	AI 1	Read only
01.21	AI 2	Read only
01.22	RO 1-3 STATUS	Read only
01.23	RO 4-6 STATUS	Read only
01.24	AO 1	Read only
01.25	AO 2	Read only
01.26	PID 1 OUTPUT	Read only
01.27	PID 2 OUTPUT	Read only
01.28	PID 1 SETPNT	Read only

ACx310/320/355 parameter	Name	Read/Write
01.29	PID 2 SETPNT	Read only
01.30	PID 1 FBK	Read only
01.31	PID 2 FBK	Read only
01.32	PID 1 DEVIATION	Read only
01.33	PID 2 DEVIATION	Read only
01.34	COMM RO WORD	Read only
01.35	COMM VALUE 1	Read only
01.36	COMM VALUE 2	Read only
01.41	MWH COUNTER	Read only
01.43	DRIVE ON TIME	Read only
01.45	MOTOR TEMP	Read only
01.50	CB TEMP	Read only
01.74	SAVED KWH	Read only
01.75	SAVED MWH	Read only
01.77	SAVED AMOUNT 2	Read only
01.78	SAVED CO2	Read only
03.01	FB CMD WORD 1	Read only
03.02	FB CMD WORD 2	Read only
03.03	FB STS WORD 1	Read only
03.04	FB STS WORD 2	Read only
03.05	FAULT WORD 1	Read only
03.06	FAULT WORD 2	Read only
03.07	FAULT WORD 3	Read only
03.08	ALARM WORD 1	Read only
03.09	ALARM WORD 2	Read only
04.01	LAST FAULT	Read only
04.12	PREVIOUS FAULT 1	Read only
04.13	PREVIOUS FAULT 2	Read only
10.01	EXT1 COMMANDS	Read/Write
10.02	EXT2 COMMANDS	Read/Write
10.03	DIRECTION	Read/Write
10.04	JOGGING SEL	Read/Write

ACx310/320/355 parameter	Name	Read/Write
11.02	EXT1/EXT2 SEL	Read/Write
11.03	REF1 SELECT	Read/Write
11.04	REF1 MIN	Read/Write
11.05	REF1 MAX	Read/Write
11.06	REF2 SEL	Read/Write
11.07	REF2 MIN	Read/Write
11.08	REF2 MAX	Read/Write
12.01	CONST SPEED SEL	Read/Write
12.02	CONST SPEED 1	Read/Write
12.03	CONST SPEED 2	Read/Write
12.04	CONST SPEED 3	Read/Write
12.05	CONST SPEED 4	Read/Write
12.06	CONST SPEED 5	Read/Write
12.07	CONST SPEED 6	Read/Write
15.02	CONST SPEED 7	Read/Write
15.03	AO1 CONTENT MAX	Read/Write
15.04	MINIMUM AO1	Read/Write
15.05	MAXIMUM AO1	Read/Write
15.08	AO2 CONTENT MIN	Read/Write
15.09	AO2 CONTENT MAX	Read/Write
15.10	MINIMUM AO2	Read/Write
15.11	MAXIMUM AO2	Read/Write
16.01	RUN ENABLE	Read/Write
16.02	PARAMETER LOCK	Read/Write
16.03	PASS CODE	Read/Write
16.08	START ENABLE 1	Read/Write
16.09	START ENABLE 2	Read/Write
20.01	MINIMUM SPEED	Read/Write
20.02	MAXIMUM SPEED	Read/Write
20.03	MAX CURRENT	Read/Write
20.06	UNDERVOLT CRTL	Read/Write
20.07	MINIMUM FREQ	Read/Write

ACx310/320/355 parameter	Name	Read/Write
20.08	MAXIMUM FREQ	Read/Write
20.13	MIN TORQUE SEL	Read/Write
20.14	MAX TORQUE SEL	Read/Write
20.15	MIN TORQUE 1	Read/Write
20.16	MIN TORQUE 2	Read/Write
20.17	MAX TORQUE 1	Read/Write
20.18	MAX TORQUE 2	Read/Write
21.02	STOP FUNCTION	Read/Write
21.03	DC MAGN TIME	Read/Write
21.05	DC HOLD SPEED	Read/Write
21.06	DC CURR REF	Read/Write
21.09	EMERG STOP SEL	Read/Write
21.12	ZERO SPEED DELAY	Read/Write
21.13	START DELAY	Read/Write
22.02	ACCELER TIME 1	Read/Write
22.03	DECELER TIME 1	Read/Write
22.04	RAMP SHAPE 1	Read/Write
22.05	ACCELER TIME 2	Read/Write
22.06	DECELER TIME 2	Read/Write
22.07	RAMP SHAPE 2	Read/Write
22.08	EMERG DEC TIME	Read/Write
23.01	PROP GAIN	Read/Write
23.02	INTEGRATION TIME	Read/Write
23.03	DERIVATION TIME	Read/Write
23.04	ACC COMPENSATION	Read/Write
30.02	PANEL COMM ERR	Read/Write
30.03	EXTERNAL REF 1	Read/Write
30.04	EXTERNAL REF 2	Read/Write
30.05	MOT THERM POT	Read/Write
30.06	MOT THERM TIME	Read/Write
30.07	MOT LOAD CURVE	Read/Write
30.08	ZERO SPEED LOAD	Read/Write

ACx310/320/355 parameter	Name	Read/Write
30.09	BREAK POINT FREQ	Read/Write
30.10	STALL FUNCTION	Read/Write
30.11	STALL FREQUENCY	Read/Write
30.12	STALL TIME	Read/Write
30.17	EARTH FAULT	Read/Write
30.18	COMM FAULT FUNC	Read/Write
30.19	COMM FAULT TIME	Read/Write
30.22	AI2 FAULT LIMIT	Read/Write
30.23	WIRING FAULT	Read/Write
33.01	FIRMWARE	Read only
33.02	LOADING PACKAGE	Read only
33.03	TEST DATE	Read only
33.04	DRIVE RATING	Read only
40.01	GAIN	Read/Write
40.02	INTEGRATION TIME	Read/Write
40.03	DERIVATION TIME	Read/Write
40.04	PID DERIV FILTER	Read/Write
40.08	0% VALUE	Read/Write
40.09	100% VALUE	Read/Write
40.10	SET POINT SEL	Read/Write
40.11	INTERNAL SETPNT	Read/Write
40.12	SETPOINT MIN	Read/Write
40.13	SETPOINT MAX	Read/Write
40.14	FBK SEL	Read/Write
40.15	FBK MULTIPLIER	Read/Write
40.16	ACT 1 INPUT	Read/Write
40.17	ACT 2 INPUT	Read/Write
40.24	PID SLEEP DELAY	Read/Write
40.25	WAKE-UP DEV	Read/Write
40.26	WAKE-UP DELAY	Read/Write
40.27	PID 1 PARAM SET	Read/Write
41.01	GAIN	Read/Write

ACx310/320/355 parameter	Name	Read/Write
41.02	INTEGRATION TIME	Read/Write
41.03	DERIVATION TIME	Read/Write
41.04	PID DERIV FILTER	Read/Write
41.08	0% VALUE	Read/Write
41.09	100% VALUE	Read/Write
41.10	SET POINT SEL	Read/Write
41.11	INTERNAL SETPNT	Read/Write
41.12	SETPOINT MIN	Read/Write
41.13	SETPOINT MAX	Read/Write
41.14	FBK SEL	Read/Write
41.15	FBK MULTIPLIER	Read/Write
41.16	ACT 1 INPUT	Read/Write
41.17	ACT 2 INPUT	Read/Write
41.24	PID SLEEP DELAY	Read/Write
41.25	WAKE-UP DEV	Read/Write
41.26	WAKE-UP DELAY	Read/Write
42.11	INTERNAL SETPNT	Read/Write
53.05	EFB CTRL PROFILE	Read/Write
99.01	LANGUAGE	Read/Write
99.04	MOTOR CTRL MODE	Read/Write
99.05	MOTOR NOM VOLT	Read/Write
99.06	MOTOR NOM CURR	Read/Write
99.07	MOTOR NOM FREQ	Read/Write
99.08	MOTOR NOM SPEED	Read/Write
99.09	MOTOR NOM POWER	Read/Write
99.10	ID RUN	Read/Write
99.15	MOTOR COS PHI	Read/Write

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Fault tracing

Contents of this chapter

This chapter lists the warning and fault messages including possible causes and corrective actions. If the warnings and faults cannot be identified and corrected using the information in this chapter, contact an ABB service representative. If you use the Drive Composer PC tool, send the Support package created by the Drive Composer to the ABB service representative.

Warnings and faults are listed in separate tables. Each table is sorted by a warning/fault code.

Safety

WARNING!
If you are not a qualified electrical professional, do not do installation or maintenance work. Obey the safety instructions of the drive. If you ignore them, injury or death, or damage to the equipment can occur.

Indications

Warnings and faults

Warnings and faults indicate an abnormal drive status. The codes and names of active warnings/faults are displayed on the control panel of the drive as well as the Drive Composer PC tool. Only the codes of warnings/faults are available over fieldbus.

Warnings do not need to be reset; they stop showing when the cause of the warning ceases. Warnings do not latch and the drive will continue to operate the motor.

Faults do latch inside the drive and cause the drive to trip, and the motor stops. After the cause of a fault has been removed, the fault can be reset from a selectable source (parameter 31.11 Fault reset selection)), such as the control panel, the Drive Composer PC tool, the digital inputs of the drive, or fieldbus. After the fault is reset, the drive can be restarted.

Note that some faults require a reboot of the control unit either by switching the power off and on, or using parameter 96.08 Control board boot – this is mentioned in the fault listing wherever appropriate.

Pure events

In addition to warnings and faults, there are pure events that are only recorded in the event logs of the drive. The codes of these events are included in the Warning, fault and pure event messages (page 408) table.

Warning/fault history

Event log

All indications are stored in the event log. The event log stores information on

- the last 8 fault recordings, that is, faults that tripped the drive or fault resets
- the last 10 warnings or pure events that occurred.

See section Viewing warning/fault information (page 406). The logs can be cleared using parameter 96.51 Clear fault and event logger.

Auxiliary codes

Some events generate an auxiliary code that often helps in pinpointing the problem. 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 (if any) is shown in the event listing.

Viewing warning/fault information

The drive is able to store a list of the active faults actually causing the drive to trip at the present time. The drive also stores a list of faults and warnings that have previously occurred.

For each stored fault, the panel shows the fault code, time and values of nine parameters (actual signals and status words) stored at the time of the fault. The values of the parameters for the latest fault are in parameters 05.80…05.88.

For active faults and warnings, see

- Main menu - Diagnostics - Active faults

- Main menu - Diagnostics - Active warnings
- Options menu - Active faults
- Options menu - Active warnings
- Parameter group 04 Warnings and faults (page 147).

For previously occurred faults and warnings, see

- Main menu - Diagnostics - Fault & event log

  Note: Active faults are also stored in the fault and event log.

- Parameter group 04 Warnings and faults (page 147).

The event log can also be accessed (and reset) using the Drive composer PC tool. See Drive composer PC tool user's manual (3AUA0000094606 [English]).

QR Code generation for mobile service application

A QR Code (or a series of QR Codes) can be generated by the drive for display on the optional assistant control panel. The QR Code contains drive identification data, information on the latest events, and values of status and counter parameters. The code can be read with a mobile device containing the ABB service application, which then sends the data to ABB for analysis. For more information on the application, contact your local ABB service representative.

Warning, fault and pure event messages

Code (hex)	Event name / Aux. code	Cause	What to do
1080	Backup/Restore timeout	Control panel or PC tool has failed to communicate with the drive when backup was being made or restored.	Request backup or restore again.
1081	Rating ID fault	Drive software has not been able to read the rating ID of the drive.	Reset the fault to make the drive try to reread the rating ID. If the fault reappears, cycle the power to the drive. You may have to be repeat this. If the fault persists, contact your local ABB representative.
2281	Calibration	Measured offset of output phase current measurement or difference between output phase U2 and W2 current measurement is too great (the values are updated during current calibration).	Try performing the motor ID run 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 (page 223) (speed control) or 28 Frequency reference chain (page 236) (frequency control). Also check parameters 46.01 Speed scaling, 46.02 Frequency scaling and 46.03 Torque scaling. Check motor and motor cable (including phasing and delta/star connection). Check there are no contactors opening and closing in motor cable. Check that the start-up data in parameter group 99 Motor data (page 390) 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.
2330	Earth leakage	Drive has detected load unbalance typically due to earth fault in motor or motor cable.	Check there are no power factor correction capacitors or surge absorbers in motor cable. Check for an earth fault in motor or motor cables by measuring the insulation resistances of motor and motor cable. See chapter Electrical installation, section Checking the

Code (hex)	Event name / Aux. code	Cause	What to do
			insulation of the assembly in the hardware manual of the drive. Try running the motor in scalar control mode if allowed. (See parameter 99.04 Motor control mode.) 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.
2340	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. After correcting the cause of the fault, reboot the control board (using parameter 96.08 Control board boot) or by cycling power.
2381	IGBT overload	Excessive IGBT junction to case temperature. This fault protects the IGBT(s) and can be activated by a short circuit in the motor cable.	Check motor cable. Check ambient conditions. Check air flow and fan operation. Check heatsink fins for dust pick-up. Check motor power against drive power.
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	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).

Code (hex)	Event name / Aux. code	Cause	What to do
			Retrofit drive with brake chopper and brake resistor. Check that the brake resistor is dimensioned properly and the resistance is between acceptable range for the drive.
3220	DC link undervoltage	Intermediate circuit DC voltage is not sufficient because of a missing supply phase, blown fuse or fault in the rectifier bridge.	Check supply cabling, fuses and switchgear.
3381	Output phase loss	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.
3385	Autophasing	Autophasing routine has failed.	Check that the motor ID run has been successfully completed. Check that the motor is not already turning when the autophasing routine starts. Check the setting of parameter 99.03 Motor type.
4110	Control board temperature	Control board temperature is too high.	Check proper cooling of the drive.
4210	IGBT overtemperature	Estimated drive IGBT temperature is excessive.	Check ambient conditions. Check air flow and fan operation. Check heatsink fins for dust pick-up. Check motor power against drive power.
4290	Cooling	Drive module temperature is excessive.	Check ambient temperature. If it exceeds 40 °C /104 °F, ensure that load current does not exceed derated load capacity of drive. See 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.

Code (hex)	Event name / Aux. code	Cause	What to do
4380	Excess temp difference	High temperature difference between the IGBTs of different phases.	Check the motor cabling. Check cooling of drive module.
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). Check the value of parameter 35.12 Temperature 1 fault limit.
5080	Fan	Cooling fan stuck or disconnected.	Check fan operation and connection. Replace fan if faulty.
5090	STO hardware failure	STO hardware diagnostics has detected hardware failure.	Contact your local ABB representative for hardware replacement.
5091	Safe torque off	Safe torque off function is active, i.e. safety circuit signal(s) connected to connector STO is broken during start or run.	Check safety circuit connections. For more information, see chapter The Safe torque off function in the hardware manual of the drive and description of parameter 31.22 STO indication run/stop.
5092	PU logic error	Power unit memory has cleared.	Contact your local ABB representative.
5093	Rating ID mismatch	The hardware of the drive does not match the information stored in the memory. This may occur e.g. after a firmware update.	Cycle the power to the drive. You may have to be repeat this.
5094	Measurement circuit temperature	Problem with internal temperature measurement of the drive.	Contact your local ABB representative.
5098	I/O communication loss	Communication failure to standard I/O.	Try resetting the fault or cycle the power to the drive.
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.
5690	PU communication internal	Internal communication error.	Contact your local ABB representative.
5691	Measurement circuit ADC	Measurement circuit fault.	This is an internal control system failure. If reset or re-powering of the drive unit does not help, or this fault appears frequently, please replace the drive.
5692	PU board powerfail	Power unit power supply failure.	This is an internal control system failure. If reset or re-powering of the drive unit does not help, or this fault appears frequently, please replace the drive.
5693	Measurement circuit DFF	Measurement circuit fault.	This is an internal control system failure. If reset or re-powering of the drive unit does not help, or this fault

Code (hex)	Event name / Aux. code	Cause	What to do
			appears frequently, please replace the drive.
5697	Charging feedback	Charging feedback signal missing.	Check the feedback signal coming from the charging system.
6181	FPGA version incompatible	Firmware and FPGA versions are incompatible.	Reboot the control unit (using parameter 96.08 Control board boot) or by cycling power. If the problem persists, contact your local ABB representative.
6200	Checksum mismatch	The calculated parameter checksum does not match any enabled reference checksum.	Check that all necessary approved (reference) checksums (96.71…96.72) are enabled in parameter 96.55 Checksum control word. Check the parameter configuration. Using parameter 96.55 Checksum control word, enable a checksum parameter and copy the actual checksum into that parameter.
6481	Task overload	Internal fault.	Reboot the control unit (using parameter 96.08 Control board boot) or by cycling power. If the problem persists, contact your local ABB representative.
6487	Stack overflow	Internal fault.	Reboot the control unit (using parameter 96.08 Control board boot) or by cycling power. If the problem persists, contact your local ABB representative.
64A1	Internal file load	File read error.	Reboot the control unit (using parameter 96.08 Control board boot) or by cycling power. If the problem persists, contact your local ABB representative.
64A6	Adaptive program	Adaptive program has faulted.	Check the auxiliary code. See actions for each code below.
	000A	Program corrupted or block non-existent.	Restore the template program or download the program to the drive.
	000C	Required block input missing.	Check the inputs of the block.
	000E	Program corrupted or block non-existent.	Restore the template program or download the program to the drive.
	0011	Program too large.	Remove blocks until the error stops.
	0012	Program is empty.	Correct the program and download it to the drive.
	001C	A nonexisting parameter or block is used in the program.	Edit the program to correct the parameter reference, or to use an existing block.
	001D	Parameter type invalid for selected pin.	Edit the program to correct the parameter reference.
	001E	Output to parameter failed because the parameter was write-protected.	Check the parameter reference in the program.

Code (hex)	Event name / Aux. code	Cause	What to do
			Check for other sources affecting the target parameter.
	0023, 0024	Program file incompatible with current firmware version.	Adapt the program to current block library and firmware version.
	Other	-	Contact your local ABB representative, quoting the auxiliary code.
64B1	Internal SSW fault	Internal fault.	Reboot the control unit (using parameter 96.08 Control board boot) or by cycling power. If the problem persists, contact your local ABB representative.
64B2	User set fault	Loading of user parameter set failed because • requested set does not exist • set is not compatible with control program • drive was switched off during loading.	Ensure that a valid user parameter set exists. Reload if uncertain.
64E1	Kernel overload	Operating system error.	Reboot the control unit (using parameter 96.08 Control board boot) or by cycling power. If the problem persists, contact your local ABB representative.
64FF	Fault reset	A fault has been reset from the control panel, Drive Composer PC tool, fieldbus or I/O.	Event. Informative only.
6581	Parameter system	Parameter load or save failed.	Try forcing a save using parameter 96.07 Parameter save manually. Retry.
6591	Backup/Restore timeout	Parameter load or save timeout caused by communication break between drive and control panel, or control panel and PC tool.	Check the communication between drive and control panel or PC. Retry.
6681	EFB communication loss	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 terminals 25, 26, 27 and 28.
6682	EFB configuration 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 (page 350).
6684	EFB load fault	Embedded fieldbus (EFB) protocol firmware could not be loaded. Version mismatch between EFB protocol firmware and drive firmware.	Contact your local ABB representative.

Code (hex)	Event name / Aux. code	Cause	What to do
6685	EFB fault 2	Fault reserved for the EFB protocol application.	Check the documentation of the protocol.
6686	EFB fault 3	Fault reserved for the EFB protocol application.	Check the documentation of the protocol.
6882	Text 32-bit table overflow	Internal fault.	Reset the fault. Contact your local ABB representative if the fault persists.
6885	Text file overflow	Internal fault.	Reset the fault. Contact your local ABB representative if the fault persists.
7081	Control panel loss	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.
7086	AI overvoltage	An overvoltage has been detected on an analog input. The analog input has temporarily been changed to voltage mode and will be changed back to current mode when the AI signal level is back within acceptable limits	Check AI signal level.
7121	Motor stall	Motor is operating in stall region because of e.g. excessive load or insufficient motor power.	Check motor load and drive ratings. Check fault function parameters.
7122	Motor overload	Motor current is too high.	Check the motor, and the machinery coupled to motor, for overload. Adjust the parameters used for the motor overload function 35.51…35.53 and 35.55…35.56.
7181	Brake resistor	Brake resistor broken or not connected.	Check that a brake resistor has been connected. Check the condition of the brake resistor. Check the dimensioning of the brake resistor.
7183	BR excess temperature	Brake resistor temperature has exceeded fault limit defined by parameter 43.11 Brake resistor fault limit.	Stop drive. Let resistor cool down. Check resistor overload protection function settings (parameter group 43 Brake chopper (page 335)). 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.

Code (hex)	Event name / Aux. code	Cause	What to do
			Replace brake chopper (if replaceable).
7192	BC IGBT excess temp	Brake chopper IGBT temperature has exceeded internal fault limit.	Let chopper cool down. Check for excessive ambient temperature. Check for cooling fan failure. Check for obstructions in the air flow. Check the dimensioning and cooling of the cabinet. Check that braking cycle meets allowed limits. Check that drive supply AC voltage is not excessive.
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 need for brake chopper and resistor(s).
73B0	Emergency ramp failed	Emergency stop did not finish within expected time.	Check the settings of parameters 31.32 Emergency ramp supervision and 31.33 Emergency ramp supervision delay. Check the predefined ramp times (23.11…23.15 for mode Off1, 23.23 for mode Off3).
73F0	Overfrequency	Maximum allowed output frequency exceeded.	Check minimum/maximum frequency settings, parameters 30.13 Minimum frequency and 30.14 Maximum frequency. Check adequacy of motor braking torque. Check need for brake chopper and resistor(s).
	00FA	Motor is turning faster than the highest allowed frequency due to incorrectly set minimum/maximum frequency or the motor rushes because of too high supply voltage or incorrect supply voltage selection in parameter 95.01 Supply voltage.	Check minimum/maximum frequency settings, parameters 30.13 Minimum frequency and 30.14 Maximum frequency. Check used supply voltage and voltage selection parameter 95.01 Supply voltage.
	Other	-	Contact your local ABB representative, quoting the auxiliary code.
8001	ULC underload	User load curve: Signal has been too long under the underload curve.	Check for any operating conditions decreasing the monitored signal (for example, loss of load if the torque or current is being monitored). Check the definition of the load curve (parameter group 37 User load curve (page 308)).
8002	ULC overload	User load curve: Signal has been too long over the overload curve.	Check for any operating conditions increasing the monitored signal (for example, the loading of the motor if the torque or current is being monitored). Check the definition of

Code (hex)	Event name / Aux. code	Cause	What to do
			the load curve (parameter group 37 User load curve (page 308)).
80A0	AI supervision fault	An analog signal is outside the limits specified for the analog input.	Check signal level at the analog input. Check the wiring connected to the input. Check the minimum and maximum limits of the input in parameter group 12 Standard AI (page 173).
80B0	Signal supervision 1	Fault generated by the signal supervision 1 function.	Check the source of the fault (parameter 32.07 Supervision 1 signal).
80B1	Signal supervision 2	Fault generated by the signal supervision 2 function.	Check the source of the fault (parameter 32.17 Supervision 2 signal).
80B2	Signal supervision 3	Fault generated by the signal supervision 3 function.	Check the source of the fault (parameter 32.27 Supervision 3 signal).
80B3	Signal supervision 4	Fault generated by the signal supervision 4 function.	Check the source of the fault (parameter 32.37 Supervision 4 signal).
80B4	Signal supervision 5	Fault generated by the signal supervision 5 function.	Check the source of the fault (parameter 32.47 Supervision 5 signal).
80B5	Signal supervision 6	Fault generated by the signal supervision 6 function.	Check the source of the fault (parameter 32.57 Supervision 6 signal).
9081	External event 1	Fault in external device 1.	Check the external device. Check setting of parameter 31.01 External event 1 source.
9082	External event 2	Fault in external device 2.	Check the external device. Check setting of parameter 31.03 External event 2 source.
9083	External event 3	Fault in external device 3.	Check the external device. Check setting of parameter 31.05 External event 3 source.
9084	External event 4	Fault in external device 4.	Check the external device. Check setting of parameter 31.07 External event 4 source.
9085	External event 5	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.)
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 (page 223) (speed control) or 28 Frequency reference chain (page 236) (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).

Code (hex)	Event name / Aux. code	Cause	What to do
			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 (page 390) corresponds to the motor rating plate. Check that there are no power factor correction capacitors or surge absorbers in motor cable.
A2B3	Earth leakage	Drive has detected load unbalance typically due to earth fault in motor or motor cable.	Check there are no power factor correction capacitors or surge absorbers in motor cable. Check for an earth fault in motor or motor cables by measuring the insulation resistances of motor and motor cable. See chapter Electrical installation, section Checking the insulation of the assembly in the hardware manual of the drive. If an earth fault is found, fix or change the motor cable and/or motor. If no earth fault can be detected, contact your local ABB representative.
A2B4	Short circuit	Short-circuit in motor cable(s) or motor.	Check motor and motor cable for cabling errors. Check motor and motor cable (including phasing and delta/star connection). Check for an earth fault in motor or motor cables by measuring the insulation resistances of motor and motor cable. See chapter Electrical installation, section Checking the insulation of the assembly in the hardware manual of the drive. Check there are no power factor correction capacitors or surge absorbers in motor cable.
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

Code (hex)	Event name / Aux. code	Cause	What to do
			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).	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.
A3AA	DC not charged	The voltage of the intermediate DC circuit has not yet risen to operating level.	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.
A490	Incorrect temperature sensor setup	Temperature cannot be supervised due to incorrect adapter setup.	Check the settings of temperature source parameter 35.11 Temperature 1 source.
A491	External temperature 1	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.
A4A1	IGBT overtemperature	Estimated drive IGBT temperature is excessive.	Check ambient conditions. Check air flow and fan operation. Check heatsink fins for dust pick-up. Check motor power against drive power.
A4A9	Cooling	Drive module temperature is excessive.	Check ambient temperature. If it exceeds 40 °C /104 °F, ensure that load current does not exceed derated load capacity of drive. See 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.

Code (hex)	Event name / Aux. code	Cause	What to do
			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.
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.
A5A0	Safe torque off	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.
A5EA	Measurement circuit temperature	Problem with internal temperature measurement of the drive.	Contact your local ABB representative.
A5EB	PU board powerfail	Power unit power supply failure.	Contact your local ABB representative.
A5ED	Measurement circuit ADC	Measurement circuit fault.	Contact your local ABB representative.
A5EE	Measurement circuit DFF	Measurement circuit fault.	Contact your local ABB representative.
A5EF	PU state feedback	State feedback from output phases does not match control signals.	Contact your local ABB representative.
A5F0	Charging feedback	Charging feedback signal missing.	Check the feedback signal coming from the charging system.
A686	Checksum mismatch	The calculated parameter checksum does not match any enabled reference checksum.	Check that all necessary approved (reference) checksums (96.71…96.72) are enabled in 96.55 Checksum control word. Check the parameter configuration. Using 96.55 Checksum control word, enable a checksum parameter and copy the actual checksum into that parameter.
A6A4	Motor nominal value	The motor parameters are set incorrectly.	Check the settings of the motor configuration parameters in parameter group 99 Motor data (page 390). Check that the drive is sized correctly for the motor.
A6A5	No motor data	Parameters in parameter group 99 Motor data (page 390) have not been set.	Check that all the required parameters in parameter group 99 Motor data (page 390) have been set.

Code (hex)	Event name / Aux. code	Cause	What to do
			Note: It is normal for this warning to appear during the start-up and continue until the motor data is entered.
A6A6	Voltage category unselected	The voltage category has not been defined.	Set voltage category in parameter 95.01 Supply voltage.
A6B0	User lock is open	The user lock is open, ie. user lock configuration parameters 96.100…96.102 are visible.	Close the user lock by entering an invalid pass code in parameter 96.02 Pass code. See section User lock (page 133).
A6B1	User pass code not confirmed	A new user pass code has been entered in parameter 96.100 Change user pass code but not confirmed in 96.101 Confirm user pass code.	Confirm the new pass code by entering the same code in 96.101 Confirm user pass code. To cancel, close the user lock without confirming the new code. See section User lock (page 133).
A6E5	AI parametrization	The current/voltage hardware setting of an analog input does not correspond to parameter settings.	Check the event log for an auxiliary code. The code identifies the analog input whose settings are in conflict. Adjust parameter 12.15 AI1 unit selection/12.25 AI2 unit selection. **Note:** Control board reboot (either by cycling the power or through parameter 96.08 Control board boot) is required to validate any changes in the hardware settings.
A6E6	ULC configuration	User load curve configuration error.	Check the auxiliary code. See actions for each code below.
	0000	Speed points inconsistent.	Check that each speed point (parameters 37.11…37.15) has a higher value than the previous point.
	0001	Frequency points inconsistent.	Check that each frequency point (parameters 37.16…37.20) has a higher value than the previous point.
	0002	Underload point above overload point.	Check that each overload point (parameters 37.31…37.35) has a higher value than the corresponding underload point (parameters 37.21…37.25).
	0003	Overload point below underload point.	Check that each overload point (parameters 37.31…37.35) has a higher value than the corresponding underload point (parameters 37.21…37.25).
A780	Motor stall	Motor is operating in stall region because of e.g. excessive load or insufficient motor power.	Check motor load and drive ratings. Check fault function parameters.
A783	Motor overload	Motor current is too high.	Check the motor, and the machinery coupled to motor, for overload.

Code (hex)	Event name / Aux. code	Cause	What to do
			Adjust the parameters used for the motor overload function (parameters 35.51…35.53 and 35.55…35.56).
A784	Motor disconnect	All three output phases are disconnected from motor.	Check if parameter 95.26 Motor disconnect detection enables the use of a motor disconnect switch. If not, check the following: • All switches between drive and motor are closed. • All cables between drive and motor are connected and secured. If no issue was detected and drive output was actually connected to motor, contact ABB.
A791	Brake resistor	Brake resistor broken or not connected.	Check that a brake resistor has been connected. Check the condition of the brake resistor.
A792	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.
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 (page 335)). Check warning limit setting, parameter 43.12 Brake resistor warning limit. Check that the resistor has been dimensioned correctly. Check that braking cycle meets allowed limits.
A794	BR data	Brake resistor data has not been given.	Check the resistor data settings (parameters 43.08…43.10).
A79B	BC short circuit	Short circuit in brake chopper IGBT.	Replace brake chopper if external. Drives with internal choppers will need to be returned to ABB. Ensure brake resistor is connected and not damaged.
A79C	BC IGBT excess temperature	Brake chopper IGBT temperature has exceeded internal warning limit.	Let chopper cool down. Check for excessive ambient temperature. Check for cooling fan failure. Check for obstructions in the air flow. Check the dimensioning and cooling of the cabinet. Check minimum allowed resistor value for the chopper being used. Check that braking cycle meets allowed limits.

Code (hex)	Event name / Aux. code	Cause	What to do
			Check that drive supply AC voltage is not excessive.
A7AC	I/O module internal error	Calibration data is not stored in the main IOMCU. Analog signals are not working with full accuracy.	Contact your local ABB representative.
A7CE	EFB comm loss	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 terminals 25, 26, 27 and 28.
A7EE	Control panel loss	Control panel or PC tool selected as active control location for drive has ceased communicating.	Check PC tool or control panel connection. Check control panel connector. Check mounting platform if being used. Disconnect and reconnect the control panel.
A8A0	AI supervision warning	An analog signal is outside the limits specified for the analog input.	Check signal level at the analog input. Check the wiring connected to the input. Check the minimum and maximum limits of the input in parameter group 12 Standard AI (page 173).
A8A1	RO Life Warning	The relay has changed states more than the recommended number of times.	Change the control board or stop using the relay output.
	0001	Relay output 1	Change the control board or stop using relay output 1.
A8A2	RO Toggle Warning	The relay output is changing states faster than recommended, eg. if a fast changing frequency signal is connected to it. The relay lifetime will be exceeded shortly.	Replace the signal connected to the relay output source with a less frequently changing signal.
	0001	Relay output 1	Select a different signal with parameter 10.24 RO1 source.
A8B0	Signal supervision 1	Warning generated by a signal supervision function.	Check the source of the warning (parameter 32.07 Supervision 1 signal).
A8B1	Signal supervision 2	Warning generated by a signal supervision function.	Check the source of the warning (parameter 32.17 Supervision 2 signal).
A8B2	Signal supervision 3	Warning generated by a signal supervision function.	Check the source of the warning (parameter 32.27 Supervision 3 signal).
A8B3	Signal supervision 4	Warning generated by a signal supervision function.	Check the source of the warning (parameter 32.37 Supervision 4 signal).
A8B4	Signal supervision 5	Warning generated by a signal supervision function.	Check the source of the warning (parameter 32.47 Supervision 5 signal).
A8B5	Signal supervision 6	Warning generated by a signal supervision function.	Check the source of the warning (parameter 32.57 Supervision 6 signal).
A8BE	ULC overload	Selected signal has exceeded the user overload curve.	Check for any operating conditions increasing the monitored signal (for example, the loading of the motor if

Code (hex)	Event name / Aux. code	Cause	What to do
			the torque or current is being monitored). Check the definition of the load curve (parameter group 37 User load curve (page 308)).
A8BF	ULC underload	Selected signal has fallen below the user underload curve.	Check for any operating conditions decreasing the monitored signal (for example, loss of load if the torque or current is being monitored). Check the definition of the load curve (parameter group 37 User load curve (page 308)).
A8C0	ULC invalid speed warning	User load curve: X-axis points (speed) are not valid.	Check that points fulfill conditions. See parameter 37.11 ULC speed table point 1.
A8C1	ULC overload warning	Selected signal has exceeded the user overload curve.	Check for any operating conditions increasing the monitored signal (for example, the loading of the motor if the torque or current is being monitored). Check the definition of the load curve (parameter group 37 User load curve (page 308)).
A8C4	ULC underload warning	Selected signal has fallen below the user underload curve.	Check for any operating conditions decreasing the monitored signal (for example, loss of load if the torque or current is being monitored). Check the definition of the load curve (parameter group 37 User load curve (page 308)).
A8C5	ULC invalid underload table	User load curve: Underload curve points are not valid.	Check that points fulfill conditions. See parameter 37.21 ULC underload point 1.
A8C6	ULC invalid overload table	User load curve: Overload curve points are not valid.	Check that points fulfill conditions. See parameter 37.31 ULC overload point 1.
A8C8	ULC invalid frequency table	User load curve: X-axis points (frequency) are not valid.	Check that points fulfill conditions. 500.0 Hz ≤ 37.16 < 37.17 < 37.18 < 37.19< 37.20 ≤ 500.0 Hz. See parameter 37.16 ULC frequency table point 1.
A981	External event 1	Fault in external device 1.	Check the external device. Check setting of parameter 31.01 External event 1 source.
A982	External event 2	Fault in external device 2.	Check the external device. Check setting of parameter 31.03 External event 2 source.
A983	External event 3	Fault in external device 3.	Check the external device. Check setting of parameter 31.05 External event 3 source.
A984	External event 4	Fault in external device 4.	Check the external device.

Code (hex)	Event name / Aux. code	Cause	What to do
			Check setting of parameter 31.07 External event 4 source.
A985	External event 5	Fault in external device 5.	Check the external device. Check setting of parameter 31.09 External event 5 source.
AF88	Season configuration warning	You have configured a season which starts before the previous season.	Configure the seasons with increasing start dates, see parameters 34.60 Season 1 start date…34.63 Season 4 start date.
AF8C	Process PID sleep mode	The drive is entering sleep mode.	Informative warning. See section Process PID control (page 81), and parameters 40.43 Set 1 sleep level…40.48 Set 1 wake-up delay.
AF90	Speed controller autotuning	The autotune routine has been interrupted.	Check the auxiliary code. 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 Speed controller autotune (page 115).
	0002	Required torque reference could not be reached before the drive reached maximum speed.	Decrease torque step (parameter 25.38 Autotune torque step) or increase speed step (25.39 Autotune speed step).
	0003	Motor could not accelerate/decelerate to maximum/minimum speed.	Increase torque step (parameter 25.38 Autotune torque step) or decrease speed step (25.39 Autotune speed step).
	0005	Motor could not decelerate with full autotune torque.	Decrease torque step (parameter 25.38 Autotune torque step) or speed step (25.39 Autotune speed step).
AFAA	Autoreset	A fault is about to be autoreset.	Informative warning. See the settings in parameter group 31 Fault functions (page 260).
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.	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.

Code (hex)	Event name / Aux. code	Cause	What to do
AFE9	Start delay	The start delay is active and the drive will start the motor after a predefined delay.	Informative warning. See parameter 21.22 Start delay.
AFED	Run permissive	Run permissive is keeping the drive from running the motor.	Check the setting of (and source selected by) parameter 20.40 Run permissive.
AFEE	Start interlock 1	Start interlock 1 is keeping the drive from starting.	Check the signal source selected for parameter 20.41 Start interlock 1.
AFEF	Start interlock 2	Start interlock 2 is keeping the drive from starting.	Check the signal source selected for parameter 20.42 Start interlock 2.
AFF0	Start interlock 3	Start interlock 3 is keeping the drive from starting.	Check the signal source selected for parameter 20.43 Start interlock 3.
AFF1	Start interlock 4	Start interlock 4 is keeping the drive from starting.	Check the signal source selected for parameter 20.44 Start interlock 4.
AFF2	Start interlock forced warning	A forced DI is used as a source for parameter 20.40 Run permissive.	If 20.40 Run permissive uses DIx as the source, check if the bit corresponding to DIx in parameter 10.03 DI force selection.
AFF3	Run permissive forced warning	One or more forced DIs is used as a source for one or more of parameters 20.41 Start interlock 1 … 20.44 Start interlock 4.	Check all parameters 20.41 Start interlock 1 … 20.44 Start interlock 4. If any of these parameters uses DIx as the source, check if the bit corresponding to DIx in parameter 10.03 DI force selection is 1.
AFF5	Override new start required	The Safe torque off function was active and has been reset while in Override.	A new start signal is required to start the drive again.
AFF6	Identification run	Motor ID run will occur at next start.	Informative warning.
AFFE	Override active	Drive is in override mode.	Informative warning.
B5A0	STO event	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.
B5A2	Power applied	The drive was powered up or the control board was rebooted successfully.	Informative event.
B5F6	ID run done	ID run completed.	Informative event.
B681	Hand mode selected	The drive was placed in Hand mode.	Informative event. Check the control panel to ensure that the current control location is correct.
B682	Off mode selected	The drive was placed in Off mode.	Informative event. Check the control panel to ensure that the current control location is correct.

Code (hex)	Event name / Aux. code	Cause	What to do
B683	Auto mode selected	The drive was placed in Auto mode.	Informative event. Check the control panel to ensure that the current control location is correct.
B686	Checksum mismatch	The calculated parameter checksum does not match any enabled reference checksum.	Check that all necessary approved (reference) checksums (parameters 96.71…96.72) are enabled in parameter 96.55 Checksum control word. Check the parameter configuration. Using parameter 96.55 Checksum control word, enable a checksum parameter and copy the actual checksum into that parameter.
B687	Auto start command	The drive received a start command while in Auto mode.	Informative event.
B688	Auto stop command	The drive received a stop command while in Auto mode	Informative event.
B689	Modulating started	The drive started modulating.	Informative event.
B68A	Modulating stopped	The drive stopped modulating.	Informative event.
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.
FA82	Safe torque off 2	Safe torque off function is active, ie. STO circuit 2 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.
FF61	ID run	Motor ID run was not completed successfully.	Check the nominal motor values in parameter group 99 Motor data (page 390). Check that no external control system is connected to the drive. Cycle the power to the drive (and its control unit, if powered separately). Check that no operation limits prevent the completion of the ID run. Restore parameters to default settings and try again. Check that the motor shaft is not locked. Check the auxiliary code. See actions for each code below
	0001	Maximum current limit too low.	Check settings of parameters 99.06 Motor nominal current and 30.17 Maximum current. Make sure that 30.17 Maximum current > 99.06 Motor nominal current.

Code (hex)	Event name / Aux. code	Cause	What to do
	0002	Maximum speed limit or calculated field weakening point too low.	Check that the drive is dimensioned correctly according to the motor. 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 Maximum speed > (0.55 × 99.09 Motor nominal speed) > (0.50 × synchronous speed) • 30.11 Minimum speed < 0, and • supply voltage > (0.66 × 99.07 Motor nominal voltage).
	0003	Maximum torque limit too low.	Check settings of parameter 99.12 Motor nominal torque, and the torque limits in parameter group 30 Limits (page 249). Make sure that the maximum torque limit in force is greater than 100%.
	0004	Current measurement calibration did not finish within reasonable time.	Contact your local ABB representative and quote this fault and auxliary code.
	0005…0008	Internal error.	Contact your local ABB representative and quote this fault and auxliary code.
	0009	(Asynchronous motors only) Acceleration did not finish within reasonable time.	Contact your local ABB representative and quote this fault and auxliary code.
	000A	(Asynchronous motors only) Deceleration did not finish within reasonable time.	Contact your local ABB representative and quote this fault and auxliary code.
	000B	(Asynchronous motors only) Speed dropped to zero during ID run.	Contact your local ABB representative and quote this fault and auxliary code.
	000C	(Permanent magnet motors only) First acceleration did not finish within reasonable time.	Contact your local ABB representative and quote this fault and auxliary code.
	000D	(Permanent magnet motors only) Second acceleration did not finish within reasonable time.	Contact your local ABB representative and quote this fault and auxliary code.
	000E…0010	Internal error.	Contact your local ABB representative and quote this fault and auxliary code.
	0011	(Synchronous reluctance motors only) Pulse test error.	Contact your local ABB representative and quote this fault and auxliary code.
	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.

Code (hex)	Event name / Aux. code	Cause	What to do
			Contact your local ABB representative and quote this fault and auxliary code.
FF63	STO diagnostics failure	Internal SW malfunction.	Reboot the control unit (using parameter 96.08 Control board boot) or by cycling power.
FF8E	EFB force trip	A fault trip command has been received through the embedded fieldbus interface.	Check the fault information provided by the PLC.

8

Modbus RTU control through the embedded fieldbus interface (EFB)

Contents of this chapter

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 the embedded fieldbus interface.

Modbus

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.

Embedded fieldbus and assistant control panel mode switch

The embedded fieldbus and the optional assistant control panel of ACH180 share the same port internally and can be switched by a jumper. You cannot use the assistant control panel together with the embedded fieldbus. If you have the EFB communication enabled in the drive, but need to temporarily change to a communication with an assistant control panel, do these steps:

1. Power-down the drive, wait for 5 minutes.
2. Place the jumper to "panel mode".
3. Connect the assistant control panel onto the drive.
4. Power-up the drive.
5. The drive identifies the panel automatically and you can use it. Be noted that at this moment the EFB does not work.
6. After the work is done, make sure that the drive is in "OFF" mode and power-down the drive.
7. Disconnect the assistant control panel from the drive.
8. Place the jumper J2 to "Modbus Mode".
9. Power-up the drive.

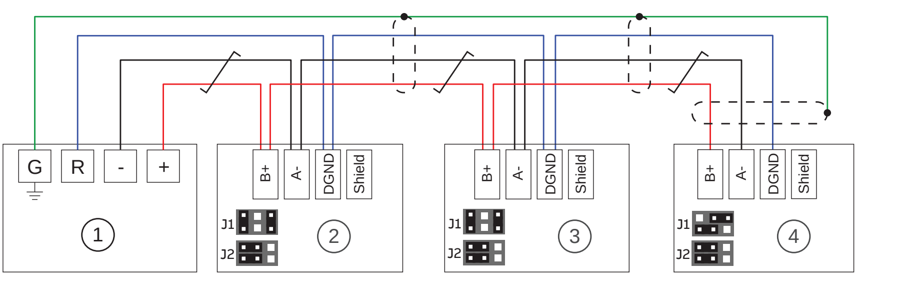
Connecting the fieldbus to the drive

Connect the fieldbus to the EIA-485 terminal on the front of the drive.

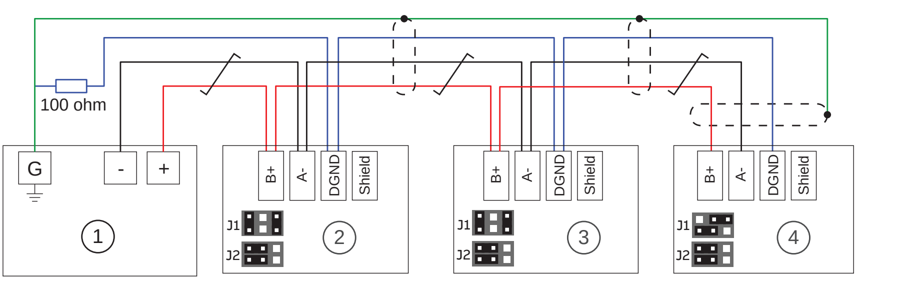
The EIA-485 network uses shielded, twisted-pair cable for data signaling with characteristic impedance between 100…130 ohm. The distributed capacitance between conductors is less than 100 pF per meter (30 pF per foot). Distributed capacitance between conductors and shield is less than 200 pF per meter (60 pF per foot). Foil or braided shields are permitted.

The connection diagram is shown below.

With signal ground reference terminal



Without signal ground reference terminal



1	Fieldbus controller. Termination ON[1)].
2	Drive. J1: Termination OFF; J2: Modbus Mode
3	Drive. J1: Termination OFF; J2: Modbus Mode
4	Drive at the end of the communication line. J1: Termination ON[1)] ; J2: Modbus Mode

1) **Note:** The device at both ends on the fieldbus must have termination set to ON.

Setting up the embedded fieldbus interface

Set the drive up for the embedded fieldbus communication with the parameters shown in the table below. The **Setting for fieldbus control** column gives either the value to use or the default value. The **Function/Information column** gives a description of the parameter.

Parameter	**Setting for fieldbus control**	**Function/Information**
COMMUNICATION INITIALIZATION		
58.01 Protocol enable	Modbus RTU	Initializes embedded fieldbus communication.

Parameter	Setting for fieldbus control	Function/Information
EMBEDDED MODBUS CONFIGURATION		
58.03 Node address	1 (default)	Node address. There must be no two nodes with the same node address online.
58.04 Baud rate	19.2 kbps (default)	Defines the communication speed of the link. Use the same setting as in the master station.
58.05 Parity	8 EVEN 1 (default)	Selects the parity and stop bit setting. Use the same setting as in the master station.
58.14 Communication loss action	No action (default)	Defines the action taken when a communication loss is detected.
58.15 Communication loss mode	Cw / Ref1 / Ref2 (default)	Enables/disables communication loss monitoring and defines the means for resetting the counter of the communication loss delay.
58.16 Communication loss time	30.0 s (default)	Defines the time-out limit for the communication monitoring.
58.17 Transmit delay	0 ms (default)	Defines a response delay for the drive.
58.25 Control profile	ABB Drives (default)	Selects the control profile used by the drive. See section Basics of the embedded fieldbus interface (page 434).
58.26 EFB ref1 type ... 58.29 EFB act2 type	Speed or frequency, Transparent, General, Torque, Speed, Frequency	Selects the reference and actual value types.
58.31 EFB act1 transparent source	Other (see Terms and abbreviations (page 16))	Defines the source of actual value 1 when 58.28 EFB act1 type = Transparent or General.
58.32 EFB act2 transparent source	Other (see Terms and abbreviations (page 16))	Defines the source of actual value 2 when 58.29 EFB act2 type = Transparent or General.
58.33 Addressing mode	eg. Mode 0 (default)	Defines the mapping between parameters and holding registers in the 400001…465536 (100…65535) Modbus register range.
58.34 Word order	LO-HI (default)	Defines the order of the data words in the Modbus message frame.

Parameter	Setting for fieldbus control	Function/Information
58.101 Data I/O 1 … 58.114 Data I/O 14	For example, the default settings (I/Os 1…6 contain the control word, the status word, two references and two actual values)	Define the address of the drive parameter which the Modbus master accesses when it reads from or writes to the register address corresponding to Modbus In/Out parameters. Select the parameters that you want to read or write through the Modbus I/O words.
	RO/DIO control word, AO1 data storage, Feedback data storage, Setpoint data storage	These settings write the incoming data into storage parameters 10.99 RO/DIO control word, 13.91 AO1 data storage, 40.91 Feedback data storage or 40.92 Setpoint data storage.
58.06 Communication control	Refresh settings	Validates the settings of the configuration parameters.

The new settings will take effect when the drive is powered up the next time, or when they are validated by parameter 58.06 Communication control.

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.

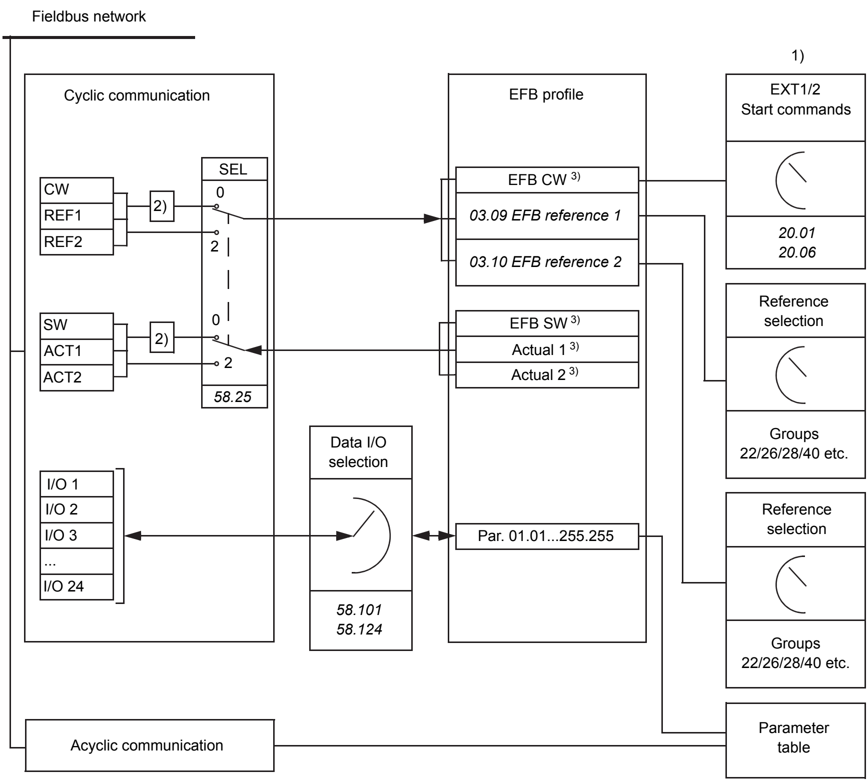
Parameter	Setting for fieldbus control	Function/Information
CONTROL COMMAND SOURCE SELECTION		
20.01 Ext1 commands	Embedded fieldbus	Selects fieldbus as the source for the start and stop commands when EXT1 is selected as the active control location.
20.06 Ext2 commands	Embedded fieldbus	Selects fieldbus 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 or EFB ref2	Selects a reference received through the embedded fieldbus interface as speed reference 1.

Parameter	Setting for fieldbus control	Function/Information
22.12 Ext1 speed ref2	EFB ref1 or EFB ref2	Selects a reference received through the embedded fieldbus interface as speed reference 2.
FREQUENCY REFERENCE SELECTION		
28.11 Ext1 frequency ref1	EFB ref1 or EFB ref2	Selects a reference received through the embedded fieldbus interface as frequency reference 1.
28.12 Ext1 frequency ref2	EFB ref1 or EFB ref2	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 (see Terms and abbreviations (page 16)), then either 03.09 EFB reference 1 or 03.10 EFB reference 2.		
CONTROL OF RELAY OUTPUTS, ANALOG OUTPUTS AND DIGITAL INPUT/OUTPUTS		
10.24 RO1 source	RO1	Connects bit 0 of storage parameter 10.99 RO/DIO control word to relay output RO1.
11.06 DIO1 output source	RO/DIO control word bit8	Connects bit 8 of storage parameter 10.99 RO/DIO control word to digital input/output DIO1.
13.12 AO1 source	AO1 data storage	Connects storage parameter 13.91 AO1 data storage to analog output AO1.
PROCESS PID FEEDBACK AND SETPOINT		
40.08 Set 1 feedback 1 source	Feedback data storage	Connect the bits of the storage parameter (10.99 RO/DIO control word) to the digital input/outputs of the drive.
40.16 Set 1 setpoint 1 source	Setpoint data storage	
SYSTEM CONTROL INPUTS		
96.07 Parameter save manually	Save (reverts to Done)	Saves parameter value changes (including those made through fieldbus control) to permanent memory.

Basics of the embedded fieldbus interface

The cyclic communication between a fieldbus system and the drive consists of 16-bit data words or 32-bit data words (with the transparent control profiles).

The diagram below illustrates the operation of the embedded fieldbus interface. The signals transferred in the cyclic communication are explained further below the diagram.



1	See also other parameters which can be controlled through fieldbus.
2	Data conversion if parameter 58.25 Control profile is set to ABB Drives. See section About the control profiles (page 437).

Control word and Status word

The Control Word (CW) is a 16-bit or 32-bit packed boolean word. It is the principal means of controlling the drive from a fieldbus system. The CW is sent by the fieldbus controller to the drive. By drive parameters, the user selects the EFB CW as the source of drive control commands (such as start/stop, emergency stop, selection between external control locations 1/2, or fault reset). The drive switches between its states according to the bit-coded instructions of the CW.

The fieldbus CW is either written to the drive as it is (see parameter), or the data is converted. See section About the control profiles (page 437).

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 437).

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 437).

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 437).

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 to 465536 are inaccessible to these masters. For more information see parameter 58.33 Addressing mode.

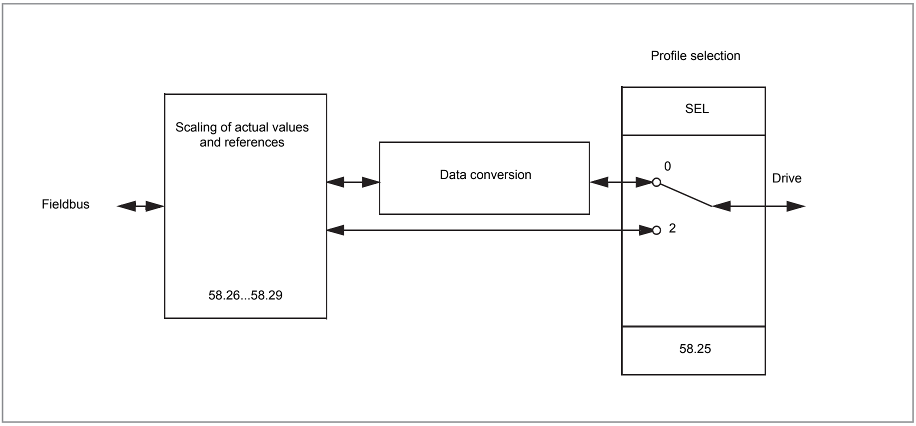
Note: Register addresses of 32-bit parameters cannot be accessed by using 5-digit register numbers.

About the control profiles

A control profile defines the rules for data transfer between the drive and the fieldbus master, for example:

- if packed boolean words are converted and how
- how drive register addresses are mapped for the fieldbus master.

You can configure the drive to receive and send messages according to the ABB Drives profile or the DCU profile. With the ABB Drives profile, the embedded fieldbus interface of the drive converts the control word and status word to and from the native data used in the drive. The DCU profile involves no data conversion. The figure below illustrates the effect of the profile selection.



Control profile selection with parameter 58.25 Control profile:

- (0) ABB Drives
- (2) DCU Profile

Note that scaling of references and actual values can be selected independent of the profile selection by parameters 58.26…58.29.

The ABB Drives profile

Control Word

The table below shows the contents of the fieldbus Control Word for the ABB Drives control profile. The embedded fieldbus interface converts this word to the form in which it is used in the drive. The upper case boldface text refers to the states shown in State transition diagram (page 441).

Bit	Name	Value	STATE/Description
0	OFF1_ CONTROL	1	Proceed to READY TO OPERATE.
		0	Stop along currently active deceleration ramp. Proceed to **OFF1 ACTIVE**; proceed to **READY TO SWITCH ON** unless other interlocks (OFF2, OFF3) are active.
1	OFF2_ CONTROL	1	Continue operation (OFF2 inactive).
		0	Emergency OFF, coast to stop. Proceed to **OFF2 ACTIVE**, proceed to **SWITCH-ON INHIBITED**.
2	OFF3_ CONTROL	1	Continue operation (OFF3 inactive).
		0	Emergency stop, stop within time defined by drive parameter. Proceed to OFF3 ACTIVE; proceed to SWITCH-ON INHIBITED. **WARNING!** Ensure that the motor and driven machine can be stopped using this stop mode.
3	INHIBIT_OPERATION	1	Proceed to **OPERATION ENABLED**. **Note:** Run enable signal must be active; see the drive documentation. If the drive is set to receive the Run enable signal from the fieldbus, this bit activates the signal.
		0	Inhibit operation. Proceed to **OPERATION INHIBITED**.
4	RAMP_OUT_ ZERO	1	Normal operation. Proceed to **RAMP FUNCTION GENERATOR: OUTPUT ENABLED**.
		0	Force Ramp Function Generator output to zero. Drive ramps to stop (current and DC voltage limits in force).
5	RAMP_HOLD	1	Enable ramp function. Proceed to **RAMP FUNCTION GENERATOR: ACCELERATOR ENABLED**.
		0	Halt ramping (Ramp Function Generator output held).

Bit	Name	Value	STATE/Description
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.
8…9	Reserved		
10	REMOTE_ CMD	1	Fieldbus control enabled.
		0	Control word and reference will not get through to the drive, except for CW bits OFF1, OFF2 and OFF3.
11	EXT_CTRL_ LOC	1	Select External Control Location EXT2. Effective if the control location is parameterized to be selected from the fieldbus.
		0	Select External Control Location EXT1. Effective if the control location is parameterized to be selected from the fieldbus.
12	USER_0		Writable control bits that can be combined with drive logic for application-specific functionality.
13	USER_1		
14	USER_2		
15	USER_3		

Status Word for the ABB Drives profile

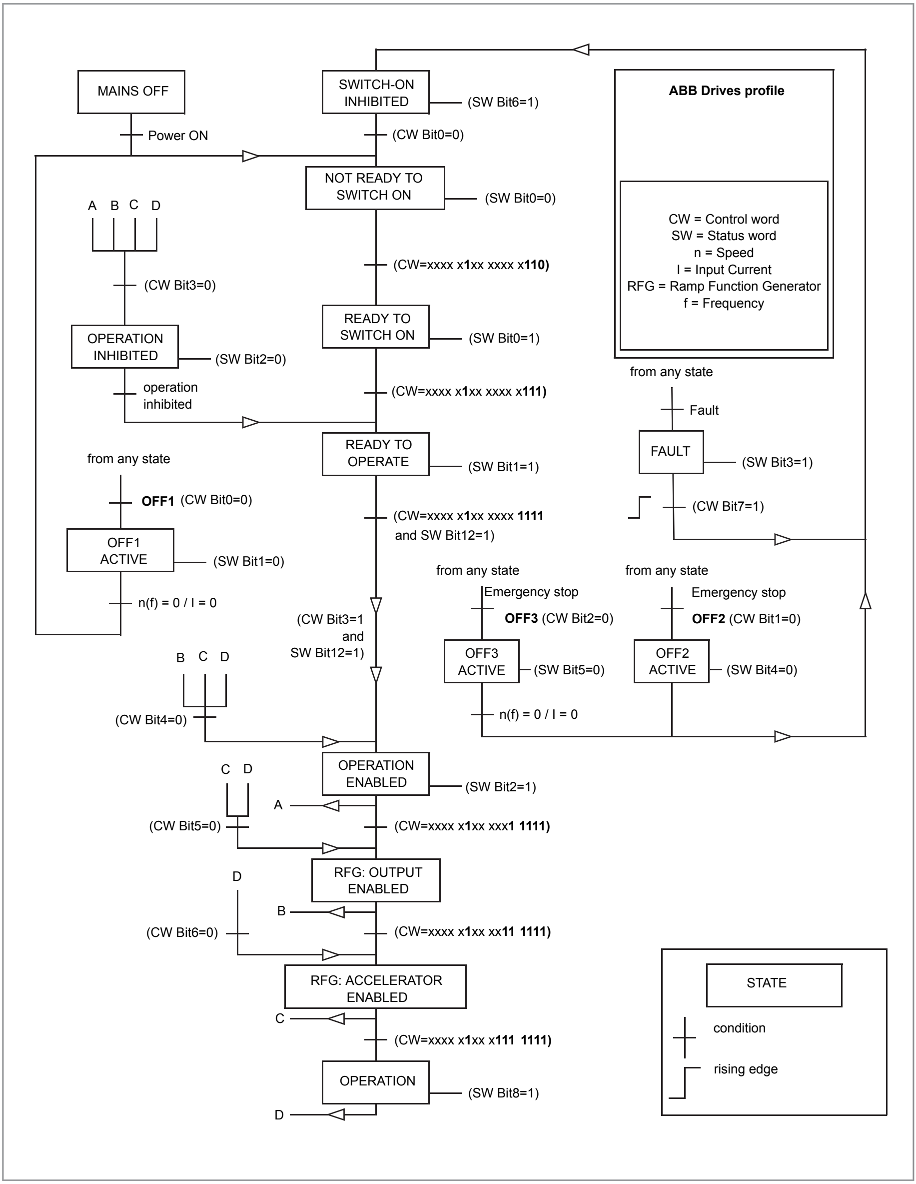
The table below shows the fieldbus Status Word for the ABB Drives control profile. The embedded fieldbus interface converts the drive Status Word into this form for the fieldbus. The upper case boldface text refers to the states shown in State transition diagram (page 441).

Bit	Name	Value	STATE/Description
0	RDY_ON	1	READY TO SWITCH ON.
		0	NOT READY TO SWITCH ON.

Bit	Name	Value	STATE/Description
1	RDY_RUN	1	READY TO OPERATE.
		0	OFF1 ACTIVE.
2	RDY_REF	1	OPERATION ENABLED.
		0	OPERATION INHIBITED.
3	TRIPPED	1	FAULT.
		0	No fault.
4	OFF_2_STATUS	1	OFF2 inactive.
		0	OFF2 ACTIVE.
5	OFF_3_STATUS	1	OFF3 inactive.
		0	OFF3 ACTIVE.
6	SWC_ON_ INHIB	1	SWITCH-ON INHIBITED.
		0	-
7	ALARM	1	Warning/Alarm.
		0	No warning/alarm.
8	AT_ SETPOINT	1	OPERATING. Actual value equals Reference = is within tolerance limits, i.e. in speed control, speed error is 10% max. of nominal motor speed.
		0	Actual value differs from Reference = is outside tolerance limits.
9	REMOTE	1	Drive control location: REMOTE (EXT1 or EXT2).
		0	Drive control location: LOCAL.
10	ABOVE_ LIMIT	1	Actual frequency or speed equals or exceeds supervision limit (set by drive parameter). Valid in both directions of rotation.
		0	Actual frequency or speed within supervision limit.
11	USER_0		Status bits that can be combined with drive logic for application-specific 12 USER_1 functionality.
12	USER_1		
13	USER_2		
14	USER_3		
15	Reserved		

State transition diagram

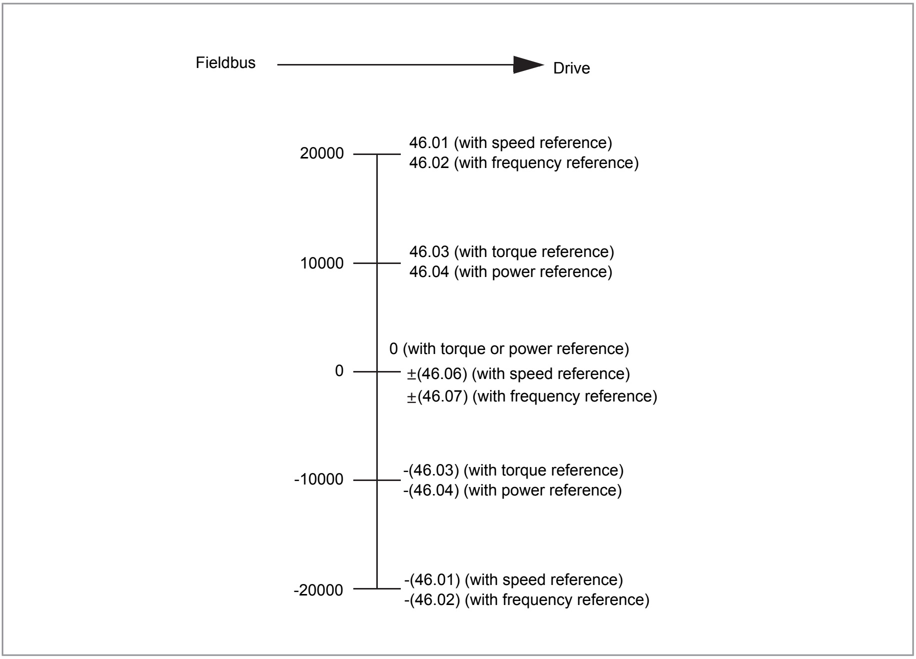
The diagram below shows the state transitions in the drive when the drive is using the ABB Drives profile, and configured to follow the commands of the control word from the embedded fieldbus interface. The upper case texts refer to the states which are used in the tables representing the fieldbus Control and Status words. See sections Control Word (page 437) and Status Word for the ABB Drives profile (page 439).


MAINS OFF
Power ON
SWITCH-ON INHIBITED
(SW Bit6=1)
(CW Bit0=0)
NOT READY TO SWITCH ON
(SW Bit0=0)
ABB Drives profile
CW = Control word
SW = Status word
n = Speed
I = Input Current
RFG = Ramp Function Generator
f = Frequency
A B C D
(CW Bit3=0)
OPERATION INHIBITED
(SW Bit2=0)
operation inhibited
(CW=xxxx x1xx xxxx x110)
READY TO SWITCH ON
(SW Bit0=1)
(CW=xxxx x1xx xxxx x111)
from any state
Fault
FAULT
(SW Bit3=1)
(CW Bit7=1)
READY TO OPERATE
(SW Bit1=1)
from any state
OFF1 (CW Bit0=0)
OFF1 ACTIVE
(SW Bit1=0)
n(f) = 0 / I = 0
(CW=xxxx x1xx xxxx 1111 and SW Bit12=1)
from any state
Emergency stop
OFF3 (CW Bit2=0)
OFF3 ACTIVE
(SW Bit5=0)
n(f) = 0 / I = 0
from any state
Emergency stop
OFF2 (CW Bit1=0)
OFF2 ACTIVE
(SW Bit4=0)
(CW Bit3=1 and SW Bit12=1)
B C D
(CW Bit4=0)
OPERATION ENABLED
(SW Bit2=1)
C D
A
(CW Bit5=0)
(CW=xxxx x1xx xxx1 1111)
RFG: OUTPUT ENABLED
D
B
(CW Bit6=0)
(CW=xxxx x1xx xx11 1111)
RFG: ACCELERATOR ENABLED
C
(CW=xxxx x1xx x111 1111)
OPERATION
(SW Bit8=1)
D
STATE
condition
rising edge

References

The ABB drives profile supports the use of two references, EFB reference 1 and EFB reference 2. The references are 16-bit words each containing a sign bit and a 15-bit integer. A negative reference is formed by calculating the two's complement from the corresponding positive reference.

The references are scaled as defined by parameters 46.01...46.07; which scaling is in use depends on the setting of 58.26 EFB ref1 type and 58.27 EFB ref2 type.

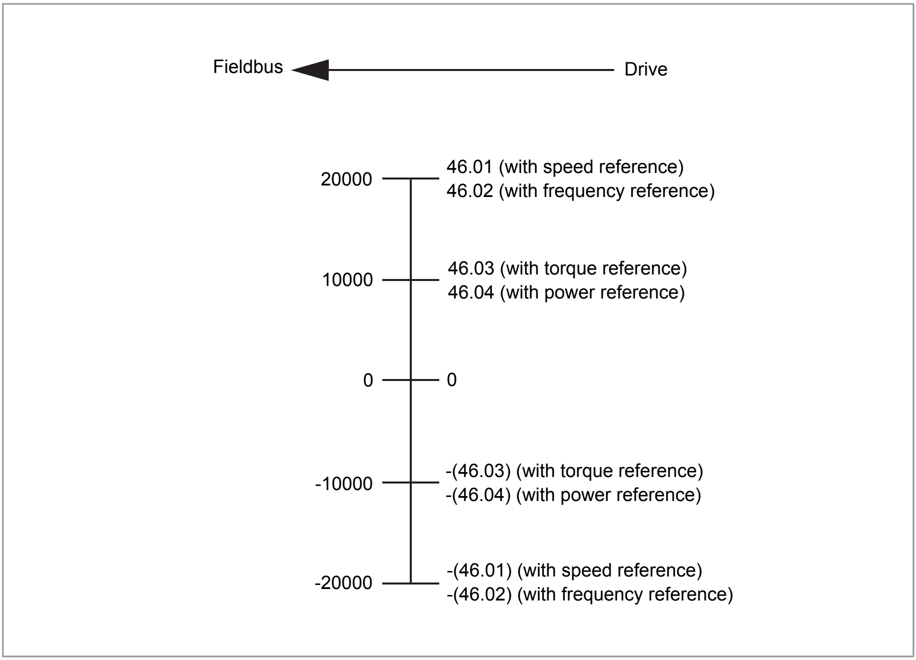


The scaled references are shown by parameters 03.09 EFB reference 1 and 03.10 EFB reference 2.

Actual values

The ABB Drives profile supports the use of two fieldbus actual values, ACT1 and ACT2. The actual values are 16-bit words each containing a sign bit and a 15-bit integer. A negative value is formed by calculating the two's complement from the corresponding positive value.

The actual values are scaled as defined by parameters 46.01...46.04; which scaling is in use depends on the setting of parameters 58.28 EFB act1 type and 58.29 EFB act2 type.



Modbus holding register addresses

The table below shows the default Modbus holding register addresses for drive data.

This profile provides a converted 16-bit access to the data.

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	Control word. See sections Control Word (page 437) and Control Word (page 446). The selection can be changed using parameter 58.101 Data I/O 1.
400002	Reference 1 (REF1). The selection can be changed using parameter 58.102 Data I/O 2.
400003	Reference 2 (REF2). The selection can be changed using parameter 58.103 Data I/O 3.
400004	Status Word (SW). See sections Status Word for the ABB Drives profile (page 439) and Status Word for the DCU profile (page 447). The selection can be changed using parameter 58.104 Data I/O 4.
400005	Actual value 1 (ACT1). The selection can be changed using parameter 58.105 Data I/O 5.
400006	Actual value 2 (ACT2). The selection can be changed using parameter 58.106 Data I/O 6.
400007...400024	Data in/out 7...24. Selected by parameters 58.107 Data I/O 7 ... 58.114 Data I/O 14.
400025...400089	Unused
400090...400100	Error code access. See section Error code registers (holding registers 400090…400100) (page 455).
400101...465536	Parameter read/write. Parameters are mapped to register addresses according to parameter 58.33 Addressing mode.

The DCU profile

Control Word

The embedded fieldbus interface writes the fieldbus Control Word as is to the drive Control Word bits 0 to 15. Bits 16 to 32 of the drive Control Word are not in use.

Bit	Name	Value	STATE/Description
0	STOP	1	Stop according to the Stop Mode parameter or the stop mode request bits (bits 7…9).
		0	(no op)
1	START	1	Start the drive
		0	(no op)
2	REVERSE	1	Reverse direction of motor rotation.
		0	(no op)
3	Reserved		
4	RESET	0=>1	Fault reset if an active fault exists.
		0	(no op)
5	EXT2	1	Select External control location EXT2. Effective if the control location is parameterized to be selected from the fieldbus.
		0	Select External control location EXT1. Effective if the control location is parameterized to be selected from the fieldbus.
6	RUN_DISABLE	1	Run disable. If the drive is set to receive the run enable signal from the fieldbus, this bit deactivates the signal.
		0	Run enable. If the drive is set to receive the run enable signal from the fieldbus, this bit activates the signal.
7	STOPMODE_RAMP	1	Normal ramp stop mode
		0	(no op) Default to parameter stop mode if bits 7…9 are all 0.
8	STOPMODE_EMERGENCY_RAMP	1	Emergency ramp stop mode.
		0	(no op) Default to parameter stop mode if bits 7…9 are all 0.
9	STOPMODE_COAST	1	Coast stop mode.
		0	(no op) Default to parameter stop mode if bits 7…9 are all 0.

Bit	Name	Value	STATE/Description
10	Reserved for RAMP_PAIR _2		Not yet implemented.
11	RAMP_OUT_ZERO	1	Force Ramp Function Generator output to zero. Drive ramps to stop (current and DC voltage limits in force).
		0	Normal operation.
12	RAMP_HOLD	1	Halt ramping (Ramp Function Generator output held).
		0	Normal operation.
13	RAMP_IN_ZERO	1	Force Ramp Function Generator input to zero.
		0	Normal operation.
14	REQ_LOCAL_LOCK	1	
		0	
15	Reserved for TORQ_LIM_PAIR_2		Not yet implemented.
16	FB_LOCAL_CTL	1	Local mode for control from the fieldbus is requested. Steal control from the active source.
		0	(no op)
17	FB_LOCAL_REF	1	Local mode for reference from the fieldbus is requested. Steal reference from the active source.
		0	(no op)
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 for the DCU profile

The embedded fieldbus interface writes the drive Status Word bits 0 to 15 to the fieldbus Status Word as is. Bits 16 to 32 of the drive Status Word are not in use.

Bit	Name	Value	STATE/Description
0	READY	1	Drive is ready to receive the start command.
		0	Drive is not ready.
1	ENABLED	1	External run enable signal is active.
		0	External run enable signal is not active.
2	Reserved for EN-ABLED_TO_ROTATE		Not yet implemented.
3	RUNNING	1	Drive is modulating.
		0	Drive is not modulating.
4	ZERO_SPEED	1	Drive is at zero speed.
		0	Drive is not at zero speed.
5	ACCELERATING	1	Not yet implemented.
		0	Not yet implemented.
6	DECELERATING	1	Not yet implemented.
		0	Not yet implemented.
7	AT_SETPOINT	1	Drive is at setpoint.
		0	Drive is not at setpoint.
8	LIMIT	1	Drive operation is limited.
		0	Drive operation is not limited.
9	SUPERVISION	1	Actual value (speed, frequency or torque) is above a limit. Limit is set with parameters 46.31…46.33
		0	Actual value (speed, frequency or torque) is within limits.
10	REVERSE_REF	1	Not yet implemented.
		0	Not yet implemented.
11	REVERSE_ACT	1	Not yet implemented.
		0	Not yet implemented.
12	PANEL_LOCAL	1	Panel/keypad (or PC tool) is in local control mode.
		0	Panel/keypad (or PC tool) is not in local control mode.
13	FIELDBUS_LOCAL	1	Fieldbus is in local control mode.
		0	Fieldbus is not in local control mode.

Bit	Name	Value	STATE/Description
14	EXT2_ACT	1	External control location EXT2 is active.
		0	External control location EXT1 is active.
15	FAULT	1	Drive is faulted.
		0	Drive is not faulted.
16	ALARM	1	Warning/Alarm is active.
		0	No warning/alarm.
17	Reserved		
18	Reserved for DIREC-TION_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		

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 re-gisters (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 refer-ence).

Code	Function name	Description
08h	Diagnostics	Provides a series of tests for checking the communication, or for checking various internal error conditions. Supported subcodes: • 00h Return Query Data: Echo/loopback test. • 01h Restart Comm Option: Restarts and initializes the EFB, clears communications event counters. • 04h Force Listen Only Mode • 0Ah Clear Counters and Diagnostic Register • 0Bh Return Bus Message Count • 0Ch Return Bus Comm. Error Count • 0Dh Return Bus Exception Error Count • 0Eh Return Slave Message Count • 0Fh Return Slave No Response Count • 10h Return Slave NAK (negative acknowledge) Count • 11h Return Slave Busy Count • 12h Return Bus Character Overrun Count • 14h Clear Overrun Counter and Flag
0Bh	Get Comm Event Counter	Returns a status word and an event count.
0Fh	Write Multiple Coils	Forces a sequence of coils (0X references) to 0 or 1.
10h	Write Multiple Registers	Writes the contents of a contiguous block of holding registers (4X references).
16h	Mask Write Register	Modifies the contents of a 4X register using a combination of an AND mask, an OR mask, and the register's current contents.
17h	Read/Write Multiple Registers	Writes the contents of a contiguous block of 4X registers, then reads the contents of another group of registers (the same or different than those written) in a server device.

Code	Function name	Description
2Bh/0Eh	Encapsulated Interface Transport	Supported subcodes: • 0Eh Read Device Identification: Allows reading the identification and other information. Supported ID codes (access type): • 00h: Request to get the basic device identification (stream access) • 04h: Request to get one specific identification object (individual access) Supported Object IDs: • 00h: Vendor Name (“ABB”) • 01h: Product Code (for example, “AINFX”) • 02h: Major Minor Revision (combination of contents of parameters 07.05 Firmware version and 58.02 Protocol ID). • 03h: Vendor URL (www.abb.com) • 04h: Product name (for example, “ACS880”)

Exception codes

The table below shows the Modbus exception codes supported by the embedded fieldbus interface.

Code	Name	Description
01h	ILLEGAL FUNCTION	The function code received in the query is not an allowable action for the server.
02h	ILLEGAL DATA ADDRESS	The data address received in the query is not an allowable address for the server.
03h	ILLEGAL DATA VALUE	The requested Quantity of Registers is larger than the drive can handle. **Note:** This error does not mean that a value written to a drive parameter is outside the valid range.
04h	SLAVE DEVICE FAILURE	The value written to a drive parameter is outside the valid range. See section Error code registers (holding registers 400090…400100) (page 455).
06h	SLAVE DEVICE BUSY	The server is engaged in processing a long-duration program command.

Coils (0xxxx reference set)

Coils are 1-bit read/write values. Control Word bits are exposed with this data type. The table below summarizes the Modbus coils (0xxxx reference set).

Reference	ABB drives profile	DCU profile
00001	OFF1_CONTROL	STOP
00002	OFF2_CONTROL	START
00003	OFF3_CONTROL	Control Word bit 2
00004	INHIBIT_OPERATION	Control Word bit 3
00005	RAMP_OUT_ZERO	Control Word bit 4
00006	RAMP_HOLD	Control Word bit 5
00007	RAMP_IN_ZERO	Control Word bit 6
00008	RESET	Control Word bit 7
00009	JOGGING_1	Control Word bit 8
00010	JOGGING_2	Control Word bit 9
00011	REMOTE_CMD	Control Word bit 10
00012	EXT_CTRL_LOC	Control Word bit 11
00013	User-defined (0)	Control Word bit 12
00014	User-defined (1)	Control Word bit 13
00015	User-defined (2)	Control Word bit 14
00016	User-defined (3)	Control Word bit 15
00017	Reserved	Control Word bit 16
00018	Reserved	Control Word bit 17
00019	Reserved	Control Word bit 18
00020	Reserved	Control Word bit 19
00021	Reserved	Control Word bit 20
00022	Reserved	Control Word bit 21
00023	Reserved	Control Word bit 22
00024	Reserved	Control Word bit 23
00025	Reserved	Control Word bit 24
00026	Reserved	Control Word bit 25
00027	Reserved	Control Word bit 26
00028	Reserved	Control Word bit 27
00029	Reserved	Control Word bit 28
00030	Reserved	Control Word bit 29
00031	Reserved	Control Word bit 30
00032	Reserved	Control Word bit 31

Reference	ABB drives profile	DCU profile
00033	Reserved	10.99 RO/DIO control word, bit 0
00034	Reserved	10.99 RO/DIO control word, bit 1
00035	Reserved	10.99 RO/DIO control word, bit 2
00036	Reserved	10.99 RO/DIO control word, bit 3
00037	Reserved	10.99 RO/DIO control word, bit 4
00038	Reserved	10.99 RO/DIO control word, bit 5
00039	Reserved	10.99 RO/DIO control word, bit 6
00040	Reserved	10.99 RO/DIO control word, bit 7
00041	Reserved	10.99 RO/DIO control word, bit 8
00042	Reserved	10.99 RO/DIO control word, bit 9

Discrete inputs (1xxxx reference set)

Discrete inputs are 1-bit read-only values. Status Word bits are exposed with this data type. The table below summarizes the Modbus discrete inputs (1xxxx reference set).

Reference	ABB drives profile	Transparent profile
10001	RDY_ON	Status Word bit 0
10002	RDY_RUN	Status Word bit 1
10003	RDY_REF	Status Word bit 2
10004	TRIPPED	Status Word bit 3
10005	OFF_2_STA	Status Word bit 4
10006	OFF_3_STA	Status Word bit 5
10007	SWC_ON_INHIB	Status Word bit 6
10008	ALARM	Status Word bit 7
10009 10009	AT_SETPOINT	Status Word bit 8
10010	REMOTE	Status Word bit 9
10011	ABOVE_LIMIT	Status Word bit 10
10012	User-defined (0)	Status Word bit 11
10013	User-defined (1)	Status Word bit 12
10014	User-defined (2)	Status Word bit 13
10015	User-defined (3)	Status Word bit 14

Reference	ABB drives profile	Transparent profile
10016	Reserved	Status Word bit 15
10017	Reserved	Status Word bit 16
10018	Reserved	Status Word bit 17
10019	Reserved	Status Word bit 18
10020	Reserved	Status Word bit 19
10021	Reserved	Status Word bit 20
10022	Reserved	Status Word bit 21
10023	Reserved	Status Word bit 22
10024	Reserved	Status Word bit 23
10025	Reserved	Status Word bit 24
10026	Reserved	Status Word bit 25
10027	Reserved	Status Word bit 26
10028	Reserved	Status Word bit 27
10029	Reserved	Status Word bit 28
10030	Reserved	Status Word bit 29
10031	Reserved	Status Word bit 30
10032	Reserved	Status Word bit 31
10033	Reserved	10.02 DI delayed status, bit 0
10034	Reserved	10.02 DI delayed status, bit 1
10035	Reserved	10.02 DI delayed status, bit 2
10036	Reserved	10.02 DI delayed status, bit 3
10037	Reserved	10.02 DI delayed status, bit 4
10038	Reserved	10.02 DI delayed status, bit 5
10039	Reserved	10.02 DI delayed status, bit 6
10040	Reserved	10.02 DI delayed status, bit 7
10041	Reserved	10.02 DI delayed status, bit 8
10042	Reserved	10.02 DI delayed status, bit 9
10043	Reserved	10.02 DI delayed status, bit 10
10044	Reserved	10.02 DI delayed status, bit 11
10045	Reserved	10.02 DI delayed status, bit 12
10046	Reserved	10.02 DI delayed status, bit 13
10047	Reserved	10.02 DI delayed status, bit 14

Reference	ABB drives profile	Transparent profile
10048	Reserved	10.02 DI delayed status, bit 15

Error code registers (holding registers 400090…400100)

These registers contain information about the last query. The error register is cleared when a query has finished successfully.

Reference	Name	Description
90	Reset Error Registers	1 = Reset internal error registers (91…95).
91	Error Function Code	Function code of the failed query.
92	Error Code	Set when exception code 04h is generated (see table above). • 00h No error • 02h Low/High limit exceeded • 03h Faulty Index: Unavailable index of an array parameter • 05h Incorrect Data Type: Value does not match the data type of the parameter • 65h General Error: Undefined error when handling query
93	Failed Register	The last register (discrete input, coil, or holding register) that failed to be read or written.
94	Last Register Written Successfully	The last register that was written successfully.
95	Last Register Read Successfully	The last register that was read successfully.

9

BACnet MS/TP control through the embedded fieldbus interface (EFB)

Contents of this chapter

The chapter describes BACnet MS/TP control through the embedded fieldbus interface (EFB): supported functionality, services and objects as well as how to configure the BACnet with parameters.

BACnet overview

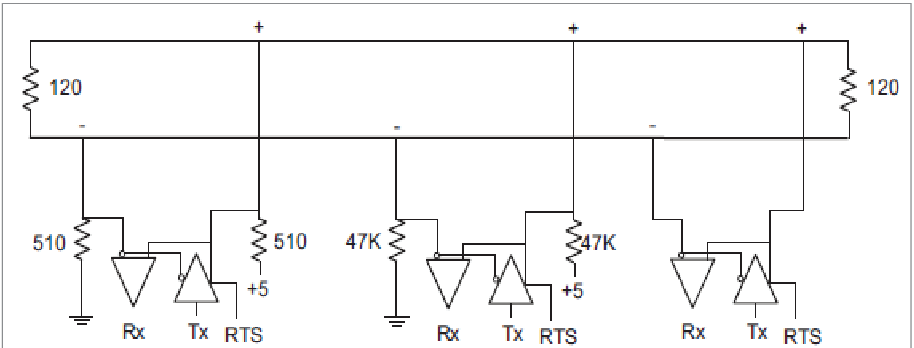
BACnet is an open standard for data communication that enables interoperability between different building systems (eg fire, security, lighting, HVAC, elevator, etc.) and devices in building automation and control applications. It enables data sharing among different types of devices from a broad set of suppliers.

You can download the most recent version of BACnet Protocol Implementation Conformance Statement (PICS) for ACH180 from https://www.bacnetinternational.net/btl/.

Hardware installation

Connecting devices to a BACnet MS/TP EIA-485 network

The figure shows three types of nodes connected on the EIA-485 network.



Connecting the drive to the building automation controller

For connecting the EFB terminal block X5 of the drive to the building automation controller via the EIA-485 network, see section Connecting the fieldbus to the drive (page 430).

Starting up fieldbus communication with parameters

Follow these steps to set up fieldbus communication with parameters in the Parameters menu. For example of appropriate values, see section Activating drive control functions (page 459).

1. Power up the drive.
2. Enable BACnet communication by setting parameter 58.01 Protocol enable to BACnet MSTP.
3. Configure network settings with parameters 58.03 Node address and 58.04 Baud rate.
4. Define the device object instance value with parameter 58.40 Device object ID.

   Note: The object instance value should be unique and in the range 1…4194303.
5. Define communication loss function to detect communication loss between EFB and the drive:
   - Set the communication loss mode and communication loss time with parameters 58.15 Communication loss mode and 58.16 Communication loss time.
   - Select how the drive reacts to an EFB communication break with parameter 58.14 Communication loss action.
6. Save the valid parameter values to permanent memory by setting the parameter 96.07 Parameter save manually value to Save.

7. Validate the settings made in parameter group 58 Embedded fieldbus (page 350) by setting the parameter 58.06 Communication control value to Refresh settings.
8. You can use parameters 58.07…58.13 for diagnostics. You can reset counters 58.08…58.12 by setting the parameter value to 0.
9. Set the relevant drive control parameters to control the drive according to the application.

Note: You find all embedded fieldbus parameters in parameter group 58 Embedded fieldbus (page 350).

Activating drive control functions

Drive control

To enable fieldbus control of various drive functions through BACnet MS/TP, do the following:

- Configure the drive to accept embedded fieldbus communication by enabling BACnet communication and defining the node address and device id for the drive.
- Select the individual control functions to use the embedded fieldbus as a source. This makes the input source come from the corresponding BACnet object.

Note: Change those parameter of the functions that you want to control through BACnet MS/TP. All other parameters can remain as factory default values.

Start/stop direction control

For Start/stop direction control through fieldbus, configure the following drive parameters and set the fieldbus controller supplied command(s) in the appropriate location:

Drive parameter	Value	Description	BACnet object
20.01 Ext1 commands	Embedded fieldbus	Start/stop by fieldbus with Ext1 selected	BV10
20.06 Ext2 commands	Embedded fieldbus	Start/stop by fieldbus with Ext2 selected	BV10
20.21 Direction	Request	Direction by fieldbus, if required	BV11

Input reference select

The tables below show how to use the BACnet embedded fieldbus to select the drive input references for frequency and speed control modes.

- For frequency control, set parameter 99.04 Motor control mode to Scalar (default value). See section Frequency reference (page 460) and parameter group 28 Frequency reference chain (page 236).
- For speed control, set parameter 99.04 Motor control mode to Vector. See section Speed reference (page 460) and parameter group 22 Speed reference selection (page 210).

Vector control has better accuracy than scalar control, but vector control cannot be used in all situations. See parameter 99.04 Motor control mode.

Frequency reference

For using the BACnet embedded fieldbus to provide input frequency references to the drive, configure the following drive parameters and set the fieldbus controller supplied reference word(s) in the appropriate location:

Drive parameter	Value	Description	BACnet object
19.11 Ext1/Ext2 selection	32 = EFB MCW bit 11	Reference set selection by fieldbus	BV13
28.11 Ext1 frequency ref1	8 = EFB ref1 [1)]	Frequency reference source 1	AV16 Input Reference1
28.15 Ext2 frequency ref1	9 = EFB ref2 [1)]	Frequency reference source 2	AV17 Input Reference 2
46.02 Frequency scaling	50.00 Hz [1)]	16-bit scaling of frequency-related parameters	No direct BACnet object

[1)] As an example

Speed reference

For using the BACnet embedded fieldbus to provide input speed references to the drive, configure the following drive parameters and set the fieldbus controller supplied reference word(s) in the appropriate location:

Drive parameter	Value	Description	BACnet object
19.11 Ext1/Ext2 selection	32 = EFB MCW bit 11	Reference set selection by fieldbus	BV13

22.11 Ext1 speed ref1	8 = EFB ref1 [1)]	Speed reference source 1	AV16 Input Reference1
22.18 Ext2 speed ref1	9 = EFB ref2 [1)]	Speed reference source 2	AV17 Input Reference 2
46.01 Speed scaling	1500 rpm [1)]	16-bit scaling of speed-related parameters	No direct BACnet object

[1)] As an example

Interlocks and permissives

To use the BACnet embedded fieldbus for different drive control functions, configure the following drive parameters and set the fieldbus controller supplied command(s) in the appropriate location:

Drive parameter	Value	Description	BACnet object
20.40 Run permissive	15 = Embedded fieldbus	Run permission by fieldbus	BV12
No direct drive parameter. Via BACnet object the fault reset always goes through.	-	Fault reset via fieldbus	BV14
20.41 Start interlock 1	15 = Embedded fieldbus	Source for start interlock 1 is fieldbus	BV20
20.42 Start interlock 2	15 = Embedded fieldbus	Source for start interlock 2 is fieldbus	BV21

Relay output control

For relay output control through BACnet embedded fieldbus,

- set the following drive parameters to select the source for the ROs
- program the drive for control through BACnet.

Drive parameter	Value	Description	BACnet object
10.24 RO1 source	40 = RO/DIO control word bit0	Relay output 1 controlled by fieldbus	BO0

Data point connections

The BACnet objects control parameter 10.99 RO/DIO control word bit values. These bits need to be connected to the corresponding RO and DO sources as above.

Drive parameter	Description	BACnet object
10.99 RO/DIO control word	Storage parameter for relay outputs and digital output	BO0…BO5

Analog output control

For analog output control through BACnet embedded fieldbus, configure the following drive parameters and set the fieldbus controller supplied analog value(s) in the appropriate location:

Drive parameter	Value	Description	BACnet object
13.12 AO1 source	37 = AO1 data storage	Analog output 1 controlled by fieldbus	AO0
13.17 AO1 source min	0.0 [1)]	Minimum value of signal selected by parameter 13.12 AO1 source	No direct BACnet object
13.18 AO1 source max	100.0 [1)]	Maximum value of signal selected by parameter 13.12 AO1 source	No direct BACnet object

[1)] As an example

Data point connections

The BACnet objects control parameter 13.91 AO1 data storage values. These values need to be connected to the corresponding AO sources as above.

Drive parameter	Description	BACnet object
13.91 AO1 data storage	Storage parameter for AO1	AO0

PID control

For PID control through BACnet embedded fieldbus, configure the following drive parameters and set the fieldbus controller supplied PID value(s) in the appropriate location:

Drive parameter	Value	Description	BACnet object
40.08 Set 1 feedback 1 source	10 = Feedback data storage	Feedback 1 source data storage	AV43
40.09 Set 1 feedback 2 source	10 = Feedback data storage	Feedback 2 source data storage	AV43
40.16 Set 1 setpoint 1 source	24 = Setpoint data storage	Setpoint 1 source data storage	AV42
40.17 Set 1 setpoint 2 source	24 = Setpoint data storage	Setpoint 2 source data storage	AV42

Data point connections

The BACnet objects control parameters 40.91 Feedback data storage and 40.92 Setpoint data storage. These values need to be connected to the corresponding PID setpoint and feedback values as above.

Drive parameter	Description	BACnet object
40.91 Feedback data storage	Storage parameter for process feedback value	AV43
40.92 Setpoint data storage	Storage parameter for process setpoint value	AV42

Communication fault

BACnet has no built-in feature to detect communication timeout, because it is not a synchronous protocol. If communication timeouts are needed, you can use the following parameters to detect timeouts based on different packets and specifying the drive action.

Drive parameter	Value	Description
58.14 Communication loss action	0 = No action 1 = Fault 2 = Last speed 3 = Speed ref safe 4 = Fault always 5 = Warning	Selects how the drive reacts to an EFB communication break. Changes to this parameter take effect after the control unit is rebooted or the new settings are validated by parameter 58.06 Communication control (1 = Refresh settings).

58.15 Communication loss mode	1 = Any message 2 = Cw / Ref1 / Ref2	Defines which message types reset the timeout counter for detecting an EFB communication loss.
58.16 Communication loss time	0.0…6000.0 s	Sets a timeout for EFB communication. If a communication break lasts longer than the timeout, the action specified by parameter 58.16 Communication loss time is taken.

Drive feedback

The inputs to the BMS controller (drive output signals) have pre-defined content. These drive feedback signals do not require any additional drive configuration. The following table lists a subset of the supported feedback data. For a complete listing, see the Protocol Implementation Conformance Statement (PICS) (3AXD10001604310 [English]) in the ABB Document library on the Internet. You can also download the most recent version from https://www.bacnetinternational.net/btl/.

Drive parameter	**Description**	**BACnet object**
01.01 Motor speed used	Estimated motor speed (rpm)	AV0
01.06 Output frequency	Estimated drive output frequency (Hz)	AV1
01.11 DC voltage	DC link voltage (V)	AV2
01.13 Output voltage	Calculated motor voltage (V AC)	AV3
01.07 Motor current	Measured (absolute) motor current (A)	AV4
01.10 Motor torque	Motor torque in percent of the nominal motor torque (%)	AV5
01.14 Output power	Drive output power (kW)	AV6
05.11 Inverter temperature	Estimated drive temperature in percent of fault limit (%)	AV7

01.20 Inverter kWh counter	Amount of energy that has passed through the drive (in either direction) in full kilowatthours. Whenever the counter rolls over, 01.19 Inverter MWh counter is incremented. The minimum value is zero.	AV9
35.01 Motor estimated temperature	Displays the motor temperature (°C or °F) as estimated by the internal motor thermal protection model. The unit is selected by parameter 96.16 Unit selection.	AV15
01.03 Motor speed %	Motor speed in percent of the synchronous motor speed.	AV31
40.01 Process PID output actual	PID controller output	AV44
40.04 Process PID deviation actual	PID deviation	AV49
01.50 Current hour kWh	Current day energy consumption. This is the energy of the last 24 hours (not necessarily continuous) the drive has been running, not the energy of a calendar day. If the power is cycled, after the drive is again up and running, the parameter value is set to the value it had before the power cycle.	AV130
01.51 Previous hour kWh	Previous hour energy consumption. The value 01.50 Current hour kWh is stored here when its values has been cumulated for 60 minutes. If the power is cycled, after the drive is again up and running, the parameter value is set to the value it had before the power cycle.	AV131

01.52 Current day kWh	Current day energy consumption. This is the energy of the last 24 hours (not necessarily continuous) the drive has been running, not the energy of a calendar day. If the power is cycled, after the drive is again up and running, the parameter value is set to the value it had before the power cycle.	AV132
01.53 Previous day kWh	Previous day energy consumption. The value 01.52 Current day kWh is stored here when its value has been cumulated for 24 hours. If the power is cycled, after the drive is again up and running, the parameter value is set to the value it had before the power cycle.	AV133
04.01 Tripping fault	Fault that caused the current trip (active fault)	AV18
04.11 Latest fault	Previous fault (non-active)	AV19
04.12 2nd latest fault	Fault before the previous fault (non-active)	AV20

The actual output values of the drive can be read from AV0…AV6, AV31 and AV32:

Object ID	Default object name	Description	Min/max present value	Unit	Present value access type
AV0	Output-RPM	Motor speed	0, nominal speed	rpm	R
AV1	Output-Freq	Output frequency	-500, 500	Hz	R
AV2	DC-Voltage	DC link voltage	0, 2000	V	R
AV3	Output-Voltage	AC output voltage	0, 2000	V	R
AV4	Output-Current	Output current of drive	0, nominal current	A	R

AV5	Output-Torque	Output torque of motor as a percentage of nominal torque	-1600, 1600	%	R
AV6	Output-Power	Output power in kW	nominal power (+/-)	kW	R
AV31	Output-Speed	Actual motor speed	-200, 200	%	R
AV32	Output-Current-Range	Actual motor current	0, 200	%	R

Parameter setting example

Frequency control

The table below shows an example of how to configure a basic frequency control application. The rest of parameters can be left as default values.

Drive parameter	**Settings**	**Description**
58.06 Communication control	0 = Enabled	Normal operation
58.03 Node address	181 1)	Defines the node address of the drive on the fieldbus link.
58.40 Device object ID	51 1)	Configures device object ID.
58.16 Communication loss time	30 1)	Sets the communication timeout as 30 seconds.
58.15 Communication loss mode	1 = Any message 1)	The timeout feature monitors any directed message received from the drive.
58.06 Communication control	0 = Refresh settings	Refreshes settings and takes changed EFB configuration settings in use.
20.01 Ext1 commands		Selects the embedded fieldbus interface as the source of start and stop commands for external control location 1.

28.11 Ext1 frequency ref1		Selects embedded fieldbus reference 1 as the source for frequency reference 1.

1) Example

Object/Property support matrix

The following table summarizes the object types/properties supported and default values:

Property	Object type							
	Binary input	Binary output	Binary value	Analog input	Analog output	Analog value	Multistate value	Loop
Object identifier	R	R	R	R	R	R	R	R
Object name	W, P	W, P	R	W, P	W, P	R(1)	R	W,P
Object type	R	R	R	R	R	R	R	R
Present value	R	C	C	R	C	C	R	R
Status flags	R	R	R	R	R	R	R	R
Event state	R	R	R	R	R	R	R	R
Out-of-service	W	W	W	W	W	W	W	W
Polarity	W, P	W, P						
Active text	R	R	R					
Inactive text	R	R	R					
Units				R	R	R		

Min present value				R	R	R		
Max present value				R	R	R		
Priority array		R	R		R	R		
Relin-quish default		W, P	W,P		W, P	W, P		
COV in-crement				W,P	W,P	W,P		
Number of states							R	
State text							R	
Property list	R	R	R	R	R	R	R	R
	• R = Read only, W = Writable, C = Commandable, P = Persist • AV16, AV17, AV21, AV22, AV40- AV44, AV55, AV56, AV59, AV120-129 have W, P • Max length of writable object names is 25 characters							

Device object instance summary

The following table summarizes the device object supported:

Device object			
Property	**Flag**	**Type**	**Default value**
Object identifier	W, P	OID	4194303
Object name	W, P	CharString, max length 25	AC Drive 4194303
Object type	R	Enum	DEV (8)
System status	R	Enum	

Vendor name	R	CharString	ABB
Vendor identifier	R	Unsigned	127
Model name	R	CharString	ACH180
Firmware revision	R	CharString	14.01
Application software revision	R	CharString	
Description	W, P	CharString, max length 100	"ACH180 is a high-performance variable speed drive designed for HVAC and refrigeration applications."
Location	W, P	CharString, max length 50	"(not set)"
Protocol version	R	Unsigned	1
Protocol revision	R	Unsigned	14
Protocol services supported	R	BitString	
Protocol object types supported	R	BitString	
Object list	R	Array of OID	
Max APDU length accepted	R	Unsigned	480
Segmentation supported	R	Enum	No segmentation (3)
Local time	R	BACnetTime	
Local date	R	BACnetDate	
APDU timeout	W, P	Unsigned	10000 ms
Number of APDU retries	W, P	Unsigned	3
Max master	W, P	Unsigned	127
Max info frames	W, P	Unsigned	1

Device address binding	R	List of Struct	
Database revision	R, P	Unsigned	
Active COV subscriptions	R	Array of BACnetCOVSubscription	
Serial number	R	CharString	
Property list	R	Array of Unsigned	
	Flags: R = Read only, W = Writable, C = Commandable, P = Persist		

Binary input object instance summary

The following table summarizes the binary input objects supported:

Object ID	Object name	Description	Active/Inactive text	Present value access type
BI0	RO1-Monitor	Status of relay output 1	On / Off	R
BI5	DO1-Monitor	Status of digital output 1	On / Off	R
BI6	DI1-Monitor	Status of digital input 1	On / Off	R
BI7	DI2-Monitor	Status of digital input 2	On / Off	R
BI8	DI3-Monitor	Status of digital input 3	On / Off	R
BI9	DI4-Monitor	Status of digital input 4	On / Off	R
BI10	DI5-Monitor	Status of digital input 5	On / Off	R

Note: For present value access types, R = Read-only, W = Writeable, C = Commandable. Commandable values support priority arrays & relinquish defaults.

Binary output object instance summary

The following table summarizes the binary output objects supported:

Object ID	Object name	Description	Active/Inactive text	Present value access type
BO0	RO1-Command	Output state of relay 1	On / Off	C
BO5	DO1-Command	Output state of digital output 1	On / Off	C

Note: For present value access types, R = Read-only, W = Writeable, C = Commandable. Commandable values support priority arrays & relinquish defaults.

Binary value object instance summary

The following table summarizes the binary value objects supported:

Object ID	Object name	Description	Active/Inactive text	Present value access type
BV0	RUN-STOP-Monitor	Drive's run status	Run / Stop	R
BV1	Direction-Monitor	Rotational direction of the motor	Reverse / Forward	R
BV2	OK-FAULT-Monitor	Actual fault status of drive	Fault / OK	R
BV3	EXT1-EXT2-Monitor	Actual control source	Ext2 / Ext1	R
BV4	HAND-AUTO-Monitor	Actual operating mode.	Hand / Auto	R
BV5	Warning-Monitor	Actual warning status	Warning / OK	R
BV7	Ready-Monitor	Actual ready status	Ready / Not-Ready	R
BV8	At-Setpoint-Monitor	Actual at setpoint status	Yes / No	R
BV9	Enabled-Monitor	Actual run enabled status	Enable / Disable	R
BV10	RUN-STOP-Command	Command to start drive	Run / Stop	C

BV11	Direction-Command	Command to rotational direction	Reverse / Forward	C
BV12	Run-Permissive-Command	Command to run permissive command	Enable / Disable	C
BV13	EXT1-EXT2-Command	Commanded to external 1 or external 2 selection	Ext2 / Ext1	C
BV14	Fault-Reset-Command	Commanded to fault reset	Reset / No	W
BV15-BV16	<Reserved>			
BV17	Lock-Parameters	Actual status of parameter lock.	Lock / Unlock	R
BV18	Control-Override-Command	Command the drive into BACnet control override. In this mode, BACnet acquires drive control from its normal source. Note that HAND mode of the panel has priority over BACnet Control Override.	On / Off	C
BV19	Control-Override-Monitor	Indicates if drive has been placed in BACnet control override by commanding BV18. In this mode, BACnet acquires drive control from its normal source. Note that HAND mode of the panel has priority over BACnet control override.	On / Off	R

BV20	Start-Interlock-1-Command	Command to start enable 1	Enable / Disable	C
BV21	Start-Interlock-2-Command	Command to start enable 2	Enable / Disable	C
BV24	Started-Monitor	Actual start status	Started / Not-Started	R
BV25	Safe-Torque-Off-Monitor	Actual status of Safe Torque Off	Active / OK	R
BV26	Underload-Monitor	Indicates if ULC signal is lower than the Underload curve	Underload / OK	R
BV27	Overload-Monitor	Indicates if ULC signal is higher than the overload curve	Overload / OK	R
BV28	Motor-Heating-Command	Command to motor heating mode	On / Off	W
BV29	Motor-Heating-Monitor	Actual status of motor heating mode	On / Off	R
BV30	User0-Monitor	Actual status of “User bit0” in drive status word	On / Off	R
BV31	User1-Monitor	Actual status of “User bit1” in drive status word	On / Off	R
BV32	User2-Monitor	Actual status of “User bit2” in drive status word	On / Off	R
BV33	User3-Monitor	Actual status of “User bit3” in drive status word	On / Off	R

BV34	User0-Command	Commands “User bit0” in drive status word	On / Off	C
BV35	User1-Command	Commands “User bit1” in drive status word	On / Off	C
BV36	User2-Command	Commands “User bit2” in drive status word	On / Off	C
BV37	User3-Command	Commands “User bit3” in drive status word	On / Off	C
BV38	<Reserved>			
BV39	Parameter-Save-Command	Command to save drive parameters and BACnet property data (properties marked as ‘P=Persist’)	Save / No	W
BV40	PID-Set-Select	Command to Process PID set1 or Process PID set2 selection	Set1 / Set2	W

Note: For present value access types, R = Read-only, W = Writeable, C = Commandable. Commandable values support priority arrays & relinquish defaults.

Analog input object instance summary

The following table summarizes the analog input objects supported:

Object ID	**Default object name**	**Description**	**Min / Max present value**	**Units**	**Present value access type**
AI0	AI1-Monitor	Indicates the input level of analog input 1.	0…100	Percent (%)	R

AI1	AI2-Monitor	Indicates the input level of analog input 2.	0…100	Percent (%)	R

Note: For present value access types, R = Read-only, W = Writeable, C = Commandable. Commandable values support priority arrays & relinquish defaults.

Analog output object instance summary

The following table summarizes the analog output objects supported:

Object ID	Default object name	Description	Min / Max present value	Units	Present value access type
AO0	AO1-Command	Controls analog output 1 (drive must be configured for BACnet control).	0…100	Percent	C

Note: For present value access types, R = Read-only, W = Writeable, C = Commandable. Commandable values support priority arrays & relinquish defaults.

Analog value object instance summary

The following table summarizes the analog value objects supported:

Object ID	Default object name	Description	Min / Max present value	Units	Present value access type
AV0	Output-RPM	Motor speed	0, nominal speed	rpm	R
AV1	Output-Freq	Output frequency	-500, 500	Hz	R
AV2	DC-Voltage	DC bus voltage	0, 2000	V	R
AV3	Output-Voltage	AC output voltage	0, 2000	V	R

AV4	Output-Current	Output current of drive	0, nominal current	A	R
AV5	Output-Torque	Output torque of motor as a percentage of nominal torque	-1600, 1600	%	R
AV6	Output-Power	Output power in kW	nominal power (+/-)	kW	R
AV7	Operating-Temp-Range	Heatsink temperature	-40, 160	%	R
AV8	Kilowatt-Hour-Meter-R	Drive's cumulative energy usage. This value is resettable.	0,65535	kWh	W
AV9	Kilowatt-Hour-Meter-NR	Drive's cumulative energy usage. This value is not resettable.	0, 65535999999	kWh	R
AV10	Process-PID-Feedback	This object is the process PID feedback signal.	0, 100	%	R
AV11	Process-PID-Deviation	This object is the process PID output signal's deviation from its setpoint.	0, 100	%	R
AV12...AV13	<Reserved>				
AV14	Running-Hours	Drive's resettable run time (reset by writing 0).	0, 3.40282347e38	hours	R
AV15	Motor-Temp-Degrees-C	Motor temperature	-10, 200	°C	R

AV16	Input-Reference-1	Speed setpoint 1	-150, 150	%	C
AV17	Input-Reference-2	Speed setpoint 2.	-150, 150	%	C
AV18	Active-Fault	Displays most recent fault currently active.			R
AV19	Previous-Fault-1	Displays most recent stored (non-active) fault			R
AV20	Previous-Fault-2	Displays the second most recent stored (non-active) fault			R
AV21	AO1-Monitor	Output level of analog output 1	0, 100	%	R
AV22	<Reserved>				
AV23	Accel-1-Seconds	Ramp1 acceleration time	0, 1800	s	W
AV24	Decel-1-Seconds	Ramp 1 deceleration time	0, 1800	s	W
AV25	Mbox-Param	Parameter number to be used by mailbox function.		No Units	W
AV26	Mbox-Data	Set (W) or indicate (R) of the data value of mailbox function		No Units	W
AV27...AV28	<Reserved>				

AV29	Min-Speed	Defines the allowed minimum output frequency	-500, 500	Hz	W
AV30	Max-Speed	Defines the allowed maximum output frequency	-500, 500	Hz	W
AV31	Output-Speed	Actual motor speed	-200, 200	%	R
AV32	Output-Current-Range	Actual motor current	0, 200	%	R
AV33	Max-Current	Max motor current	0, nominal current	A	W
AV34	DC-ripple	Vp-p ripple on DC bus	0, 200	V	R
AV35-AV39	<Reserved>				
AV40	LOOP-Feedback-Monitor	Loop controller feedback value after source selection, mathematical function and filtering (read-only)	0, 100	%	R
AV41	LOOP-Setpoint-Monitor	Loop controller setpoint value after source selection, mathematical function limitation and ramping (read-only)	0,100	%	R

AV42	LOOP-Setpoint	Command to store loop controller setpoint value used as input for the process	0,100	%	C
AV43	LOOP-Feedback	Stores the feedback value for loop controller	0, 100	%	W
AV44	LOOP-Output	Loop controller output	0, 100	%	R
AV45	LOOP- Gain	Loop controller gain	0.1, 100	No Units	W
AV46	LOOP-Integration-Time	Loop controller integration time	0, 3600	s	W
AV47-AV48	<Reserved>				
AV49	LOOP-Deviation-Monitor	Loop controller deviation	0, 100	%	R
AV50-AV52	<Reserved>				
AV53	LOOP-1-Gain	Loop controller gain (set 2)	0.1, 100	No Units	W
AV54	LOOP-1-Integration-Time	Loop controller integration time (set 2)	0, 3600	s	W
AV55	LOOP-2-Feedback-Monitor	External loop controller feedback value after source selection, mathematical function and filtering (read-only)	0, 100	%	R

AV56...AV119	<Reserved>				
AV120	Data-IO-1	Holds the value of drive parameter, which is mapped using Data I/O parameter 58.101		No Units	W
AV121	Data-IO-2	Holds the value of drive parameter, which is mapped using Data I/O parameter 58.102		No Units	W
AV122	Data-IO-3	Holds the value of drive parameter, which is mapped using Data I/O parameter 58.103		No Units	W
AV123	Data-IO-4	Holds the value of drive parameter, which is mapped using Data I/O parameter 58.104		No Units	W
AV124	Data-IO-5	Holds the value of drive parameter, which is mapped using Data I/O parameter 58.105 (Read-only)		No Units	R

AV125	Data-IO-6	Holds the value of drive parameter, which is mapped using Data I/O parameter 58.106 (Read-only)		No Units	R
AV126	Data-IO-7	Holds the value of drive parameter, which is mapped using Data I/O parameter 58.107 (Read-only)		No Units	R
AV127	Data-IO-8	Holds the value of drive parameter, which is mapped using Data I/O parameter 58.108 (Read-only)		No Units	R
AV128	Data-IO-9	Holds the value of drive parameter, which is mapped using Data I/O parameter 58.109 (Read-only)		No Units	R
AV129	Data-IO-10	Holds the value of drive parameter, which is mapped using Data I/O parameter 58.110 (Read-only)		No Units	R

AV130	Kilowatt-Hour-This-Hour	Current hour energy consumption	0, 3.40282347e38	kWh	R
AV131	Kilowatt-Hour-Last-Hour	Last hour energy consumption	0, 3.40282347e38	kWh	R
AV132	Kilowatt-Hour-This-Day	Current day energy consumption	0, 3.40282347e38	kWh	R
AV133	Kilowatt-Hour-Last-Day	Last day energy consumption	0, 3.40282347e38	kWh	R

Note: For present value access types, R = Read-only, W = Writeable, C = Commandable. Commandable values support priority arrays & relinquish defaults.

Multistate value object instance summary

The following table summarizes the multistate value objects supported:

Object ID	Object name	Description	State text	Present value access type
MSV0	HAND-AUTO-Reference	Indicates whether the drive is under Hand or Auto control, or if Override mode is active.	Off, Hand, Auto, Override	R

MSV1	Active-Fault-1	Enumerated type of the most recent fault currently active	None, Comm-Error, Overcurrent, Overtemperature, Overspeed, Overvoltage, Undervoltage, Short-Circuit, Ground-Fault, Motor-Overload, Inverter-Overload, Motor-Underload, External-Fault, Operator-Interface-Error, Config-Error, Feedback-Failure, Output-Phase-Loss Motor-Stall, Power-Unit-Error, Input-Phase-Fault, Internal-Failure, STO-Active, Other	R

MSV2	Active-Fault-2	Enumerated type of the 2nd most recent fault currently active	None, Comm-Error, Overcurrent, Overtemperat-ure, Overspeed, Overvoltage, Undervoltage, Short-Circuit, Ground-Fault, Motor-Overload, Inverter-Over-load, Motor-Under-load, External-Fault, Operator-Inter-face-Error, Config-Error, Feedback-Fail-ure, Output-Phase-Loss Motor-Stall, Power-Unit-Er-ror, Input-Phase-Fault, Internal-Failure, STO-Active, Other	R

MSV3	Active-Fault-3	Enumerated type of the 3rd most recent fault currently active	None, Comm-Error, Overcurrent, Overtemperat-ure, Overspeed, Overvoltage, Undervoltage, Short-Circuit, Ground-Fault, Motor-Overload, Inverter-Over-load, Motor-Under-load, External-Fault, Operator-Inter-face-Error, Config-Error, Feedback-Fail-ure, Output-Phase-Loss Motor-Stall, Power-Unit-Er-ror, Input-Phase-Fault, Internal-Failure, STO-Active, Other	R

MSV4	Active-Warning-1	Enumerated type of the most recent warning currently active	None, Comm-Error, Current-Limit, Overtemperat-ure, Start-Interlock-1, Start-Interlock-2, Start-Interlock-3, Start-Interlock-4, Run-Permissive, Internal-Warn-ing, Start-Delay, Other	R
MSV5	Active-Warning-2	Enumerated type of the 2nd most recent warning cur-rently active	None, Comm-Error, Current-Limit, Overtemperat-ure, Start-Interlock-1, Start-Interlock-2, Start-Interlock-3, Start-Interlock-4, Run-Permissive, Internal-Warn-ing, Start-Delay, Other	R

MSV6	Active-Warning-3	Enumerated type of the 3rd most recent warning currently active	None, Comm-Error, Current-Limit, Overtemperature, Start-Interlock-1, Start-Interlock-2, Start-Interlock-3, Start-Interlock-4, Run-Permissive, Internal-Warning, Start-Delay, Other	R

Note: For present value access types, R = Read-only, W = Writeable, C = Commandable. Commandable values support priority arrays & relinquish defaults.

Loop object instance summary

The following table summarizes the loop objects supported:

Object ID	Object name	Description	Manipulated variable reference	Controlled variable reference	Setpoint reference	Present value access type
LOOP0	LOOP-Set1	Loop object for process PID set 1	AV44 Present Value	AV43 Present Value	AV42 Present Value	R
LOOP1	LOOP-Set2	Loop object for process PID set 2	AV44 Present Value	AV43 Present Value	AV42 Present Value	R

Note: For present value access types, R = Read-only, W = Writeable, C = Commandable. Commandable values support priority arrays & relinquish defaults.

10

N2 control through the embedded fieldbus interface (EFB)

Contents of this chapter

The chapter describes N2 control through the embedded fieldbus interface (EFB): supported functionality, services and objects as well as how to configure the N2 with parameters.

N2 overview

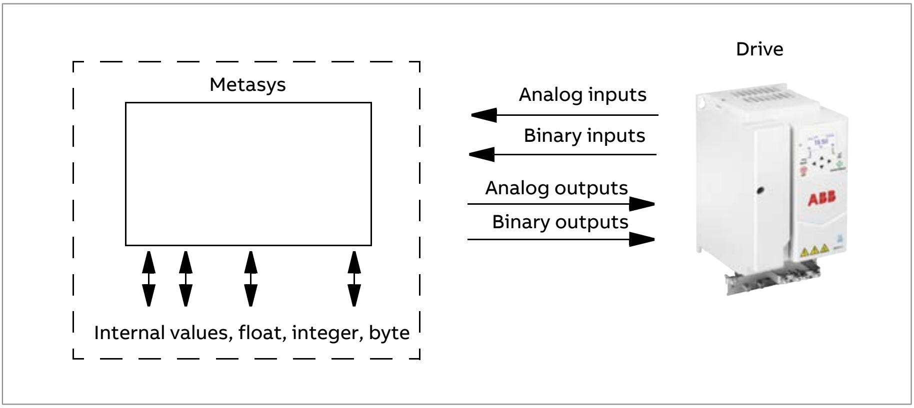
The N2 fieldbus connection to the drive is based on an industry standard RS-485 physical interface. The N2 fieldbus protocol is a master-slave type, serial communication protocol, used by the Johnson Controls Metasys® system. In the Metasys architecture the N2 fieldbus connects object interfaces and remote controllers to network control units (NCUs).

The N2 fieldbus can also be used to connect the drives to the Metasys Companion product line.

This section describes the use of the N2 fieldbus with the drive's connection and does not describe the protocol in detail.

Supported features

In the N2 fieldbus protocol the drive appears as a “virtual object”.



Note: Metasys inputs are drive outputs and drive inputs are Metasys outputs.

A virtual object is made up of:

- analog inputs
- binary inputs
- analog outputs
- binary outputs
- internal values for floating point, integer, and byte values.

The drive does not support N2 fieldbus communication “internal values”.

All of the analog and binary I/O objects are listed below, starting with N2 analog input objects.

Analog input - the analog input objects support the following features:

- analog input actual value in engineering units
- low alarm limit
- low warning limit
- high warning limit
- high alarm limit
- differential value for the hysteresis of the alarms and warnings
- change of state (COS) enabled
- alarm enabled
- warning enabled
- override value is received, but there is no action taken.

Binary input - the binary input objects support the following features:

- binary input actual value
- normal / alarm state specification
- alarm enabled
- change of state (COS) enabled
- override value is received, but there is no action taken.

Analog output - the analog output objects support the following features:

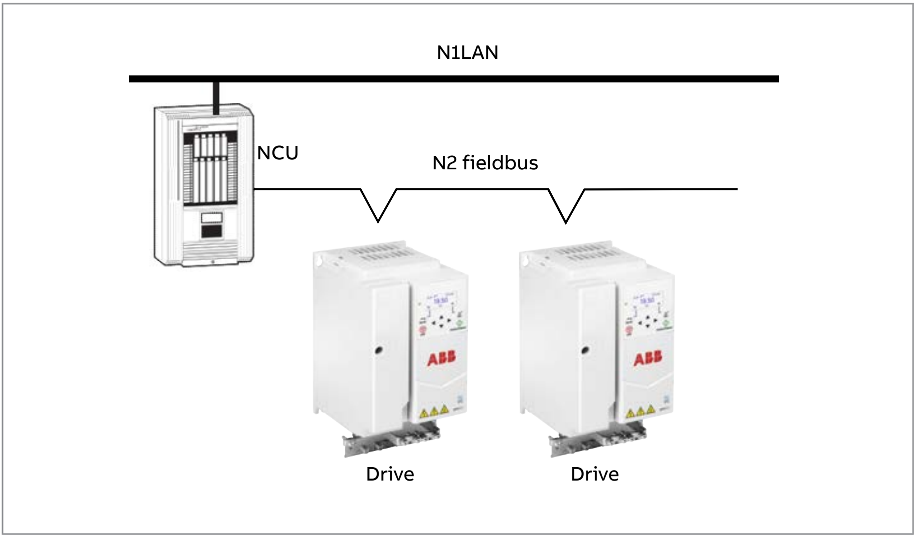
- analog output value in engineering units
- override value is used to change the analog output value. It is not possible to return to the previous value by removing the override. The Override feature is used only to change the value.

Binary output - the binary output objects support the following features:

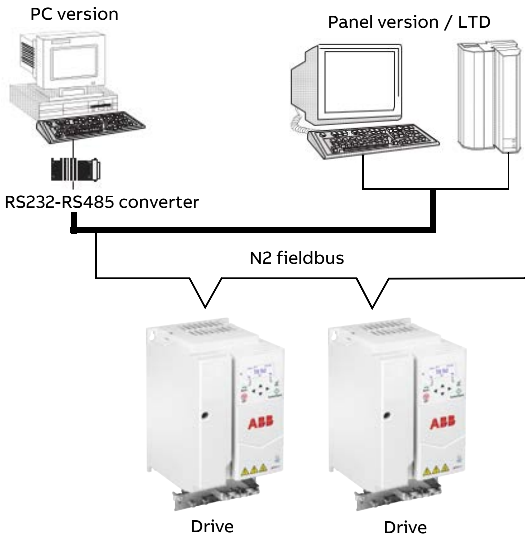
- binary output value
- override value is used to change the binary output value. It is not possible to return to the previous value by removing the override. The Override feature is used only to change the value.

Metasys integration

The following diagram shows the drives' integration to the Johnson Controls Metasys system.



The following diagram shows the drive's integration to the Johnson Controls Metasys Companion system.



On the N2 fieldbus each drive can be accessed by the full complement of Metasys FMS features, including change-of-state (COS) monitoring, alarm notification, scheduling, trend, and totalization.

On one N2 fieldbus segment there can be up to 32 nodes while integrating drives with Johnson Controls Metasys.

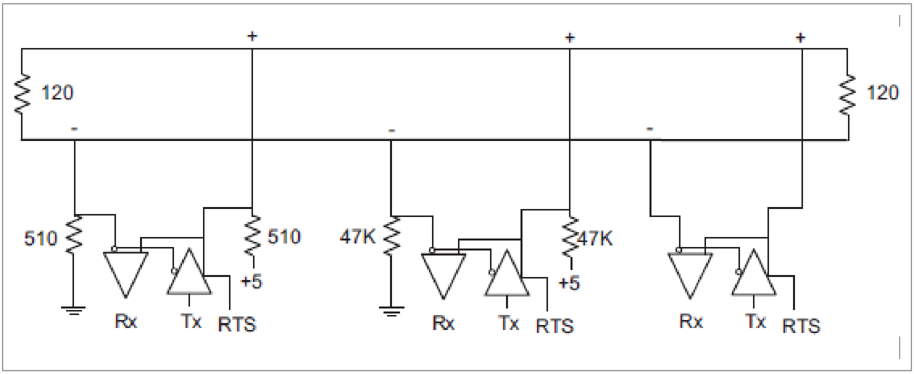
Drive device type

For the Metasys and Metasys Companion products, the device type for the drive is VND.

Hardware installation

Connecting devices to a N2 EIA-485 network

The figure shows three types of nodes connected on the EIA-485 network.



Connecting the drive to the building automation controller

For connecting the EFB terminal block X5 of the drive to the building automation controller via the EIA-485 network, see section Connecting the fieldbus to the drive (page 430).

N2 analog input objects

The following table lists the N2 analog input objects defined for the drive.

N2 analog inputs						
No	**Object**	**Drive parameter**	**Scale factor**	**Units**	**Range**	**Notes**
AI1	OUTPUT FREQUENCY	01.06 Output frequency	100	Hz	0…250	
AI2	RATED SPEED	01.62 Abs motor speed %	100	%	0…100	
AI3	SPEED	01.01 Motor speed used	100	rpm	0…9999	
AI4	CURRENT	01.07 Motor current	100	A	0…9999	
AI5	TORQUE	01.10 Motor torque	100	%	-200…200	
AI6	POWER	01.17 Motor shaft power	10	kW	0…9999	

N2 analog inputs						
No	**Object**	**Drive parameter**	**Scale factor**	**Units**	**Range**	**Notes**
AI7	DRIVE TEMPERATURE	05.11 Inverter temperature	10	%	-40…160	
AI8	KILOWATT HOURS	01.58 Cumulative inverter energy (resettable)	10	kW	0…65535	
AI9	MEGAWATT HOURS	Derived value	10000	MWh	0…65535	Parameter 01.54 Cumulative inverter energy / 1000
AI10	RUN TIME	05.03 Hours run	10	h	0…65535	
A11	DC BUS VOLTAGE	01.11 DC voltage	100	V	0…999	
AI12	OUTPUT VOLTAGE	01.13 Output voltage	1	V	0…999	
AI13	PRC PID FEEDBACK	40.97 Process PID feedback %	100	%	0…100	
AI14	PRC PID DEVIATION	40.99 Process PID deviation %	100	%	0…100	
AI17	LAST FAULT	Derived value	1		fault code	Most recent fault
AI18	PREV FAULT	Derived value	1		fault code	Second most recent fault
AI19	OLDEST FAULT	Derived value	1		fault code	Third most recent fault
AI20	AI 1 ACTUAL	12.101 AI1 percent value	100	%	0…100	

N2 analog inputs						
No	**Object**	**Drive parameter**	**Scale factor**	**Units**	**Range**	**Notes**
AI21	AI 2 ACTUAL	12.102 AI2 percent value	100	%	0…100	
AI22	AO 1 ACTUAL	13.11 AO1 actual value	1000	mA	0…20	
AI23	<Reserved>					
AI24	MOTOR TEMP	Derived value	1	°C	0…200	Value is derived from 35.01 and 35.02: • If 35.11 is non-zero, the temperature is the value of 35.02. • If 35.11 is zero, the temperature is the value of 35.01.

N2 binary input objects

The following table lists the N2 binary input objects defined for the drive.

N2 binary inputs			
No	**Object**	**Drive parameter**	**Range**
BI1	STOP/RUN	Status Word, bit 2	0 = Drive received start command 1 = Drive has not received start command
BI2	FORWARD/REVERSE	Status Word, bit 11	0 = Forward, 1 = Reverse
BI3	FAULT STATUS	Status Word, bit 15	0 = OK, 1 = Drive fault
BI4	RELAY 1 STATUS	10.21 RO status, bit 0	0 = Off, 1 = On
BI5...BI9	<Reserved>		
BI10	INPUT 1 STATUS	10.02 DI delayed status, bit 0	0 = Off, 1 = On
BI11	INPUT 2 STATUS	10.02 DI delayed status, bit 1	0 = Off, 1 = On
BI12	INPUT 3 STATUS	10.02 DI delayed status, bit 2	0 = Off, 1 = On
BI13	INPUT 4 STATUS	10.02 DI delayed status, bit 3	0 = Off, 1 = On
BI14	INPUT 5 STATUS	10.02 DI delayed status, bit 4	0 = Off, 1 = On
BI15	<Reserved>		
BI16	EXTERNAL 2 SELECT	DCU Status Word, bit 14	0 = EXT1 active, 1 = EXT2 active
BI17	HAND/AUTO	DCU Status Word, bit 12	0 = AUTO, 1 = HAND
BI18	ALARM	DCU Status Word, bit 16	0 = OK, 1 = Warning/alarm
BI20	DRIVE READY	DCU Status Word, bit 0	0 = Not ready, 1 = Ready

N2 binary inputs			
No	**Object**	**Drive parameter**	**Range**
BI21	AT SETPOINT	DCU Status Word, bit 7	0 = No, 1 = At set-point
BI22	RUN ENABLED	DCU Status Word, bit 1	0 = Not enabled, 1 = Enabled
BI23	N2 LOCAL MODE	DCU Status Word, bit 13	0 = Auto, 1 = N2 local
BI24	N2 CONTROL SRC	DCU Status Word, bit 26	0 = No, 1 = Yes
BI25	N2 REF1 SRC	DCU Status Word, bit 27	0 = No, 1 = Yes
BI26	N2 REF2 SRC	DCU Status Word, bit 28	0 = No, 1 = Yes

N2 analog output objects

The following table lists the N2 analog output objects defined for the drive.

N2 analog outputs						
No	**Object**	**Drive parameter**	**Scale factor**	**Units**	**Range**	**Notes**
AO1	REFERENCE 1	Reference 1	10	%	0…100	
AO2	REFERENCE 2	Reference 2	10	%	0…100	

N2 analog outputs						
No	**Object**	**Drive parameter**	**Scale factor**	**Units**	**Range**	**Notes**
AO3	ACCEL TIME 1	No direct mapping	1000	s	0.1…1800	If parameter 99.04 Motor control mode is set • to vector mode (99.04 = 0), map to 23.12 Acceleration time 1. • to scalar mode (99.04 = 1), map to 28.72 Freq acceleration time 1.
AO4	DECEL TIME 1	No direct mapping	1000	s	0.1…1800	If parameter 99.04 Motor control mode is set • to vector mode (99.04 = 0), map to 23.13 Deceleration time 1. • to scalar mode (99.04 = 1), map to 28.73 Freq deceleration time 1.
AO5	CURRENT LIMIT	30.17 Maximum current	100	A	0…1.3*I2N	
AO6	PID1-CONT GAIN	40.32 Set 1 gain	100	%	0.1…100	

N2 analog outputs						
No	**Object**	**Drive parameter**	**Scale factor**	**Units**	**Range**	**Notes**
AO7	PID1-CONT I-TIME	40.33 Set 1 integration time	10	s	0.1…600	
AO8	PID1-CONT D-TIME	40.34 Set 1 derivation time	10	s	0…10	
AO9	PID1-CONT D FILTER	40.35 Set 1 derivation filter time	10	s	0…10	
AO10	PID2-CONT GAIN	41.32 Set 2 gain	100	%	0.1…100	
AO11	PID2-CONT I-TIME	41.33 Set 2 integration time	10	s	0.1…600	
AO12	PID2-CONT D-TIME	41.34 Set 2 derivation time	1000	s	0…10	
AO13	PID2-CONT D FILTER	41.35 Set 2 derivation filter time	10	s	0…10	
AO14	COMMAND AO 1	13.91 AO1 data storage	10	%	0…100	

N2 analog outputs						
No	**Object**	**Drive parameter**	**Scale factor**	**Units**	**Range**	**Notes**
AO17	SPD OUT MIN	Derived value	10	%	0…200	Writing: • scalar mode: 30.13 Minimum frequency = AO17 * 99.08 Motor nominal frequency • vector mode: 30.11 Minimum speed = AO17 * 99.09 Motor nominal speed. Reading: • scalar mode: 99.08 Motor nominal frequency / 30.13 Minimum frequency • vector mode: 99.09 Motor nominal speed / 30.11 Minimum speed.

N2 analog outputs						
No	**Object**	**Drive parameter**	**Scale factor**	**Units**	**Range**	**Notes**
AO18	SPD OUT MAX	Derived value	10	%	0…200	Writing: • scalar mode: 30.14 Maximum frequency = AO17 * 99.08 Motor nominal frequency • vector mode: 30.12 Maximum speed = AO17 * 99.09 Motor nominal speed. Reading: • scalar mode: 99.08 Motor nominal frequency / 30.13 Minimum frequency • vector mode: 99.09 Motor nominal speed /30.11 Minimum speed.
AO19	MAILBOX PARAMETER		1		0…65535	Mailbox feature is not supported
AO20	MAILBOX DATA		1		0…65535	Mailbox feature is not supported

N2 binary output objects

The following table lists the N2 binary output objects defined for the drive.

N2 binary outputs				
No	**Object**	**Drive parameter**	**Range**	**Notes**
BO1	STOP/START	DCU Control Word, bit 0 and bit 1	0 = Stop, 1 = Start to Speed	Stop: set bit 0, clear bit 1 Start: set bit 1, clear bit 0
BO2	FORWARD/RE-VERSE	DCU Control Word, bit 12	0 = Forward, 1 = Reverse	
BO3	PANEL LOCK	Derived	0 = Open, 1 = Locked	Derived from 96.03 Access level status, bit 14 parameter lock
BO4	RUN ENABLE	Derived value	0 = Enable, 1 = Disable	Invert DCU control word bit 6, RUN_DISABLE
BO5	REF1/REF2 SE-LECT	DCU Control Word, bit 5, EXT	0 = Ref1, 1 = Ref2	
BO6	FAULT RESET	DCU Control Word, bit 4, RE-SET	Change 0 -> 1 Resets	
BO7	COMMAND RO 1	10.99 RO/DIO control word, bit 0	0 = Off, 1 = On	
BO8	COMMAND RO 2	10.99 RO/DIO control word, bit 1	0 = Off, 1 = On	
BO9	COMMAND RO 3	10.99 RO/DIO control word, bit 2	0 = Off, 1 = On	
BO10	COMMAND RO 4	10.99 RO/DIO control word, bit 3	0 = Off, 1 = On	

N2 binary outputs				
No	**Object**	**Drive parameter**	**Range**	**Notes**
BO11	COMMAND RO 5	10.99 RO/DIO control word, bit 4	0 = Off, 1 = On	
BO12	COMMAND RO 6	10.99 RO/DIO control word, bit 5	0 = Off, 1 = On	
BO13	RESET RUN TIME	Indirectly mapping	0 = N/A, 1 = On (Reset run rime, 05.03 Hours run)	
BO14	RESET KWH COUNT	Indirectly mapping	0 = N/A, 1 = On (Reset kWh count 01.58 Cumulative inverter energy (resettable))	
BO15	PRC PID SELECT	40.57 PID set1/set2 selection (indirectly)	0 = SET1, 1 = SET2	If BO15 = 0, 40.57 PID set1/set2 selection is set to PID Set1 (1). If BO15 = 1, 40.57 PID set1/set2 selection is set to PID Set2 (2).
BO16	N2 LOCAL CTL [1)]	DCU Control Word, bit 16	0 = Auto, 1 = N2	
BO17	N2 LOCAL REF [1)]	DCU Control Word, bit 17	0 = Auto, 1 = N2	
BO18	SAVE PARAMETERS	96.07 Parameter save manually (indirectly)	0 = N/A, 1 = On (Save Parameters)	
BO19	READ MAILBOX		0 = No, 1 = Yes	Mailbox feature is not supported
BO20	WRITE MAILBOX		0 = No, 1 = Yes	Mailbox feature is not supported

N2 binary outputs				
No	**Object**	**Drive parameter**	**Range**	**Notes**
1) N2 LOCAL CTL and N2 LOCAL REF have priority over drive input terminals. Use these binary outputs for temporary N2 control of the drive when COMM is not the selected control source.				

DDL file for NCU

The listing below is the data definition language (DDL) file for ACH180 drives used with the network control units (NCU). It is useful when defining drive I/O objects to the network controller units. Below is the ACH180.DDL file listing.

****

ABB Drives, ACH180 Variable Frequency Drive

****

CSMODEL "ACH_180","VND"

AITITLE "Analog_Inputs"

BITITLE "Binary_Inputs"

AOTITLE "Analog_Outputs"

BOTITLE "Binary_Outputs"

CSAI "AI1",N,N,"FREQ_ACT","Hz"

CSAI "AI2",N,N,"PCT_ACT","%"

CSAI "AI3",N,N,"SPEED","RPM"

CSAI "AI4",N,N,"CURRENT","A"

CSAI "AI5",N,N,"TORQUE","%"

CSAI "AI6",N,N,"POWER","kW"

CSAI "AI7",N,N,"DRV_TEMP_PCT","%"

CSAI "AI8",N,N,"ENERGY_k","kWh"

CSAI "AI9",N,N,"ENERGY_M","MWh"

CSAI "AI10",N,N,"RUN_TIME","H"

CSAI "AI11",N,N,"DC_VOLT","V"

CSAI "AI12",N,N,"VOLT_ACT","V"

CSAI "AI13",N,N,"PID1_ACT","%"

CSAI "AI14",N,N,"PID2_DEV","%"

CSAI "AI15",N,N,"PID2_ACT","%"

CSAI "AI16",N,N,"PID2_DEV","%"

CSAI "AI17",N,N,"LAST_FLT","Code"

CSAI "AI18",N,N,"PREV_FLT","Code"

CSAI "AI19",N,N,"1ST_FLT","Code"

CSAI "AI20",N,N,"AI_1_ACT","%"

CSAI "AI21",N,N,"AI_2_ACT","%"

CSAI "AI22",N,N,"AO_1_ACT","mA"

CSAI "AI23",N,N,"AO_2_ACT","mA"

CSAI "AI24",N,N,"MTR_TEMP","°C"

CSBI "BI1",N,N,"STOP/RUN","STOP","RUN"

CSBI "BI2",N,N,"FWD/REV","FWD","REV"

CSBI "BI3",N,N,"FAULT","OK","FLT"

CSBI "BI4",N,N,"RELAY_1","OFF","ON"

CSBI "BI5",N,N,"RELAY_2","OFF","ON"

CSBI "BI6",N,N,"RELAY_3","OFF","ON"

CSBI "BI7",N,N,"RELAY_4","OFF","ON"

CSBI "BI8",N,N,"RELAY_5","OFF","ON"

CSBI "BI9",N,N,"DO_1","OFF","ON"

CSBI "BI10",N,N,"INPUT_1","OFF","ON"

CSBI "BI11",N,N,"INPUT_2","OFF","ON"

CSBI "BI12",N,N,"INPUT_3","OFF","ON"

CSBI "BI13",N,N,"INPUT_4","OFF","ON"

CSBI "BI14",N,N,"INPUT_5","OFF","ON"

CSBI "BI15",N,N,"INPUT_6","OFF","ON"

CSBI "BI16",N,N,"EXT1/2","EXT1","EXT2"

CSBI "BI17",N,N,"HND/AUTO","AUTO","HAND"

CSBI "BI18",N,N,"ALARM","OFF","ON"

CSBI "BI20",N,N,"DRV_REDY","NO","YES"

CSBI "BI21",N,N,"AT_SETPT","NO","YES"

```
CSBI "BI22",N,N,"RUN_ENAB","NO","YES"
CSBI "BI23",N,N,"N2_LOC_M","AUTO","N2_L"
CSBI "BI24",N,N,"N2_CTRL","NO","YES"
CSBI "BI25",N,N,"N2_R1SRC","NO","YES"
CSBI "BI26",N,N,"N2_R2SRC","NO","YES"
CSAO "AO1",Y,Y,"REF_1","%"
CSAO "AO2",Y,Y,"REF_2","%"
CSAO "AO3",Y,Y,"ACCEL_1","s"
CSAO "AO4",Y,Y,"DECEL_1","s"
CSAO "AO5",Y,Y,"CURR_LIM","A"
CSAO "AO6",Y,Y,"PID1_GN","%"
CSAO "AO7",Y,Y,"PID1_I","s"
CSAO "AO8",Y,Y,"PID1_D","s"
CSAO "AO9",Y,Y,"PID1_FLT","s"
CSAO "AO10",Y,Y,PID2_GN","%"
CSAO "AO11",Y,Y,"PID2_I","s"
CSAO "AO12",Y,Y,"PID2_D","s"
CSAO "AO13",Y,Y,"PID2_FLT","s"
CSAO "AO14",Y,Y,"CMD_AO_1","%"
CSAO "AO15",Y,Y,"CMD_AO_2","%"
CSAO "AO16",Y,Y,"PI2_STPT","%"
CSAO "AO17",Y,Y,"MIN_SPD","%"
CSAO "AO18",Y,Y,"MAX_SPD","%"
CSAO "AO19",Y,Y,"MB_PARAM",""
CSAO "AO20",Y,Y,"MB_DATA",""
CSBO "BO1",Y,Y,"START","STOP","START"
CSBO "BO2",Y,Y,"REVERSE","FWD","REV"
CSBO "BO3",Y,Y,"PAN_LOCK","OPEN","LOCKED"
CSBO "BO4",Y,Y,"RUN_ENAB","ENABLE","DISABLE"
CSBO "BO5",Y,Y,"R1/2_SEL","EXT_1","EXT_2"
```

```
CSBO "BO6",Y,Y,"FLT_RSET","-","RESET"
CSBO "BO7",Y,Y,"CMD_RO_1","OFF","ON"
CSBO "BO8",Y,Y,"CMD_RO_2","OFF","ON"
CSBO "BO9",Y,Y,"CMD_RO_3","OFF","ON"
CSBO "BO10",Y,Y,"CMD_RO_4","OFF","ON"
CSBO "BO11",Y,Y,"CMD_RO_5","OFF","ON"
CSBO "BO12",Y,Y,"CMD_RO_6","OFF","ON"
CSBO "BO13",Y,Y,"RST_RTIM","OFF","RESET"
CSBO "BO14",Y,Y,"RST_KWH","OFF","RESET"
CSBO "BO15",Y,Y,"PID_SEL","SET1","SET2"
CSBO "BO16",Y,Y,"N2_LOC_C","AUTO","N2"
CSBO "BO17",Y,Y,"N2_LOC_R","AUTO","N2"
CSBO "BO18",Y,Y,"SAV_PRMS","OFF","SAVE"
CSBO "BO19",Y,Y,"READ_MB","NO","READ"
CSBO "BO20",Y,Y,"WRITE_MB","NO","WRITE"
```

11

Control chain diagrams

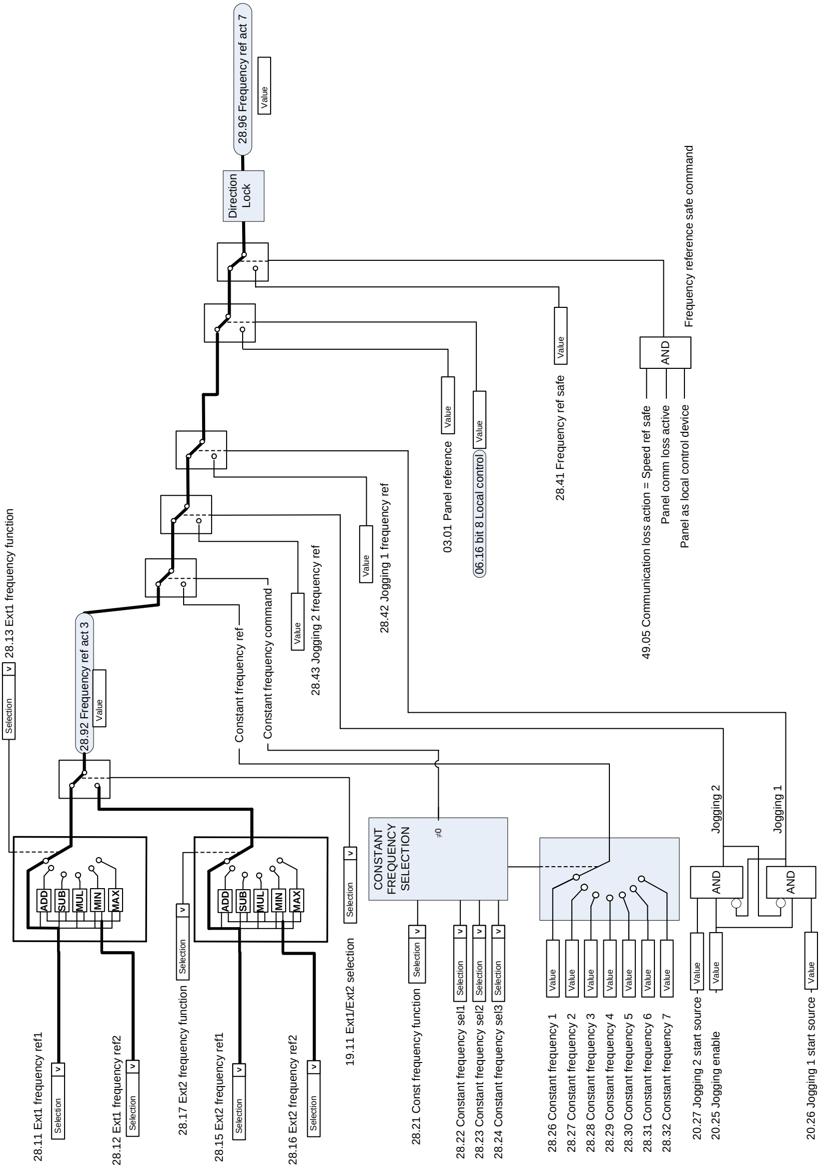
Contents of this chapter

This chapter presents the reference chains of the drive. The control chain diagrams can be used to trace how parameters interact and where parameters have an effect within the drive parameter system.

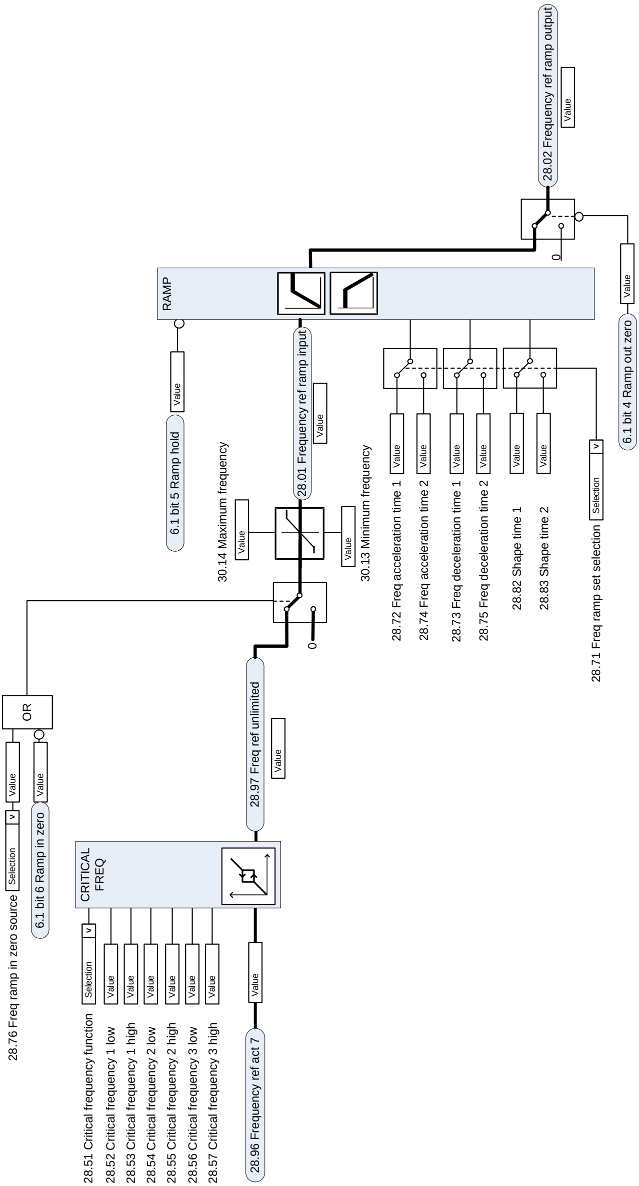
For a more general diagram, see section Operating modes of the drive (page 46).

Note: The panel references in the diagrams refer to ACX-AP-x Assistant control panels and the Drive Composer PC tool.

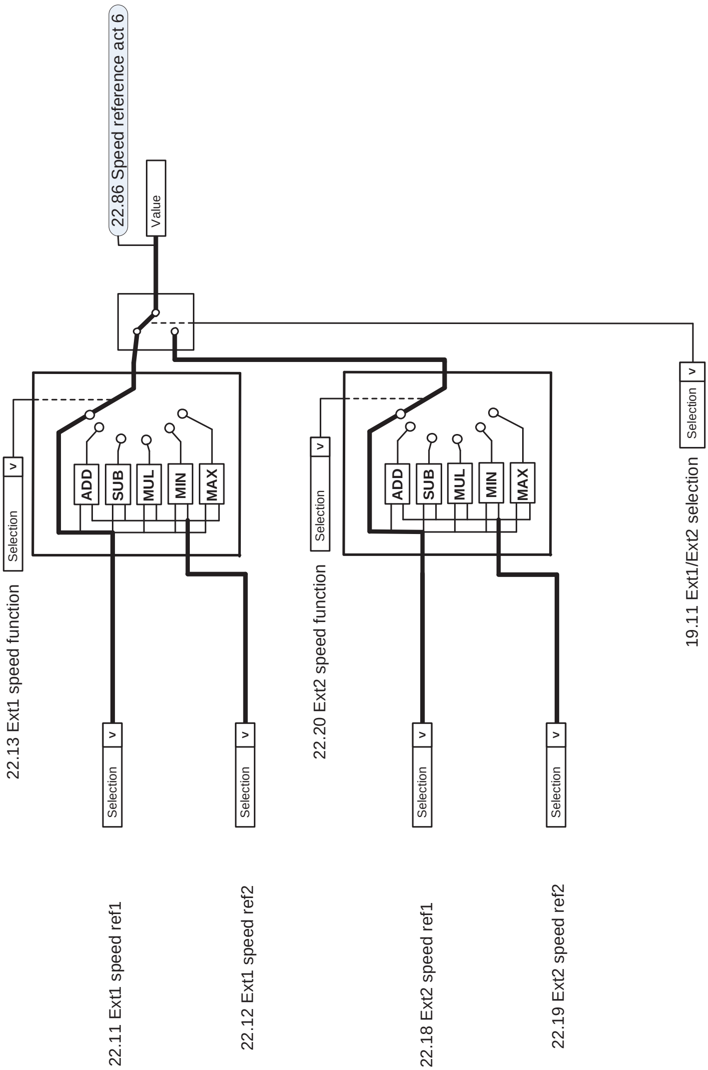
Frequency reference selection



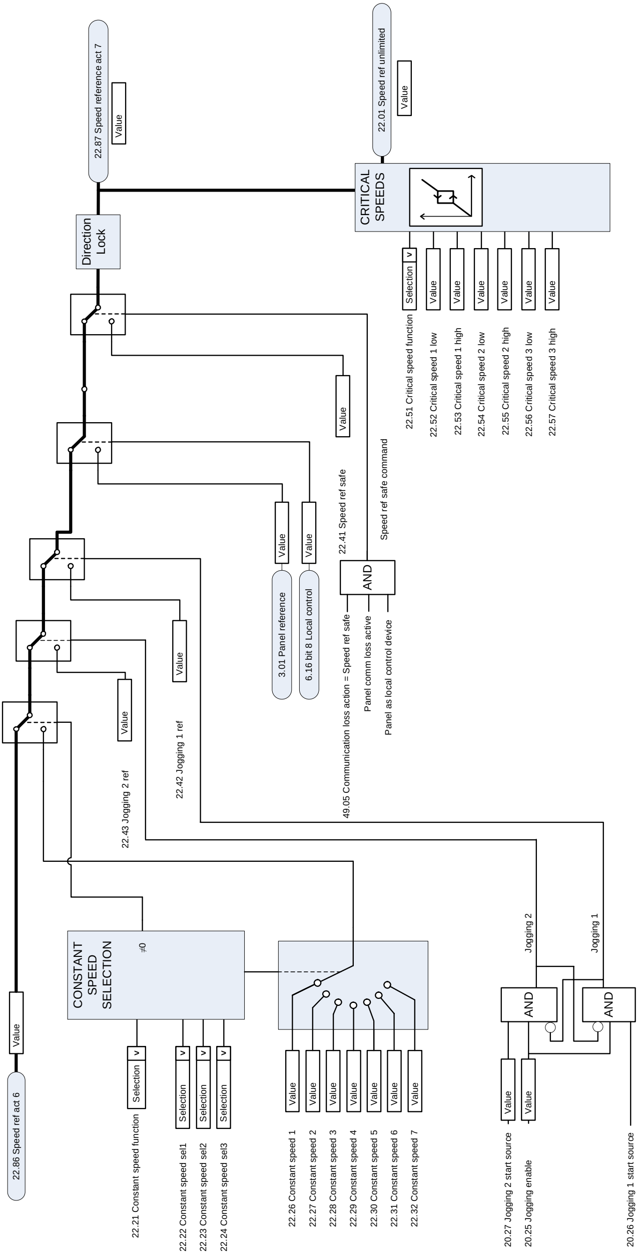
Frequency reference modification



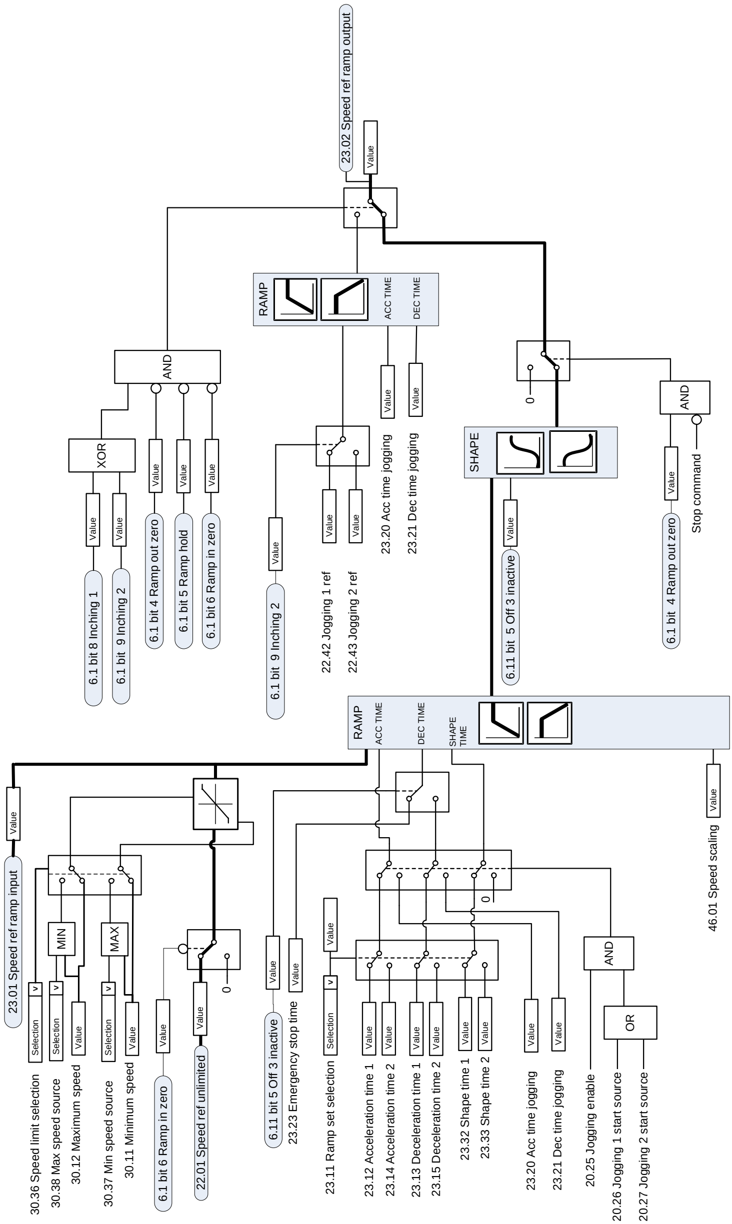
Speed reference source selection I



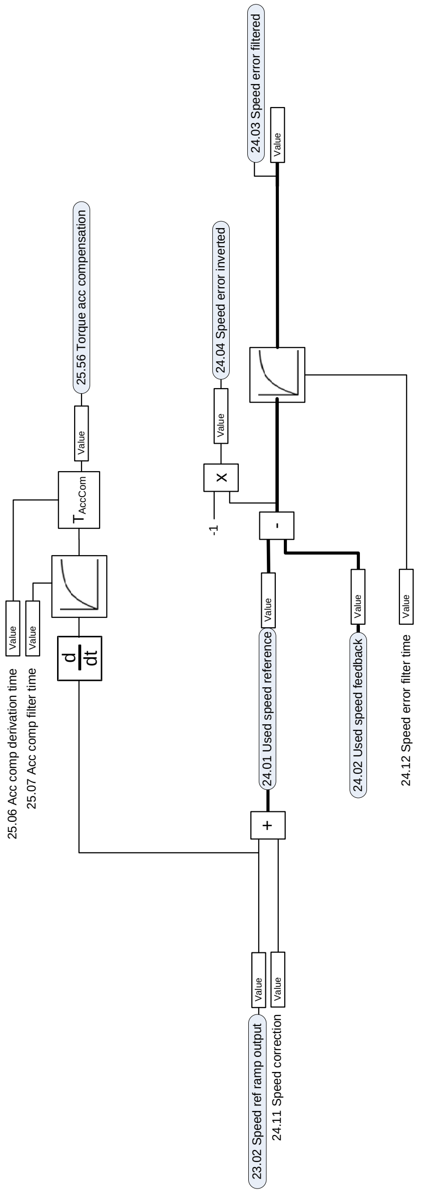
Speed reference source selection II



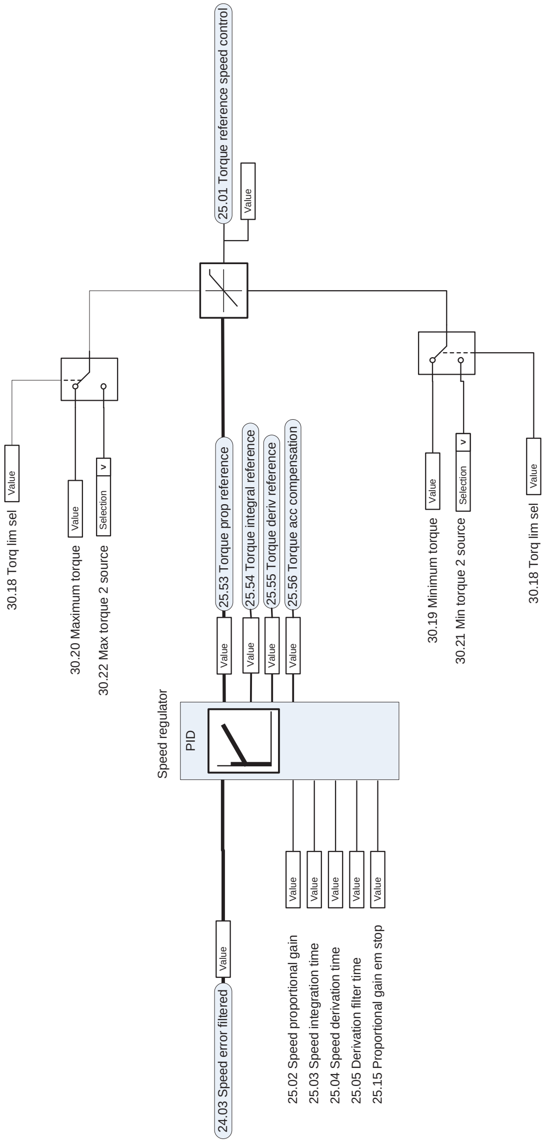
Speed reference ramping and shaping



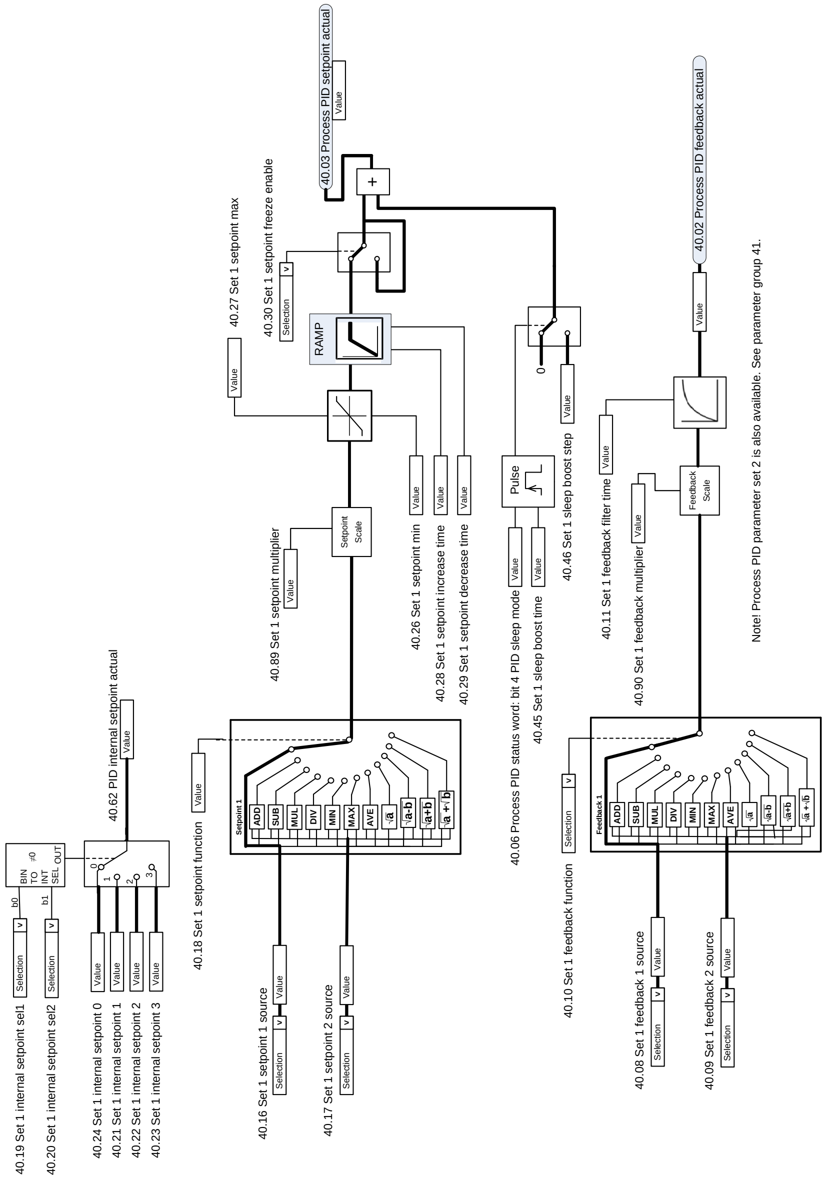
Speed error calculation



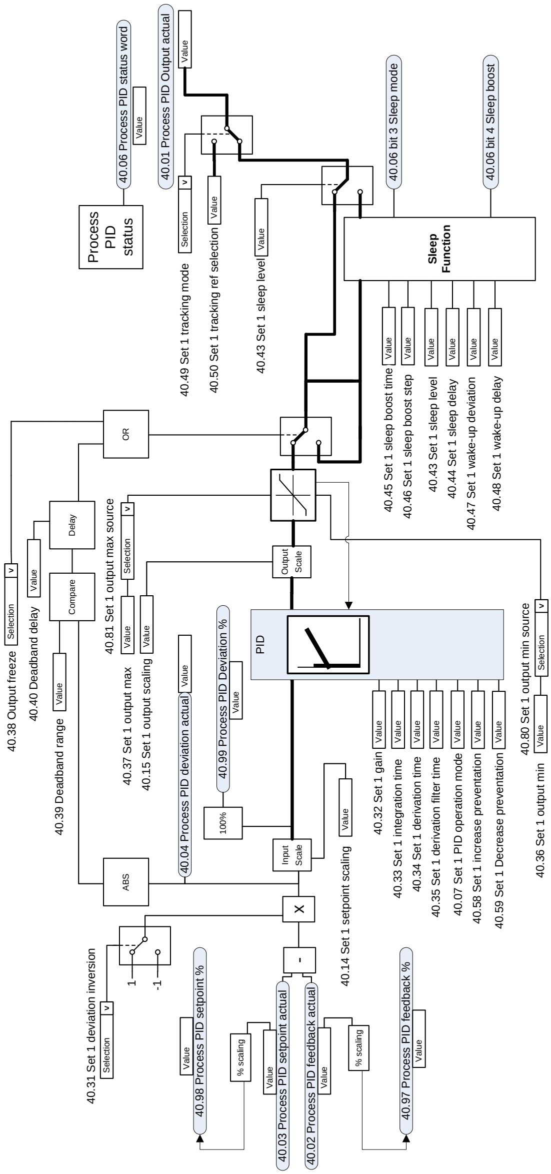
Speed controller



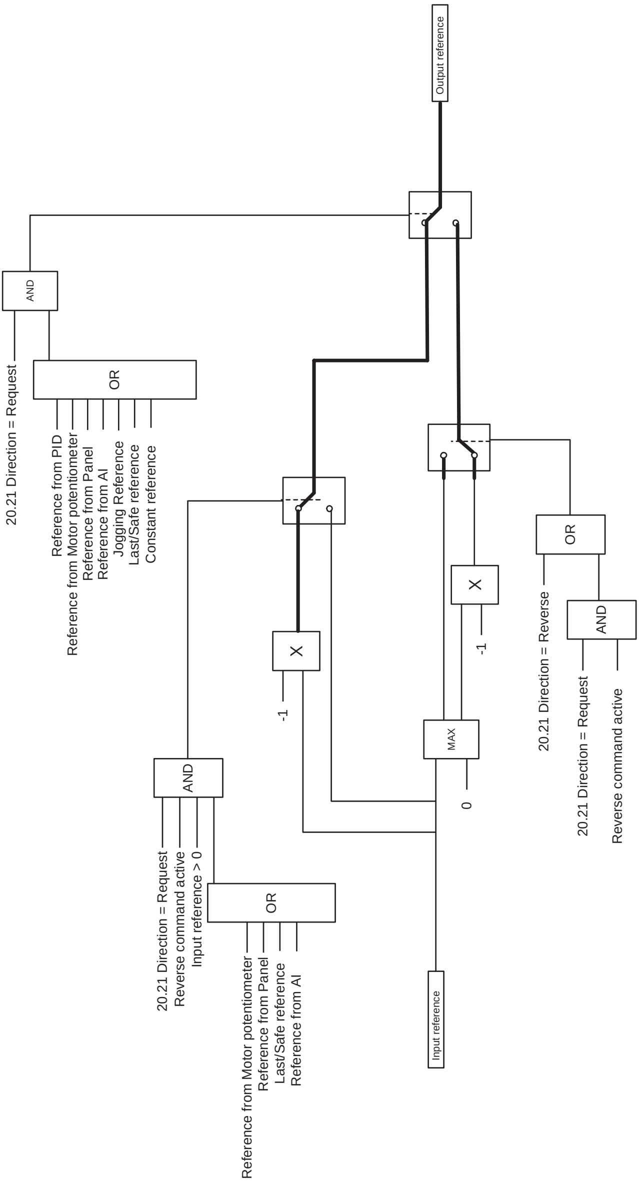
Process PID setpoint and feedback source selection



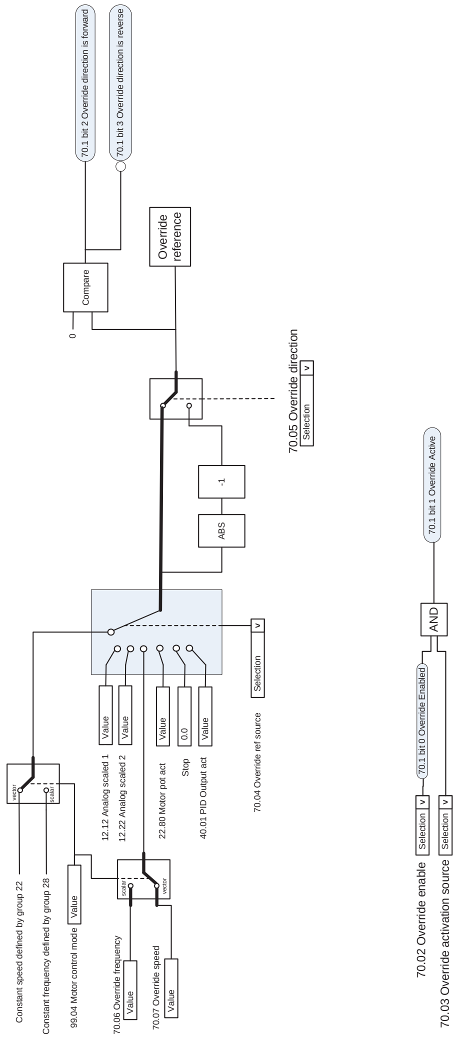
Process PID controller



Direction lock



Override


70.1 bit 2 Override direction is forward
70.1 bit 3 Override direction is reverse
Compare
0
Override reference
-1
ABS
70.05 Override direction
Selection
70.1 bit 1 Override Active
AND
70.1 bit 0 Override Enabled
70.02 Override enable
70.03 Override activation source
Selection
Value
0.0
12.12 Analog scaled 1
12.22 Analog scaled 2
22.80 Motor pot act
Stop
40.01 PID Output act
70.04 Override ref source
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

Further information

Product and service inquiries

Address any inquiries about the product to your local ABB representative, quoting the type designation and serial number of the unit in question. A listing of ABB sales, support and service contacts can be found by navigating to www.abb.com/contact-centers.

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For information on ABB product training, navigate to new.abb.com/service/training.

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